City of Arlington
Final
Comprehensive Water System Plan

Prepared by:

City of Arlington

Water System ID 02950K

With assistance from:

RH2 ENGINEERS PLANNERS SCIENTISTS

and

FCS GROUP Solutions-Oriented Consulting

January 2016

Cover photos:

Foreground photo shows the Stillaguamish River and the Northern Pacific railroad trestle at confluence of the North and South Forks at Arlington. The River is one of three water sources used by the City of Arlington and can produce more than 90 percent of its annual water supply. Background photo shows the Pacific Keystone filter trains within the Water Treatment Plant. Water from riverbank wells is filtered through up to three trains with filtration media consisting of sand and anthracite. The WTP can treat 1700 gpm, or more than 2.4 MGD.

Recommended citation:

City of Arlington. 2016. 2015 Comprehensive Water System Plan, Final. Released January 2016. Prepared with assistance from RH2 Engineering, Inc. and FCS Group Inc.

Approvals

Washington State Department of Health
Office of Drinking Water

_____ _____

Erika Lindsey, PE, Regional Engineer Richard Rodriguez, Regional Planner

Snohomish County
Department of Planning and Development Services

_____

Randy Sleight, PE

City of Arlington
Planning Commission

_____

Bruce Angell, Chair Date

City of Arlington
City Council

_____

Barbara Tolbert, Mayor Date

This page blank for formatting and duplex printing.

City of Arlington Certification

Chapters 1, 2, 3, 4, 5, 6, and 8 of this Comprehensive Water System Plan were prepared by City of Arlington staff under the direction of the following registered professional engineer. Chapter 10 was prepared by FCS Group under the direction of the same. City of Arlington staff received support from RH2 Engineering on Chapter 4.

James X. Kelly, P.E.

This page blank for formatting and duplex printing.

RH2 Engineering Certification

Chapters 7 and 9 of this Comprehensive Water System Plan were prepared for the City of Arlington under the direction of the following registered professional engineers. In addition, RH2 Engineering staff provided support to much of the remaining document

1/15/16

Richard L. Ballard, P.E.

1/15/16

Michele R. Campbell, P.E.

This page blank for formatting and duplex printing.

Table of Contents

Table of Contents--Expanded

List of Tables

List of Charts

List of Figures (Maps)

Appendices

This page blank for formatting and duplex printing.

Executive Summary

ES.1 PURPOSE OF THE PLAN

The City of Arlington's (City) water production, treatment, and distribution systems form a complex infrastructure. Just as intricate are the monitoring and management procedures, industry best practices, and regulatory requirements intended to make that infrastructure an instrument for public health and fire protection. The City's water utility matches skilled and qualified staff to the operational and maintenance (O&M) requirements of these systems, implements a capital improvement program (CIP) to schedule replacements of necessary components to keep the systems working optimally, and assures compliance with all federal and state laws and permit conditions. When these efforts occur conscientiously within the context of a Comprehensive Water System Plan (WSP), customers' water taps serve as a lifeline of health and wholeness, and the water distribution system doubles as a generous fire suppression system.

This update to the City's WSP is intended to achieve the following objectives. In doing so, it will comply with Washington State Department of Health (DOH) regulations for WSPs under Washington Administrative Code (WAC) 246-290-100.

- Prepare the water system and personnel to meet the City's future growth,
- Set CIP goals and priorities to match City Comprehensive Plan,
- Evaluate current service levels
- Evaluate current O&M activities,
- Review compliance with City policies and state/federal regulations,
- Identify any deficiencies which threaten public health and fire safety,

- Identify corrective measures which ensure a safe and reliable supply of water to current and future customers, and
- Develop and evaluate Water Utility funding requirements.

ES.2 CHANGES SINCE THE LAST COMPREHENSIVE WATER SYSTEM PLAN

The City's last WSPs were completed in 2004 and 2011. The following digest includes some of the changes or events that have occurred since the 2011 WSP update that affect water system planning for the City.

ES.2.1 Water Rights and Water Law.

- Completed three water right transfers totaling 471 gpm and 215 acre-feet.
- Pre-purchased up to 150 gpm and 60 acre-feet from the City's cemetery for transfer at a later date.
- Developing case law, including Washington Supreme Court decisions, upheld the Municipal Water Law, and overturned the Skagit Instream Flow Rule (IFR) (with influence on the similar Stillaguamish IFR), etc.

ES.2.2 Planning Efforts.

- Expanded the City's water service area (WSA) through the acquisition of the National Food Corporation's property south of 172nd Street, west of 51st Avenue, and east of 43rd Avenue from the City of Marysville.
- Prepared the City's 2015 Update of its Comprehensive Plan concurrently with this WSP.
- Decreased population projection in previous WSP significantly from 30,500 by 2025, to 24,937 in the City by 2035.
- Submitted application to Snohomish County to extend its UGA for residential growth west of I-5.
- Regional recognition of the proposed Airport Manufacturing Industrial Center (MIC), which is anticipated to bring the employment of up to 12,000 persons in the City's WSA.

ES.2.3 Physical Infrastructure Changes.

- Converted the services along 91st Avenue and the WSA southeast the intersection of SR9 and SR531 from the 520 Pressure Zone (PZ) to the 710 PZ.
- Took Burn Road Reservoir (342 PZ) off-line in anticipation of decommissioning
- Completed replacement of nearly all high priority Asbestos-Concrete water main, resulting in the proportion of the distribution network in AC pipe at 10.4 percent

- Constructed filter train backwash discharge line from the WTP to the constructed wetland, added dechlorination, and now discharge the majority of the WTP backwash to the wetland—and potentially the Stillaguamish River as well (thus, NPDES General WTP permit compliance is also new).

ES.2.4 Limitations with Aging Physical Infrastructure.

- Well 3, the oldest well in the Haller wellfield, is more than 100 years old. The second oldest well, Well 2, is more than 50 years old. At 14 years old, Well 1R is the youngest, but is not used for water quality reasons. A 2012 rehabilitation effort to regain some declining capacity at Well 2 was unsuccessful, and resulted in even greater drawdown per unit rate of production, and in reduced raw water quality.
- Formerly 185 feet deep, the Airport well has collapsed twice in the last decade, and the pump has been raised to 100 feet below ground surface, closer to the potential contaminants of the industrial area around the airport.
- Active replacement programs in a historically small city that is recently burgeoning with growth have resulted in predominately young age distributions for water meters and mains. As a result, the City is well-positioned to maintain a sustainable, structurally sound distribution infrastructure.

ES.2.5 Integrated Water Resource Management Actions.

- Obtained Reclaimed Water Reuse Permit for irrigation of constructed wetland using reclaimed water.
- Obtained NPDES General Water Treatment Plant Discharge Permit to discharge backwash water to the constructed wetland.

ES.2.6 Emergency Response and Climate Change Experience.

- The Oso Landslide occurring on March 22, 2014 created immediate—and at the time unknown—impacts to the quantity and quality of flows in the Stillaguamish River. Staff relied on the trending of real-time data (river stage, river turbidity, well water depth, raw water turbidity), river water quality from grab samples, the diversity of the City's water sources, communications with emergency management personnel, and professional judgement to continue production from the well field at reduced rates without contaminating the surrounding formation, affecting the treatment process, or increasing risks to public health.
- During the Oso Landslide response, the City of Arlington was a key hub for emergency response. Many hundreds of personnel from local, state, and federal agencies, and many more volunteers and journalists from around the world provided additional demand while relying on the City's water system for relief and recovery.
- The combination of the low snowpack from winter 2015 and the drought of summer 2015 tested the ability of the City's supply infrastructure to meet demands under harsh conditions—and under what could be *common* conditions with continuing climate change.

The City's sources met customers' needs without the requiring any drought restrictions. Quantities and levels of water supplies at each of the City's sources are continuously monitored and recorded using SCADA to identify emerging trends associated with climate change.

ES.2.7 Changing Supply and Demand Scenario.

- Based on a water supply study conducted by Brown and Caldwell in 2011, the City made the decision to increase production from its wells in lieu of increasing purchases of wholesale water.
- Several planning parameters are significantly different from those used in the previous 2011 WSP. Peaking factors (MDD/ADD) are reduced and per capita consumption has declined. Water losses, or distribution system leakage (DSL), has increased.
- The City's greatest peak day (3 MGD on 7/4/2015) and month (67 MG in July 2015) ever occurred with the "least water" climatic extremes of the 2015 drought. The Stillaguamish River at its confluence recorded 321 cfs, one of its lowest discharges on record. (At the same time, the North Fork measured 171 cfs, and its lowest-ever measurement of 117 cfs occurred on 9/23/1938.) Although concerned, the City did not have trouble meeting demand under drought conditions.

ES.2.8 Water Quality Observations.

- The non-repeatable detection of a very small quantity of 1,4-dioxane at the Airport Wellfield during the UCMR3 study, though not considered a health risk in itself, has prompted staff to consider anew the military and industrial influence on the aquifer. Alternatives to the wellfield are considered in this WSP.
- Several observations have caused uncertainty around the ability of the Haller Wellfield to provide consistent, redundant and perhaps increased supplies to the water system. These include the increasing frequency of manganese detections, the inability of bringing the reserve well online without the risk of contaminating the treated water in the clearwell with iron, and a failed effort to rehabilitate Haller Well 2 and increase its specific capacity, which has declined in recent years.

ES.3 WHAT HAS NOT CHANGED SINCE THE LAST COMPREHENSIVE WATER SYSTEM PLAN

The following sections of this Water System Plan have not changed or have had only minor and/or formatting changes since the 2011 WSP Update:

- Appendix F – Watershed and Wellhead Protection Program;
- Appendix G – Cross Connection Control Program;
- Appendix I – Integrated Water Resources Management Program; and
- Appendix M – Snohomish County PUD No. 1 Wholesale Water Agreement.

ES.4 SUMMARY OF KEY ELEMENTS

This WSP contains: a description of the existing water system and service area; a forecast of future water collection and treatment demands; policies and design criteria for water system operation and improvements; water system hydraulic analyses; the operations and maintenance program; staffing requirements; a schedule of improvements; and a financial plan to accomplish the improvements. A summary of the key issues related to these elements is provided in the following sections.

ES.4.1 Customers within the Water Service Area (WSA)

The City provides water service to approximately 16,245 residents and more than 600 businesses and institutions through 5,458 customer accounts within its existing WSA boundary, which extends well beyond the City's corporate limits to cover approximately 25.3 square miles. The City is responsible for providing public water service, utility management and water system development within the WSA. The City will provide water service within the retail WSA if the following conditions can be met.

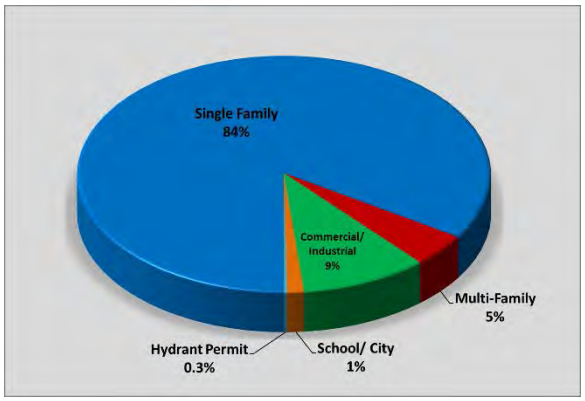
- The City has sufficient capacity to serve water in a safe and reliable manner.
- The applicant is in compliance with all applicable local plans, development regulations, and utility standards and policies.
- Sufficient water rights and supply are available.
- The City can provide such service in a timely and reasonable manner.

The project must also be in compliance with the City's utility standards and policies, WSP and water rights; and Snohomish County's adopted land use plan and zoning and development regulations.

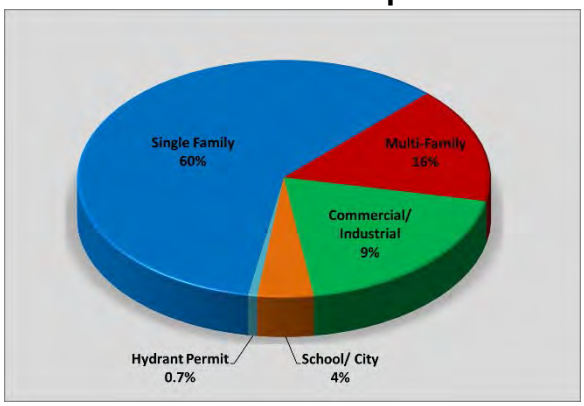
For water service applications outside of the City limits, the applicant must first obtain a water utility service agreement from the City. The City will review the agreement and determine the availability of water.

In 2014, the City provided water service primarily to its 16,245 residential customers, which make up approximately 89 percent of all customer accounts and use approximately 76 percent of all water supplied.

2014 Water Connections



2014 Water Consumption



ES.4.2 Infrastructure

The Water Department manages assets with a replacement value of approximately $137 million allocated as follows:

Facility	Value (2015)
Haller Wellfield	$2,500,000
Airport Wellfield	$1,100,000
Water Treatment Plant	$28,000,000
Distribution--Water Mains	$91,469,040
Distribution-_All Other	$12,399,500
Administrative Office/Shop	$1,750,000
Total	**$137,218,540**

Components within the water utility include wells yielding groundwater under the influence of surface water, a groundwater well, a water treatment plant (WTP), a master meter at the intertie with a wholesale purchase connection, water mains, reservoirs, a pump station, pressure reducing stations, and numerous hydrants, valves, and other supporting equipment.

The Haller wellfield has produced water via riverbank filtration in one or more wells for over 100 years. It is consistent and remains the City's "work horse" for water supply, pumping at up to 1,700 gpm. It produced 1.17 MGD in 2014, or about 85 percent of the City's total water supply. Aquifer production measured as specific capacity has declined somewhat in recent years, and a rehabilitation effort on one of the wells in 2012 was unsuccessful.

The Airport wellfield currently consists of a single groundwater well that has been in production since it and other wells were installed in the 1940s. The well has collapsed (and pumped sand) on more than one occasion, and the pump has been raised from about 185 feet bgs to about 110 feet bgs. It is pumped at less than its capacity, approximately 200 gpm, in order to minimize further

damage to the well and aquifer. In 2014, the Airport well produced 0.08 MGD, or about 5 percent of the City's total water supply.

The City purchased about 10 percent of its water in 2014 under a wholesale contract with the Snohomish County PUD. Although the contract allows up to 1,000 gpm, the City has been drawing only about 50 gpm.

The WTP is a rapid sand filtration plant with chlorine disinfection because of the surface water influence of the Stillaguamish River on the Haller wellfield. The WTP performs extremely well, and the facility has earned recognition under the Department of Health's Treatment Optimization Program in all 15 years of the program's existence. It is only one of four filtration plants in the State of Washington to earn this distinction. Design capacity of the WTP is 1,710 gpm. However, clearwell pump efficiency has declined in recent years, and the WTP can currently send about 1,500 gpm to distribution. Operators are monitoring pump performance.

The water utility maintains approximately 96.2 miles of mains throughout its service area. The mains are composed primarily of cement mortar-lined ductile iron (89.2 percent). Asbestos-concrete (AC) pipe composes about 10.4 percent of the distribution network. The diameter of most water mains (88 percent) is between 8 and 12 inches. Two-thirds of the pipe in the distribution network is 30 years old or less and generally in good condition. About 10 percent of the system was constructed in the 1950s and 1960s and is reaching its life expectancy of about 75 years. Most of the main breaks are in older, AC pipe laid in wetter soils. The City has an active main replacement program, and recently replaced the last segment of pipe with what it considers to be the highest risk for breaking and leaking.

Eight pressure reducing and flow control valves serve to maintain four pressure zones in the service area. A single pump station helps assure that 98 percent of its water demand can be served from multiple sources located both up-gradient and down-gradient.

ES.4.3 Historic and Forecast Demand

Average daily demand (ADD) for water over the last ten years (2005 to 2014) ranged from 1.28 to 1.57 MGD, with an average flow of 1.41 MGD (980 gpm). Average per capita demand declined from about 106 to 78 gpd/person by 2011, but then rose to 97 gpd/person in 2014. An average per capita demand of 90 gpd/person and an average demand per equivalent residential unit (ERU) of 187 gallons per day were used to quantify existing conditions.

Maximum day demands were evaluated and a peaking factor (MDD/ADD) of 1.75 was selected. MDD in 2014 was calculated to be 2.75 MGD, or 1,912 gpm. Peak hour demand (PHD) based on observations was calculated to be 4.97 MGD, or 3,451 gpm. Peak hour factors for PHD/MDD and PHD/ADD were 1.81 and 3.16, respectively.

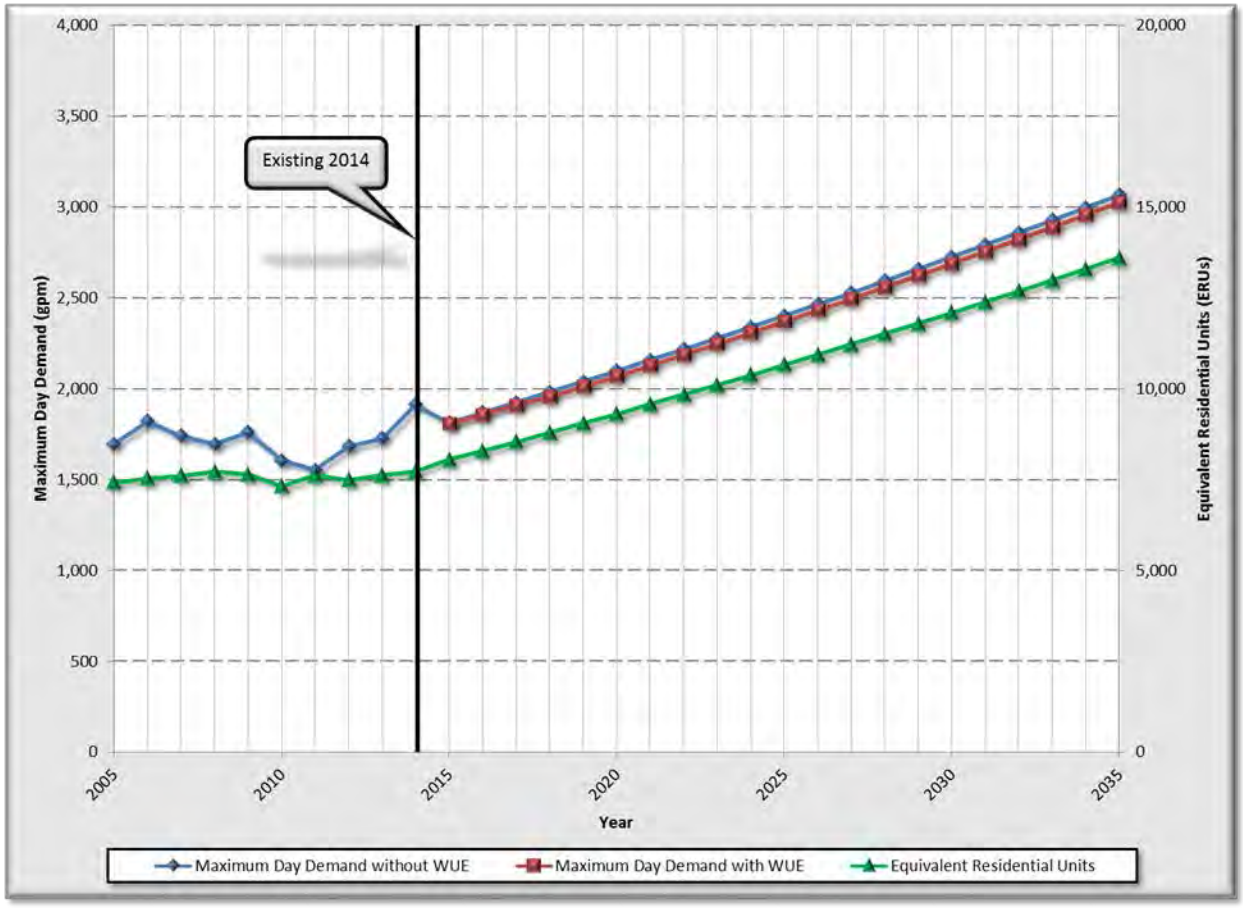
Demand forecasts were developed based on population growth allocated to the City of Arlington by Puget Sound Regional Council (PSRC) and Snohomish County during the comprehensive

planning effort required by the Growth Management Act and due in 2015. In the prior 2011 WSP update, the City had anticipated growth to 20,590 by 2014, and to 30,500 by 2025. Due in part to delayed recovery after the economic recession, this WSP update estimated the 2014 population at 18,360 and established growth to 24,937 by 2035. Because a portion of the City's Smokey Point neighborhood is outside of the City's WSA, the population served by the utility is 16,245 in 2014. The WSA population is forecast to grow in 6, 10, and 20 years to 18,157, 19,431, and 22,617, respectively.

In addition, the PSRC and other planning authorities have recognized the Arlington-Marysville Manufacturing Industrial Center and its influence on regional employment forecasts. Employment within the WSA may increase by as much as 12,000. This WSP update endeavors to accommodate the additional demands of manufacturing processes and the labor force by increasing the existing per capita demand of 90 gpd/person to 110 gpd/person by 2035.

Based on these and other planning assumptions, ADD is forecast to increase to 1,198 gpm, 1,336 gpm, and 1,712 gpm for the 6-, 10-, and 20-year horizons, respectively. MDD is forecast to increase to 2,097 gpm (9.7 percent), 2,338 gpm (22.2 percent), and 2,996 gpm (56.7 percent) for the 6-, 10-, and 20-year horizons, respectively. See the chart below.

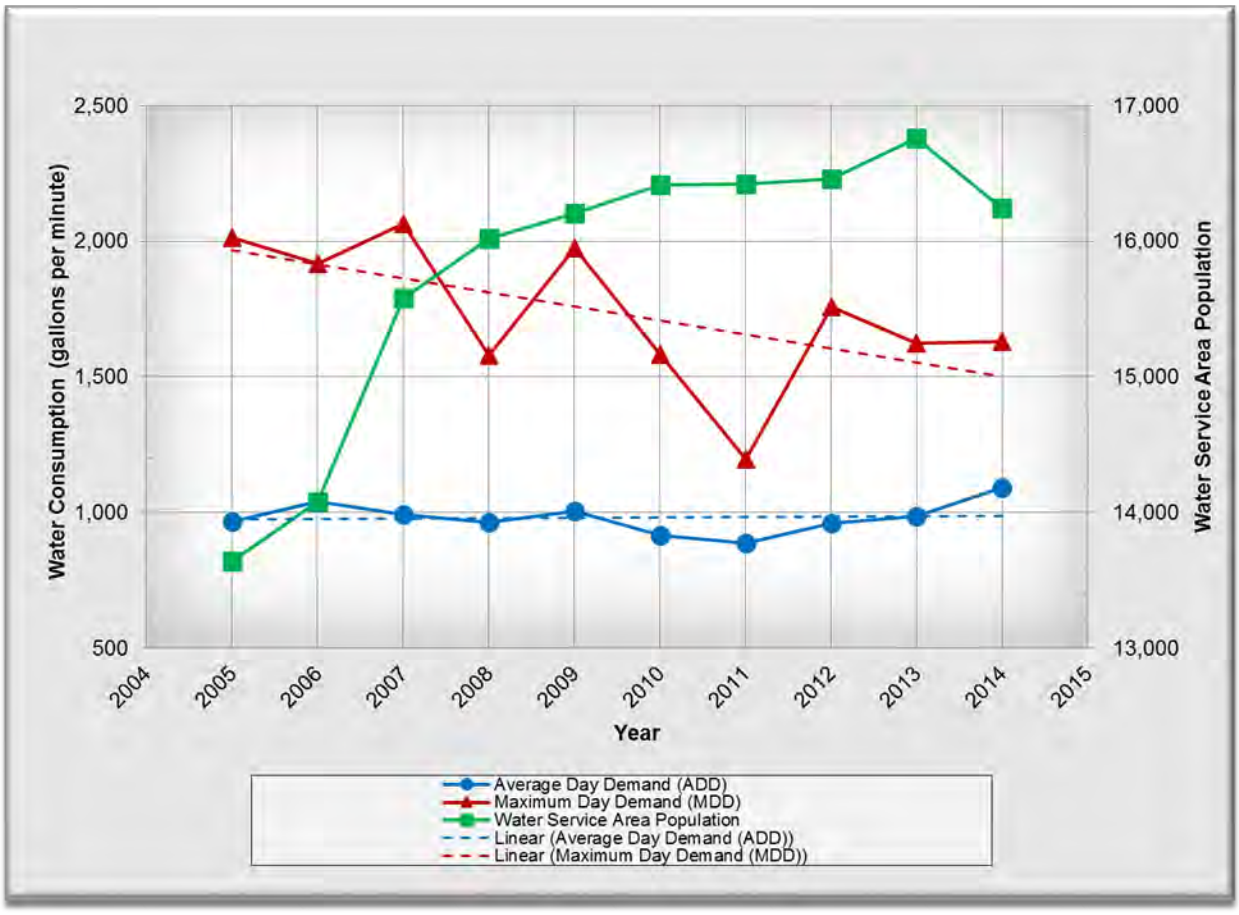
Past and Future Water Demands and ERUs



ES.4.4 Water Use Efficiency

The City's WUE efforts since the 1990s are described and evaluated in detail in Appendix E. One goal has been to maintain a gradual reduction in the average demand per individual customer (per connection, per capita, per ERU). This WSP evaluates these individual parameters against the goal, but success may be more telling using the figure below. The WSA population has *increased* by 2,069 persons, or more than 19 percent in the last 10 years. During this same time, the system-wide average daily demand (ADD) has basically *stayed the same*. In addition, the observed maximum day demand (MDD) over the same period has *declined* by about 383 gpm (19 percent).

Average and Maximum Day Demands
by Population in the Water Service Area
2005 to 2014



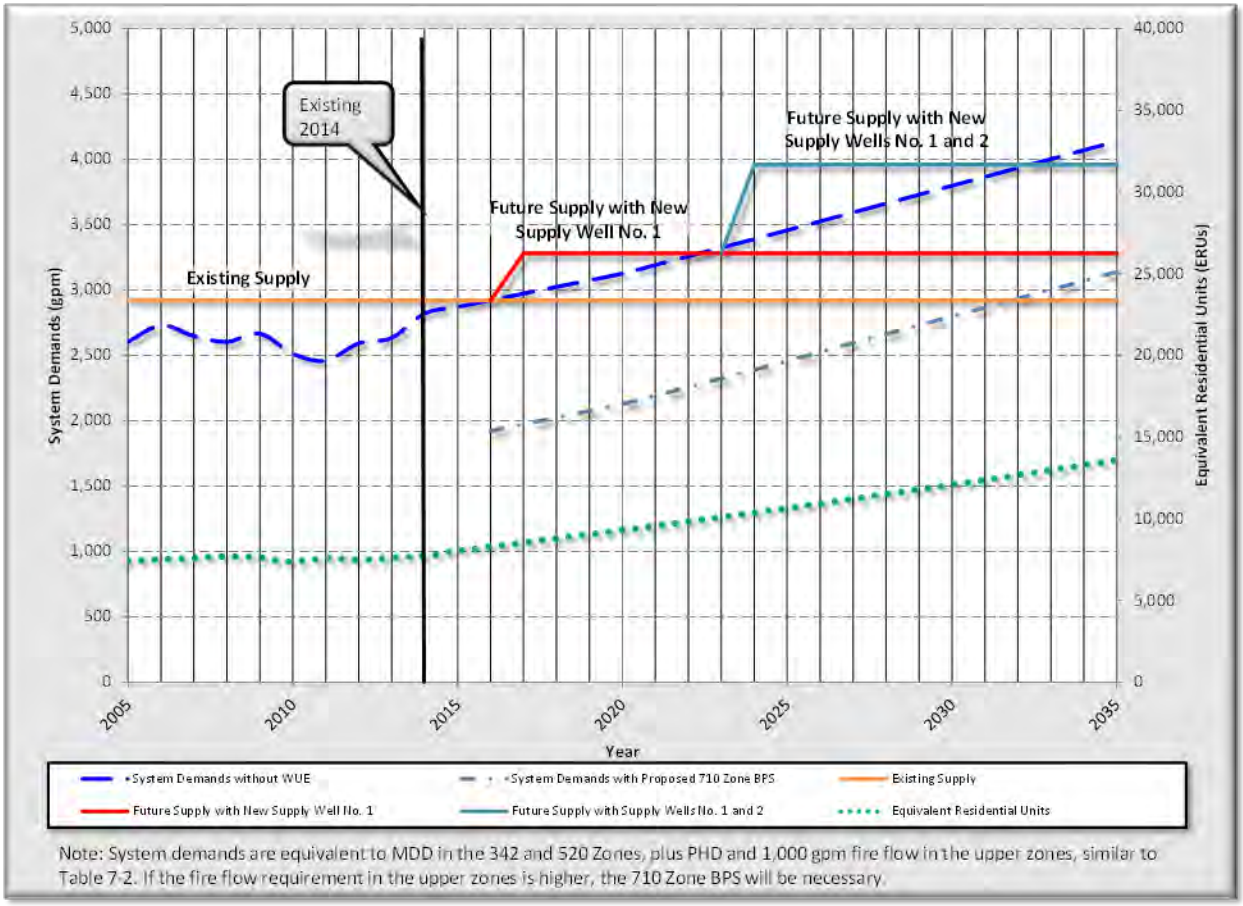
Another supply-side goal of the utility has been to reduce real and apparent losses of water from the system (also referred to as distribution system leakage, or DSL) and maintain it at less than 10 percent. The City was successful for a number of years, but beginning in 2012, annual DSL values increased 11 to 15 percent through 2014. Using a 3-year rolling average for DSL directed by DOH, the City's DSL increased to 13.2 percent in 2014. The City has prepared a Water Loss Control Action Plan as part of Appendix E in order to return DSL to less than 10 percent. Because

of a change in 2012 in the financial management software which handles meter reading and utility billing functions, it is anticipated that apparent (not real) losses in the form of accounting errors are the most likely cause of much of the elevated DSL.

ES.4.5 Future Water Demands and Water Supply

Overall water demand within the City's system is expected to increase by nearly 10 percent within the next 6 years and by more than 56 percent within the next 20 years, depending on the amount of future water use reductions from the City's Water Use Efficiency Program. The City has sufficient water supply from its water treatment plant, groundwater wellfields and wholesale water supply to meet the existing demand and fire flow requirements. The City also has sufficient water rights and secured wholesale supplies to meet the 20-year demand requirements and beyond (nearly 50 years). However, the poor condition of the Airport Well, concerns for the Airport and Haller Wellfield indicate the City is unable to meet projected demands and is need of securing additional production (supply) wells in the near future. Following increased source capacity at the Haller and Airport Wellfields and the construction of a booster pump station to supply fire flows in the highest pressure zones (summarized in the next section), the City will have sufficient supply capacity to meet the demand requirements until beyond 2050.

Future Water Supply and Demand Projections



ES.4.6 Staffing for Operations and Maintenance

The City's Water Department staff are well-qualified, technically trained personnel equipped to operate and maintain the existing infrastructure. City staff regularly participates in safety and training programs to keep abreast of the latest changes in the water industry and to ensure a smooth and safe operation of the source, treatment, distribution, and metering systems. The current staff of nine (one supervisor and eight field crew), is one shy of the 10 estimated in a labor analysis during the 2011 WSP (not revised for this update). However, the Water Department has consistently demonstrated it is capable of adequately operating the water system, complying with the minimum DOH public health requirements, and conducting preventive maintenance tasks at the desired frequency. The City will add staff in the future, as necessary and as allowed by budget, to meet the increasing requirements of system operation and maintenance, due to customer growth and increased regulatory requirements.

ES.4.7 Water System Evaluation

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

- The City has sufficient water supply from its water treatment plant, groundwater wellfields and wholesale water supply to meet the existing demand and fire flow requirements. The City also has sufficient water rights to meet the 20-year and nearly the 50-year demand requirements. It is increasingly unlikely, however, that improvements to the Haller and Airport Wellfields would allow the City to increase the available source capacity at these sites to take full advantage of the water rights to meet future demands.

- The existing Airport Well needs to be abandoned or relocated related to a well casing collapse, aging structure, and general safety issues. The City intends on evaluating alternative locations within its service area at which one or more wells may be sited.

- A booster pump station is needed to improve back-up and fire flow supply to the 710 Zone and the proposed 615 Zone (currently 540 Zone).

- Existing storage is adequate for 10 years, but additional storage will be required prior to the 20-year horizon for redundancy and for future storage requirements related to growth. A 1.0 million gallon reservoir is proposed to provide water storage to the City's 520 Zone and to resolve the projected 20-year system-wide storage deficiency. If the booster pump station (identified above) and additional supply wells are delayed, the reservoir would need to be built sooner.

- The Burn Road Reservoir is surrounded by unstable slopes and was taken off-line in 2014. Demolition of the storage reservoir is necessary.

- General structural (roof) and ventilation improvements are necessary at the Gleneagle Reservoir.

- Several areas of the system require replacement of existing water main to resolve deficiencies related to low fire flows, aging water main and undesirable materials.

- The existing 540 Zone along Burn Road has moderately low pressures and will be divided and converted to the 520 Zone and the 615 Zone by modifying (installing and removing) two pressure reducing stations.

- The lower elevations of the existing 710 Zone along 107th Avenue have high pressures and will be converted to a 560 Zone by installing a pressure reducing station on 107th near 184th Street.

- The lower 710 Zone along Burn Road west of McElroy Road also has high pressures and will be converted to a 615 Zone by installing a pressure reducing station on Burn east of McElroy.

ES.5 PROPOSED WATER SYSTEM IMPROVEMENTS AND FINANCING PLAN

This WSP identifies a capital improvement program (CIP) with annual expenditures over the first 11 years (2025), and lump sum expenditures over the second decade (2035). The 20-year CIP total is $56.836 million in 2015 dollars. CIP projects preliminarily scheduled for the first 11 years total of $20.693 million, including$14.635 million borne by the City, and $6.058 million funded by developers. The remaining $36.143 million in projects slated to occur in the second decade are composed primarily of main replacement projects and construction of the future 1.0 MG reservoir in the 520 Zone. The actual implementation of these improvements will be predicated on growth.

A financial strategy to fully fund the CIP and operating expenses and service existing debt is also presented. The plan relies primarily on cash funding from rates and connection charges and does not forecast the need to issue any new debt. Rates are proposed to be held at current levels through 2017, followed by annual rate increases of 3.25 percent through 2025. In addition, a reinvestment strategy is proposed where revenues from reserves augment rate revenues. This plan would completely fund the 20-year CIP and projected O&M expenses, and meet policy objectives for funding system reinvestment. The operating fund would end each year with a minimum of 90 days of O&M expenses. Existing debt service would also be retired after two years of payments in 2015 and 2016.

A study is underway at the time of this writing to evaluate costs of service and rates by customer class. Preliminary indications suggest decreases in both rates and connection charges are feasible prior to the implementation of the financing plan described herein. Chapter 10 of this WSP may be amended in the foreseeable future depending on the final recommendations of the rate study.

1 Introduction

1.1 WATER SYSTEM OWNERSHIP AND MANAGEMENT

The City of Arlington (City) is a municipal corporation that owns and operates a public water system within and outside of its City limits. Day-to-day operations of the water system are performed by the Water Utility Department. Water system data on file at the Department of Health (DOH) for the City's system is shown below in **Table 1-1**. The most recent copy of the Water Facilities Inventory (WFI) form maintained by the Department of Health is include in **Appendix A**.

Table 1-1

Water System Ownership Information

Information Type	Description
System Type	Group A - Community - Public Water System
System Name	Arlington Water Department
County	Snohomish
DOH System ID Number	02950K
Owner Number	200
Address	154 West Cox Avenue, Arlington, WA 98223
Contact	Mr. Don Smith, Water Utility Supervisor
Contact Phone Number	(360) 403-3507

1.2 OVERVIEW OF EXISTING SYSTEM

In 2014, the City provided service to approximately 5,458 customer connections, or 7,705 equivalent residential units (ERUs), within the City's retail water service area (WSA), which

extends beyond the City limits as defined in the *2010 North Snohomish County Coordinated Water System Plan*. The City limits comprise an area of approximately 9.7 square miles, and the existing retail WSA is approximately 25.3 square miles. The 2014 population within the City limits was 18,360, while water service was provided to approximately 16,245 people.

Water supply to the City is provided by: one treatment plant that receives water from three groundwater wells within the Haller Wellfield, which are under the influence of surface water; a groundwater well within the Airport Wellfield; and wholesale water purchased from the Snohomish County PUD No. 1 (PUD). Water storage is provided by two reservoirs that have a total capacity of 4.0 million gallons (MG). In addition, the City's water system has four pressure zones with eight pressure reducing stations, one booster pump station and approximately 96.22 miles of water mains. A summary of 2014 water system data for the City's system is shown below in **Table 1-2**.

Table 1-2

2014 Water System Data

Description	Data
Population in City Limits	18,360
Water Service Population	16,245
Water Service Area	25.2 square miles
Total Connections	5,548
Total ERUs	7,705
Demand per ERU	187 gallons per day
Annual Production	574,120,924 gallons
Average Day Demand	1,092 gpm
Per Capita Demand	90 gal/day/capita
Distribution System Leakage (3-Year Rolling Average)	13%
Maximum Day/Average Day Demand Factor	1.75
Peak Hour/Maximum Day Demand Factor	1.81
Number of Pressure Zones	4
Number of Wells & Total Capacity	4 (1,920 gpm)
Treatment Plant Capacity	1,710 gpm
PUD Wholesale Source Capacity	1,000 gpm
Number of Pump Stations & Total Capacity	1 (790 gpm)
Number of Reservoirs & Total Capacity	2 (4.0 MG)
Number of Pressure Reducing Stations	8
Total Length of Water Main	96.2 miles

1.3 AUTHORIZATION AND PURPOSE

In April 2014, the City authorized RH2 Engineering, Inc. (RH2) to assist the City in preparation of a *Comprehensive Water System Plan* (WSP) as required by State law under WAC 246-290-100. In accordance with WAC 246-290-100, the plan shall be updated and submitted to DOH every six years (DOH intends to allow a 10 year update cycle effective 2015). The previous WSPs were prepared for the City and released in 2004 and 2011. The purpose of this updated WSP is as follows.

In February 2014, the City initiated an update to its *Comprehensive Water System Plan* (Plan, WSP). RH2 Engineering (RH2) was retained in April 2014 to provide modeling and analytical support. FCS Group was also retained to provide financial planning assistance for the utility, including financial analyses for this WSP and conducting a utility rate study. The City previously prepared WSPs in August 2004 and October 2011. The purpose of this updated Plan is to:

- Comply with all requirements of a Water System Plan (WSP) under WAC 246-290-100.
- To evaluate existing water demand data and project future water demands.
- To analyze the existing water system to determine if it meets minimum requirements mandated by DOH and the City's policies and design criteria.
- To evaluate past water quality and identify water quality improvements, if necessary.
- To document the City's operations and maintenance program.
- To prepare water use efficiency, emergency response, cross connection control, wellhead and watershed protection, and water quality monitoring plans.
- To comply with all other DOH water system plan requirements.
- To identify water system improvements that resolve existing system deficiencies and accommodate future needs of the system for at least 20 years into the future.
- To prepare a schedule of improvements that meets the goals of the City's financial program.

Further, this WSP Update serves, by adoption, as a critical element of the 2015 Update to the City of Arlington's General Comprehensive Plan. Consistency between the plans, and the 2015 Update to Snohomish County's Plan, has been assured during their concurrent preparation. Arlington is forecast to accommodate a total of 24,937 citizens and at least 12,224 jobs by 2035. As stated in its 2015 Comprehensive Plan update, the City is taking a proactive role in attracting developments to meet the needs of its citizens, prioritizing alternative uses of land and public resources, and identifying in explicit terms the impact proposed developments will have on the community. Six focus area were identified in Arlington's 2015 Comprehensive Plan as being the most suitable for future residential, industrial and retail growth; these same focus areas were evaluated in this WSP

to assure adequate water infrastructure to assure a high level of service to existing customers, and to facilitate the growth of new customers. See chapter 3 for additional Land Use discussion.

Finally, in addition to these regulatory requirements, this WSP maintains unchanged the City's Integrated Water Resources Management Program (IWRMP), first drafted in the 2011 WSP. The IWRMP seeks to integrate the management of the City's multiple water uses within the framework of the natural climate, water resources and other water uses of the Stillaguamish and Quilceda basins. The IWRMP develops policies and actions that flexibly manage the City's water resources to improve water availability, reliability and environmental quality in a cost-effective manner.

1.4 SUMMARY OF PLAN CONTENTS

The following is brief summary of the content of the chapters in the WSP.

- The **Executive Summary** provides a brief summary of the key elements of this WSP.
- **Chapter 1** introduces the reader to the City's water system, the objectives of the WSP and the WSP's organization.
- **Chapter 2** presents the WSA, describes the existing water system and identifies the adjacent water purveyors.
- **Chapter 3** presents related plans, and land use and population characteristics.
- **Chapter 4** identifies existing water demands and projected future demands.
- **Chapter 5** presents the City's operational policies and design criteria.
- **Chapter 6** discusses the City's water source and water quality monitoring program.
- **Chapter 7** discusses the water system analyses and existing system deficiencies.
- **Chapter 8** discusses the City's operations and maintenance program.
- **Chapter 9** presents the proposed water system improvements, and their estimated costs and implementation schedule.
- **Chapter 10** summarizes the financial status of the water utility and presents a plan for funding the water system improvements.
- The **Appendices** contain additional information and plans that supplement the main chapters of the WSP.

1.5 DEFINITION OF TERMS

The following terms are used throughout this WSP.

Consumption: The true volume of water used by the water system's customers. The volume is measured at each customer's connection to the distribution system.

Connection Fee: A charge for a share of the City's potable water system that each service connection must pay as a condition of being allowed to connect to the City's potable water system.

Cross-Connection: Any physical connection, actual or potential, between a water system and any source of non-potable substance that presents the potential for contaminating the public water system, as determined by the City's cross-connection control specialist.

Demand: The quantity of water required from a water supply source over a period of time necessary to meet the needs of domestic, commercial, industrial and public uses, and to provide enough water to supply firefighting, system losses and miscellaneous water uses. Demands are normally discussed in terms of flow rate, such as million gallons per day (MGD) or gallons per minute (gpm), and are described in terms of a volume of water delivered during a certain time period. Flow rates pertinent to the analysis and design of water systems are as follows.

- **Average day demand (ADD):** The total amount of water delivered to the system in a year divided by the number of days in the year.
- **Maximum day demand (MDD):** The maximum amount of water delivered to the system during a 24-hour time period of a given year.
- **Peak hour demand (PHD):** The maximum amount of water delivered to the system, excluding fire flow, during a one-hour time period of a given year. A system's peak hour demand usually occurs during the same day as the maximum day demand.

Distribution System Leakage: Water that is measured as going into the distribution system but not metered as going out of the system.

Equivalent Residential Units (ERUs): One ERU represents the amount of water used by one single family residence for a specific water system. The demand of other customer classes can be expressed in terms of ERUs by dividing the demand of each of the other customer classes by the demand represented by one ERU.

Fire Flow: The flow rate of water required during firefighting, which is usually expressed in terms of gallons per minute (gpm).

Head: A measure of pressure or force exerted by water. Head is measured in feet and can be converted to pounds per square inch (psi) by dividing feet by 2.31.

Head Loss: Pressure reduction resulting from pipeline wall friction, bends, physical restrictions or obstructions. Falling reservoir levels also head losses affecting water pressure.

Hydraulic Elevation: The height of a free water surface above a defined datum; the height above the ground to which water in a pressure pipeline would rise in a vertical open-end pipe.

Maximum Contaminant Level (MCL): The maximum permissible level of contaminant in the water that the purveyor delivers to any public water system user, measured at the locations identified under WAC 246-290-300, Table 3.

Meter Installation Fee: A fee charged for the costs associated with the physical installation of a water meter, including costs of materials, labor, and equipment. The fee is dependent on the size of the meter installed.

Potable Water: Water suitable for human consumption.

Pressure Zone: A portion of the water system that operates from sources at a common hydraulic elevation. For example, 342 Zone refers to the City's pressure zone that has reservoirs with an overflow elevation of 342 feet.

Purveyor: An agency, subdivision of the state, municipal corporation, firm, company, mutual or cooperative association, institution, partnership, or persons or other entity owning or operating a public water system. Purveyor also means the authorized agents of such entities.

Supply: Water that is delivered to a water system by one or more supply facilities, which may consist of supply stations, booster pump stations, springs and wells.

Storage: Water that is stored in a reservoir to supplement the supply facilities of a system and provide water supply for emergency conditions. Storage is broken down into the following five components, which are defined and discussed in more detail in **Chapter 7**: 1) operational storage; 2) equalizing storage; 3) standby storage; 4) fire flow storage; and 5) dead storage.

1.6 LIST OF ABBREVIATIONS

The abbreviations listed below in **Table 1-3** are used throughout this WSP.

Table 1-3
Abbreviations

Abbreviation	Description
AC	Asbestos-cement (water main material)
ADD	Average Day Demand
AMC	Arlington Municipal Code
AWWA	American Water Works Association
BPS	Booster Pump Station
CCC	Cross-connection Control
CCR	Consumer Confidence Report
cfs	cubic feet per second
CIP	Capital Improvement Project/Program
City	City of Arlington
County	Snohomish County
CWA	Clean Water Act
CWSSA	Critical Water Supply Service Area
CWSP	Coordinated Water System Plan (for the CWSSA)
DBP	Disinfection By-Product
DI	Ductile Iron (water main material)
DNS	Determination of Non-significance (SEPA decision)
DOH	Department of Health
DSL	Distribution System Leakage
EPA	Environmental Protection Agency
ERU	Equivalent Residential Unit
FCV	Flow Control Valve
fps	feet per second
GMA	Growth Management Act
gpcd	gallons per capita per day
gpm	gallons per minute
GWC	Groundwater Certificate (water right)
GWI	Groundwater under the influence of surface water
ICI	Industrial, Commercial, and Institutional (connections)
IFR	Stillaguamish Instream Flow Rule
IWRMP	Integrated Water Resources Management Program
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal
MDD	Maximum Day Demand
MG	Million Gallons

Continued

Table 1-3
Abbreviations, Continued

Abbreviation	Description
MGD	Million Gallons per Day
mg/l	milligrams per liter
MIC	Manufacturing Industrial Center (Arlington-Marysville)
MWL	Municipal Water Law
NPDES	National Pollutant Detection and Elimination System (CWA)
O&M	Operations and Maintenance
OSHA	Occupational Safety & Health Administration
PDS	Snohomish County Dept. of Planning and Development Services
PHD	Peak Hour Demand
PRV	Pressure Reducing Valve
psi	pounds per square inch
PSPL	Puget Sound Power and Light
PSRC	Puget Sound Regional Council
PUD	Snohomish County Public Utility District No. 1
RCW	Revised Code of Washington
RUTA	Rural-Urban Transition Area
SDWA	Safe Drinking Water Act
SEPA	State Environmental Policy Act
SOC	Synthetic Organic Chemical
SSMA	Satellite System Management Agency
SWC	Surface Water Certificate (water right)
SWTR	Surface Water Treatment Rule
TDR	Transfer of Development Rights
THM	Trihalomethane
UGA	Urban Growth Area
USGS	United States Geological Survey
VOC	Volatile Organic Chemical
WAC	Washington Administrative Code
WFI	Water Facilities Inventory (DOH Form)
WISHA	Washington Industrial Safety & Health Act
WRF	Water Reclamation Facility (formerly the WWTP)
WSA	Water Service Area
WSP	Comprehensive Water System Plan
WTP	Water Treatment Plant
WUCC	Water Utility Coordinating Committee (CWSSA member utilities)
WUE	Water Use Efficiency

2 Water System Description

2.1 INTRODUCTION

This chapter describes the City of Arlington's (City) existing and future water service areas (WSAs) and water service agreements and provides a thorough description of the water system and its individual components. The results of the evaluation and analyses of the existing water system are presented later in **Chapter 7**.

2.2 WATER SERVICE AREA (WSA)

2.2.1 History

The City of Arlington was incorporated in 1903. After early efforts to provide a reliable water supply through its wood stave mains floundered, the City granted a franchise in 1916 to Puget Sound Power and Light Company (PSPL) to provide the City with water. The City purchased the water system back from PSPL in 1939, including the water filtration plant, distribution system, potable water well and water rights. Since 1939, the City has renovated the water treatment system, supplemented the system with additional supply and storage facilities, and expanded the distribution network.

Much of the downtown area water system that remains today consists of Asbestos Cement (AC) water main and was constructed in the 1950s and 1960s. The remaining water system is relatively new, with the majority of the construction occurring within the last 30 years.

2.2.2 Geology

The City is located in northwestern Snohomish County, Washington, at the confluence of the North Fork and South Fork of the Stillaguamish River. The City is located primarily on upland areas and terraces above the alluvial Stillaguamish River floodplain. Upland areas are situated on the

Getchell Plateau, with its northern terminus at Old Town Arlington, and continuing to the south-southeast (Burn Rd and SR 9 are predominately on the Getchell Plateau). The terraces are associated with the Marysville Trough, with its northern terminus at Old Town Arlington and the bluff above the floodplain near Island Crossing. The Marysville Trough is the a broad low-lying region between the Getchell and Tulalip Plateaus that forms, at the Arlington Municipal Airport, the low divide between the Stillaguamish and Snohomish River basins.

The City's WSA overlies a variable and complex sequence of hydrogeologic units, each with distinct characteristics. Soils developed from parent geologic units contain widely variable percentages of silt and gravel content. Shallow groundwater occurs at or near the surface adjacent in the Stillaguamish floodplain. Deep groundwater occurs at depths of tens to hundreds of feet below the Marysville Trough. Groundwater from two distinct aquifers provides much of the City's water supply as described below.

Hydrogeologic Units

The complex geology of the WSA can be grouped into seven units or formations, most of which are the result of the glacial and interglacial depositional processes in the region (Pacific Groundwater Group (PGG), 2007). These units can be envisioned as strata, or layers, that are youngest near the surface and older with increasing depth. Not all the units are found continuously beneath the WSA; however, their distribution changes with the landforms across the WSA. Units that are relatively coarse-grained (sands and gravels) store and release groundwater more efficiently and may be considered as water sources called aquifers. Fine grained units (silts and clays) may function as confining beds overlying aquifers (United States Geological Survey (USGS), 1997). The seven hydrogeologic units are discussed below in order from the youngest to the oldest.

Alluvium (Qal). The youngest hydrogeologic unit, the alluvial aquifer (Qal) is primarily associated with the floodplain of the mainstem Stillaguamish River and its tributaries, Portage Creek and March Creek. It is also found to a lesser extent along the South Fork of the Stillaguamish River and its tributary, Eagle Creek. This unit consists of sand and gravel with cobbles and boulders, and is typically between 0 and 30 feet thick in the area, but does reach up to 100 feet below the Stillaguamish floodplain. Groundwater within the aquifer is unconfined and in hydrologic continuity with surface water, meaning that groundwater and surface water readily exchange with each other at different rates and directions throughout the year. The alluvial aquifer is a significant water source for domestic and municipal uses and represents the City's largest source of water at the Haller Wellfield.

Vashon Recessional Outwash (Qvr). The Vashon recessional outwash aquifer (Qvr) is the next youngest hydrogeologic unit, consisting of loose gravel and sand deposited at the terminus of the retreating glaciers. The Qvr occurs extensively at the surface in the Marysville Trough, including middle segments and tributaries of Portage Creek, Old Town Arlington and the headwaters of Quilceda Creek near the Arlington Airport (Airport). Recessional outwash has been eroded and/or

overlain by alluvium along the river floodplain. The recessional sand and gravel in this unit is typically about 100 feet thick, reaching 130 feet thick in some areas. The aquifer is commonly used as a water source for domestic and agricultural uses, although thinner layers may dry up during summer months.

Vashon Glacial Till (Qvt). The Vashon till (Qvt) consists of unsorted, gray, silt, sand and gravel deposited directly beneath the advancing glacier and compacted to form a very dense "hardpan." The density and silt content of the till impedes the vertical movement of water and confines underlying groundwater. The till thickness ranges from 70 feet thick beneath the City to 100 feet thick on the Getchell Plateau. Locally, till either underlies younger alluvium and outwash, or exists at the surface on uplands, such as on the Getchell Plateau. The till is not a significant groundwater source.

Vashon Advance Outwash (Qvr). Vashon advance outwash (Qva) was deposited by meltwater streams at the terminus of the advancing glacier that subsequently over-rode and consolidated the sediment. The Qva either underlies the till where present, or, if absent, underlies alluvium in the Stillaguamish floodplain and recessional outwash in the Marysville Trough. The Qva is typically 200 feet thick but ranges from 100 to 350 feet thick. The Qva is exposed on slopes such as the base of the Getchell Plateau, and locally within incised stream channels. Groundwater in the Qva is generally confined; unconfined the unit is exposed at the surface. The aquifer is a significant water source for domestic and municipal uses, including the Airport Wellfield.

Quaternary Transitional Beds (Qtb). The Qva is underlain by transitional beds (Qtb) deposited at the onset of the Vashon glaciation. The Qtb is typically comprised of approximately 100 feet of sandy to silty clay and interpreted as interglacial lakebed sediments. These widespread deposits are not exposed at the surface and underlie the Qva, but are exposed locally along the western slopes of the Getchell Plateau south of 172nd Street NE. The Qtb is not a source of groundwater supply.

Quaternary Undifferentiated Units (Qu). Deeper undifferentiated units (Qu) underlie the transitional beds and overlay bedrock. This complex consists of both glacial and interglacial deposits and contains clay to gravel-sized deposits. These deposits are not exposed in the WSA. The undifferentiated unit is relatively thick, ranging from 500 to 1,000 feet in the area. PGG (2007) identifies the Quaternary Older Gravel (Qog), a subset of Qu, as a relatively coarse grained deposit that is thought to be 100 feet thick. The deeper groundwater is used less than shallow groundwater, but is tapped where shallow groundwater quantity or quality is insufficient to meet demand.

Bedrock (Br). Basal bedrock (Br) underlies the glacial and interglacial units in the area. The bedrock is locally comprised of volcanic and sedimentary rock. Minor exposures of the bedrock occur in the Getchell Plateau in the southeast portion of the WSA. The bedrock is not considered a groundwater source.

Groundwater Characteristics

Shallow groundwater occurring in the Qal, Qvr and Qva are typically recharged directly by precipitation and in hydrologic continuity with surface water and adjacent groundwater systems, resulting in groundwater elevations that resemble adjacent surface water elevations. Glacial till (Qvt), particularly on the Getchell Plateau, restricts recharge into and confines underlying groundwater in the Qva. Deeper groundwater in the Qu is recharged by groundwater seepage from overlying units and is separated from shallow groundwater by the intervening Qtb unit.

Groundwater flow direction and rates within shallow groundwater systems are controlled by topography and the hydrogeologic unit characteristics. Groundwater in the Qal and Qvr beneath the floodplain flows sub-parallel with the rivers. Within the Qvr, groundwater generally follows topographically to the north or south within the Marysville Trough. Groundwater in the Qva under the Getchell Plateau flows to the north and east. Deeper groundwater discharges to the west off the Getchell Plateau into Qvr.

A groundwater divide in Qvr of the Marysville Trough is an indistinct demarcation where groundwater on the northern side of the divide flows northerly toward the Stillaguamish River and on the southern side of the divide flows southerly toward Quilceda Creek and Ebey Slough. The divide is identified based on groundwater elevations in Qva wells and occurs near (approximately 0 to 1 mile south of), and roughly parallel to, 172nd Street NE. The divide is approximately 2 miles south of the topographic divide in the vicinity of the Arlington Airport at approximately 188th Street NE. Consequently, precipitation and infiltration within the headwaters of the State recognized Water Resource Inventory Area (WRIA) 7 (Snohomish basin) boundary may recharge groundwater in WRIA 5 (Stillaguamish basin).

2.2.3 Topography

The topography of the City's WSA varies greatly in elevation. The lowest elevations within the service area are located near Interstate 5 at Island Crossing where the elevation is approximately 40 feet above mean sea level (NAVD 88). A majority of the WSA is on the Marysville Trough above the Stillaguamish River floodplain. Ground elevations range from 40 feet near the crossing of Interstate 5 and State Route 530 to 400 feet near the crossing of State Route 9 and State Route 531. The highest areas served are in the eastern portion of the service area where elevations along Burn Road reach approximately 600 feet. Steep slopes are located along the Stillaguamish River, where elevations drop 80 to 100 feet, and along transitions between the Getchell Plateau and the Marysville Trough, and between the Marysville Trough and the alluvium of the Stillaguamish floodplain.

Sharply incised areas with highly variable terrain along the perimeter of the Getchell Plateau make serving some neighborhoods difficult, and to do so would require additional development expenses. Accordingly, a number of neighborhoods use alternative water supplies despite expressing interest, historically, in obtaining water service from the City. Examples include Arlington Terrace and McPherson Hills, which rely on private distribution systems, and Brekhus-

Beach, whose properties rely on private wells. Crown Ridge is an example of a topographically-constrained neighborhood which does receive water service, but where the mains are not adequately looped and flushing and additional measures are required to maintain water quality.

2.2.4 Water Service Area (WSA)

The City is located in northwestern Snohomish County, Washington, at the confluence of the North Fork and South Fork of the Stillaguamish River. The City's corporate boundary encompasses an area of approximately 9.7 square miles, as shown in **Figure 2-1**. The *existing* water distribution system generally extends south to State Route 531, north to either the Stillaguamish River or SR 530, east to either SR 9 or Old Town Arlington, and west to Interstate 5. The City's existing water distribution system also extends beyond the City limits west of the Arlington cemetery and along Burn Road as shown in **Figure 2-1**.

The City's *future* WSA boundary is authorized under the Public Water System Coordination Act (RCW 70.116), and is defined in the *2010 North Snohomish County Coordinated Water System Plan* (CWSP), as amended. The future WSA encompasses an area of approximately 25.3 square miles and extends 1 to 2 miles beyond the existing distribution system as shown in **Figure 2-2**. It extends north to the Stillaguamish River and its South Fork, east to 115th Avenue NE, south to 152nd Street NE, and approximately one to two miles west of Interstate 5 to the Burlington Northern Santa Fe Railway. The future WSA adjoins, but currently does not include: the City's Smokey Point neighborhood served by the City of Marysville (Marysville); the Marysville remote WSA containing one service connection to Arlington Christian School; the Silvana Water Association; and several smaller systems to be discussed later in this chapter.

The CWSP allows for revision of future service areas through an established process. Most recently, during the preparation of this WSP update in 2015, the City of Arlington acquired from the City of Marysville that portion of Arlington city limits situated west of 43rd Avenue, east of 51st Avenue, and south of 172nd Street to the municipal boundary (Appendix L).

The City's retail WSA is coincident with the City's future WSA or CWSP boundary. This is the area where the City has a duty to serve new connections when it has the capacity to do so, consistent with regulations, from sources with sufficient water rights, in a timely and reasonable manner. The City's policies for meeting these obligations are contained in **Chapter 5**. In accordance with CWSP procedures, residents and business owners within the City's retail WSA who desire water service must first apply to the City. However, the City has the "right of first refusal" and may decline if it cannot (financial or otherwise) provide the service in accordance with its policies.

According to the Municipal Water Law, the place of use for the City's water rights is defined as the retail service area. Thus, the City can use their water rights outside of their corporate limits if the use is within the retail service area and all legal requirements defined in RCW 90.03.386(2) have been met. The City's service area is consistent with the legal requirements since it does not

conflict with other adopted plans or regulations (see **Chapter 3**). With this WSP, the City is therefore expanding the water right place of use to be the retail WSA in accordance with the Municipal Water Law.

2.3 WATER SERVICE AGREEMENTS

2.3.1 Critical Water Supply Service Area Agreement

All water purveyors located within a Critical Water Supply Service Area (CWSSA) are required to have a WSA agreement that identifies the external boundary of their WSA. North Snohomish County was declared a CWSSA on October 19, 1988. The City prepared and signed a WSA agreement during the development of the CWSP, which was originally finalized in 1991. The City also actively participated in the 2010 CWSP revision process, which was approved by Snohomish County Council in December 2010, and approved by DOH in February 2011. It includes a process for revision of service area maps as may be needed from time to time. The future WSA shown in **Figure 2-2** is consistent with the CWSP-approved map at the time of this WSP update. A copy of the 1991 and 2010 agreements are contained in **Appendix L**.

At the time of this writing, the City is investigating the acquisition of portions of the Marysville WSA that are either within Arlington City limits (e.g., Smokey Point), or otherwise contained within the City's WSA (Arlington Christian School).

2.3.2 Snohomish County PUD No. 1 Wholesale Water Agreement

A July 1998 wholesale water agreement between the City of Arlington and the PUD provides water from the City of Everett's regional surface water supply and groundwater from two PUD wells to the City's water supply portfolio. The agreement allows the City to purchase wholesale water from the PUD at rates up to 1,000 gallons per minute (gpm) for resale to the City's water utility customers. The agreement extends through "2018 and thereafter", and PUD staff have indicated their intent to maintain the agreement indefinitely. A copy of the agreement is contained in **Appendix M**.

2.3.3 Former Interlocal Agreements with City of Marysville Utilities

Prior updates to this WSP documented two interlocal agreements for utility interties between the City and the City of Marysville. Both are no longer effective.

A March 1978 interlocal agreement granted Marysville an easement for construction of water transmission main from Marysville's Ranney Well on the Stillaguamish River through the City. In return, the City was granted three connections for providing water to then-remote portions of the City's water system (west of the airport), and an emergency intertie. All have been abandoned. The two cities no longer have any connections under this agreement. The final connection under this agreement, serving the Stillaguamish Athletic Club and Weston High School, was removed when these facilities connected to the City's distribution system in 2014. Marysville continues to

operate its transmission main and WTP through an easement and fee simple ownership, respectively.

A separate August 1998 agreement transferred the Island Crossing water system (aka the Petunia water system) and all water services north of 180th Street NE along Smokey Point Boulevard from Marysville to the City. It also provided water to serve these customers. Improvements to the City's water distribution system allowed the City to close the intertie valve at Smokey Point Boulevard and 180th Street NE and directly serve this area since February 2005.

Marysville purchases water from the City to serve one connection (Arlington Christian School) in a remote portion of the Marysville WSA through an 8-inch water main under Interstate 5 (the school was excluded from the 1998 sale described above). The City initiated negotiations with Marysville in March 2015 to purchase this last remaining connection and directly serve the Arlington Christian School.

2.4 SATELLITE SYSTEM MANAGEMENT

A Satellite System Management Agency (SSMA) is defined as a person or entity that is certified by DOH to own or operate more than one public water system without the necessity for a physical connection between such systems. SSMAs were created to stop the proliferation of small water systems, many of which could not meet federal and state water quality and water system planning regulations. Based on the success of SSMAs, DOH made recommendations to the legislature to include rules for designating entities as qualified SSMAs.

In July 1995, Senate Bill 5448 became law, governing approval of new water systems and setting forth requirements for SSMAs. The goal of the law is to ensure that the people of Washington State will receive safe and reliable water supplies in the future from professionally managed or properly operated water systems. SSMAs can provide three different levels of service:

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

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

The City does not own or operate any satellite systems and is not currently a SSMA. Under the CWSP, the City may elect to serve smaller systems within its CWSP boundary either directly or as an SSMA. Outside and adjacent to the City's CWSP boundary (aka its future WSA boundary), the CWSP authorizes the PUD to function as the SSMA, giving it first right of refusal when a new or failing system desires management oversight.

2.5 INVENTORY OF EXISTING WATER FACILITIES

This section provides a detailed description of the existing water system and the current operation of the facilities. The analysis of the existing water system is presented in **Chapter 7**.

2.5.1 Pressure Zones

The City currently serves customers within an elevation range of approximately 40 feet near the crossing of Interstate 5 and State Route 530 to approximately 605 feet along Burn Road in the eastern portion of the system. The wide range of elevations requires that the water pressure be increased or reduced to maintain pressures that are safe and sufficient to meet the system's flow requirements. The City achieves this by dividing the water system into four distinct pressure zones, as shown in **Figure 2-1**.

The pressures in the 520 and 342 Zones are regulated by reservoir levels, as illustrated in the hydraulic profile, **Figure 2-2**. Pressures in the 342 Zone, which has a maximum hydraulic elevation of 342 feet, are established by the range of surface water levels in Gleneagle Reservoir. The 342 Zone is primarily located in Old Town Arlington and the areas surrounding the Arlington Airport on the Marysville Trough and Stillaguamish floodplain. Service elevations in the 342 Zone range from approximately 40 to 260 feet.

Pressures in the 520 Zone, which has a maximum hydraulic elevation of 520 feet, are established by the surface water level in the 520 Zone Reservoir. The 520 Zone serves neighborhoods on the Getchell Plateau, including the Gleneagle and Crown Ridge neighborhoods.. Service elevations in the 520 Zone range from approximately 190 to 420 feet.

The 540 and 710 Zones are located at even higher elevations on the Getchell Plateau, are supplied with water directly from the PUD through an intertie located east of the City on Burn Road. The hydraulic elevation of the PUD master meter is approximately 710 feet and pressures must be reduced with pressure reducing valves (PRV) along Burn Road and 186th Street to achieve satisfactory service pressures. Within the 710 Zone itself, service elevations range from approximately 340 to 605 feet.

The 710 Zone supplies the 540 Zone through the Upper Burn Road PRV. Maximum hydraulic elevation is 540 feet, and service elevations range from approximately 260 to 420 feet.

The 710 Zone also supplies the 520 Zone through the 186th Street flow control valve.

2.5.2 Supply Facilities

Introduction

The City's water supply is provided by three wells (plus one reserve well) and a wholesale purchase agreement with the PUD.

The primary source of water is the City's three wells in the Haller Wellfield near the Stillaguamish River. The first of these wells was reportedly hand-dug in the late 1890s to serve Haller City and shingle mills along the Stillaguamish River. The three wells withdraw groundwater from the Stillaguamish Alluvial Aquifer, which is in hydraulic connection with the river (also referred to as groundwater under the influence of surface water, or GWI). The Airport Wellfield includes a single well that withdraws groundwater from the Marysville Trough Aquifer. A summary of the well sources is shown in **Table 2-1**, and a detailed description of each source of supply is provided in the following sections.

The City's wholesale agreement with the PUD authorizes the purchase of up to 1,000 gpm of water. A master meter monitors and controls the supply of water into the City's distribution system. The master meter is located in a vault at the intersection of Burn Road and 172nd Street NE and is owned and maintained by the PUD. A summary of the PUD master meter is shown in **Table 2-2**.

As described earlier in this chapter, two former interlocal agreements with the City of Marysville which provided water supply to Arlington are no longer effective. The last two services in the Arlington WSA supplied by the City of Marysville began to be supplied from Arlington's other sources in 2014. The Marysville master meter has been removed from the meter summary in Table 2-2 effective with this WSP update.

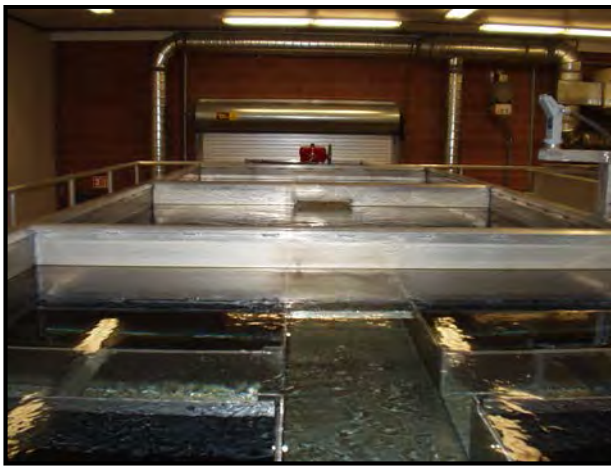
Table 2-1

Well Facilities Summary

Well	Pressure Zone	Year Drilled	Pumping Capacity (gpm)	Well Depth (feet)	Well Diameter (inches)	Pump Type	Pump Motor Size (hp)	Water Treatment[1]	Control Facility
Airport Well	342	1945, 1996	220	166	10	Vertical Turbine	60	NaOCl	Gleneagle Reservoir
Haller No. 1	342	~1963, 2002	570	36	16	Vertical Turbine	25	NaOH, NaOCl	Water Treatment Plant
Haller No. 2	342	1961, 2001	570	38	36	Vertical Turbine	25	NaOH, NaOCl	Water Treatment Plant
Haller No. 3	342	1906 or prior, 2001	570	38	72	(2) Vertical Turbine	(2) 25	NaOH, NaOCl	Water Treatment Plant

(1) NaOH: Sodium hydroxide corrosion control; NaOCl: chlorination.

Water Treatment



The water treatment plant, originally constructed in 1924 and replaced in 2001, is located within the City's utilities compound, and treats water from the Haller Wellfield. Filtration and disinfection of the Haller source is required because the wellfield is under the influence of the Stillaguamish River (as described earlier in this section, it is GWI). Water is pumped from the Haller wells through a single influent pipe to the direct filtration system, which consists of three filter beds. Primary coagulant and filter aid are added to the raw water, which is also chlorinated prior to filtration. The total capacity of the filtration system is 1,710 gpm. The plant operates with one or two filter beds in the winter and increases to three in the peak of the summer. Filtered water is then chlorinated by a 0.8 percent chlorine solution as it enters a 270,000 gallon clear well which provides adequate contact time for disinfection and provides storage. The chlorine solution is produced by an on-site sodium hypochlorite generation system. As the water exits the clear well, sodium hydroxide is added to adjust the pH level for corrosion control, and the water is disinfected in the distribution system as outlined below. Three pumps are available for pumping the water into the distribution system, although only two can operate simultaneously. The design pumping capacity with one pump operating is 910 gpm and is 1,710 gpm with two pumps operating. For unknown reasons, capacity was reduced to 1,650 gpm approximately 7 to 10 years ago. With just one pump running, capacity has declined to about 800 to 850 gpm. The City has scheduled one pump repair or replacement each year for 2016 through 2018. Two additional pumps are available for backwashing the filter beds.

The City's water is disinfected in the distribution system by flow-pacing diluted sodium hypochlorite during operation of the pump at the Airport Wellfield. Bulk 12.5 percent sodium hypochlorite is diluted and then injected into the pumped water through a metering pump feed system with a target dose of 0.5 milligrams per liter (mg/L).

Supplemental chlorination has taken place at the 520 Zone Pump Station. However, chlorine residual and disinfectant byproduct monitoring results have shown that supplemental chlorination is not generally required and may increase HAA5 and THM levels throughout the distribution system. Based on these monitoring results, supplemental chlorination was discontinued at the 520 Zone Booster Pump Station in December 2005.

Haller Wellfield

The Haller Wellfield is located within the 342 Zone near the confluence of the North and South Forks of the Stillaguamish River. Thanks in part to the high background water quality of the river and the use of riverbank filtration, the well field pumps clear water with only occasional concerns for manganese.

The well houses are located at Haller Park within a fenced area near the abandoned railroad trestle. Each well is housed in a separate building that contains the mechanical and electrical equipment. The telemetry and motor control center (MCC) equipment is also housed in Well No. 2's building.

Haller Well No. 1 was constructed between 1962 and 1964 and was abandoned in 2001 due to low yields. The well was relocated and reconstructed as Well No. 1R in 2002. The well's 570 gpm vertical turbine pump is powered by a 25 horsepower motor and is housed in a cement masonry unit (CMU) block building. The 16-inch-diameter, 36-foot-deep well has distinctly higher iron and manganese levels relative to Haller Well Nos. 2 and 3. A 2013 effort to purge the well and develop the surrounding formation through regular pumping resulted in very low turbidities in the pumped water at the wellfield. Upon pumping to the WTP, the filter trains were effective in further reducing turbidity in the mildly pre-chlorinated influent. Dosing with chlorine for disinfection, however, resulted in the rapid precipitation of iron and manganese in the clearwell, which was immediately discharged to the wastewater facility. Well No. 1R therefore remains off-line and suitable for water supply only on an emergency basis.

Haller Well No. 2 was constructed in 1961. It was rehabilitated in 2001 and is now housed in a CMU block building. The 36-inch-diameter, 38-foot-deep well is equipped with a 570 gpm vertical turbine pump powered by a 25 horsepower motor.

Haller Well No. 3 is understood to have been constructed by a shingle mill between 1897 and 1906. It provided portions of the City with water service prior to PSPL ownership of the water system. The City rehabilitated the well in 1939 upon purchasing the water system from the PSPL and again in 2001. The CMU block building houses two 570 gpm vertical turbine pumps, and each are powered by a 25 horsepower motor. The two pumps are installed in the 72-inch-diameter, 38-foot-deep well.

All three regularly operated pumps in Haller Wells No. 2 and No. 3 can alternate or run simultaneously depending on the volume of water required at the water treatment plant. Design

capacity for the wellfield pumps was about 1,710 gpm, matching the water rights of the wellfield and the capacity of the WTP when the WTP was constructed. The City initiated rehabilitation efforts on Haller Well Nos. 2 and 3 in 2012 in order to have a clear and current assessment of the reliability of the wellfield for long-term water supply. The City hoped that cleaning would help to increase well yield while reducing drawdown in the aquifer. Impulse technology (using Hydropuls®) was effective in cleaning impacted sediment and encrustations from the perforations and formation of Well No. 2, but also resulted in cracks in the concrete casing. It appeared to release a lot of iron and manganese laden sediments from the surrounding formation. A post-cleaning pump test on Well No. 2 (prior to cleaning of Well No. 3) observed a decline in well field production at the time from approximately 1,700 gpm to 1,500 gpm as a result of decreased specific capacity. Pumping at 1,700 would increase drawdown relative to the pre-rehabilitation effort. The City decided to postpone cleaning of Well No. 3 until the following year. When aquifer drawdown did not significantly improve, the City elected to not implement cleaning of Well No. 3.

All three wells feed into a 12-inch water supply or transmission main (a 10-inch segment was upgraded in 2012) that flows directly into the treatment trains at the water treatment plant. Additional data on the Haller Wellfield and the City's other sources is contained in **Appendix B**.

Airport Wellfield

The Airport Wellfield is located in the 342 Zone on fenced, Airport-owned property near 59th Avenue NE. It is within the airport/industrial area of the Marysville Trough. The City operated the Airport in the 1930s and early 1940s at which point it was purchased by the United States military. The military developed three or four wells in or around 1945. When the City re-acquired the Airport from the military in the 1960s, it gained control of any functional wells. The City supplied portions of the City with potable water for municipal use and irrigation from Airport Well No. 1 since before 1965. The City's Water Department continues to lease the property from the Airport. The well building also contains the well's mechanical, electrical and telemetry equipment. An emergency generator is located adjacent to the well building in a weather-tight enclosure.

The well's original water right was obtained in 1965 and increased in 1986 to allow for a maximum instantaneous rate of withdrawal of 580 gpm. The original pump in the 10-inch-diameter, 185-foot-deep well was replaced in 1996 with a vertical turbine pump equipped with a 60 horsepower motor. The City has increased the pump elevation twice since 1996 to avoid pumping sand deposits from the bottom of the well and due to a well casing collapse in 2009.

The well's supply rate has decreased from 580 gpm to approximately 220 gpm as a result of this well casing collapse.

Additional data on the Airport Wellfield and the City's other sources is contained in **Appendix B**.

Snohomish County PUD No. 1 Master Meter

The City has one connection to the PUD water system and has purchased water rights to withdraw a maximum of 1,000 gpm from this connection. A flow test performed by the City and PUD on April 28, 2011 resulted in at least 1,138 gpm being available at a hydrant in the City's 710 Zone. The static pressure on the City's side the PUD master meter was 75 psi prior to the flow test and the residual pressure at the same location was 33 psi during a flow rate of 1,138 gpm at the hydrant.

The primary source of PUD water is the regional supply provided by the City of Everett from reservoirs on the Sultan River. PUD also operates two groundwater wells near Lake Stevens which influence the water received at Arlington. Water supplied by the PUD is treated before it reaches the master meter and is not re-chlorinated or subjected to any additional treatment prior to entering the City's distribution system. The PUD master meter has a 6-inch main meter with a 2-inch bypass meter located within a below-grade concrete vault, which was constructed in 2000. A summary of the City's master meter is shown in **Table 2-2**. Additional data is also contained in **Appendix B**.

The PUD source provides "full fluoridated" water to the City since the City of Everett adds 0.7 mg/L of fluoride at its source. In comparison, water from the City's wells contains negligible amounts of fluoride. Fluoride and other quality considerations are addressed in Chapter 6.

Table 2-2

Master Meter Facilities Summary

Meter	Pressure Zone	Year Installed	Capacity	Master Meter Size (inches)	Operation Status	Contract Expiration Date
PUD Master Meter	710	2000	1,000 gpm	6 and 2	Active	12/31/2018

continued

2.5.3 Pump Station Facilities

520 Zone Booster Pump Station

The above-grade 520 Zone Booster Pump Station was constructed in 1998. The pump station and adjacent Gleneagle Reservoir are located on City-owned property in the Gleneagle residential neighborhood. The pump station is equipped with two end-suction pumps to pump water supplied from the 342 Zone Gleneagle Reservoir to the 520 Zone Reservoir. The two pumps operate on an alternating schedule to extend pump life and serve as a back-up for use when needed. The pumps are each rated at 395 gpm and powered by 40 horsepower motors. The normal pumping rate of the facility is approximately 430 gpm. The pump station is equipped with an emergency generator. A summary of the pump station is shown in **Table 2-3.**

520 Zone Pump Station

The previous WSP described how the pump station was managed only to pump water from the lower to higher pressure zone during emergency conditions. The typical operation was to serve the 520 Zone through a flow control valve from the 710 Zone, which obtained water from the PUD. Subsequent to the WSP, the City conducted a water supply study which demonstrated economic benefits to greater reliance on its own water sources. The City's approach is now to serve the 520 Zone from the 342 Zone by operating the booster facilities on a regular basis. The City replaced one pump and electric motor in 2015, and is scheduled to replace a second pump in 2016. Additional data on the 520 Zone Booster Pump Station is contained in **Appendix B**.

Table 2-3
Booster Pump Station Facilities Summary

Pump Station	Suction Pressure Zone	Dischrage Pressure zone	Year Constructed	Existing Pumping Capacity* (gpm)	Number of Pumps	Pump Type	Pump Motor Size (hp)
520 Zone Booster Pump Station	342	520	1998	790	2	End Suction	40

* 395 gpm for each of two pumps; typically operated one at a time in alternating fashion

Water Treatment Plant

The City's water treatment plant has a pump room that houses five pumps. Three of the pumps are 910 gpm vertical turbine pumps with 100 horsepower motors that pump treated water from the clear well into the distribution system. Two pumps can operate simultaneously with a combined pumping capacity of 1,710 gpm. The other two 1,000 gpm vertical turbine pumps are backwash

pumps powered by 25 horsepower motors. A spare 100 hp pump motor is held on reserve in the WTP. The treatment plant's emergency generator has the capacity to operate all of the pumps during an emergency event.

2.5.4 Storage Facilities

The City's water system has two storage facilities that provide storage to the 342 and 520 Zones. A summary of the storage facilities is shown in **Table 2-4** and a detailed description of each facility is provided below. Additional data is also contained in **Appendix B**.

Table 2-4

Storage Facilities Summary

Reservoir	Location	Pressure Zone	Year Constructed	Material	Capacity (MG)	Diameter (feet)	Base Elevation (feet)	Overflow Elevation (feet)	Overflow Height (feet)
Gleneagle	17913 Oxford Drive	342	1975	Concrete	2	100	304.7	342.0	37.3
520 Zone	17003 91st Ave NE	520	1993	Steel	2.0	132	499.0	520.0	21.0

Burn Road Reservoir

Constructed in 1962 as the City's second reservoir, the 0.5 MG Burn Road Reservoir provided 52 years of service before being taken off-line in February 2014. The reservoir, located on a fenced site off a remote gravel road near the intersection of Burn Road and 207th Street NE, is scheduled for demolition in this planning horizon (**Chapter 9**). At 48-foot-diameter and 37-foot-tall, the steel tank provided approximately 13,698 gallons of storage per foot of height. It served behind the Gleneagle Reservoir as redundant storage in the 342 Zone. It was decommissioned primarily because of slope stability concerns at and below the reservoir site, and because it is not anchored for seismic events.

520 Zone Reservoir

The 2.0 MG 520 Zone Reservoir is located on a fenced site in a residential area near the intersection of 172nd Street NE and 91st Avenue NE. The 132-foot-diameter, 21-foot-tall steel tank was constructed in 1993 and provides approximately 95,200 gallons of storage per foot of height. A single 16-inch-diameter water main serves as the reservoir's common inlet/outlet pipe. The reservoir is anchored for seismic events per 1993 standards. An adjacent building houses the reservoir's telemetry equipment and altitude valve. The altitude valve is not currently used because the reservoir is without an adequate drainage system. Additional data on the 520 Reservoir and the City's other reservoirs is contained in **Appendix B**.

Gleneagle Reservoir

The 2.0 MG Gleneagle Reservoir is located near the intersection of Eaglefield Drive and Oxford Drive and provides water storage to the 342 Zone. The 100-foot-diameter, 37-foot-tall concrete tank was constructed in 1975 and provides approximately 53,619 gallons of storage per foot of height. A single 14-inch-diameter water main serves as the reservoir's common inlet/outlet pipe. The reservoir is anchored for seismic events per 1975 standards. The Gleneagle Reservoir is equipped with telemetry. The reservoir's wooden roof is scheduled for replacement in the City's Capital Improvement Program shown in **Chapter 9**.

Gleneagle Reservoir

2.5.5 Distribution and Transmission System

The City's WSA contains approximately 96 miles of water main ranging in size from 2 inches to 16 inches. As shown in **Table 2-5**, half of the water main (approximately 50 percent) within the service area is 8-inch-diameter and 38 percent is 10 inches in diameter or larger.

Table 2-5

Water Main Diameter Inventory

Diameter (inches)	Length (feet)	Length (miles)	Percentage of Total
2	2,060	0.39	0.4%
4	18,985	3.60	3.7%
6	35,832	6.79	7.1%
8	254,350	48.17	50.1%
10	52,031	9.85	10.2%
12	138,973	26.32	27.4%
14	2,508	0.48	0.5%
16	2,835	0.54	0.6%
Unknown	445	0.08	0.1%
Totals	**508,017**	**96.22**	**100.0%**

Just over 89 percent of all water mains in the water system are constructed of ductile iron pipe (DIP). Most of the remaining mains are constructed of asbestos cement (AC). All new water main installations are required to use cement mortar lined, class 152 DIP in accordance with the City's Public Works Design and Construction Standards and Specifications; a copy is contained in **Appendix D**. More than half (55%) of the asbestos cement pipe occurs in Old Town Arlington. Other areas where AC is concentrated are along Cemetery Road (22%) and the industrial area east of the Airport (16%). About a half-mile of main composed of other materials is distributed in 13 segments around Old Town. A detailed breakdown of the City's water main material inventory is shown in **Table 2-6**.

Table 2-6

Water Main Material Inventory

Material	Length (feet)	Length (miles)	Percentage of Total
Asbestos Cement	52,610	9.96	10.4%
Cast Iron[1]	0	0.00	0.0%
Ductile Iron	452,902	85.78	89.2%
Galvanized Iron	628	0.12	0.1%
Plastic[2]	1,432	0.27	0.3%
Unknown	445	0.08	0.1%
Totals	**508,017**	**96.22**	**100.0%**

[1] The previous WSP reported almost 10,000 feet of cast iron pipe in Smokey Point Boulevard. Subsequent investigations have shown the pipe to be ductile iron and in good condition.

[2] PVC and HDPE

Historically, the life expectancy of water main is generally 50 years. However, corrosion within water mains has been greatly reduced through the development of cement mortar lined ductile iron pipe, which has a life expectancy in excess of 75 years. Approximately 10 percent of water main within the system was constructed in the 1950s and 1960s and is reaching or has reached its life expectancy. The majority of this older water main is 4- and 6-inch diameter asbestos cement pipe and is located in the old town and airport areas. Two-thirds of the water main in the City's water system is primarily 30 years old or less and is generally in good condition. A detailed breakdown of the age of the City's water mains is shown in **Table 2-7**.

Virtually all of the City's water main breaks occur in AC pipe. Where soils are well drained and soil moisture is relatively low, such as in the Marysville Trough near the Airport, AC pipe has been examined and found to be in excellent condition. In wetter soils, such as in Old Town Arlington, AC pipe is much less competent and more prone to breaks. Accordingly, the City

implements an annual main replacement program with focus on upgrading AC mains around Old Town first.

Table 2-7

Water Main Installation Year Inventory

Year Installed	Age (years)	Length (feet)	Length (miles)	Percentage of Total
1950s	56 to 65	17,241	3.27	3.4%
1960s	46 to 55	34,414	6.52	6.8%
1970s	36 to 45	43,484	8.24	8.6%
1980s	26 to 35	41,695	7.90	8.2%
1990s	16 to 25	149,424	28.30	29.4%
2000s	6 to 15	120,839	22.89	23.8%
2010s	0 to 5	22,370	4.24	4.4%
Unknown	Unknown	78,551	14.88	15.5%
Totals		**508,017**	**96.22**	**100.0%**

2.5.6 Pressure Reducing Stations

Pressure reducing stations are connections between adjacent pressure zones that allow water to flow from the higher pressure zone to the lower pressure zone by reducing the pressure of the water as it flows through the station, thereby maintaining a safe range of pressures in the lower zone. A pressure reducing station is essentially a below-grade vault (typically concrete) that normally contains two pressure reducing valves, sometimes a pressure relief valve, piping and other appurtenances. The pressure reducing valve hydraulically varies the flow rate through the valve (up to the flow capacity of the valve) to maintain a constant set pressure on the downstream side of the valve for water flowing into the lower pressure zone.

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

The City's water system has a total of seven pressure reducing stations, as shown in the profile view in **Figure 2-3**. Five of the seven pressure reducing stations are located at the boundary

between the 342 and 520 Zones. All five of these pressure reducing stations only provide water to the lower zone on a *standby* basis—during fire flow situations and occasionally during peak demand events. The remaining two pressure reducing stations, located along Burn Road at 95th Avenue NE, and along Old Burn Road at 209th Street NE, are needed to bring higher pressure water from the PUD into the City's distribution system. The latter station supplies water from the 540 Pressure Zone to the 342 Zone on a *standby* basis, while the former reduces pressure from the 710 Zone to the 540 Zone while providing a *continuous* supply of water. A summary of these PRVs is shown in **Table 2-8** and a listing of all pressure reducing stations and related data is contained in **Appendix B**.

The City's water system also has one flow control valve (FCV) located on 186th Street NE near Arlington High School at the boundary between the 520 and 710 Zones. This FCV is manually operated by the City to provide *continuous* water service to the 520 Zone by reducing the pressure from the PUD's system. A summary of this FCV is also shown in **Table 2-8**.

Table 2-8

Pressure Reducing Station Inventory

Name	Location	Pressure Zone (From)	Pressure Zone (To)	Valve Size (inches)	Pressure Setting (psi)	Hydraulic Grade Setting (feet)
Pressure Reducing Valves						
PRV 1 (Highland View)	17700 Highland View Drive	520	342	6 and 2	38	340
PRV 2 (Woodlands Way)	6850 Woodlands Way	520	342	6 and 2	30	333
PRV 3 (Cedarbough Loop)	Cedarbough Loop and Woodbine Drive	520	342	6 and 2	35	340
PRV 4 (Woodbine Drive)	Woodbine Drive and Silverleaf Place	520	342	6 and 2	30	301
Bovee Acres PRV	6900 Bovee Lane	520	342	6 and 2	38	334
Lower Burn Road PRV	Burn Road and 209th Street NE	540	342	8 and 2	35	320
Upper Burn Road PRV	Burn Road and 95th Avenue NE	710	540	8 and 2	45	540
Flow Control Valves						
186th Street FCV	8756 186th Street NE	710	520	6	---	---

2.5.7 Water System Interties

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

source of supply or a major transmission main and is unable to provide a sufficient quantity of water to its customers.

The City has one normal supply intertie with the PUD. This intertie provides the City with the capability to obtain a maximum of 1,000 gpm from the PUD. This supply source has value in that it is a sole source for much of the 540 and 710 pressure zones. (The 520 reservoir could back feed into the lower 540 zone—lower Burn Road area—with changes at the 186th Street flow control valve.) The flow control valve also regulates flow to a low, steady rate, but will open to pass fire flows in the event of a pressure drop in the 520 pressure zone. It also serves as a generous and reliable back-up supply should one of the City's production sources become unavailable. This was shown after the March 2014 Oso mudslide when withdrawals at the Haller wellfield were temporarily halted and then continued at a reduced rate for several months while turbid river water passed downstream. It is noted, however, as discussed in chapter 7, that operation of the intertie at flows above 100 gpm encroach on fire supplies for the 540 and 710 pressure zones. Flow rates in recent years have typically ranged from 40 to 80 gpm.

The City does not currently have an emergency intertie with an adjacent water system. An emergency intertie between Marysville's transmission main and the City's water system under the 1978 agreement along has been abandoned. A physical connection between the City and Marysville on Smokey Point Boulevard at 180th Street established under the 1998 agreement still exists but is valved closed. That agreement allowed certain flows during fire emergencies. Flows afforded to the City under the agreement are met or exceeded at higher pressure under the City's own operations. There is no benefit to the City to maintain the 1998 agreement only for a fire emergency.

The City currently has no plans for additional future interties with new parties, but may consider re-establishing an intertie with Marysville. Marysville's Stillaguamish River Water Treatment Plant, which is located within Arlington City limits, could provide supply directly to the City's 342 Zone with a booster pump station. The City could also directly supply Marysville's 240 Zone with a pressure reducing station.

2.5.8 Telemetry and Supervisory Control System

Successful operation of any municipal water system requires gathering and using accurate water system information. A telemetry and supervisory control system gathers information and can efficiently control a water system by automatically optimizing facility operations. A telemetry and supervisory control system also provides instant alarm notification to operations personnel in the event of equipment failure, operation problem, fire or other emergency situations.

The City's telemetry and supervisory control system was installed in 2001 and manufactured by Allen Bradley. The system consists of a master telemetry unit at the water treatment plant that operates the water treatment plant, Haller Wellfield, Airport Wellfield, 520 Zone Reservoir, 520 Zone Pump Station and Gleneagle Reservoir. Remote telemetry units are located at the Haller

Wellfield, Airport Wellfield, 520 Zone Reservoir and the 520 Zone Pump Station/Gleneagle Reservoir. The transmitting and receiving telemetry units communicate to each other using bridged circuit phone lines.

2.5.9 Water System Operation and Control

The City's system is supplied with water from the Haller and Airport Wellfields and through a metered connection from the PUD water system, as shown in **Figure 2-1**.

The 342 Zone is supplied with water from all three sources. The 342 Zone's main source of supply, the Haller Wellfield, supplies water to the water treatment plant. The main control panel (MCP) at the plant signals the remote control panel (RCP) at Haller Well No. 2 to operate the pumps. The number of pumps operating depends on the water treatment plant flow and the number of treatment trains operating, and reflects the operator's decision in anticipation of system demands. The telemetry system is programmed to alternate the pumps in operation at the Haller Wellfield and recognizes the source as four pumps instead of three wells (or three pumps instead of two wells, since Well 1R is off-line for water quality reasons and is used for emergencies only). Up to three pumps may run at any one time. The RCP will send a signal to the MCP if there are well problems (i.e. low water level, pressure problems, etc.) and the MCP will shut down the well. Treated water is supplied to the Gleneagle Reservoir. Water is pumped through the distribution system and to the reservoir when the water treatment plant clear well is full and disinfection contact time is satisfied. The amount of water pumped from the clear well to the system is set by the water treatment plant operator. A high reservoir level at the Gleneagle Reservoir will generate an alarm to signal an operator.

The 342 Zone is also supplied with water from the Airport Wellfield and the PUD. The Airport Well No. 1 is controlled by water levels in the Gleneagle Reservoir. The water treatment plant operator inputs reservoir operating set points into the MCP to operate the well as needed. Water is pumped directly into the 342 Zone from the Airport Well.

Water from the PUD can be transferred to the 342 Zone from the 540 Zone on a standby basis through the Lower Burn Road PRV. Additionally, the five pressure reducing stations between the 520 and 342 Zones do not normally supply water, but are set to supply water to the 342 Zone upon a suppressed level in the 342 Zone reservoirs or during a localized drop in pressure, such as during a fire flow.

The 520 Zone is primarily supplied by the 520 Zone Booster Pump Station, which operates using two alternating pumps. The 520 Zone is also supplied with water purchased from the PUD, through the 186th Street flow control valve (FCV) from the 710 Zone. The 186th Street FCV is a continuous source of supply to the 520 Zone and the 520 Zone Reservoir. At the present time, it typically operates at 40 gpm to 50 gpm. During periods of high demands, emergency conditions such as a fire event or an interruption in supply from the PUD, the pump station increases its supply

to the 520 Zone. The pump station can be controlled by the City's telemetry system and is dependent on the level of the 520 Zone Reservoir.

The City's connection to the PUD and a pressure reducing station located along Burn Road at 95th Avenue NE provide a continuous source of supply to customers in the 540 and 710 Zones along the Burn Road Transmission Line.

2.6 ADJACENT WATER SYSTEMS

The largest water systems adjacent to the City's WSA are Marysville and the PUD. Several smaller water systems are located within or in the vicinity of the City's WSA. Eighteen water systems located adjacent to or within the City's service area boundary are shown in **Figure 2-2**. A brief description of each water system is summarized from their Water Facilities Inventory (WFI) on DOH's Sentry Internet database in 2014.

2.6.1 Large, Expanding Group A Community Water Systems

Under the North Snohomish County Coordinated Water System Plan (CWSP), expanding systems like the City of Arlington are peer utilities which anticipate the ability to expand their infrastructure to add additional connections through time. Expanding systems have future WSAs which are clearly defined footprints within the Critical Water Supply Service Area (CWSSA). Future service area boundaries may themselves expand, consistent with established procedures, until the entire CWSSA is served.

Snohomish County PUD No. 1 – Lake Stevens (Water System ID 80907)

The Snohomish County PUD No. 1's (PUD) Lake Stevens water system (aka as PUD's Integrated System) abuts the City's eastern service area boundary, with most of its adjacent infrastructure near the southeastern corner of the service area.. The PUD's May 2014 WFI indicates it serves 18,782 total connections, including a residential population of 46,298 in 18,356 dwelling units. Industrial, commercial, and industrial (ICI) connections compose the remaining 415 services. A recent transfer of the Sunnyside neighborhood from the PUD to the City of Marysville reduced PUD's active water customers by about 20 percent to the levels given here.

The PUD receives most of its water from approximately eight interties with the City of Everett. However, it has recently begun increasing the amount of water it produces from two wells near Lake Stevens at up to 2,400 gpm. The City of Arlington receives water from the PUD via a wholesale water supply line. In 2013, about 6% of the City's supply was received from the PUD.

The City of Marysville (Water System ID 51900)

Marysville's water system is located south of the City's service area boundary. Marysville's WFI indicates approximately 20,683 water service connections. It serves a population of 62,115 in 19,395 dwelling units. The WFI indicates 1,288 additional industrial, commercial, and industrial (ICI) and other connections. However, a recent transfer of the Sunnyside neighborhood from PUD

to the City of Marysville is understood to have resulted in a significant increase in the number of Marysville's residential water customers.

Water is supplied to the Marysville system from Edward Springs, from three groundwater wells near the springs, from two other groundwater wells, from a Ranney well in the Stillaguamish River, and from an intertie with the City of Everett. A filtration plant for the Ranney well is located within Arlington city limits, but only serves City of Marysville customers. Although interties between the two cities formerly existed, no interties currently exist. The only exception is Arlington water purveyed to a single service in an isolated portion of the Marysville service area. As described elsewhere in this WSP, the City and Marysville are working to transfer this service to the City of Arlington.

Marysville has a large WSA that extends well beyond its city limits. As described previously, Marysville serves water to Arlington's Smokey Point neighborhood. The City has initiated negotiations with Marysville for some modifications to our mutual service area boundaries, but no plans currently exist for renewing interties between the two systems.

Seven Lakes Water Association (Water System ID 77660)

Seven Lakes Water Association operates a water system in the lakes region of the lower Stillaguamish basin, west of the BNSF railroad which marks the western margin of Arlington's WSA. Seven Lake's WFI indicates approximately 2,223 water service connections. It serves a permanent population of 5,557 in 2,215 dwelling units. The WFI indicates three additional industrial, commercial, and industrial (ICI) connections. It also serves five recreational camps and RV parks where transient populations range from 1,905 in January to 8,075 in July and August.

Water sources for the Seven Lakes Water Association include three deep wells (depths exceeding 150 to more than 330 feet) and one shallow well. Other reserve wells and an intertie with Marysville are maintained for emergency purposes.

Tulalip Reservation

The Tulalip Reservation water system is located southwest of the City's WSA. The water system serves an area of approximately 24 square miles. Water is supplied to the system by a surface water spring and interties with Marysville and Everett. There are no current plans for interties between the Tulalip system and the City.

2.6.2 Other Non-expanding Group A Community Water Systems

Under the CWSP, non-expanding systems formed to serve isolated communities or remote parcels with a public service function in areas where larger municipal systems did not exist. Under the CWSP, these systems remain autonomous, and their service area footprints are recognized but not permanent. They may exist within the future water service boundary of an expanding system (see 2.6.1). In the event of a failure of or request by the non-expanding system, the expanding system has an obligation and the first right of refusal to serve that system. If the expanding system chooses

to *not* integrate their systems or manage it as a satellite system, the non-expanding system may be managed by another satellite management agency.

Five non-expanding Group A systems exist within the City's future WSA. One, Arlington Terrace, is within City limits. Four systems abut or are very near city limits: Meadowbrook, McPherson Hills, New Start, and Stilli Ridge Estates. These five are the non-expanding systems the City may most likely consider acquiring in the future. The remaining non-expanding systems are identified because of their proximity and the opportunities to cooperate and coordinate in the future.

Arlington Terrace (Water System ID 27241)

Arlington Terrace is a small water system located at about 192nd Street between 67th Avenue and SR 9. It is east of the Arlington Airport and entirely within Arlington's city limits and WSA. The system serves about 104 people on approximately 28 of 29 approved service connections. Two groundwater wells provide water to the Arlington Terrace water system. Well No. 1 is 85 feet deep and produces 34 gpm. Well No. 2 is 76 feet deep and produces 50 gpm. While the topography poses challenges for the City to provide this neighborhood with water and sewer service, the City may acquire this water system in the future.

McPherson Hills (Water System ID 529307)

The McPherson Hills private water system is located southeast of the Arlington Airport just outside of city limits but within the City's WSA. The system uses all of its 11 approved service connections to provide water to 30 people. One 250 foot deep groundwater well discharging 26 gpm provides the sole water source for this system. The City has considered providing service to McPherson Hills in the past, but the topography makes it difficult to do so. Although there are no current plans for interties between McPherson Hills and the City, the City may acquire this system in the future.

Meadowbrook Homeowner's Association (Water System ID 03449)

Meadowbrook Homeowner's Association is a private water system within the City's WSA located immediately east of the City along Tviet Road. It abuts City limits. The system supplies 35 persons using all of its approximately 15 approved service connections with one 216 foot deep groundwater well that supplies 36 gpm. Although there are no current plans for interties between Meadowbrook and the City, the City may reasonably consider acquiring this system in the future.

New Start Landowners Water Association (Water System ID 22380)

Formerly the Top of the Hill Water Association, New Start is a private water system located southeast of the Arlington Airport just outside of city limits but within the City's WSA. It is immediately adjacent to the McPherson Hills system. The New Start system supplies water to an estimated 90 people on approximately 26 of 52 approved service connections. One 172 foot deep groundwater well is the primary water source, supplying 25 gpm. The City has considered providing service to Top of the Hill in the past, but the topography made it difficult to do so. Although there are no current plans for interties between New Start and the City, the City may acquire this system in the future.

Stilli Ridge Estates (Water System ID 187072)

Stilli Ridge Estates is a private water system located east of downtown Arlington along Tviet Road. It is within the City's WSA. The system supplies approximately 72 persons on 30 of 44 approved service connections with one active, shallow groundwater well. This well is approximately 40 feet deep and produces 31 gpm. Although there are no current plans for interties between Stilli Ridge and the City, the City may acquire this system in the future.

Arlington East Mutual Water Association (Water System ID 02948)

The Arlington East Mutual Water Association is a private water system located northeast of the City's WSA. The system supplies approximately 36 service connections with one groundwater well that is approximately 35 feet deep and produces 35 gpm. There are no current plans for interties between this system and the City.

Arlington Heights Water Company (Water System ID 111342)

The Arlington Heights Water Company is a private water system located northeast of the City's WSA. The system supplies approximately 20 service connections with one groundwater well that is approximately 30 feet deep and produces 15 gpm. There are no current plans for interties between this system and the City.

Arlington View Estates Water Association (Water System ID 02945)

The Arlington View Estates Water Association is a private water system located northeast of the City's WSA. The system supplies approximately 24 service connections with one groundwater well that is approximately 31 feet deep and produces 80 gpm. There are no current plans for interties between this system and the City.

Eagle Ridge Water Association (Water System ID 24731)

The Eagle Ridge Water Association is a private water system located north of the Stillaguamish River mid-way between I-5 and SR 9. It is outside of the City's WSA. Two shallow groundwater wells supply water to 250 people on approximately 137 of 146 approved service connections. Well No. 1 is approximately 52 feet deep and produces 140 gpm. Well No. 2 is approximately 38 feet deep and produces 160 gpm. There are no current plans for interties between this system and the City's water system.

Silvana Water Association (Water System ID 79050)

The Silvana Water Association is located adjacent to the northwest corner of the Arlington WSA. A spring provides its sole water source to 150 residents on 44 unapproved connections, and eight ICI connections. It also provides service to a transient population of about 78 persons from May through October. There are no current plans for interties with this system.

Sudden View (Water System ID 12451)

The Sudden View water system is a private water system which abuts the southeast corner of the City's WSA. The water system purchases water from the PUD to serve 60 people on 21 of 48

approved service connections. Sudden View maintains two groundwater wells for emergency supply. Well No. 1 is approximately 430 feet deep and produces 22 gpm, and Well No. 2 is approximately 20 feet deep and produces 40 gpm. When used, water from the groundwater wells is chlorinated prior to entering the distribution system. There are no plans for interties between this system and the City's water system. The City understands that Snohomish PUD has the first right of refusal to operate Sudden View in the event of a system failure.

2.6.3 Other Water Systems

Arlington Fuel Stop (Water System ID AA613)

Arlington Fuel Stop is a truck stop just west of the City's Island Crossing neighborhood on the west side of I-5. It abuts City limits and is inside of the City's WSA. Arlington Fuel Stop operates a Group A, Transient Non-Community water system serving approximately 900 customers each month from a single private well. Although there are no current plans for interties between Arlington Fuel Stop and the City, the City may reasonably consider acquiring this water system in the future.

Arlington LDS Church (Water System ID 36136)

Arlington LDS Church is located northeast of the City at the intersection of SR 530 and Arlington Heights Road. It outside City limits but within the City's WSA. The church operates a Group A, Transient Non-Community water system serving approximately 299 parishioners eight days each month. Its primary source is a 160 foot deep groundwater well producing just 2 gpm. Although there are no current plans for interties between Arlington LDS Church and the City, the City may reasonably consider acquiring this water system in the future.

Snohomish County PUD No. 1 – Otis (Water System ID 06956)

The PUD's Otis water system is a Group B system located southeast of Old Town and adjacent to the City's Brekhus-Beach neighborhood, within the City's WSA. The system is managed by the PUD as a SSMA and supplies 10 persons on 4 connections with one well. The well is 233 feet deep and produces 30 gpm. Although there are no current plans for interties between Otis and the City, the City may reasonably consider acquiring this water system in the future.

3 Land Use and Population

3.1 INTRODUCTION

The City of Arlington (City) *Comprehensive Plan*, first completed in 1995 and updated in 2005, was updated once again in 2015. The recent update was adopted by the City Council in June 2015. The plan was developed to meet the requirements of the State of Washington Growth Management Act (GMA). The GMA requires, among other things, consistency between land use and utility plans and their implementation.

This Comprehensive Water System Plan (WSP) update is developed, in part, to support the citywide comprehensive planning process. This chapter demonstrates the compatibility of this WSP with the Comp Plan and with other plans, identifies the designated land uses within the existing and future service area, and identifies population projections within the City of Arlington's (City) planning area.

3.2 COMPATIBILITY WITH OTHER PLANS

3.2.1 Introduction

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

- Growth Management Act
- City of Arlington 2015 Comprehensive Plan (Comprehensive Plan)
- Snohomish County 2015 Comprehensive Plan
- Snohomish County Countywide Planning Policies

- North Snohomish County Coordinated Water System Plan (2010)

3.2.2 Growth Management Act

The State of Washington Growth Management Act of 1990 (GMA, and its multiple amendments) defines four goals relevant to this WSP.

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

Urban Growth Area

The GMA requires that Snohomish County (County) and the City cooperate in designating an Urban Growth Area (UGA). As part of the development of its 2005 *Comprehensive Plan* update, the City and the County designated a UGA that would accommodate the City's projected population growth and provide resource conservation. The City filed a petition on the County's 2014 docket for expansion of the UGA west of I-5 in an area that is located within the Rural Urban Transition Area (RUTA) designated by the County. The County tabled the petition until after completion of County's and City's comprehensive plans, and is expected to rule on the petition in 2016. Meanwhile, the County completed its *2015 Comprehensive Plan Update*, which was adopted by the County Council in June 2015. This CWP update anticipates County approval of its petition for UGA expansion, and allocates growth to the expansion area. If the petition is not approved, however, the WSP will require an amendment, as population growth and increases in water demand would need to be allocated to other areas of the City. The expansion area is identified and tracked separately from the existing UGA in text, tables, and maps for evaluation of its effects on water supply and distribution infrastructure. This will also facilitate an amendment should it be required. The current and proposed UGA areas are shown in **Figure 3-1**.

Consistency

The GMA requires planning consistency from two perspectives. First, it requires consistency of plans among jurisdictions. This means that plans and policies of the City and the County must be consistent (RCW 36.70A.100). Second, the GMA requires the implementation of the WSP be consistent with the City's *Comprehensive Plan* (RCW 36.70A.120). While this WSP and the City's *2015 Comprehensive Plan* were in development, Snohomish County was also updating its *Comprehensive Plan*. Both were completed and adopted in June 2015. The City's Planning staff and its Public Works staff worked with their counterparts in Snohomish County Planning and Development Services (PDS) to assure they are aware of the City's service levels, capital development needs, and planning proposals. In addition, the Public Works Department coordinated with the City's Community and Economic Development Department to assure this WSP utilized the same growth projections, the same focus areas for residential and commercial/industrial growth, and other assumptions as were used in the City's *2015*

Comprehensive Plan. Consistency Review forms completed by both the City and PDS are included in **Appendix N**. Ordinances and resolutions recently passed by the Arlington City Council are included in **Appendix O**.

Concurrency

Concurrency means that adequate public facilities and services be provided at the time growth occurs. For example, growth should not occur where schools, roads and other public facilities are overloaded. To achieve this objective, the GMA directs growth to areas already served or readily served by public facilities and services (RCW 36.70A.110). It also requires that when public facilities and services cannot be maintained at an acceptable level of service, new development should be prohibited (RCW 36.70A.110). This WSP complies with concurrency requirements because it has been developed with consideration of and consistency with the City's Comprehensive Plan. The capital projects schedule (**Chapter 9**) and financial plan (**Chapter 10**) demonstrate the City's ability to provide water service when and where it is needed.

Critical Areas

The GMA requires that critical areas be designated and protected. Critical areas include fish and wildlife habitat, flood zones, aquifer recharge areas, streams, creeks, rivers, lakes, wetlands and other surface water, as well as geologic hazard areas such as steep slopes and liquefaction zones. Designated critical areas within the City's future water service area (WSA) are shown in **Figure 3-2**. **Appendix Q** contains a SEPA checklist that addresses other environmental concerns.

3.2.3 City of Arlington Comprehensive Plan

The Land Use Element of the City's current *Comprehensive Plan* is the City's vision of how growth and development should occur over a 20-year horizon.

While the Land Use Element goals and policies set forth general standards for locating land uses, the Zoning Map, which is shown in **Figure 3-1**, indicates geographically where certain types of uses may be appropriate.

The Land Use Element considers the general location of land uses, as well as the appropriate intensity and density of land uses given the current development trends. The utilities, transportation and capital facilities elements ensure that new development will be adequately serviced without compromising existing levels of service, similar to the principal of concurrency as defined in the GMA. The City's WSP is reviewed and taken into consideration during the development of revisions to the Capital Facilities Element of the *Comprehensive Plan*. After review, the City's Planning Department will validate consistency of the WSP with the *Comprehensive Plan* (**Appendices D, T**).

3.2.4 Snohomish County Comprehensive Plan

The Snohomish County Council first adopted its *Snohomish County Comprehensive Plan* in June 1995. Since that time, the plan has been amended numerous times to incorporate UGA changes,

Capital Facility Plan changes and land use changes. The most recent update was adopted in June 2015. The plan consists of the following five sections.

1. General Policy Plan
2. Future Land Use Map
3. Transportation Element
4. Capital Facilities Plan
5. Park and Recreation Comprehensive Plan

The County's *Comprehensive Plan* guides development in unincorporated Snohomish County and designates land use in the unincorporated UGA. Similar to the City's *Comprehensive Plan*, the County's plan contains the following land use goals that "form the basis of the County's land use strategy and:

- provide for a supply and distribution of land use types to accommodate the majority of county population and employment growth within urban growth area;
- reduce land consuming urban development patterns and provide structure for urban development within neighborhoods or urban centers;
- reduce development pressures and patterns of sprawl within rural areas;
- conserve agricultural, forest and mineral resource lands of long-term commercial significance; and
- preserve and protect open space, scenic and cultural resources."

3.2.5 Snohomish County Countywide Planning Policies (CPPs)

Countywide Planning Policies (CPPs) were established by the legislature to provide a framework for consistency between GMA, the County Comprehensive Plan, and the City's Comprehensive Plan. Snohomish County CPPs assure coordination and interjurisdictional cooperation in comprehensive plans for regional issues and initiatives, and issues affecting common borders. Within the structure of established core principals and general policies, the CPPs encourage flexibility in local interpretations in several areas, including Development Patterns, Housing, Economic Development, Transportation, Natural Environment, and Public Services and Facilities. These and other areas are addressed holistically within city and county comp plans.

This WSP has been adopted by reference as one component of the City of Arlington Comprehensive Plan, and as such does not attempt to address all of the CPPs in itself. For example, policies guiding Development Patterns are best addressed within the City's General Comprehensive Plan. The WSP, responsible for providing water service to these areas, are guided by CPPs focusing on Public Services and Facilities. CPPs were reviewed in the context of the

WSP, and selected ones best addressed through the WSP are identified below. The list is not intended to be exhaustive.

- PS-1: Jurisdictions should support cities as the preferred urban service providers.
- PS-2 Cities shall determine the appropriate methods for providing urban services in their incorporated areas including any annexations thereto.
- PS-4: The County and cities should support the planned development of jobs and housing through strategic investment decisions and coordination of public services and facilities.
- PS-5: Public services and infrastructure provided by jurisdictions in rural and resource areas should be at a level, scale, and in locations that do not induce urban development pressures.
- PS-6 The County and cities should design infrastructure and public services to promote conservation of natural resources.
- PS-7 Jurisdictions should promote improved conservation and efficient use of water to ensure long-term water availability.
- PS-15 The County and cities should develop and coordinate compatible capital facility construction standards for all service providers in individual Urban Growth Areas.
- DP-5: The County and cities shall adopt comprehensive plans and development regulations [to]:
    - Permit the urban growth that is projected to occur in the succeeding twenty-year period, and
    - Provide for urban governmental services and capital facilities sufficient to accommodate the broad range of needs and uses that will accompany the projected urban growth.
- DP-26: Domestic water supply systems may be developed in rural and resource areas to meet the needs of rural areas. Water sources and transmission lines may be developed in rural and resource areas to meet the needs of urban growth areas.

3.2.6 North Snohomish County Coordinated Water System Plan

The *North Snohomish County Coordinated Water System Plan* (CWSP), originally prepared in October 1991 and revised in 2010, is the result of a study performed by the Snohomish County Water Utility Coordinating Committee (WUCC) in conjunction with Snohomish County

Department of Planning Services. The members of the WUCC represent all public water systems with more than ten service connections that provide service within the Critical Water Supply Service Area (CWSSA). The Snohomish County Council declared North Snohomish County a CWSSA on October 19, 1988.

The purpose of the CWSP is to assist the area's water utilities in establishing an effective process for planning and development of public water systems and restricting the proliferation of small public water systems. The CWSP accomplishes this by establishing current and future service area boundaries, minimum design standards, service review procedures, appeals procedures, long-term regional water supply strategy, water conservation program and goals, and the satellite system management program. As can be seen in the following sections of this WSP, the City has established policies, design criteria and goals that meet or exceed the requirements and goals of the CWSP.

3.3 LAND USE

The City's future WSA is described in Chapter 2. The WSA totals approximately 16,176 acres, and includes areas within these recognized jurisdictions: City of Arlington, Arlington UGA, and Snohomish County. The City conducted a developable lands inventory of lands within city limits, UGA, and prospective UGA situated west of I-5 for preparation of the City's *Comprehensive Plan.* This WSP Update is consistent with the *Comprehensive Plan* through its use of the City's zoning map and the developable lands inventory for its development of population and water demand projections below and in Chapter 4.

3.3.1 City of Arlington

The Arlington City limits currently encompass an area of approximately 6,215 acres (38 percent of WSA). The City's vision for its growth and development is incorporated in its Zoning Map, provided in **Figure 3-1**. Land use designations are summarized in **Table 3-1**. Within the City, residential allocations comprise most of the zoning (2,657 acres, 43 percent). About 72 percent of the residential area is zoned at moderate densities (6.05 dwelling units/acre). Higher density (>10.1 DU/ac) and lower density (4.5 DU/ac) zoning complete 15 percent and 13 percent of the City's residential areas, respectively. Approximately 1100 acres (18 percent) of the City is zoned commercially, primarily in General Commercial and Highway Commercial allocations. Industrial areas occupy this same amount of land within the City, primarily near the airport. The Arlington Municipal Airport and aviation-related commercial and industrial enterprise make up 737 acres of the Aviation Flightline District (12 percent of the City). The City has also three percent of its area for designated business-centric use. This includes 155 acres for a business park to be developed on the west side of the airport, and another 20 acres for Medical Services around the Cascade Valley Hospital. Finally, 450 acres (seven percent) of the City is dedicated to Public/Semi-Public uses, including parks, schools, and other government and community services.

3.3.2 City of Arlington Urban Growth Area (UGA)

The City's current UGA encompasses an additional 387 acres (2% of WSA) outside of City limits. The City's Comprehensive Plan includes land use zoning to guide the transition of these parcels into the City, and direct their subsequent development (**Figure 3-1**). About two-thirds of the acreage in the UGA is designated for residential development (**Table 3-1**). One-fifth of the area is designated as Public/Semi-Public. Twelve percent is zoned for commercial and additional business park development.

The City of Arlington has petitioned Snohomish County for the addition of about 236 acres (1% of WSA) situated west of Interstate 5 into the City's UGA. This area is consistent with the intent of the County's R-5 zoning to maintain rural character on about 5-acre lots. The City proposes to zone it as moderate density residential (RMD) with 6.05 DU/ac. Approximately 41 acres that are currently vacant would contain new residential developments, and an estimated 110 acres may be redeveloped for residential use as well.

Snohomish County anticipates a 2016 decision date on the UGA petition for parcels west of I-5. This WSP Update therefore tracks this area separately, referring to it as the "UGA expansion area".

3.3.3 Snohomish County

More than half (58 percent) of the Arlington WSA is currently under Snohomish County jurisdiction. About 56% of this land is zoned by the County as R-5 in order to preserve the rural character of non-resource lands. Some areas (44%, primarily on the Stillaguamish floodplain) are zoned A-10 for the protection of agricultural land and promote agriculture as critical to the regional economy. The Zoning Map, shown in **Figure 3-1**, identifies Snohomish County's jurisdiction and zoning classifications within the WSA as well.

Transfer of Development Rights

The City has implemented a transfer of development rights program (TDR), which allows important agricultural lands in the Stillaguamish River Valley to be preserved. Owners of agricultural land within the Stillaguamish Valley Sending Area are eligible to sell the development rights of the land, while keeping the ability to use the land in a manner that optimizes natural resources. Developers who purchase development right certificates from agricultural land owners can use them to develop or redevelop land to a higher density within the designated receiving area. In the previous WSP, the Brekhus-Beach annexation was identified as the primary receiving area. Because of the slow start of both the TDR program in the Stillaguamish basin and the development of a master planned community in Brekhus-Beach, City land use planners have now identified the West Arlington area along Smokey Point Boulevard to be the new receiving area, as shown in **Figure 3-1**.

The importance of TDR to the water utility lies with the protecting the health of the Stillaguamish River—its primary source of supply, and planning for and maintaining infrastructure to meet established levels of service in the receiving area with its potentially greater demands. Changes

in land use toward increased urbanization can negatively affect water quality and maintenance of river flow regimes.

Table 3-1

Land Use Zoning Allocations by Jurisdiction

Land Use Type	Area (Acres)				
	City	Existing UGA	Expanded UGA West of I-5	Snohomish County	Total
Airport	737	0	0	0	737
Business Park	155	11	0	0	166
Commercial	1,088	34	12	17	1,151
Industrial	1,108	0	0	39	1,147
Medical	20	0	0	0	20
Public	450	81	0	0	531
Residential	2,657	261	224	0	3,142
Rural Residential	0	0	0	5,222	5,222
Agricultural	0	0	0	4,060	4,060
Total	6,215	387	236	9,338	16,176

3.4 POPULATION

3.4.1 Household Trends

The City is a residential community comprised of a full range of housing types. In 2013, the Office of Financial Management (OFM) estimated that two-thirds of 7,053 housing units (4,695) within the City limits were single family detached homes. Approximately one-fourth of the residences (1,773) had two or more units. The remaining 585 units (8 percent) were in mobile homes and special housing.

According to the U.S. Census Bureau, the average household size in the City was 2.70 persons per household in 2010, down slightly from 2.72 in 2000, but still above 2.51 in 1990. The average household size in all of Snohomish County was 2.65 persons per household in 2000, dropping slightly to 2.62 in 2010.. The 2005 *Comprehensive Plan* anticipated that the average household size for Arlington would decrease to approximately 2.50 persons per household by the year 2020. The average number of people per household in 2000 was 2.82 for owner-occupied housing units and 2.54 for renter-occupied units. The densities by housing type and the anticipated future trending could not be located in the 2010 census data at the time of this writing.

3.4.2 Existing and Future Population

The County has experienced rapid population growth and extensive physical developments since 1990. The County's population increased by more than 25 percent in the 1990s, and remained high at 17.7 percent from 2000 to 2010. It increased another 2.4 percent by 2013, totaling 730,500 people.

Including annexations, the City's population increased by approximately 82 percent during the 1990s, and another 62.5 percent from 2000 to 2010. It increased another 2.4 percent by 2014, totaling 18,360 people. **Table 3-2** illustrates the City's historical population growth from 1990 through 2014.

Future population growth is established by county and regional planners under the direction of GMA. Snohomish County established a target population of 24,937 for the City of Arlington and its UGA in the year 2035. As a basis for projecting water demand, the City assumed linear annual residential growth of 313 persons per year in order to increase by an additional 6,577 persons, from 18,360 in 2014 to 24,937 in 2035 (21 years). For the purposes of long-term water supply only, this WSP assumes continued growth within the City of 1.35 percent through 2065 (51 years to obtain a water service population of more than 35,000. Further assumed annual growth of one percent and 0.5 percent each for 25 years provides a 100 year water service population estimate of nearly 52,000 persons. **Table 3-2** illustrates the City's projected future growth within the City limits and the WSA for 2020 (6 years), 2024 (10 years), 2034 (20 years), 2035 (21 years, and the target for the City's Comp Plan), 2064 (50 years), and 2114 (100 years).

The actual population served by the water system differs from the population that resides within the City limits. The City's existing and future population is modified by adding and subtracting various other population values to the annual series of City population described above.

There are areas within the City limits that obtain water service directly from other purveyors including the City of Marysville, which provides water service to the City's Smokey Point and Country Manor neighborhoods, and the Arlington Terrace Group A water system. The populations of these areas, as estimated by City planning staff[1], are subtracted from the City population values.

The City also provides water service to customers outside the City limits. Services outside the City and within the UGA include The Eagles' neighborhood and parcels west of the Arlington Cemetery. Services outside the City and the UGA include customers along Burn Road, and one

[1] Smokey Point and Country Manor estimated as 861 lots times a density of 2.6 persons per household, or 2,239 total persons. Arlington Terrace estimated as 37 occupied lots times a density of 2.7 persons per household, or 100 total persons. Both estimates are assumed to reflect built-out conditions under existing land use classifications, and therefore do not increase into the future.

non-residential customer west of Interstate 5. The populations of these services, as estimated by City planning staff[2], are added to the City population values.

The actual population served by the water system in 2014 was 16,245. The population served in 2035 is projected to be 22,936, as shown in **Table 3-2**. This is an increase in the water service population of 6,690 persons by 2035. Note that the population served by the water system apparently decreases from 2013 to 2014 because of a modification of (increase in) the estimated number of Arlington citizens residing in the Smokey Point area that is served by the City of Marysville. The estimate increased the assumed built-out population of the Smokey Point and Country Manor neighborhoods by 606 persons, from 1,633 to 2,239.

3.5 POPULATION PLACEMENT

3.5.1 By Pressure Zone

The population projections are based on the growth projections prepared by the City 's Planning Department. **Table 3-3** shows the projected additional population in the City's four pressure zones, with 2014 as the base year. Growth west of I-5 is anticipated to result in much of the growth occurring within the 342 zone. Growth could also occur in the West Arlington neighborhood, which is the receiving area for the City's TDR program. Growth in the 520 Zone is expected to be concentrated during this planning cycle in the vicinity of the intersection of SR9 and 172nd Street NE. Growth in the 540, 615 and 710 Zones is expected to occur within currently undeveloped parcels along the Burn Road corridor, including the Quail Ridge, Parkwood, and Riverview East developments. Approximate pressure zone boundaries for the City's future water system are described in **Chapter 9** and are shown in **Figure 9-1**.

The population projections, along with the historical per capita water use data presented in **Chapter 4**, form the basis for determining future water demands for the City's water system.

Table 3-4 places the growth projections provided in **Tables 3-2** and **3-3** into the land use context presented earlier in Chapter 3 and summarized in **Table 3-1**. Ignoring growth outside of city limits and its existing and future UGA, Arlington is projected to grow from 18,360 persons in 2014 to 24,937 people by 2035, an increase of 6,577 persons. The Arlington WSA is projected to grow by 6,690 people, from 16,151 persons in 2014 to 22,828 people by 2035. About 32% will occur as infill within existing City limits, and another 8% will occur within existing UGA. One third will be accommodated in new and redevelopment in the proposed UGA expansion area west of I-5. And just over one-quarter will occur as redevelopment near the intersection of SR 9 and 172nd

[2] The Eagles estimated as 35 occupied and built-out lots times a density of 2.7/HH, or 95 total persons. Service population along Burn Rd. is estimated for existing conditions as 48 served parcels times 2.7/HH, or 130 total persons. The Burn Rd service population in 2035 is conservatively estimated by adding 46 new, unoccupied lots with *existing* city infrastructure times 2.7/HH, or 243 total persons. A linear growth projection is assumed.

Street NE. This WSA also assumes about two percent of the growth would be accommodated on existing vacant lots in rural cluster subdivisions along Burn Road.

Table 3-2

Population Trends and Projections

Year	Population	
	City Limits	Water System
Historical		
1990	4,037	0
1991	4,397	0
1992	4,614	0
1993	4,863	0
1994	5,167	0
1995	5,692	5,779
1996	6,019	6,131
1997	6,514	6,652
1998	7,188	7,452
1999	8,054	8,343
2000	11,927	12,269
2001	12,912	13,392
2002	13,676	12,921
2003	14,431	13,750
2004	14,838	14,119
2005	15,173	13,636
2006	15,693	14,083
2007	17,094	15,582
2008	17,527	16,018
2009	17,711	16,202
2010	17,926	16,417
2011	17,930	16,421
2012	17,970	16,461
2013	18,270	16,761
2014	18,360	16,245
Projected		
2020 (+6 years)	20,239	18,157
2024 (+10 years)	21,492	19,431
2034 (+20 years)	24,624	22,617
2035 (+21 years)	24,937	22,936
2064 (+50 years)	36,790	34,789
2114 (+100 years)	53,898	51,897

Table 3-3

Projected Additional Population by Pressure Zone

Pressure Zone	2020 (+6 years)	2024 (+10 years)	2034 (+20 years)	2035 (+21 years)
342	1,215	2,025	4,050	4,253
520	581	968	1,936	2,033
540/615	94	157	314	329
710	22	36	72	76
Total	1,912	3,186	6,372	6,691

3.5.2 By Growth Centers

Infill within the city is estimated to assume only one-third of total residential growth, and commercial and industrial growth associated with increased employment will create land use changes with the potential for significant effects on the City's water system. Therefore, six general areas within our WSA. where concentrated growth is expected and where concentrated impacts to our water system area likewise expected, have been defined to facilitate discussion. The six areas are shown in **Figure 3-1** and characterized in **Table 3-5**.

Table 3-4

Projected Additional Population in 2035 by Development Type1

Pressure Zone	Existing City Limits	Existing UGA	UGA Expansion (W of I-5)	City Limits in 2035	Additional Water Service Area	Totals
342	1,580	436	2,236	4,253	0	4,253
520	1,393	640	0	2,033	0	2,033
540/615	291	0	0	291	38	329
710	0	0	0	0	76	76
Totals	3,265	1,076	2,236	6,577	114	6,691

[1] Base year 2014 with population within existing city limits of 18,360

Table 3-5

Growth Center Attributes and Assumptions

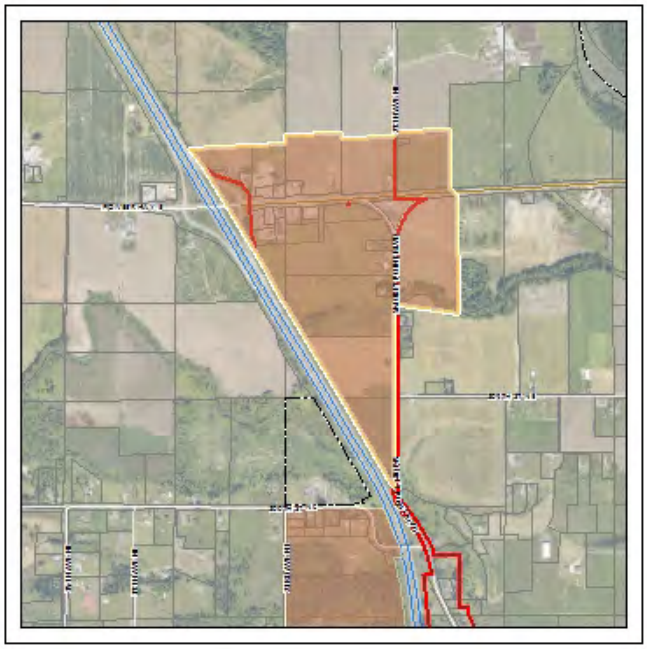
Focus Area	Area	Zoning Type[1]			Occupancy by Zoning		
		Residential	Commercial	Industrial	Residential[1]	Commercial[2]	Industrial[2]
	(acres)	(Percent)			(Persons)	(Facility Area, sq. ft.)	(Facility Area, sq. ft.)
Island Crossing	157	0%	100%	0%	0	2,735,568	0
UGA Expansion Area	235	95%	5%	0%	2,236	209,088	0
AP Business Park	188	0%	95%	0%	0	3,118,896	0
MIC--South of 172nd	348	0%	57%	43%	0	3,484,800	3,223,440
SR9/SR531	227	65%	33%	0%	1,718	1,306,800	0
Central Industrial	343	8%	24%	68%	949	1,428,768	5,096,520

[1] City of Arlington data

[2] AWWA Commercial and Institutional End uses of Water indicate 40% and 50% of parcel areas are developed for water consumption in commercial and industrial facilities, respectively

Island Crossing

The Island Crossing focus area is situated at the northwest corner of the City, immediately west of I5 and entirely on the Stillaguamish River floodplain. It contains 157 acres of city and county land that is primarily in commercial and agricultural use. Current zoning anticipates that land use in 2035 will be 100 percent commercial. For planning purposes, this WSP update assumes 40 percent of the total area--about 2.7 million square feet--contributes to water demand. Capital projects within this focus area are assumed to occur in the second decade of the 20-year planning horizon.



The county land included in this growth center is entirely within the City's WSA and is owned in part by the Stillaguamish Tribe. The Tribe has approached the City regarding utility service to these parcels, and although development approval is outside of the City's jurisdiction, the Water Department has an obligation to serve this property and assumes it will develop within the design life of infrastructure necessary to serve

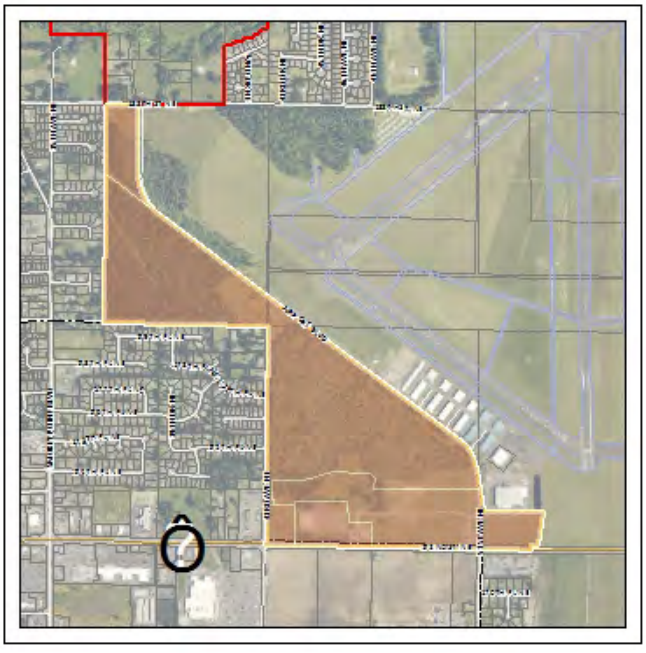
neighboring City parcels to the west. We therefore include these parcels in the Island Crossing focus area.

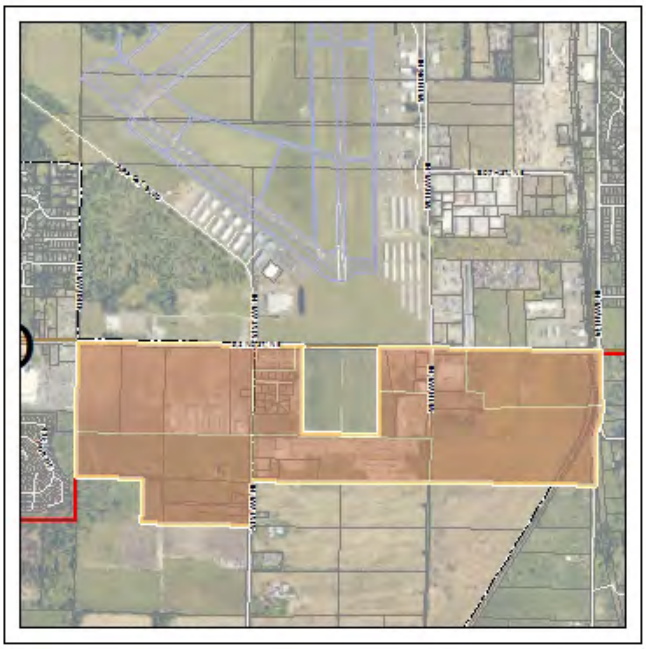
UGA Expansion West of I-5

The UGA expansion area includes 235 acres situated on uplands located west of I-5. The City anticipates predominately residential growth, and this WSP Update assumes minor commercial growth in order to assure adequate fire flows from the bulk of the distribution system within the City to the expansion area to the west. The area is anticipated to house 2,474 persons and provide an estimated 209,088 sq. ft. of retail space. Capital projects within this focus area are assumed to occur in the second decade of the 20-year planning horizon.

Airport Business Park

The Airport Business Park includes parcels zoned for the formal business park southwest of the airport, and north of 172nd Street (SR 531) and west of Airport Blvd. It also contains additional commercially-zoned parcels further north along Airport Blvd toward 188th St. It is nearly entirely zoned for commercial and business use. About 5 percent is zoned for open space within the Airport Flightline. It is estimated that the area will contain about 3.1 million sq. ft. of facilities contributing to water demand in 2035. Capital projects within this focus area are assumed to occur in the first decade of the 20-year planning horizon.





Manufacturing Industrial Center (MIC) South of 172nd St

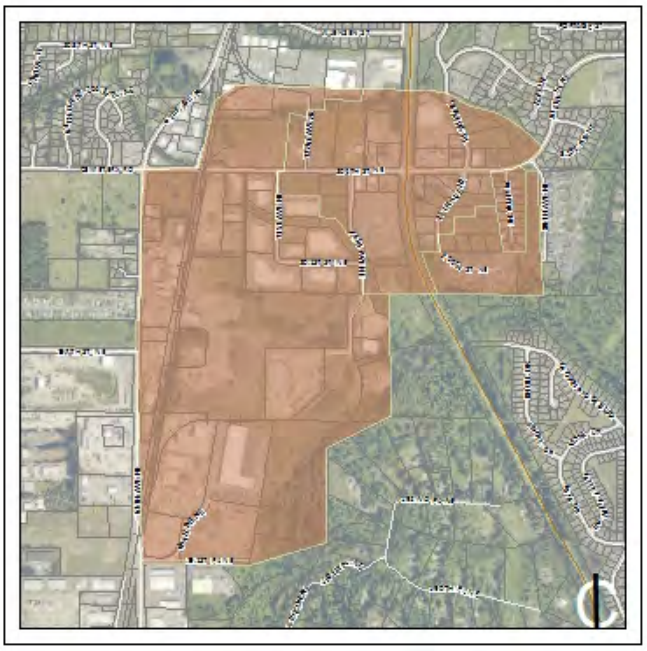
Arlington City Council and Community & Economic Development goals for the City in 2014 include emphasis on the development of a Manufacturing and Industrial Center (MIC) with the City of Marysville. The City is working with PSRC to have the Arlington-Marysville MIC recognized as a Regional Center, though full recognition has not yet occurred. PSRC is working on its Regional Center's Update Project and has identified the MIC in the Snohomish County Work Session. Snohomish County has already recognized the Arlington-Marysville MIC as a Regional Center. Employment figures in this WSP are the same as those used in the City's General Comprehensive Plan.

The MIC would develop primarily on areas zoned as General and Light Industrial. South of 172nd St, the MIC would contain about 57 percent commercial area, and 43 percent industrial area. For planning purposes, this WSP update assumes 40 percent of the commercial area contributes to water demand, or about 3.5 million square feet. Another 3.2 million square feet of industrial facilities would develop and draw water from the City. Capital projects within this focus area are assumed to occur in the second decade of the 20-year planning horizon.

The location of this portion of the MIC is consistent with FAA requirements for the Runway Protection Zone (RPZ) and the Object Free Area (OFA). A study is currently being finalized as part of the SR-531 Widening Project that looks at widening SR-531 within the RPZ, a variance memorandum has been forwarded to regional FAA and to FAA Headquarters (DC) for consideration."

Vicinity of the SR9/SR531 Roundabout

In addition to infill in existing lots across the City, one of two centers for greater residential development is on 227 acres within existing City limits—the vicinity of the intersection of SR 9 and 172nd Street (aka SR 531). Nearly two-thirds of this area is zoned for residential use at high and suburban densities. This area is also slated for mixed use with about one-third of the area zoned for General and Highway Commercial land use. It is as estimated that it will provide housing for approximately 2,286 persons. In addition, the area may accommodate 1.3 million square feet of commercial retail facilities. Capital projects within this focus area are assumed to occur in the second decade of the 20-year planning horizon.



Central Industrial Area in the Vicinity of Arlington Valley Road

The sixth growth center is anticipated to be the existing central industrial area currently housed in Jensen Business Park. The area is anticipated to grow with access provided by construction of the Arlington Valley Rd. Capital projects within this focus area are assumed to occur in the first decade of the 20-year planning horizon.

The area is zoned to accommodate more than two-thirds industrial land use in 2035, along with about one-quarter in commercial use, and another eight percent in residential land use. These developments will increase water demand through about residential dwellings for 949 persons, industrial facilities totaling 5.1 million square feet, and another 1.4 million square feet in commercial facilities.

4 Water Demands

4.1 INTRODUCTION

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

The magnitude of water demands is typically based on three main factors:

1. Population;
2. Weather; and
3. Water use classification.

Population and weather have the two largest impacts on water system demands. Population growth has a tendency to increase the annual demand, whereas high temperatures have a tendency to increase the demand over a short period of time. Population does not solely determine demand because different populations use varying amounts of water. The use varies based on the number of users in each customer class, land use density and irrigation practices. Water conservation efforts also impact demands and can be used to accommodate a portion of system growth without increasing a system's supply capacity.

Demands on the water system determine the size of storage reservoirs, supply facilities, water mains and treatment facilities. Several different types of demands were analyzed and are addressed

in this chapter, including average day demand, maximum day demand, peak hour demand, fire flow demand, future demands and a demand reduction forecast based on the proposed Water Use Efficiency program.

4.1.1 Certificate of Water Availability

In accordance with the requirements of the Growth Management Act (GMA), the City of Arlington (City) must identify that water is available prior to issuing a building permit. A Certificate of Water Availability (CWA) is issued if there is sufficient water supply to meet the domestic water service and fire flow requirements of the proposed building.

The requirement for providing evidence of an adequate water supply was codified in 1990 under Title 19.27.097 of the Revised Code of Washington (RCW) in the Building Code Section. To assist governments with implementing these requirements, the Washington State Department of Health (DOH) has developed a handbook titled *Guidelines for Determining Water Availability for New Buildings*.

4.2 CURRENT POPULATION AND SERVICE CONNECTIONS

4.2.1 Residential Population Served

The population within the City limits was 18,360 in 2014. The City does not provide water service to all residents within the City limits. Outside the City limits, the City serves water to some customers, including west of the Arlington Cemetery and along Burn Road. The City of Marysville (Marysville) provides water service to many customers within the southwest portion of the City limits, west of 43rd Avenue NE and south of 180th Street NE. Marysville also serves a small residential area south of 172nd Street NE and east of 51st Avenue NE. The 2014 residential population served by the City is estimated to be approximately 16,245. The computation of this number is discussed later in this chapter, and a more detailed discussion of the City's population and household trends is in **Chapter 3**.

In 2014, the City provided water service to an average of 5,444 customer accounts of all types, up from 4,738 accounts in 2005. This is an increase of 706 accounts, increasing on average at 70 accounts per year.

4.3 EXISTING WATER DEMANDS

4.3.1 Water Use Classifications

The City has installed water meters at all permanent service locations (connections) for all revenue-generating customers. The customers purchasing water through each connection are assigned to one of six different water use classes for utility billing purposes. These consist of single family residential, multi-family residential, commercial/industrial, schools, City accounts and other. For planning purposes, the water use classes have been combined into four different groups as shown in **Table 4-1**. With 2014 connection data, these are:

1) single family residential, 4,589 accounts (84 percent);
2) multi-family residential, 246 accounts (4.5 percent);
3) commercial/industrial, 538 accounts (10 percent); and
4) school/city (71 accounts, 2 percent).

Institutional users such as civic groups, churches and hospitals are included with commercial and industrial customers.

In addition to permanently metered service locations, the City makes available portable meters for short-term use of water by qualifying customers via hydrant permits. Typically, contractors in the construction and landscaping trades obtain a permit for each unique job from specified hydrants. For the purposes of this WSP, each permit is handled the same as each connection.

The demand analysis that follows will report on customer water use patterns by the four customer classes above. Hydrant permits are added as a fifth customer class. In doing so, all water consumption which generates revenue is evaluated in one location.

The City also tracks authorized, non-revenue water uses using a number of public works and fire department categories. This consumption will be evaluated later in this chapter under Distribution System Leakage.

4.3.2 Water Consumption

Water consumption is the amount of water used by water system customers as measured by the customer's meters. **Table 4-1** shows the historical average number of connections, annual consumption and average daily consumption per connection for each customer class from 2005 through 2014.

As shown in **Charts 4-1** and **4-2**, the single family residential class represents approximately 84 percent of all connections, but only about 60 percent of total system consumption. This is due to the lower consumption per connection of the single family residential customers as compared to other customer classes. As shown in **Table 4-1**, the single family residential customers use an average of approximately 158 gallons per day per connection, compared to the multi-family customers who use an average of 773 gallons per day per connection, the commercial/industrial customers who use an average of 600 gallons per day per connection, and the school and city customers who use an average of 644 gallons per day per connection. The higher consumption of non-single family residential customers is not unexpected. For example, multi-family residential customers generally have one connection serving several units, and may include irrigation. Some commercial and industrial customers require large water demands in their production process or for the services they provide.

Table 4-2 shows the system's largest water users in 2014 and their total metered consumption for the year. The total water consumption of these 25 water accounts represented approximately 13 percent of the system's total consumption in 2014. The list of accounts in the table consists primarily of commercial and industrial facilities, schools, and multi-family residences. As with all water system customers, the City promotes water conservation efforts to the largest water users to ensure that water is used as efficiently as possible. The City's Water Use Efficiency Program is contained in **Appendix E**.

4.3.3 Water Supply

Water supply, or production, is the amount of water supplied to the system as measured by the meters at each supply source. Water supply is different than water consumption in that water supply is essentially the measured amount of water put into the system and water consumption is the measured amount of water taken out of the system. The measured amount of water supply of any system is typically larger than the measured amount of water consumption due to non-metered water use and water loss (i.e. distribution system leakage), which will be described further in the **Distribution System Leakage** section. **Table 4-3** summarizes the total amount of water supplied to the City's system from its three sources from 2005 through 2014, and the calculated average day demand for each year.

Table 4-4 presents the computation of the existing system per capita demand for each of the last 10 years. The residential population served by the City's water system is derived from the City's annual April 1st population published by the Office of Financial Management, less the Arlington residents that are not provided water service by the City, plus the estimated population served outside of city limits. Per capita demand is the annual raw water supply divided by that year's WSA population. The City's per capita water demand has generally declined over the last 10 years, with a high of 106 gpd/person in 2006, and a low of 78 gpd/person in 2011. Per capita demand increased to 97 gpd/person in 2014. This plan uses the 10-year average of approximately 90 gpd/person. The decline observed around 2010 and 2011 is thought to be in part related to the national recession and related economic changes, which saw the closing of some of the City's largest water users (e.g., Northwest Hardwoods mill, Bayliner Boats, etc.). Irrigation at the high school, another very large water use, declined in 2014 with conversion of the football field to artificial turf. Nevertheless, a 10-year average of 90 gpd/person remains a relatively low per capita demand compared to other systems in the Puget Sound area.

Table 4-5 shows the average demand of the City's four existing pressure zones based on 2014 water demand data. The City's largest pressure zone, the 342 Zone, accounts for approximately 74 percent of the total system demand. Like most other water systems, the City's water use varies seasonally. **Chart 4-3** shows the historical amount of water supplied to the City's system for each month from 2005 to 2014.

As shown in **Chart 4-3**, water supply increases significantly during summer months, primarily due to outdoor uses such as irrigation. The City's highest water use typically occurs in July and

August. On average, the amount of water supplied during these months is approximately 24 percent of the total supply for the entire year. It is expected that the water supply in these months would be considerably higher if not for the City's current utility rates, which are designed to encourage water conservation. Water production from the Haller Park Well Field and Airport Well Field sources and the water supplied by Snohomish County PUD No. 1 is increased to meet the additional demand during these peak periods, as shown for 2014 in **Chart 4-4**.

Table 4-1
Average Annual Revenue Consumption and Service Connections

Year	Customer Class					Totals
	Single Family	Multi-Family	Commercial/ Industrial	School/ City	Hydrant Permits	
Average Number of Connections						
2005	4,075	177	383	105	96	4,836
2006	4,264	187	399	106	82	5,038
2007	4,342	192	426	106	95	5,161
2008	4,396	196	449	106	59	5,206
2009	4,375	236	496	71	11	5,189
2010	4,394	245	502	71	7	5,218
2011	4,434	245	507	71	7	5,264
2012	4,514	245	516	71	11	5,357
2013	4,577	246	529	71	10	5,432
2014	4,589	246	538	71	14	5,458
Average Annual Consumption (1,000 gallons)						
2005	244,109	60,507	115,415	24,012	3,604	447,647
2006	268,674	57,014	127,424	21,540	3,096	477,747
2007	267,645	56,954	125,945	18,184	873	469,602
2008	260,780	59,971	119,012	17,555	359	457,677
2009	245,196	60,357	100,792	21,856	220	428,421
2010	250,869	57,216	97,160	12,656	96	417,996
2011	245,400	68,454	85,274	22,463	221	421,812
2012	239,295	64,354	75,065	17,570	421	396,705
2013	249,729	65,833	76,240	19,150	4,494	415,446
2014	254,080	67,782	83,008	18,616	3,124	426,611
Average Daily Consumption Per Connection (gal/day/conn)						
2005	164	937	826	627	103	254
2006	173	835	875	557	103	260
2007	169	813	810	470	25	249
2008	162	836	724	453	17	240
2009	154	701	557	843	55	226
2010	156	640	531	488	37	219
2011	152	765	461	867	87	220
2012	145	718	397	676	105	202
2013	150	735	395	739	1,231	210
2014	152	755	423	718	611	214
2005-2014 Average	158	773	600	644	237	229

Chart 4-1

2014 Water Connections by Customer Class

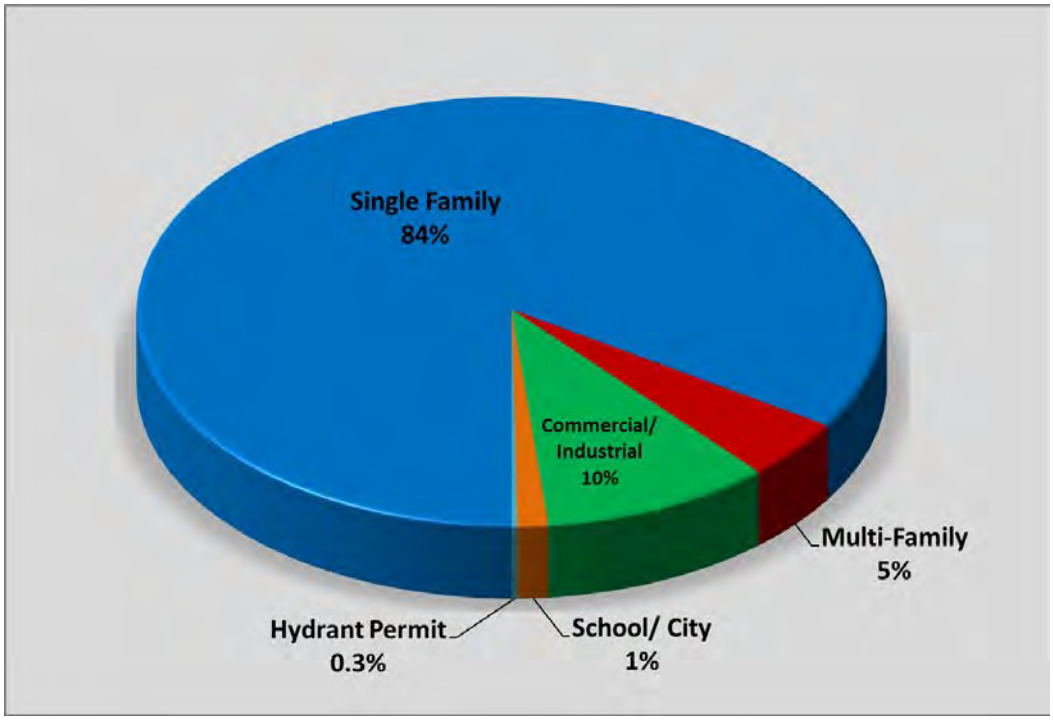


Chart 4-2

2014 Water Consumption by Customer Class

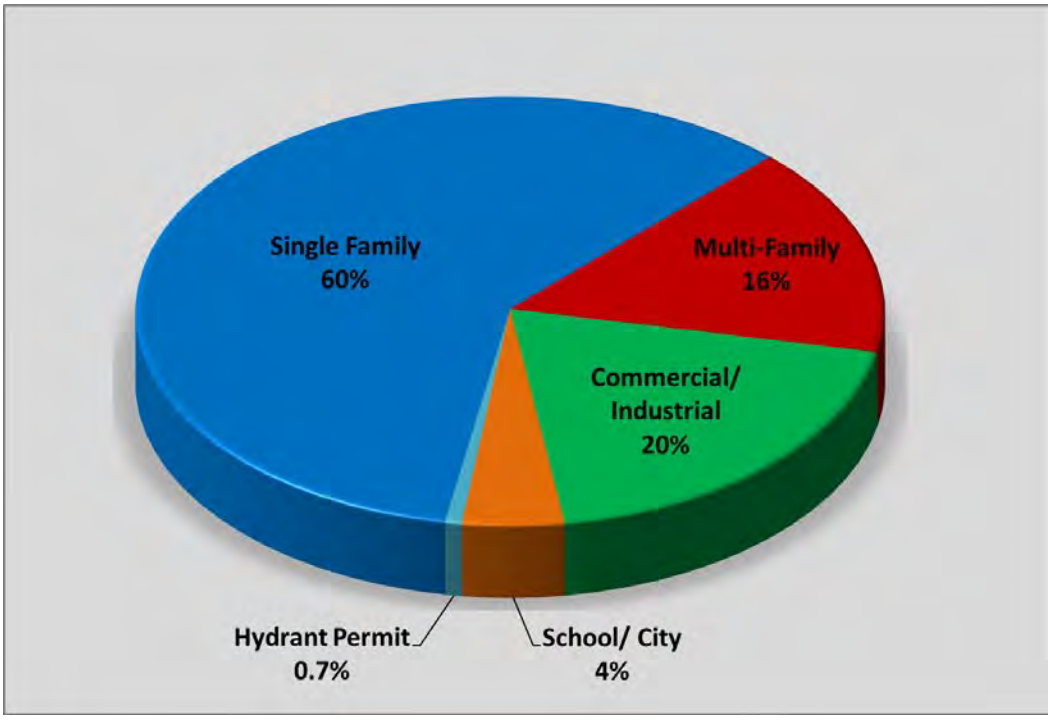


Table 4-2

2014 Largest Water Users

Name	Address	Customer Class	Annual Consumption (gallons)
WSDOT Smokey Point Rest Area	I-5 Smokey Pt Rest Areas	Commercial	4,450,974
Arlington School Dist, High School Irrig	18821 Crown Ridge Blvd Irr	Schools	3,824,524
McFarland Cascade	6520 188th St Pole Yard	Commercial	3,541,556
Puget Sound Kidney Cntr	18828 Smokey Point Blvd	Commercial	3,080,444
Rosecreek	625 Stillaguamish Ave S	Multi-Family	2,715,090
Cascade Valley LLC	8400 208th Pl	Multi-Family	2,701,103
City Of Arlington	59th Ave, Quake Field Irr	City	2,485,148
Arlington Health And Rehabilitation	620 Hazel	Commercial	2,441,173
Olympic Place Retirement	20909 Olympic Pl Bldg A	Multi-Family	2,336,004
Hidden Glen Mobile park LLC	20102 67th Ave	Multi-Family	2,274,324
Otto Investments LLC	6206 188th St	Multi-Family	2,250,582
Safeway #1522	20500 Olympic Pl	Commercial	2,144,067
Kent Prairie Apartments	7900 200Tth St -7960	Multi-Family	2,033,887
Stimach, Janet	105 E Cox	Multi-Family	1,931,186
Twin Ponds	8510 212th St Bldg L	Multi-Family	1,925,202
Wesley Point Apartments	1010 Wesley	Multi-Family	1,762,094
Cascade Valley Hospital	330 Stillaguamish Ave S	Commercial	1,604,333
Haggen Food/Pharmacy 23	20115 74th Ave	Commercial	1,593,853
Aerospace Mfg	20100 71st Ave NE	Commercial	1,492,036
Olympic Place Retirement	20909 Olympic Pl Bldg A	Commercial	1,398,932
McFarland Cascade	6520 188th St Pole Yard	Commercial	1,389,560
Denny's Restaurant	2202 SR 530	Commercial	1,326,840
Microgreen Polymers Inc	7220 201st St	Commercial	1,325,680
Arlington School Dist	1220 E Fifth St	Schools	1,266,932
Southvillage Apartments	Jensen Farm Lane	Multi-Family	1,253,065

Largest 25 Water Users (Facilities) Total	54,548,588
Water System Total Consumption	426,612,643
Percent of Total Consumption	13%

Table 4-3

Historical Water Supply and System Demand

Year	Annual Supply to Distribution System (1,000 gallons)				Average Daily Demand (gpm)
	Haller Well Field	Airport Well Field	PUD	Total	
2005	335,593	17,612	153,183	508,989	968
2006	342,065	7,807	196,910	547,087	1,041
2007	338,863	10,404	173,369	522,651	994
2008	312,022	9,507	187,517	509,073	966
2009	334,292	12,369	181,396	528,057	1,005
2010	307,264	19,069	155,636	481,969	917
2011	324,928	12,038	128,928	465,893	886
2012	448,713	13,502	43,554	505,769	960
2013	477,628	9,587	30,917	518,131	986
2014	485,624	30,052	58,445	574,121	1,092

Table 4-4

Existing Per Capita Demand

Year	Total Annual Supply (1,000 gallons)	Average Daily Demand (gpd)	Water Service Area Population	Average Per Capita Demand (gpd/person)
2005	508,989	1,394,491	13,636	102
2006	547,087	1,498,870	14,083	106
2007	522,651	1,431,922	15,582	92
2008	509,073	1,390,909	16,018	87
2009	528,057	1,446,732	16,202	89
2010	481,969	1,320,463	16,417	80
2011	465,893	1,276,420	16,421	78
2012	505,769	1,381,882	16,461	84
2013	518,131	1,419,538	16,761	85
2014	574,121	1,572,934	16,245	97
Existing Per Capita Demand Used in This Analysis (gal/day/capita)				**90**

Table 4-5

2014 Demands by Pressure Zone

Pressure Zone	2014 Annual Supply (1,000 gallons)	Average Daily Demand (gpm)	Percent of Total Demand (%)
342	424,849	808	74.0%
520	145,827	277	25.4%
540	574	1.1	0.1%
710	2,871	5.5	0.5%
Total	574,121	1,092	100.0%

Chart 4-3

Historical Monthly Water Supply by Year (2005-2014)

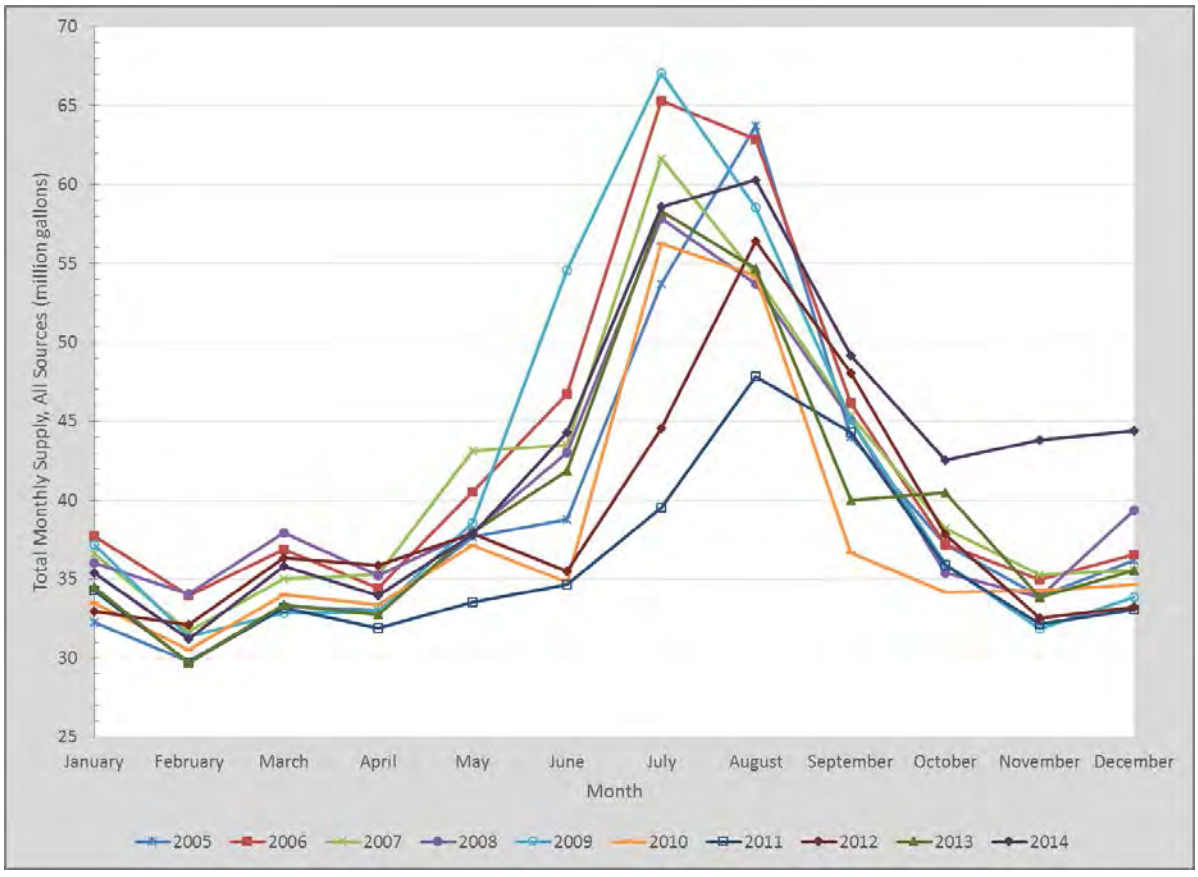
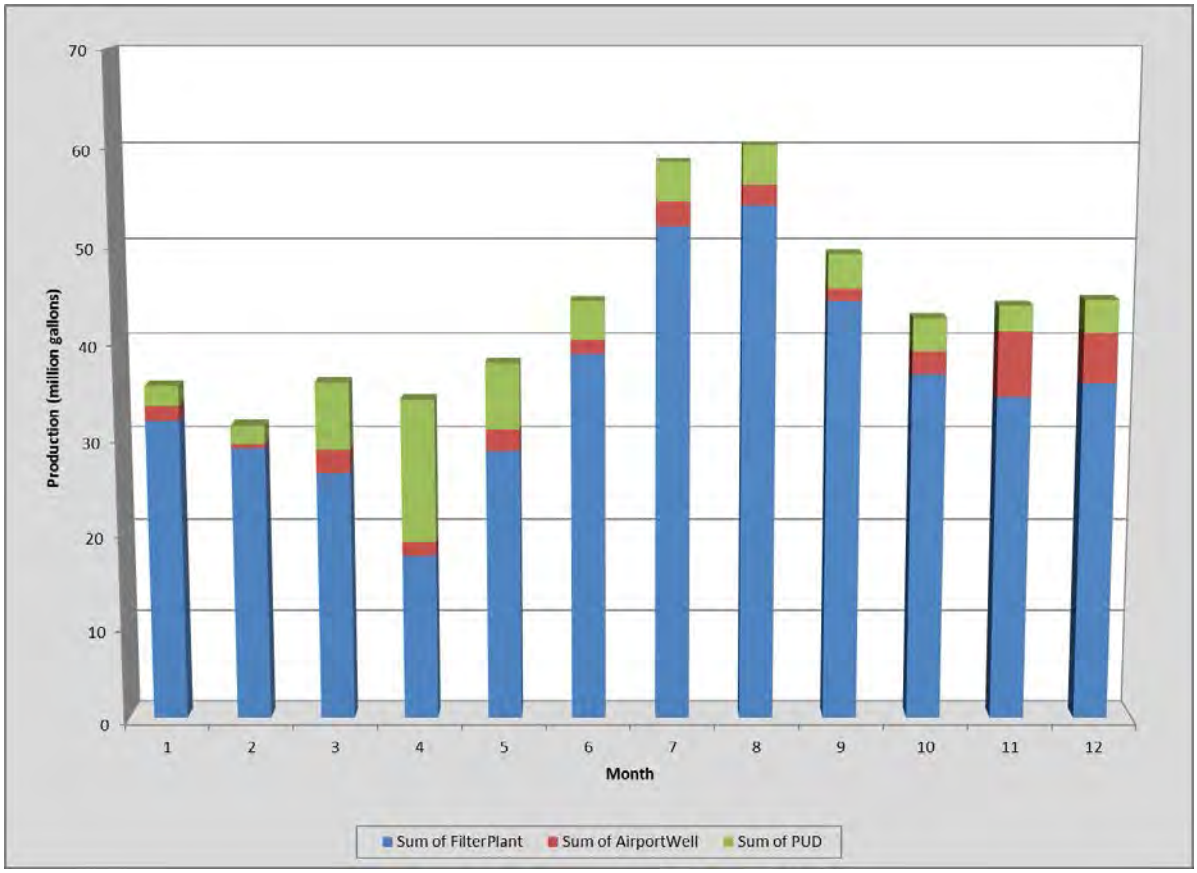


Chart 4-4

2014 Monthly Water Supply by Source



Distribution System Leakage

The difference between the amount of water supply and authorized water consumption is the amount of distribution system leakage (DSL). The City's authorized water consumption includes water service to customers' parcels, all of which are metered, and temporary service from hydrants via portable meters under hydrant use permits. This usage is termed revenue water. Authorized consumption also includes certain non-revenue uses, all of which is measured and tracked. The Water Department uses raw and treated water to maintain the filters critical to potable water production at the Haller Water Treatment Plant (WTP). Staff in most City departments estimate and report the water they are authorized to use in their day-to-day operations. These include: Public Works' uses such as maintenance flushing of water mains and sanitary and storm sewers, and street sweeping; and Fire Department uses such as training, hose testing, and community heat relief.

DSL includes any unauthorized and often unknown "losses" from a water system. Some losses (leakage) are real, such as main breaks and leaking facilities (on the city's side of the meter). These

losses are tracked but not necessarily quantified. Other losses are simply apparent. They include: firefighting; errors in production and consumption metering and data management; water theft from illicit connections; and water theft from hydrants. The Water Use Efficiency Rule, which became effective in 2007, established a DSL standard of 10 percent or less based on a rolling three-year average. Ranging from 6 to 9 percent, the City met this standard annually since 2005, as shown in **Table 4-6**. For reasons not yet understood, however, the City's DSL jumped to 13% in 2014.

Historically, the City reached a recorded high DSL of 20 percent for calendar year 2003. After implementing a number of improvements, annual DSL was reduced to single digits for several years. Since 2009, DSL has been somewhat erratic, including three years at or above about 11 percent, as shown in **Table 4-6**. The initial success was credited to four factors:

1) the City's replacement of old and likely inaccurate customer meters on a 20-year life cycle basis;
2) database improvements to the City's accounting system;
3) the promotion of water use efficiency (WUE) within the system; and
4) accounting for as much non-revenue water as possible.

Reasons for the erratic trending are thought to be related to errors made in understanding the conversion to a new accounting system (BIAS) in approximately September 2010, and possible actual leaks in the distribution system.

A Water Loss Control Action Plan is required under WAC 246-290-820 when the 3-year rolling average of DSL exceeds 10 percent. As shown in **Table 4-6**, the City exceeded this criterion in 2014, and finds its recent trending unacceptably high. The City maintained the 10 percent criterion in its goals adopted with the prior WSP, but also established for itself a higher goal: "maintain 5 to 7 percent or lower DSL in the water system on an annual basis (see the Water Use Efficiency Program in **Appendix E**). The City intends to correct the erratic nature of our DSL and return it to levels within the 10 percent threshold. The Water Loss Control Action Plan drafted and included within the Water Use Efficiency Program (**Appendix E**) outlines the approach the City will take. Specific actions in the water loss control action plan are anticipated to include: an audit of account metering, billing, and reporting processes; continuing its customer meter replacement program; improving its documentation of authorized, non-revenue consumption; and conducting leak detection surveys of the system.

Table 4-6
Distribution System Leakage

Water Use Classification	Calendar Year									
	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Authorized Consumption--Revenue (1,000 gallons)										
Metered Customer Use	447,647	477,747	469,602	457,677	428,421	417,996	421,812	396,705	415,446	426,611
Authorized Consumption--Non-revenue (1,000 gallons)										
WTP Backwashing--Filter Maintenance	35,571	33,455	27,134	19,504	28,125	28,218	35,873	41,813	45,063	56,809
Distribution System Flushing	721	317	388	327	1,037	423	349	265	369	433
Sanitary Sewer Collection System	16	20	19	53	42	22	19	40	40	48
Stormwater System	0	0	0	18	0	16	8	17	17	25
Street Sweeping	0	0	10	49	44	31	30	16	16	14
Unmetered Facilities[2,3]	0	0	0	0	0	0	0	0	357	524
Fire Training & Hoses Tests[4]	0	0	0	0	139	76	76	76	103	168
Heat Relief (Fire Dept)	0	0	0	0	90	0	0	0	0	0
Total Authorized Non-revenue Consumption	36,309	33,792	27,551	19,951	29,477	28,786	36,355	42,227	45,964	58,045
Total Raw Water (1,000 gallons)										
Total Raw Water Production/Supply[1]	508,989	547,087	522,651	509,073	528,057	481,969	465,893	505,769	518,131	574,121
Distribution System Leakage										
Total DSL (1,000 gallons)	25,034	35,548	25,498	31,445	70,160	35,187	7,726	66,837	56,721	89,465
Total DSL (%)	4.9%	6.5%	4.9%	6.2%	13.3%	7.3%	1.7%	13.2%	10.9%	15.6%
Rolling 3-Year Average DSL (%)	4.5%	5%	5%	6%	8%	9%	7%	7%	9%	13%

[1] Total raw water is equal to finished water production plus water used to backwash and maintain WTP filters.

[2] Includes flushing of WTP clearwell after water quality concern for iron and manganese.

[3] Includes 500,000 gallons for partial draining of reservoirs during cleaning.

[4] 2013 and 2014 data include data from Arlington Heights Fire District 21 in addition to Arlington Fire Department.

Equivalent Residential Units

The demand of each customer class can be expressed in terms of equivalent residential units (ERUs) for demand forecasting and planning purposes. One ERU is equivalent to the amount of water used by a single family residence. The number of ERUs representing the demand of the other customer classes is determined from the total demand of the customer class and the unit demand per ERU from the single family residential demand data.

Table 4-7 presents the computed number of ERUs for each customer class from 2005 through 2014 for the City's retail water service area (WSA). The annual demands per ERU shown are based on consumption data that was computed for each customer class and the average amount of non-revenue water (authorized uses, and unauthorized DSL) from each year. Much like the average day demand, the system's average demand per ERU varies from year to year based on factors such as weather and DSL. However, such factors can affect single family residential customers differently than multi-family, commercial/industrial and the other customer classes.

Table 4-7

Equivalent Residential Units (ERUs)

Year	Average Number of Connections	Total ERUs	Average Annual Demand (gallons)	Demand per ERU (gal/day/ERU)
Single Family Residential (ERU Basis)				
2005	4,075	4,075	277,560,148	187
2006	4,264	4,264	307,668,904	198
2007	4,342	4,342	297,880,047	188
2008	4,396	4,396	290,064,746	181
2009	4,375	4,375	302,219,902	189
2010	4,394	4,394	289,263,025	180
2011	4,434	4,434	271,045,652	167
2012	4,514	4,514	305,082,472	185
2013	4,577	4,577	311,454,281	186
2014	4,589	4,589	341,934,025	204
2005-2014 Average				187
Multi-Family Residential				
2005	177	1,010	68,798,230	187
2006	187	905	65,288,815	198
2007	192	924	63,388,295	188
2008	196	1,011	66,705,574	181
2009	236	1,077	74,393,969	189
2010	245	1,002	65,972,111	180
2011	245	1,237	75,608,291	167
2012	245	1,214	82,046,526	185
2013	246	1,206	82,104,534	186
2014	246	1,224	91,219,015	204
Commercial/Industrial				
2005	383	1,927	131,231,258	187
2006	399	2,022	145,918,515	198
2007	426	2,043	140,172,803	188
2008	449	2,006	132,376,549	181
2009	496	1,798	124,233,037	189
2010	502	1,702	112,029,815	180
2011	507	1,541	94,185,132	167
2012	516	1,416	95,702,546	185
2013	529	1,397	95,083,529	186
2014	538	1,499	111,710,046	204

Table 4-7

Equivalent Residential Units (ERUs) – Continued

Year	Average Number of Connections	Total ERUs	Average Annual Demand (gallons)	Demand per ERU (gal/day/ERU)
School/City				
2005	105	401	27,301,988	187
2006	106	342	24,666,384	198
2007	106	295	20,238,693	188
2008	106	296	19,526,603	181
2009	71	390	26,938,587	189
2010	71	222	14,593,501	180
2011	71	406	24,809,975	167
2012	71	331	22,400,835	185
2013	71	351	23,883,495	186
2014	71	336	25,053,548	204
Hydrant Permits				
2005	96	60	4,097,699	187
2006	82	49	3,544,824	198
2007	95	14	971,625	188
2008	59	6	399,376	181
2009	11	4	271,508	189
2010	7	2	110,475	180
2011	7	4	244,299	167
2012	11	8	536,405	185
2013	10	82	5,605,369	186
2014	14	56	4,204,290	204
System-Wide Totals				
2005	4,836	7,473	508,989,322	187
2006	5,038	7,582	547,087,442	198
2007	5,161	7,618	522,651,462	188
2008	5,206	7,715	509,072,848	181
2009	5,189	7,643	528,057,003	189
2010	5,218	7,320	481,968,927	180
2011	5,264	7,621	465,893,350	167
2012	5,357	7,483	505,768,786	185
2013	5,432	7,613	518,131,209	186
2014	5,458	7,705	574,120,924	204

The average demand per ERU from 2005 through 2014 was 187 gpd. This is less than the typical range of between 250 and 300 gpd for single family demand in the Puget Sound area. This demand per ERU value will be used later in this chapter to forecast ERUs in future years based on estimated

future water demand. This demand per ERU value will also be used to determine the capacity (in terms of ERUs) of the existing system in **Chapter 7**.

Average Day Demand

Average day demand (ADD) is the total amount of water delivered to the system in a year divided by the number of days in the year. The ADD is determined from historical system water use patterns and can be used to project future demand within the system. ADD data is typically used to determine standby storage requirements for water systems. Standby storage is the volume of a reservoir used to provide water supply under emergency conditions when supply facilities are out of service. Water production records from the City's water treatment plant and wholesale sources were reviewed to determine the system's ADD. The system's ADD from 2005 through 2014 ranged from 886 gpm to its all-time high of 1,092 gpm as shown in **Table 4-8**.

Maximum Day Demand

Maximum day demand (MDD) is the maximum amount of water used throughout the system during a 24-hour time period of a given year. MDD typically occurs on a hot summer day when lawn watering is occurring throughout much of the system. In accordance with WAC 246-290-230, the distribution system shall provide fire flow at a minimum pressure of 20 pounds per square inch (psi) during MDD conditions. Supply facilities (wells, pump stations, interties, etc.) are typically designed to supply water at a rate that is equal to or greater than the system's MDD.

Daily water production and reservoir level records were reviewed to determine the system's MDD. The City's MDD over the last 10 years occurred on July 11, 2007. Although many peak demand days are associated with periods of high temperatures, the high on July 11 was only 71°F, and adjacent days only got as high as 75°F. As shown in **Table 4-8**, MDD of the system that day was 2,063 gpm for a daily total of 2.97 MG.

The maximum day peaking factor (the ratio of MDD to ADD) was greatest on July 11, 2007, matching the 2005 factor of 2.08. Peak day factors have decreased over the last 10 years, ranging from a maximum of 2.08 to a minimum of 1.35 (**Table 4-8**). A review of production data indicates that while average days have basically remained steady at about 1.41 MGD, maximum days have declined by about 23 percent from 2.97 MGD to about 2.31 MGD

Peak Hour Demand

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

The PHD, like the MDD, is typically determined from the combined flow of water into the system from all supply sources and reservoirs. Hourly water production records and chart recordings of

reservoir levels are available for all of the City's supply and storage facilities. Instantaneous production and storage data were reviewed for the peak day (July 11, 2007). In addition, data for five other peak or high use days over the last 10 years were reviewed where total water supply was greatest, and/or where rates of decline in water reservoir levels appeared greatest (i.e., they were discharging to the system at high rates).

As shown in **Table 4-8**, the greatest annual MDD measured over the past decade occurred on July 11, 2007, and PHD on this day was 2,478 gpm at 7:00 pm. However, this was only the third highest PHD for this evaluation period. On August 8, 2005 at 9:30 am, a PHD of 2,866 gpm was observed during that year's MDD. The greatest PHD observed during the period evaluated did not occur on an annual MDD. The PHD over the past decade was 2,943 gpm, recorded on August 4, 2014 at 4:30 pm. During this event, all water *sources* produced 1,957 gpm (two-thirds of the PHD) direct to distribution, and *reservoirs* discharged a record-high 986 gpm.

Table 4-8 shows the peaking factors of the water system based on the average day, maximum day and peak hour demand data presented above. These peaking factors will be used later in this chapter in conjunction with projected average day demands to estimate the system's future maximum day and peak hour demands. The MDD/ADD ratio of 2.08 is within the typical range of 1.2 to 2.5 for most systems.

The estimated PHD/MDD ratio of 1.42 is within the typical range of 1.3 to 2.0 for most systems. In the previous WSP, PHD could not be computed based on actual system data because not all reservoirs were monitored. Instead, a PHD/MDD factor typical of similarly sized systems of 1.80 was applied to the system's estimated MDD, resulting in an estimated PHD of 3,630 gpm. The PHD/MDD factor based on actual data of 1.42 is less than the previously used assumption, and the actual PHD estimate is 687 gpm (19 percent) less.

Fire Flow Demand

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

The Arlington Fire Department provided a list of existing buildings with large fire flow requirements within the City. It is anticipated that fire flow requirements of future buildings will be lower than the older buildings because many larger buildings are now required to have sprinkler systems. The City has adopted the 2012 International Fire Code, with few exceptions, for determining fire flow requirements throughout the City.

Table 4-8

Maximum Day and Peak Hour Demands and Peaking Factors

Maximum Day Demand Data (in gpm)

Year	Average Day Demand (ADD)	Maximum Day Demand (MDD)	Date	Peak Day Factor
2005	967	2,013	8-Aug	2.08
2006	1,039	1,918	21-Jul	1.85
2007	992	2,063	11-Jul	2.08
2008	964	1,578	12-Jul	1.64
2009	1,005	1,976	30-Jul	1.97
2010	917	1,582	27-Jul	1.73
2011	886	1,197	4-Aug	1.35
2012	960	1,756	16-Aug	1.83
2013	986	1,624	26-Jul	1.65
2014	1,092	1,630	27-Aug	1.49

Peak Hour Demand Data for Selected Periods (in gpm)

Date	Hour	All Production Sources	Reservoirs to Distribution	Peak Hour Demand (PHD)
8-Aug-05	9:30	2,547	319	2,866
8-Aug-05	15:00	2,537	-1,296	1,241
11-Jul-07	8:00	1,515	873	2,388
11-Jul-07	8:30	1,814	71	1,885
11-Jul-07	12:40--15:30	1,366	729	2,095
11-Jul-07	19:00	2,096	382	2,478
11-Jul-07	20:00	1,739	710	2,449
20-Jul-09	19:00	1,435	764	2,199
20-Jul-09	20:00	2,202	496	2,698
3-Aug-14	17:00	910	933	1,843
4-Aug-14	14:00	1,957	0	1,957
4-Aug-14	16:30	1,957	986	2,943
27-Aug-14	12:30	1,957	500	2,457

Peaking Factors

Maximum Day Peaking Factor (MDD/ADD)	1.75
Peak Hour Demand/Maximum Day Demand 8/14/2014 (PHD/MDD)	1.81
Peak Hour Demand/Average Day Demand (PHD/ADD)	3.16

General planning level fire flow requirements were established for the different land use categories to provide a target level of service for planning and sizing future water facilities. The general planning level fire flow requirement for each land use category is shown in **Table 4-9**. The water system analyses presented in **Chapter 7** are based on an evaluation of the water system for

providing sufficient fire flow in accordance with these general planning level fire flow requirements and the fire flow requirements of existing buildings. The fire flow requirements shown in the table do not necessarily equate to actual existing or future fire flow requirements for all buildings, since this is typically based on building size, construction type and fire suppression systems provided. Improvements to increase the available fire flow to meet actual fire flow requirements greater than those shown in the table shall be the responsibility of the developer.

Table 4-9

General Planning-Level Fire Flow Requirements Used in this WSP Update

Land Use Category	Fire Flow Requirement (gpm)	Flow Duration (hours)
Existing 540 and 710 Zones[1]	900	2
Low Density Residential	1,000	2
Medium Density Residential	1,750	2
High Density Residential	2,500	2
Commercial/Business Park	3,000	3
Industrial	3,500	3
Schools	3,500	3

(1) For general planning level purposes, the future fire flow requirement in the 540 and 710 Zones is considered to be 1,000 gpm.

As shown in **Table 4-9**, the City's general planning level fire flow requirements range from a minimum of 900 gpm for a duration of two hours for the existing 540 and 710 Zones which consists of suburban residential and rural land uses, to a maximum of 3,500 gpm for a duration of three hours for industrial and school areas, which are primarily located in the area surrounding the Arlington Airport. The City's Fire Chief currently allows 900 gpm of fire flow for two hours in the residential areas of the 540 and 710 Zones. For general planning level purposes, the future fire flow requirement in these areas is considered to be 1,000 gpm. Actual fire flow requirements in these zones will continue to be evaluated on a case-by-case basis by the City's Fire Chief.

4.4 FUTURE WATER DEMANDS

4.4.1 Basis for Projecting Demands

Future demands were calculated from the results of the existing per capita demand computations shown in **Table 4-4** and the projected population data from **Chapter 3**. Future water demands are projected to increase not only as a result of population growth, but also as a result of increasing per capita demand. Projections were computed with and without water savings expected from

implementing the water use efficiency measures contained in the City's WUE Program in **Appendix E**.

Trending of Average Day Demand

The City's WUE Program (**Appendix E**) analyzed three variants on the measure of average annual demand on its water supply, gallons per day—per capita, per connection, and per ERU. All demonstrated decreases in consumption sharply in the 1990s, and then gradually but fairly steadily since 2000.

Demand-side goals for decreasing consumption which were established by the City in 2004, 2008, and 2011 were attained and/or on target for attainment. For example, 2014 and 2018 have target years since goal setting first occurred in the 2004 WSP. On a per connection basis, the 2004 goal of reducing system-wide consumption by 10 percent by 2018 was met in 2009. The 2011 WSP established goals of reducing consumption by two percent by 2014 and five percent by 2018. On a per capita basis, system-wide demand declined from 87 gpcd in 2008 to as low as 78 gpcd in 2012 (a reduction of 10.3 percent). This beat the goal of 85 gpcd before it spiked to 97 gpcd in 2014 itself. The goal of 82 gpcd in 2018 remains not unreasonable. For planning purposes, the 2011 WSP estimated 90 gpcd for all future year projections, a level that appeared conservative at that time.

Water Use Efficiency and Other Factors Influencing Per Capita Demand

The City attributes the declining trend in average annual demand, in part, to successful implementation of its WUE Program. For the last decade, the City implemented more than the minimum amount of WUE measures required, including distribution of indoor and outdoor conservation kits, customer education, conservation rate structures and rebate programs. The City also assumes it has benefitted from the cultural attitudes of western Washington and the Pacific Northwest, as numerous other utilities in the Puget Sound have observed similar trends.

It would be incorrect to assert that all gains in efficiency over the last 20 years are the result of the WUE program, however. The economic recession which began in 2008 contributed to diminished water use by residents and businesses attempting to save money through conservation practices or reduced water-based services. The City also "lost" some of its largest water customers during this period. For example, the recession forced the closure of the Bayliner Boats facility and the Northwest Hardwoods' sawmill. Cascade Valley Hospital implemented efficiency improvements during its expansion and remodel. Arlington High School converted its grass football field to artificial turf and dramatically reduced the school district's irrigation demand. What remains unclear is the extent of the influence of the economy on declining demand. The extended decline over multiple decades and several changes in the economic climate speaks to increasingly efficient water use.

The City anticipates the reversal of some of the apparent gains in efficiency as economic recovery and growth occur in the Arlington marketplace. It is not unlikely that the 97 gpcd demand in 2014

is not a "fluctuation", but an indicator of economic recovery. In fact, the City of Arlington, along with the City of Marysville, is poised for a burst of industrial and commercial growth with the preliminary approval and recognition by Puget Sound Regional Council (PSRC) of the Arlington-Marysville Manufacturing Industrial Center (MIC). The Central Arlington area is also anticipated to receive an influx of commercial and industrial growth during the next planning cycle. Both of these areas are identified as two of the six focus areas for growth in Chapter 3. Growth in these and other non-residential areas will serve to increase per capita demand. The City is optimistic that the employment outlook will return to or exceed pre-recession levels within 10 to 20 years.

Estimating Future Per Capita Demand

The City feels it could be presumptuous to assume, as it did in the previous 2011 WSP, sustained levels of reduced or "lower" average day demand, at least on a per capita or per connection basis. Staff are concerned there may even be an economic swing toward increased per capita demand. Growth projections for the City of Arlington issued by PSRC and Snohomish County identify a 2035 population of 24,937, as referenced in **Chapter 3**, but also an employment estimate of more than 8,500 additional jobs (**Table 4-10**). Using OFM data for 2006, the ratio of population to jobs for 2035 (1.20) is about *three percent higher* than that observed in 2006 (1.16). The ratio had increased through the recession to at least 1.49 (in 2014) as the City saw numerous closures of commercial and industrial businesses. During the same period, per capita consumption continued its decrease begun in the 1990s to less than 90 gpcd. With the forecast increase in population *and* jobs for the City, the City selected to forecast average day demand from approximately current levels to a level *three percent higher* than it was in 2006. Therefore, per capita demand is shown to increase linearly from 90 gpcd in 2015 to 110 gpcd in 2035 (**Table 4-11**). These future per capita demand values are projections made without savings from WUE measures implemented over the same period.

Table 4-10

Employment Assumptions Affecting Future Water Demand Projections

Year	Jobs (count)	Population (count)	Ratio (Pop./Jobs)	Per capita consumption (gal/day/capita)
2006	13,560	15,693	1.16	106
2014	12,284	18,250	1.49	*90
2035	20,829	24,937	1.20	*110

Source of population and jobs data: PRSC and Snohomish County

* Range of 78 to 97 gpdc over the seven previous years, average of 86 gpdc; Range of 90 gpdc to 110 gpdc used for planning future demand

4.4.2 Demand Forecasts and Conservation

Table 4-11 presents the demand forecast for the City's water system. The actual demand data from 2013 and 2014 are also shown in the table for comparison purposes. The future average day demands were projected based on population estimates for the given years (**Table 3-2**) and the estimated demand per capita values. The future maximum day and peak hour demands were computed from the projected average day demands and the existing system peaking factors shown in **Table 4-8**. The future demand projections are also shown with and without estimated reductions in water use from achieving WUE goals described above and in **Appendix E**.

A 50-year (2064) demand forecast was not formally developed in this WSP update as it was in the previous WSP, when population growth after the 20-year planning horizon was assumed at up to two percent. For purposes of evaluating the capacity of the City's water rights over the long term, however, growth from year 20 to year 50 was assumed at 1.3 percent and per capita consumption was held at 110 gallons per capita per day, as described above for 2034. With an estimated service population of 34,789 in 2064, the ADD and MDD would be 2,657 gpm and 4,651 gpm, respectively.

The 50-year demand allows for early planning of system supply, locating future supply sources to maximize efficiency and minimize infrastructure and pumping costs, supply assurance through structuring of wholesale contracts and water right permits and certificates, reducing environmental impacts, redundancy of supply sources, and for the purposes of the Integrated Water Resource Management Program, included in **Appendix I**.

Table 4-11

Future Water Demand Projections

Description	2013 Acutal[1]	2014 Actual[1]	Projected 2015 (+1 yrs)	2016 (+2 yrs)	2017 (+3 yrs)	2018 (+4 yrs)	2019 (+5 yrs)	2020 (+6 yrs)	2021 (+7 yrs)	2022 (+8 yrs)	2023 (+9 yrs)	2024 (+10 yrs)	2034 (+20 yrs)	2035 (+21 yrs)
Population Data														
Population	16,761	16,245	16,564	16,882	17,201	17,519	17,838	18,157	18,475	18,794	19,112	19,431	22,617	22,936
Increase from Base Year 2014			319	637	956	1,274	1,593	1,912	2,230	2,549	2,867	3,186	6,372	6,691
Demand Basis Data (gal/day/capita)														
ADD without WUE	85	97	90	91	92	93	94	95	96	97	98	99	109	110
ADD with WUE			90	90	91	92	93	94	95	96	97	98	108	109
Average Day Demand (gpm)														
Demand without WUE	986	1,092	1,036	1,067	1,099	1,132	1,165	1,198	1,232	1,266	1,301	1,336	1,712	1,752
Demand with WUE			1,032	1,061	1,091	1,117	1,149	1,182	1,215	1,249	1,284	1,318	1,689	1,729
Maximum Day Demand (gpm)														
Demand without WUE	1,725	1,912	1,812	1,868	1,924	1,981	2,038	2,097	2,156	2,216	2,277	2,338	2,996	3,066
Demand with WUE			1,806	1,857	1,909	1,954	2,011	2,069	2,127	2,186	2,246	2,307	2,956	3,025
Peak Hour Demand (gpm)														
Demand without WUE	3,115	3,451	3,272	3,372	3,473	3,576	3,680	3,786	3,892	4,001	4,110	4,221	5,409	5,535
Demand with WUE			3,261	3,352	3,446	3,528	3,631	3,735	3,840	3,947	4,055	4,165	5,337	5,461

(1) 2013 and 2014 maximum day and peak hour demand values are based on actual average day demand amounts for the given year and historical peaking factors and do not necessarily represent actual peak demands for these years.

The analysis and evaluation of the existing water system with proposed improvements, as presented in **Chapters 7** and **9**, is based on the projected demand data without WUE savings. This ensures that the future system will be sized properly to meet all requirements, whether or not additional water use savings are achieved. However, the City will continue to pursue reductions in water use by implementing the WUE Program contained in **Appendix E** of this Comprehensive Water System Plan.

Table 4-12 presents the existing and projected ERUs of the system. The ERU forecasts are based on the projected water demands from **Table 4-10** and the average demand per ERU that was computed from the actual 2005 through 2014 data shown in **Table 4-7**. The historical and projected water demand and ERU data from **Tables 4-11** and **4-12** is also shown graphically in **Chart 4-5**.

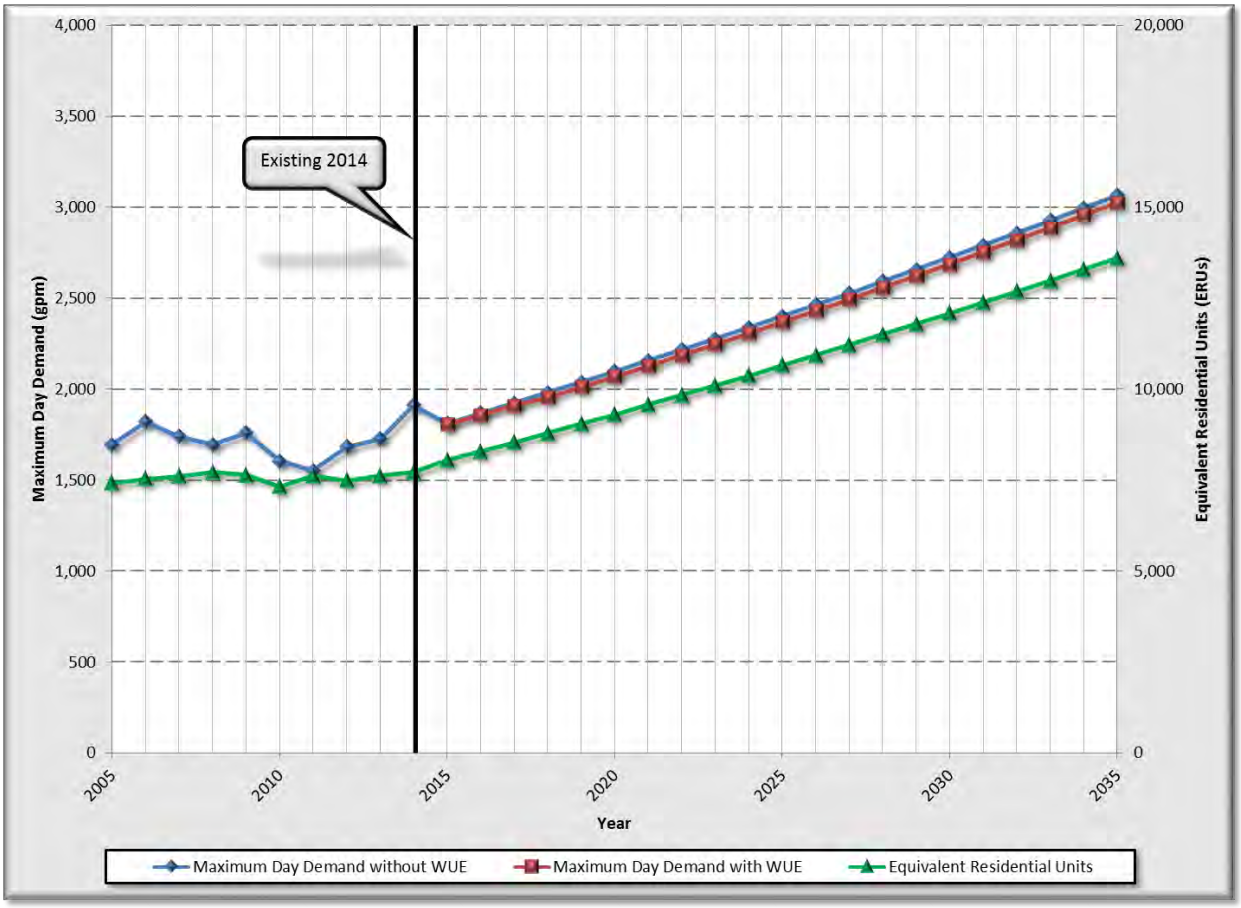
Table 4-12

Future ERU Projections

Description	2013 Actual	2014 Actual	Projected 2015 (+1 yrs)	2016 (+2 yrs)	2017 (+3 yrs)	2018 (+4 yrs)	2019 (+5 yrs)	2020 (+6 yrs)	2021 (+7 yrs)	2022 (+8 yrs)	2023 (+9 yrs)	2024 (+10 yrs)	2034 (+20 yrs)	2035 (+21 yrs)
Demand Data (gpm)														
ADD without WUE	986	1,092	1,036	1,067	1,099	1,132	1,165	1,198	1,232	1,266	1,301	1,336	1,712	1,752
ERU Basis Data (gal/day/ERU)														
Demand per ERU without WUE	186	204	185	185	185	185	185	185	185	185	185	185	185	185
Demand per ERU with WUE			185	184	184	183	183	183	183	183	183	183	183	183
Equivalent Residential Units (ERUs)														
Total System ERUs	7,613	7,705	8,040	8,286	8,534	8,787	9,043	9,302	9,564	9,831	10,100	10,373	13,291	13,602

Chart 4-5

Future Water Demand and ERU Projections



This page blank for formatting and duplex printing.

5 Policies and Design Criteria

5.1 INTRODUCTION

The City of Arlington (City) operates and plans water service for City residents and businesses according to the design criteria, laws and policies that originate from the seven agencies shown in **Table 5-1**. The agencies are listed from those with the broadest to the narrowest authority.

These laws, design criteria and policies guide the City's operation and maintenance of the water system and its planning for growth and improvements. The seven agencies' overall objective is to ensure that the City provides high quality water service at a fair and reasonable cost to its customers. The seven agencies also set the standards the City must meet to ensure the water supply is adequate to meet existing and future water demands. The water system's ability to meet these demands is detailed in **Chapter 7** and the recommended improvements are identified in **Chapter 9**.

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

Continued

Table 5-1

Regulatory Agencies

Agency	Design Criteria/Laws/Policies
U.S. Department of Health & Human Services	Federal Regulations
U.S. Environmental Protection Agency	Federal Regulations
Washington State Department of Health	State Regulations
Washington State Department of Ecology	State Regulations
Snohomish County Council	County Regulations
Arlington City Council	Administrative Policies
American Water Works Association	Design Criteria
North Snohomish County Water Utility Coordinating Committee	Policies and Design Criteria

The policies associated with these five categories are presented in the sections which follow:

- Supply
- Customer Service
- Facilities
- Finance and
- Organization.

5.2 SUPPLY POLICIES

5.2.1 Quality Protection

A. The City will pursue steps to meet or exceed all water quality laws and standards.

B. The City will take all reasonable measures to protect its system and customers.

5.2.2 Cross-connection Control

A. The City has a responsibility to protect the public water system from contamination due to cross connections. Cross connections that can be eliminated will be eliminated.

B. The City has a cross-connection control program for eliminating cross connections. A copy of the City's Cross-connection Control Program is contained in **Appendix G**.

C. The City has staff certified for backflow prevention and inspection.

D. The City will comply with the backflow prevention assembly installation and testing requirements as indicated in Washington Administrative Code (WAC) 246-290-490, and

as published in the Pacific Northwest Section, American Water Works Association (AWWA) manual *Cross-connection Control Manual Accepted Procedure and Practice*.

5.2.3 Quantity

A. The City will plan for at least a 50-year projected use of its supply sources so that future water resource limitations can be handled effectively.

B. The City will ensure the capacity of the system, including its supply facilities, storage and transmission mains, is sufficient to meet the peak day demands of the system.

5.2.4 Reliability and Sustainability

A. The City will ensure, to the maximum extent practicable, that service interruptions are minimized in terms of number and duration. This will require planning and preparation for various event scenarios, including source contamination, treatment failures, main and hydrant breaks, accidents, drought, climate change, fire and other emergencies, and earthquakes and other natural disasters.

B. Reliability and sustainability goals will be met using:

   i. multiple and diverse water sources.

   ii. distribution infrastructure such as looping of mains, flow control and pressure relief valves, pump stations, and other redundancy measures.

   iii. emergency response planning for all identified stressors that may lead to water service interruptions, including those listed above.

   iv. Integrated water resource management (IWRM) opportunities identified in the IWRM Program in **Appendix I.**

5.2.5 Fire Flow

A. The City will plan to provide the following minimum fire flows for future development.

   i. Low Density Residential: 1,000 gallons per minute (gpm) for a 2-hour duration.

   ii. Medium Density Residential: 1,750 gpm for a 2-hour duration.

   iii. High Density Residential: 2,500 gpm for a 2-hour duration.

   iv. Commercial/Business Park: 3,000 gpm for a 3-hour duration.

   v. Industrial/Schools: 3,500 gpm for a 3-hour duration.

Improvements to increase the available fire flow to meet actual fire flow requirements greater than those shown shall be the responsibility of the developer. In areas where development can meet fire flow requirements by installing water mains sized per this Comprehensive Water System Plan (WSP), but the City desires larger pipes for fire flow in other areas, the City will endeavor to pay the cost difference associated with the increased pipe size.

5.2.6 Water Use Efficiency

A. The City has and will continue to promote the efficient and responsible use of water and will conserve water.

B. The City's Water Use Efficiency Program will be updated at least as frequently as its Water System Plans (six to ten years), and will include an evaluation of goals and measures for implementation. The City's current adopted program is contained in **Appendix E**.

C. Progress toward water use efficiency goals will be reviewed and reported annually to staff, customers, and agencies.

5.2.7 Regional Participation

The City will continue to participate in regional supply management and planning activities to protect the environment, reduce cost of service, increase reliability, improve water quality and secure needed water quantities. The City currently participates in the following activities.

- North Snohomish County Water Utility Coordinating Committee (NSWUCC);
- City of Everett Water Utilities Committee (EWUC).
- EWUC Water Conservation Subcommittee.
- EWUC Mutual Aid Agreement.
- Water Supply Forum (Central Puget Sound. through EWUC).
- Washington Water Utility Council (WWUC. within the AWWA Pacific Northwest Section).
- Washington State Department of Health (DOH) regional training opportunities.

5.2.8 Integrated Water Resources Management Program

An Integrated Water Resources Management Program (IWRMP) is defined by the Technical Committee of the Global Water Partnership as "a process which promotes the coordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems." The City's IWRMP establishes policies and criteria related to operating and managing its multiple water sources. Recommendations and evaluations regarding water use efficiency, water sources, water storage, customer rate structures and water reuse, among other items, are included in the IWRMP. A copy of the City's IWRMP is contained in **Appendix I**.

5.2.9 Environmental Responsibility

A. The water utility will implement procedures, and modifications to procedures, when it is demonstrated that such procedures, as part of an integrated watershed management plan involving other utilities and land uses in the Stillaguamish and Quilceda basins, would result in net environmental benefits at a reasonable cost to the utility.

B. The water utility will manage its operations, withdrawals, and discharges with consideration for parameters known to cause, or which potentially could cause, impairments to water quantity and quality in the Stillaguamish River. As of this plan, parameters of primary concern include: instream flows, water temperature, phosphorus and other nutrients, and copper and zinc.

C. The water utility will maintain lists of viable alternatives for adaptive management planning in the event that changes in effluent or receiving water quality require the consideration or implementation of such procedures.

5.3 CUSTOMER SERVICE POLICIES

5.3.1 Water Service and Connection

A. The City's future water service area (WSA) is consistent with that established by the 2010 CWSP, or as may be modified consistent with procedures established within the CWSP.

B. The City will strive to provide potable water service to the people within the City's retail WSA, provided all policies related to service can be met.

C. All proposed developments within the City's retail WSA shall connect directly to the City's water system, unless deemed unfeasible by the City at the time of the request.

D. Water system extensions required to provide water service to proposed developments shall be approved by the City's Department of Public Works and must conform to the City's adopted design criteria and construction standards and specifications, as shown in the City's Public Works Design and Construction Standards and Specifications, which are contained in **Appendix D**. All costs of the extension shall be borne by the developer or applicant.

E. Water utility extensions shall be given based on system capacity with the following priorities.

   i. Extensions shall first be given to applicants within the City limits.

   ii. Second priority shall be given to those applicants within the UGA.

   iii. Third priority shall be given to those applicants within the retail WSA.

   iv. Extensions may be given higher priority where existing water quality or quantity problems make extension necessary.

F. Water service can be extended within the retail WSA if the project is in compliance with the City's utility standards and policies, WSP, water rights, Snohomish County's adopted land use plan, and zoning and development regulations.

G. The City has the duty to serve all customers within the retail WSA if all of the following conditions can be met.

i. The City has sufficient capacity to serve water in a safe and reliable manner.

ii. The applicant is in compliance with all applicable local plans, development regulations, and utility standards and policies.

iii. Sufficient water rights and supply are available.

iv. The City can provide such service in a timely and reasonable manner.

H. Water service cannot be extended outside of the future WSA identified in the North Snohomish County Coordinated Water System Plan unless a special agreement with an adjacent purveyor exists and all of the following conditions are met.

i. The designated water purveyor cannot provide such service in a timely and reasonable manner.

ii. The designated water purveyor agrees to transfer the WSA.

iii. The change complies with the requirements and regulations of the Snohomish County Comprehensive Plan and the North Snohomish County Coordinated Water System Plan.

iv. The extension is approved in a WSP amendment.

v. All duty to serve conditions can be met by the City.

I. For water service applications within the City limits, the City will review the availability for water service during land use permitting, site civil review and building permit review. During the land use permitting process, the City will determine if water is available for the site in accordance with the adopted protocols in the CWSP. During the site civil review, the City will address the sizing and looping of the water main. The formal water service application begins at the time of building permit application when fire flow and service sizing is evaluated. The complete process takes several months to complete.

J. For water service applications outside of the City limits, the applicant must first obtain a water utility service agreement from the City. The City will review the agreement and determine the availability of water. Water availability requests can be processed in approximately two weeks.

K. Water system capacity, pressure and fire flow will be evaluated at the time of the water service application. The City will use the capacity analysis contained in Chapter 7 to evaluate sources of supply, treatment, storage, distribution system and water rights capacity available to the applicant.

L. The Certificate of Water Service Availability shall expire at the time that the associated permit expires (i.e. land use, site civil or building permit).

M. Time extensions in regards to the Certificate of Water Service Availability shall be granted in accordance with the associated permit requirements. When extensions are denied, the disputes are handled through the rules guiding the associated permit process. Disputes can be brought to the City Council for discussion and resolution.

N. Individual wells may be installed on existing lots of record within the City's retail WSA if the City determines it is unfeasible to provide direct connection to the City's water system at the time of the request. This option is strictly limited to individual cases where timely and reasonable service is not possible. State and County approvals for new wells must be obtained, and regulations governing well construction and operation must be followed. Owners of individual wells will be required to connect to the City's water system at the time City water becomes available.

5.3.2 Annexations

A. The City will follow state guidelines in the assumption of facilities in annexation areas.

B. Service to areas outside of the City limits without annexation will be evaluated on a case by case basis by the City Council.

5.3.3 Temporary Services

A. No temporary service is allowed, unless there are plans for timely permanent water service that meet City standards. All temporary services will be evaluated by the City Council.

5.3.4 Emergency Service

A. Compliance with standards may be temporarily deferred for emergency water service.

B. Policy criteria may be temporarily waived for emergency service.

5.3.5 Planning Boundaries

A. The City's retail WSA and existing and future WSAs will be designated in the current WSP and will be consistent with the North Snohomish County Coordinated Water System Plan.

B. The City will follow State of Washington guidelines in assuming portions of adjacent water systems as a result of annexation.

5.3.6 Transfer of Development Rights

A. In order for the transfer of development rights (TDR) to be certified, TDR applicants must comply with Snohomish County Code Chapters 30.35A and 30.35B, and the City's Land Use Code Chapter 20.37.

5.3.7 Satellite System Management

A. The City will consider providing management or ownership services to satellite water systems within or adjacent to the City's retail WSA.

5.4 FACILITY POLICIES

This section describes the planning criteria and policies used to establish an acceptable hydraulic operating level and a standard of quality for the water system. Additional criteria are contained in the City's Public Works Design and Construction Standards and Specifications, a copy of which is included in **Appendix D**.

5.4.1 Minimum Standards

A. All proposed developments within the City's existing and future retail WSA shall conform to the City's adopted design criteria, construction standards and specifications in addition to the requirements of governmental agencies.

5.4.2 Pressure

A. The City will endeavor to maintain a maximum pressure of 125 pounds per square inch (psi) in the water mains during normal demand conditions. Individual residences and businesses are responsible for reducing pressures to a satisfactory pressure or to residential building code standards.

B. The City will endeavor to maintain a minimum pressure of 40 psi at customer meters during normal demand conditions, excluding a fire or emergency.

C. The City will endeavor to maintain a minimum pressure of 30 psi at customer meters during peak and all other demand conditions, excluding a fire or emergency.

D. During fire conditions, the City will endeavor to maintain a minimum pressure of 20 psi at customer meters and throughout the remainder of the system.

E. During a failure of any part of the system, the maximum pressure will not exceed 150 psi.

5.4.3 Velocities

A. During normal demand conditions, the City will ensure the velocity of water in a water main is less than 5 feet per second (fps).

B. During emergency conditions such as a fire, and for design purposes, the City will endeavor to ensure the velocity of water in a water main does not exceed 10 fps.

5.4.4 Storage

A. Storage within the distribution system must be of sufficient capacity to supplement supply when system demands are greater than the supply capacity (equalizing storage), and still maintain sufficient storage for proper pump operation (operational storage) fire suppression (fire flow storage) and other emergency conditions (standby storage).

B. Gravity standby storage must be located above the elevation that yields a 20 psi service pressure to the highest service in the zone under peak hour demand conditions. The City will endeavor to maintain a minimum standby storage volume of 200 gallons per equivalent residential unit (ERU).

C. Gravity fire flow storage must be located above an elevation that yields a 20 psi service pressure to all services in the zone under maximum day demand conditions.

D. The City will provide sufficient standby storage for an emergency condition in which a major supply source is out of service. The volume of storage will be sufficient to maintain uninterrupted supply to the system during an emergency condition for a duration of two days.

E. The City will provide sufficient storage for a fire condition equal to the system's maximum fire protection water demand and the required duration.

F. The City will have high-water level and low-water level alarms for each storage facility, and alarms will report to the WTP Operations and Maintenance Office.

G. A water level indicator for each storage facility will be located at the WTP Operations and Maintenance Office.

H. Storage facilities will be located in areas where they will satisfy the following requirements.

   i. Minimize fluctuations in system pressure during normal demands.

   ii. Maximize the use of storage facilities during fires and peak demands.

   iii. Improve the reliability of supply to the City.

   iv. Maintain water quality by usage cycling. Consideration may also be given to internal tank mixing devices.

5.4.5 Transmission and Distribution

A. Unless deemed impractical by the City, transmission and distribution mains will be looped to increase reliability and fire flow capacity and to decrease head losses.

B. All mains will comply with the generally recognized design criteria from the AWWA and DOH guidelines that follow.

   i. All new construction will be in accordance with the City's Public Works Design and Construction Standards and Specifications, of which Chapter 2 is included in **Appendix D**.

   ii. Distribution system designs will be engineered such that adequately sized service lines will be used. All residential service lines will be one-inch or larger. Service lines will be the same size as the meter or larger.

C. The minimum diameter of distribution mains will be 8 inches in all locations. All water mains will be cement-mortar lined ductile iron pipe. The City may consider other piping materials for specialized applications on a case by case basis.

D. All new distribution main design will utilize a hydraulic analysis to assist in determining water main size.

E. All new mains providing fire flow will be sized to provide the required fire flow at a minimum residual pressure of 20 psi during peak day demand conditions, while maintaining a maximum pipeline velocity of less than 10 fps. New water mains in commercial, government and school areas shall be a minimum of 12 inches in diameter and looped.

F. Valve installations will satisfy the following criteria.

   i. Zone valves will be located at all pressure zone boundaries to allow future pressure zone realignment without the need for additional pipe construction.

   ii. Isolation valves will typically be installed in the lines to allow individual pipelines to be shut down for repair or installation services. Unless it is impractical to do so, the distance between in-line isolation valves shall not exceed 1,000 feet. A minimum of four valves shall be provided per cross and three valves per tee. The City may reduce the number of valves and increase distance between valves for new construction based on the system's configuration.

   iii. Air/vacuum release valves will be placed at all high points, or "crowns," in all pipelines and must have City approval prior to installation.

   iv. Blowoff assemblies shall be located at main dead ends where there is no fire hydrant or as required by the City to allow flushing of distribution main lines. Locations of blow-off assemblies shall be determined based on ease of access and the ability to dispose of flushed water. Blowoff assemblies shall be installed in utility rights-of-way except when an access and construction easement is provided for in writing for the City. Blowoff assemblies shall have valves the same size as the main with concrete thrust blocking.

   v. Individual pressure-reducing or check valves will be installed on all new or replacement customer service lines in the City. Pressure-reducing valves protect customers from high pressures in case a mainline pressure-reducing station fails. Check valves prevent hot water tanks from emptying into the City's distribution system when a nearby water main is empty or when the pressure in the main is less than the pressure in the tank, and prevent contamination of the system mains by possible cross connections in the customer's pipes or fixtures.

G. Fire hydrant installations will satisfy the following criteria.

i. Fire hydrants serving detached single-family dwellings or duplex dwellings on individual lots will be located not more than 600 feet apart on center, such that all single-family lots are within 300 feet of a fire hydrant, as measured along the path of vehicular access.

ii. Fire hydrants serving any use other than detached single-family dwellings or duplex dwellings on individual lots will be located not more than 300 feet apart on center and will be located so that at least one hydrant is located within 150 feet of all structures, but not closer than 50 feet, unless approved by the Arlington Fire Department (Fire Department).

iii. A minimum of one fire hydrant shall be installed per intersection.

iv. The Fire Department will review all proposed fire hydrant installations to ensure the correct number and spacing of fire hydrants for each project per the Fire Department's standards.

5.4.6 Supply and Booster Pump Stations

A. All existing and future booster pump stations will be modified and constructed to comply with the following minimum standards.

i. All structures will be designed to minimize combustibility, where practical.

ii. All buildings will have adequate heating, cooling, ventilation, insulation, lighting and work spaces necessary for on-site operation and repair.

iii. Sites will be fenced to improve security, reduce vandalism and reduce the potential for City liability.

iv. Each station will be equipped with a flow meter and all necessary instrumentation to assist personnel in operating and troubleshooting the facility.

v. Emergency power capability will be provided to at least one supply or booster pump station per pressure zone.

B. Pumps will be operated automatically, with flexibility in pump start/stop settings.

C. Stations will be operated with the provision for at least two methods of control to minimize system vulnerability.

D. Manual override of stations will be provided locally at stations and at the WTP Operations and Maintenance Office using the City's supervisory control and data acquisition (SCADA) system.

E. Stations will be monitored with alarms for the following conditions.

i. Pump started automatically or manually.

ii. Power phase failure.

iii. Power outage/generator running.

iv. Communication failure.

v. Flood in structure.

vi. Low suction pressure.

vii. High and low discharge pressure.

viii. Intrusion.

ix. Smoke detector.

x. Heat detector.

F. Stations will have the following indicators.

i. Local flow indication and totalizing.

ii. Flow indication and totalizing at the WTP Operations and Maintenance Office.

iii. Recording of combined supply flow to the system.

iv. Discharge pressure gauges.

v. Motor amperage gauges.

vi. Alarm indicators for all items included under station monitoring.

vii. Appropriate hazardous material signage on exterior of buildings.

G. Booster pump stations will be placed wherever necessary to fulfill the following criteria.

i. Provide supply redundancy to a pressure zone.

ii. Improve the hydraulic characteristics of a pressure zone.

iii. Maximize storage availability and transmission capacity.

iv. Improve water quality (i.e. increase circulation) and quantity.

5.4.7 Pressure Reducing Stations

A. All pressure reducing valves will be placed in vaults that are large enough to provide ample workspace for field inspection and valve repair.

B. Vaults will be provided with adequate drainage to prevent water accumulation and equipped with sump pumps to prevent vault flooding or pumped of excess water annually.

C. Pressure relief valves may be provided on the low pressure side of the pressure reducing valves to prevent the system from over-pressurizing in case of a pressure reducing valve failure.

5.4.8 Water Treatment Plant

A. The City's water treatment plant (WTP) must be operated under the direct supervision of a certified operator (WAC 246-292).

B. All future water treatment facilities shall be designed in accordance with WAC 246-290-250.

C. All water treatment facilities shall treat water to levels that comply with all current DOH standards.

D. All water treatment facilities shall treat water to levels that comply with all current DOH standards, including the Washington State DOH Treatment Optimization Program (TOP).

5.4.9 Control

A. The City's monitoring system must be capable of efficiently operating the water system's components in accordance with this WSP and in response to reservoir levels, system pressures and abnormal system conditions.

5.4.10 Maintenance

A. Facility and equipment breakdown is given the highest maintenance priority. Emergency repairs are to be made even if overtime labor is involved.

B. Equipment will be scheduled for replacement when it becomes obsolete and as funding is available.

C. Worn parts will be repaired, replaced or rebuilt before they represent a high failure probability.

D. Spare parts will be stocked for all equipment items whose failure will impact the ability to meet other policy standards.

E. Equipment that is out of service will be returned to service as soon as possible.

F. A preventive maintenance schedule will be established for all facilities, equipment and processes.

G. Tools will be obtained and maintained to repair all items whose failure will impact the ability to meet other policy standards.

H. Dry, heated shop space will be available for maintenance personnel to maintain facilities.

I. All maintenance personnel will be trained and certified to efficiently perform their job descriptions.

J. Maintenance will be performed by the water maintenance staff or other approved sources and supervised by the Water Utility Supervisor.

K. Written records and reports showing the operation and maintenance history will be maintained on each facility and item of equipment.

5.4.11 Joint Use

A. All joint-use facilities (with other public water systems) must comply with the City policy and design standards.

B. Maintenance of all joint-use facilities will be consistent with a written operations and maintenance manual prepared jointly with the cooperating agency for each specific joint-use facility.

C. Joint-use facilities will be pursued only in those areas that improve reliability or reduce operating costs.

5.5 FINANCIAL POLICIES

5.5.1 General

A. The City will set rates that comply with state regulations.

B. Rates and additional charges established for the City should be as follows.

   i. Cost-based rates that recover current, historical and future costs associated with the City's water system and services;

   ii. Equitable charges to recover costs from customers, commensurate with the benefits they receive.

   iii. Adequate and stable source of funds to cover the current and future monetary needs of the City.

   iv. Do not subsidize the operation of other City departments.

C. Existing City customers pay the direct and indirect costs of operating and maintaining the facilities through water rates. In addition, the water rates will include debt service incurred to finance the City's capital assets serving existing customers, if required.

D. New customers seeking to connect to the water system will be required to pay connection fees and charges for an equitable share of the historical cost of the system and for the system's Capital Improvement Program (CIP). Connection charge revenues in conjunction with rate revenue, will be used to fund the growth CIP and existing system CIP when designed to provide for growth.

E. New and existing customers will be charged for extra services through separate ancillary charges based on the costs to provide the services. Ancillary charges can increase equitability, as well as operating efficiency, by discouraging unnecessary demand for services. The charges will be reviewed regularly and updated on an as-needed basis to reflect increases in operating or material costs. Revenue from ancillary charges will be used to finance annual operations and maintenance or existing system CIP requirements.

F. The City will maintain information systems that provide sufficient financial and statistical information to ensure conformance with rate setting policies and objectives.

G. User charges must be sufficient to provide cash for the expenses of operating and maintaining the system. To ensure the fiscal and physical integrity of the utility, an amount should also be set aside each year and retained for capital expenditures. The amount may be transferred from the Operations and Maintenance Fund to the water Improvement Fund for general or specific purposes.

H. A Working Capital Reserve will be maintained to cover unanticipated emergencies and fluctuations in cash flow.

I. Water rates will strive to equitably charge customers with different service requirements based on the cost of providing the water service. Service requirements relate to the total volume of water used, peak rates of use and other factors.

J. Water rates will be based on an inclining block rate structure to encourage the efficient use of water.

K. Fees and charges are calculated based on the service provided. Rates will be the same for all customers of the same class within the retail WSA.

5.5.2 Connection Charges

A. Owners of properties that have not been assessed, charged or borne an equitable share of the cost of the water system will pay one or more of the following connection charges prior to connection to a water main.

B. Latecomers Fee: Latecomers fees are negotiated with developers and property owners and provide for the reimbursement of a pro rata portion of the original cost of water system extensions and facilities.

C. Connection Charge: The connection charge will be assessed against any property that has not participated in the development of the water system. Meter charges, or hookup fees, are additional in order to recover the cost of meter and service line installation.

D. Developer Extension Charges: These charges are for the administration, review and inspection of a developer extension project.

5.6 ORGANIZATIONAL POLICIES

5.6.1 Staffing

A. Personnel certifications will meet or exceed Washington State standards.

B. The Water Department actively supports and funds staff training.

5.6.2 Relationship with Other Departments

A. The Water Department is a subdivision of the City's Public Works Department. The Wastewater and Stormwater Departments are sister departments within Public Works.

B. The Finance Department is responsible for customer billing, payment collection, project cost accounting and fund activity reporting.

C. The Human Resources Department is responsible for employee records and salary schedules.

D. The Building Department, Fire Department and Engineering Department establish fire flow requirements.

E. The Building Department, Fire Department and Water Department work cooperatively in the development and maintenance of a hazardous materials inventory and database to facilitate emergency response and to assure public safety and source water protection.

F. The Police Department and/or the City Code Enforcement Officer are responsible for enforcing violations of City water ordinances.

G. The Fire Department uses water utility facilities for fire protection and training.

H. The Fire Department is responsible for emergency responses to hazardous events at water system facilities.

I. The Fire Department is responsible for hydrant fire flow testing under the supervision of the Water Department.

6 Water Source and Quality

6.1 INTRODUCTION

The two basic objectives of a water system are to provide a sufficient quantity of water to meet customer usage demands and to provide high quality water. **Chapter 7** discusses the City of Arlington's (City) ability to supply a sufficient quantity of water and identifies future source requirements. This chapter discusses the City's existing water sources, water rights, water quality regulations and water quality monitoring results.

6.2 EXISTING WATER SOURCES AND TREATMENT

6.2.1 Water Sources

The City's water supply is provided by four wells and a wholesale purchase agreement with the Snohomish County Public Utility District No. 1 (PUD), with the primary source of water coming from the City's Haller Wellfield. The Haller Wellfield is located immediately adjacent to the Stillaguamish River and comprised of three individual wells under the influence of surface water. The Airport Wellfield is comprised of one groundwater well that withdraws water from the Marysville Trough Aquifer. The City's wholesale agreement with the PUD allows for the purchase of up to 1,000 gallons per minute (gpm) of treated water. Additional information on each of the City's existing sources is presented in **Chapter 2** and contained in **Appendix B**.

6.2.2 Water Treatment

The City's Water Treatment Plant, originally constructed in 1924 and replaced in 2001, treats water from the Haller Wellfield. Water is pumped from the Haller Wellfield to the direct filtration system, which consists of three filter beds. All three regularly operated pumps in the Haller Wellfield can alternate or run simultaneously depending on the volume of water required at the water treatment plant. Primary coagulant and filter aid are added to the combined filter influent. The total capacity of the filtration system is currently 1,710 gpm. The plant operates with one or two filter beds in the winter and increases to three in the peak of summer. After processing, filtered water is chlorinated and is discharged into a 270,000 gallon clear well to receive a 4-hour chlorine

contact time. As the water exits the clear well, sodium hydroxide is added to adjust the pH level for corrosion control and there is sufficient chlorine in the water to provide a disinfecting residual in the distribution system. Two pumps are available for backwashing the filter beds.

Water pumped from the Airport Wellfield is chlorinated by flow pacing diluted sodium hypochlorite into the system during pump operation. Bulk 12.5 percent sodium hypochlorite is diluted and injected into the water pipeline through a metering pump feed system. Target doses are 0.5 milligrams per liter (mg/L).

The City does not add fluoride to its water sources which have naturally low fluoride levels. Water supplied by the PUD to the City is fluoridated at its source by the City of Everett. It remains fully fluoridated when it reaches the City's master meter. Fluoride levels decline and are variable once the water enters the City's distribution system depending on proximity to the PUD master meter and water system demands. Water supply from the PUD is not re-chlorinated or subjected to any additional treatment prior to entering the City's distribution system.

6.3 WATER SUPPLY, WATER RIGHTS, AND WATER PURCHASES

6.3.1 Overview

A water right is a legal authorization to use a specified amount of public water from specified points of diversion or withdrawal for specific beneficial purposes on specified places of use. The water right amount is expressed in terms of instantaneous withdrawal rate and annual withdrawal volume. Washington State law requires users of public water to apply for and receive approval from the Washington State Department of Ecology (Ecology) prior to actual water use. This approval is granted in the form of a water right permit or certificate.

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

A water right permit is issued by Ecology only if the proposed use meets the following requirements:

- Water will be put to beneficial use;
- There will be no impairment to existing or senior rights;
- Water is available for appropriation; and
- Issuance of the requested water right will not be detrimental to public welfare.

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

Water right claims are another type of water right document intended to represent water rights established prior to adoption of the relevant water code. Beginning in 1974, water right claims were required to be filed with Ecology to document vested water rights established prior to 1917 for surface water, and prior to 1945 for groundwater.

Municipal Water Law

The 2003 Municipal Water Law (MWL) (Second Engrossed Second Substitute House Bill 1338; Chapter 5, Laws of 2003; 58th Legislature; 2003 1st Special Session; Municipal Water Supply -- Efficiency Requirements) clarified municipal water rights, providing the flexibility and certainty that municipalities need to plan for growth.

The MWL allows a municipal water supplier's place of use under its water rights to be changed to match the current service area. It allows changes to the water right place of use to occur via the approval of the service area by the Washington State Department of Health (DOH), as opposed to the previous method of the water right change application process with Ecology (RCW 90.03.386(2)).

Water right certificates issued before September 9, 2003, for municipal water supply purposes were often based on system capacity rather than full perfection of the water right by placing the water to beneficial use. These are known as "pumps and pipes" certificates, and the MWL confirms that they were water rights "in good standing" (RCW 90.03.330(3)).

The MWL also added the definitions for "municipal water supplier" and "municipal water supply purposes" in RCW 90.03.015(3) and (4). Under RCW 90.03.330(2), Ecology is prohibited from revoking or diminishing a water right certificate for municipal water supply purposes unless the certificate was issued with ministerial errors or was obtained through misrepresentation. The only exceptions are for issuance of certificates following approval of water right change or transfer applications and in the context of general water rights adjudications.

The MWL also imposed new conservation and use efficiency requirements on municipal water suppliers to ensure that the water resource is judiciously managed. The City of Arlington has embraced these efforts, including metering of all sources and services, engaging the public in goal setting, limiting the amount of unaccounted for water, and implementing conservation measures (see **Appendix E**, Water Use Efficiency). In addition, water use efficiency is a key component of

the Integrated Water Resources Management Program (IWRMP) included for the first time in this WSP (**Appendix I**).

A June 11, 2008, King County Superior Court decision held 3 of 12 sections of the MWL were unconstitutional and in violation of the doctrine of separation of powers. Ecology issued "Interim Guidance" on the MWL pending the outcome of this litigation, and then rescinded that document after the Washington State Supreme Court upheld the entire MWL as facially constitutional. This WSP was completed with full recognition and implementation of the MWL provisions upheld by the Supreme Court in October 2010.

Stillaguamish Instream Flow Rule

On August 26, 2005, Ecology adopted the Stillaguamish Instream Flow Rule (IFR) as a water management program to guide water management decisions in the Stillaguamish River basin (WRIA 5). It became effective September 26, 2005. Both of the City's production sources—the Haller well field and the Airport well field—are within the Stillaguamish basin and subject to the IFR. (It is important to note that although some documents exist which reference the Airport well field as being within the Quilceda Creek/Snohomish River basin [WRIA 7], the presence of a groundwater divide near the south end of the City—distinct from the surface divide near 188th Street—places all or nearly all of the well field in the Stillaguamish basin.)

Major provisions of the IFR include:

- declaring the appropriation of any previously unappropriated waters to instream values (streams received their own water right);
- prohibiting the appropriation of all surface and ground waters through new water rights for consumptive and/or out-of-stream uses (referred to as closing the basin);
- establishing minimum stream-flows for various river segments and tributary streams necessary to protect the resources that depend on flowing water (quantifying the water rights of the streams);
- establishing exceptions to these provisions through:
    - unquestioned reservations of limited quantities of water for:
        - permit-exempt wells for individual homes,
        - stockwatering, and
        - lakes; and
    - changes to existing water rights only to the extent that any impairment (reduction) of instream flows is fully mitigated.

The Stillaguamish IFR affects the City of Arlington because no reservation or other provision is made for the future urban population to be served by its water utility. Further, the closure of the

basin to new appropriations which would impact streams and rivers and the groundwaters connected to them constrains the water supply alternatives, even innovative ones, available to the City. Nearly any alternative for additional water will require mitigation of impacts to instream flows through the "retiring" of a like amount of water. In other words, an increase of 100 gallons of water for municipal supply within the basin would require that the beneficial use of 100 gallons for another purpose be retired.

6.3.2 Water Rights Portfolio

The City's water rights portfolio includes eight water rights for its Airport and Haller Wellfields and the Stillaguamish River established for conventional municipal supply, such as potable domestic uses, manufacturing, and fire flows. Three water right transfers that were pending in the previous WSP have been successfully completed, and these certificates are included as existing water rights in this WSP. The portfolio also includes three water rights it holds to meet other municipal supply purposes on city-owned properties, such as cemetery irrigation, irrigation of a constructed wetland and park, and turf farm irrigation within an industrial/business park in the airport flight zone. One other existing application for a new water right, filed prior to the passage of the Stillaguamish Instream Flow Rule (Chapter 173-505 WAC) in September 2005, remains pending. **Table 6-1** presents a comprehensive overview of all water rights, and refers to subsequent tables with details for existing potable, pending potable, and other water rights the City holds.

6.3.3 Existing Water Rights for Potable Supply

The City currently holds seven water right certificates and one water right claim for its sources of municipal water supply for potable uses including domestic, manufacturing, and fire. These documents are provided in **Appendix K**. Existing sources utilized by the City to provide water supply to its distribution system include the Airport and Haller Wellfields. As described previously, the MWL assures these water rights apply to the City's water service area (WSA) as it may expand or be modified from time to time. Even though the place of use on these water right documents may indicate "City of Arlington" or some other location, they are tied to the service area shown in the City's most recent approved water system plan. A summary of the water rights information is presented in **Table 6-2**. All were recognized by Ecology as active, 100-percent consumptive, out-of-stream uses when they quantified minimum instream flows in the Stillaguamish Instream Flow Rule in 2005.

Airport Wellfield

Two water rights have been issued to the City with the point of withdrawal being the Airport Wellfield. These water rights are Ground Water Certificate (GWC) 5170 and Ground Water Certificate G1-24900C. GWC 5170 was granted with a priority date of February 12, 1965, for a maximum instantaneous withdrawal rate of 200 gpm and an annual volume of 320 acre-feet. Though the City inherited three or four wells when it re-acquired the airport from the military, this water right applied to what was then known as Navy Well No. 3. In 1986, Ecology approved water

right G1-24900C, which increases the withdrawal rate and volume from the Airport Wellfield to a combined total of 580 gpm and 696 acre-feet per year with the caveat that the additional annual amount was non-additive to existing rights (**Table 6-2**). This increases annual withdrawal at the airport from 320 to up to 696 acre-feet as long as total annual withdrawal at Haller Wellfield is up to 376 acre-feet less than the sum of annual amounts on all Haller water rights. The City sees this flexibility as a valuable tool in the future of its IWRMP.

Haller Wellfield

The water right held by the City with the earliest priority date, October 10, 1924, is surface water certificate SWC 194 (also known as the PSPL right). The water right pre-dates regulation of groundwater in Washington State. It was applied to a well collecting seepage from the Stillaguamish River via riverbank filtration. For a period of time, the well was augmented by water directly from the river by a pipe, but the well operated as the Town's supply prior to that time, and the City continues to use the same well today. PSPL includes authorized withdrawals up to 5 cfs continuously, and as a surface water right, has provided the City with a large inchoate source of supply. Ecology validated SWC 194 in its Administrative Order 11WRNR—DE 7563 in 2011, both of which are included in **Appendix K**.

The history of the PSPL water right is complex and is briefly summarized here. In the early 1960s, following the construction of Haller Wells No. 1 and No. 2 immediately adjacent to the original Haller Well (aka No. 3), the City consulted the State regarding water rights. Groundwater certificate GWC 5169 was issued with a priority date of February 12, 1965, authorizing 1,700 gpm instantaneous withdrawal, and an annual volume of 1,344 acre-feet. However, having failed to recognize PSPL, the State made an administrative error in issuing GWC 5169. In 2011, the Department of Ecology corrected this error with Administrative Order 11WRNR—DE 7563. The Order maintained the City's holding of both water rights, but converted GWC 5169 to non-additive quantities as shown in **Table 6-2**. Effectively, GWC 5169 serves a protective function for the City when water rights in the Stillaguamish basin are adjudicated. A more detailed history of the PSPL water right is also provided in **Appendix K**.

The City has acquired four additional water rights for the Haller wellfield. All were originally primarily irrigation rights converted to municipal supply upon transfer to the City. Three of the four transfers were still pending in the previous WSP, but were approved for inclusion in the City's portfolio in 2012.

In 2009, a portion of the split Klein water right claim 300889CL(A) provided the City 135 gpm to be withdrawn instantaneously and 72.18 acre-feet of water to be withdrawn on an annual basis (**Table 6-2**). Priority date is March 1931. A maximum of 68.94 acre-feet of this annual water right is to be withdrawn between March 1st and September 30th. The remaining 3.24 acre-feet may be withdrawn year-round.

Table 6-1
City of Arlington Comprehensive Water Rights Portfolio[a]

For Additional Details, See		Surface or Ground Right	Water Right Type	Water Right Number	Current Use	Season of Use	Name, Originally Issued to	Priority Date	Status	Existing (or Target) Use at Wellfield	Existing Water Rights				Acreage (Irrigation Only)
											Instantaneous		Annual		
Table No.	Table Subject										Additive (gpm)	Non-Additive (gpm)	Additive (acre-feet)	Non-Additive (acre-feet)	
6-2	Existing	Ground	Certificate	GWC 5170	Municipal	Year-round	City of Arlington	2/12/1965	In-hand	Airport	200	--	320.00	--	--
6-2	Existing	Ground	Certificate	G1-24900C	Municipal	Year-round	City of Arlington	9/17/1986	In-hand	Airport	380	--	--	376.00	--
6-2	Existing	Surface	Certificate	SWC 194	Domestic	Year-round	Puget Sound Power & Light	10/10/1924	In-hand	Haller	2,244	--	3619.84	--	--
6-2	Existing	Ground	Claim	Claim 300889CL(A)	Municipal	Seasonal[b]	Don Klein	3/1/1931	In-hand	Haller	135	--	72.18	--	--
6-2	Existing	Surface	Certificate	SWC 5983	Municipal	Year-round	Sill (Graafstra)	8/30/1951	In-hand	Haller	112	--	49.09	--	--
6-2	Existing	Ground	Certificate	GWC 1488	Municipal	Interruptible[c]	Robertson (Neunzig)	9/4/1951	In-hand	Haller	90	--	40.00	--	--
6-2	Existing	Surface	Certificate	SWC 10024	Municipal	Interruptible[c]	Foerester (Graafstra)	3/29/1965	In-hand	Haller	269	--	122.72	--	--
6-2	Existing	Ground	Certificate	GWC 5169	Municipal	Year-round	City of Arlington	2/12/1965	In-hand	Haller	--	1,700	--	1344.00	--
6-3	Pending	Ground	Application	G1-26641C	Municipal	Year-round[d]	City of Arlington	7/7/1992	Cost Reimbursement - Phase 1 complete	(Airport)[e]	900	--	850.00	--	--
6-4	Other	Ground	Certificate	G1-23085GWRIS	Irrigation	Seasonal[b]	Green Valley Turf Farms	4/17/1978	In-hand	(Airport)[e]	150	--	80.00	--	140
6-4	Other	Ground	Certificate	GWC 02968	Irrigation	Seasonal[b]	Hammer	4/9/1952	In-hand	(Haller)[e]	156	--	30.00	--	26
6-4	Other	Ground	Certificate	GWC 02401	Irrigation	Seasonal[b]	Arlington Cemetery	4/20/1955	In-hand	(Haller)[e]	150	--	60.00	--	30

[a] This table provides a summary of all water rights actively managed by the City of Arlington. Not all provide potable water, but all are managed with the anticipation of providing potable water.

[b] Water right is available only during the irrigation season, which may be specifically defined in the water right. The Klein right has a small continuous withrawal component.

[c] Water right is available year-round except when flow-limited during low flows the winter season. The Foerester right has a small continuous withrawal component.

[d] Application is for year-round use. If awarded, use of the water right would require mitigation or would be flow-limited during the entire year.

[e] Where current use is irrigation, the water right is managed for eventual transfer to the intended point of withdrawal shown. Application G1-26641 is intended for use at the Airport wellfield.

This page blank for formatting and duplex printing.

Table 6-2

Existing Water Rights for Potable Supply

DOH No.	Water Right Number	Priority Date	Surface or Ground Right	Existing Water Rights			
				Instantaneous		Annual	
				Additive (gpm)	Non-Additive (gpm)	Additive (acre-feet)	Non-Additive (acre-feet)
Airport Wellfield							
S04	GWC 5170	2/12/1965	Ground	200	---	320.00 [a]	---
S04	G1-24900C	9/17/1986	Ground	380	---	---	376.00 [a]
Total Airport Wellfield Potable Supply Water Rights				**580**	**0**	**320.00**	**376.00**
Haller Wellfield							
S05	SWC 194 (aka PSPL)	10/10/1924	Surface	2,244 [b]	---	3,619.84 [b]	---
S05	Claim 300889CL(A) (aka Klein)	3/1/1931	Ground	135	---	72.18 [c]	---
S05	SWC 5983	8/30/1951	Surface	112	---	49.09	---
S05	GWC 1488	9/4/1951	Ground	90 [d]	---	40.00 [d]	---
S05	GWC 5169 [e]	2/12/1965	Ground	---	1,700	---	1,344.00
S05	SWC 10024	3/29/1965	Surface	269 [f]	---	122.72 [f]	---
Total Haller Wellfield Potable Supply Water Rights				**2,850**	**1,700**	**3,903.83**	**1,344.00**
Total Potable Supply Water Rights				**3,430**	**1,700**	**4,223.83**	**1,720.00**
Subset of these rights that are interruptible October 1 to April 15				334 [d,f,g]	---	151.12 [d,f,g]	---
Subset of these rights that are interruptible October 1 to February 29				n/a	---	68.94 [c]	---
Subtotals for interruptible water rights				334 [g]	---	220.06 [g]	---
Subtotals for interruptible water rights (percent of column totals)				9.7%	---	5.2%	---

(a) The Airport Wellfield includes a primary water right of 320 acre-feet of water (under GWC 5170) and an additional 376 acre-feet of water (under G1-24900C), which *can* be withdrawn at this location but must be counted towards the City's total annual allotment of water.

(b) The water right certificate specifies an instantaneous rate of 5.0 cfs, and does not specify an annual quantity. Administrative order 11WRNR quantifies the certificate as 2,244 gpm and 3,619.84 ac-ft.

(c) The City did not apply for a change in season of use when transferring this water right. Based on the original array of beneficial uses, a maximum of 68.94 of 72.18 ac-ft of this water is to be withdrawn seasonally (March 1 through September 30). The remaining 3.24 acre-feet and the 135 gpm withdrawal rate may be applied year-round.

(d) All 40 acre-feet may be withdrawn continuously (at a maximum of 90 gpm) April 16 to September 30, or it may be considered interruptible during the intervening period when the mainstem Stillaguamish River drops below established minimum flows (2,000 to 2,200 cfs).

(e) Administrative order 11WRNR, dated November 30, 2011, identified that GWC 5169 was issued in error. The City operates its Haller well field under SWC 194 (aka PSPL). The City holds GWC 5169 in "reserve", and the water quantities are non-additive.

(f) 11.6 of 122.72 ac-ft is continuous all year, whereas 111.12 ac-ft is continuous 4/16 to 9/30, and interruptible from 10/1 to 4/15; 25 of 269 gpm is continuous all year, whereas 244 gpm is continuous 4/16 to 9/30, and interruptible from 10/1 to 4/15. See notes (d), (g).

(g) GWC 1488 and SWC 10024 sum to 40+111.12 = 151.12 ac-ft of interruptible water when the mainstem Stillaguamish River drops below established minimum flows (2,000 to 2,200 cfs) between October 1 and April 15. Adding 68.94 ac ft for 300889CL(A) results in 220.06 ac-ft of water rights that are interruptible--all of which fall outside the peak summer season. For instantaneous demands, GWC 1488 and SWC 10024 reduce total Qi by 90+244=334 gpm when the river is limited as described in this footnote.

Floyd Sill's surface water certificate SWC 5983 provides the City with 112 gpm and 49.09 ac-ft of water without restriction. The priority date is August 30, 1951 (**Table 6-2**). The City obtained this water right upon its purchase of Henry Graafstra's Country Charm Dairy in 2010. Similar to the City's use of the PSPL surface water right in the operation of the Haller wellfield, Graafstra had implemented a *de facto* change by converting the surface water diversion to withdrawal from a riverside well.

GWC 1488 authorizes the City to withdrawal an annual volume of 40 acre-feet at a maximum rate of 90 gpm; (**Table 6-2**). The priority date is September 4, 1951. Originally issued to P. Robertson, the City purchased and transferred the water right from Linda Neunzig dba Ninety Farms. Despite its earlier priority date, the water right is subject to interruption between October 1 and April 15 when flows in the mainstem Stillaguamish River at I-5 drop below 2,000 cfs to 2,200 cfs. The City's overall portfolio is immediately reduced by the stated quantities whenever the flow-based interruptions may occur.

Gordon Foerester's surface water certificate SWC 10024 was obtained from Henry Graafstra at the same time as the Sill water right. The maximum rate of withdrawal is 269 gpm; annual volume is limited to 122.72 acre-feet (**Table 6-2**). The priority date is March 29, 1965. Similar to GWC 1488, the water right is interruptible—but only partially so—between October 1 and April 15 when flows in the mainstem Stillaguamish River at I-5 drop below 2,000 cfs to 2,200 cfs. Under these conditions the City's overall portfolio is immediately reduced by 244 gpm and 111.12 ac-ft.

In all, up to 3,903.83 ac-ft of water may be withdrawn from the Haller Wellfield at an instantaneous rate of 2,850 gpm. Combined with water rights for potable use at the airport, the City has a total water rights portfolio providing 4,223.83 ac-ft of water at a maximum rate of 3,430 gpm. As shown in **Table 6-2**, these quantities may be reduced when the instream flow requirements described above are not met. The instantaneous rate is reduced by 334 gpm (nearly 10%) to 3,096 gpm. The annual quantity would be reduced by up to 220.06 ac-ft (more than 5%) to 4003.77 ac-ft if minimum instream flows between October 1 and April 15 were never met.

Additional water rights information for each source may be found on the certificates and permits, which are included in **Appendix K**.

6.3.4 Pending Water Rights for Potable Supply

In addition to the water rights secured above, the City continues to pursue other water rights opportunities where they may advantageous to the City. A summary of pending water rights information is presented in **Table 6-3**.

Table 6-3

Pending Water Rights for Potable Supply

DOH No.	Water Right Number	Priority Date	Surface or Ground Right	Existing Water Rights: Instantaneous Additive (gpm)	Existing Water Rights: Annual Additive (acre-feet)
Airport Wellfield					
S04	G1-26641	7/7/1992	Ground	900	850.00
Total Pending at Airport Wellfield				**900**	**850.00**
Total Pending Potable Supply Water Rights				**900**	**850.00**

Airport Wellfield

In 1992, the City applied for a water right to develop a new well source on the Airport Wellfield (Application G1-26641, with priority date July 7, 1992). The application requests 900 gpm and 850 acre-feet per year of water for conventional potable supplies (**Table 6-3**). Ecology issued a preliminary permit (G1-26641) to the City, who drilled an investigative well to evaluate the aquifer. Results were promising, though water quality testing indicated manganese treatment would be required. In 2007, the City initiated the cost reimbursement process for review of this application. Phase 1 was successfully completed. No other competing water right applications are senior to the City, and Ecology approved modification of the City's application to include production from up to three wells, rather than one well. However, Ecology has determined that a new groundwater withdrawal at this location would require mitigation for impairment to the 2005 Stillaguamish IFR. A satisfactory mitigation plan will address the impacts of the quantities, timing, and location of the water right. In addition, hydrogeologic evaluation indicated that an east-west groundwater divide in the proximity of 172nd Street and very close to the proposed well site had not been located with confidence, and that development of the well might impair tributaries in the south-trending Quilceda Creek basin, which were closed by Surface Water Source Limitation (SWSL) in about 1945. This complication resulted in a delay in initiating cost reimbursement phase 2.

However, the City has always intended that under this application it would appropriate Stillaguamish basin water. To do so with the least amount of effort, the proposed points of withdrawal would need to be moved further north onto the airport and away from the groundwater divide between the Stillaguamish and Quilceda/Snohomish basins. Amending the 1992 application to do so would require re-advertisement of the public notice, and a mitigation proposal to counter impairment under the Stillaguamish IFR. The 1992 priority date should not be affected. The amended application could be immediately evaluated under phase 2 of the cost reimbursement program. Whether the City moves forward with this water right in this or some other fashion will

likely be decided in the near future. See the discussion under Long-Term Water Supply Planning later in this chapter.

Haller Wellfield

No water right acquisitions for the Haller Wellfield, including new applications and transfers, are currently being pursued at this time. Three water rights identified as pending for transfer to the Haller Wellfield in the previous WSP have been approved. They are addressed earlier in this chapter with other existing water rights.

6.3.5 Existing Water Rights for Other Municipal Supply Purposes

The City currently holds three groundwater right certificates under which water is used to meet municipal water supply purposes other than conventional potable supplies. These water rights are appurtenant to city-owned properties and critical to the achievement of specific objectives the City has for these parcels. These three water rights are used for beneficial uses generally associated with the use of water within a municipality, which meet the definition of "municipal water supply purposes" under RCW 90.03.015(4). A summary of the water rights information is presented in **Table 6-4**.

Table 6-4

Existing Water Rights for Other Municipal Supply Purposes

DOH No.	Water Right Number	Priority Date	Surface or Ground Right	Use	Existing Water Rights: Instantaneous Additive (gpm)	Existing Water Rights: Annual Additive (acre-feet)	Acreage (acres)
Airport Wellfield							
S04	G1-23085GWRIS	4/17/1978	Ground	Irrigation	150	80.00	140
Total Existing Airport Wellfield Other Uses Water Rights					**150**	**80.00**	**140**
Haller Wellfield							
S05	GWC 02968	4/9/1952	Surface	Irrigation	156	30.00	26
S05	GWC 02401	4/20/1955	Surface	Irrigation	150	60.00	30
Total Existing Haller Wellfield Other Uses Water Rights					**306**	**90.00**	**56**
Total Existing Other Uses Water Rights					**456**	**170.00**	**196**

The City's intent in this water right self-assessment is to formally conform these water rights as rights for municipal water supply purposes pursuant to RCW 90.03.560. In addition, long-term demand identified in this WSP indicates opportunities to change the beneficial use of these water rights from irrigation to potable supply. The City's Water Reclamation Facility produces Class A Reclaimed Water, and its NPDES permit authorizes re-use of the reclaimed water (currently limited to irrigation of a constructed treatment wetland). The IWRMP identifies the opportunity to change/transfer the irrigation rights discussed here for potable supply in exchange for the distribution (now or at a future time) of reclaimed water to these locations for irrigation.

This same intent was expressed in the previous WSP, but conforming documents for these water rights were ultimately not issued—perhaps due to confusion over ownership. RCW 90.03.560 indicates that water right documents may be amended "to ensure that water rights that are for municipal water supply purposes, as defined in RCW 90.03.015, are correctly identified as being for municipal water supply purposes." It does not specify that the rights needed to be originally issued to a municipality, simply that they are held by the municipality. RCW 90.03.015 defines "municipal water supply purposes", in part, as a City's beneficial use of water for "governmental proprietary purposes". It then clearly provides examples of beneficial uses considered as meeting municipal water supply purposes, including "irrigation of parks and open spaces".

Municipal corporations serve a proprietary function when they enter into business ventures or perform discretionary acts in the best interests of its citizens. This is what is occurring when the City of Arlington provides burial services in its cemetery, stormwater treatment and open space functions in its Old Town Wetland, or commercial turf farming on otherwise unusable lands in its airport runway protection zones. All of these proprietary functions occur on properties held in fee simple ownership by the City, and involve water use authorized under water rights attached to those properties.

Cemetery Well

The Arlington Cemetery holds GWC 2401 for irrigation of 30 acres of lawn. The maximum rate of withdrawal from a dug well is 150 gpm; annual volume is limited to 60 acre-feet (**Table 6-4**). The priority date is April 20, 1955.

The groundwater right was initially issued to the Arlington Cemetery. Title transferred to the City of Arlington when the City purchased the cemetery. The City Council and the Cemetery Advisory Board place high value on the aesthetics of the cemetery, which is situated on gravelly, sandy loam soils. Accordingly, the City has historically irrigated all of its developed and utilized areas from Memorial Day to fall each year.

The cemetery was formerly irrigated by hand lines and a big gun maneuvered between various connections on a piecemeal irrigation system. Begun in 2010, the City completed upgrade of its entire irrigation system to include new distribution mains, laterals and numerous *in situ* sprinkler heads. The City also installed in 2013 nearly 5,000 feet of trunk line ("purple pipe") for the conveyance of reclaimed water to the cemetery and other locations with potential for reclaimed water use. This is about 50% of the total length necessary to re-use reclaimed water at the cemetery.

Hammer Well

The City of Arlington also holds GWC 2968, originally issued to Curtis Hammer for irrigation of 26 acres of pasture from a dug well. The maximum rate of withdrawal is 156 gpm; annual volume is limited to 30 acre-feet (**Table 6-4**). The priority date is April 9, 1952.

The City purchased the Hammer property in 2000 for purposes of constructing a wetland for the treatment of otherwise untreated stormwater from 280 acres of Old Town Arlington. Initially, the City leased the parcel for continued agricultural production of silage and hay. Construction of the unlined wetland was begun in 2010 and completed in August 2011. The wetland also includes walking trails, educational signage, educational facilities, and other open space as an extension of Haller Park from the east. The well is used to irrigate and maintain the sinuous "hills" and swales of the wetland during summer months when stormwater runoff is limited. The water reclamation facility is located due east of the wetland, across SR9. With a reclaimed water permit in hand, flood irrigation of the wetland using reclaimed water may begin replacing use of the well in 2015. Application for transfer of the Hammer water right to the Haller Wellfield is anticipated to occur shortly thereafter.

Airport Turf Farm Well

The City of Arlington holds G1-23085 originally issued to Green Valley Turf Farms for irrigation of 140 acres of turf (as a sod farm) at the Arlington municipal airport. The maximum rate of withdrawal is 150 gpm; annual volume is limited to 80 acre-feet (**Table 6-4**). The priority date is April 17, 1978.

In addition to flight facilities and operations, the City of Arlington Municipal Airport includes numerous parcels leased as part of an industrial center and business park. This water right was first issued to Green Valley Turf Farms for irrigation of a turf farm on property owned by the City immediately north of 172nd Street. After a number of years of operation immediately adjacent to runways with low vertical clearance requirements, the Federal Aviation Administration (FAA) ordered the City to discontinue turf farm locations on that site for safety reasons. Airport staff and lessees initiated *de facto* changes by moving the points of withdrawal and place of use to 53 acres immediately south of 172nd Street, approximately 50 to 1,500 feet south of the original location. Soils on the site are a complex of Lynnwood loamy sand and Custer fine sandy loam, and irrigation use has remained consistent despite this change. A review of the water right during this self-assessment clarified the *de facto* changes and identified the need to submit a change application to conform the authorized and actual point of withdrawal and place of use for this water right. When reclaimed water becomes available to the turf farm, or if turf farm operations are discontinued, the City anticipates transferring this water right to the Airport Wellfield.

6.3.6 Wholesale Water Purchases

The City entered into a Wholesale Water Agreement with PUD No. 1 of Snohomish County on June 15, 1998. The agreement has been amended on occasion to provide each of five annual increments of 200 gpm up to 1000 gpm at a master meter at the boundary between service areas along Burn Rd. It established the bases for initial water rates and general facilities charges (GFCs), and for increases to these costs. The City clarified its intent to continue use of its existing sources, and agreed to not use PUD water to solely meet peaks. The PUD agreed to maintain the quality, quantity, pressure, reliability of its water supply. The term of the Agreement is "through 2018 and

thereafter unless terminated by mutual agreement or upon 5-year written notice by either party". Conversations with the PUD, have confirmed the intent of both parties to maintain the agreement indefinitely.

Late in the decade of the 2000s, the City reached its maximum reliance on the PUD source. Average day demands ranged between 350 and 400 gpm, and in 2009 the City placed a maximum day demand of 656 gpm on the PUD. The City's 2011 Water Supply Study demonstrated the economic benefit to the City of relying more heavily on its own production sources. Since then, the City has drawn between 50 and 110 gpm from the PUD.

The PUD delivers filtered and disinfected surface water from the City of Everett's Spada Reservoir on the Sultan River to Arlington. This is an inter-basin transfer of water and is considered a "foreign flow" to the Stillaguamish Basin. Foreign flows can provide creative opportunities in the context of the City's IWRMP, including as mitigation for impairments that may be created by the issuing of new water rights.

6.3.7 Water Supply Evaluation

An evaluation of the City's existing water rights and wholesale purchase agreement was performed to determine the sufficiency of the water rights to meet both existing and future water demands. **Table 6-5** compares the total instantaneous water right amounts of the sources with the maximum day demand of the system. It also compares the total annual water right amounts of the sources with the average day demand of the system. As shown in **Table 6-5**, the City has sufficient water rights (both instantaneous and annual) to meet the current demands of existing customers.

Table 6-5

Existing Water Supply Evaluation

Description	Instantaneous Rights/ Maximum Day Demand (gpm)	Annual Rights/ Average Day Demand (acre-feet)	Annual Rights/ Average Day Demand (gpm)
Available Water Supply			
Total Water Rights	3,430	4,223.83	2,618
PUD Wholesale Supply Source	1,000	1,612.90	1,000
Totals	4,430	5,836.73	3,618
Required Supply			
Existing (2014) Water Demand	1,912	1,761.41	1,092
Surplus or Deficient Water Supply			
Surplus (or Deficient) Supply	2,518	4,075.33	2,526

Table 6-6 summarizes the results of the future water rights evaluation, which compares the water rights of the existing sources with the future 6-, 10-, 20-, and 50-year demand projections of the system. The analysis considered future demand projections first without (**Table 6-6a**) and then with additional water use reductions from planned water use efficiency efforts (**Table 6-6b**). The City has sufficient instantaneous and annual water rights to meet the projected average day and maximum day demands for nearly 50 years. Deficits are projected in year 50 (2064) for maximum day demand, even with conservation. However, the deficits are based on assumed, sustained population growth rates. And if they are indeed realistic, the unmet demands are at a scale such that they can be corrected using plumbing improvements, efficiency practices and additional storage facilities.

Table 6-6a

Future Water Supply Evaluation Without Conservation

Description	Instantaneous Rights/ Maximum Day Demand (gpm)	Annual Rights/ Average Day Demand (acre-ft)	Annual Rights/ Average Day Demand (gpm)
Year 2020 (6-year) Without Conservation			
Total Water Rights	3,430	4,223.83	2,618
PUD Wholesale Supply Source	1,000	1,612.90	1,000
Projected (2014) Water Demand	2,097	1,932.39	1,198
Surplus (or Deficient) Supply	**2,333**	**3,904.35**	**2,420**
Year 2024 (10-year) Without Conservation			
Total Water Rights	3,430	4,223.83	2,618
PUD Wholesale Supply Source	1,000	1,612.90	1,000
Projected (2024) Water Demand	2,338	2,154.98	1,336
Surplus (or Deficient) Supply	**2,092**	**3,681.75**	**2,282**
Year 2034 (20-year) Without Conservation			
Total Water Rights	3,430	4,223.83	2,618
PUD Wholesale Supply Source	1,000	1,612.90	1,000
Projected (2034) Water Demand	2,996	2,761.47	1,712
Surplus (or Deficient) Supply	**1,434**	**3,075.26**	**1,906**
Year 2064 (50-year) Without Conservation			
Total Water Rights	3,430	4,223.83	2,618.00
PUD Wholesale Supply Source	1,000	1,612.90	1,000.00
Projected (2064) Water Demand	4,651	4,285.77	2,657.00
Surplus (or Deficient) Supply	**(221)**	**1,550.97**	**961.00**

Table 6-6b

Future Water Supply Evaluation With Conservation

Description	Instantaneous Rights/ Maximum Day Demand (gpm)	Annual Rights/ Average Day Demand (acre-ft)	Annual Rights/ Average Day Demand (gpm)
Year 2020 (6-year) With Conservation			
Total Water Rights	3,430	4,223.83	2,618.00
PUD Wholesale Supply Source	1,000	1,612.90	1,000.00
Projected (2020) Water Demand	2,069	1,906.58	1,182.00
Surplus (or Deficient) Supply	**2,361**	**3,930.15**	**2,436.00**
Year 2024 (10-year) With Conservation			
Total Water Rights	3,430	4,223.83	2,618.00
PUD Wholesale Supply Source	1,000	1,612.90	1,000.00
Projected (2024) Water Demand	2,307	2,125.95	1,318.00
Surplus (or Deficient) Supply	**2,123**	**3,710.79**	**2,300.00**
Year 2034 (20-year) With Conservation			
Total Water Rights	3,430	4,223.83	2,618.00
PUD Wholesale Supply Source	1,000	1,612.90	1,000.00
Projected (2034) Water Demand	2,956	2,724.37	1,689.00
Surplus (or Deficient) Supply	**1,474**	**3,112.36**	**1,929.00**
Year 2064 (50-year) With Conservation			
Total Water Rights	3,430	4,223.83	2,618.00
PUD Wholesale Supply Source	1,000	1,612.90	1,000.00
Projected (2064) Water Demand	4,588	4,229.31	2,622.00
Surplus (or Deficient) Supply	**(158)**	**1,607.42**	**996.00**

6.4 LONG-TERM WATER SUPPLY PLANNING

6.4.1 Beyond the Projections

Despite the favorable outlook derived from projections of system-wide water supply, numerous other factors facing the City are influencing supply-side decision making. These are summarized below.

- Water rights
    - Washington State statutes are clear that determinations of the extent and validity of existing water rights are tentative, as final decisions can only be made by Superior Courts through general adjudication of water rights.
    - The interruptibility of the City's water rights was not considered in the evaluations in Table 6-5 and Table 6-6. As shown in Table 6-2, up to 334 gpm (10 percent) of the City's facial instantaneous rate and up to 220.06 ac-ft (5 percent) of the City's facial annual allocation may be reduced when the instream flow requirements described above are not met.
    - The unit costs of finished water from each source has not been considered in the supply analysis. In addition, other water rights in the City's portfolio have economic and environmental values that need to be carefully managed. See Sections 6.3.4 and 6.3.5.
- Water quality
    - Source water quality is a critical concern for potable supplies. The high and moderate susceptibility of the Haller and Airport Wellfields, respectively, make protection of paramount concern. Potential for contamination at the Airport Wellfield was marked by the possible detection of 1,4-dioxane during UCMR3 monitoring.
    - The Airport Wellfield occupies a former military base and is surrounded by the City's industrial area.
- Declining infrastructure and aquifer condition
    - Efforts in 2012 to rehabilitate the Haller Wellfield and regain some lost productivity from wells that are greater than 50 and greater than 100 years old were unsuccessful.
    - Successive structural failures in the casing of the only production well in the Airport Wellfield have resulted in repeated raising of the pump from a depth of 185 feet bgs to about 110 feet bgs.

- Regulatory requirements
    - Revisions to the Skagit Instream Flow Rule occurred somewhat concurrent with the development of the Stillaguamish Instream Flow Rule, resulting in numerous similarities between the two rules. At least one subbasin in the Skagit Basin which borders the Stillaguamish basin divide has been found to be without water and a moratorium has been placed on development of its lands. This has caused some confusion and concern over the status of these and other instream flow rules where reservations were created while the basins were closed to new appropriations.
    - Case law is growing more complex as court decisions involving water resources increase. Numerous water-related bills are introduced by the legislature each year, and some are enacted into law. The Stillaguamish has been referenced in more than one bill, in part because its instream flow rule was not promulgated through the watershed planning process adopted as RCW 90.82 in 1998.
- Energy requirements
    - The distribution of water from the City's sources to its reservoirs and between its pressure zones requires water to be pumped at significant cost. Only the smaller 540 and 710 zones facilitate the gravity flow of water purchased from the PUD. Alternative sources and source locations could help reduce the utility's energy dependence.
- Changes in WSA
    - The growth of the City—particularly expansion west of I-5—presents new needs and new opportunities for situating sources and designing distribution networks to best serve these areas.

6.4.2 Identification of Alternative Sources

Concurrent with the publication of this WSP (2015), the City is beginning a dedicated effort to identify additional and/or alternative water sources that would address as many of the concerns identified above as possible. A diversity of sources will assure the reliable and sustainable production of potable water in the City's WSA and in the Stillaguamish basin.

6.4.3 Water Rights

In 2006, the City retained West Water Research to conduct an evaluation of water rights available to the City for purposes of municipal supply and mitigation. The assessment process screened 2,490 water rights in the Stillaguamish and Quilceda basins. A total of 131 water rights met aerial photo and field review criteria established by the City. The final evaluation report then identified 16 high priority and 59 medium priority water rights for potential transfer to either the Haller or Airport Wellfield (or for mitigation). The City has investigated several of these 75 potentially transferable water rights consistent with capital funding availability. All four of the water rights transfers discussed earlier were identified through this process. Effective with this WSP, the City

is reducing its water right acquisition efforts to an opportunistic approach. Rather than broadly identify water rights acquisition as a separate line item in the capital improvements schedule for the Water Department, water rights are included with the development of specific alternative water sources in **Chapter 9**.

6.4.4 Integrated Water Resources Management

To best meet the 50-year future demand projections, the water rights identified in this WSP must be available for municipal water supply purposes. Programmatic efforts to improve water use efficiency and adaptively manage the City's water resources also need to be successful. Finally, alternative sources may need to be developed, including production wells and the optional purchase of wholesale water supplies from the PUD in excess of its current 1,000 gpm contract.

The City will strive to continue to use its existing water sources efficiently by continuing the current water conservation measures and implementing proposed measures outlined in the City's Water Use Efficiency Program, which is included in **Appendix E**.

The City's Integrated Water Resources Management Program (IWRMP) was prepared as part of the prior WSP in **Appendix I**. The IWRMP initiates a program to integrate the management of the City's multiple water uses within the framework of the natural climate, water resources and other water uses of the Stillaguamish and Quilceda basins. The IWRMP develops policies and actions to flexibly manage the City's water resources to improve long-term water availability, reliability and environmental quality in a cost-effective manner.

The City's water system currently has interties with the PUD. The PUD purchases water from the City of Everett's (Everett) raw water supply, which originates in the Spada Lake Reservoir created by the Culmback Dam on the Sultan River, approximately 30 miles east of Everett. As a regional water provider, Everett provides water to over 550,000 people in Snohomish County. It should be noted, however, that Everett may not meet its long-term water demand projections without the development of new water rights, including a pending 1954 application.

6.5 DRINKING WATER REGULATIONS

6.5.1 Overview

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

6.5.2 Existing Regulations

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

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

The EPA set two limits for each contaminant regulated under the rules. The first limit is a health goal referred to as the Maximum Contaminant Level Goal (MCLG), at which no known or anticipated adverse effect on the health of persons would occur, and which allows an adequate margin of safety. The MCLG is zero for many contaminants, especially known cancer-causing agents (carcinogens), because it is assumed that any amount of exposure may pose some risk of cancer.

The second limit is a legal limit referred to as the Maximum Contaminant Level (MCL). MCLs are the enforceable, maximum permissible levels of contaminants in water which is delivered to any user of a public water system. Each MCL is set as close to (equal to or higher than) its MCLG as feasible. EPA determines an MCL as the level that may be achieved using the best available technology, treatment techniques, and other means which EPA finds are cost effective. A summary of each rule follows.

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

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

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

Phase I Rule

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

Phase II and IIb Rules

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

Phase V Rule

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

Surface Water Treatment Rule

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

with pristine sources that continuously meet stringent source water quality and protection requirements. The Haller Park Wellfield is classified as a GWI source and is subject to the SWTR. The City currently complies with all requirements under this rule.

Interim Enhanced Surface Water Treatment Rule

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

Long Term 1 Enhanced Surface Water Treatment Rule

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

Total Coliform Rule

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

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

The rule established the MCLG for total coliform at zero. To comply with the legal limit, systems must not find coliform in more than 5 percent of the samples taken each month. For smaller systems like the City's that take fewer than 20 samples per month, 1 sample that contains coliform would exceed the legal limit and trigger the follow-up sampling requirements. A copy of the City's Water Quality Monitoring Plan is contained in **Appendix H**. The City currently complies with all contaminant monitoring requirements under this rule. See also discussion of the Revised Total Coliform Monitoring Rule later in this chapter.

Lead and Copper Rule

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

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

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

Radionuclides Rule

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

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

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

Wellhead Protection Program

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

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

Consumer Confidence Report

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

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

Stage 1 Disinfectants/Disinfection By-products Rule

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

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

Compliance with this rule must have been satisfied by December 16, 2001 for large surface water systems (those serving over 10,000 people) and by December 16, 2003 for smaller surface water systems and all groundwater systems. The City complied with all contaminant monitoring

requirements under this rule. With the authorization of the subsequent Stage 2 D/DBP rule and the completion of a long term monitoring plan it required, the Stage 1 Rule no longer has an effect on the City's operations and drinking water quality.

Unregulated Contaminant Monitoring Rule

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

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

The City of Arlington was not large enough nor selected to participate in the first two cycles of the UCMR, though it has monitored some unregulated contaminants for a number of years. It participated for the first time in the third cycle of the Rule (UCMR3), which was authorized April 16, 2012. Between June 2013 and March 2014, quarterly or biannual water samples were collected from each source and a point of maximum residence time in the distribution system. Samples were analyzed for 21 contaminants ranging from naturally-occurring metals to pesticides, flame retardants, and pharmaceuticals. The City currently complies with all contaminant monitoring requirements under this rule.

Arsenic

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

further input. On October 31, 2001, the EPA reaffirmed the final rule as published on January 22, 2001. The Arsenic Rule subsequently became effective on February 22, 2002.

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

Filter Backwash Recycling Rule

The 1986 SDWA Amendments required the EPA to promulgate a regulation governing the recycling of filter backwash water within public water systems' treatment processes. Public water systems using surface water or groundwater under the direct influence of surface water that utilize filtration processes and recycling must comply with the rule. The rule aims to reduce risks associated with recycling contaminants removed during filtration. The EPA issued a proposed regulation on June 22, 2000, and allowed a 90 day public review period. The final rule was published in the Federal Register on June 8, 2001, and became effective on August 7, 2001.

The rule requires filter backwash water be returned to a location that allows complete treatment. In addition, filtration systems must provide detailed information regarding the treatment and recycling process to the State. The regulation requires water systems to have complied with the rule starting December 8, 2003 if filter backwash water was recycled.

From its inception in 2001 to November 18, 2014, the City's water treatment plant backwash was discharged to its wastewater treatment plant for recycling. Effective November 18, 2014, filtration backwash is discharged to one of two locations. The initial fractions (15 percent to 50 percent) of the various backwash cycles are laden with sediments, and these continue to be discharged to the wastewater facility for treatment. The remaining 50 to 85 percent of the backwash is dechlorinated, if needed, and discharged to a constructed treatment wetland to support wetland vegetation and recharge groundwater adjacent to the Stillaguamish River. The City currently complies with all requirements under this rule.

Stage 2 Disinfectants/Disinfection By-products Rule

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

Similar to the Stage 1 D/DBPR, this rule applies to most water systems that add a disinfectant to the drinking water other than ultraviolet light or those systems which deliver such water. The Stage 2 D/DBPR changes the calculation procedure requirement of the MCLs for two groups of

DBPs (TTHM and HAA5) by requiring each sampling location to determine compliance with MCLs based on their individual annual average DBP levels (termed the Locational Running Annual Average), rather than utilizing a system-wide annual average. The rule also proposes new MCLGs for chloroform (0.07 mg/L), trichloroacetic acid (0.02 mg/L) and monochloroacetic acid (0.03 mg/L).

Additionally, the rule requires systems to document peak DBP levels and prepare an Initial Distribution System Evaluation (IDSE) report to identify Stage 2 D/DBPR compliance monitoring sites. IDSEs require each water system to prepare a separate IDSE plan and report, with the exception of those systems who obtain a 40/30 Certification or a Very Small System (VSS) Waiver. In order to qualify for the 40/30 Certification, all samples collected during Stage 1 monitoring must have TTHM and HAA5 levels less than or equal to 0.040 mg/L and 0.030 mg/L, respectively. The first stage of the IDSE schedule required systems serving 100,000 or more people to submit IDSE plans by October 1, 2006. Systems serving 50,000 to 99,999 people had to submit IDSE plans by April 1, 2007, while systems serving 10,000 to 49,999 people had to submit plans by October 1, 2007. Systems serving fewer than 10,000 people had to submit an IDSE plan by April 1, 2008 if they did not qualify for 40/30 Certification or a VSS Waiver.

The City currently complies with all contaminant monitoring requirements under this rule and has completed its IDSE plan. When relying primarily on its local production sources (Haller and airport well fields), the City is eligible for the 40/30 Certification. Water purchased from the PUD can blend with the well sources and cause these levels to be exceeded. The City is currently documenting total organic carbon (TOC) concentrations in its distribution system for 12 consecutive months to demonstrate low levels of organics. With qualifying results for TTHM, HAA5, and TOC, the City anticipates it will be issued a 40/30 Certification in 2016.

Long Term 2 Enhanced Surface Water Treatment Rule

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

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

minimum 3-log inactivation of *Cryptosporidium*. All unfiltered systems are also required to utilize a minimum of two disinfectants in their treatment process.

The LT2ESWTR also addresses systems with unfinished water storage facilities. Under this rule, systems must either cover their storage facilities or achieve inactivation and/or removal of 4-log virus, 3-log *Giardia lamblia* and 2-log *Cryptosporidium* on a state-approved schedule. Lastly, the rule extends the requirement of the disinfection profiles mandated under the LT1ESWTR to the proposed Stage 2 D/DBPR. The City's Water Treatment Plant is currently in compliance with all requirements under this rule. Water samples will be analyzed for LT2ESWTR parameters again in 2016.

Groundwater Rule

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

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

1. Periodic sanitary surveys of groundwater systems that require the evaluation of eight critical elements and the identification of significant deficiencies (such as a well located near a leaking septic system). States must complete the initial survey for most community water systems by December 31, 2012, and for community water systems with outstanding performance and all non-community water systems by December 31, 2014. DOH conducted its most recent sanitary surveys of the City's water system in 2011 (all facilities outside of the WTP, including the airport well) and 2012 (WTP) under the state's existing sanitary survey program.

2. Source water monitoring to test for the presence of E. coli, enterococci or coliphage in the sample. There are two monitoring provisions.

    - Triggered monitoring for systems that do not already provide treatment that achieves at least 99.99 percent (4-log) inactivation or removal of viruses and that have a total coliform positive routine sample in the distribution system under the Total Coliform Rule.

    - Assessment monitoring is a complement to triggered monitoring. A state has the option to require systems to conduct source water assessment monitoring at any time to help identify high risk systems.

3. Corrective actions are required for any system with a significant deficiency or source water fecal contamination. The system must implement one or more of the following corrective action options: 1) correct all significant deficiencies; 2) eliminate the source of contamination; 3) provide an alternate source of water; or 4) provide treatment that reliably achieves 99.99 percent inactivation or removal of viruses.

4. Compliance monitoring to ensure that treatment technology installed to treat drinking water reliably achieves at least 99.99 percent inactivation or removal of viruses.

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

6.5.3 Future Regulations

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

Revised Total Coliform Rule

The 1989 Total Coliform Rule was developed to increase public health protection from pathogenic microbial contaminants. It requires all public water systems to monitor for the presence of total coliform bacteria in the distribution system.

Coliform bacteria is not pathogenic but is an indicator of pathogens that is relatively easy to detect.

In 2003 EPA announced the results of its first Six-Year Review of existing drinking water regulations, which at that time included 69 National Primary Drinking Water Regulations, including the TCR.

Based on that review, EPA decided to revise the TCR and used a negotiated rulemaking process to develop the appropriate revisions. In July 2007, EPA established the TCR Distribution System Advisory Committee to provide advice and make recommendations on revisions to the TCR. In September 2008, the DSAC recommended a number of changes to the TCR, which are reflected in an Agreement in Principle.

Based on that agreement, EPA proposed the Revised TCR in 2010.

On Feb. 13, 2013, the final Revised TCR was published in the Federal Register. Significant improvements were made during the revision process, including new requirements that ensure assessment and corrective action when monitoring results indicate a potential risk of contamination exists.

The RTCR applies to all public water systems. Systems will have until April 2016 to comply with the rule requirements.

The revised rule eliminates the total coliform MCL and public notice based solely on total coliform occurrence. The revisions reflect the work of the EPA's TCR/ Distribution System Advisory Committee, AWWA, consumer and environmental advocates, and other stakeholders.

The final RTCR is very similar to the proposed RTCR. In finalizing the RTCR, EPA:

- Eliminates the total coliform MCL,
- Requires assessments to identify sanitary defects when there are total coliform or E. coli exceedances.
- Requires systems to fix sanitary defects identified through assessments.

This rule-making does not change the analytical methods used to comply with the TCR. Neither does it establish new requirements for finished water storage facility inspection and maintenance, cross connection control, water loss prevention, pressure management, distribution system management plans, or other distribution system operations.

Unregulated Contaminant Monitoring Rule

Analyses from UCMR3 monitoring described earlier are not scheduled for completion until 2016, but EPA has already started work in developing the next five-year monitoring cycle under UCMR4. In accordance with the original Unregulated Contaminant Monitoring Regulation (UCMR), the EPA is proposing an updated contaminant monitoring list in addition to other minor revisions to the UCMR. The proposed revisions include a list of 30 monitoring parameters and several new testing methods to conduct the monitoring. The City will be tasked with preparatory activities in 2017. Beginning in about January 2018, the City will sample its surface water and GWI sources four times, and its groundwater source(s) twice over the course of one year.

Lead and Copper Rule Long-Term Revisions

Beginning in 2004, EPA conducted a wide-ranging review of implementation of the Lead and Copper Rule (LCR) to determine if there is a national problem related to elevated lead levels. EPA's comprehensive review consisted of several elements, including a series of workshops designed to solicit issues, comments, and suggestions from stakeholders on particular issues; a review of monitoring data to evaluate the effectiveness of the LCR; and a review of the LCR implementation by States and water utilities. As a result of this multi-part review, EPA identified seven targeted rule changes and EPA promulgated a set of short-term regulatory revisions and clarifications on October 10, 2007, to strengthen implementation of the existing Lead and Copper Rule. After implementing the short-term revisions, EPA identified and initiated in December 2009 several regulatory changes to be considered as part of the more comprehensive changes to the rule. These considerations are longer-term in nature as they require additional data collection, research,

analysis, and stakeholder involvement to support decisions. Changes will be made to make the rule more cost effective and more protective of public health. The current target for release of the draft rule for public review and comment in the Federal Register is December 2016 (http://yosemite.epa.gov/opei/RuleGate.nsf/byRIN/2040-AF15).

Perchlorate Rule

Perchlorate is both a naturally occurring and man-made chemical that is used to produce rocket fuel, fireworks, flares and explosives. Perchlorate can also be present in bleach and in some fertilizers. Perchlorate may have adverse health effects because scientific research indicates that this contaminant can disrupt the thyroid's ability to produce hormones needed for normal growth and development.

EPA has been on all contaminant candidate lists (CCLs) required by the 1996 SDWA amendments since 1998. Following public comment periods in 2007, 2008, and 2009, EPA issued its determination to regulate perchlorate as primary drinking water contaminant. This determination initiated the process for establishing a primary drinking water standard. Initially, EPA anticipated release of the draft rule in 2013. The current target for release of the draft rule for public review and comment in the Federal Register is March 2017 (http://yosemite.epa.gov/opei/RuleGate.nsf/byRIN/2040-AF28).

Carcinogenic Volatile Organic Compound Rule

After reaching out to stakeholders via multiple meetings and its web site, EPA initiated on March 24, 2011 the development of one national primary drinking water regulation covering up to 16 carcinogenic volatile organic compounds (VOCs). EPA also plans to seek input from the Science Advisory Board, the National Drinking Water Advisory Council, the Department of Health and Human Services, and State and tribal drinking water programs prior to issuing a proposed rule.

EPA will develop a proposed regulation to address carcinogenic VOC contaminants as a group, rather than individually, in order to provide public health protections more quickly and also to allow utilities to more effectively and efficiently plan for improvements. PCE and TCE, which EPA determined to be candidates for regulatory revision under a planned review of existing drinking water regulaitions, will be included in the VOC drinking water standard. Besides PCE and TCE, the group may include up to six additional regulated VOCs; and up to eight unregulated VOCs from the EPA's Contaminant Candidate List 3. The current target for release of the draft rule for public review and comment in the Federal Register is February 2018 (http://yosemite.epa.gov/opei/rulegate.nsf/byRIN/2040-AF29).

Radon

Regulation of radon in drinking water has been a contested issue since it was first proposed by EPA in July 1991. The 1996 SDWA Amendments required EPA to withdraw their original proposal due to agency comments, and new regulation was proposed in November 1999. The rule proposes a dual MCL standard, including a less stringent MCL for systems or states which

implement an EPA-approved program to reduce radon risks in household indoor air and tap water. The development of a final rule has been tabled, apparently on and off, since that time. Primary concerns within the drinking water community include highly variable background levels, implementation of the dual standard, implementation of mitigation programs involving air quality, program costs, and tort risks. Radon volatilizes readily and is a much greater risk from an indoor air quality perspective. According to one source cited by EPA, even after 89 percent of the radon in affected drinking water volatilizes, it composes only about 1 to 2 percent of the radon in indoor air. It is not currently known when or what a radon regulation may require as adopted by the EPA or what will be the rule's implementation schedule. Because the final radon rule requirements are uncertain, the impact of this rule on the City is unknown at this time.

6.6 SOURCE WATER QUALITY

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

6.6.1 Drinking Water Standards

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

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

6.6.2 Source Monitoring Requirements and Waivers

The City is required to perform water quality monitoring at each of its active sources for inorganic chemical (IOC) and physical substances, organic chemicals and radionuclides. The monitoring requirements that the City must comply with are specified in WAC 246-290-300. A description of

the source water quality monitoring requirements and procedures for each group of substances is contained in the City's Water Quality Monitoring Plan that is included in **Appendix H**.

In 1994, DOH developed the Susceptibility Assessment Survey Form for water purveyors to complete to determine a drinking water source's potential for contamination. The results of the susceptibility assessment may provide monitoring waivers that allow reduced source water quality monitoring. Based on the results of the susceptibility assessment survey for each source, DOH assigned a moderate susceptibility rating to the Airport Wellfield and a high susceptibility rating for the Haller Wellfield.

Despite the confirmed susceptibility, the sources have been granted monitoring waivers that allow the City to reduce monitoring of certain analytes or suites (panels) of parameters. Source waivers include:

- Complete inorganic panel (IOCs)—once at each source in the 9-year period 2011 through 2019;
- Synthetic organic chemicals (SOCs), herbicides—once at each source in the 9-year period 2014 through 2022;
- Synthetic organic chemicals (SOCs), pesticides and fumigants—monitoring exempted at each source in the 3-year period 2014 through 2016.
- Volatile organic chemicals (VOCs)—once at the airport well field in the 6-year period 2014 through 2019.

Although the City has obtained these waivers, it has historically completed the water quality testing for information purposes, particularly IOCs.

6.6.3 Source Monitoring Results

The quality of the City's sources has been good and meets or exceeds all drinking water standards. In 14 years of monitoring IOCs and physical characteristics at both sources, the only exceedance of a water quality standard has been when manganese mildly exceeded its secondary (non-health, aesthetic based) standard at the Airport Wellfield one time in 2001. Since that time, manganese has been either undetected or detected at levels within standards at either source.

Nitrates, barium, chromium, and radionuclides have all been detected regularly or occasionally in at least one source, but have always easily met primary and secondary standards.

VOCs have also monitored and all standards were met. As required by DOH, the City sampled for the chemical ethylene dibromide (EDB), which was once commonly used as a pesticide and gasoline additive, and the chemical dibromo-chloropropane (DBCP) in 1998 and 2001. The results of the EDB and DBCP monitoring indicated that the City is meeting the regulatory requirements.

Five parameters were detected in at least one sample at each source under UCMR3 in 2013 and 2014. Chlorate, chromium-6, and strontium were consistently detected in all required samples. Total chromium and vanadium were each detected in one sample from each source. The laboratory also detected 1,4-dioxane at a very low level in the first sample taken at the airport well. Subsequent efforts by the lab to validate the detection using the same sample and additional follow-up samples did not detect the parameter. Under EPA protocols, 1,4-dioxane was recorded as a non-detection at the well.

In the Fall of 2009, increased fish activity within the Stillaguamish River generated increased organic compounds. This impacted the water supply from the Haller Wellfield which led to taste issues and numerous customer complaints. While the finished water from the treatment facility met all safe drinking water regulations, the treatment process does not have a granular activated carbon filter or similar process to improve tastes and odors.

6.7 DISTRIBUTION SYSTEM WATER QUALITY

6.7.1 Monitoring Requirements and Results

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

The City has been in compliance with all monitoring requirements for the past several years. A summary of the results of distribution system water quality monitoring within the City's system is presented below.

Coliform Monitoring

The City is required to collect a minimum of 15 coliform samples per month from different locations throughout the system, based on a population served of 16,245 in 2014. The results of coliform tests since the prior WSP, and years prior, were all satisfactory.

Disinfectant Residual Concentration Monitoring

Disinfection requirements applicable to City's Airport Wellfield are contained in WAC 246-290-451, which states that a disinfectant residual concentration shall be detectable in all active parts of the distribution system. Disinfection requirements applicable to the City's Haller Wellfield are contained in WAC 246-290-662 for filtered systems, which states that a minimum 0.2 mg/L disinfectant residual concentration shall be maintained at the point the water enters the system and that the disinfectant residual concentration in the distribution system is detectable in at least 95 percent of the samples taken each calendar month. In an effort to comply with these requirements, the City has established a chlorination target to maintain a residual disinfectant concentration of at least 0.2 mg/L in the distribution system. The water samples collected by the City for coliform

analysis are also tested for residual disinfectant concentration. The results of residual disinfectant concentration tests in 2014 indicate a range of 0.10 mg/L to 1.75 mg/L, with the average being 0.79 mg/L. All of the 3,017 distribution samples taken during 2014 had detectable levels of chlorine residual. Therefore, the system was in compliance with the regulations.

Lead and Copper Monitoring

The Lead and Copper Rule identifies the action level for lead as being greater than 0.015 mg/L and the action level for copper as being greater than 1.3 mg/L. The results of the tests from the most recent (2012) monitoring period, which included 31 sample sites, indicate a range of less than 0.001 mg/L to 0.006 mg/L for lead and a range of 0.022 mg/L to 0.521 mg/L for copper. The 90^{th} percentile concentration for lead was 0.003 mg/L, and the 90^{th} percentile concentration for copper was 0.430 mg/L. Results for both parameters are below their action levels specified above. Therefore the City complies with this regulation.

Asbestos

Asbestos monitoring is required if the sources are vulnerable to asbestos contamination or if the distribution system contains more than 10 percent of asbestos cement pipe. Although none of the City's sources are susceptible to asbestos contamination, asbestos cement (AC) pipe comprises approximately 10.4 percent of the City's distribution system (**Table 2-6**). Therefore, the City must monitor for asbestos in the distribution system on a nine-year cycle. Monitoring must be accomplished during the first three-year compliance period of each nine-year compliance cycle. The water sample must be taken at a tap that is served by an asbestos cement pipe under conditions where asbestos contamination is most likely to occur. The current MCL for asbestos is 7 million fibers per liter and greater than 10 microns in length. The City's most recent sample in 2013 did not detect asbestos contamination.

Disinfectants/Disinfection By-products Monitoring

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

The City has been required to monitor for trihalomethanes because the Haller Wellfield source is under the influence of surface water and requires disinfection. Monitoring from 2008 to 2014 resulted in the running annual average of TTHM being approximately 0.023 mg/L. This is below the TTHM MCL of 0.08 mg/L, and the City is in compliance. In the same 2008 to 2014 timeframe, the running annual average of HAA5 was approximately 0.017 mg/L. This is below the HAA5 MCL of 0.06 mg/L, and the City is in compliance.

This page blank for formatting and duplex printing.

7 Water System Analysis

7.1 INTRODUCTION

This chapter presents the analysis of the City of Arlington's (City) existing water system. Individual water system components were analyzed to determine their ability to meet policies and design criteria under both existing and future water demand conditions. The policies and design criteria are presented in **Chapter 5**, and the water demands are presented in **Chapter 4**. A description of the water system facilities and current operation is presented in **Chapter 2**. The last section of this chapter presents the existing and projected system capacity analyses that were performed to determine the maximum number of equivalent residential units (ERUs) that can be served by the City's existing water system.

7.2 PRESSURE ZONES

The ideal static pressure of water supplied to customers is between 40 and 80 pounds per square inch (psi). Pressures within a water distribution system are commonly as high as 120 psi, requiring pressure regulators on individual service lines to reduce the pressure to 80 psi or less. It is difficult for the City's water system (and most others) to maintain distribution pressures between 40 and 80 psi, primarily due to the topography of the water service area (WSA). Therefore water utilities divide their distribution system into pressure zones in order to manage customers' water pressures within acceptable ranges.. The City's distribution system currently consists of four pressure zones, as shown in **Figure 2-1**.

Table 7-1 lists each of the City's four pressure zones, the highest and lowest elevation served in each zone, and the minimum and maximum distribution system pressures within each zone, based on maximum static water conditions (full reservoirs and zero demands). The City is currently providing water at pressures of at least 40 psi to all services throughout the water system, except for a limited area within the 520 Zone. The lower pressure in the 520 Zone occurs in the higher elevations, and these pressures are above the Washington State Department of Health (DOH) minimum requirement of 30 psi. Recent pressure zone improvements along 89th Avenue NE eliminated pressures that were below 30 psi in the 520 Zone. The pressure in all of the zones after completion of future pressure zone improvements are shown in the lower portion of **Table 7-1**.

Table 7-1

Minimum and Maximum Distribution System Static Pressures

	Highest Elevation Served		Lowest Elevation Served	
Pressure Zone	Elevation (feet)	Static Pressure (psi)	Elevation (feet)	Static Pressure (psi)
Existing System - Before Proposed Zone Modifications				
342 Zone	245	42	40	131
520 Zone	438	39	206	136
540 Zone	423	51	257	123
710 Zone	580	56	300	178
Future System - After Proposed Zone Modifications				
342 Zone	245	42	40	131
520 Zone	438	36	206	136
560 Zone	469	39	300	113
615 Zone	500	50	410	89
710 Zone	580	56	448	113

All of the City's pressure zones have areas of pressure higher than 80 psi, as shown in **Table 7-1**. Excess pressure can increase the risk of pipe failure. The highest pressures in the 342 Zone occur in the Island Crossing area along SR 530 east of I-5. The highest pressures in the 520 Zone occur within the cul-de-sacs along the pressure zone boundary with the 342 Zone. The highest pressures in the 540 Zone occur just upstream of the Lower Burn Road pressure reducing valve (PRV), whereas the highest pressures in the 710 Zone, occur along 105th Avenue NE, north of 195th Street NE. A future pressure zone reconfiguration creating the 560 Zone will reduce the maximum pressure in the 710 Zone, as shown in **Table 7-1**.

The City requires individual services that have pressures greater than 80 psi to install customer-owned pressure regulators to reduce the pressures to acceptable levels, per the plumbing code. In **Table 7-1**, the listed static pressures are calculated in the water mains after calibration at hydrants. Actual service pressures reaching customers will be lower where the City requires pressure regulators. The City has accepted these higher pressures in the system due to the pressure

regulator requirement, good condition of the water mains, and the material of the water main being primarily Class 150 ductile iron. Therefore, no pressure zone improvements are planned to resolve the existing high pressures in the 342, 520, and 540/615 Zones.

7.3 SOURCE CAPACITY EVALUATION

This section evaluates the combined capability of the City's existing sources (two existing groundwater wellfields and one wholesale supply source) to determine if there is sufficient capacity to meet the overall demands of the system based on existing and future water demands. The section that follows will also address the evaluation of the individual facilities to determine if they have sufficient capacity to meet the existing and future demands of the individual zone, or zones, that they supply.

7.3.1 Analysis Criteria

Supply facilities must be capable of adequately and reliably supplying high-quality water to the system in quantities and at pressures that meet the requirements of Washington Administrative Code (WAC) 246-290-230. The evaluation of the combined capacity of the sources in this section is based on the criteria that they provide supply to the system at a rate that is equal to or greater than the maximum day demand (MDD) of the system.

7.3.2 Source Capacity Analysis Results

The combined capability of the City's active sources to meet both existing and future demand requirements, based on existing pumping capacities of the individual supply facilities, is presented in **Table 7-2**. The demands used in the evaluation for 2020, 2024, and 2035 are future demand projections without reductions from the water use efficiency efforts shown in **Table 4-10** of **Chapter 4**. If additional reductions in water use are achieved through water use efficiency efforts, the total source capacity required in the future will be less than that shown in **Table 7-2**.

Since the 540 and 710 Zones are currently supplied directly by the Snohomish County PUD No. 1 (PUD) and do not rely on City storage, the City's system must be capable of supplying the maximum rate of fire flow and the peak hour demands (PHD) for those zones in addition to the MDD of the 342 and 520 Zones. Once the booster pump station (BPS) improvements are completed to make storage from the 342 and 520 Zones available to the upper zones for fire flow purposes, the City's required source capacity will be equivalent to the MDD of the 342 and 520 Zones and the PHD of the upper zones, as shown in 2035. The existing fire flow requirement in the upper zones is 900 gallons per minute (gpm), but the analyses in **Table 7-2** assumes that the fire marshal will require a residential fire flow requirement of 1,000 gpm in the future. **Table 7-2** also assumes that commercial development at the SR9 roundabout will not occur until 2025. If commercial development occurs in the 615 Zone prior to 2035, the 710 Zone BPS will be needed to provide adequate fire flow to the commercial development (i.e., fire flow requirement greater than 1,000 gpm).

Table 7-2
Source Capacity Evaluation

Description	Actual[1] 2014	Future Projections 2020 (+6 years)	2024 (+10 years)	2035 (+21 years)
Required Source Capacity (gpm)				
Maximum Day Demand (342 and 520 Zones)	1,900	2,060	2,273	2,976
Peak Hour Demand (540/615 and 710 Zones)	21	67	117	163
540/615 and 710 Zones Max Fire Flow Requirement[2]	900	1,000	1,000	---
Totals	2,821	3,127	3,391	3,139
Available Source Capacity (gpm)				
Haller Wellfield	1,700	1,700	1,700	1,700
Airport Wellfield	220	220	0	0
PUD Wholesale Source	1,000	1,000	1,000	1,000
New Supply Well No. 1	0	360	580	580
New Supply Well No. 2	0	0	679	679
Totals	2,920	3,280	3,959	3,959
Surplus or Deficient Source Capacity (gpm)				
Surplus or Deficient Amount	99	153	569	821

(1) 2014 maximum day and peak hour demand values are based on actual average day demand amounts and historical peaking factors and do not necessarily represent the actual peak demands.
(2) Assumes fire flow in the upper zones will be provided from storage in the 342 and 520 Zones via a proposed 710 Zone Booster Pump Station instead of directly from the PUD intertie by 2035. If the fire flow requirement at the SR9 roundabout in the 615 Zone is greater than 1,000 gpm with commercial development, the 710 Zone Booster Pump Station will be necessary at the time of that development.

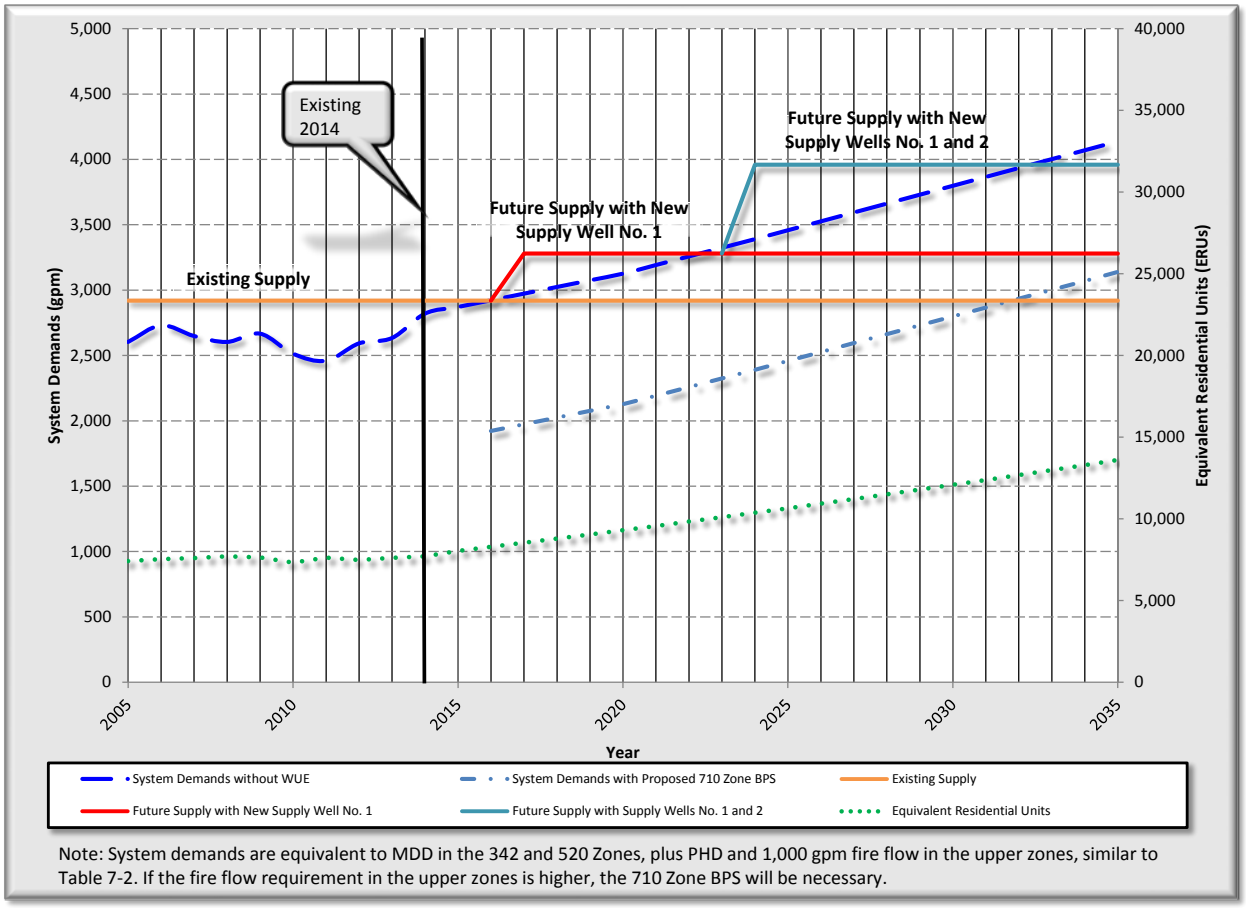
The results of the analyses indicate that the City's existing sources have sufficient capacity to meet existing demands, but additional supply will be necessary prior to 2020. As introduced in Section 6.4, the City is evaluating improvements to relocate the Airport Wellfield to a location outside of the airport industrial area. New Supply Well No. 1 will utilize the water right available to the Airport Wellfield and supply availability at this source will increase between 2020 and 2024 when the Airport Wellfield will be abandoned. The City also plans to introduce an additional supply source, New Supply Well No. 2, to increase the available source capacity available to the system to meet the current available water right amount. These and other source capacity improvements, to meet the required source capacity of the system, are described further in **Chapter 9**.

As shown in **Chart 7-1**, the existing configuration is sufficient to meet existing system demands, but may not be sufficient prior to 2016. The system demands include the MDD of the 342 and 520 Zones, the PHD of the 540 and 710 Zones, and the 1,000 gpm fire flow requirement of the 540 and 710 Zones. The projected system demands with the 710 Zone BPS shows the reduction in system demand when this station is constructed. This improvement makes storage from the 342 and 520 Zones available to the upper zones, allowing fire flow in the upper zones to be supplied

by the proposed 710 Zone BPS instead of directly from the intertie with the PUD. Without the 710 Zone BPS improvement, Supply Well No. 1 is necessary in 2016 and Supply Well No. 2 is necessary by 2023, as shown in **Chart 7-1**. The City intends to closely monitor system demands as development occurs. Since actual 2014 demands are less than the projected demands that the supply analysis is based on, the City may have sufficient capacity to meet future demands prior to the Supply Well Nos. 1 and 2 improvements.

Chart 7-1

Future Water Supply and Demand Projections



Note: System demands are equivalent to MDD in the 342 and 520 Zones, plus PHD and 1,000 gpm fire flow in the upper zones, similar to Table 7-2. If the fire flow requirement in the upper zones is higher, the 710 Zone BPS will be necessary.

7.4 WATER SUPPLY FACILITIES EVALUATION

This section evaluates the existing supply facilities to determine if they have sufficient capacity to provide water supply at a rate that meets the existing and future demands of the one or more zones they supply. This section also identifies facility deficiencies that are not related to the capacity of the supply facilities. Improvements to resolve these deficiencies are described further in **Chapter 9**.

7.4.1 Analysis Criteria

The DOH evaluation to determine if supply facilities have adequate capacity is based on one of two criteria, as follows:

1) if the facility provides to a pressure zone that has water storage, then the amount of supply required is equal to the MDD of the zone; or
2) if the pressure zone that the facility provides supply to does not have water storage, then the amount of supply required is equal to the PHD of the zone.

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

7.4.2 Supply Analysis Results

710 Zone Facilities

The 710 Zone is currently a closed zone (served by a single source) and is supplied with water directly from the PUD through an intertie located east of the City on Burn Road. **Table 7-3** summarizes the existing water supply evaluation for the 710 Zone. The existing required supply is based on the PHD and the existing maximum fire flow requirement of the 710 Zone. The results of the analyses indicate that the existing configuration is sufficient to meet existing demands of the 710 Zone.

A future BPS is planned to transfer water from the 520 Zone to provide redundant supply to the 710 Zone. The 710 Zone analyses in **Table 7-3** are computed with the 710 Zone BPS constructed in 2035 (i.e., top half of the table), and with the 710 Zone BPS constructed in 2020 (i.e., bottom half of the table). The results of the analyses indicate that the existing configuration is sufficient to meet the existing needs of the 710 Zone, but not the 6- and 20-year demands without the proposed developer-funded 710 Zone BPS.

The analyses assume that the current fire flow requirement of 900 gpm in the 710 Zone will increase to 1,000 gpm as growth occurs, in accordance with standard single-family residential fire requirements. However, if the fire marshal determines that proposed future residential structures in the 710 Zone require less than the planning level fire flow requirement of 1,000 gpm assumed in the 2020 and 2024 analyses, the existing configuration of the zone without the BPS may be sufficient to support the development depending on its domestic demand requirements. In addition, portions of the 710 Zone will be converted to a lower pressure zone in the future, which will reduce the PHD of the zone, as indicated by the 2035 demand in **Table 7-3**. The City will closely monitor future development of the zone, and track existing demands and actual fire flow requirements to ensure sufficient capacity is available prior to the approval of new water services in this zone.

Table 7-3

710 Zone Supply Evaluation

Without Proposed 710 Zone BPS (CIP DF15) in 2020

Description	Actual[1] 2014	Future Projections 2020 (+6 years)	2024 (+10 years)	2035 (+21 years)
Required Supply (gpm)				
710 Zone Peak Hour Demand	17	49	84	2
710 Zone Max Fire Flow Requirement	900	1,000	1,000	1,000
Totals	917	1,049	1,084	1,002
Available Supply (gpm)				
PUD Wholesale Supply Source	1,000	1,000	1,000	1,000
Future 710 Zone Booster Pump Station	---	---	---	3,200
Totals	1,000	1,000	1,000	4,200
Surplus or Deficient Supply (gpm)				
Surplus or Deficient Amount	83	-49	-84	3,198

With Proposed 710 Zone BPS (CIP DF15) in 2020

Description	Actual[1] 2014	Future Projections 2020 (+6 years)	2024 (+10 years)	2035 (+21 years)
Required Supply (gpm)				
710 Zone Peak Hour Demand	17	49	84	2
710 Zone Max Fire Flow Requirement	900	1,000	1,000	1,000
Totals	917	1,049	1,084	1,002
Available Supply (gpm)				
PUD Wholesale Supply Source	1,000	1,000	1,000	1,000
Future 710 Zone Booster Pump Station	---	3,200	3,200	3,200
Totals	1,000	4,200	4,200	4,200
Surplus or Deficient Supply (gpm)				
Surplus or Deficient Amount	83	3,151	3,116	3,198

(1) 2014 maximum day and peak hour demand values are based on actual average day demand amounts and historical peaking factors and do not necessarily represent the actual peak demands.

540 and 615 Zone Facilities

The 540 Zone is currently a closed zone (i.e., does not have water storage) and is supplied with water directly from the PUD through the Upper Burn Road PRV. **Table 7-4** summarizes the existing water supply evaluation based on supply requirements for the 540 Zone. The existing required supply is based on the PHD and the existing maximum fire flow requirement in the 540 Zone. The results of the analyses indicate that the existing configuration is sufficient to meet existing demands of the 540 Zone, but the existing configuration may not be sufficient by 2020.

Table 7-4 summarizes the future water supply with and without the proposed developer-funded 710 Zone BPS. The fire flow requirement for the 615 Zone increases to 3,000 gpm in 2020 due to the commercial land use located near the SR9 roundabout. If the commercial development occurs, the 710 Zone BPS will be necessary at the time of that development. If the commercial development is delayed and the fire marshal determines that proposed future residential structures require the existing 900 gpm fire flow requirement, the existing configuration of the zone may be sufficient to support the development depending on its domestic demand requirements at least through 2020. The City will track existing demands and actual fire flow requirements to ensure sufficient capacity is available prior to approval of new water services in this zone. The City intends to closely monitor demands in these zones as development occurs, similar to the 710 Zone.

The City intends to reconfigure the upper zones prior to 2035, which will include conversion of the 540 Zone to a 615 Zone. Once the proposed 710 Zone BPS is constructed, additional supply from the 520 Zone will be available to the 615 Zone through the Upper Burn Road PRV, and a potential additional PRV at the 710 Zone BPS. Since fire flow demand is assumed to be limited to one pressure zone at any given time, the transfer amount available from the 710 Zone is the difference of the 710 Zone total available supply and the PHD of the 710 Zone.

342 Zone Facilities

The Haller Wellfield and Airport Wellfield provide water supply directly to the 342 Zone. These facilities can also indirectly serve the 520 Zone through the 520 Zone BPS. **Table 7-5** summarizes the current and future supply requirements of the 342 Zone, based on the zone's existing and projected water demands. **Table 7-5** also summarizes the current amount of water supply directly available to the 342 Zone, based on the capacity of the wellfields. Although water from the PUD can be transferred to the 342 Zone from the 540 Zone through the Lower Burn Road PRV, and water can be transferred to the 342 Zone from the 520 Zone through five PRVs located along the western boundary of the 520 Zone, the transfer amounts are excluded from this direct supply analyses. The results of the analyses indicate that the existing configuration is sufficient to meet the existing demands of the 342 Zone. Future supply will be needed, as indicated by the new supply wells in 2020 and 2024.

Table 7-4

540 and 615 Zones Supply Evaluation

Without Proposed 710 Zone BPS (CIP DF15) in 2020

Description	Actual[1] 2014	Future Projections 2020 (+6 years)	2024 (+10 years)	2035 (+21 years)
Required Supply (gpm)				
540/615 Zone Peak Hour Demand	3	17	34	160
540/615 Zone Max Fire Flow Requirement	900	3,000	3,000	3,000
Totals	903	3,017	3,034	3,160
Available Supply (gpm)				
Transfer from 710 Zone via PRV Station(s)	983	951	916	4,198
Surplus or Deficient Supply (gpm)				
Surplus or Deficient Amount	79	-2,067	-2,117	1,037

With Proposed 710 Zone BPS (CIP DF15) in 2020

Description	Actual[1] 2014	Future Projections 2020 (+6 years)	2024 (+10 years)	2035 (+21 years)
Required Supply (gpm)				
540/615 Zone Peak Hour Demand	3	17	34	160
540/615 Zone Max Fire Flow Requirement	900	3,000	3,000	3,000
Totals	903	3,017	3,034	3,160
Available Supply (gpm)				
Transfer from 710 Zone via PRV Station(s)	983	4,151	4,116	4,198
Surplus or Deficient Supply (gpm)				
Surplus or Deficient Amount	79	1,133	1,083	1,037

(1) 2014 maximum day and peak hour demand values are based on actual average day demand amounts and historical peaking factors and do not necessarily represent the actual peak demands.

Table 7-5

342 Zone Supply Evaluation

Description	Actual[1] 2014	Future Projections 2020 (+6 years)	2024 (+10 years)	2035 (+21 years)
Required Supply (gpm)				
342 Zone Maximum Day Demand	1,415	1,549	1,734	2,348
Available Supply (gpm)				
Haller Park Wellfield	1,700	1,700	1,700	1,700
Airport Wellfield	220	220	0	0
New Supply Well No. 1	0	360	580	580
New Supply Well No. 2	0	0	679	679
Totals	1,920	2,280	2,959	2,959
Surplus or Deficient Supply (gpm)				
Surplus or Deficient Amount	505	731	1,225	611

(1) 2014 maximum day and peak hour demand values are based on actual average day demand amounts and historical peaking factors and do not necessarily represent the actual peak demands.

520 Zone Facilities

The 520 Zone is supplied water through the 186th Street flow-control valve (from the 710 Zone), and through the BPS (from the 520 Zone). The flow-control valve located on 186th Street NE near Arlington High School provides water purchased from the PUD to the 520 Zone through the 710 Zone. The current flow rate is 80 gpm and the City intends to convert this to an emergency supply PRV when adjacent pressure zone improvements are completed. The 342 Zone storage facilities indirectly serve the 520 Zone through the 520 Zone BPS. **Table 7-6** summarizes the current and future supply requirements of the 520 Zone, based on existing and projected water demands for the system. **Table 7-6** also summarizes the amount of water supply available to the 520 Zone. The transfer amount available from the 342 Zone is equal to the surplus supply amount from the 342 Zone, as shown in **Table 7-5**. The transfer amount available from the 615 Zone through the 186th Street flow control valve (FCV) is equal to the surplus supply amount from the 615 and 710 Zones. The results of the analyses indicate that the existing configuration is sufficient to meet the existing 6-, 10-, and 20-year demands of the 520 Zone.

Table 7-6

520 Zone Supply Evaluation

Description	Actual[1] 2014	Future Projections 2020 (+6 years)	2024 (+10 years)	2035 (+21 years)
Required Supply (gpm)				
520 Zone Maximum Day Demand	486	511	539	628
Available Supply (gpm)				
Transfer from 342 Zone via 520 Zone Booster Pump Station	505	731	790	611
Transfer from 186th Street FCV	30	0	0	1,037
Totals	535	731	790	1,649
Surplus or Deficient Supply (gpm)				
Surplus or Deficient Amount	50	220	251	1,021

(1) 2014 maximum day and peak hour demand values are based on actual average day demand amounts and historical peaking factors and do not necessarily represent the actual peak demands.

7.4.3 Facility Deficiencies

The WTP and PUD master meter facilities were both constructed in the early 2000s and are in excellent condition. The clearwell pumps at the WTP are operating at a reduced hydraulic grade line and show signs of excessive wear. Replacement of the clearwell pumps will be necessary to improve the hydraulic performance of the facility. In addition, the City's old water treatment plant is no longer used and needs to be fully demolished.

The Haller Wellfield includes wells that are more than 50- and 100-years old and which have experienced declining specific capacities. A rehabilitation effort in 2012 was ineffective. In addition, the third well, drilled in 2002, has iron and manganese issues making it unusable without additional treatment for these parameters. The older wells have also had an increased number of manganese detections in recent years.

The Airport Wellfield has had declining capacity, water quality issues associated with manganese, and is sited in the City's industrial core. The City intends to place this well at another location. The City is also planning to construct an additional source of supply to allow full utilization of the City's existing water rights. Proposed improvements to resolve these deficiencies are identified in **Chapter 9**.

7.5 STORAGE FACILITIES

This section evaluates the City's existing reservoirs to determine if they have sufficient capacity to meet the system's existing and future storage requirements.

7.5.1 Analysis Criteria

Water storage is typically made up of the following components: operational storage; equalizing storage; standby storage; fire flow storage; and dead storage. Each storage component serves a different purpose and will vary from system to system. A definition of each storage component and the criteria used to evaluate the capacity of the City's reservoirs is provided below and in WAC 246-290-010.

Operational Storage – Volume of a reservoir used to supply the water system under normal conditions when the source or sources of supply are not delivering water to the system (i.e., sources are in the off mode). Operational storage is the average amount of draw-down in the tank during normal operating conditions, which represents a volume of storage that will most likely be unavailable for equalizing, fire flow, or standby storage. The operational storage in the City's reservoirs is the amount of storage between the fill or pump-start set-point level and the overflow elevation of the reservoir.

Equalizing Storage – Volume of a reservoir used to supply the water system under peak demand conditions when the system demand exceeds the total rate of supply of the sources. DOH requires that equalizing storage be stored above an elevation that will provide a minimum pressure of 30 psi at all service connections throughout the system during PHD conditions. Because the City's supply sources primarily operate on a "call-on-demand" basis to fill the storage tanks, the equalizing storage requirements are determined using the standard DOH formula that considers the difference between the system PHD and the combined capacity of the supply sources.

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

Where:

ES = Equalizing Storage, in gallons.

PHD = Peak Hour Demand, in gpm.

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

For the equalizing storage analyses, the well sources serving the 342 Zone and the BPS and flow control valve serving the 520 Zone were utilized for the supply capacity for their respective zones.

Standby Storage – Volume of the reservoir used to supply the water system under emergency conditions when supply facilities are out-of-service due to equipment failures, power outages, loss of supply, transmission main breaks, and any other situation that disrupts the supply source. DOH

requires that standby storage be stored above an elevation that will provide a minimum pressure of 20 psi at all service connections throughout the system. The criteria for determining the standby storage requirements for the City's system, which has multiple supply sources, is based on the standard DOH formula that requires that the amount is sufficient to supply the system for a 48-hour period when the primary supply facility is out-of-service and the system is experiencing demands that are close to average day demands (ADD).

$$\mathbf{SB = (2\ days)[(ADD)(N) - t_m\ (Q_S\text{-}Q_L)]}$$

Where:

SB = Standby Storage, in gallons.

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

N = Number of ERUs.

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

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

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

The standby storage analyses was completed for each reservoir operating area. For the 342 Zone, the largest capacity source that was assumed to be out-of-service was the Haller Wellfield, but it was assumed that the PUD wholesale supply source would be available to the 342 Zone in the event that the Haller Wellfield is out-of-service and that the PUD supply source would not be needed for fire flow in the upper zones during this circumstance. For the 520 Zone analysis, the 520 Zone BPS was assumed to be out-of-service in the existing analyses and the PUD wholesale supply source was assumed to be out-of-service in the future analyses. DOH recommends that the minimum standby storage volume be no less than 200 gallons per ERU. In the future storage analyses, this calculation determined the standby storage volume required for the City's reservoir operating areas.

Fire Flow Storage – Volume of the reservoir used to supply water to the system at the maximum rate and duration required to extinguish a fire at the building with the highest fire flow requirements. The magnitude of the fire flow storage is the product of the fire flow rate and duration of the system's maximum fire flow requirement established by the local fire authority. DOH requires that fire flow storage be stored above an elevation that will provide a minimum

pressure of 20 psi at all points throughout the distribution system under MDD conditions. The fire flow storage requirements shown in the analyses that follow are based on the maximum fire flow requirement in the system of 4,750 gpm for four hours.

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

7.5.2 Storage Analyses Results

The storage analyses are based on an evaluation of the existing storage facilities providing water to two operating areas: the 342 Zone, which is within the operating area of the Gleneagle Reservoir; and the 520 Zone, which is within the operating area of the 520 Zone Reservoir.

Existing Storage Analysis

As shown in **Table 7-7**, the maximum combined storage capacity of the City's reservoirs is approximately 4.00 million gallons (MG). The calculations assume that the fire flow storage in the 520 Zone is available to the 342 Zone through PRVs. The results of the existing storage evaluation, as shown in **Table 7-7**, indicate that the system does have sufficient storage.

Table 7-7

Existing Storage Evaluation

Description	Supply Area		Totals
	342 Zone	520 Zone	
Available/Usable Storage (MG)			
Maximum Storage Capacity	2.00	2.00	4.00
Dead (Non-usable Storage)	0.00	0.00	0.00
Total Available Storage	2.00	2.00	4.00
Required Storage (MG)			
Operational Storage	0.44	0.26	0.70
Equalizing Storage	0.10	0.05	0.15
Standby Storage	1.14	0.68	1.82
Fire Flow Storage	0.00	1.14	1.14
Totals	1.68	2.13	3.81
Surplus or Deficient Storage (MG)			
Surplus or Deficient Amount	0.32	-0.13	0.19

Note: Fire flow for the 342 Zone is provided by the 520 Zone through various PRVs.

Future Storage Analysis

The system's future storage requirements were computed for the 6-, 10-, and 20-year planning periods based on year 2020, 2024, and 2035 demand projections. The analyses were performed to determine the adequacy of the City's storage facilities to meet future storage requirements for each storage supply area. The future analyses are based on New Supply Well Nos. 1 and 2 being online, as indicated in **Table 7-2**. The equalizing storage requirement is less in 2020 and 2024 than in 2014, due to the increased available source capacity scheduled to become available by 2020 and 2024. The calculations assume that the PUD wholesale supply source is available to the 342 Zone when the Haller Wellfield is offline. The calculations also assume that the fire flow storage in the 520 Zone is available to the 342 Zone through PRVs, and that 615 and 710 Zones storage will be provided in the existing and proposed 520 Zone reservoirs. Water will be conveyed to these zones via the proposed 710 Zone BPS. As shown in **Table 7-8**, the City will have approximately 0.06 MG of surplus storage in 2024 with the supply improvements, and a 0.75 MG storage deficiency in 2035. Additional storage is required to meet the needs of the system through the 20-year planning period. If the new well and 710 BPS improvements are postponed, the future storage projections will need to be updated accordingly. Storage requirements will increase if these other improvements are not completed. Site acquisition and the design and construction of a new reservoir is identified in **Chapter 9** to provide the system's projected additional storage needs.

Table 7-8

Future Storage Projections

Description	2020 Supply Area			2024 Supply Area			2035 Supply Area		
	342 Zone	520/615/710 Zones	Totals	342 Zone	520/615/710 Zones	Totals	342 Zone	520/615/710 Zones	Totals
Available/Usable Storage (MG)									
Maximum Storage Capacity	2.00	2.00	4.00	2.00	2.00	4.00	2.00	2.00	4.00
Dead (Non-usable Storage)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Available Storage	2.00	2.00	4.00	2.00	2.00	4.00	2.00	2.00	4.00
Required Storage (MG)									
Operational Storage	0.44	0.26	0.70	0.44	0.26	0.70	0.44	0.26	0.70
Equalizing Storage	0.08	0.00	0.08	0.03	0.00	0.03	0.19	0.00	0.19
Standby Storage	1.37	0.49	1.86	1.54	0.54	2.07	2.08	0.64	2.72
Fire Flow Storage	0.00	1.14	1.14	0.00	1.14	1.14	0.00	1.14	1.14
Totals	1.90	1.88	3.78	2.01	1.93	3.94	2.72	2.03	4.75
Surplus or Deficient Storage (MG)									
Surplus or Deficient Amount	0.10	0.12	0.22	-0.01	0.07	0.06	-0.72	-0.03	-0.75

7.5.3 Facility Deficiencies

The City's newest reservoir, the 520 Zone Reservoir, was constructed in 1993 for the 520 Zone. The reservoir does not have any noticeable deficiencies and was designed to withstand a seismic event. Although the steel tank's paint coating is currently in good condition, a qualified coating inspector has been retained to inspect the integrity of the coating on a five-year time schedule, or more frequently if visible signs of coating deterioration appear. In addition, the exterior needs to

be pressure washed for general cleaning purposes. The cleaning and inspection of the 520 Zone Reservoir last occurred in 2014. The site does need a chain link fence to improve facility security.

The City's Gleneagle Reservoir provides water storage to the 342 Zone. The Gleneagle Reservoir is a post-tensioned concrete tank with a wooden roof that requires replacement. The existing roof is decaying, has persistent moss problems, and poorly designed vents. Although the tank's paint coating is currently in good condition, a qualified coating inspector has been retained to inspect the integrity of the coating on a five-year time schedule, or more frequently if visible signs of coating deterioration appear. In addition, the exterior needs to be pressure washed for general cleaning purposes. The cleaning and inspection of the Gleneagle Reservoir last occurred in 2014. Following replacement of the existing roof and with continued regular maintenance and inspections, the City does not anticipate the need to replace the Gleneagle Reservoir within the 20-year planning period.

The Burn Road Reservoir was taken offline and drained in 2014 because of age and vandalism issues. The reservoir still needs to be properly demolished.

Proposed improvements to resolve these deficiencies are identified in **Chapter 9**.

7.6 DISTRIBUTION AND TRANSMISSION SYSTEM

This section evaluates the City's existing distribution and transmission system (i.e., water mains) to determine if they are adequately sized and looped to provide the necessary flow rates and pressures to meet the system's existing and future requirements. This section also identifies deficiencies that are not related to the capacity of the water mains.

7.6.1 Analysis Criteria

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

Hydraulic analyses of the existing system were performed under existing PHD conditions to evaluate its current pressure capabilities and identify existing system deficiencies. The existing system was also analyzed under existing MDD conditions to evaluate the current fire flow capabilities and identify additional existing system deficiencies. Additional hydraulic analyses were then performed with the same hydraulic model under future MDD conditions and with the proposed improvements to demonstrate that the identified improvements will eliminate the

deficiencies and meet the requirements far into the future. The following is a description of the hydraulic model, the operational conditions and facility settings used in the analyses.

7.6.2 Hydraulic Model

Description

A computer-based hydraulic model of the existing water system was updated using Version 8i of the WaterGEMS® program, developed by Bentley Systems, Inc. All water mains in the City's water system, including dead-end mains, were included in the model and based on AutoCAD® water system maps, as-built records provided by the City, or GIS records provided by the City. The junction node elevation data was extracted from a topographic file that was generated by the Puget Sound LiDAR Consortium. A hydraulic model node diagram providing a graphical representation of the model of the water system is contained in **Appendix C**.

Demand Data

The hydraulic model of the existing system contains 2014 ADD data. The peaking factors calculated in **Chapter 4** were used to analyze the system under MDD and PHD conditions. Demand distribution was established during the previous water system plan (WSP) when consumption data from 2008 metered billing records were distributed, based on the recorded usage for each parcel to the closest representative junction node of the model.

The hydraulic model of the proposed system contains six-year demand levels that are projected for the year 2020, 10-year demand levels that are projected for year 2024, and 20-year demand levels that are projected for the year 2035. The future distribution is based on the City's estimated future demand levels in each pressure zone.

Facilities

The hydraulic model of the existing system contains all active existing system facilities. For the proposed system analyses in the years 2020, 2024, and 2035, the hydraulic model contains all active existing system facilities and proposed system improvements identified in **Chapter 9** for the six-year, 10-year, and 20-year planning periods, respectively.

The facility settings for the pressure analyses corresponded to a PHD event in the water system. All sources of supply that are currently available to the system, or will be available in the future for the 2020, 2024, and 2035 analyses, during a peak period were operating at their normal summertime pumping rates. The reservoir levels were modeled to reflect full utilization of operational and equalizing storage. The operational conditions for the pressure analyses are summarized in **Table 7-9**.

Table 7-9

Hydraulic Analyses Operational Conditions

Description	PHD Pressure Analysis				Fire Flow Analysis			
	2014	2020	2024	2035	2014	2020	2024	2035
Demand	2014 PHD	2020 PHD	2024 PHD	2035 PHD	2014 MDD	2020 MDD	2024 MDD	2035 MDD
Gleneagle Reservoir HGL (ft)	331.9	332.3	333.2	330.1	331.9	332.3	333.2	330.1
520 Zone Reservoir HGL (ft)	516.8	517.3	517.3	517.3	504.8	505.3	505.3	505.3
520 Zone Booster Pump Station	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
Proposed 710 Zone Booster Pump Station	---	---	---	ON	---	---	---	ON
Airport Wellfield	ON	ON	OFF	OFF	ON	ON	OFF	OFF
Haller Park Wellfield	ON	ON	ON	ON	ON	ON	ON	ON
New Supply Well No. 1	---	ON	ON	ON	---	ON	ON	ON
New Supply Well No. 2	---	---	ON	ON	---	---	ON	ON
Snohomish County PUD No. 1 Master Meter	ON	ON	ON	ON	ON	ON	ON	ON

Separate fire flow analyses were performed on the system to size distribution system improvements and calculate fire flow availability. The hydraulic model for the fire flow analyses contain settings that correspond to MDD events. All sources of supply that are currently available to the system during a peak period were operating at their normal pumping rates, and the reservoir levels were modeled to reflect full utilization of operational, equalizing, and fire flow storage, based on the maximum planning-level fire flow requirement. **Table 7-9** summarizes the operational conditions for the fire flow analyses for the existing, year 2020, year 2024, and year 2035 systems.

Calibration

Hydraulic model calibration is the process of adjusting hydraulic model data so the model closely reflects actual system pressures and flows under similar demand and operating conditions. Initial Hazen Williams roughness coefficients were entered into the model, based on computed estimates of the coefficients from available pipe age and material data. For example, assuming that the internal surface of water pipes become rougher as they get older, older water mains were assigned lower roughness coefficients than new water mains. In 2010, additional calibration of the model was achieved using field fire flow and pressure data, which was collected throughout the system for this purpose. Hydraulic model calibration was achieved by adjusting the roughness coefficients of the water mains and elevations of the junction nodes in the model until the model results reflected an acceptable level of accuracy. The average accuracy of the calibrated model was better than 98 percent of the actual field data collected, with a range of 100 to 94 percent accuracy at individual analysis locations. For the purposes of this WSP, some model pressures were field-checked to verify elevations, but field flow tests were not performed.

7.6.3 Hydraulic Analyses Results

Several hydraulic analyses were performed to determine the capability of the system to meet the pressure and flow requirements identified in **Chapter 5** and contained in WAC 246-290-230. The first analysis was performed to determine the pressures throughout the system under existing (i.e., 2014) PHD conditions. The results of this analysis were used to identify locations of low and high pressures. To satisfy the minimum pressure requirements, the pressure at all water service locations must be at least 30 psi during PHD conditions. In addition, the system should not have widespread areas with high pressures, generally considered to be more than 120 psi. A summary of the pressure deficiencies identified from the results of this analysis is contained in **Table 7-10**.

There are several areas within the City's distribution system that have pressures in excess of 100 psi. Most areas of the 710 Zone currently experience high pressures as does the lower elevations of the 520 Zone near the boundary with the 342 Zone. The high pressures in the 342 Zone occur near Haller Park, the areas near the Stillaguamish River and March Creek, Island Crossing and several other lower elevation areas of the pressure zone.

The second set of analyses was performed to determine the capability of the existing water system to provide fire flow throughout the system under MDD conditions. A separate fire flow analysis was performed for each node in the model to determine the available fire flow at a minimum residual pressure of 20 psi in the main adjacent to the hydrant and a maximum allowable water main velocity of 10 feet per second. More than 800 fire flow analyses were performed to comprehensively evaluate the water system. For each node analyzed, the resulting fire flow was compared to its general planning-level fire flow requirement, which was assigned according to its land use classification. As is typical of most water systems, the City's distribution system was constructed to meet fire flow requirements that were in place at the time of construction. Land use classification changes and/or increase in fire flow requirements over time may create deficiencies. A summary of the results of the analyses for representative system nodes is presented in **Table 7-11**.

Table 4-9 in **Chapter 4** lists the general planning-level fire flow requirements for each land use classification. Since the fire flow requirement varies for buildings within each land use classification, the land use based fire flow requirements are only used as a general target for the primary purpose of the system-wide analyses that were performed for this WSP. Additional improvements may be needed in areas where actual fire flow requirements exceed the planning-level targets, and shall be the responsibility of the developer. The results of the fire flow analyses were used to identify undersized water mains and proposed water main improvements.

Once all deficiencies were identified, proposed water main improvements were included in the model, and pressure and fire flow analyses were performed throughout the system to demonstrate that the improvements will eliminate the deficiencies and meet the flow and pressure requirements. These analyses were modeled under projected year 2035 MDD conditions to ensure that the improvements are sized sufficiently to meet the needs of the future. A summary of the results of

these analyses is shown in **Table 7-11** for the same areas that were summarized from the existing water system analyses. The results of the analyses indicate that all fire flow deficiencies are resolved with the proposed improvements. Many of the fire flow deficiencies will be resolved prior to 2035, but since the selection of specific projects to resolve existing fire flow deficiencies will be accomplished annually during the City's budget development process, all fire flow deficiencies were assumed to be resolved in 2035 for the purposes of this WSP. A description of these improvements and a figure that shows their locations are presented in **Chapter 9**.

Table 7-10

Pressure Analysis Summary

Land Use	Approximate Location	Existing Pressure Zone	Proposed Pressure Zone	Existing Node Number	Pressure (psi)			
					Existing System	Future w/Improvements 2020	2024	2035
Low Pressure Areas								
Public/Semi-Public	Arlington High School	520 Zone	520 Zone	J-1089	37	37	37	33
Low/Mod Dens Res	Noble Dr & Cedarbough Loop	520 Zone	520 Zone	J-178	37	37	37	35
High Pressure Areas								
Mod Dens Res	211th Pl NE & Ronning Rd	342 Zone	342 Zone	J-511	103	103	103	101
Highway Comm	Smokey Point Concrete	342 Zone	342 Zone	J-691	125	125	125	123
OTBD3	Near Haller Park Wellfield	342 Zone	342 Zone	J-1	111	111	110	108
Mod Dens Res	Kraetz Rd & 59th Ave NE	342 Zone	342 Zone	J-581	107	107	107	105
Moderate Density Residential	Crossroads Fellowship Church	342 Zone	342 Zone	J-924	107	108	108	105
Low/Mod Dens Res	196th Pl NE & 45th Dr NE	342 Zone	342 Zone	J-391	105	106	105	103
Low/Mod Dens Res	North of Stillaguamish River on Arlington-Darrington Rd	342 Zone	342 Zone	J-518	114	114	114	112
Highway Comm	Island Crossing at Intersection of Interstate 5 and SR 530	342 Zone	342 Zone	J-117a	125	125	125	123
Low/Mod Dens Res	Crown Ridge Boulevard & SR 9	520 Zone	520 Zone	J-351	105	105	105	100
Low/Mod Dens Res	North end of Heron Ct	520 Zone	520 Zone	J-530	134	134	134	130
Low/Mod Dens Res	Near 71st Avenue NE along 172nd St NE	520 Zone	520 Zone	J-649	127	127	127	124
Low/Mod Dens Res	Old Burn Rd & Burn Hill Rd	540 Zone	520 Zone	J-625	134	123	123	104
Rural Residential	Zaretzke Rd & ~183rd St NE	710 Zone	560 Zone	J-814	104	40	40	40
Rural Residential	In 105th Ave NE, north of 195th St N	710 Zone	560 Zone	J-984	178	113	113	113
Rural Residential	186th St NE & ~95th Ave NE	710 Zone	615 Zone	J-823	108	67	67	63
Rural Residential	95th Ave NE & Burn Rd	710 Zone	615 Zone	J-786	119	78	78	74
Low/Mod Dens Res	In 182nd St NE, west of 89th Ave NE	710 Zone	615 Zone	J-366	121	80	80	76

Table 7-11

Fire Flow Analysis Summary

Description	Approximate Location	Existing Pressure Zone	Node Number	Available Fire Flow (gpm)				Target Fire Flow (gpm)
				Existing System	Future w/Improvements			
					2020	2024	2035	
High Dens Res	E Gilman Ave & Talcott Ave	342 Zone	J-517	4,485	4,562	4,441	5,000	2,500
Low Density Res.	Shady Grove Pl & Cedarbough Lp	342 Zone	J-184	914	920	924	1,720	1,000
Moderate Density Res.	E Robinhood Dr & ~E 2nd St	342 Zone	J-520	869	876	878	3,821	1,750
Stillaguamish Senior Center	18308 Smokey Point Blvd	342 Zone	J-736	2,775	2,771	3,197	3,193	2,500
Island Crossing	Interstate 5 & SR 530	342 Zone	J-117a	2,340	2,456	3,006	3,007	3,000
Business Park	184th Pl NE & ~36th Dr NE	342 Zone	J-731	2,598	2,599	2,719	5,000	3,000
Puget Sound Kidney Center	18828 Smokey Point Blvd	342 Zone	J-682	2,726	2,726	2,579	5,000	3,000
Moderate Density Res.	183rd Pl NE & 31st Ave NE	342 Zone	J-738	2,867	2,863	3,062	3,049	1,750
Crossroads Fellowship Church	2425 200th St NE	342 Zone	J-924	1,727	1,727	3,825	3,823	1,750
Cascade Valley Hospital	Stillaguamish Ave & Medical Dr	342 Zone	J-460	1,724	1,724	1,723	5,000	3,500
Moderate Density Res.	Ronning Rd & 210th St NE	342 Zone	J-602	1,599	1,595	1,594	3,100	1,750
Smokey Point Concrete	23315 Dike Rd	342 Zone	J-692	1,314	1,320	1,315	5,000	3,000
Moderate Density Res.	Kraetz Rd & 59th Ave NE	342 Zone	J-581	1,699	1,696	1,693	2,669	1,750
Mod Dens Res	Hillcrest Dr & Florence St	342 Zone	J-1075	886	884	884	3,191	1,750
Regency Care Center	620 S Hazel St	342 Zone	J-108	1,957	1,958	1,956	4,256	1,750
Arlington Municipal Airport	188th St NE & 58th Ave NE	342 Zone	J-910	2,664	2,646	2,645	5,000	3,500
Aviation Flightline	188th St NE & ~49th Ave NE	342 Zone	J-663	3,822	3,821	3,821	5,000	3,500
Haller Middle School	French Ave & E 1st St	342 Zone	J-634	2,032	2,032	2,032	5,000	3,500
Post Middle School	1220 E Fifth St	342 Zone	J-47	2,395	2,394	2,394	5,000	3,500
General Industrial	20800 67th Ave NE	342 Zone	J-1070	2,949	2,946	2,943	5,000	3,500
High Density Res.	Medical Center Dr	342 Zone	J-701	3,719	3,719	3,716	5,000	2,500
Old Town Res. District	E Division St & High St	342 Zone	J-12	1,474	1,474	1,474	5,000	2,500
High Density Res.	201st St NE & 80th Ave NE	342 Zone	J-568	2,173	2,173	2,172	4,860	2,500
Haggen Food & Pharmacy	20115 74th Ave NE	342 Zone	J-572	3,057	3,056	3,055	5,000	3,000
General Commercial	59th Ave NE south of SR 531	342 Zone	J-664	2,781	3,500	5,000	5,000	3,500
General Commercial	7607 204th St NE	342 Zone	J-798	2,836	2,836	2,836	5,000	3,000
Crossroads Car Wash	51st Ave NE & SR 531	342 Zone	J-553	3,526	5,000	5,000	5,000	3,000
Arlington Dry Kilns	19406 68th Dr NE	342 Zone	J-248	4,361	4,352	4,341	5,000	3,500
Presidents Elem. School	401 N French Ave	342 Zone	J-35	2,256	2,256	2,255	5,000	3,500
General Industrial	19009 62nd Ave NE	342 Zone	J-145	3,488	3,500	3,500	5,000	3,500
Arlington Hardware	215 N Olympic Ave	342 Zone	J-30	4,547	4,625	4,495	5,000	3,000
Smokey Point Distributing	17305 59th Ave NE	342 Zone	J-473	2,507	2,919	2,918	5,000	3,500
Arlington High School	18821 Crown Ridge Blvd	520 Zone	J-1089	1,532	1,539	1,523	2,682	1,500
Pioneer Elem. School	8213 Eaglefield Dr	520 Zone	J-431	1,831	1,838	1,817	3,771	3,500
Gleneagle Golf Clubhouse	7619 East Country Club Dr	520 Zone	J-194	2,342	2,349	2,320	4,113	3,250
Low Density Res./Rural-5[1]	Burn Rd & Old Burn Rd	540 Zone	J-353	940	940	920	3,773	1,000
Low Density Res./Rural-5[1]	196th St & Old Burn Rd	540 Zone	J-860	940	940	920	5,000	1,000
Low Density Res./Rural-5[1]	Burn Rd & McElroy Rd	710 Zone	J-354	940	918	888	5,000	1,000
Low Density Res./Rural-5[1]	Zaretzke Rd & ~183rd St NE	710 Zone	J-814	443	900	890	1,690	1,000
Low Density Res./Rural-5[1]	10310 195th St NE	710 Zone	J-598	940	915	887	1,405	1,000

(1) The existing target fire flow in the 540 and 710 Zones is 900 gpm.

7.6.4 Other Deficiencies

This section presents a summary of deficiencies not related to the capacity of the mains. These deficiencies will be eliminated upon completion of the proposed improvements that are presented in **Chapter 9**.

Several areas throughout the system have sufficient fire flow; however, high water velocities are experienced in the system because the water mains are undersized to carry the fire flows at acceptable water velocities. Operating the system with high water velocities can potentially damage the system due to the high surge pressures that commonly occur with high water velocities. Water main improvements identified in **Chapter 9** have been sized to prevent water velocities from exceeding 10 feet per second.

Some areas of the system have water mains that are more than 50 years old, which is beyond the average life expectancy of water mains. Most of the older water mains are located in the City's downtown area in the 342 Zone.

Approximately 10.4 percent of the City's water main is asbestos cement (AC). Most of the AC pipe is located in downtown Arlington and near the Arlington Airport. Several important water mains are also AC pipe, including the water main water main adjacent to Cascade Valley Hospital, Haller Middle School, and President's Elementary School.

The City is planning to replace these mains in the future, as shown in the schedule of planned improvements in **Chapter 9**. All new water main installations are required to use cement-mortar lined ductile iron water main in accordance with the City's Public Works Design and Construction Standards and Specifications, of which Chapter 2 is included in **Appendix D**.

7.7 PRESSURE REDUCING STATIONS

This section evaluates the City's existing pressure reducing stations to identify deficiencies related to their current condition and operation capability.

7.7.1 Evaluation and Deficiencies

The City has a total of seven operational pressure reducing stations, all of which are less than (approximately) 20 years old. Five of the pressure reducing stations transfer water from the 520 Zone to the 342 Zone during a fire flow event or other drop in pressure within the lower zone. All five pressure reducing stations are functioning properly. Some of the stations have drainage issues, which can interfere with access to the valves and piping.

The two remaining PRV stations are located along Burn Road and reduce the pressure from the PUD wholesale supply source. These PRVs are operating properly. Proposed improvements for additional pressure reducing stations are addressed in **Chapter 9**.

7.8 TELEMETRY AND SUPERVISORY CONTROL SYSTEM

This section evaluates the City's existing telemetry and supervisory control system to identify deficiencies related to its condition and current operational capability.

7.8.1 Evaluation and Deficiencies

The City's telemetry system was installed in 2001, and remote telemetry units are installed at all of the major water system facilities except the Burn Road Reservoir (now offline) and the PUD master meter. The existing remote telemetry units are linked to the master telemetry unit with bridged-circuit telephone lines.

7.9 SYSTEM CAPACITY

This section evaluates the capacity of the City's existing and future water system components (supply, storage, transmission, and water rights) to determine the maximum number of ERUs it can serve. Once established, system capacity becomes useful in determining how much capacity is available in the water system to support new customers that apply for water service through the building permit process. The system capacity information, together with the projected growth of the system expressed in ERUs, as shown in **Chart 4-5** of **Chapter 4**, also provides the City with a schedule of when additional system capacity is needed.

7.9.1 Analysis Criteria

The capacity of the City's system was determined from the limiting capacity of the water rights, supply, storage, and transmission facilities. The supply capacity analysis was based on two operating areas; the 342 and 520 Zones, and the 540/615 and 710 Zones. The supply capacity analysis was based on the combined MDD of the 342 and 520 Zones and the combined PHD and the maximum fire flow requirement of the 540/615 and 710 Zones. Since the City's water treatment plant capacity is equal to the capacity of the Haller Wellfield, a separate analysis was not completed for the capacity of the water treatment facility. The transmission capacity analysis was based on the total capacity of the transmission system for the supply sources and the system's MDD per ERU.

The storage capacity analysis was based on the storage capacity for equalizing and standby storage, and the computed storage requirement per ERU. Operational, dead, and fire flow storage capacity were excluded from the storage analyses because these components are not directly determined by water demand or ERUs. For the analyses, a reserve amount equivalent to the existing operational, dead, and fire flow storage requirements was deducted from the total available storage capacity to determine the storage capacity available for equalizing and standby storage. This storage capacity available for equalizing and standby storage was divided by the existing number of ERUs presented in **Chapter 4** to determine the storage requirement per ERU. The annual water rights capacity evaluation was based on the existing annual water rights, as summarized in **Chapter 6**, and the system's ADD per ERU. The instantaneous water rights capacity evaluation was based on the existing instantaneous water rights, as summarized in **Chapter 6**, and the system's MDD per

ERU. The ERU-based demand data was derived from the ADD of the system and demand peaking factors from **Chapter 4**.

7.9.2 Existing Capacity Analysis Results

A summary of the results of the existing system capacity analysis is shown in **Table 7-12**. The results indicate that the limiting capacity of the system is supply, which can support up to a maximum of approximately 8,282 ERUs. The existing water system has a surplus of approximately 577 ERUs. All other water system components also have sufficient capacity to support existing water system customers.

Table 7-12

Existing System Capacity Analysis

Demands Per ERU Basis	
Average Day Demand Per ERU (gal/day)	204
Maximum Day Demand Per ERU (gal/day)	357
Peak Hour Demand Per ERU (gal/day)	645
Supply	
Limiting Supply Rate - Source Capacities (gal/day)	3,022,982
Maximum Supply Capacity (ERUs)	8,282
Storage Capacity	
Maximum Equalizing & Standby Storage Capacity (gal)	2,158,234
Existing ES & SB Storage Requirements (gal)	1,969,433
Equalizing & Standby Storage Requirement Per ERU (gal)	256
Maximum Storage Capacity (ERUs)	8,444
Transmission Capacity	
Limiting Transmission Capacity (gal/day)	6,204,200
Maximum Day Demand Per ERU (gal/day)	357
Maximum Transmission Capacity (ERUs)	17,367
Annual Water Rights and Wholesale Supply Capacity	
Annual Water Right & Wholesale Supply Capacity (gal/day)	5,209,920
Average Day Demand Per ERU (gal/day)	204
Maximum Annual Water Right Capacity (ERUs)	25,521
Instantaneous Water Rights and Wholesale Supply Capacity	
Instantaneous Water Right & Wholesale Supply Capacity (gal/day)	6,379,200
Maximum Day Demand Per ERU (gal/day)	357
Maximum Instantaneous Capacity (ERUs)	17,857
Maximum System Capacity	
Based on Limiting Facility - Supply Capacity	8,282
Unused Available System Capacity	
Maximum System Capacity (ERUs)	8,282
Existing (2014) ERUs	7,705
Surplus Capacity (ERUs)	577

7.9.3 Future Capacity Analysis Results

A summary of the results of the six-year projected system capacity analysis is shown in **Table 7-13**. The six-year projected system capacity analysis includes improvements that are planned to be completed within the six-year planning period, as described in **Chapter 9**. These improvements include the construction of New Supply Well No. 1. The results of the 2014 system capacity analyses indicate that the proposed improvements will increase the system capacity to approximately 10,115 ERUs based on the limiting component of the City's supply system. The future water system will have a surplus of approximately 813 ERUs with the construction of these improvements.

Table 7-13

2020 Future System Capacity Analysis with New Supply Well No. 1

Demands Per ERU Basis	
Average Day Demand Per ERU (gal/day)	185
Maximum Day Demand Per ERU (gal/day)	325
Peak Hour Demand Per ERU (gal/day)	586
Supply	
Limiting Supply Rate - Source Capacities (gal/day)	3,283,200
Maximum Supply Capacity (ERUs)	10,115
Storage Capacity	
Maximum Equalizing & Standby Storage Capacity (gal)	2,158,234
Existing ES & SB Storage Requirements (gal)	19,113
Equalizing & Standby Storage Requirement Per ERU (gal)	208
Maximum Storage Capacity (ERUs)	10,359
Transmission Capacity	
Limiting Transmission Capacity (gal/day)	6,204,200
Maximum Day Demand Per ERU (gal/day)	325
Maximum Transmission Capacity (ERUs)	19,113
Annual Water Rights and Wholesale Supply Capacity	
Annual Water Right & Wholesale Supply Capacity (gal/day)	5,209,920
Average Day Demand Per ERU (gal/day)	185
Maximum Annual Water Right Capacity (ERUs)	28,088
Instantaneous Water Rights and Wholesale Supply Capacity	
Instantaneous Water Right & Wholesale Supply Capacity (gal/day)	6,379,200
Maximum Day Demand Per ERU (gal/day)	325
Maximum Instantaneous Capacity (ERUs)	19,652
Maximum System Capacity	
Based on Limiting Facility - Supply Capacity	10,115
Unused Available System Capacity	
Maximum System Capacity (ERUs)	10,115
Projected (2020) ERUs	9,302
Surplus Capacity (ERUs)	813

A summary of the results of the 10-year projected system capacity analysis is shown in **Table 7-14**. The 10-year projected system capacity analysis includes improvements that are planned to be completed within the 10-year planning period, as described in **Chapter 9**. These improvements include the construction of New Supply Well No. 1 and No. 2. The results of the 2024 system capacity analyses indicate that the proposed improvements will increase the system capacity to approximately 10,659 ERUs based on the limiting component of the City's storage system. The future water system will have a surplus of approximately 286 ERUs with the construction of these improvements.

Table 7-14

2024 Future System Capacity Analysis with New Supply Well Nos. 1 and 2

Demands Per ERU Basis	
Average Day Demand Per ERU (gal/day)	185
Maximum Day Demand Per ERU (gal/day)	325
Peak Hour Demand Per ERU (gal/day)	586
Supply	
Limiting Supply Rate - Source Capacities (gal/day)	4,261,176
Maximum Supply Capacity (ERUs)	13,127
Storage Capacity	
Maximum Equalizing & Standby Storage Capacity (gal)	2,158,234
Existing ES & SB Storage Requirements (gal)	19,113
Equalizing & Standby Storage Requirement Per ERU (gal)	202
Maximum Storage Capacity (ERUs)	10,659
Transmission Capacity	
Limiting Transmission Capacity (gal/day)	6,204,200
Maximum Day Demand Per ERU (gal/day)	325
Maximum Transmission Capacity (ERUs)	19,113
Annual Water Rights and Wholesale Supply Capacity	
Annual Water Right & Wholesale Supply Capacity (gal/day)	5,209,920
Average Day Demand Per ERU (gal/day)	185
Maximum Annual Water Right Capacity (ERUs)	28,088
Instantaneous Water Rights and Wholesale Supply Capacity	
Instantaneous Water Right & Wholesale Supply Capacity (gal/day)	6,379,200
Maximum Day Demand Per ERU (gal/day)	325
Maximum Instantaneous Capacity (ERUs)	19,652
Maximum System Capacity	
Based on Limiting Facility - Storage Capacity	10,659
Unused Available System Capacity	
Maximum System Capacity (ERUs)	10,659
Projected (2024) ERUs	10,373
Surplus Capacity (ERUs)	286

8 Operations and Maintenance

8.1 INTRODUCTION

The City of Arlington's (City) water operations and maintenance program consists of the following elements.

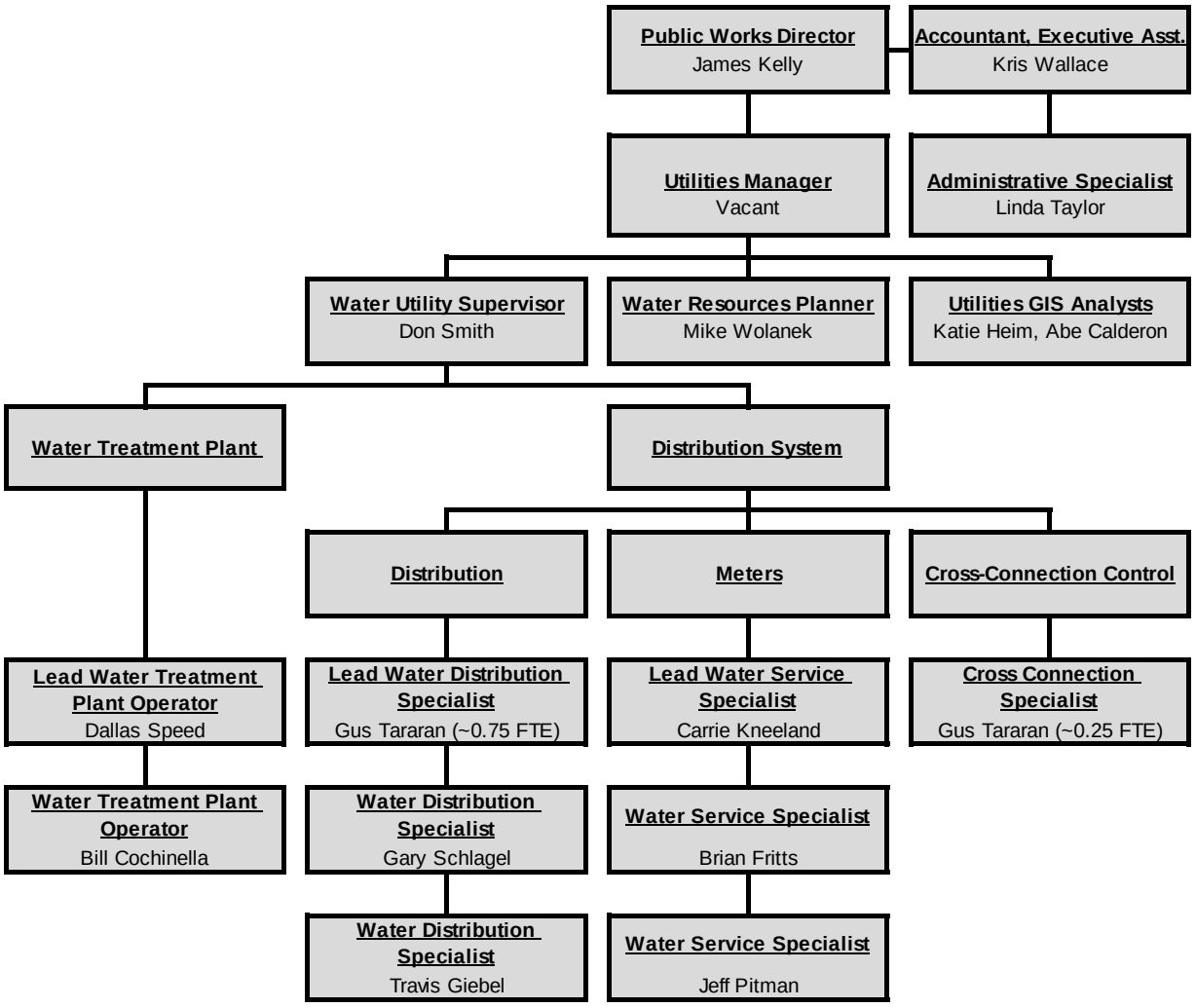
- Normal operation of the water supply, treatment and distribution systems.
- Emergency operation of the water system, when one or more of the components is not available for normal use due to natural or man-made events.
- A preventive maintenance program to ensure that the water system is receiving maintenance in accordance with generally accepted standards.
- A cross-connection control program, as required by law, to ensure that there is no compromise of the water system's integrity due to contamination introduced from a customer's operation.

8.2 NORMAL OPERATIONS

8.2.1 Organizational Structure

The City's Water Department is part of the Utilities Division of the Public Works Department. The Utilities Manager reports to the Public Works Director, Mr. James Kelly. The Utilities Manager position is currently vacant. The Water Utility Supervisor, Utilities and Administrative Specialists, Water Resources Planner and Utilities GIS Specialists normally report to the Utilities Manager, but report to the Public Works Director during vacancies of the Utilities Manager position. Operators and specialists of the water treatment plant and distribution system report to the Water Utility Supervisor, Mr. Don Smith. The department's organizational chart is shown in **Figure 8-1**. The essential functions of the various positions and groups are discussed later in this chapter.

Chart 8-1
Public Works Functional Organization Chart



The current water utility staff consists of WTP operators and distribution specialists who function under the Water Utility Supervisor, as shown in **Figure 8-1**. Each of these personnel perform routine operations and maintenance activities, including inspecting, testing, installing and repairing system facilities; routine operation and preventive maintenance; water quality sampling; regulatory compliance monitoring; recordkeeping; administrative tasks; general clerical work; and corrective or breakdown maintenance required in response to emergencies.

Washington State law (Chapter 246-292 WAC) requires that the City's water system be operated under the direct supervision of a certified operator, or a Water Utility Supervisor of appropriate class required by Health for the type of WTP managed. The water treatment process is required to be supervised by a certified Water Treatment Plant Operator appropriate for the complexity of the

treatment process. In addition, specialty certification is required for backflow device testing and cross-connection control program activities and management. **Table 8-1** shows the current certifications of the City's water operations and maintenance staff. It is City policy to maintain a well-qualified, technically trained staff. The City annually allocates funds for personnel training, certification and membership in professional organizations such as the American Water Works Association (AWWA). The City believes that the time and money invested in training, certification and professional organizations are repaid many times in improved safety, skills and confidence.

Table 8-1

Personnel Certification

Name	Position	Certification
Bill Cochinella	Water Treatment Plant Operator	WTPO-2, CCS
Brian Fritts	Water Service Specialist	WDS, CCS
Travis Giebel	Water Distribution Specialist	New employee in 2014 (WTPO-IT)
Jeff Pitman	Senior Water Distribution Specialist	WDM-2, WDS, WTPO-2, CCS
Gary Schlagel	Senior Water Distribution Specialist	WTPO-IT, WDS, CCS
Don Smith	Water Utility Supervisor	WDM-2, WDS, WTPO-3, CCS
Dallas Speed	Senior Water Treatment Plant Operator	WTPO-2, CCS
Gus Tararan	Cross-Connection Specialist	BAT, WDS, WTPO-IT, CCS
Carrie Young	Senior Water Service Specialist	WDM-2, WDS, WTPO-IT, CCS

Certification Definitions

BAT - Backflow Assembly Tester
CCS - Cross-Connection Control Specialist
IT - In Training
WDM - Water Distribution Manager
WDS - Water Distribution Specialist
WTPO - Water Treatment Plant Operator

8.2.2 Personnel Responsibilities

The key responsibilities of the water operations and maintenance management and staff are summarized below.

Public Works Director – Provides overall direction and guidance to the Public Works Department; approves priorities and activities; planning of capital projects; approval of fund expenditures; and functions as Utilities Manager during position vacancy.

Utilities Manager – Vacant. Supervises, organizes, directs and performs activities related to the operation and maintenance of the Utilities Department.

Water Utility Supervisor – Organizes, directs and performs activities related to the operation and maintenance of the City's water system, including treatment and distribution.

Water Resources Planner – Develops and administers water conservation, wellhead protection and watershed control programs; leads long-term water supply efforts, including water right acquisition and water use efficiency implementation; primary regulatory lead within utilities; meet integrated water resource management objectives through coordination between water, wastewater, and stormwater utilities, and through partnerships established across the basin; and assists with water quality programs and customer outreach.

Utilities GIS Analysts – Develop and administer a GIS database for the utility infrastructure, particularly distribution network; and develop and administer an asset management program for the utility, including integrating a work order process for maintenance and operations of the distribution network with the GIS database.

Public Works Accountant – Day to day financial management of all utilities; develops and tracks budgets; asset management; compiles staff timesheets; coordinates public works' affairs with the Finance Department; prepares reports for Department Heads, Executive Directors, and City Council; coordinates with state auditors as may be required.

Utilities Specialist – Vacant. Coordinates development and building permit review comments and ensures timely submittal of comments; calculates water and sewer fees for new connections; coordinates the business license review process for the utilities division; tracks employee reviews, training and certifications; and organizes and oversees as-built records and the filing system.

Administrative Specialist – Performs the administrative support and general secretarial duties for the utilities division; receives, resolves and/or directs responses to customer inquiries and complaints; calculates water and sewer fees for new connections; and assists with Cross-connection Control Program and database management; and administers bulk water and hydrant permit programs.

Water Treatment Plant Operator – Performs a variety of skilled tasks to efficiently operate and maintain the City's water treatment plant, including technical work to perform all routine and non-routine water treatment plant operations, maintenance and laboratory work.

Lead Water Distribution Specialist – Performs non-routine trouble shooting, maintenance, inspection, installation and repair work for the water distribution system; and directs all necessary routine water distribution system tasks.

Water Distribution Specialist – Performs all necessary routine activities in the installation, construction, maintenance, repair and testing of the water distribution system.

Water Service Specialist – Performs work in the installation, maintenance and repair of the City's water meters, and performs minor service repairs, reads meters and responds to customer inquiries regarding water usage.

Cross Connection Specialist – Administers the Cross-connection Control Program, including development reviews, backflow assembly inspection and testing, building permit inspections, well decommissioning, database maintenance and regulatory reporting; and assists water distribution specialists as needed.

8.2.3 Available Equipment

The water department has several types of equipment available for both routine and emergency operation and maintenance of the water system. The equipment is stored at the City's water treatment plant and at the City's maintenance yard. If additional equipment is required for specific projects, the City will rent or contract with a local contractor for the services needed. A stock of supplies in sufficient quantities for normal system operation and maintenance and short-term emergencies is stored at the water treatment plant. A list of major equipment and chemicals used in the normal operation of the water system is shown in **Table 8-2**. In addition, equipment from other City departments, such as wastewater, stormwater, street and parks, is available if needed.

The vactor truck has been acquired by the Stormwater Department since the previous WSP update, and is shared by all City utilities. It has become an integral part of Water Department operations, and emergency repair of main breaks in particular.

8.2.4 Service, Equipment and Supply Vendors

The list in **Table 8-3** identifies the typical vendors for service, materials, supplies and chemicals. The City maintains adequate supplies and materials for normal operation. The suppliers are local and maintain adequate materials for unusual needs.

8.2.5 Routine Operations

Routine operations involve the analysis, formulation and implementation of procedures to ensure that the facilities are functioning efficiently and meeting pressure and water quality requirements and other system demands. The utility's maintenance procedures are effective, with repairs being made promptly so customers receive high quality water service.

8.2.6 Continuity of Service

As a municipality, the City of Arlington has the structure, stability, authority and responsibility to ensure that water service will be continuous. For example, changes in the City Council or staff would not have a pronounced effect on the City's customers or quality of service.

Table 8-2

Water Department Equipment and Chemical Inventory

Quantity	Description	Size/Special Features
	Mobile Equipment Inventory	
1	Backhoe	
2	Dump Truck	12 ton, 6 ton
2	Emergency Generator	5 kW
1	Emergency Generator	1 kW
2	Pickup Truck	3/4 Ton
6	Pickup Truck	1/2 Ton
3	Portable Pumps	3 inch, 2.5 inch
2	Utility Trailer	Enclosed
1	Utility Trailer	Open
1	Vactor Truck	Shared by all utilities depts.
Varies	Miscellaneous Equipment	
	Chemical Inventory	
Varies	Calcium Thiosulfate	
Varies	Filter Aide	
Varies	Primary Coagulant	
Varies	Sodium Hydroxide	25 percent
Varies	Sodium Hypochlorite	0.8 and 12.5 percent

8.2.7 Routine Water Quality Sampling

Washington State Department of Health (DOH) has adopted federal regulations that specify minimum monitoring requirements for water systems. The sampling requirements depend on the population served, source type and treatment provided. The specific requirements are contained in WAC 246-290-300. The City currently performs all routine coliform sampling throughout the distribution system, taking a total of 15 samples each month. A further discussion of the water quality monitoring program is contained in **Chapter 6** and **Appendix H** of this Comprehensive Water System Plan (WSP).

8.2.8 Cross-Connection Control (CCC)

The City first drafted a Cross-Connection Control Program in 1999 to comply with state regulations (WAC 246-290-490) pertaining to contamination of potable water due to cross connections. The current Cross-Connection Control Program, revised in 2006 and 2010 and included without revision in this WSP in **Appendix G**, is a combination program between the City's Water Department and Building Department that permits the Water Department Cross-Connection Control Officer to regulate all cross-connection control devices. The staff members with Cross-Connection Control Specialist certifications are shown in **Table 8-1**.

Table 8-3

Service, Equipment and Supply Vendors List

Name	Address	Phone	Products
Engineering and Technical Services			
City Engineer	154 Cox Avenue, Arlington, WA 98223	360-403-3512	Engineering Support
RH2 Engineering, Inc.	12100 NE 195th Street, Suite 100 Bothell, WA 98011	425-951-5400 800-720-8052	Engineering Support
Brown and Caldwell	701 Pike St # 1200, Seattle, WA 98101	206-749-2257 206- 624-0100	Engineering Support
Pacific Groundwater Group	2377 Eastlake Avenue E Seattle, WA 98101	206-329-0141	Groundwater Engineering Support
Process Solutions	19155 62nd Avenue NE Arlington, WA 98223	360-403-7037	Control Systems (SCADA)
Adjacent Purveyors			
City of Marysville	80 Columbia Avenue Marysville, WA 98270	360-651-5100	Equipment, Materials, Labor
Snohomish County PUD	3301 Old Hartford Rd Lake Stevens, WA 98258	425-397-3000	Equipment, Materials, Labor and Emergency Water Supply
Laboratory and Analytical Services			
Edge Analytical	11525 Knudson Road Burlington, WA 98233	360-757-1400	Water Quality Testing
Materials and Supplies			
HB Jaeger	1830 16th Street, Snohomish, WA 98290	360-568-5958 425-486-5958	Pipes, Valves, Fittings
HD Fowler	6016 29th Drive NE Marysville, WA 98271	360-651-2400	Pipes, Valves, Fittings
Unit Process Co.	6600 Merrill Creek Parkway Everett, WA 98203	425-349-4242 800-833-8726	Bray Valves and Actuators
Summit Research Labs	45 River Road, Suite 300 Flemmington, NJ 08822	(360) 371-0246	Chemical (Primary Coagulant)
Clearbrook, Inc.	328 Nicolet Blvd Manasha, WA 54954	920-722-2243	Chemical (Filter Aid)
Univar	8201 S 212th Kent, WA 98032	253-872-5091	Chemical (Sodium Hydroxide & Sodium Hypochlorite)
Measurement Technologies, Inc.	P.O. Box 2195 Redmond, Washington 98073	877-889-8482 425-836-8683	Chemical (Calcium thiosulfate)
GC Systems, Inc.	2310 Inter Avenue Puyallup, WA 98372	800-525-9425	Control Valves
Equipment and Service			
PumpTech, Inc.	13251 Northup Way Bellevue, WA 98005	425-644-8501	Pumps and Service
Whitney Equipment, Inc.	21222 30th Drive SE Bothell, WA 98021	425-486-9499	Pumps and Service
Technical Controls	830 SW 34th Street, Suite E Renton, WA 98057	425-282-6030	Pumps and Service (LMI Metering Pumps)
Severn Trent Services	1077 Dell Avenue Campbell, CA 95008	360-710-5368 800-524-6542	Equipment and Service (Chlorine Generator)
TMG Services	898 Valentine Avenue SE Pacific, WA 98047	253-891-0247 800-562-2310	Equipment and Service (Chlorine Analyzer)
Generator Services Northwest	3229 152nd St SW, Lynnwood, WA 98087	425-745-2096	Service and Repair (Generator)
Control Contractors, Inc.	5300 Denver Avenue S Seattle, WA 98108	206-328-1730	Service and Repair (HVAC)

8.2.9 Backwash Waste Discharge to Wetland

Effective November 2014, the City modified its operations with regard to the effluent generated during maintenance of the filter trains within the WTP. Prior to this date, all backwash used to maintain the clarifier and filters of the three treatment trains discharged directly to the Water Reclamation Facility (WRF). Depending on the changing characteristics of the effluent through the various backwash cycles, it is now discharged either to the WRF, or to a constructed treatment wetland west of the WTP. The wetland also receives stormwater runoff from Old Town Arlington, and reclaimed water from the WRF. At the time of this WSP update, the portion of daily backwash waste discharged from the WTP to the wetland has ranged from 45% to 80%, and averages 70%. This benefits the wetland, by maintaining its hydrology, as well as the WRF, by not diluting the mixed liquor in the membrane bioreactors. Discharging to the wetland requires the City to operate under an NPDES permit for discharges of waste to waters of the State. Although the wetland itself is not considered a water of the State, it does overflow to the Stillaguamish River. A copy of the NPDES permit is included in **Appendix R**.

8.2.10 Recordkeeping and Reporting

DOH has enacted regulations for recordkeeping and reporting procedures for operations and water quality testing that may be found in WAC 246-290-480.

Recordkeeping

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

- Bacteriological analysis results: five years.
- Chemical analysis results: for as long as the system is in operation.
- Daily source meter readings: ten years.
- Water treatment plant records: ten years.
- Other records of operation and analyses as may be required by DOH: three years.
- Documentation of actions to correct violations of primary drinking water standards: three years after last corrective action.
- Records of sanitary surveys: ten years.
- Project reports, construction documents and drawings, construction completion (inspection) reports and approvals: life of the facility. A project completion report form is included in **Appendix D**.
- Backwash volume and quality data and reports for NPDES discharge permit: 5 years
- Where applicable, daily records of chlorine residual, fluoride level, water treatment plant performance and turbidity: three years.

The City's recordkeeping procedure is as follows.

1. Data is recorded daily at all sites, and monthly logs are kept in a folder at the utilities office or water treatment plant.
2. Monthly reports for the water treatment plant are automated for calculations.
3. Service information is entered into an Access database.

Reporting

The City must report the following to DOH:

- Within 48 hours: A failure to comply with the primary standards or treatment technique requirements specified in Chapter 246-290 WAC;
- Within 48 hours: A failure to comply with the monitoring requirements specified in Chapter 246-290 WAC;
- Within 48 hours: A violation of a primary maximum contaminant level (MCL);
- Within one business day: A backflow incident, per WAC 246-290-490 (8)f; and
- As soon as possible, but no later than 24 hours after the violation is known: National Primary Drinking Water Regulation (NPDWR) violations and situations with significant potential to have serious adverse effect on human health as a result of short-term exposure, which require Tier 1 public notices per 40 CFR 141.202.

The City must submit all applicable reports to DOH as required by Chapter 246-290 WAC. Monthly reports are due by the tenth day of the following month, unless otherwise specified. Daily and annual source meter readings must be made available to DOH on request. Records regarding the status of monitoring waivers must be submitted during each monitoring cycle. Waiver information is updated annually by DOH, and the utility is provided with a testing schedule.

A water facilities inventory and report form (WFI) must be submitted to DOH within 30 days of any change in name, category, ownership or responsibility for management of the water system.

The City must notify DOH of the presence of:

- Coliform in a sample within ten days of notification by the testing laboratory; and
- Fecal coliform or E. coli in a sample by the end of the business day in which the City is notified by the testing laboratory.

When a coliform MCL violation is determined, the City must:

- Notify DOH within 24 hours of determining acute coliform MCL violations;

- Notify DOH before the end of the next business day when a non-acute coliform MCL is determined; and
- Notify water customers in accordance with WAC 246-290-71001 through 71007 and the Environmental Protection Agency's (EPA) Public Notification Rule.

If volatile organic compound monitoring is required, a copy of the results of the monitoring and any public notice must be sent to DOH within 30 days of receipt of the test results.

The City must report the following to Ecology:

- By the 15th of each month: Discharge Monitoring Report (DMR) containing discharge volumes water quality monitoring results for parameters required by the NPDES permit. A failure to comply with the primary standards or treatment technique requirements specified in Chapter 246-290 WAC;
- Immediately, as necessary: notifications of non-compliance, planned bypass, changes in operations and maintenance, and spills or other discharges.

Other Reports

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

8.2.11 Operations and Maintenance Records

Facilities Operations and Maintenance Manuals

Operations and maintenance manuals are available for staff member's reference. These manuals are kept on file at the water treatment plant and utilities office. The City intends to maintain its policies of requiring complete operation and maintenance manuals for all new equipment and facilities.

Mapping and As-Built Drawing Records

Maintenance of as-built drawings is essential to maintenance crews, city planners, developers and anyone else needing to know how the water system is laid out. The drawing records are stored in an organized file at the utilities office and are maintained by the utilities department. The City is in the process of filing all existing and new drawings in portable document format (pdf files, using Adobe Acrobat), and making them available to staff through a searchable electronic engineering library.

Operations and Maintenance Records

Records are stored at the Water Department or on the City's computer network for nearly every asset or process, including but not limited to:

- Backflow and cross-connections
- Bacteriological tests
- Backwash quality and discharge
- Billing and consumption records
- Chlorination levels
- Confined spaces
- Customer complaints
- Hydrant repairs
- Hydrant meter forms
- Hydrant databases
- Inorganic chemical tests
- Lead and copper tests
- Precipitation
- Pump motor tests
- Synthetic organic compound tests
- Vandalism forms
- Volatile organic compound tests
- Water balance
- Water used for construction
- Water maintenance
- Water main notes
- Water worksheets
- Water main flushing
- Water samples from new developments
- Well sounding and static water levels

8.2.12 Safety Procedures and Equipment

Safety is the concern and responsibility of all water operations and maintenance staff. To maintain the highest level of safety, the City has taken steps toward educating its staff and providing resources to ensure a safe working environment. The City continuously improves the safety program as the requirements and affected operations change. The American Water Works Association publishes a manual entitled *Safety Practices for Water Utilities* (M3) that describes safety programs and provides guidelines for safe work practices and techniques for a variety of water utility work situations.

The following procedures should be followed for operations and maintenance tasks that involve the most common potential workplace hazards in the City's water system. Many of these procedures are written in greater detail and on file at Water Department offices.

Use of Chlorine, Chlorine Products, Primary Coagulant, Filter Aide and Calcium Thiosulfate

Standard Procedure – Handle with care, provide adequate ventilation, and wear safety glasses and rubber gloves.

Sodium Hydroxide

Standard Procedure – Handle with care, provide adequate ventilation, wear safety goggles, apron and rubber gloves. Keep the container tightly closed and store in a dry, corrosion-proof area. Protect from unintentional contact with water. Never return contaminated material to its original

container. Immediately contact the chemical supplier/manufacturer for handling instructions if drums of caustic appear to be swollen.

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. Certified flaggers are to be used when traffic management requires flagging around a work site.

Working on or around Water Reservoirs

Standard Procedure – Follow proper safety harness procedures for working on tall structures. Entry into a reservoir is a confined space work area, and those regulations and procedures apply.

Working in or around Pump Stations

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

Working on Asbestos Cement (AC) Water Main

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

The water utility personnel are required to take training courses on the following topics.

- Asbestos Cement Pipe Handling
- Confined Space Entry
- Hazardous Waste
- Fall Protection
- Hearing Protection
- Competent Persons
- Laboratory Safety
- Electrical Hazards
- Heavy Equipment Operation
- CPR and First Aid
- Blood-borne Pathogens
- Traffic Flagging
- Lockout-Tag out

The City's facilities are equipped with confined space entry equipment, oxygen-gas meters and lockout-tag out equipment where appropriate. Each City vehicle is equipped with first aid and

blood-borne handling kits, fire extinguishers and road safety equipment. The City also owns flagging signs and equipment for the safe handling of traffic.

The Public Works Department follows all appropriate OSHA and 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.

8.3 EMERGENCY OPERATIONS

8.3.1 Capabilities

The City is equipped to accommodate short-term system failures and abnormalities. The general water system emergency response capabilities are as follows.

Multiple Supply Capability

The City could lose the operation of one of its groundwater wells without adversely impacting its ability to meet the normal demands of its customers. The City currently has three operational wells that could be used to provide customers with water in an emergency. In the event that a water treatment plant train is out of service, there are two other trains to continue treatment of the Haller Wellfield water. The City also has an intertie with the Snohomish County PUD No. 1 (PUD) that could be used to augment supply to the system in the event that a well is out of service.

The diversity of the City's water sources worked extremely well during the very large landslide which impacted the North Fork Stillaguamish River at Oso in March 2014. The City temporarily shut-down the Haller well field and WTP until the river conditions and risk to riverbank facilities could be assessed (a period of hours). The City continued to operate the Haller well field and WTP at reduced levels while increasing supplies at the airport and PUD sources (a period lasting days to months). This allowed staff to monitor influent water turbidity levels, effects on treatment processes, and assess the water quality impacts on the raw water in the Stillaguamish River.

An emergency intertie established in 1978 between the City's distribution system and the City of Marysville (Marysville) Ranney Well Transmission Main and the City's water system has since been abandoned. However, the new Marysville water treatment plant, which is located within Arlington City limits, could provide supply directly to the City's 342 Zone with a booster pump

station and the City could also directly supply Marysville's 240 Zone with a pressure reducing station.

Multiple Reservoirs

Water storage is provided by three active reservoirs located at two sites, as the Burn Road reservoir was taken off-line in 2014 for safety concerns related to the age of the reservoir and the stability of the slope. The loss of the Burn Road reservoir removes the redundancy it provided to the 342 Zone and the Gleneagle reservoir when it is out of service for cleaning, painting or repairs. Several pressure reducing stations allow discharge of water from the 520 Zone to the 342 Zone, however. The 520 Zone Booster Pump Station provides the capability to distribute water to the 520 Zone from the 342 Zone when the 520 Zone Reservoir or PUD intertie is out of service.

Distribution System

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

Emergency Equipment

The City is equipped with the necessary tools to deal with common emergencies. If a more serious emergency should develop, the City will hire a local contractor to make repairs to alleviate the emergency condition. A vactor truck was acquired by the Stormwater Department since the previous WSP update, and is shared by all City utilities. It has become an integral in the emergency repair of main breaks.

Emergency Communications

The Water Department has a published emergency number (360-386-5926) for the public to directly contact water department personnel. The police and other City departments can also reach any member of the water department via employee cell phones or home contact numbers. Emergency contact information, including cell phone and home phone numbers, is provided to each City department.

The Water Department is also outfitted for emergency radio communications (as are the Wastewater and Stormwater Departments). Each vehicle that may respond in an emergency is equipped with two-way radios. The Public Works Administration and the Water Reclamation Facility offices are also equipped with base units for radio communications with field crews. The Administration office has also been identified as an Emergency Operations Center (EOC) for use as needed during certain emergencies.

On-call Personnel

The designated on-call person is equipped with a service vehicle and required to respond to a call within 30 minutes, but can often respond to a call within 15 minutes. A list of emergency telephone numbers is provided to each on-call employee. New employees are not placed on-call

until they are familiar with the water system and maintenance procedures and are properly certified by the State of Washington.

Contacts

The City maintains a list of adjacent utility contacts for routine and emergency use, shown in **Table 8-4**.

Table 8-4

Utility and Agency Contacts

Agency	Contact	Phone*	Address
Utility Contacts			
City of Marysville	Public Works	360-363-8161 (W) 360-363-8100 (PW)	80 Columbia Avenue Marysville, WA 98270
City of Everett	Water Dept.	425-257-8800 (W) 425-257-8821 (E)	3200 Cedar Street Everett, WA 98201
City of Stanwood	Water Division	360-629-9781 (W, E)	10220 270th Street NW Stanwood, WA 98292
Snohomish County PUD	Water Operations Center	425-397-3000 (W) 877-783-1000 (E)	3301 Old Hartford Rd. Lake Stevens, WA 98258
Tatoosh Water Company	Administration	360-629-6800 (W)	1624 300th Street NW Stanwood, WA 98292
Agency Contacts			
Washington State Department of Health	Richard Rodriguez Erika Lindsey Emergency	253-395-6771 (W) 253- 395-6766 (W) 877-481-4901 (E)	20425 72nd Ave. South, Building 2, Suite 310 Kent, WA 98032-2358
Washington State Department of Ecology	Tonya Lane Spill Emergency	425-649-7050 (W) 800-424-8802 (E)	3190 160th Avenue SE Bellevue, WA 98008-5452

*Phone Key: (W) = Water business; (PW) = Public Works; (E) = Emergency

Material Readiness

Some critical repair parts, tools and equipment are kept on-hand and in fully operational condition. As repair parts are used, they are re-ordered. Inventories are kept current and are adequate for most common emergencies that can reasonably be anticipated. The City has ready access to an inventory of repair parts, including parts required for repair of each type and size of pipe within the service area. Additionally, the City has been provided with after-hours emergency contact phone numbers for key material suppliers, which gives the City 24-hour access to parts not kept in inventory.

Mutual Aid Agreement

In addition to the above considerations, the City is a signatory to a 2006 Water and Sewer Mutual Aid Agreement with multiple Snohomish County water purveyors. The agreement provides the opportunity for sharing of equipment, personnel, materials and other resources during emergencies. The agreement is invoked at the request of the City Mayor to neighboring water purveyors. During emergencies the Public Works Director is the primary contact and the Water Utility Supervisor is the secondary contact. A contact list for all participating purveyors was last updated in 2013. A copy of the 2006 Agreement and the 2013 Contact List is contained in **Appendix P**.

The City is not currently a member of WA-WARN, a similar but separate network of water and wastewater systems which facilitates the provision of rapid mutual aid and assistance from member utilities in an emergency.

8.3.2 Emergency Response Plan and Vulnerability Assessment

An *Emergency Response Plan* and a vulnerability assessment was prepared in February 2003 to comply with the requirements of the Bioterrorism Act of 2002. The documents contain a vulnerability assessment of the City's water system facilities, a contingency operation plan for responding to emergency events, a list of water personnel responsible for making decisions in emergency situations and other elements. The Vulnerability Assessment and Emergency Response Plan also contain detailed action plans and other confidential information that is exempt from public disclosure under the provisions of *RCW 42.56.210*. They are available for review by authorized personnel on a need to know basis. The City recognizes this plan needs to be updated with new contact information and additional details for selected response procedures. A team of City utility staff is anticipated to convene in 2016 to begin the update process.

8.3.3 Public Notification

Kristen Banfield is the City's Human Resources & Communications Director, and is responsible for speaking on behalf of the City in the event that a public notice is required.

The federal Safe Drinking Water Act (SDWA), WAC 246-290-71001 through 71007 and the EPA Public Notification Rule require purveyors to notify their customers if any of the following conditions occur.

- National Primary Drinking Water Regulations (NPDWR) violations.
- 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 Chapter 246-290 WAC.
- Operation under a variance or exemption.

- Failure to comply with the requirements of any schedule that has been set under a variance or exemption.
- Failure to comply with testing procedures as prescribed by drinking water regulations.
- Occurrence of a water-borne disease outbreak or other water-borne emergency.
- Exceedance of the secondary maximum contaminant level (SMCL) for fluoride.
- Availability of unregulated contaminant monitoring data.
- Issuance of a departmental order.
- Failure to comply with a departmental order.
- Issuance of a category red operating permit by DOH.

Public notice requirements for each type of violation or situation are organized into three tiers per 40 CFR 141.201 through 208 and are based on the seriousness of the violation and the potential for adverse health effects. Tier 1 public notices are required for NPDWR violations and situations with significant potential to have serious adverse effects on human health as a result of short-term exposure. Public notices in this tier must be provided as soon as possible (no later than 24 hours after the violation is known). DOH must also be notified within this timeframe, and it may require repeat or additional notices.

Tier 2 public notices are required for all other NPDWR violations and situations not covered in Tier 1 with the potential to have serious adverse effects on human health. Public notices under Tier 2 requirements, with the exception of turbidity violations, must be provided as soon as possible, but no later than 30 days after the violation is known. Turbidity violations must be reported to DOH as soon as possible, but no later than 24 hours after the violation is known, to determine whether a Tier 1 public notice will be necessary. Repeat notices must be issued for as long as the violation persists.

All other NPDWR violations and situations not included in Tier 1 and Tier 2 are grouped within Tier 3. Tier 3 public notices must be provided within one year of the City learning of the violation or beginning operations under a variance or exemption. The notice must be repeated annually for as long as the violation, variance, exemption or other situation persists.

8.4 PREVENTIVE MAINTENANCE

Maintenance schedules that meet or exceed manufacturer's recommendations have been established for all critical components in the water system. The following schedules are used as a minimum for preventive maintenance, and manufacturer's recommendations should be followed where conflict exists.

Storage Facilities

Daily	Visual and audio inspections. Check security and inspect facilities for proper operation.
Annually	Check interior condition, vents, hatches, etc. on tanks.
Every 5 years	Underwater video inspections.
As Needed	Clean and/or repaint interior and exterior as needed on tanks (estimated 10 to 20 year frequency).

Distribution System

Annually or As Needed	Leak survey.
Semi-Annually	Flushing.

Wells

Daily	Log and record volume delivered and current supply rate; visual and audio inspection; check oil level (Airport Well only); check packing; check security; check for excessive heat and vibration of pump motors.
Annually	Check all valves and screens; check control valve settings; re-grease; change oil (Airport Well only).
As Needed	Maintain electrical and mechanical equipment; paint structures and piping; calibrate equipment; replace o-rings and diaphragms in equipment.

Water Treatment Plant

Daily	Log and record run hours, motor starts, chemicals used, chemicals added, chlorine solution generated, fuse indicators, backwash volumes, volume delivered and current supply rate; visually inspect pumps; check pump packing; check pump oil levels; check all equipment for proper function and operation; check security.
Monthly	Exercise the emergency eyewash and emergency shower. Confirm charge on fire extinguishers and rotate per vendor service plan.
Quarterly	Measure treatment train media.
Annually	Check all valves and screens; check control valve settings; re-grease pumps; change pump oil.
As Needed	Maintain electrical and mechanical equipment; paint structures and piping; equipment calibration; indoor and outdoor facility maintenance and repairs.

Booster Pump Stations

Daily	Visual and audio inspection; check security; check pump motors for excessive heat and vibration.
Weekly	Observe and record motor current draw (three phases); log and record volume delivered and pump motor hours; check motor oil level; measure and record discharge pressure; check motor noise, temperature and vibration.
Annually	Take inventory of parts, pumps and motors.
As Needed	Calibrate flow meter; maintain electrical and mechanical equipment; paint structures and piping; routine maintenance of equipment.

Engine Generator Sets (WTP, Booster Pump Station)

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

Pressure Reducing Stations

Annually	Flush and check all valves and screens; check pressure settings.
As Needed	Rebuild and paint every five years or as necessary.

Interties

Annually	Review intertie procedures, if any, with adjacent utilities.

Isolation Valves

5 to 10 Year Intervals	Operate fully open and closed; uncover where buried; clean out valve boxes and repair as necessary. Repair and/or install valve marker posts as necessary.

Hydrants

Year 1 (of 2-year cycle)	Check for leakage and visual damage. Operate and flush; lubricate as necessary; measure pressure. Check nozzle and cap threads, and clean and lubricate per manufacturer's recommendations. Replace lost and damaged gaskets. Inspect drain system to ensure proper drainage and protection from freezing weather. Check and operate the auxiliary valve in accordance with the valve maintenance schedule. Leave in open position.
Year 2 (of 2-year cycle)	Check for leakage and visual damage. Clean exterior and paint as necessary. Landscape as needed for accessibility (repeat more often if necessary).

Meters

Annually	WTP raw and finished water meters are serviced and calibrated annually by a third-party vendor. Service and calibration records are maintained at the WTP.
2 to 5 Year Intervals	The source meter at the Airport Wellfield is serviced and calibrated as needed. The meter at the 520 Booster Pump Station is service and calibrated as needed. Service includes: time and measure volume of meter-delivered flow; dismantle, clean and inspect all parts; replace worn or defective parts; retest meter for accuracy. The PUD source meter is maintained by the PUD.
2 to 30 Year Intervals	Customer meters shall be replaced when reading problems are encountered.

Air and Vacuum Release Valve Assemblies

Annually	Flush and inspect, repair as needed.

Blowoff Assemblies

Annually	Flush and inspect, repair as needed.

Telemetry and Control System

Daily	Backup program and data.
Monthly	Visually inspect cabinets and panels for damage, dust and debris.
Semi-Annually	Inspect the inside of cabinets and panels for damage, dust and debris. Vacuum clean all modules. Test alarm indicator units. Clean and flush all pressure sensitive devices. Visually inspect all meters to coordinate remote stations.
Annually	Check master and remote telemetry units for proper operation; repair as necessary.

Tools and Equipment

Rolling Stock	
Weekly	Check all fluid levels and brakes. Fluid levels and brakes are checked each time the equipment is used if less than weekly.
As Needed	Replace fluids and filters in accordance with manufacturer's recommendations (or more frequently depending on type of use); preventive maintenance per manufacturer's recommendation.
Tools	
As Needed	Clean after each use; lubricate and maintain as necessary; inspect for damage and wear before each use; preventive maintenance performed per manufacturer's recommendation.

8.5 STAFFING

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

8.5.1 Current Staff

The current staff includes management and supervisory personnel, operators, maintenance workers and office personnel engaged in operating and maintaining the water system. There are currently eight field crew and two supervisory personnel in the operations and maintenance organization that support the City's water system. The Public Works Director (serving as the Utilities Manager)

the Water Resources Planner, and the Utilities Specialist each support the City's water, wastewater, and stormwater utilities; thus, only a portion of their time is available for the water utility. Therefore, the water utility is supported by approximately ten full-time staff equivalents.

8.5.2 Current Staff Required

The amount of time annually available for each staff member for operations and preventative maintenance of the water system is shown in **Table 8-5**.

Table 8-5

Time Available Per Year Per Person

Beginning Hours Available	2,080
Less average vacation of 3 weeks per year	-120
Less average sick leave of 2 weeks per year	-80
Less holidays of 10 days per year	-80
Less average training of 40 hours per year	-40
Less average small tasks other than above of 1 hour per day	-220
Net Available Hours Per Year Per Person	1,540

The estimated hours of work required to achieve optimum operation and maintenance of the water system is shown in **Table 8-6**. The table identifies the staffing time for maintenance tasks, operational tasks, capital improvements and construction of water system facilities. The upper section of the tables identifies the staffing time requirements for recommended preventive maintenance tasks, and the lower section identifies the staffing time requirements for recommended operations tasks. The estimates of the time required for each component are based on a composite of similarly sized utilities in the region that are considered to have a responsible preventive and corrective water system maintenance program.

The regional productivity rates are modified as appropriate to reflect the characteristics of the utility being analyzed. System complexity and geographic characteristics can have a significant impact on productivity. The City's characteristics were considered when adjusting the regional values in this analysis.

To achieve the level of operations and maintenance shown in **Table 8-6**, approximately 10.2 full-time personnel are required for the water system alone. The City's current available water system staff is sufficient to meet these requirements. At the current staffing level, the City is capable of adequately operating the water system, complying with the minimum DOH and Ecology requirements and accomplishing the preventive maintenance tasks at the desired frequency listed previously in this chapter. The City will add staff in the future, as necessary and as allowed by budget, to meet the increasing requirements of system operation and maintenance, due to customer growth and increased regulatory requirements.

Table 8-6

Current Staff Required

Description	Total Units In System	Frequency (Times/Year)	Time/Unit (Hours)	Time/Year (Hours)
Preventive Maintenance				
Hydrants	800	0.25	0.5	100
Isolation Valves, Hydrant Valves	2,000	0.1	0.25	50
Air and Vacuum Release Valves	10	1	0.5	5
Blowoff Assemblies	50	1	0.25	13
Meters	5,147	0.1	2	1,029
Leak Survey of Water Mains	89 miles	1	0.5	45
Flushing Water Mains	89 miles	1	5	445
Booster Pump Station	1	1	40	40
Pressure Reducing Stations	8	1	6	48
Interties	3	1	6	18
Wells	4	1	50	200
Water Treatment Plant	1	1	4,620	4,620
Reservoirs	3	1	30	90
Telemetry and Control System	1	1	40	40
Operations				
Monitor System	10	260	0.3	780
False Alarm Response	1	12	2	24
Meter Reading	5,147	6	0.1	3,088
Groundskeeping	6	12	6	432
Inventory	1	1	40	40
Meter Repair/Replace	257	1	4	1,030
Main Breaks	1	4	8	32
System Failures	1	4	8	32
Hydrant Repairs	5	1	8	40
Service Connections	150	1	8	1,200
Main Connections	2	1	24	48
Water Quality Sampling	20	12	0.5	120
Administration	1	260	8	2,080
Total Staff Required				
Total Hours Required				15,689
Total Full Time Staff Required	**(based on 1,540 hours per year per person)**			**10.2**

9 Water System Improvements

9.1 INTRODUCTION

This chapter presents proposed improvements to the City of Arlington (City) water system that are necessary to resolve existing system insufficiencies and accommodate the projected growth of water customers. The water system improvements were identified from an evaluation of the results of the water system analyses presented in **Chapter 7**. The water system improvements have been sized to meet both the existing and future demand conditions of the system.

A Capital Improvement Program (CIP) number has been assigned to each proposed improvement. Numbers were assigned to the improvements starting at the north end of the system, and in general, incrementally increase to the south, as shown in **Figure 9-1**, a plan view of the improvements. The improvements are also illustrated in the hydraulic profile of the future water system that is shown in **Figure 9-2**. The improvements are organized and presented in this chapter according to the following categories (next page): The remainder of this chapter presents a brief description of each group of improvements, the criteria for prioritizing, the basis for the cost estimates, and the implementation schedule.

- Water System Improvements Since Last Water System Plan
- Water Main (WM) Improvements
- Pressure Zone (PZ) Improvements
- Pressure Reducing Station Improvements
- Facility (F) Improvements
- Miscellaneous (M) Improvements
- Developer-funded (DF) Improvements

9.2 WATER SYSTEM IMPROVEMENTS SINCE LAST WATER SYSTEM PLAN

The water system has undergone several changes since 2011 when the City last updated its Comprehensive Water System Plan (WSP). The City has implemented numerous recommended projects from the 2011 CIP. One notable improvement is the conversion of the water main in 89th Avenue NE from the 520 Zone to the 710 Zone. This conversion increases pressures on 89th Avenue NE and eliminate dead storage in the 520 Zone. The City has also implemented numerous high priority asbestos cement (AC) water main replacement and water main extension projects. **Table 9-1** lists the water system improvements that have been completed since the last WSP. The CIP numbers shown in parenthesis correspond to the 2011 WSP.

Table 9-1

Improvements Completed Since Last Water System Plan

Project Description	Year	Diameter (inches)
Highway 9 Crossing 16" Water Main (WM4)	2012	16
Conversion of 342 Zone in 520 Zone in Cedarbough Loop (PZ3)	2012	8
Haller Wellfield Assessment (F5)	2012	n/a
Security System Improvements (M4)	2012	n/a
AC Water Main Replacement (Airport)	2012	8
AC Water Main Replacement (Lenore, Gifford, Washington) (24, 26, 31)	2012	12
AC Water Main Replacement (Broadway at SR 530) (1)	2012	12
Utility Administrative Building (F2)	2013	n/a
Airport Boulevard Water Main Extension (DF8)	2013	12
173rd Street Water Main	2013	12
WTP Discharge to Wetland	2014	n/a
AC Water Main Replacement (Gilman and Alcazar) (4 and 11)	2014	12
89th Avenue NE Pressure Zone Conversion (PZ1)	2015	n/a

The completed improvements are also crossed out on the 2011 WSP CIP, which is provided in **Table 9-2**. Projects that are ongoing are highlighted accordingly, and projects that have been removed from the CIP prepared for this WSP are also noted. Projects that were not completed or removed are included in the CIP prepared for this WSP and provided at the end of the chapter.

A brief explanation of the removed projects is as follows:

- WM3 – North Airport 12-inch Water Main: The City determined that this main was not necessary for redundancy, water quality, or fire flow.
- M5 – Groundwater Recharge Feasibility Assessment: The City decided not to pursue this as an opportunity.
- DF9 – 12-inch Water Main in 172nd Street NE from Airport Boulevard to 60th Avenue NE: The water main was moved to the proposed WM5 Manufacturing Industrial Center (MIC) water main improvements.
- DF10 – 12-inch Water Main in 172nd Street NE from 63rd Avenue NE to 67th Avenue NE: The water main was moved to the proposed WM5 MIC water main improvements.
- DF13 – 107th Avenue NE to Burn Road 8-inch Water Main Loop: In order to resolve existing high pressures, this water main loop was removed and a new 560 pressure zone is proposed.

9.3 WATER MAIN IMPROVEMENTS

The following water main improvements were identified based on the results of the distribution and transmission system analyses discussed in **Chapter 7**. Most of the water main improvements are up-sizing of existing distribution water mains and replacement of AC mains. These water main improvements are grouped in the Annual Water Main Replacement Program project (CIP WM1). The individual water main improvement projects within this group are numbered 1 through 113, as shown on **Figure 9-1**. The other water main improvements are mostly larger-diameter water mains that function more like transmission than distribution mains, and are identified as individual projects (CIP WM2 through WM5).

9.3.1 Future Water Main Extensions and Replacements

All new water main extensions and replacements shall be installed in accordance with the City's Design and Construction Standards and Specifications, which are contained in **Appendix D**. All new water mains shall be cement-mortar lined ductile iron pipe and sized by a hydraulic analysis to ensure that all pressure, flow, and velocity requirements, as stated in **Chapter 5**, are met. In general, new water mains that will carry fire flow in residential areas shall be a minimum of 8 inches in diameter, and looped for multi-family residential developments and single family transmission purposes. New water mains in commercial, business park, industrial, school, and airport areas shall be a minimum of 12 inches in diameter and looped.

Table 9-2

Modified Improvement Schedule from the Previous (2011) Water System Plan

CIP No.	Description	Estimated Cost (2010 $$)	20-Year Schedule of Improvements Planned Year of Project and Estimated Cost in 2010 $$							
			2011	2012	2013	2014	2015	2016	2017-2022	2023-2030
Water Main Improvements										
WM1	Annual Water Main Replacement Program	$25,459,000	$400K	$400K	$300K	$200K	$400K	$400K	$2,400K	$20,959K
WM2	12" Water Main in 204th Street NE for North Island Crossing	$1,580,000							$1,580K	
~~WM3~~	~~North Airport 12" Water Main~~	~~$515,000~~							~~$515K~~	
~~WM4~~	~~Highway 9 Crossing 16" Water Main~~	~~$400,000~~	~~$400K~~							
Pressure Zone Improvements										
~~PZ1~~	~~89th Avenue NE 12" Water Main~~	~~$1,070,000~~		~~$535K~~	~~$535K~~					
PZ2	Conversion of 540 Zone to 520 and 615 Zones	$280,000							$280K	
~~PZ3~~	~~Conversion of 342 Zone to 520 Zone in Cedarbough Loop~~	~~$90,000~~						~~$90K~~		
Facility Improvements										
F1	Demolish Old WTP	$170,000			$170K					
~~F2~~	~~Utility Administration Building~~	~~$700,000~~	~~$450K~~	~~$250K~~						
F3	Demolish Burn Road Reservoir	$75,000						$75K		
F4	Airport Wellfield Well Rehabilitation and Treatment	$945,000		$45K	$250K	$650K				
~~F5~~	~~Haller Wellfield Assessment and Well Replacement~~	~~$165,000~~	~~$165K~~							
F6	Future 2.0 MG Reservoir	$4,050,000							$4,050K	
F7	Gleneagle Reservoir Roof Replacement	$350,000			$350K					
F8	520 Reservoir Improvements	$25,000		$25K						
Miscellaneous Improvements										
~~M1~~	~~Water Rights Acquisition Program~~	~~$400,000~~	~~$100K~~	~~$100K~~	~~$100K~~	~~$100K~~				
M2	Drive-by Read Meter Conversion	$540,000	$30K	$30K	$40K	$40K	$50K	$50K	$300K	
M3	Source Water Protection Program	$30,000			$30K					
~~M4~~	~~Security System Improvements~~	~~$15,000~~			~~$10K~~	~~$5K~~				
M5	Groundwater Recharge Feasibility Assessment	$35,000							$35K	
~~M6~~	~~Comprehensive Water System Plan Update~~	$360,000						~~$120K~~		$240K
Total Estimated Project Costs of City Funded Improvements		**$37,254,000**	**$1,545K**	**$1,385K**	**$1,785K**	**$995K**	**$450K**	**$735K**	**$9,160K**	**$21,199K**
Developer Funded Improvements										
DF1	12" Water Main Loop from 59th Ave NE to 66th Ave NE	$480,000	Timing of Project Based on Timing of Future Developments							
DF2	8" Water Main Replacement in 211th Pl NE	$210,000	Timing of Project Based on Timing of Future Developments							
DF3	Jensen Farm High Density Residential 8" and 12" Water Main Loop	$70,000	Timing of Project Based on Timing of Future Developments							
DF4	59th Ave and Cemetery Road Industrial Improvements	$750,000	Timing of Project Based on Timing of Future Developments							
DF5	12" Water Main in 196th St NE from Burn Road to Crown Ridge Blvd	$350,000	Timing of Project Based on Timing of Future Developments							
DF6	Northwest Airport 12" Water Main Loop	$640,000	Timing of Project Based on Timing of Future Developments							
DF7	North Island Crossing Commercial 12" Water Main Loop	$760,000	Timing of Project Based on Timing of Future Developments							
~~DF8~~	~~Island Crossing 12" Water Main Connection in 180th St NE~~	~~$600,000~~	Timing of Project Based on Timing of Future Developments							
DF9	12" Water Main in 172nd St NE from Airport Blvd to 60th Ave NE	$590,000	Timing of Project Based on Timing of Future Developments							
DF10	12" Water Main in 172nd St NE from 63rd Ave NE to 67th Ave NE	$320,000	Timing of Project Based on Timing of Future Developments							
DF11	12" Water Main in 172nd St NE from 67th Ave NE to 71st Ave NE	$300,000	Timing of Project Based on Timing of Future Developments							
DF12	12" Water Main in Troon Ct from Troon Ct Cul-de-Sac to 174th St NE	$190,000	Timing of Project Based on Timing of Future Developments							
DF13	107th Ave NE to Burn Road 8-inch Water Main Loop	$530,000	Timing of Project Based on Timing of Future Developments							
DF14	615 Zone Water Main East of 89th Ave NE	$1,470,000	Timing of Project Based on Timing of Future Developments							
DF15	710 Zone Booster Pump Station and Water Main	$2,400,000	Timing of Project Based on Timing of Future Developments							
Total Estimated Project Costs of Developer Funded Improvements		**$9,660,000**								

~~Project~~ = Project completed since previous WSP
~~Project~~ = Project removed since previous WSP
Project = Ongoing project

9.3.2 CIP WM1: Annual Water Main Replacement Program

Deficiency: Most of the water main improvements shown in **Figure 9-1** are required to resolve existing system fire flow deficiencies caused primarily by older undersized water mains installed prior to the local government adoption of fire flow requirements. The improvements also include the City's AC water main replacement program.

Improvement: Replace existing water main with new ductile iron water main in accordance with the City's Public Works Design and Construction Standards and Specifications, which are contained in **Appendix D**. The individual water main improvements grouped under this project

are numbered 1, 2, 3, etc., as shown in **Figure 9-1.** The selection of specific projects will be accomplished annually during the City's budget development process and will be guided by the prioritization presented later in this chapter. This provides the City with the flexibility to coordinate these projects with other projects that may occur within the same area. An allowance of $500,000 per year has been established for the annual replacement of the water mains.

9.3.3 CIP WM2: 12-inch Water Main in 204th Street NE for North Island Crossing

Deficiency: The City began directly serving the Island Crossing Water System on February 8, 2005. Although there is existing 10-inch water main in Smokey Point Boulevard, CIP WM2 is necessary to improve fire flow and reliability in the Island Crossing area.

Improvement: Install new 12-inch ductile iron water main in 204th Street NE, 43rd Avenue NE, and Cemetery Road from 47th Avenue NE to Smokey Point Boulevard. A creek crossing will be necessary. Approximately 75 percent of this project will be developer-funded.

9.3.4 CIP WM3: 198th Place NE/Cemetery Road Water Main

Deficiency: The City's supply and storage facilities are located in the eastern portion of the service area. The water main in 198th Place NE and Cemetery Road is one of the primary water mains connecting the service areas on the east and west sides of the Arlington airport. This vital water main is comprised of 12-inch AC, 10-inch ductile iron (DI), 8-inch DI, and is 45 to 55 years old.

Improvement: Install new 12-inch ductile iron water main in 198th Place NE/Cemetery Road/204th Street NE from 49th Avenue NE to 67th Avenue NE.

9.3.5 CIP WM4: West I-5 Expansion Area Water Main

Deficiency: The City is proposing Urban Growth Area (UGA) expansion into its Rural Urban Transition Area (RUTA) west of I-5. This area does not currently have municipal water service. Water main extensions and looping are necessary to service this area.

This WSP plans for projected water service needs throughout the City's WSA, including both currently serviced and currently unserviced areas. Because this would be the City's first extension of its distribution system west of I-5, the actual improvements and timing of those improvements are predicated on events that are neither known nor certain. Water service will not be provided to this area unless or until there is approval by the County Council (through the 2016 or later docket) and a sound development proposal. This is noted in the 25%/75% capital cost split between the City and a future developer in Table 9-6. See additional discussion in Section 3.2.2.

Improvement: Install new 12-inch ductile iron water in 188th Street NE from 29th Avenue NE to 23rd Avenue NE, 23rd Ave NE from 188th Street NE to 200th Street NE, and 200th Street NE from 23rd Avenue NE to Smokey Point Boulevard. Two I-5 freeway borings will be necessary to provide a looped system. Approximately 75 percent of this project will be developer-funded.

9.3.6 CIP WM5: South of 172nd Area MIC Water Main

Deficiency: The Manufacturing Industrial Center (MIC) area south of 172nd Street NE is planned for industrial development. Water main extensions and looping are necessary to service this area.

Improvement: Install new 12-inch ductile iron water in 43rd Avenue NE from approximately 174th Place NE to approximately 168th Street NE, approximately 47th Avenue NE from SR 531 to approximately 168th Street NE, 51st Avenue NE from SR 531 to approximately 168th Street NE, approximately 168th Street NE from 43rd Avenue NE to approximately 65th Avenue NE, approximately 65th Avenue NE from SR 531 to approximately 168th Street NE, and SR 531 from approximately 64th Avenue NE to approximately 65th Avenue NE. Approximately 75 percent of this project will be developer-funded.

9.4 PRESSURE ZONE IMPROVEMENTS

The following pressure zone improvements are proposed in the portions of the City's water service area (WSA) that do not meet the City's pressure standards, and will improve various high- and low-pressure problem areas throughout the water system. A brief description of the existing deficiency and proposed improvement for each project are provided in the next paragraph.

9.4.1 CIP PZ1: Conversion of 710 Zone to 560 Zone (107th Avenue NE)

Deficiency: As shown in **Table 7-10** of **Chapter 7**, existing customers in the lower elevations of the 710 Zone on 107th Avenue NE and 195th Street NE have high pressure well above 100 pounds per square inch (psi).

Improvement: Convert a portion of the 710 Zone on 107th Avenue NE and 195th Street NE to a 560 Zone by installing a pressure reducing station on 107th Avenue NE at approximately 184th Street NE. The proposed pressure reducing station should have an 8-inch valve and a 3-inch valve.

9.4.2 CIP PZ2: Conversion of 710 Zone to 615 Zone

Deficiency: Portions of the 710 Zone on Burn Road, 186th Street NE, and 89th Avenue NE have high pressure.

Improvement: Convert the 710 Zone to a 615 Zone by installing a pressure reducing station on Burn Road east of McElroy Road. The proposed pressure reducing stations should each have an 8-inch valve and a 3-inch valve.

9.4.3 CIP PZ3: Conversion of 540 Zone to 615 and 520 Zone.

Deficiency: The 540 Zone located along Burn Road has moderately low pressures.

Improvement: Convert a portion of the 540 Zone to the 520 Zone by installing a pressure reducing station on Burn Road at 196th Street NE. Convert a portion of the 540 Zone to the 615 Zone by

abandoning the existing Upper Burn Road pressure reducing valve (PRV). The proposed pressure reducing stations should each have an 8-inch valve and a 3-inch valve.

9.5 FACILITY IMPROVEMENTS

The following water system facility improvements were identified from the results of the water system analyses that are discussed in **Chapter 7**. The improvements are primarily necessary to resolve existing system deficiencies, but have also been sized to accommodate projected growth.

9.5.1 CIP F1: Demolish Old Water Treatment Plant

Deficiency: Constructed in 1924, the old water treatment plant was replaced with a new water treatment plant in 2001. The old WTP is no longer in use, but was painted with an attractive mural by at-risk youth in 2014.

Improvement: Demolish the old water treatment plant later in this planning horizon. Demolition could require stabilization of the slope on the north side of the new WTP.

9.5.2 CIP F2: Source of Supply Study

Deficiency: The results of the source capacity evaluation in **Chapter 7** indicate that the City's existing sources do not have sufficient capacity to meet projected demands. In addition, the well casing in the City's existing Airport Well collapsed in 2009, reducing the well depth from 185 feet to approximately 120 feet, and the well's supply rate from 580 gallons per minute (gpm) to 220 gpm. The Airport Well is also an aging facility with other deficiencies, including drainage problems, electrical hazards, limited clearances, and corrosion. According to the water rights analysis in **Chapter 6**, the City has excess water rights available to utilize to meet future demand projections.

Improvement: Prepare a source of supply study that evaluates options for utilizing the excess water rights within the WSA to replace the existing Airport Well.

9.5.3 CIP F3: Demolish Burn Road Reservoir

Deficiency: The City's Burn Road Reservoir is nearly 50 years old and is surrounded by steep slopes. The facility also experiences continuous vandalism. In 2014, the Burn Road Reservoir was taken off line and drained.

Improvement: Rather than protect the steep hillside, increase security measures, and improve the Burn Road Reservoir, the City will demolish it.

9.5.4 CIP F4: New Supply Well No. 1 (Replace Airport Well)

Deficiency: The results of the source capacity evaluation in **Chapter 7** indicate that the City's existing sources do not have sufficient capacity to meet projected demands. The well casing in the City's existing Airport Well collapsed in 2009, reducing the well depth from 185 feet to

approximately 120 feet, and the well's supply rate from 580 gpm to 220 gpm. The equipment in the Airport Well building is located below grade, which causes drainage problems and electrical hazards. The aging building also has limited clearances and exposed insulation. The interior piping has signs of corrosion and requires replacement. If additional water rights are obtained for this well, a larger pump, along with iron and manganese treatment, will be required at this facility. Replacement of the Airport Well at the existing location or at another site outside of the airport area will be determined by CIP F2 – Source of Supply Study.

Improvement: Construct a new facility that includes a new well, structure, piping, well pump, on-site chlorine generation system, and an iron and manganese treatment process. The reuse of the Airport Well's existing electrical equipment will be examined during the design phase. The piping and treatment facility will be designed to accommodate future supply sources as determined in CIP F2 - Source of Supply Study. The cost estimates assume that the well will produce approximately 580 gpm and be drilled to a depth of approximately 200 feet. After the well is drilled, a treatment pilot study will be performed to determine the exact design parameters of the filter and chlorination systems.

9.5.5 CIP F5: New Supply Well No. 2

Deficiency: The results of the source capacity evaluation in **Chapter 7** indicate that the City's existing sources and New Supply Well No. 1 do not have sufficient capacity to meet projected demands.

Improvement: Construct an additional well facility at the site of the New Supply Well No. 1, if determined to be an acceptable location for water right transfer, per CIP F2 – Source of Supply Study. The facility will include drilling a well with a depth of approximately 200 feet and a capacity of approximately 679 gpm. Supply Well No. 2 water will be treated by the treatment facility constructed for CIP F4.

9.5.6 CIP F6: Future 1.0 Million Gallon (MG) Reservoir

Deficiency: The City's future water system will have insufficient storage.

Improvement: Locate and install a new 520 Zone Reservoir to provide additional gravity storage for future customers. The new reservoir will have an overflow elevation of approximately 520 feet to enable gravity supply to the 520 Zone. The reservoir will be sized to provide at least 1.0 MG of usable storage to provide adequate storage for future customers. The optimal location of the proposed 520 Zone Reservoir is within the area shown in **Figure 9-1**.

9.5.7 CIP F7: Gleneagle Reservoir Roof Replacement

Deficiency: The City's Gleneagle Reservoir has a wooden roof that requires replacement. The existing roof experiences decay and persistent moss problems. The structure also has poorly designed vents.

Improvement: Evaluate the existing concrete structure and determine the requirements for a new roof. Remove and replace the roof, along with any necessary structural members associated with the roof replacement.

9.5.8 CIP F8: 520 Reservoir Improvements

Deficiency: The City's 520 Reservoir site does not have a chain link fence to prevent intruders from entering the site.

Improvement: Install a chain link fence on the 520 Reservoir site to improve security and deter vandalism.

9.5.9 CIP F9: Replacement Clearwell Pumps

Deficiency: At least two of the City's three clearwell pumps that supply the 342 Zone with treated water from the Haller Wellfield are showing signs of excess wear and reduced capacity from their design conditions. The pumps are critical to the City's ability to provide water supply to its customers.

Improvement: Install three replacement clearwell pumps at the water treatment plant.

9.6 MISCELLANEOUS IMPROVEMENTS

The following miscellaneous improvements are planning efforts and program elements that are required to comply with various water regulations or are improvements that do not fit into one of the previous categories.

9.6.1 CIP M1: Drive-by Read Meter Conversion

Deficiency: The City currently uses a significant amount of staff time to read customer water meters.

Improvement: The City will continue to upgrade manual customer meters to drive-by meter read systems. Existing touch meter systems will also be updated with drive-by transponders.

9.6.2 CIP M2: Source Water Protection Program

Deficiency: The City's Haller and Airport Wellfields are susceptible to contamination. The City has begun, but needs to complete a Wellhead Protection and Watershed Control Program.

Improvement: The City will improve the mapping of its wellhead protection areas and implement wellhead protection requirements in its municipal code. Objectives include protection of high-quality water to promote public health, minimizing customer costs, protection of instream water resources, and to advocate for the City's interests within the Upper Stillaguamish Basin.

9.6.3 CIP M3: WSP Update

Deficiency/Requirement: The Washington Administrative Code (WAC) 246-290-100 requires that the City's WSP be updated every 6 years and submitted to Washington State Department of Health (DOH) for approval. Proposed changes to the WAC may extend the update requirement to 10 years.

Improvement: The City will update and submit its WSP every 6 years to comply with state requirements, or 10 years if the state standard is modified.

9.7 DEVELOPER-FUNDED IMPROVEMENTS

The following water system improvement costs shall be borne by the developers, rather than the existing water customers, unless over-sizing of the improvements provides benefit to the existing customers. Improvements have been identified for the undeveloped areas of the City's existing and expected service area to illustrate the major facilities that will be required to properly serve that area. Additional developer-funded projects include localized on-site water main improvements that are not associated with overall water distribution, but would be necessary if the property served by the water main is redeveloped or expanded. The locations of the facilities are shown schematically in **Figure 9-1**.

9.7.1 CIP DF1: 12-inch Water Main Loop from 59th Avenue NE to 66th Avenue NE

Deficiency: Commercial development that occurs near SR 530 and 59th Avenue NE in the 342 Zone will require 12-inch water main to provide adequate levels of fire flow service to the area.

Improvement: Install 12-inch water main in SR 530 and 211th Place NE from Kraetz Road to Ronning Road.

9.7.2 CIP DF2: 12-inch Water Main Replacement in 211th Place NE

Deficiency: Commercial development that occurs near SR 530 and 59th Avenue NE in the 342 Zone will require a 12-inch water main connection to the existing system. The existing water main in 211th Place NE is 6-inch diameter pipe.

Improvement: Replace the 6-inch water main in 211th Place NE with 12-inch water main from Ronning Road to 67th Avenue NE.

9.7.3 CIP DF3: Jensen Farm High Density Residential 12-inch Water Main

Deficiency: Future high density apartments that develop in the vicinity of the 8-inch dead-end water main will have sufficient fire flow capacity, but with high velocities.

Improvement: Replace the existing 8-inch dead-end water main in Anna Lane, Lois Lane, and Jensen Park with 12-inch water main.

9.7.4 CIP DF4: 59th Avenue and Cemetery Road Industrial Improvements

Deficiency: The existing available fire flow at the fire hydrants at the end of the 8-inch dead-end water mains is less than the general fire flow requirement, and velocities are higher than acceptable.

Improvement: Upon further development of the adjacent properties, install 12-inch water main on-site.

9.7.5 CIP DF5: 12-inch Water Main in 196th Street NE from Burn Road to Crown Ridge Boulevard

Deficiency: Development that occurs east of Burn Road will require an extension of the 520 Zone to allow for continuous flow from the 520 Reservoir to the proposed developments.

Improvement: Install 12-inch water main within 196th Street NE from Burn Road to the 520 Zone.

9.7.6 CIP DF6: Northwest Airport 12-inch Water Main Loop

Deficiency: Development that occurs in the light industrial area located northwest of the airport will be required to install a 12-inch water main loop to improve reliability and fire flow in the area.

Improvement: Install 12-inch water main within the light industrial zone from approximately 188th Street NE to approximately 196th Place NE and 51st Drive NE.

9.7.7 CIP DF7: North Island Crossing Commercial 12-inch Water Main Loop

Deficiency: Development that occurs in the commercial areas of North Island Crossing will require looping for reliability and adequate fire flow capabilities.

Improvement: Install 12-inch water main within the commercial properties that will connect the Smokey Point Boulevard water main to the SR 530 water main.

9.7.8 CIP DF8: Kraetz Road Water Main

Deficiency: Development that occurs in the commercial areas at the end of the Kraetz Road water main will be required to replace the existing water main with 12-inch water main.

Improvement: Install 12-inch water main within Kraetz Road and Dike Road from SR 530 to Smokey Point Concrete as development occurs.

9.7.9 CIP DF9: 12-inch Water Main in 172nd Street NE from 67th Avenue NE to 71st Avenue NE

Deficiency: Development that occurs along 172nd Street NE between 67th Avenue NE and 71st Avenue NE will be required to extend the 12-inch water main from the existing water system for distribution of storage and supply to new development.

Improvement: Install 12-inch water main in 172nd Street NE between 67th Avenue NE and 71st Avenue NE as development occurs.

9.7.10 CIP DF10: 12-inch Water Main in Troon Court from Troon Court Cul-de-sac to 174th Street NE

Deficiency: Development that occurs south of Troon Court will be required to replace the existing 8-inch water main in Troon Court with 12-inch water main, and extend the 12-inch water main from the Troon Court cul-de-sac to the south for distribution of storage and supply to new development.

Improvement: Replace the existing 8-inch water main in Troon Court with 12-inch water main, and install the 12-inch water main south of the Troon Court cul-de-sac to approximately 174th Street NE as development occurs.

9.7.11 CIP DF11: 615 Zone Water Main East of 89th Avenue NE

Deficiency: Development that occurs east of 89th Avenue NE between 172nd Street NE and 186th Street NE will be required to extend and loop 8- and 12-inch water mains from the proposed 8-inch water main in 89th Avenue (CIP PZ1).

Improvement: Install 8- and 12-inch water mains east of 89th Avenue NE from 172nd Street NE to 186th Street NE to create a loop. Multiple creek crossings will be necessary.

9.7.12 CIP DF12: 710 Zone Booster Pump Station and Water Main

Deficiency: Development that occurs in the 615 and 710 Zones along Burn Road will not be adequately served by the existing PUD wholesale supply.

Improvement: Install a new pump station that will function as the back-up and fire flow supply facility for the 615 and 710 Zones. The pump station will supply the zones in conjunction with the PUD wholesale supply source. Additionally, install 12-inch water main from the Burn Road transmission main to the proposed 710 Zone booster pump station to convey supply throughout the area. The layout of the water main will be determined in the future by the location of roadways for the new development.

The pump station will have a maximum capacity to satisfy the largest fire flow requirement and peak water demand of the zone, estimated at approximately 3,200 gpm. The recommended pump arrangement is two smaller pumps for providing domestic service and one larger pump to provide

fire flow and peak demand supply. The actual pump capacities and final configuration will be determined during the preliminary design phase of the project when more information is available about the area to be served. The preliminary design should consider the installation of a PRV at the pump station to provide fire flow to the 615 Zone near the pump station site and/or having the ability to use the same fire flow pump for both the 615 and 710 Zones, as needed.

9.8 ESTIMATING COSTS OF IMPROVEMENTS

Project costs for the proposed improvements were estimated by the City and RH2 Engineering, Inc., (RH2) based on costs of similar, recently-constructed projects in the City and around the Puget Sound area. The total cost estimates, which are presented in 2015 dollars, include the estimated construction cost of the improvement and indirect costs estimated at 35 percent for engineering preliminary design, final design, construction management services, permitting, legal, and administrative services. The construction cost estimates include a 10-percent contingency and sales tax of 8.8 percent.

Construction cost estimates for water main projects were determined from the water main unit costs (i.e., cost per foot length) shown in **Table 9-2** and the proposed diameter and approximate length of each improvement.

Table 9-3

Water Main Unit Costs

Water Main Diameter (inches)	Construction Cost Per Foot Length (2015 $/LF)
8	$170
12	$187
16	$206

The unit costs for each water main size are based on estimates of all construction-related improvements, such as materials and labor for the water main installation, water services, fire hydrants, fittings, valves, connections to the existing system, trench restoration, asphalt surface restoration, other work necessary for a complete installation, contingency, and sales tax. Additional costs were added to some water main improvements to cover anticipated, increased costs related to the project location and degree of difficulty. Indirect costs are estimated at 35 percent of the water main construction cost utilizing the construction cost per foot and the additional project related costs, and are included in the total cost for each water main project.

9.9 PRIORITIZING IMPROVEMENTS

The water system improvements were evaluated against established criteria to schedule projects that will correct the most deficiencies and meet the greatest need for improvement prior to projects correcting fewer deficiencies. A description of the criteria and method for prioritizing each category of improvements are provided below.

9.9.1 Water Main Improvements

Table 9-3 lists criteria that were established for prioritizing the water main improvements. The criteria are based on the underlying deficiencies of the existing water main that will be replaced by the proposed water main improvements. The criteria are arranged in four different categories with a weight factor assigned to each category. The criterion given the most weight is the Existing Water Main Fire Flow Capability.

Table 9-4

Water Main Improvements Priority Ranking Criteria

Points	Category	Weight Factor	Weighted Points
	Existing Water Main Fire Flow Capability		
3	Available Fire Flow is 69% or Less of Required Fire Flow	4	12
2	Available Fire Flow is 70-89% of Required Fire Flow	4	8
1	Available Fire Flow is 90-100% or More of Required Fire Flow	4	4
	Existing Water Main Year of Installation		
3	Before 1960	3	9
2	1960 - 1980	3	6
1	After 1980	3	3
	Existing Water Main Material		
3	Asbestos Cement	3	9
2	Galvanized Iron, Steel, or Cast Iron	3	6
1	Ductile Iron or PVC	3	3
	Existing Water Main Benefit Area		
3	Large Benefit Area (i.e. transmission main)	2	6
2	Medium Benefit Area	2	4
1	Small Benefit Area (i.e. localized area)	2	2

The Existing Water Main Fire Flow Capability category ranks the water main improvements based on the ability of the existing water mains to provide the required fire flow, as determined from the

results of the hydraulic analyses in **Chapter 7**. The Existing Water Main Year of Installation category ranks the water main improvements based on the age of the existing water mains. The Existing Water Main Material category ranks the water main improvements based on the material of the existing water main. The Existing Water Main Benefit Area category ranks the water main improvements based on the size of the area that will benefit from the replacement.

The water main priority ranking criteria were applied to the annual water main replacement projects, which are grouped under CIP WM1. CIP 1 through 113, as shown in **Figure 9-1**, are presented in **Table 9-4** with their priority ranking.

9.9.2 Other Improvements

The additional pressure zone, pressure reducing station, and facility improvements were prioritized based on existing deficiencies, safety concerns, maintenance requirements, and capacity requirements. The miscellaneous improvements were prioritized based on regulatory requirements and assessment of the water system needs. The priority order of these improvements is reflected in the schedule of improvements, which is presented in the next section.

9.10 SCHEDULE OF IMPROVEMENTS

The results of prioritizing the improvements were used to assist in establishing an implementation schedule that can be used by the City for preparing its six-year CIP and yearly water department budget. The implementation schedule for the proposed improvements is shown in **Table 9-5**. An allowance of $500,000 per year has been established for the annual replacement of the water mains. The City will identify and schedule the replacement of water mains to be funded by the annual water main replacement program during the annual budget process. This provides the City with the flexibility to coordinate these projects with road or other projects within the same area. The developer-funded improvement projects and their associated cost estimates are shown near the bottom of the table. However, the implementation dates for these improvements are not shown, due to the uncertainty of the timing of the future developments that will be responsible for these improvements.

9.10.1 Future Project Cost Adjustments

All cost estimates shown in the tables are presented in year 2015 dollars. These cost estimates will need to be adjusted to account for the effects of inflation and changing construction market conditions to determine future costs at the actual time of project implementation. Future costs can be estimated using the Engineering News Record (ENR) Construction Cost Index for the Seattle area, or by applying an estimated rate of inflation that reflects the current and anticipated future market conditions.

Continued

Table 9-5

Prioritized Annual Water Main Replacement Projects

No.	Size		Location			Estimated Cost	Priority[1]
	Length	Diam	In	From	To		
1	261	12	Broadway St	Falcon St	Dead End	$66,000	H
	671	12	Haller Ave	West Ave	Dead End	$183,000	
	124	12	Railroad St	WTP	Haller Park	$32,000	
2	1,245	12	Burke Ave	Broadway St	Manhattan Ave	$315,000	H
	897	12	Manhattan St	Gilman Ave	Fifth St	$227,000	
3	925	12	Gilman St	Railroad Ave	Newberry St	$234,000	H
4	890	12	Talcott St, Division St	Gilman Ave	Alcazar Ave	$225,000	M
5	1,919	12	Division St, SR9	West Ave	Burke Ave	$485,000	H
	390	12	Burke Ave	SR 9	West Ave	$99,000	
6	141	12	Olympic Ave	Division St (South)	Division St (North)	$36,000	M
7	1,150	8	Dunham Ave, Division St	Fifth St	Manhattan Ave	$264,000	H
	524	8	French Ave	Fifth St	Division St	$121,000	
8	744	12	Park Hill Dr	Alcazar Ave	Park Hill Dead End	$188,000	H
9	856	12	Fifth St	Clara St	Clara St Dead End	$217,000	M
	390	12	Driveway	Fifth St	Parking Lot	$99,000	
10	1,099	8	Clara St	Fifth St	Clara St Dead End	$253,000	H
11	589	12	Broadway St	SR 530	Division St	$149,000	H
	1,056	12	Division St, Rockery Rd	Dunham Ave	Manhattan Ave	$267,000	
12	464	12	Fifth St	West Ave	Olympic Ave	$131,000	H
	1,779	8	Fifth St	Olympic Ave	Just West of	$409,000	
	511	12	Fifth St	Just West of Washington Ave	Just West of Alcazar Ave	$130,000	
	344	12	Parking Lot	West Ave	Parking Lot	$87,000	
13	422	8	Fourth St	SR 9	West Ave	$97,000	H
14	308	8	Fourth St	Macleod Ave	Dunham Ave	$71,000	H
	67	12	Fourth St	Olympic Ave	Just West of Olympic	$17,000	
15	570	12	Fourth St	Gifford Ave	Stillaguamish Ave	$144,000	M
16	444	12	Gifford Ave	Fifth St	School	$113,000	H
	457	12	Washington Ave	Fifth St	School	$116,000	
	423	12	Washington Ave	Third Street	School	$107,000	
	446	12	Stillaguamish Ave	Fifth St	Fourth St	$113,000	
17	263	12	Washington Ave	Fifth St	Dead End	$67,000	M
18	626	12	School Property	School	School	$159,000	L
19	204	12	Clara St	Fifth St	Fourth St	$52,000	M
20	3,717	12	Third St	SR 9	E Robinhood Dr Dead	$952,000	H
21	438	12	West Ave	Third St	Second St	$111,000	L
	533	12	Second St	West Ave	Macleod Ave	$149,000	
22	894	12	Macleod Ave	Third St	First St	$226,000	M
23	322	12	Second St	French Ave	Lenore Ave	$82,000	L
24	59	12	Parking Lot	Macleod Ave	Parking Lot	$15,000	M
25	295	8	Second St	Washington Ave	Stillaguamish Ave	$68,000	M
26	263	12	Parking Lot	71st Ave NE	Parking Lot	$67,000	M
	852	12	Parking Lot	71st Ave NE	Aerospace	$216,000	
27	1,247	12	First St	French Ave	Stillaguamish Ave	$315,000	L
28	206	12	218th Pl NE	87th Ave NE	Dead End	$53,000	L

(1) Priority: H = High, M = Medium, L = Low

Continued

Table 9-5

Prioritized Annual Water Main Replacement Projects (Continued)

No.	Size		Location			Estimated Cost	Priority [1]
	Length	Diam	In	From	To		
29	190	12	217th Pl NE	87th Ave NE	Dead End	$48,000	L
30	490	8	Maple St	Stillaguamish Ave	West Side of Hamlin Dr	$113,000	H
	41	12	Maple St	West Side of Hamlin Dr	East Side of Hamlin Dr	$11,000	
	712	8	Maple St	East Side of Hamlin Dr	87th Ave NE	$164,000	
31	2,595	12	School Property	School	School	$656,000	H
	103	12	Lenore Ave	First St	School	$27,000	
32	179	8	Driveway off Old Burn Rd	Driveway	Driveway	$42,000	M
33	510	12	Maple St	West Ave	Olympic Ave	$399,000	H
34	557	12	Union St	Cobb Ave	Macleod Ave	$141,000	H
	314	8	Union St	Macleod Ave	Dunham Ave	$73,000	
35	840	8	Cobb Ave	Union St	Highland Dr	$193,000	H
36	86	12	Jackson St	Olympic Ave	~Macleod Ave	$22,000	M
37	209	12	Maple St	Dunham Ave	Alley West of Dunham Ave	$53,000	H
	1,598	8	Maple St, Macleod Ave	Alley West of Dunham Ave	Highland Dr	$367,000	
	236	12	Macleod Ave	Highland Dr	Dead End	$60,000	
38	3,465	12	French Ave	Fifth St	Highland Dr	$875,000	H
39	1,304	12	Hospital Property	Stillaguamish Ave	Highland Dr	$330,000	H
40	856	8	Stillaguamish Ave	Third St	First St	$197,000	H
	2,413	12	Stillaguamish Ave	First St	Apartment Driveway	$610,000	
41	918	12	Medical Center Dr	Stillaguamish Ave	212th St SE	$232,000	L
	325	12	Apartment Property	North Apartment Driveway	South End of Hamlin Dr	$83,000	
	329	12	Hamlin Dr	South End of Hamlin Dr	Maple St	$84,000	
42	266	12	Highland Dr	Hazel St	Cobb Ave	$68,000	H
	1,107	8	Highland Dr	Cobb Ave	French Ave	$255,000	
	1,169	12	Highland Dr	French Ave	Stillaguamish Ave	$296,000	
	390	12	SR 9	Highland Dr	Between Florence St and Marion St	$99,000	
43	361	8	Easement	Joanne Ln	67th Ave NE	$353,000	M
44	264	12	Hazel St	Highland Dr	Florence St	$67,000	H
	338	8	Florence St	Hazel St	Hillcrest Dr	$78,000	
	240	12	Hillcrest Dr	Florence St	Dead End	$61,000	
	174	8	Florence St	Hillcrest Dr	Corner of Florence St and Kona Dr	$40,000	
	449	8	Kona Dr	Corner of Florence St and Kona Dr	Marion St	$104,000	
	1,202	8	Marion St	Kona Dr	Hazel St	$276,000	
45	978	12	Wesley St, Parking Lot	Stillaguamish Ave	Parking Lot	$247,000	L
46	248	12	79th Ave NE	Portage St	Cul-de-Sac	$63,000	M
	208	12	Portage St	210th Pl NE	Dead End	$53,000	
	244	12	Retirement Home	Parking Lot	Parking Lot	$62,000	
47	1,058	12	Jensen St	Hazel St	Jensen St Dead End	$268,000	H
48	3,681	12	Oso Lumber	67th Ave NE	Hazel St	$1,200,000	M
49	1,326	12	Hazel St	Jensen St	204th St NE (S)	$430,000	H
	75	12	Dead End	North of 204th St NE	Just West of Hazel St	$19,000	
50	906	12	Safeway Property	Olympic Pl	Olympic Pl	$229,000	M
	173	12	Autozone Property	Olympic Pl	Dead End	$44,000	
51	394	12	Keith Ln	207th St NE	81st Dr NE	$100,000	L
	266	12	81st Dr NE	Keith Ln	North Dead End	$68,000	
	419	12	81st Dr NE	Keith Ln	South Dead End	$106,000	

(1) Priority: H = High, M = Medium, L = Low

Continued

Table 9-5

Prioritized Annual Water Main Replacement Projects (Continued)

No.	Size		Location			Estimated Cost	Priority [1]
	Length	Diam	In	From	To		
52	660	12	Stillaguamish Ave	Lower Burn Rd PRV	207th St NE	$167,000	M
	991	12	School Property	Stillaguamish Ave	207th St NE	$251,000	
53	434	12	210th St NE	66th Ave NE	Cul-de-Sac	$110,000	L
54	603	8	Circle Bluff Dr	Circle Bluff Dr	Circle Bluff Dr	$139,000	L
55	346	8	Lantern Ln	204th St NE	Cul-de-Sac	$80,000	M
56	774	8	64th Dr NE	204th St NE	206th Pl NE	$273,000	M
	339	8	Easement	206th Pl NE	64th Dr NE Dead End	$78,000	
	332	8	64th Dr NE	Dead End	208th St NE	$77,000	
	441	8	208th St NE	64th Dr NE	West of Ronning Rd	$102,000	
	849	8	208th St NE, Ronning Rd	West of Ronning Rd	210th St NE	$195,000	
	605	8	Ronning Rd	210th St NE	211th Pl NE	$139,000	
57	262	12	Easement	67th Ave NE	69th Ave NE	$67,000	M
	332	12	69th Ave NE	Dead End	North of 204th St NE	$84,000	
58	1,949	12	204th St NE	71st Ave NE	77th Ave NE	$493,000	H
	641	12	Parking Lot	77th Ave NE	Parking Lot	$162,000	
	81	12	207th St NE	207th St NE	80th Ave NE	$21,000	
59	1,883	12	Haggen Property	74th Ave NE	Haggen Property	$476,000	M
60	1,647	12	Portage Green Mobile Home Park	Portage Green Mobile Home Park	Portage Green Mobile Home Park	$416,000	M
61	340	8	62nd Dr NE	Cemetery Rd	202nd Pl NE	$79,000	M
	226	8	202nd Pl NE	62nd Dr NE	Dead End	$52,000	
	325	8	201st Pl NE	62nd Dr NE	Dead End	$75,000	
62	513	12	Vicinity of 520 Reservoir	Vicinity of 520 Reservoir	Vicinity of 520 Reservoir	$130,000	M
63	1,920	12	Mobile Home Park	199th St NE	67th Ave NE	$485,000	M
64	1,281	12	197th St NE	63rd Ave NE	67th Ave NE	$324,000	M
65	1,369	8	Cedarbough Loop	Woodlands Way	West of Country Club Dr	$315,000	M
	152	8	Oakwood Pl	Cedarbough Loop	Dead End	$35,000	
	174	8	Shady Grove Pl	Cedarbough Loop	Dead End	$40,000	
	220	8	Sprucewood Pl	Woodlands Way	Dead End	$51,000	
66	140	8	54th Dr NE	Cemetery Rd	Dead End	$33,000	H
67	992	12	51st Dr NE	198th Pl NE	Dead End	$251,000	H
	784	12	Airport Property	Dead End	Airport Property	$198,000	
68	622	8	196th Pl NE, 50th Ave NE	49th Ave NE	Dead End	$143,000	L
69	2,599	12	Airport Property	47th Ave NE	Airport Property	$657,000	M
70	1,180	12	62nd Ave NE	195th St NE	192nd St NE	$298,000	H
	1,742	12	Parking Lot/Easement	192nd St NE	188th St NE	$440,000	
	329	12	Easement	192nd St NE	Dead End	$84,000	
71	2,168	12	Hampton Lumber, UPS	67th Ave NE	Dead End	$818,000	H
72	294	12	Easement	63rd Ave NE	Dead End	$75,000	M
73	646	12	Easement	192nd St NE	Dead End	$164,000	M
74	2,094	12	Airport Property	59th Ave NE	Hangars	$529,000	H
	544	12	W.E. Evans Park	59th Ave NE	188th Pl NE	$138,000	
75	2,061	12	Airport Property	59th Ave NE	59th Dr NE	$521,000	L
76	1,307	12	Easement	191st Pl NE, 67th Ave NE	Easement	$330,000	M
77	1,052	12	66th Ave NE	188th St NE	South of 67th/66th Intersection	$266,000	M

(1) Priority: H = High, M = Medium, L = Low

Continued

Table 9-5

Prioritized Annual Water Main Replacement Projects (Continued)

No.	Size		Location			Estimated Cost	Priority [1]
	Length	Diam	In	From	To		
78	466	12	188th St NE	67th Ave NE	East of 67th Ave NE	$118,000	M
	288	8	188th St NE	East of 67th Ave NE	Iris Ct	$67,000	
79	388	12	188th St NE	67th Ave NE	Lumber Yard	$98,000	H
	1,194	12	Lumber Yard	188th St NE	Dead End	$302,000	
	1,178	8	Lumber Yard	188th St NE	67th Ave NE	$271,000	
80	544	12	Mobile Home Park	188th St NE	Dead End	$138,000	M
81	1,252	12	59th Ave NE	188th St NE	South of 188th St NE	$317,000	M
82	1,924	12	Airport Property	Flightline	Flightline	$486,000	M
83	1,868	12	School Property	Eaglefield Dr	Eaglefield Dr	$472,000	M
84	90	12	175th St NE	85th Ave NE	Dead End	$23,000	M
	69	12	84th Ave NE	85th Ave NE	Dead End	$18,000	
	95	12	Shooting Range Parking Lot	SR 531	Parking Lot	$24,000	
85	393	12	Junkyard	Easement	Easement	$100,000	M
86	2,391	12	Easement	59th Ave NE	Easement	$604,000	M
87	3,410	12	Easement	59th Ave NE	Easement	$1,131,000	M
88	632	12	Airport Property	Hangars	Hangars	$160,000	M
89	1,107	12	Easement	172nd St NE	Easement	$280,000	M
90	1,498	12	Easement	59th Ave NE	59th Ave NE	$379,000	M
91	875	12	Airport Property	59th Dr NE	59th Dr NE	$221,000	M
	1,048	12	59th Dr NE	59th Dr NE	59th Dr NE	$265,000	
	1,129	12	Airport Property	59th Dr NE	Hangars	$286,000	
92	4,059	12	59th Ave NE	Business Park	Business Park	$1,295,000	M
	123	12	Airport Property	59th Ave NE	Hangars	$32,000	
93	2,754	12	Business Park	Business Park	Business Park	$696,000	H
94	109	12	Airport Property	Flightline	Flightline	$28,000	M
95	1,081	12	Bowman Manufacturing	51st Ave NE	Flightline	$273,000	L
96	890	12	Buzz Inn Property	51st Ave NE	Parking Lot	$225,000	M
97	1,277	12	Airport Property	51st Ave NE	Hangars	$323,000	M
98	411	12	187th Pl NE	35th Ave NE	Dead End	$104,000	L
99	647	12	Bjorn Rd	35th Ave NE	Smokey Point Blvd	$164,000	L
	42	12	Smokey Point Blvd	Bjorn Rd	Just North of Bjorn Rd	$11,000	
100	1,030	12	Parking Lot	Smokey Point Blvd	Bjorn Rd	$261,000	M
	435	12	Parking Lot	Bjorn Rd	Parking Lot	$110,000	
101	658	12	186th Pl NE	35th Ave NE	Easement	$167,000	M
	535	12	Easement	186th Pl NE	End of Driveway	$136,000	
	646	12	Driveway	35th Ave NE	End of Driveway	$164,000	
102	512	8	Easement	Smokey Point Blvd	Just East of 32nd Ave NE	$118,000	L
	206	12	185th Pl NE	Smokey Point Blvd	Dead End	$53,000	
103	581	12	183rd Pl NE	Smokey Point Blvd	Dead End	$147,000	L
104	466	12	Driveway	Smokey Point Blvd	36th Dr NE	$118,000	M
	240	12	36th Dr NE	Driveway	36th Dr NE End of Pavement	$61,000	
	460	12	181st Pl NE	Smokey Point Blvd	36th Dr NE	$117,000	
	756	12	Easement, 180th Pl NE	36th Dr NE End of Pavement	Smokey Point Blvd	$191,000	

(1) Priority: H = High, M = Medium, L = Low

Continued

Table 9-5

Prioritized Annual Water Main Replacement Projects (Continued)

No.	Size		Location			Estimated Cost	Priority [1]
	Length	Diam	In	From	To		
105	283	12	185th Pl NE	31st Ave NE	Dead End	$72,000	L
106	239	12	184th Pl NE	31st Ave NE	Dead End	$61,000	L
107	156	12	Driveway	182nd St NE	Dead End	$40,000	L
108	178	12	Driveway	182nd St NE	Dead End	$45,000	M
	179	12	Driveway	Easement	Easement	$46,000	
109	229	12	31st Ave NE	181st St NE	180th St NE	$58,000	L
110	213	12	Parking Lot	Smokey Point Blvd	Parking Lot	$54,000	M
111	509	12	43rd Ave NE	SR 531	Walmart Parking Lot	$129,000	M
	1,479	12	Walmart Parking Lot	43rd Ave NE	SR 531	$374,000	
	82	12	SR 531	Just North of SR 531	Just South of SR 531	$21,000	
112	134	12	I-5	Smokey Point Blvd	Portage Creek	$34,000	M
113	359	12	193rd St NE	Smokey Point Blvd	Dead End	$91,000	M

(1) Priority: H = High, M = Medium, L = Low

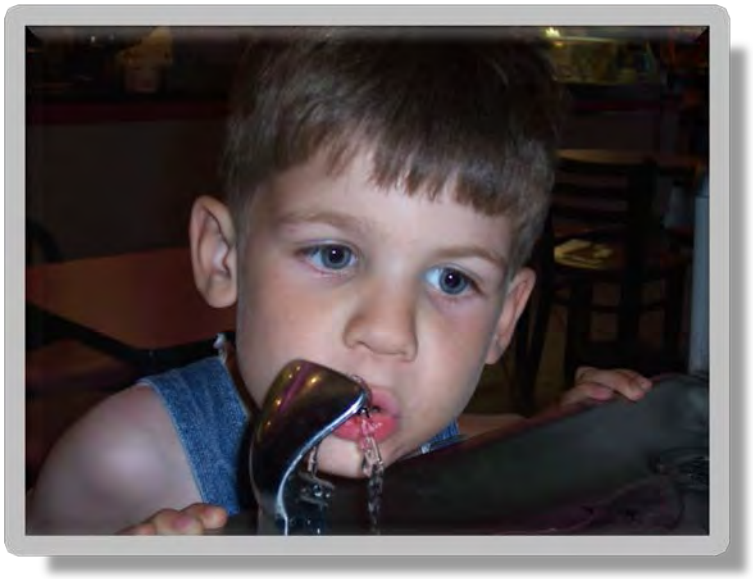
Table 9-6
Proposed Improvements Implementation Schedule

CIP No.	Description	Estimated Cost (10 Year) (2015 $$)	Estimated Cost (20 Year) (2015 $$)	10 Year Funding ($)		10 Year Funding Source (%)		20-Year Schedule of Improvements Planned Year of Project and Estimated COA Cost in 2015 $$											
				COA	DF	COA	DF	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026-2035
Water Main Improvements																			
WM1	Annual Water Main Replacement Program	$5,500,000	$38,333,000	$5,500,000	$0	100%	0%	$500K	$500K	$500K	$500K	$500K	$500K	$500K	$500K	$500K	$500K	$500K	$32,833K
WM2	12" North Island Crossing Water Main	$2,056,750	$2,057,000	$514,000	$1,543,000	25%	75%								$257K	$257K			
WM3	198th Place NE/Cemetery Road Water Main	$1,641,000	$1,641,000	$1,641,000	$0	100%	0%						$821K	$821K					
WM4	West I-5 Expansion Area Water Main	$2,577,000	$2,577,000	$644,250	$1,932,750	25%	75%										$322K	$322K	
WM5	South of 172nd MIC Area Water Main	$3,443,000	$3,443,000	$860,750	$2,582,250	25%	75%				$430K	$430K							
Pressure Zone Improvements																			
PZ1	Conversion of 710 Zone to 560 Zone (107th Ave NE)	$90,000	$90,000	$90,000	$0	100%	0%					$90K							
PZ2	Conversion of 710 Zone to 615 Zone	$90,000	$90,000	$90,000	$0	100%	0%						$90K						
PZ3	Conversion of 540 Zone to 615 and 520 Zone	$90,000	$90,000	$90,000	$0	100%	0%											$90K	
Facility Improvements																			
F1	Demolish Old WTP	$0	$170,000	$0	$0	100%	0%												$170K
F2	Source of Supply Study	$25,000	$25,000	$25,000	$0	100%	0%		$25K										
F3	Demolish Burn Road Reservoir	$75,000	$75,000	$75,000	$0	100%	0%		$75K										
F4	New Supply Well No. 1 (Replace Airport Well)	$2,600,000	$2,600,000	$2,600,000	$0	100%	0%		$600K	$2,000K									
F5	New Supply Well No. 2	$1,000,000	$1,000,000	$1,000,000	$0	100%	0%						$125K	$875K					
F6	Future 1.0 MG Reservoir	$0	$2,970,000	$0	$0	100%	0%												$2,970K
F7	Gleneagle Reservoir Roof Replacement	$350,000	$350,000	$350,000	$0	100%	0%				$350K								
F8	520 Reservoir Improvements - Fence	$25,000	$25,000	$25,000	$0	100%	0%			$25K									
F9	Replacement Clearwell Pumps	$200,000	$200,000	$200,000	$0	100%	0%								$200K				
Miscellaneous Improvements																			
M1	Drive-by Read Meter Conversion	$800,000	$800,000	$800,000	$0	100%	0%		$80K	$80K	$80K	$80K	$80K	$80K	$80K	$80K	$80K	$80K	
M2	Source Water Protection Program	$30,000	$30,000	$30,000	$0	100%	0%				$30K								
M3	Comprehensive Water System Plan Update	$100,000	$270,000	$100,000	$0	100%	0%										$100K		$170K
Total Estimated Project Costs of City Funded Improvements		**$20,692,750**	**$56,836,000**	**$14,635,000**	**$6,058,000**	**-**	**-**	**$500K**	**$1,280K**	**$2,605K**	**$1,390K**	**$1,100K**	**$1,616K**	**$2,276K**	**$1,037K**	**$837K**	**$1,002K**	**$992K**	**$36,143K**
Developer Funded Improvements																			
WM2-DF	12" North Island Crossing Water Main	$1,542,750	$1,542,750	100% Developer Funded				Timing of Project Based on Timing of Future Developments											
WM4-DF	West I-5 Expansion Area Water Main	$1,932,750	$1,932,750	100% Developer Funded				Timing of Project Based on Timing of Future Developments											
WM5-DF	South of 172nd MIC Area Water Main	$2,582,250	$2,582,250	100% Developer Funded				Timing of Project Based on Timing of Future Developments											
DF1	12" Water Main Loop from 59th Ave NE to 66th Ave NE	$660,000	$660,000	100% Developer Funded				Timing of Project Based on Timing of Future Developments											
DF2	12" Water Main Replacement in 211th Pl NE	$320,000	$320,000	100% Developer Funded				Timing of Project Based on Timing of Future Developments											
DF3	Jensen Farm High Density Residential 12" Water Main	$360,000	$360,000	100% Developer Funded				Timing of Project Based on Timing of Future Developments											
DF4	59th Ave and Cemetery Road Industrial Improvements	$700,000	$700,000	100% Developer Funded				Timing of Project Based on Timing of Future Developments											
DF5	12" Water Main in 196th St NE from Burn Road to Crown Ridge Blvd	$460,000	$460,000	100% Developer Funded				Timing of Project Based on Timing of Future Developments											
DF6	Northwest Airport 12" Water Main Loop	$680,000	$680,000	100% Developer Funded				Timing of Project Based on Timing of Future Developments											
DF7	North Island Crossing Commercial 12" Water Main Loop	$1,270,000	$1,270,000	100% Developer Funded				Timing of Project Based on Timing of Future Developments											
DF8	Kraetz Rd Water Main	$1,720,000	$1,720,000	100% Developer Funded				Timing of Project Based on Timing of Future Developments											
DF9	12" Water Main in 172nd St NE from 67th Ave NE to 71st Ave NE	$490,000	$490,000	100% Developer Funded				Timing of Project Based on Timing of Future Developments											
DF10	12" Water Main in Troon Ct from Troon Ct Cul-de-Sac to 174th St NE	$250,000	$250,000	100% Developer Funded				Timing of Project Based on Timing of Future Developments											
DF11	615 Zone Water Main	$2,220,000	$2,220,000	100% Developer Funded				Timing of Project Based on Timing of Future Developments											
DF12	710 and 615 Zone Booster Pump Station and Water Main	$3,520,000	$3,520,000	100% Developer Funded				Timing of Project Based on Timing of Future Developments											
Total Estimated Project Costs of Developer Funded Improvements		**$12,650,000**																	

This page blank for formatting and duplex printing.

10 Financial Plan

10.1 INTRODUCTION



The objective of the financial plan is to identify the total cost of providing utility service and to provide a financial program that allows the utility to remain financially viable during execution of the identified Capital Improvement Program (CIP). This analysis considers the historical financial condition of the utility, the sufficiency of utility revenues to meet current and future financial and policy obligations, and the financial impact of executing the CIP. Furthermore, the plan provides a review of the utility's rate structure with respect to rate adequacy and customer affordability, as well as the promotion of water conservation.

10.2 PAST FINANCIAL PERFORMANCE

This section includes a summary of historical financial performance for the utility (2010-2014), including a summary of Fund Resources and Uses and the schedule of outstanding debt.

10.2.1 Summary of Fund Resources and Uses

Water Utility Fund 401

Fund 401 serves as the Water Utility operating account where operating revenues are deposited and operating expenses are paid. The primary source of revenue comes from water service charges. Operating expenses include labor and materials for operations and maintenance of treatment and distribution facilities, debt payments, transfers to capital funds, and more. During the historical time period, average annual revenues have remained relatively flat, with an overall change of only -0.4%, or a decrease of about $17,000. Total expenditures (operating, debt service costs, and minor capital) have decreased 8% over the same period, or about $241,000. **Table 10-1** presents the detail of annual revenues, expenditures, and ending cash over the time period 2010 to 2014.

Water Utility Fund 405

Fund 405 serves as the Water Utility capital account where capital revenues are deposited and capital expenditures are paid. Examples of capital revenues include connection charges, grant and debt proceeds, and capital transfers from the operating fund. Capital expenditures are investments in the utility through acquisition or upgrade of fixed, physical, non-consumable assets, such as buildings and equipment. Average annual revenues increased 34% over the time period, representing about $305,000. Total expenditures over that same period have more than doubled, representing an increase of about $759,000. **Table 10-2** presents the detail of annual revenues, expenditures, and ending cash over the time period 2010 to 2014.

Table 10-1

Summary of Historical Fund Resources and Uses Arising From Cash Transactions Water Utility Fund 401

Water Utility Fund 401	2010	2011	2012	2013	2014
Beginning Net Cash and Investments					
Unspecified	$ -	$ -	$ -	$ -	**$ -**
Reserved	$ -	$ -	$ -	$ -	$ -
Unreserved [A]	$ 1,049,598	$ 1,336,570	$ 1,450,456	$ 1,666,867	$ 2,031,955
Total Beginning Cash Balance	**$ 1,049,598**	**$ 1,336,570**	**$ 1,450,456**	**$ 1,666,867**	**$ 2,031,955**
Revenues and Other Sources:					
Taxes [B]	$ 52,755	$ -	$ -	$ -	$ -
Intergovernmental Revenues	$ -	$ -	$ 3,587	$ -	$ 1,698
Charges For Services	$ 3,826,527	$ 3,733,553	$ 3,822,330	$ 3,864,066	$ 3,905,772
Fines & Forfeitures	$ 117,779	$ 96,130	$ 87,140	$ 76,125	$ 73,300
Miscellaneous Revenues	$ 38,639	$ 62,460	$ 34,148	$ 26,049	$ 35,709
Non Revenues	$ 3,656	$ 850	$ -	$ 545	$ 1,749
Insurance Recoveries	$ -	$ -	$ -	$ -	$ 4,278
Total Revenues and Other Sources	**$ 4,039,355**	**$ 3,892,994**	**$ 3,947,205**	**$ 3,966,784**	**$ 4,022,506**
Total Resources	**$ 5,088,953**	**$ 5,229,564**	**$ 5,397,661**	**$ 5,633,652**	**$ 6,054,461**
Operating Expenditures:					
Water Utility	$ 2,814,191	$ 2,882,918	$ 2,629,140	$ 2,653,684	**$ 2,677,426**
Non Expenditures	$ 673	$ -	$ 750	$ -	$ 924
Total Operating Expenditures	**$ 2,814,864**	**$ 2,882,918**	**$ 2,629,890**	**$ 2,653,684**	**$ 2,678,350**
Debt Services	$ 170,020	$ 170,020	$ 371,728	$ 141,205	$ 90,803
Interest & Other Debt Svc Costs	$ 21,055	$ 18,241	$ 9,726	$ 4,136	$ 2,724
Capital Expenditures	$ 7,005	$ 6,229	$ 17,750	$ 971	$ -
Total Expenditures	**$ 198,080**	**$ 194,490**	**$ 399,204**	**$ 146,312**	**$ 93,527**
Other Financing Uses	$ 739,439	$ 701,700	$ 701,700	$ 801,700	$ 751,700
Total Uses	**$ 3,752,383**	**$ 3,779,108**	**$ 3,730,794**	**$ 3,601,697**	**$ 3,523,577**
Excess (Deficit) of Resources Over Uses	$ 1,336,570	$ 1,450,456	$ 1,666,867	$ 2,031,955	$ 2,530,884
Non-Revenues					
Non-Expenditures					
Ending Net Cash and Investments					
Unspecified					
Reserved					
Unreserved	$ 1,336,570	$ 1,450,456	$ 1,666,867	$ 2,031,955	$ 2,530,884
Total	**$ 1,336,570**	**$ 1,450,456**	**$ 1,666,867**	**$ 2,031,955**	**$ 2,530,884**

[A] The beginning fund balance in 2010 was backcalculated by assuming that the ending balance for 2010 is the beginning balance for 2011.
[B] In 2011, taxes began to be included in "Charges for Services"

Table 10-2

Summary of Historical Fund Resources and Uses Arising From Cash Transactions Water Improvement Fund 405

Water Improvement Fund (405)	2010	2011	2012	2013	2014
Beginning Net Cash and Investments	4,894,963	5,446,249	5,304,683	4,813,544	4,641,426
Revenues:					
Miscellaneous Revenues	58,935	67,057	50,990	35,602	41,107
Capital Contributions	91,110	251,550	449,350	148,350	66,650
Non Revenues	2,250	50,272	50,000	53,230	349,612
Interfund Transfers	750,000	700,000	700,000	800,000	750,000
Total Revenues and Other Sources	**902,295**	**1,068,879**	**1,250,340**	**1,037,182**	**1,207,369**
Total Resources	**5,797,258**	**6,515,128**	**6,555,023**	**5,850,726**	**5,848,795**
Operating Expenditures:					
Water Utility	253,465	95,361	356,446	42,728	39,501
Non Expenditures	2,138	258	-	450,000	-
Total Operating Expenditures	**255,603**	**95,620**	**356,446**	**492,728**	**39,501**
Capital Expenditures	95,406	1,084,825	1,311,558	101,347	1,070,545
Total Expenditures	**351,009**	**1,180,444**	**1,668,004**	**594,075**	**1,110,047**
Other Financing Uses	-	30,000	73,476	615,225	-
Total Uses	**351,009**	**1,210,444**	**1,741,480**	**1,209,300**	**1,110,047**
Excess (Deficit) of Resources Over Uses	5,446,249	5,304,683	4,813,544	4,641,426	4,738,748
Nonrevenues					
Nonexpenditures					
Ending Net Cash and Investments	**5,446,249**	**5,304,683**	**4,813,544**	**4,641,426**	**4,738,748**

10.2.2 Outstanding Debt Principal

Table 10-3 presents outstanding utility debt as of the end of 2014. As shown in the table, debt will be fully paid in 2016.

Table 10-3

Summary of Outstanding Debt

Debt Description	Principal Outstanding	Maturity Year
PWTF Loan: Water Treatment Plant Replacement	$ 181,607	2016
Total	**$ 181,607**	

10.3 AVAILABLE CAPITAL RESOURCES

Feasible long-term capital funding strategies must be defined to ensure that adequate resources are available to fund the CIP identified in this WSP. In addition to the City's internal resources such as accumulated cash reserves, capital revenues, and rate revenues designated for capital purposes, capital needs can be met from outside sources such as grants, low-interest loans, and bond financing. The following is a summary of potential internal and external resources that might be available for funding the CIP.

10.3.1 Internal Utility Resources

Internal utility resources appropriate for funding capital needs include accumulated cash in capital funds, transfers from operating revenues, and capital revenue such as connection charges or local facilities charges. These resources are discussed below.

Utility Funds and Cash Reserves

Ongoing user charges (rates) paid by utility customers are operating revenues that are the primary funding source for all utility activities. While capital revenue cannot be used for operating or maintenance expenses, operating revenues can be used for capital investment. Rate revenue can pay for capital projects in two ways: either paying for debt service or directly paying for capital projects. Funding capital costs directly through rates avoids the interest expense associated with issuing new debt. Rate funded capital investment should be designed as a regular transfer from operating revenue each year; otherwise, trying to pay for capital projects with current-year operating revenue can lead to rate volatility. If regular transfers of operating revenue are made into the capital fund, then if capital spending is relatively low in any given year, cash reserves can be accumulated that will offset future capital project costs. The utility has been very successful at funding capital projects with reserves and not having to issue new debt.

Capital Connection Charges

A connection charge, as provided for by RCW 35.92.025, refers to a one-time charge imposed on new customers as a condition of connection to the utility system. Connection charges are separate from meter installation fees or similar charges for the labor and materials used to make a physical connection. Instead connection charges are intended to recover a proportionate share of existing infrastructure and planned future capital investment that will serve new customers.

Equity is served by providing a vehicle for new customers to share the cost of infrastructure investment. Further, connection charge revenue provides a source of cash flow used to support utility capital needs. Revenue can only be used to fund utility capital projects or to pay debt service incurred to finance those projects; it cannot be used for operating or maintenance costs.

In the absence of a connection charge, growth-related capital costs would be borne in large part by existing customers. In addition, the net investment in the utility already collected from existing

customers would be diluted by the addition of new customers, effectively subsidizing new customers with prior customers' payments.

The City currently charges all new utility customers a connection charge based on meter size, starting at $4,300 for a 5/8" or 3/4" meter. A study is currently underway to review and update connection charges.

Local Facilities Charges

While a connection charge is the manner in which new customers pay their share of plant investment costs, local facilities charges is a funding mechanism that is used to pay the costs of local facilities that connect each property to the system's infrastructure. Local facilities funding is often overlooked in rate forecasting because it is funded up-front by either connecting customers, developers, or through an assessment to properties, but never from rates. Although these funding mechanisms do not provide a capital resource toward funding CIP costs, a discussion of these charges is included in this chapter because of their impact on new customers.

A number of mechanisms can be considered toward funding local facilities. One of the following scenarios typically occurs: (a) the utility charges a connection fee based on the cost of the local facilities (under the same authority as the connection charge); (b) a developer funds extension of the system to its development and turns those facilities over to the utility (contributed capital); or (c) a local assessment is set up called a Utility Local Improvement District (ULID/LID) or a Local Utility District (LUD) which collects tax revenue from benefited properties.

A local facilities charge (LFC) is a variation of the connection charge authorized through RCW 35.92.025. It is a city-imposed charge to recover the cost related to service extension to local properties. Often called a front-footage charge and imposed on the basis of footage of the main "fronting" a particular property, it is usually implemented as a reimbursement mechanism to a city for the cost of a local facility that directly serves a property. It is a form of connection charge and thus can accumulate up to 10 years of interest. It typically applies in instances where the city installs the facilities prior to the properties being developed.

A developer extension is a requirement that a developer install onsite and sometimes offsite improvements as a condition of extending service. These are in addition to the connection charge required and must be built to city standards. Part of the agreement between the city and the developer might include a late-comer agreement, resulting in a late-comer charge to other properties later served by the developer-funded extension.

A Latecomer charge is a variation of developer extensions whereby new customers connecting to a developer-installed improvement make a payment to the city based on their share of the developer's cost (RCW 35.91.920). The city passes this charge on to the developer who installed the facilities. Latecomer obligations are recorded on the title of affected properties. No interest is

allowed, and the reimbursement agreement is in effect for a period of 20 years, unless a longer duration is approved by the city.

A LID/ULID is another mechanism for funding infrastructure that assesses benefited properties based on the special benefit received by the construction of specific facilities (RCW 35.43.042). Most often used for local facilities, some ULIDs also recover related general facilities costs. Substantial legal and procedural requirements can make this a relatively expensive process, and there are mechanisms by which a ULID can be rejected.

10.3.2 Government Programs & Resources

Historically, federal and state grant programs were available to local utilities for capital funding assistance. However, these assistance programs have been mostly eliminated, substantially reduced in scope and amount, or replaced by loan programs. Remaining miscellaneous grant programs are lightly funded and heavily subscribed. Nonetheless, even the benefit of low-interest loans makes the effort of applying worthwhile. Grants and low-cost loans for Washington State utilities are available from various Washington State Departments. Several grant and loan programs that the City might be eligible for are described in greater detail below. Some of these programs may not pertain to all utility functions.

Department of Commerce

A September 2014 document from the Department of Commerce summarizes various loan and grant programs available for utility projects. The document titled "Summary of Some Grant and Loan Programs for Drinking Water and Wastewater Projects" can be found at http://www.commerce.wa.gov/Documents/9-2-14_multi-program_funding_program_summary.pdf

A few of those programs are described below:

Community Development Block Grant (CDBG) General Purpose Grant

These grants are made available through a competitive application process to assist small cities, towns and counties in Washington State in carrying out significant community and economic development projects that principally benefit low and moderate income persons.

- Eligible applicants are Washington State cities and towns with a population less than 50,000 and counties with a population less than 200,000 that are not participating in a CDBG Entitlement Urban County Consortium.
- Eligible projects include public facilities such as water, wastewater, and streets.
- Further details are available at:
    - http://www.commerce.wa.gov/Programs/Infrastructure/CDBG-Program-Overview/Pages/default.aspx
    - http://www.commerce.wa.gov/Documents/2015_CommerceResourceBook.pdf

Community Economic Revitalization Board (CERB)

CERB, a division of the Washington State Department of Commerce, primarily offers low cost loans; grants are made available only to the extent that a loan is not reasonably possible. The CERB targets public facility funding for economically disadvantaged communities, specifically for job creation and retention. Priority criteria include the unemployment rates, number of jobs created and/or retained, wage rates, projected private investment, and estimated state and local revenues generated by the project. According to their website, "CERB funds a variety of projects that create jobs including (but not limited to) domestic and industrial water, storm and sewer water projects, telecommunications and port facilities." Eligible applicants include cities, towns, port districts, special purpose districts, federally recognized Indian tribes and municipal corporations.

Funding details for the 2013 – 2015 Program are as follows per the Washington Commerce website: "$9 million was appropriated to CERB for the 2013-2015 Biennium. By state law, CERB must award 75% of this funding to projects in rural counties. The Board has also allocated $2,182,500 to be available for construction and planning grants on a first-come, first-served basis."

Program	Funding Limitations
Committed Private Sector Partner Construction	• $2 million per project loan award limit • Up to $300,000 or 50% of total award, **whichever is less**, may be grant funds. • 20% cash match required (minimum, percent of total project cost)
Prospective Development Construction	Available to rural communities only. • $2 million per project loan award limit • Up to $300,000 or 50% of total award, **whichever is less**, may be grant funds. • 50% cash match required (minimum, percent of total project cost)
Planning/Economic Feasibility Studies	• $50,000 grant per project award limit • 25% cash match required (minimum, percent of total project cost)

Further details are available at:

- http://www.commerce.wa.gov/commissions/CommunityEconomicRevitalizationBoard/
- http://www.commerce.wa.gov/Documents/2013-15_Policies.pdf
- http://www.commerce.wa.gov/commissions/CommunityEconomicRevitalizationBoard/Pages/CERB-Traditional-Programs.aspx

Public Works Board (PWB) Financial Assistance

The Board's goal is community access to financial and technical resources that help sustain local infrastructure. Cities, towns, counties, and special purpose districts are eligible to receive financial assistance for qualifying projects. When funding is available, the following tools exist:

- Construction Loan Program: http://www.pwb.wa.gov/financial-assistance/Construction/Pages/default.aspx
    - Funding Cycle: Per the Board website, the Governor's proposed 2015-17 budget offers $69.7M for 19 projects.

- Program Description: Low-interest loans for local governments to finance public infrastructure construction and rehabilitation. Eligible projects must improve public health and safety, respond to environmental issues, promote economic development, or upgrade system performance.
- Terms: For non-distressed communities, a term of five years or less has an interest rate of 1.28% and a term from six to twenty years has an interest rate of 2.55%.

- Pre-Construction Loan Program: http://www.pwb.wa.gov/financial-assistance/Pre-Construction/Pages/default.aspx
  - Funding Cycle: No funding has been allocated to the Pre-construction loan program for the 2013-15 biennium but the program still exists and could be funded in a future biennium.
  - Program Description: Local governments may apply for low interest loans to finance pre-construction activities to prepare a project for construction.
  - Terms: Terms are limited to a five year repayment period (the loan term may be converted to 20-years once the project has secured construction funding) with a 1% interest rate.
- Emergency Loan Program: http://www.pwb.wa.gov/financial-assistance/Emergency-Loan/Pages/default.aspx
  - Funding Cycle: No funding has been allocated to the Emergency loan program for the 2013-15 biennium, but the program still exists and could be funded in a future biennium.
  - Program Description: The Emergency Loan Program provides funding to address public works emergencies, thereby helping provide immediate restoration of critical public works services and facilities.
  - Terms: Funds are limited to $500,000 per jurisdiction per biennium, and come with a 20-year term (or the life of the project), and a 3% interest rate. No local match is required.
- Energy and Water Efficiency Loan Program: http://www.pwb.wa.gov/financial-assistance/Energy-Water/Pages/default.aspx
  - Funding Cycle: No funding has been allocated to the Energy and Water Efficiency (EWE) loan program for the 2013-15 biennium but the program still exists and could be funded in a future biennium.
  - Program Description: The EWE program is designed to encourage energy, water, and efficiency upgrades to existing infrastructure by providing low-cost loans.
  - Terms: The maximum loan amount is $1,000,000. The interest rate is dependent upon the term of the loan. Loans less than 5 years receive a 0.50% rate. Loans

between 5 and 10 years receive a 1% interest rate. Loans between 11 and 20 years receive a 1.50% interest rate.

- Drinking Water State Revolving Fund Loan Program: http://www.pwb.wa.gov/financial-assistance/Drinking-Water/Pages/default.aspx
    - Funding Cycle: The DWSRF program has shifted their application cycle to fall, starting September 1, 2014.
    - Program Description: The DWSRF loan program is a federal and state partnership program to provide low-interest loans to finance projects that increase public health protection. A 2012 Washington State law requires all public water systems that receive loans or grants for infrastructure to complete an Investment Grade Efficiency Audit (IGEA). This is an effort to apply energy efficiency to water systems, similar to DOH's Green Projects that was started in 2009, and may be financed as part of the DWSRF loan.
    - Terms: For construction loans, interest rates range from 1% to 1.5% with repayment periods of 20 years or life of the project being financed, whichever is less.
- Further general resources are available at:
    - http://www.pwb.wa.gov/financial-assistance/Pages/default.aspx
    - http://www.pwb.wa.gov/Documents/FINAL-MASTER-GUIDELINES.pdf
    - http://www.commerce.wa.gov/Documents/9-2-14_multi-program_funding_program_summary.pdf

10.3.3 Public Debt Financing

Public debt financing options include General Obligation Bonds and Revenue Bonds.

General Obligation Bonds

General Obligation (G.O.) bonds are bonds secured by the full faith and credit of the issuing agency, committing all available tax and revenue resources to debt repayment. With this high level of commitment, G.O. bonds have relatively low interest rates and few financial restrictions. However, the authority to issue G.O. bonds is restricted in terms of the amount and use of the funds, as defined by Washington constitution and statute. Specifically, the amount of debt that can be issued is linked to assessed valuation.

RCW 39.36.020 states:

> *"(ii) Counties, cities, and towns are limited to an indebtedness amount not exceeding one and one-half percent of the value of the taxable property in such counties, cities, or towns without the assent of three-fifths of the voters therein voting at an election held for that purpose.*

(b) In cases requiring such assent counties, cities, towns, and public hospital districts are limited to a total indebtedness of two and one-half percent of the value of the taxable property therein."

While bonding capacity can limit availability of G.O. bonds for utility purposes, these can sometimes play a valuable role in project financing. A rate savings may be realized through two avenues: the lower interest rate and related bond costs; and the extension of repayment obligation to all tax-paying properties (not just developed properties) through the authorization of an ad valorem property tax levy.

Revenue Bonds

Revenue bonds are commonly used to fund utility capital improvements. The debt is secured by the revenues of the issuing utility. With this limited commitment, revenue bonds typically bear higher interest rates than G.O. bonds and also require security conditions related to the maintenance of dedicated reserves (a bond reserve) and financial performance (added bond debt service coverage). The city agrees to satisfy these requirements by resolution as a condition of bond sale.

Revenue bonds can be issued in Washington without a public vote. There is no bonding limit, except the practical limit of each utility's ability to generate sufficient revenue to repay the debt and provide coverage. In some cases, poor credit might make issuing bonds problematic.

10.3.4 Capital Resource Funding Summary

An ideal capital financing strategy would include the use of grants and low-cost loans when debt issuance is required. However, these resources are very limited and competitive in nature and do not provide a reliable source of funding for planning purposes. It is recommended that the City pursue these funding avenues but assume bond financing to meet needs for which the City's available cash resources are insufficient. G.O. Bonds may be useful for special circumstances, but since bonding capacity limits are most often reserved for non-utility purposes, revenue bonds are a more secure financing mechanism for utility needs. The capital financing strategy developed to fund the CIP identified in this WSP generally follows the funding priority below:

- Available grant funds and/or developer contributions
- Accumulated capital cash reserves from prior years
- Interest earned on capital fund balances and other miscellaneous capital resources
- Annual revenue from connection charges
- Annual transfers of rate-funded capital or excess cash (above target balances) from the operating account
- Revenue bond financing

10.4 FINANCIAL PLAN FRAMEWORK

10.4.1 Overview

The Water Utility is a self-supporting enterprise fund responsible for funding all of its costs. It is not dependent upon general tax revenues or other General Fund resources. The primary source of funding for the utility is service charges. The City controls the level of service charges by ordinance and can adjust them as needed to meet financial objectives.

The financial plan can give assurance of financial feasibility only if it considers the total cost of service – capital and operating. To meet this objective, the following analytical steps were taken:

Capital Funding Plan

The capital funding plan identifies total costs for the 20-year capital planning period, which is 2015 through 2035. The plan then shows how those costs can be paid for by some combination of existing reserves, current rate revenue, connection charges, debt financing and any special resources that may be readily available (e.g. grants, developer contributions, etc.). The capital funding plan impacts the financial forecast in two ways: debt financing results in annual debt service and potential debt service coverage requirements, and any rate revenue used for capital funding increases the rate revenue requirement.

Financial Forecast

The financial forecast, or revenue sufficiency analysis, forecasts the amount of annual rate revenue needed to be generated throughout the short-term planning horizon. It is our understanding that the Department of Health will be changing from the current 6-year cycle to a 10-year cycle for updating Comprehensive Water System Plans, so the short-term planning period is defined as the 10-year period (2015-2025).

The analysis incorporates operating revenues, O&M expenses, debt service payments, rate-funded capital needs, and any other identified revenues or expenses related to utility operations. The objective of the financial forecast is to evaluate the sufficiency of the current level of rates. In addition to annual operating costs, revenue needs are impacted by debt covenants (typically revenue bonds) and specific fiscal policies and financial goals of the utility. For this analysis, two revenue sufficiency tests have been developed to reflect the financial goals and constraints of the City: cash needs must be met, and debt coverage requirements must be realized. In order to operate successfully with respect to these goals, both tests of revenue sufficiency must be met.

Cash Test – The cash flow test identifies all known cash requirements for the utility in each year of the planning period. Typically these include O&M expenses, debt service payments, rate-funded system reinvestment funding or directly funded capital outlays, and any additions to specified reserve balances. The total annual cash needs of the utility are then compared to projected cash revenues using the current rate structure. Any projected revenue shortfalls are identified and the rate increases necessary to make up the shortfalls are established.

Coverage Test – The coverage test is based on a commitment made by the City when issuing revenue bonds and some other forms of long-term debt. For purposes of this analysis, revenue bond debt is assumed for any needed debt issuance. As a security condition of issuance, the City would be required per covenant to agree that the revenue bond debt would have a higher priority for payment (a senior lien) compared to most other expenditures; the only outlays with a higher lien are O&M expenses. Debt service coverage is expressed as a multiplier of the annual revenue bond debt service payment. For example, a 1.0 coverage factor would imply that no additional cushion is required. A 1.25 coverage factor means revenue must be sufficient to pay O&M expenses, annual revenue bond debt service payments, plus an additional 25 percent of annual revenue bond debt service payments. The excess cash flow derived from the added coverage (if any) can be used for either rate-funded capital expenditures or to build reserves. Targeting a higher coverage factor can help the City achieve a better credit rating and provide lower interest rates for future debt issues. The Water Utility does not have outstanding revenue bond debt and no new debt is forecasted over the 20-year planning horizon.

In determining the annual revenue requirement, both the cash and coverage sufficiency tests must be met and the test with the greatest deficiency drives the level of needed rate increase in any given year.

Independent Growth Assumptions – The customer growth assumptions in the financial forecast are independent of the long-term population growth assumptions contained in other chapters of this Comprehensive Plan. The reason is that the meaning of the word "conservative" for the purpose of facilities planning is the opposite of "conservative" for the purpose of financial forecasting. In planning capital facilities, a conservative customer and demand forecast will tend to fall on the high side of the reasonable range, because underestimating demand could lead to a capacity shortfall, a more serious problem than would result from overestimated demand. For financial planning, the opposite is true: a conservative growth forecast will tend to fall on the low side of the reasonable range, because assuming too many customers could lead to a revenue shortfall and rate spike, a more serious problem than would result from assuming too few customers.

Financial Forecast Customer Growth Assumptions – To be consistent with average growth over the last five years, customer growth is forecasted at 45 connections, or ERUs, per year over the 20-year planning horizon (averaging 0.63 percent per year).

10.4.2 Fiscal Policies

The City maintains a fund structure and implements financial policies that target management of a financially viable and fiscally responsible water utility. A brief summary of the key financial policies employed by the City, as well as those recommended and incorporated in the financial program are discussed below.

Reserve Policies

Utility reserves serve multiple functions: they can be used to address variability and timing of expenditures and receipts; occasional disruptions in activities, costs or revenues; utility debt obligations; and many other functions. The collective use of individual reserves helps to limit the City's exposure to revenue shortfalls, meet long-term capital obligations, and reduce the potential for bond coverage defaults.

Operating Reserve – An operating reserve is designed to provide a liquidity cushion; it protects a utility from the risk of short-term variation in the timing of revenue collection or payment of expenses. Like other types of reserves, operating reserves also serve another purpose: they help smooth rate increases over time. Target funding levels for an operating reserve are generally expressed as a certain number of days of operating and maintenance (O&M) expenses, with the minimum requirement varying with the expected revenue volatility. Industry practice for utility operating reserves ranges from 30 days (8%) to 120 days (33%) of O&M expenses, with the lower end more appropriate for utilities with stable revenue streams and the higher end of the range more appropriate for utilities with significant seasonal or consumption-based fluctuations.

The City's current policy is to maintain a minimum balance in the operating account equal to 3 months of operating reserves (90 days). Industry practice is to maintain a reserve range of 60 to 90 days of O&M expenses for water utilities. There are no changes recommended to this policy for the short term.

Rate Stabilization Reserve (Account) – A rate stabilization reserve is often required to be established per revenue bond covenants, although the amount of designated funding is not usually stipulated. The purpose of this type of reserve is to avoid unexpected rate increases, while ensuring that debt service payments can be made and coverage requirements will be met if revenue collections fall below normal levels. Per typical bond covenants, reserve amounts used in any given year are allowed to meet coverage requirements. There can be specific rules for the accounting of deposits and withdrawals into a rate stabilization reserve, so care must be taken when administering this reserve. The City may consider funding this reserve in the future if needed. It is recommended that the City confer with a bond advisor prior to funding this reserve.

Capital Contingency Reserve – A capital contingency reserve is the minimum fund balance in a capital fund, set aside for capital needs that are large, urgent, and unexpected. These needs could result from a sudden asset failure, or they could come from capital project cost overruns. There is more than one way to determine an appropriate level for this reserve. For instance, a utility could choose a certain percentage of the total cost of its assets, or it could base the minimum reserve on the cost of replacing a particular highly critical asset, or it could set the capital contingency as a percentage of average capital spending per year. The final target level should balance industry practice with the risk level of the City. The most common method is to set a minimum capital fund balance equal to 1% to 2% of the original cost of plant in service.

The City's current policy is to maintain a minimum balance in the Improvement Fund equal to $1 million (about 1.5% of current fixed assets). There are no changes recommended to this policy.

Restricted Bond Reserve – When issuing revenue bonds, bond underwriters require that the utility establish a restricted cash reserve, typically equal to one year's debt service payment (principal and interest) for each bond issue. The reserve can be used to fund the last year's debt service payment for each issue. The Water Utility does not have outstanding revenue bonds; therefore this reserve is not funded.

System Reinvestment Funding – System reinvestment funding promotes system integrity through reinvestment in the system. Target system reinvestment funding levels are commonly linked to annual depreciation expense as a measure of the decline in asset value associated with routine use of the system. Particularly for utilities that do not already have an explicit system reinvestment policy in place, implementing a funding level based on depreciation expense could significantly impact rates. A common alternative benchmark is annual depreciation expense net of debt principal payments on outstanding debt. This approach recognizes that customers are still paying for certain assets through the debt component of their rate, and intends to avoid simultaneously charging customers for an asset and its future replacement. The specific benchmark used to set system reinvestment funding targets is a matter of policy that must balance various objectives including managing rate impacts, keeping long-term costs down, and promoting "generational equity" (i.e. not excessively burdening current customers with paying for facilities that will serve a larger group of customers in the future).

The City does not have a policy in place for system reinvestment funding. It is recommended to establish a policy to annually fund from rates an amount equal to annual depreciation expense net of annual debt principal payments. To smooth rate impacts over the planning period, the financial plan incorporates a phase-in strategy beginning in 2016 that achieves the target by the end of the 10-year period.

Debt Management – It is prudent to consider policies related to debt management as part of broader utility financial policy structure. Debt management policies should be evaluated and formalized including the level of acceptable outstanding debt, debt repayment, bond coverage and total debt coverage targets.

The Water Utility does not have any outstanding revenue bonds, nor is any new debt forecasted to be needed to fund the 20-year CIP.

10.5 FINANCIAL PLAN RESULTS

10.5.1 Capital Improvement Program

The CIP developed for this WSP identifies $33.7 million in project costs ($37.6 million inflated) over the 10-year planning horizon (including study year 2015). This includes $18.4 million of developer funded projects and $15.3 million of utility funded projects. The 20-year period totals

$42.1 million ($50.4 million inflated). Costs are stated in 2015 dollars and are escalated to the year of planned spending at an annual rate of 3.0% per year.

Table 10-4 summarizes the expected capital expenditures. Approximately 80% (2015 dollars) of the capital costs are included in the 10-year planning period.

Table 10-4

10-Year and 20-Year CIP

Year	Total Annual Cost (2015 $)	Developer Funded (2015 $)	Utility Funded (2015 $)	Total Annual Cost (Inflated) [a]
Study Year 2015	$ 1,096,000	$ -	$ 1,096,000	$ 1,096,000
2016	13,645,000	12,290,000	1,355,000	14,054,350
2017	2,620,000	-	2,620,000	2,779,558
2018	2,696,500	1,291,125	1,405,375	2,946,538
2019	2,406,500	1,291,125	1,115,375	2,708,537
2020	1,630,500	-	1,630,500	1,890,196
2021	2,290,500	-	2,290,500	2,734,977
2022	1,670,000	806,250	863,750	2,053,889
2023	1,670,000	806,250	863,750	2,115,506
2024	1,983,500	966,375	1,017,125	2,588,018
2025	1,973,500	966,375	1,007,125	2,652,219
10- Year Capital Total	**33,682,000**	**18,417,500**	**15,264,500**	**37,619,788**
2026-2035	8,460,000	-	8,460,000	12,816,966
20- Year CIP Total	**$ 42,142,000**	**$ 18,417,500**	**$ 23,724,500**	**$ 50,436,754**

[a] Inflated to year of implementation

10.5.2 Capital Funding Plan

A capital funding plan is developed to identify the total resources available to pay for the CIP and determine if new debt financing is required.

The Water Utility began 2015 with $2.3 million in the Operating Fund and $4.7 million in the Improvement Fund. Funds in excess of the Operating Fund maximum target of 90 days of O&M expenses are planned to be transferred to the Improvement Fund. Rate funded system reinvestment funds are projected to range between $109,313 and $1.7 million in the 10-year forecast.

The cash resources described above are forecasted to fully fund the 20-year CIP without the need for additional debt. Escalated developer funded projects total $20.1 million. **Table 10-5** presents the corresponding 20-year capital financing strategy.

Table 10-5

20-Year Capital Funding Strategy

Year	Capital Expenditures 2015 $	Capital Expenditures Escalated	Debt Financing	Developer Funding	Cash Funding	Total Financial Resources
2015	$ 1,096,000	$ 1,096,000	$ -	$ -	$ 1,096,000	$ 1,096,000
2016	13,645,000	14,054,350	-	12,658,700	1,395,650	14,054,350
2017	2,620,000	2,779,558	-	-	2,779,558	2,779,558
2018	2,696,500	2,946,538	-	1,410,847	1,535,691	2,946,538
2019	2,406,500	2,708,537	-	1,453,173	1,255,364	2,708,537
2020	1,630,500	1,890,196	-	-	1,890,196	1,890,196
2021	2,290,500	2,734,977	-	-	2,734,977	2,734,977
2022	1,670,000	2,053,889	-	991,586	1,062,304	2,053,889
2023	1,670,000	2,115,506	-	1,021,333	1,094,173	2,115,506
2024	1,983,500	2,588,018	-	1,260,900	1,327,117	2,588,018
2025	1,973,500	2,652,219	-	1,298,727	1,353,492	2,652,219
Subtotal	**33,682,000**	**37,619,788**	**-**	**20,095,266**	**17,524,522**	**37,619,788**
2026-2035	8,460,000	12,816,966	-	-	12,816,966	12,816,966
Total	**$ 42,142,000**	**$ 50,436,754**	**$ -**	**$ 20,095,266**	**$ 30,341,488**	**$50,436,754**

10.5.3 Financial Forecast

The financial forecast is developed from the 2015 budget documents along with other key factors and assumptions to develop a complete portrayal of the utility's annual financial obligations. The following is a list of the key revenue and expense factors and assumptions used to develop the financial forecast:

Revenue Assumptions

- As previously discussed, rate revenues are assumed to grow at about 0.63% per year.
- Miscellaneous revenues are forecasted to increase at the customer growth rate, for the most part. Miscellaneous revenues include late penalties, NSF fees, and charges for special services.
- Connection charge revenue is budgeted at $86,000 for 2015. Based on the growth forecast, connection charge revenue is assumed at about $138,000 per year over the study period.
- Interest earnings initially assume a rate of 0.15% applied to beginning of year cash balances based on existing Local Government Investment Pool rates. The interest rate phases up to 1.0% within five years.

Expenditure Assumptions

- O&M expense projections are based on the 2015 budget and are forecasted to increase with general and labor cost inflation of 2.0% and benefit cost inflation of 7.0%.
- Utility and state taxes are calculated based on forecasted revenues and prevailing tax rates.

- The utility currently has one outstanding Public Works Trust Fund due to mature in 2016. Loan payments are about $92,000 per year in 2015 and 2016.
- The capital financial strategy developed for this WSP does not forecast the need to issue new debt.
- Any Operating Fund balance above the minimum requirement is assumed to be transferred to the Improvement Fund each year. The 2015 Operating Fund balance is expected to end the year at 90 days of O&M expenses, with the remainder transferred to the Improvement Fund.

Although the financial plan is completed for a 20-year planning period, the rate strategy focuses on the shorter term horizon, 2015 through 2025. It is recommended that the City revisit the proposed rates annually to ensure that the rate projections developed remain adequate. Any significant changes should be incorporated into the financial plan and future rates should be adjusted as needed.

Table 10-6 summarizes the annual revenue requirement for 2015 through 2025 based on the forecast of revenues, expenditures, fund balances, fiscal policies, and capital funding.

Table 10-6

10-Year Financial Forecast

	Study Year	10 Year Forecast									
Revenue Requirement	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**
Revenues											
Rate Revenues Under Existing Rates	$ 3,819,403	$ 3,845,225	$ 3,871,049	$ 3,896,873	$ 3,922,697	$ 3,948,522	$ 3,974,346	$ 4,000,170	$ 4,025,994	$ 4,051,818	$ 4,077,643
Non-Rate Revenues	100,496	115,280	130,001	131,283	138,431	138,923	135,989	125,415	130,481	135,885	139,159
Total Revenues	**$ 3,919,898**	**$ 3,960,505**	**$ 4,001,050**	**$ 4,028,157**	**$ 4,061,128**	**$ 4,087,444**	**$ 4,110,334**	**$ 4,125,585**	**$ 4,156,475**	**$ 4,187,704**	**$ 4,216,802**
Expenses											
Cash Operating Expenses	$ 2,763,264	$ 2,825,995	$ 2,889,954	$ 2,956,026	$ 3,024,315	$ 3,044,930	$ 3,116,990	$ 3,191,600	$ 3,268,891	$ 3,349,005	$ 3,432,091
Existing Debt Service	92,619	91,711	-	-	-	-	-	-	-	-	-
New Debt Service	-	-	-	-	-	-	-	-	-	-	-
Rate Funded System Reinvestment	-	109,313	293,003	456,182	620,529	789,227	969,755	1,169,671	1,353,763	1,542,679	1,740,630
Total Expenses	**$ 2,855,883**	**$ 3,027,019**	**$ 3,182,958**	**$ 3,412,209**	**$ 3,644,843**	**$ 3,834,158**	**$ 4,086,746**	**$ 4,361,271**	**$ 4,622,655**	**$ 4,891,684**	**$ 5,172,721**
Net Surplus (Deficiency)	**$ 1,056,965**	**$ 911,206**	**$ 783,318**	**$ 581,865**	**$ 377,085**	**$ 214,205**	**$ (12,086)**	**$ (260,147)**	**$ (495,081)**	**$ (737,653)**	**$ (992,248)**
Additions to Meet Coverage	-	-	-	-	-	-	-	-	-	-	-
Total Surplus (Deficiency)	**$ 1,056,965**	**$ 911,206**	**$ 783,318**	**$ 581,865**	**$ 377,085**	**$ 214,205**	**$ (12,086)**	**$ (260,147)**	**$ (495,081)**	**$ (737,653)**	**$ (992,248)**
Annual Rate Adjustment	0.00%	0.00%	0.00%	3.25%	3.25%	3.25%	3.25%	3.25%	3.25%	3.25%	3.25%
Cumulative Annual Rate Adjustment	0.00%	0.00%	0.00%	3.25%	6.61%	10.07%	13.65%	17.34%	21.15%	25.09%	29.16%
Rate Revenues After Rate Increase	$ 3,819,403	$ 3,845,225	$ 3,870,877	$ 4,023,166	$ 4,181,265	$ 4,345,391	$ 4,515,769	$ 4,692,632	$ 4,876,221	$ 5,066,787	$ 5,264,589
Additional Taxes from Rate Increase	$ -	$ -	$ -	$ 12,700	$ 25,984	$ 39,871	$ 54,386	$ 69,551	$ 85,390	$ 101,929	$ 119,194
Net Cash Flow After Rate Increase	**1,056,965**	**911,206**	**783,318**	**695,801**	**610,186**	**571,893**	**475,813**	**363,798**	**270,962**	**176,764**	**77,054**
Coverage After Rate Increases	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**

Annual rate adjustments of 3.25% are projected for years 2018 through 2025 to cover projected O&M expenses, meet policy objectives for funding system reinvestment, and achieve other stated financial policy objectives. This rate strategy also provides sufficient funding to cash finance the 20-year CIP without the need for additional debt.

Table 10-7 shows a summary of the projected ending balances for the Operating Fund and Improvement Fund through 2025.

The combined minimum target balance is based on 90 days of O&M expenses plus $1 million for the Improvement Fund. The Water Utility does not have a restricted bond reserve. Funds remain above the targets throughout the forecast.

Table 10-7

Ending Cash Balance Summary

	Study Year	10 Year Forecast									
Ending Fund Balances	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**
Water Utility Fund	$ 681,353	$ 694,913	$ 712,584	$ 728,871	$ 745,705	$ 748,733	$ 768,548	$ 786,941	$ 805,995	$ 823,488	$ 846,227
Water Improvement Fund	6,369,907	5,772,266	4,223,449	3,874,976	3,847,650	3,491,479	2,354,627	2,783,066	3,244,769	3,494,980	3,776,488
Water Bond Reserve	-	-	-	-	-	-	-	-	-	-	-
Total	**$7,051,260**	**$ 6,467,179**	**$ 4,936,033**	**$ 4,603,847**	**$ 4,593,355**	**$ 4,240,212**	**$ 3,123,175**	**$ 3,570,007**	**$ 4,050,763**	**$ 4,318,468**	**$ 4,622,715**
Combined Minimum Target Balance	*1,454,235*	*1,463,276*	*1,475,056*	*1,485,914*	*1,497,137*	*1,499,155*	*1,512,365*	*1,524,627*	*1,537,330*	*1,548,992*	*1,564,151*

10.6 CURRENT AND PROJECTED RATES

10.6.1 Current Rates

The current water rate structure is comprised of a monthly fixed charge increasing by meter size, which includes up to 300 cubic feet of usage and an increasing block volume charge per hundred cubic feet (ccf) of use above the allowance. The same schedule of rates applies to all customer classes. **Table 10-8** shows the existing rate schedule.

The increasing block volume charge addresses water conservation incentives, consistent with the state's guidelines for a rate structure that encourages water demand efficiency (WQC 246-290-100).

Table 10-8

Existing Schedule of Rates

2015 Water Rates	
Monthly Base Rate	
Meter size (Inches)	**Current**
5/8"	$ 32.15
1"	$ 44.96
1 1/2"	$ 57.78
2"	$ 93.07
3"	$ 353.50
4"	$ 450.05
Metered Water Rate (per ccf)	
first 3 ccf	included
next 7 ccf	$ 2.94
over 10 ccf	$ 3.10

10.6.2 Projected Rates

Table 10-9 presents the proposed 10-year schedule of water rates, incorporating the proposed 3.25 percent annual rate increases, beginning in 2018. For purposes of the Financial Plan, the rate increases are applied uniformly to the existing rate structure. A study is underway to evaluate cost of service and rates by customer class.

Table 10-9

10-Year Proposed Rates

Across the Board Projected Rate Increases

Meter size (Inches)	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
5/8"	$ 32.15	$ 32.15	$ 32.15	$ 33.19	$ 34.27	$ 35.39	$ 36.54	$ 37.73	$ 38.95	$ 40.22	$ 41.52
1"	$ 44.96	$ 44.96	$ 44.96	$ 46.42	$ 47.93	$ 49.49	$ 51.10	$ 52.76	$ 54.47	$ 56.24	$ 58.07
1 1/2"	$ 57.78	$ 57.78	$ 57.78	$ 59.66	$ 61.60	$ 63.60	$ 65.67	$ 67.80	$ 70.00	$ 72.28	$ 74.63
2"	$ 93.07	$ 93.07	$ 93.07	$ 96.09	$ 99.22	$ 102.44	$ 105.77	$ 109.21	$112.76	$116.42	$120.21
3"	$353.50	$ 353.50	$ 353.50	$ 364.99	$ 376.85	$ 389.10	$ 401.74	$ 414.80	$428.28	$442.20	$456.57
4"	$450.05	$ 450.05	$ 450.05	$ 464.68	$ 479.78	$ 495.37	$ 511.47	$ 528.09	$545.26	$562.98	$581.27
Volume Charge (per ccf)											
first 3 ccf	included	included	included	included	included	included	included	included	included	included	included
next 7 ccf	$ 2.94	$ 2.94	$ 2.94	$ 3.04	$ 3.13	$ 3.24	$ 3.34	$ 3.45	$ 3.56	$ 3.68	$ 3.80
over 10 ccf	$ 3.10	$ 3.10	$ 3.10	$ 3.20	$ 3.30	$ 3.41	$ 3.52	$ 3.64	$ 3.76	$ 3.88	$ 4.00

Table 10-10 shows residential monthly bill comparisons for the proposed annual increases.

Table 10-10

10-Year Monthly Bills

Residential	Current	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Monthly Bill	$40.97	$40.97	$ 40.97	$ 42.30	$ 43.68	$ 45.10	$ 46.56	$ 48.07	$ 49.64	$ 51.25	$ 52.92
% Increase		0.00%	0.00%	3.25%	3.25%	3.25%	3.25%	3.25%	3.25%	3.25%	3.25%
$ Difference		$0.00	$ -	$ 1.33	$ 1.37	$ 1.42	$ 1.47	$ 1.51	$ 1.56	$ 1.61	$ 1.67

Sample bill at 5/8" meter using 6 ccf monthly

10.7 AFFORDABILITY

The Washington State Department of Health and the State Public Works Board have historically used an affordability index to prioritize low-cost loan awards. The typical threshold looks at whether a system's rates exceed 1.5% to 2.0% of the median household income for the demographic area. As a result, if monthly bills are less than 1.5% of the median household income for the demographic area, they are generally considered affordable.

According to a 2015 Alliance for Housing Affordability report, the median household income for the City of Arlington was $61,817. This figure is escalated for future years based on the assumed 2.0 percent labor cost inflation rate. **Table 10-11** presents the estimated residential water bill with the projected increases for the forecast period. The affordability mark (Monthly Bill *12 ÷ Median Income) averages 0.80% throughout the study period, indicating that rates are expected to remain affordable through 2025.

Table 10-11

Affordability Test

Year	Inflation	Median HH income	2.00% Monthly Threshold	Projected Monthly Bill	% of Median HH Income
2015		$ 61,817	$ 103.03	$ 40.97	0.80%
2016	2.00%	$ 63,053	$ 105.09	$ 40.97	0.78%
2017	2.00%	$ 64,314	$ 107.19	$ 40.97	0.76%
2018	2.00%	$ 65,601	$ 109.33	$ 42.30	0.77%
2019	2.00%	$ 66,913	$ 111.52	$ 43.68	0.78%
2020	2.00%	$ 68,251	$ 113.75	$ 45.10	0.79%
2021	2.00%	$ 69,616	$ 116.03	$ 46.56	0.80%
2022	2.00%	$ 71,008	$ 118.35	$ 48.07	0.81%
2023	2.00%	$ 72,428	$ 120.71	$ 49.64	0.82%
2024	2.00%	$ 73,877	$ 123.13	$ 51.25	0.83%
2025	2.00%	$ 75,355	$ 125.59	$ 52.92	0.84%

10.8 CONCLUSION

The analysis indicates that rate increases are necessary to fund ongoing operating and capital needs and to achieve stated policy objectives. Implementation of the proposed rate increases should provide for continued financial viability while maintaining affordable rates.