City of Camas
WASHINGTON

Water System Plan Update

FINAL
October 2019

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City of Camas
Water System Plan Update

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CITY OF CAMAS

WATER SYSTEM PLAN UPDATE

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CITY OF CAMAS

WATER SYSTEM PLAN UPDATE

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ACRONYMS & ABBREVIATIONS

2010 WSP	City of Camas 2010 Water System Plan
AACE	American Academy of Cost Engineers
ADD	average day demand
AFY	acre-feet per year
AKS	AKS Engineering & Forestry
AL	action level
AMR	advanced meter reading
AWWA	American Water Works Association
BAT	Backflow Assembly Tester
BPS	booster pump station
CARA	Critical Aquifer Recharge Area
CCC	Clark County Code
ccf	hundred cubic feet
CCL	Contaminant Candidate List
CCL3	Third Contaminant Candidate List
CCR	Consumer Confidence Report
CCS	connection control specialist
CEU	continuing education unit
cfs	cubic feet per second
CI	cast iron
CIP	Capital Improvement Program
City	City of Camas
CMC	City of Camas Municipal Code
CMP	Coliform Monitoring Plan
Corps	United States Army Corps of Engineers
CPU	Clark Public Utilities
CT	contact time
CWA	Clean Water Act
CWR	Clean Water Rule
CWSP	Coordinated Water System Plan
CWSP MSS	Coordinated Water System Minimum Standards & Specifications
DBP	disinfection by-product
DBPR	Disinfectants and Disinfection Byproducts Rule

DI	ductile iron
DNS	determination of non-significance
DOE	Washington State Department of Ecology
DOH	Washington State Department of Health
DSL	distribution system leakage
DWSRF	Drinking Water State Revolving Fund
EIS	Environmental Impact Statement
ENR	Engineering New Report
ENR CCI	Engineering New Report Construction Cost Index
ERP	Emergency Response Rule
ERU	equivalent residential unit
ESA	Endangered Species Act
ESU	Evolutionarily Significant Unit
ESWTR	Enhanced Surface Water Treatment Rule
FBRR	Filter Backwash Recycling Rule
FONSI	Finding of No Significant Impact
ft	feet
FTE	full-time equivalent
gal	gallon
gpd	gallons per day
gpd/ERU	gallons per day per equivalent residential unit
GMA	Growth Management Act
G.O.	general obligation
gpm	gallons per minute
GWI	ground water under the direct influent of surface water
GWR	Groundwater Rule
HAA	Haloacetica Acid
HGL	hydraulic grade line
HPA	hydraulic project approval
HPC	Heterotrophic plate count
hp	horsepower
IDSE	Initial Distribution System Evaluation
IFC	International Fire Code
IGEA	Investment Grade Efficiency Audit

Interim ESWTR	Interim Enhanced Surface Water Treatment Rule
IOC	inorganic chemicals
LCR	lead and copper rule
LFC	local facilities charge
LID	Low Impact Development
LPH	Lower Prune Hill
LRAA	locational running annual average
LT1ESWTR	Long Term 1 Enhanced Surface Water Treatment Rule
LT2ESWTR	Long Term 2 Enhanced Surface Water Treatment Rule
LUD	Local Utility District
M	Million
MCC	motor control center
MCE	meter capacity equivalent
MCL	maximum contaminant level
MCLG	maximum contaminant level goal
MDD	maximum day demand
MFR	multifamily residential
MG	million gallons
mgd	million gallons per day
mg/L	milligrams per liter
mL	milliliter
MPA	microscopic particulate analysis
MRDL	maximum residual disinfectant level
MWS	municipal water suppliers
µg/L	micrograms per Liter
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NS	North Shore Expansion
NTU	nephelometric turbidity unit
O&M	Operations and Maintenance
PAA	Pleistocene Alluvial Aquifer
PCE	tetrachloroethylene
pCi/L	Picocures per liter

PHD	peak hour demand
PHG	public health goal
Plan	Water System Plan Update
PNR	Public Notification Rule
ppb	parts per billion
ppm	parts per million
PRV	pressure reducing valve
psi	pounds per square inch
PVC	polyvinyl chloride
PWS	public water system
PWTF	Public Works Trust Fund
Qa	Annual Water Right
Qi	Instantaneous Water Right
RAA	running annual average
RCW	Revised Code of Washington
R&R	Repair and Replacement
RTCR	Revised Total Coliform Rule
RTP	Regional Transportation Plan
RTU	remote terminal unit
RUL	Remaining Useful Life
RWSA	Retail Water Service Area
SCADA	Supervisory Control and Data Acquisition
SDC	standard development charge
SDWA	Safe Drinking Water Act
SEPA	State Environmental Policy Act
SFR	single-family residential
SMP	Standard Monitoring Program
SOC	synthetic organic chemicals
SRF	State Revolving Fund
SSF Plant	slow sand filtration treatment plant
SSS	System-Specific Study
ST	steel
SWTR	Surface Water Treatment Rule
TAZ	transportation analysis zones

TCE	trichloroethylene
TCR	Total Coliform Rule
THM	Triahalomethanes
μg/L	micrograms per liter
UCMR	Unregulated Contaminant Monitoring Rule
UCMR 1	Unregulated Contaminant Monitoring Rule, First Revision
UCMR 2	Unregulated Contaminant Monitoring Rule, Second Revision
UCMR 3	Unregulated Contaminant Monitoring Rule, Third Revision
UCMR 4	Unregulated Contaminant Monitoring Rule, Fourth Revision
UGA	Urban Growth Area
ULID/LID	Utility Local Improvement District
UPC	Uniform Plumbing Code
UPH	Upper Prune Hill
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Services
VOC	volatile organic compounds
WAC	Washington Administrative Code
WDM	Water Distribution Manager
WETRC	Washington Environmental Training Resources Center
WFI	Water Facility Inventory
WHP	wellhead protection
WHPA	Wellhead Protection Area
WHPP	wellhead protection plans
WQM	water quality monitoring
WRIA	Water Resource Inventory Area
WSP	Water System Plan
WTPO	Water Treatment Plant Operator
WUCC	Water Utility Coordinating Committee
WUE	Water Use Efficiency
WWTP	wastewater treatment plant

EXECUTIVE SUMMARY

ES.1 INTRODUCTION

This executive summary presents a brief overview of the City of Camas (City) Water System Plan Update (Plan). The Plan meets state, county, and local requirements. It complies with the requirements of the Washington State Department of Health (DOH) as set forth in the Washington Administrative Code (WAC) 246-290-100, Water System Plan. This Plan is an update of the City's 2010 Plan. The City's DOH water system identification number is 108002.

The purpose of the Plan is to develop a long-term planning strategy for the City's Retail Water Service Area (RWSA), which is shown in Figure ES.1. The Plan evaluates the ability of the water system to meet demand growth over a twenty year planning period. Water system improvements are recommended to meet the expanding water system (primarily in the North Shore), growing demands, and infrastructure repair and replacement. The Plan also identifies planning level costs for capital improvement projects and a financial plan for funding the projects.

A State Environmental Policy Act (SEPA) Checklist has been prepared for this Plan. The City anticipates the Plan does not have probable significant adverse impacts on the environment in accordance with WAC 197-11-340(2). The SEPA Checklist is included in Appendix B. The City will submit this Plan to DOH, the Washington State Department of Ecology (DOE), Clark County, and adjacent Utilities as part of the Agency Review process. See Appendix B for comment letters by these Agencies. The City's Adopting resolution will be included in Appendix A, upon Plan approval by the City Council.

ES.2 PLANNING CONSIDERATIONS

Chapter 2 summarizes the City's water planning considerations that influence the Plan, including background on the study area, policies, criteria, and related documents. The City maintains a Duty to Serve customers within the RWSA:

> *The City will exercise reasonable diligence and care to furnish and deliver a continuous and sufficient supply of pure water to the customer, and to avoid any shortage or interruption of delivery of same.*

The City's Water Service Area is shown in Figure ES.1.

Water system planning is based on a careful analysis of a water utility's responsibility to comply with applicable regulatory requirements while providing service to existing and future customers. These laws are monitored and enforced by a number of federal, state, and local agencies. The Plan incorporates several regional and local plans of the southwest region of Washington, such as Clark County, that affect the water utility.

The City has adopted many resolutions regarding water system planning that are included in the City Code. The City manages its water utility in accordance with established water system policies. The policies provide a consistent framework for the design, operation, maintenance, and service of the water system for appropriately implementing programs, designing new infrastructure, and serving additional customers. The Plan summarizes many of these policies and provides criteria needed to evaluate the water system.

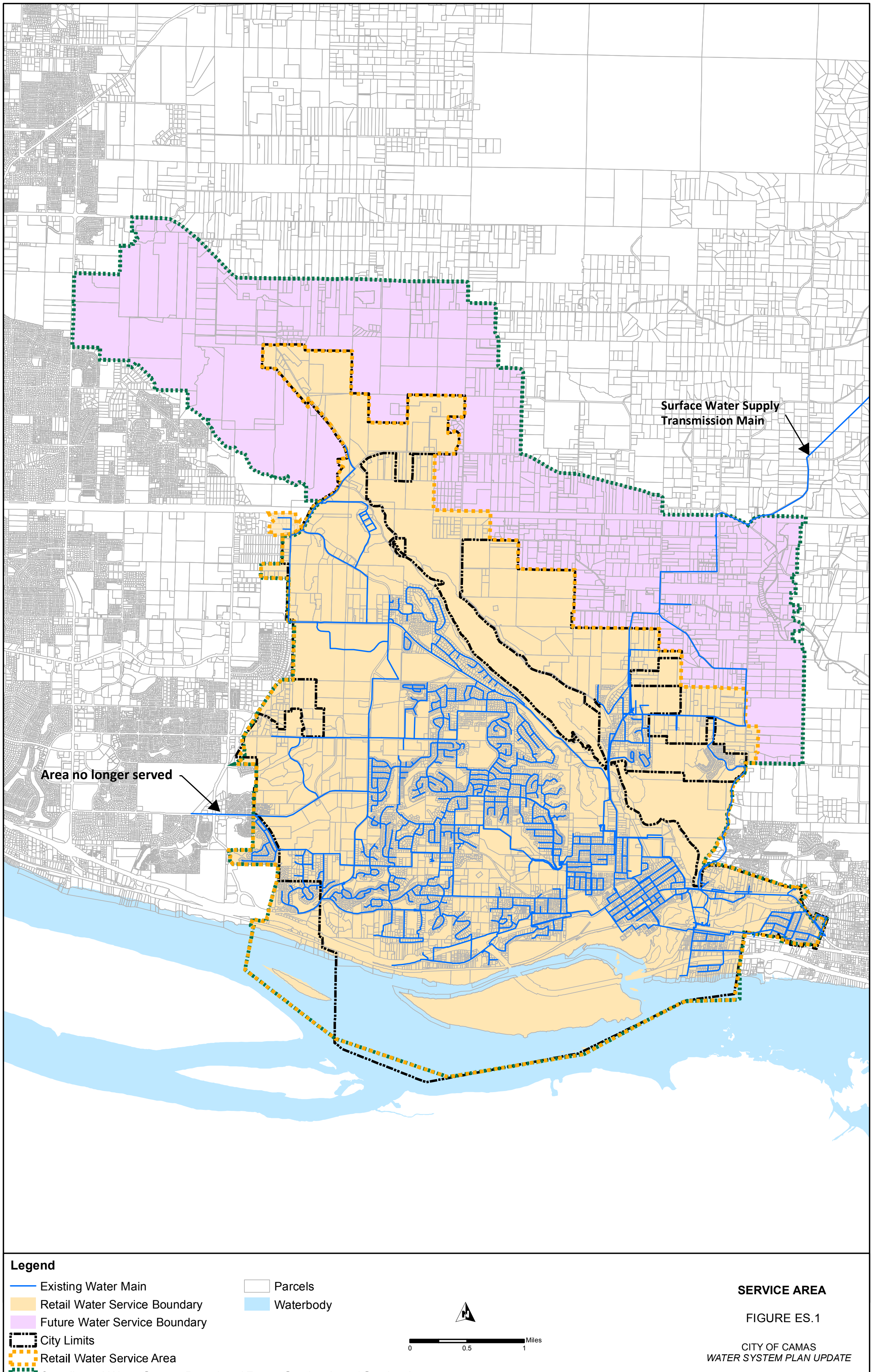
ES.3 EXISTING SYSTEM

The City owns and operates a multi-source municipal water system- summarized in Chapter 3 - which includes supply, treatment, storage, and distribution of potable water to residential and commercial customers. The City currently obtains its water from ten groundwater wells and two surface water sources that are treated to provide high quality water to customers. The City owns over 143 miles of pipelines in its water transmission and distribution system. Service is provided to customers across five major pressure zones and 18 subzones. Eight booster pumping stations are used to move water between pressure zones. Seven storage facilities with a combined total of 8.45 million gallons (MG) provide storage for normal and emergency conditions, such as fire suppression. Additionally, distribution system includes numerous meters, isolation valves, and hydrants. Major elements of the water system are shown in Figure ES.2.

ES.4 OPERATIONS AND MAINTENANCE

The water system is operated and maintained (O&M) by the City staff, with contractor provided services that City staff are not trained or equipped to perform. O&M of the water system requires the combined effort of the Public Works Department, Engineering Department, and Finance Department. The City's water system operators are experienced and well trained, exceeding the minimum state requirements (WAC 246-292-050). The City provides opportunities for its staffs' professional growth and training to maintain up-to-date knowledge.

The City has a well operated and maintained system, as documented in Chapter 4. As part of the Plan, a high-level condition assessment identified repair and replacement projects for above ground assets (i.e., pump stations, wells, and reservoirs, etc.). The majority of projects were necessary due to aging electrical equipment and normal replacement of pumps and motors. The City also plans to replace two reservoirs, built prior to 1940, that have reached the end of their usable life.



SERVICE AREA

FIGURE ES.1

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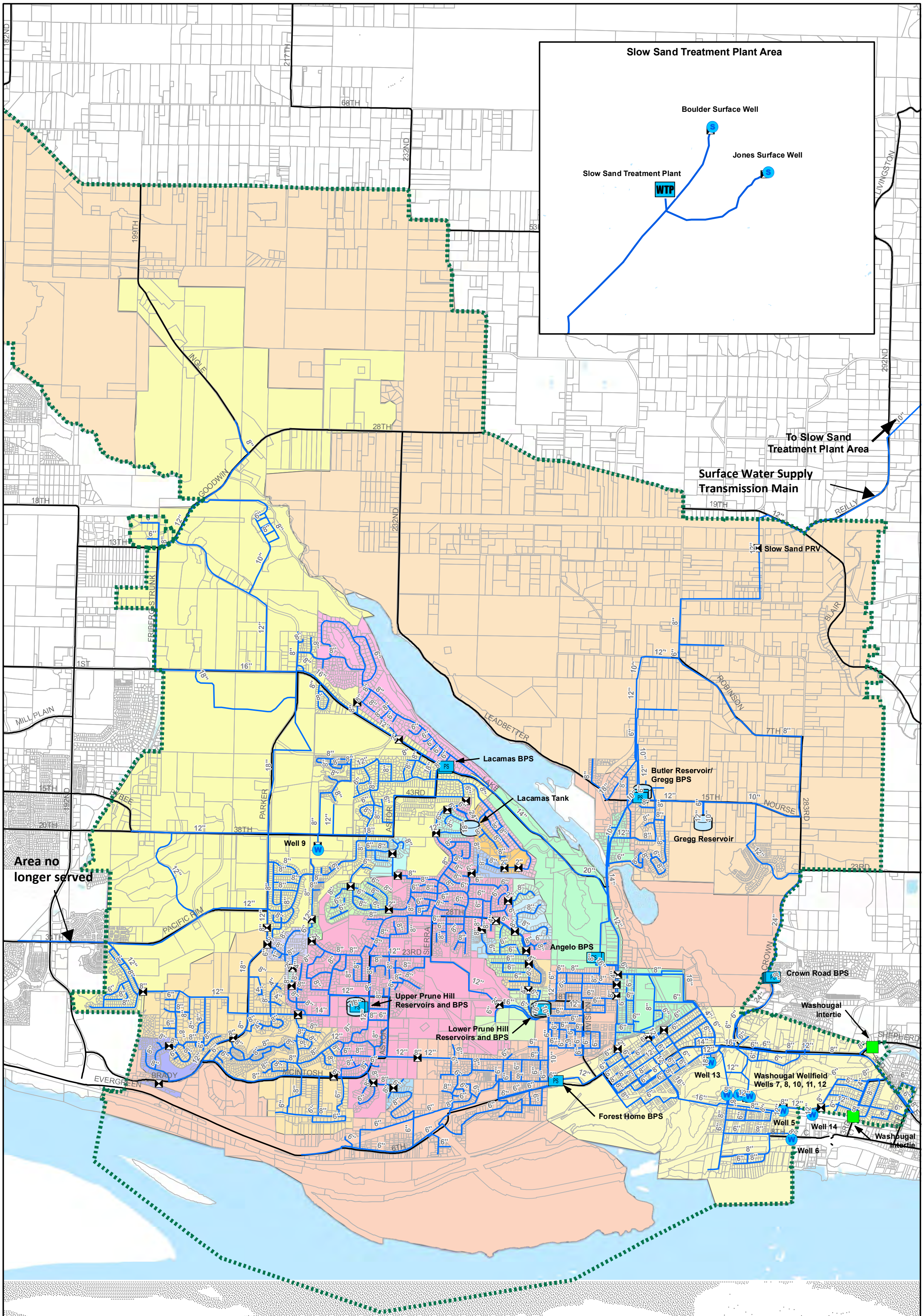

Legend

- Water Service Area
- Waterbody
- PRV
- Intertie
- Potable Wells
- Surface Water Supplies
- Slow Sand Treatment Plant
- Pump Station
- Water Tank
- Existing Water Main
- Pressure Zones

0 2,000 4,000 Feet

SYSTEM FACILITY MAP

FIGURE ES.2

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ES.5 WATER REQUIREMENTS

Projecting realistic future water demand is necessary for planning infrastructure projects and securing adequate water supply to meet future growth. Chapter 5 projects the water system requirements, i.e., demand, for the next 20 years. Demographic projections were used to predict where and how much growth will occur in the water system based on the City's comprehensive planning. The resulting future accounts were converted to projected demands using the historical water use patterns and parameters.

Demand projections were generated for the planning period of 2015 to 2035 for the City's established RWSA. The projections were divided into three planning scenarios: Short-term, 6-year (2015 - 2021), Medium-term, 10-year (2022 - 2025), and Long-term, 20-year (2026 - 2035).

Demand projections were expressed as average day demand (ADD), and maximum day demand (MDD). The ADD is typically used in operational evaluations. The MDD represents the single largest day water demand during the year and is a key parameter for infrastructure sizing.

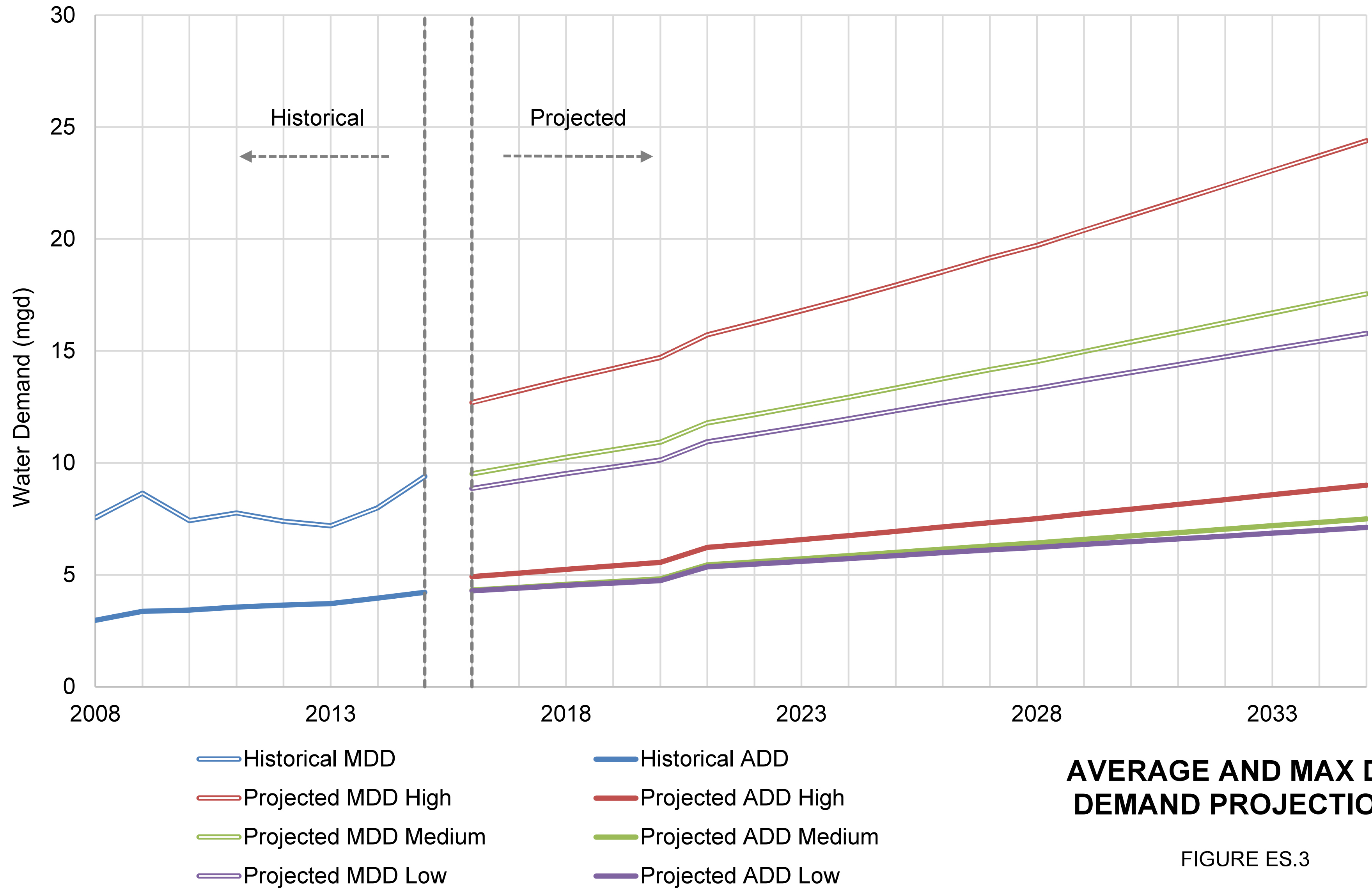
Changes in water use, conservation activities, system growth, and other factors may result in higher or lower than projected water use. Planning for the potential changes allows the City to better manage potential risks from these changes. Therefore, three demand scenarios were developed and shown in Figure ES.3: Low, Medium, and High demand scenarios. The low demand scenario represents future demand with conservation; the medium demand scenario is a conservative projection between the low and high projections; the high demand scenario generally reflects the highest demands in the last eight years.

ES.6 WATER USE EFFICIENCY

The City promotes efficient water use to conserve and protect their existing water supplies for present and future residents. Chapter 6 summarizes the City's Water Use Efficiency (WUE) efforts. The WUE Program goals established in 2013, which have been maintained, are:

- **Demand-Side Goal:** Reduce customer consumption per equivalent residential unit (ERU) by 1 percent or approximately 2 gallons per day (gpd) per year over the next 6 years.
- **Supply-Side Goal:** Continue to reduce distribution loss to at or below 10 percent for the next 5 years.

To meet these goals, the City promotes water conservation and efficient use of water through a variety of activities with the aim of reducing customer water use (conservation) and water loss through leak detection activities. The City's new Advanced Meter Reading (AMR) meters support both WUE aims.



AVERAGE AND MAX DAY DEMAND PROJECTIONS

FIGURE ES.3

CITY OF CAMAS
WATER SYSTEM PLAN UPDATE

ES.7 WATER QUALITY

The City is defined as a Group A – Community Water System and must comply with the drinking water standards of the federal Safe Drinking Water Act (SDWA) and its amendments, as regulated by the United States Environmental Protection Agency (USEPA). DOH adopted the updated federal standards under WAC 246-290, of which the most recent version became effective April 8, 2016. The City is in compliance with all requirements, as described in Chapter 7. Alternatively to the Chapter, the City publishes an annual Water Quality Report that keeps consumers informed as to the quality of the City's water supply and water delivery systems.

The City does not anticipate issues with meeting future regulatory requirements based on the limited available information.

ES.8 WATER RESOURCES

To meet future demands, the City will be required to fully use its water resources and develop new sources to continue to provide a high level of service. Chapter 8 presents a water right strategy for future water rights and supply needs.

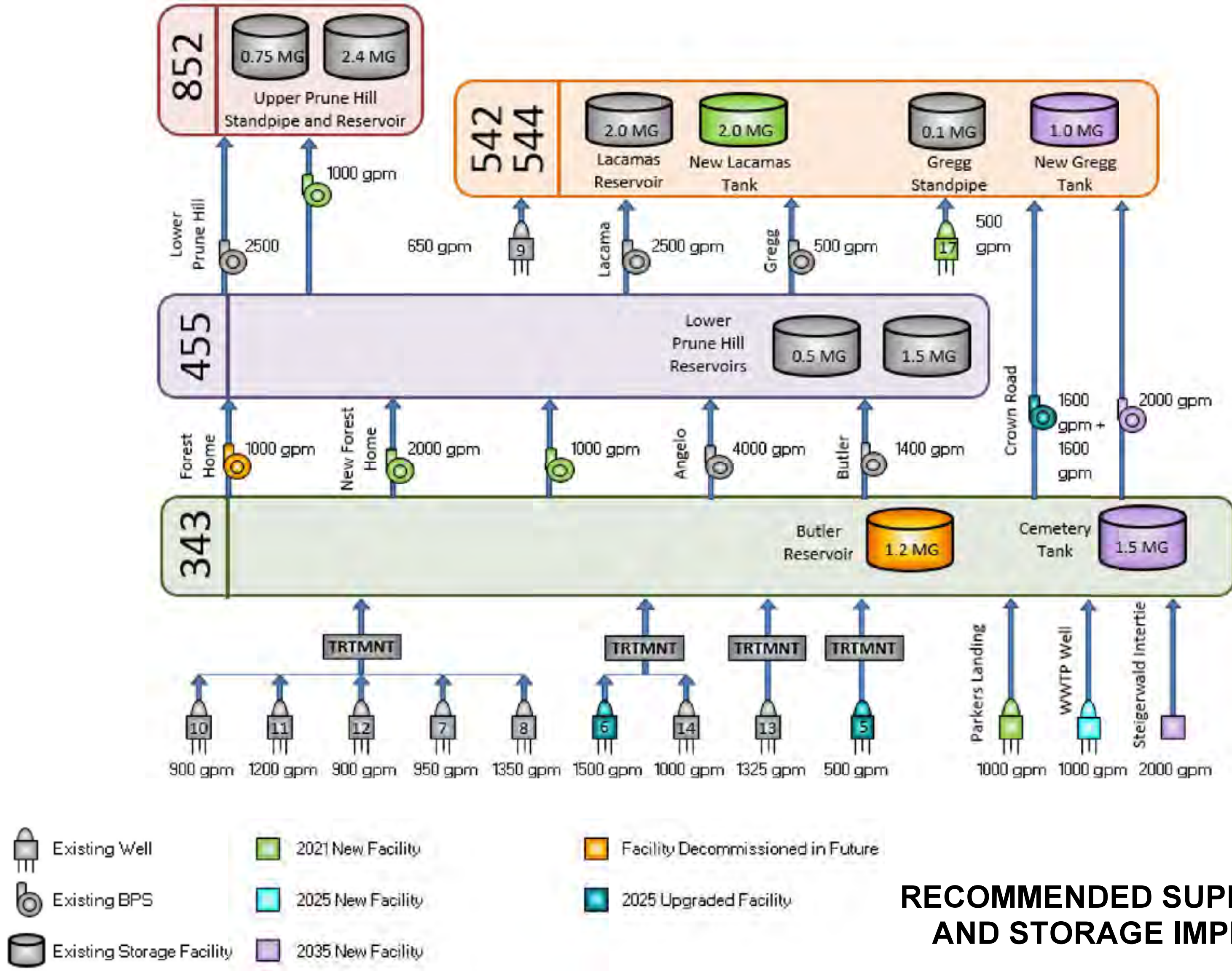
The City water supply strategy largely continues previously planned water supply projects and new water sources. Previously planned projects will be needed to meet growth, including Well 17 and the Parkers Landing Well. In addition to previously planned projects, the City anticipates completing the Washougal Wellfield Renewal Project to increase the ability to pump and reliability of the wellfield. Future supplies beyond the City's existing or planned wells will be from the Steigerweld Regional Supply.

In addition to new supplies, it is recommended that they continue its WUE program efforts to reduce the risk of very high peak demands.

ES.9 SYSTEM ANALYSIS

The City's water distribution system was evaluated for its ability to meet the City's performance criteria under 2021, 2025, and 2035 future conditions. The distribution system was evaluated for its pumping reliability and redundancy and the availability of storage using a desktop system analysis. Service pressures and available fire flows for both MDD and ADD conditions were evaluated using the City's updated hydraulic model.

Chapter 9 presents the results of the system analysis and discusses in detail recommended improvements to meet the City's level of service goals. These recommendations form the basis of the City's capital improvement program (CIP) outlined in Chapter 10. Supply, pumping, and storage project will be necessary during the planning horizon to meet the City's projected substantial growth in water demand, as shown in Figure ES.4.



RECOMMENDED SUPPLY, PUMPING, AND STORAGE IMPROVEMENTS

FIGURE ES.4

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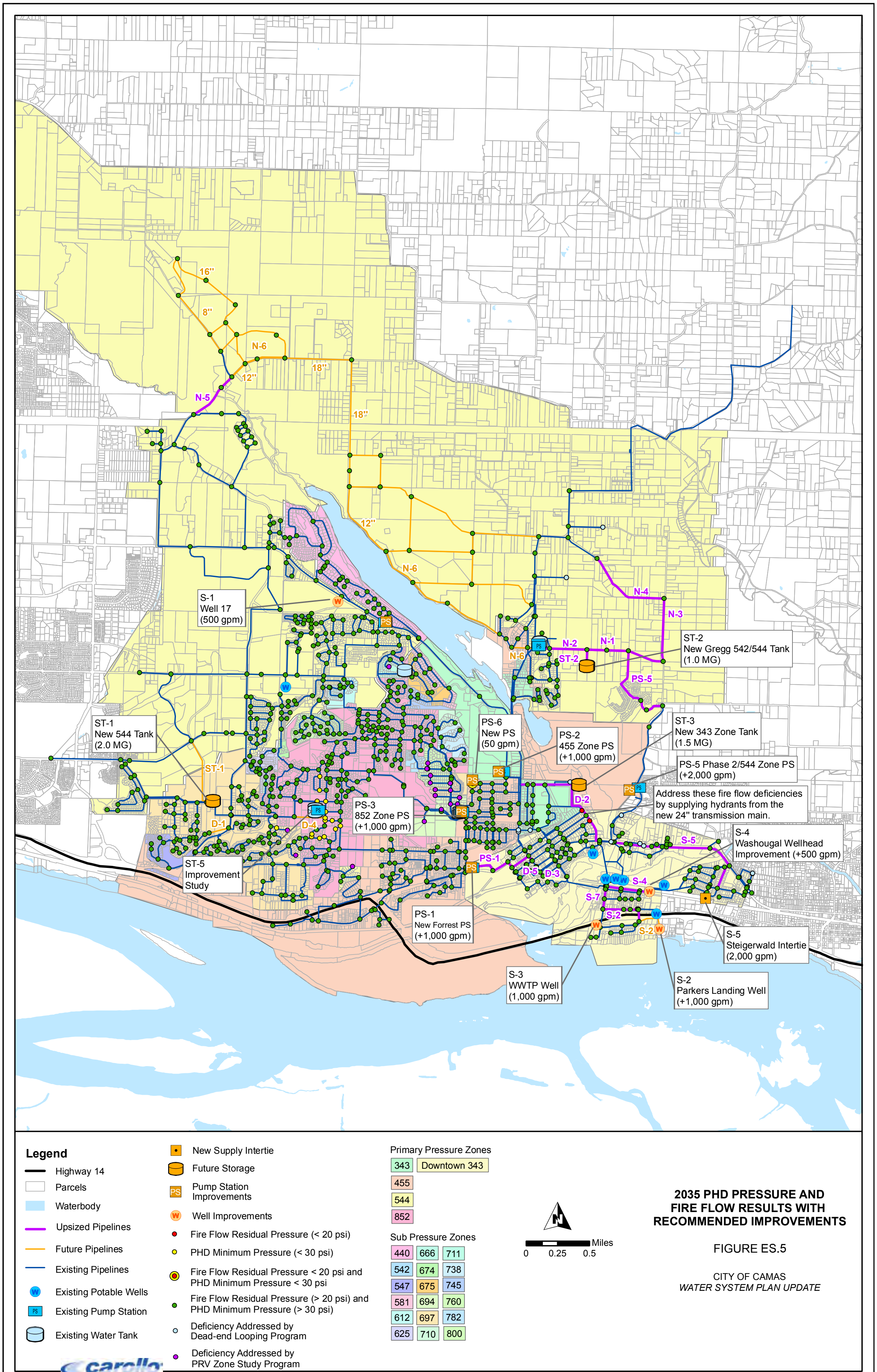
The existing distribution system was evaluated for pressure during peak demand use and during fire flow events. Capacity improvements recommended to address pressure and fire flow deficiencies. Overall, the City had relatively few distribution system improvements, which are shown in Figure ES.5. The majority of deficiencies occur on dead-end mains or areas of high elevation. Additional flows can be supplied to these areas through small, local projects likely completed when the parcels redevelop or a nearby project occurs. It is recommended that the City address these as a programmatic manner that provides funds to address one or two of these areas per year. Additional distribution system improvements are recommended in conjunction with supply or pump station projects.

Within the planning period the City expects significant expansion of the water system in the North Shore area. Future pipelines were sized for the North Shore area.



2035 PHD PRESSURE AND FIRE FLOW RESULTS WITH RECOMMENDED IMPROVEMENTS

FIGURE ES.5

CITY OF CAMAS
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ES.10 CAPITAL IMPROVEMENT PLAN

Chapter 10 summarizes the City's comprehensive CIP for the water system that is based on the analyses presented in previous Chapters. The purpose of the CIP is to provide the City with a guideline for planning and budgeting of its water system. The CIP consists of schedule and cost estimates in present dollars for each project, as shown in Table ES.1.

The CIP cost estimates presented in this chapter are American Academy of Cost Engineers (AACE) Class 4 estimates. Class 4 estimates are budget level estimates. Actual costs may vary from these estimates by -30 percent to +50 percent. These costs were determined based on the City's and Consultant's perception of current conditions at the project locations.

This Plan contains time fames that are the intended framework for future funding decisions. However, these timeframes are estimates and may change depending on factors involved in the growth, project implementation, and availability of funding. The framework does not represent actual commitments by the City.

ES.11 FINANCIAL PLAN

FCS GROUP provided a financial program that allows the City's water utility to remain financially viable during the planning period, which is summarized in Chapter 11. This financial viability analysis considers the historical financial condition, current and identified future financial and policy obligations, O&M needs, and the ability to support the financial impacts related to the completion of the capital projects identified in this Plan. Furthermore, this Chapter provides a review of the water utility's current rate structure with respect to rate adequacy and customer affordability.

The results of this Financial Plan indicate that rates must increase to provide revenue sufficient to cover all utility financial obligations, including the addition of new debt and partial cash funding of the capital program through 2026. A rate increase of 5.0 percent in 2018, followed by annual rate increases of 2.5 percent through 2026 should provide for continued financial viability while maintaining generally affordable rates.

Table ES.1 CIP Project Summary
Water System Plan Update
City of Camas

Project No.	SDC Area	Project Name	Developer Share	Total CIP Cost Estimate	2017	2018	2019	2020	2021	2022	2023	Short-term (2017-2022)	Mid-term (2023-2026)	Long-term (2027-2036)	Capacity	Upgrade	R&R
Capital Improvement Program Summary																	
Supply				**$28,937,000**	**$2,852,000**	**$2,296,000**	**$759,000**	**$3,595,000**	**$440,000**	**$723,000**	**$2,813,250**	**$10,665,000**	**$7,684,000**	**$10,588,000**			
S-1	Common	Well 17	0%	$1,815,000	$150,000	$1,665,000	$ -	$ -	$ -	$ -	$ -	$1,815,000	$ -	$ -	100%	0%	0%
S-2	Common	Parkers Landing Well	0%	$4,560,000	$ -	$456,000	$684,000	$3,420,000	$ -	$ -	$ -	$4,560,000	$ -	$ -	100%	0%	0%
S-3	Common	WWTP Well	0%	$3,651,000	$ -	$ -	$ -	$ -	$365,100	$547,650	$2,738,250	$912,750	$2,738,250	$ -	100%	0%	0%
S-4	Common	Washougal Wellfield Improvements	0%	$4,446,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$4,446,000	$ -	100%	0%	0%
S-5	Common	Steigerwald Regional Source	0%	$10,823,000	$60,000	$75,000	$75,000	$75,000	$75,000	$75,000	$75,000	$435,000	$300,000	$10,088,000	100%	0%	0%
S-6	Common	Watershed Forest Management	0%	$1,070,000	$70,000	$100,000	$ -	$100,000	$ -	$100,000	$ -	$370,000	$200,000	$500,000	0%	0%	100%
S-7	Common	544 Zone Watershed Source Improvements	0%	$2,572,083	$2,572,083	$ -	$ -	$ -	$ -	$ -	$ -	$2,572,083	$ -	$ -	0%	0%	100%
Distribution System Improvements				**$6,024,000**	**$515,000**	**$55,000**	**$861,000**	**$2,064,000**	**$778,000**	**$55,000**	**$55,000**	**$4,328,000**	**$2,070,000**	**$1,476,000**			
D-1	South	Transmission main from NW 11 Cir to NW Brady Rd	0%	$269,000	$ -	$ -	$ -	$ -	$269,000	$ -	$ -	$269,000	$ -	$ -	0%	0%	100%
D-2	Common	343 Zone Supply Transmission Upsizing	0%	$2,505,000	$ -	$ -	$626,250	$1,878,750	$ -	$ -	$ -	$2,505,000	$ -	$ -	50%	50%	0%
D-3	South	NE Birch St upsized transmission main	0%	$65,000	$ -	$ -	$ -	$ -	$65,000	$ -	$ -	$65,000	$ -	$ -	0%	0%	100%
D-4	South	New transmission main along NW 16th Ave	0%	$519,000	$ -	$ -	$ -	$129,750	$389,250	$ -	$ -	$519,000	$ -	$ -	0%	0%	100%
D-5	South	New Distribution along NW 6th Ave/ NE Adams St	0%	$926,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$926,000	100%	0%	0%
D-6	South	Dead-end Looping Program	0%	$1,045,000	$ -	$55,000	$55,000	$55,000	$55,000	$55,000	$55,000	$275,000	$220,000	$550,000	0%	0%	100%
D-7	Common	PRV Adjustment Study	0%	$180,000	$ -	$ -	$180,000	$ -	$ -	$ -	$ -	$180,000	$ -	$ -	0%	0%	100%
D-8	Common	Well 6/14 Transmission Line	0%	$515,050	$515,050	$ -	$ -	$ -	$ -	$ -	$ -	$515,050	$ -	$ -	0%	0%	100%
D-9	Common	Parallel Boulder Creek Intake	0%	$1,850,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$1,850,000	$ -	100%	0%	0%
Pump Station				**$11,526,000**	**$ -**	**$925,000**	**$463,000**	**$28,000**	**$ -**	**$ -**	**$544,500**	**$1,416,000**	**$4,141,000**	**$5,969,000**			
PS-1	South	New Forest Home PS	0%	$3,117,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$779,250	$2,337,750	0%	50%	50%
PS-2	Common	New 455 Zone PS Capacity	0%	$1,258,000	$ -	$ -	$ -	$ -	$ -	$ -	$314,500	$ -	$1,258,000	$ -	0%	50%	50%
PS-3	Common	Lower Prune Hill PS Expansion	0%	$1,388,000	$ -	$925,000	$463,000	$ -	$ -	$ -	$ -	$1,388,000	$ -	$ -	0%	50%	50%
PS-4	25% South/75% North Shore	North Shore PS Capacity Phase I	75%	$1,184,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$1,184,000	$ -	100%	0%	0%
PS-5	25% South/75% North Shore	North Shore PS Capacity Phase II	75%	$3,631,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$3,631,000	100%	0%	0%

Table ES.1 CIP Project Summary
Water System Plan Update
City of Camas

Capital Improvement Program Summary																	
Project No.	SDC Area	Project Name	Developer Share	Total CIP Cost Estimate	CIP Phasing										Project Type		
					2017	2018	2019	2020	2021	2022	2023	Short-term (2017-2022)	Mid-term (2023-2026)	Long-term (2027-2036)	Capacity	Upgrade	R&R
Pump Station				**$11,526,000**	**$ -**	**$925,000**	**$463,000**	**$28,000**	**$ -**	**$ -**	**$544,500**	**$1,416,000**	**$4,141,000**	**$5,969,000**			
PS-6	South	NW Couch St PS	0%	$920,000	$ -	$ -	$ -	$ -	$ -	$ -	$230,000	$ -	$920,000	$ -	0%	0%	100%
PS-7	South	NW 10th Ave Study	0%	$28,000	$ -	$ -	$ -	$28,000	$ -	$ -	$ -	$28,000	$ -	$ -	0%	0%	100%
Storage				**$21,087,000**	**$2,947,000**	**$4,289,000**	**$ -**	**$711,000**	**$1,205,000**	**$5,331,000**	**$ -**	**$14,483,000**	**$ -**	**$6,604,000**			
ST-1	Common	New 544 Zone Reservoir	0%	$7,236,000	$2,946,660	$4,289,340	$ -	$ -	$ -	$ -	$ -	$7,236,000	$ -	$ -	100%	0%	0%
ST-2	Common	New Gregg Tank	75%	$3,984,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$3,984,000	100%	0%	0%
ST-3	South	343 Zone Reservoir	0%	$7,108,000	$ -	$ -	$ -	$710,800	$1,066,200	$5,331,000	$ -	$7,108,000	$ -	$ -	25%	0%	75%
ST-4	Common	Lower Prune Hill Reservoir Rehabilitation	0%	$2,620,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$2,620,000	0%	25%	75%
ST-5	Common	Upper Prune Hill Pressure Improvements Study	0%	$139,000	$ -	$ -	$ -	$ -	$139,000	$ -	$ -	$139,000	$ -	$ -	0%	50%	50%
General				**$550,000**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$275,000**	**$275,000**			
G-1	Common	Water System Plan Update	0%	$550,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$275,000	$275,000	0%	0%	100%
Repair and Replacement				**$44,327,000**	**$320,000**	**$470,000**	**$470,000**	**$470,000**	**$1,164,000**	**$390,000**	**$1,951,750**	**$3,284,000**	**$7,807,000**	**$33,236,000**			
R-1	South	Supply R&R Projects	0%	$1,256,000	$120,000	$ -	$ -	$ -	$148,000	$ -	$93,500	$268,000	$374,000	$614,000	0%	0%	100%
R-2	South	Pump R&R Projects	0%	$1,505,000	$ -	$ -	$ -	$ -	$546,000	$ -	$145,750	$546,000	$583,000	$376,000	0%	0%	100%
R-3	South	Pipeline R&R Projects	0%	$40,266,000	$ -	$195,000	$195,000	$195,000	$195,000	$390,000	$1,712,500	$1,170,000	$6,850,000	$32,246,000	0%	0%	100%
R-4	South	Meter Replacement Program	0%	$1,300,000	$200,000	$275,000	$275,000	$275,000	$275,000			$1,300,000	$ -	$ -			
North Shore Expansion				**$25,353,000**	**$3,100,000**	**$ -**	**$2,225,000**	**$2,225,000**	**$2,225,000**	**$2,225,000**		**$12,000,000**	**$4,450,000**	**$8,903,000**			
NS-1	North Shore	Annual North Shore Distribution Program	75%	$22,253,000	$ -	$ -	$2,225,000	$2,225,000	$2,225,000	$2,225,000		$8,900,000	$4,450,000	$8,903,000	100%	0%	0%
NS-2	North Shore	Leadbetter Road Transmission Main	75%	$3,100,000	$3,100,000	$ -	$ -	$ -	$ -	$ -	$ -	$3,100,000	$ -	$ -			
CIP Total				**$139,654,067**	**$9,733,897**	**$8,035,170**	**$4,778,125**	**$9,092,650**	**$5,812,275**	**$8,723,825**	**$5,364,500**	**$46,175,942**	**$26,427,250**	**$67,050,875**	**$69,050,875**	**$4,858,500**	**$61,007,133**
Annual Cost				$6,983,000	$9,734,000	$8,035,200	$4,778,100	$9,092,700	$5,812,300	$8,723,800	$5,364,500	$7,696,000	$6,606,800	$6,705,100			

Chapter 1

INTRODUCTION

1.1 PURPOSE

The City of Camas (City) prepared this Water System Plan (Plan) Update to document the water system, its programs, and analyze the future needs of the water system. The Plan is an update to the City's 2010 Plan. The purpose of this Plan is to document changes to the City's water system, to identify required system modifications, and to appropriately outline capital improvement projects to meet system growth and address aging infrastructure. Maintaining a current Plan is required to meet the regulations of the Washington State Department of Health (DOH) and the requirements of the Washington State Growth Management Act. This Plan complies with the requirements of DOH as set forth in the Washington Administrative Code (WAC) 246-290-100, Water System Plan.

1.2 LOCATION

The City is located in Clark County, WA and is considered part of the greater Portland, OR metropolitan area. The City is bordered to the south by the Columbia River, the west by the City of Vancouver, WA water system, the City of Washougal, WA water system to the east, and unincorporated Clark County to the north.

1.3 OWNERSHIP AND MANAGEMENT

The City owns and operates their water system (DOH ID 108002) and serves the City and portions of its Urban Growth Area (UGA) as defined by tis water service area. The water service boundaries are further discussed in Chapter 2. The City provides internal staffing for the management, operations, and maintenance of the water system.

1.4 ENVIRONMENTAL ASSESSMENT

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

1.5 APPROVAL PROCESS

This Plan is required to meet state, county, and local requirement. The City will submit the Plan to DOH, Clark County, and adjacent Utilities as part of the Agency Review process.

See Appendix B for Agency comment letters, responses, and approvals. As required by WAC 246-290-108, a local government consistency review checklist has been prepared and is included in Appendix B. The Adopting Resolution by City Council documenting the final approval of the Plan will also be included in Appendix A.

1.6 DOH WATER SYSTEM PLAN CHECKLIST

To assist review of the Plan, the DOH Water System Plan checklist is provided in Table 1.1 with references to the required information.

Table 1.1 DOH Water System Plan Checklist
Water System Plan Update
City of Camas

Required	*Content Description*	*WSP Page #*
	Description of Water System	
(✓)	Updated Water Facility Inventory (WFI), signed and dated	8.1.1/ App. F
(✓)	Ownership and management	1.3
(✓)	System history and background	2.2.2
(✓)	Inventory of existing facilities	Chapter 3
(✓)	Description of and discussion about related plans: CWSP, groundwater management plan, WRIA and City/County land use plans & zoning.	Chapter 3/5
(✓)	Service Area Maps: clearly identifying existing, retail and future service areas.	Figure 2.1
(✓)	Policies: Service area, SMA, conditions of service, annexation	2.7
(✓)	Duty to serve requirement: procedures, conditions, appeals	2.7
(✓)	Consistency from local planning agency (LGC checklist)	2.7
	Planning Data	
(✓)	Demand analysis based on water use:	Chapter 5
	• Include analysis of population, service connections & ERUs	
	• Source and service meter data (preferably three or more, typically 6 years). Provide monthly and annual production and consumption totals.	
	• Provide usage by customer class. Analyze industrial and commercial demands separate from the residential demand and multifamily structures separate from the single family residences.	
	• Define ERU	
	• Provide data and assumptions (including DSL) for calculation MDD, PHD, and ADD	
	• Demand analysis per pressure zone and the whole system	
	• Consider water supplied to other systems	
	• If >1000, include seasonal variations in consumption by customer class	

Table 1.1	DOH Water System Plan Checklist Water System Plan Update City of Camas	
(✓)	Provide 6 & 20 year projections: • Provide 6 & 20 year projections for demand forecasts with and without expected efficiency savings (conservation)	5.6
(✓)	Interties – discussion of all existing and proposed interties and copies of agreements	8.3
(✓)	Provide 6 & 20 year projections for land use and zoning	3.8
(✓)	Distribution System Leakage percentage and volume	5.4
	System Analysis	
(✓)	Provide assumptions and basis of analysis: • System design standards • Policies on operations and expected level of service (such as standby storage, pumping restrictions and emergency back-up power) • Fire flow requirements and if nesting is allowed. May need a confirmation from local fire authority.	Chapter 9
(✓)	System inventory and description	Chapter 3
(✓)	Capacity analysis (legal and physical capacity): • Limiting factor analysis (WSDM worksheet 6-1) • Include the results of the limiting factor analysis in a table • Analysis per pressure zone and the whole system • Water rights analysis – include water right self-assessment forms for existing, 6 & 20-year projections, including copies of water right certificate(s) • Consider source, pumping, treatment, storage, and distribution	
(✓)	Hydraulic analysis of distribution system: • Describe the model used • Evaluate the system based on PHD and MDD + Fire flow • Evaluate the current conditions, and 6- and 20-year planning periods • Check minimum pressures and maximum velocities • Include assumptions of model, pressure zone boundary conditions, and a summary of model in/out information. Storage assumptions should be based on minimum reservoir levels. • Include verification and calibration methods and results • Summary of system deficiencies	Chapter 9
(✓)	Analysis of possible improvement projects	9.6

Table 1.1	DOH Water System Plan Checklist Water System Plan Update City of Camas	
	Water Use Efficiency Program	
(✓)	Water Use Efficiency (WUE) Program per WAC 246-290-810: • Describe the current WUE program • Describe WUE goal & document public adoption process • Describe measures that will be implemented to achieve the goal & include schedule & costs in the budget • Describe process used to evaluate the WUE measures you did not implement • Describe yearly consumer education • Estimated projected water savings from selected measures • Describe process that will be used to determine effectiveness of the program >= 1000 Connections • Estimate water saved from efficiency measures over the past 6 years • Quantitative evaluation of measures to determine if they are cost-effective, include marginal costs of water production • Evaluate measures for cost-effectiveness if shared with other systems • Quantitative of qualitative evaluation of measures to determine if they are cost-effective from the societal perspective	Chapter 6
(✓)	Source & Service Meters - or schedule w/ activities to minimize leakage	6.1.1.1
(✓)	Water Loss Action Plan WAC 246-290-820	Not Required
(✓)	Water supply characteristics, description & discussion on effect of water use	Chapter 8
(✓)	Source of supply analysis and evaluation of supply alternatives	Chapter 8
(✓)	>= 1000 connections explore reclaimed water opportunities	6.2.1.2
	Source Water Protection	
(✓)	Wellhead protection program	8.5
	2 year update (contaminant inventory, letters and map)	
(✓)	Analysis and discussion of Water Quality	Chapter 7
(✓)	Watershed control program	2.6.2.9
	Operation and Maintenance Program	
(✓)	Water system management and personnel	Figure 4.1
(✓)	Operator certification	Figure 4.1
(✓)	Routine operating procedures and preventative maintenance: • Standard Operating Procedures (SOP Manual-Surface Water Treatment Plant)	4.2
(✓)	Water quality sampling procedures & program	Chapter 7

Table 1.1	DOH Water System Plan Checklist Water System Plan Update City of Camas	
(✓)	Coliform monitoring plan, including maps (and triggered source monitoring plan)	Provided Separately
(✓)	Emergency response plan:	4.4
	• Water system contacts	
	• Vendor contacts (Equipment replacement, water haulers, etc.)	
	• Example notices (water outages, BWA, coliform MCL, emergency conservation)	
	• Emergency government officials contact info (ODW, County Health Dept., State and County Emergency Operations Centers)	
	• List of emergency sources ad interties	
	• Emergency response planning activates to ensure preparedness	
(✓)	Water shortage plan and service reliability	6.3
(✓)	Cross-connection control program	4.5
(✓)	Recordkeeping, reporting, and customer complaint program	4.7
(✓)	Summary of O&M deficiencies	4.9
	Distribution Facilities Design and Construction Standards	
(✓)	Standard construction specification for distribution mains	Appendix K
	Improvement Program	
(✓)	Capital improvement schedule for 6 and 20 years	Chapter 10
	• Include inventory and assessment of existing system components	
	Financial Program	
(✓)	Summary of past Income and Expenses (at least 2 years)	11.1/11.2
(✓)	>= 1000 connections – Balanced 1-year budget	11.1/11.2
(✓)	Show revenue and cash flow stability to fund capital and emergency improvements	11.4
(✓)	Affordable rate structure that covers the full cost of producing, treating, storing and distributing water to customers now and into the future	11.15
	Miscellaneous Documents	
(✓)	Meeting of the consumers (may be combined with WUE public meeting)	At later date
(✓)	Date, agenda, meeting minutes	At later date
	• County/Adjacent Utility Correspondence	
(✓)	>= 1000 connections – State Environmental Policy Act (SEPA) Determination	At later date
(✓)	Agreements: franchise, wheeling, financial aid, inter-local and other agreements (if any exist)	At later date
(✓)	Satellite Management Program	At later date

PLANNING CONSIDERATIONS

2.1 INTRODUCTION

The objective of this chapter is to document the City of Camas (City) water system planning considerations that influence the plan including background on the study area, policies, criteria, and related documents.

2.2 STUDY AREA

2.2.1 Water System History

The first known settler, David Parker, came to the City of Camas in 1845. In 1883 the La Camas Colony Company of Portland purchased 2,600 acres encompassing Lacamas, Round, and Dead Lakes, the stream connecting them to the Columbia River, and constructed dams for water power for new flour and paper mills, a sawmill, and a furniture factory in the area. The City was incorporated in 1906. In 1913, the City's first water system was storing Jones Creek supply in Butler Reservoir. The system has continued to expand and adapt to new challenges and regulations, as described in Table 2.1. This Plan provides a roadmap to continue to provide high quality water into the future.

Table 2.1 Water System Historical Timeline
Water System Plan Update
City of Camas

1845	Camas first settled
1913	Jones Creek Intake constructed
1913	0.6 MG(1) Butler Reservoir, South Half
1923	0.6 MG Butler Reservoir, North Half (1.2 MG total)
1931	Boulder Creek Intake constructed
1935	0.5 MG Lower Prune Hill Reservoir
1936	Wells 1 and 2 constructed
1945	Well 3 constructed
1948	Butler Booster Station - 800 gpm(1)
1949	Forest Home Booster Station - 450 gpm
1952	Chlorination Plant - injects chlorine into water from Jones Creek and Boulder Creek before it goes to the Filter Plant
1959	Well 4 constructed
1965	Filter Plant - 1,200 gpm - filters water from Jones Creek and Boulder Creek intakes
1965	10th Street Booster Station

Table 2.1	Water System Historical Timeline Water System Plan Update City of Camas
1968	Well 5 constructed
1969	Well 6 constructed
1971	Well 7 constructed
1971	1.5 MG Lower Prune Hill Reservoir
1971	0.75 MG Upper Prune Hill Reservoir
1971	Lower Prune Hill Booster Station - 500 gpm, 500 gpm, 750 gpm
1977	Well 8 constructed 1,350 gpm
1978	0.1 MG Gregg Reservoir
1978	Old Gregg Booster Station - 500 gpm
1988	SCADA(1) System installed
1993	2.0 MG La Camas Reservoir
1993	La Camas Booster Station - 500 gpm, 500 gpm, 1,500 gpm
1998	Forest Home Booster Station Upgrade - 1,000 gpm
1999	Butler Booster Station Upgrade
2000	Well No. 9 constructed - 650 gpm
2001	Angelo Booster Station constructed - 3,000 gpm capacity
2001	Lower Prune Hill Booster Station Upgrade - 1,000 gpm replacement pump
2002	Upper Prune Hill Reservoir (2.4 MG) and Booster Station (2,900 gpm capacity) construction
2002	New Gregg Zone Booster Station Constructed, 1,500 gpm
2002	Lower Prune Hill Upgrade, 2,000 gpm
2002	Jones and Boulder Creek intake metering
2002	Chlorine and CT(1) improvements
2002	Well 1 & 2 abandoned
2003	Well 3 decommissioned
2003	Well 11 (1,200 gpm) & Well 12 (900 gpm) constructed, Washougal Wellfield Chemical Feed Facility installed
2003	New Gregg Booster Pump Station - 1,500 gpm
2004	Well 10 constructed - 900 gpm
2007	Well 4 decommissioned
2008	Well 13 constructed, 1,325 gpm
2008	Washougal River 24-inch pipe crossing installed
2008	Ostenson Canyon Pipeline installed

Table 2.1 Water System Historical Timeline Water System Plan Update City of Camas	
2008	City and Department of Ecology sign agreement regarding use of service water sources and increased water rights associated with groundwater
2009	Well 14 constructed - 1,000 gpm
2009	Sodium hypochlorite disinfection system installed at Well 5 and 9
2011	Crown Road Booster Pump installed - 1,600 gpm

Note:

(1) CT - contact time; gpm - gallons per minute; MG - million gallons; SCADA - Supervisory Control and Data Acquisition.

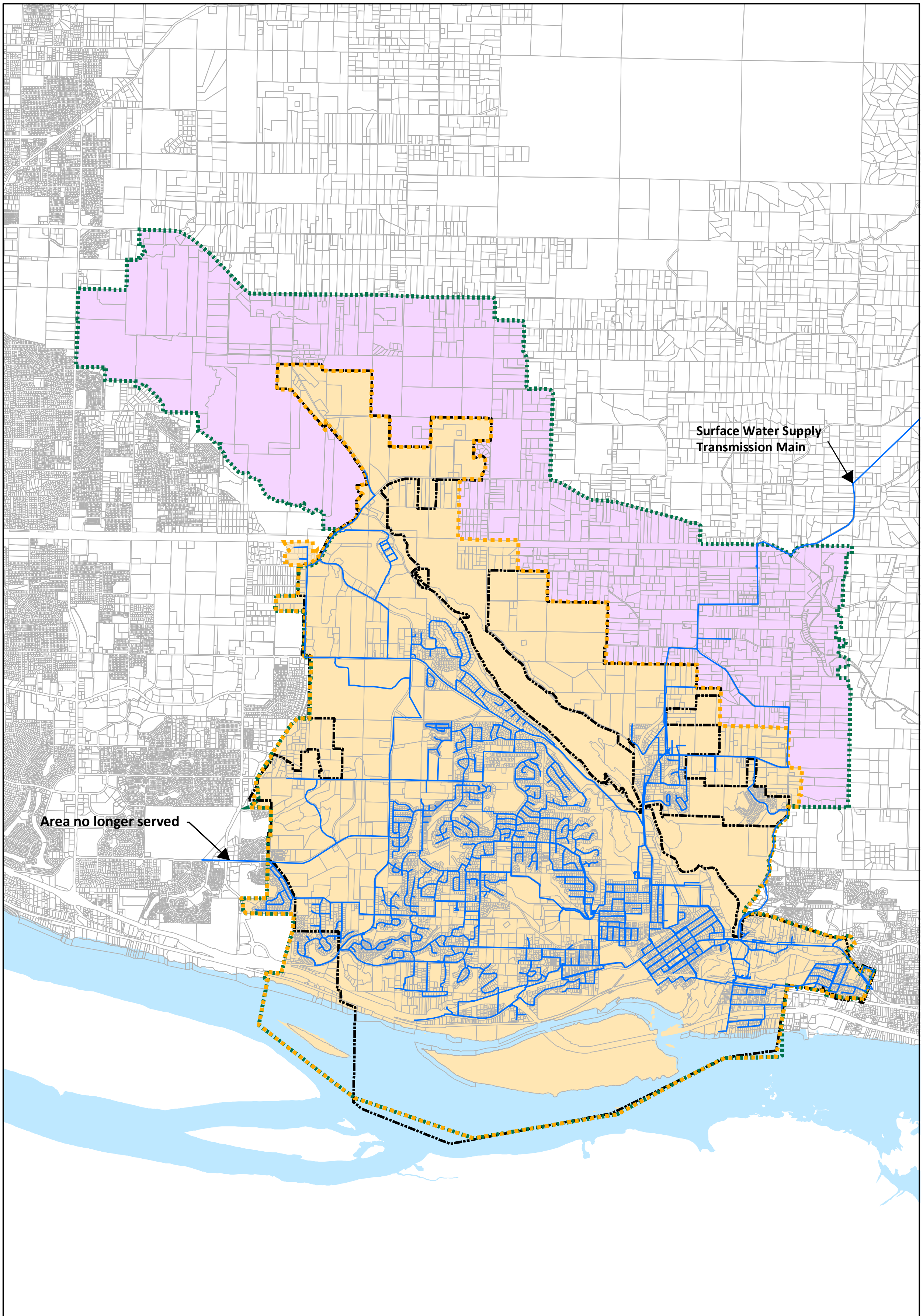
2.2.2 Ownership and Management

The City's water system is owned and operated by the City of Camas. The City is governed by a mayor and seven council members, all of which are elected officials. The Public Works Director is appointed by the council and, as one of his or her duties, heads the City's water department. The water department is divided into two branches: engineering and operations.

The City has both surface water and groundwater sources. The surface water sources, Boulder and Jones Creeks, are located on the south side of Larch Mountain, northeast of Camas. The ground water sources include nine wells near the Washougal River, and one well in Grass Valley. The City treats all of its water with chlorine for disinfection, fluoride, and sodium. Water pressure and fire flows are maintained throughout the service area with seven distribution reservoirs, nine pump stations, and over 143 miles of piping to serve their 23,000, and growing, customers.

2.2.3 Service Area

In accordance with the Municipal Water Law, the City is required to designate a retail service area within that it has a duty to serve all customers meeting the City’s stated conditions of service – the City’s service policies are summarized in Table 2.3 - and also designate a future service area. The City’s retail water service area, future service areas, and service area are shown in Figure 2.1. The retail water service area is largely defined by the City’s urban growth boundary. The City’s service area, defined by the Clark County Coordinated Water System Plan, expands the retail service area to the urban growth boundary. The Regional planning does not anticipate the entire future service area to develop during the planning period (next 20-years); however, the City reserves the first right of refusal for providing water service to developments in its Service Area. Note, the map shows pipelines outside of the service area are associated with the surface water supply transmission (to the northeast) or that reflect historical retail water sales that no longer occur (to the west).



Legend

- Existing Water Main
- Retail Water Service Boundary
- Future Water Service Boundary
- City Limits
- Retail Water Service Area
- Coordinated Water System Boundary/Future Water Service Area/Service Area
- Parcels
- Waterbody

0 0.5 1 Miles

SERVICE AREA

FIGURE 2.1

CITY OF CAMAS
WATER SYSTEM PLAN UPDATE

2.2.4 Regional Environment

2.2.4.1 Climate

The climate in the City and the surrounding greater Clark County area is influenced by the Coast Mountain Range to the west and the Cascade Mountain Range to the east. The Coast Mountain Range provides some limited protection from the direct influence of the Pacific Ocean. Moist heavy air from the Pacific is cooled as it rises over the Coast Mountain Range and releases moisture as rainfall. The air is further cooled as it approaches the Cascade Mountain Range, resulting in moderate rainfall for lower lying area, and heavier precipitation along the west slopes of the Cascades. This results in a large variation of rainfall across the county. The Cascade Mountains also provide a barrier against continental air masses originating over the Columbia Basin to the east.

Clark County has wet, mild winters and warm, dry summers. Average annual precipitation in the City of Camas is 45 inches, while the northeastern end of the County receives 144 inches. Approximately 80 to 85 percent of the precipitation occurs between the months of October and May and the City receives 143 days of sunshine per year.

Temperatures across Clark County average 33.6 degrees Fahrenheit in January, increasing to an 82-degree high in July. Winter storms come generally from the southwest, with infrequent snowstorms originating from the Gulf of Alaska. Fall and winter storms can be accompanied by high winds, resulting in power outages.

2.2.4.2 Topography

Clark County is located in the Willamette-Puget Trough, a geographic basin formed by the Cascade and Coast Mountain Ranges. The county is bounded on the south and west by the Columbia River, on the north by the Lewis River, and on the east by the foothills of the Cascades. The City of Camas itself resides in the Southeast side of the county, with Vancouver to its west and Washougal to its east.

The ground slope and natural drainage features within the City play a significant role in the planning and design of the water distribution storage facilities. The elevation within the City ranges from about 20 feet above sea level along the shores of the Columbia and Washougal Rivers, to approximately 752 feet (NGVD 29) at the Upper Prune Hill Standpipe located at the top of Prune Hill. The terrain in the City includes a flat plateau in the Downtown area and generally increasing elevations to the North, as shown in Figure 2.2.

2.2.4.3 Surface Water

The surface water features within the City urban growth area (UGA) boundary include Lacamas Lake, the Columbia River, the Washougal River, Lacamas Creek, Fallen Leaf Lake, and Round Lake. The City also owns the majority of the watershed for the Jones and Boulder Creeks north of the City's intakes for these sources. Jones and Boulder Creek are tributaries of the Little Washougal River, which is a tributary of the Washougal River. The basin characteristics for the creeks, streams, and rivers discussed below were obtained from stream gauging published by the U.S. Geological Survey.

The Columbia River begins in Canada, enters the United States in northeastern Washington, continues traveling southwest through eastern Washington, where it travels over a series of dams until it empties into the Pacific Ocean. The Columbia River forms the border between the states of Washington and Oregon from the point where it crosses the 46th Parallel until it empties into the Pacific Ocean. The Columbia River drainage area is approximately 241,000 square miles, with an average flow of 603,000 cubic feet per second (cfs).

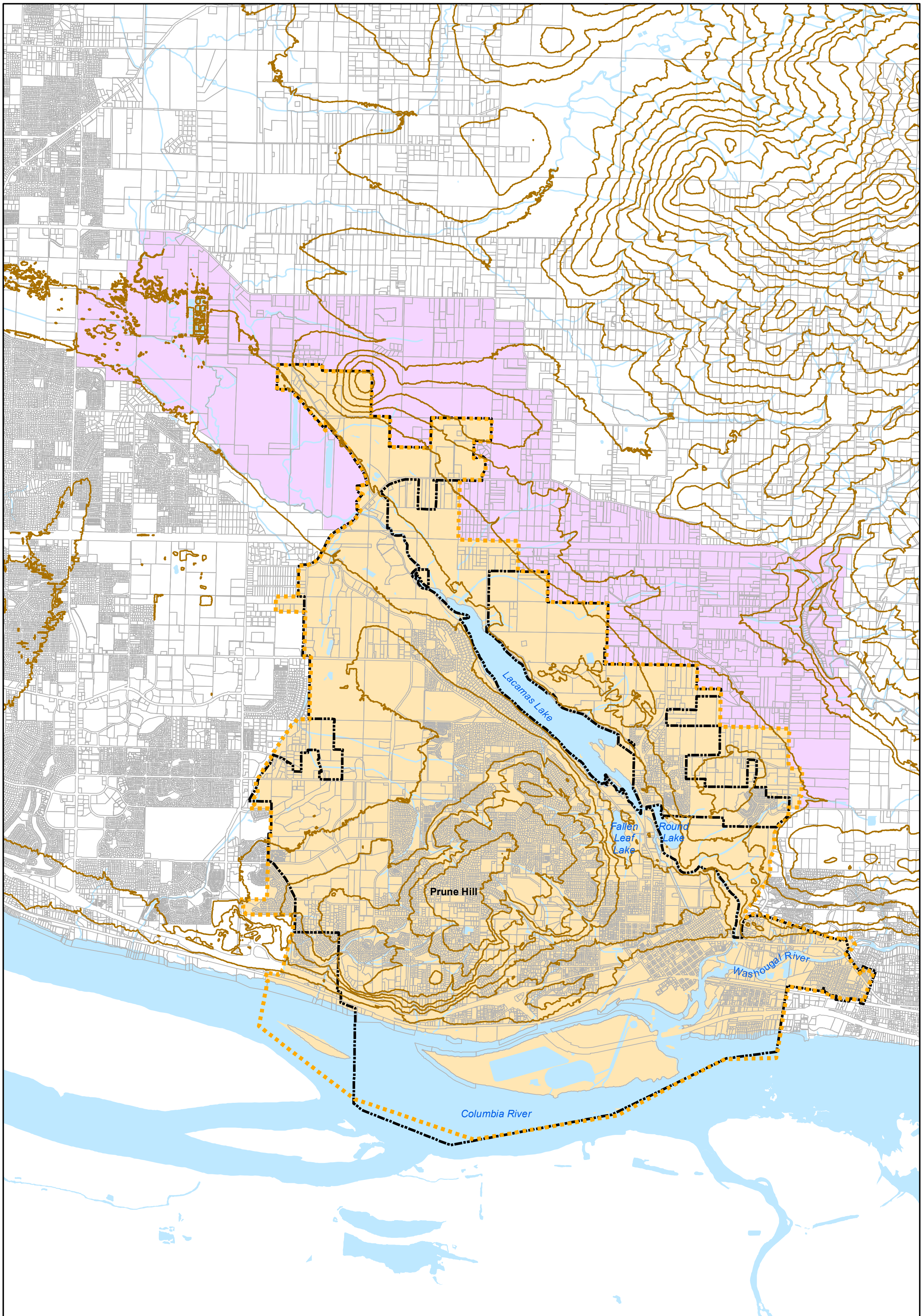
Lacamas Lake is over 60 feet deep in places. It receives flow from Lacamas Creek and Dwyer Creek. The Lake then discharges into Lacamas Creek, which flows into the Washougal River. The water level is controlled by dam located at the south end of the lake. Fallen Leaf Lake and Round Lake are man-made lakes and are smaller parts of Lacamas Lake, separated from Lacamas Lake by Everett Street.

The Washougal River flows southwest from the Cascade Mountains to the City of Camas, where it empties into the Columbia River. The Washougal River drainage basin is approximately 108 square miles in size and historical records report average flows at approximately 9,000 cfs.

The Little Washougal River, of which Jones and Boulder Creeks are tributaries, flows to the southwest out of the Cascade Mountains. The Little Washougal turns to the southeast before it crosses into the City of Camas UGA and empties into the greater Washougal River. The Little Washougal drainage basin covers approximately 23 square miles with historical average daily peak flows of approximately 1,317 cfs.

2.2.4.4 <u>Critical Areas</u>

Critical areas within the City include those classified as Critical Aquifer Recharge Areas, Fish and Wildlife habitat conservation areas, frequently flooded areas, geologically hazardous areas and wetlands. Given its importance to the water system, the City's Critical Aquifer Recharge area map is included as Figure 2.3. Please refer to the City's website for the up-to-date description and mapping of its Critical Areas.



Legend

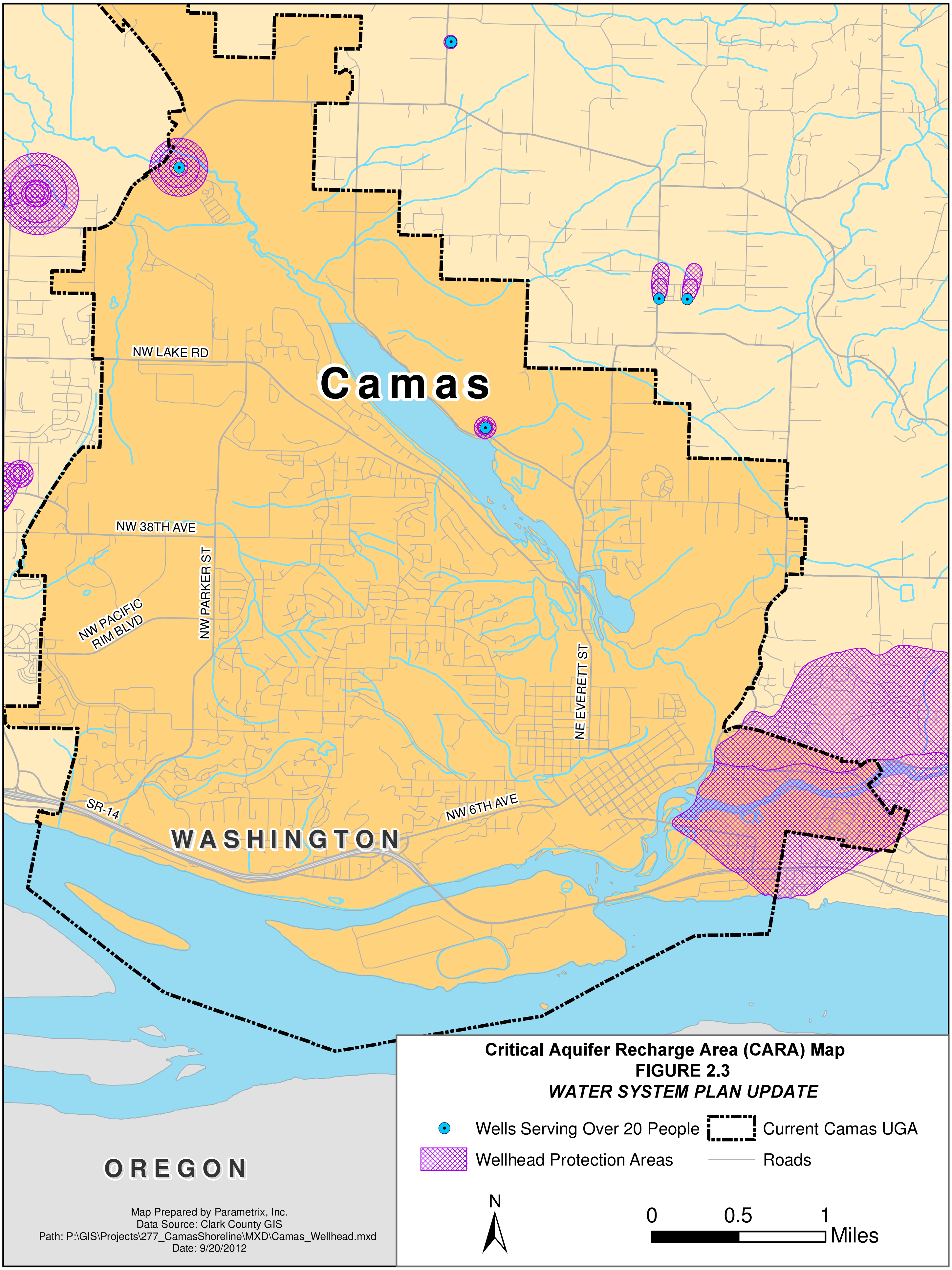
- Hundred Foot Contours
- Retail Water Service Boundary
- Future Water Service Boudary
- City Limits
- ugabnd
- Parcels
- Waterbody

0 0.5 1 Miles

PHYSICAL ENVIRONMENT

FIGURE 2.2

CITY OF CAMAS
WATER SYSTEM PLAN UPDATE



Critical Aquifer Recharge Area (CARA) Map
FIGURE 2.3
WATER SYSTEM PLAN UPDATE

2.2.4.5 Geology

The Clark County area exhibits traces of its geologic history, including repeated inundation by fluctuating sea levels during glacial epochs, the sedimentary processes of repeated flooding of the Columbia River, volcanic activity, periodic earthquakes, and other tectonic activity. The geologic units in Clark County reflect this varied history and can be placed into two general categories: older consolidated rocks and volcanic rocks. These include Columbia River Basalts and Skamania and Goble volcanic series, and sedimentary rocks incorporating unconsolidated gravels, silts, sands, and clays created by glacial and alluvial processes.

The main geological feature of Camas is Prune Hill, which is an extinct volcanic vent that much of the residential area resides on. Prune Hill is at the Northwest end of Camas and the City elevation drops off to the west and the Columbia River Gorge to the south. Lady Island, in the Columbia River Gorge, is separated from the mainland by the Camas Slough, and is mostly used for industrial purposes.

2.3 LEGISLATION, REGULATIONS, AND PERMITS

Water system planning is based on a careful analysis of a water utility's responsibility to comply with applicable regulatory requirements while providing service to existing and future customers. These regulatory requirements are the result of a number of state and federal laws. These laws are monitored and enforced by a number of federal, state, and local agencies.

In this section, the various state and federal legislation that may affect City operations are discussed, as well as other relevant permits, programs, and regulations

2.3.1 Federal Clean Water Act

The Federal Water Pollution Control Act is the principal law regulating the water quality of the nation's waterways. Although originally enacted in 1948, it was significantly revised in 1972 and 1977, when it was given the common title of the "Clean Water Act." The Clean Water Act (CWA) has been amended several times since 1977. The 1987 amendments replaced the Construction Grants program with the State Revolving Fund (SRF) which provides low-cost financing for a range of water quality infrastructure projects.

A CWA Section 401 Water Quality Certification is required for any activity that may result in discharge to surface waters including excavation activities that occur in streams, wetlands, or other Waters of the United States. In Washington State, CWA Section 401 responsibility has been assumed by the Washington State Department of Ecology (DOE), and is required for projects with CWA Section 404 Permits.

Section 404 of the CWA regulates discharges of fill or dredged materials in wetlands, including any related draining, flooding, and excavation. Pipeline and pump station projects in wetlands will require a Section 404 Permits, in addition to any related local permits. CWA Section 404 Permits require Endangered Species Act (ESA), Section 7 consultation with the United States Fish and Wildlife Services (USFWS) and the National Marine Fisheries Service (NMFS) as a result of recent listings of salmonids. Biological Assessments, Biological Opinions, and their review have significantly lengthened the time required for issuance of CWA Section 404 Permits.

The Clean Water Rule (CWR), implemented by the United State Environmental Protection Agency (USEPA) in 2015, is an extension to the CWA whose purpose is to better define which waterways must be protected and to what extent. The CWR does not regulate groundwater but should be used to confirm the definition of all other waterways during City projects.

2.3.2 Safe Drinking Water Act

The Federal Safe Drinking Water Act (SDWA) was passed in 1974 and amended in 1986 and 1996. The Washington State Department of Health (DOH) adopted the federal standards under WAC 246-290, which became effective April 27, 2003. All public water systems as defined by the USEPA are affected by the SDWA. A public water system is defined as one that serves piped water to at least 25 people, or 15 connections for at least 60 days per year. The SDWA contains regulations regarding water quality, sampling, treatment, and public notification requirements that are applicable to the City.

2.3.3 Endangered Species Act

The purpose of the 1972 ESA is to "provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved…" In pursuit of this goal, the ESA authorizes USFWS and NMFS to list species as endangered or threatened, and to identify and protect the critical habitat of listed species. USFWS has jurisdiction over terrestrial and freshwater plants and animals such as bull trout and cutthroat trout, while NMFS is responsible for protection of marine species including anadromous salmon. Under the ESA, endangered status is conferred upon "any species within the foreseeable future throughout all or a significant portion of its range." The ESA defined critical habitat as the "geographical area containing physical and biological features essential to the conservation of species."

The Table 2.2 lists the Evolutionarily Significant Units (ESUs) of salmonid species present in the Camas area listed, or proposed for listing, under the authority of the ESA.

Table 2.2 Evolutionarily Significant of Listed Salmonid Species Water System Plan Update City of Camas		
Species	**Listing Status**	**Date Listed**
Columbia River Bull Trout	Threatened	June 1998
Lower Columbia River Chinook	Threatened	March 1999
Lower Columbia River Chum	Threatened	March 1999
Lower Columbia River Coho	Threatened	June 2005
Lower Columbia River Steelhead	Threatened	March 1998

Once a species is listed as endangered or threatened, the ESA makes it illegal for the government or individuals to "take" a listed species. "Take" has been interpreted by the federal courts to include "significant modification or degradation of critical habitat" that impairs essential behavior patterns. For species listed as endangered, the blanket prohibitions against "take" are immediate. However, threatened species may be protected through a more flexible Section 4(d) rule describing specific activities that are likely to result in a "take."

Since 2007, The City of Camas has updated its ordinance on critical areas and has adopted the Shoreline Master Program. These updates helped to clarify the specific activities in Section 4(d) and to increase the focus on migratory species.

2.3.4 Reclaimed Water Standards

The standards for the use of reclaimed water are outlined in the Revised Code of Washington (RCW) Section 90.46 and in a separate document published by DOE and DOH entitled "Water Reclamation and Reuse Standards." Reclaimed water is "the effluent derived in any part from sewage from a wastewater treatment system that has been adequately and reliably treated, such that it is no longer considered wastewater and is suitable for a beneficial use or a controlled use that would not otherwise occur" (Water Reclamation and Reuse Standards). The legislature has declared that "the utilization of reclaimed water by local communities for domestic, agricultural, industrial, recreational, and fish and wildlife habitat creation and enhancement purposes (including wetland enhancement) will contribute to the peace, health, safety, and welfare of the people of the State of Washington."

2.3.5 National Environmental Policy Act

The National Environmental Policy Act (NEPA) was established in 1969 and requires federal agencies to conduct environmental review or assessments of projects to determine impacts on all projects requiring federal permits or funding. If the project is determined to be environmentally insignificant, a Finding of No Significant Impact (FONSI) is issued, otherwise an Environmental Impact Statement (EIS) is required. City activities requiring CWA Section 404 permits fall under the jurisdiction of NEPA.

The National Historic Preservation Act (NHPA) regulates federal activities with the potential to impact materials of historic, cultural, or archaeological significance under Section 106, which requires consultation with affected Native American Tribes and the Washington State Department of Archaeology and Historic Preservation. Documentation of this consultation is included in NEPA Environmental Reports and Assessments. Recent decisions by the United States Army Corps of Engineers (Corps) require an independent NHPA Section 106 consultation process for projects permitted by the Corps, which can result in significant delays to project implementation.

The State of Washington regulates state funded projects with the potential to impact material of historic, cultural, or archaeological significance under Governor's Executive Order 05-05, which requires consultation with the Department of Archaeology and Historic Preservation and affected Tribes similar to the NHPA Section 106 process.

2.3.6 State Environmental Policy Act

The State Environmental Policy Act (SEPA) that environmental issues are taken into consideration during the planning and process for Non-Federal projects. An EIS is required if a project will have a significant adverse environmental impact. The EIS looks at potential environmental problems that would be cause by the project; ways the project could be changed to minimize the impact; and mitigation options. The City is currently pursuing alternate source of supply, which may require an EIS depending on the type of projects that are involved. Most projects including water right applications and transfers, typically do not require an EIS. A SEPA checklist is prepared and a Determination of Non-significance is issued instead. This Plan will fall under the SEPA Checklist Non-Project Action requirement. The water system projects listed in the capital improvement plan will each be completed under a separate SEPA checklist. A SEPA checklist and determination of Non-significance for the Plan is indicated in the Appendix B.

2.3.7 Growth Management Act

The Washington State Growth Management Act (GMA) was enacted in 1990 and requires certain local governments to plan for the population growth that will occur over the next twenty years within an established UGA. The GMA also requires cities to classify critical areas (wetlands, aquifer, recharge areas, fish and wildlife habitat areas, geologically hazardous areas, and frequently flooded areas) and to establish development regulations to protect these areas. Clark County is updating its current plan, which was adopted in 2007, to extend through 2035. The update will include changes regarding population and employment growth for the next 20 years.

2.3.8 Shoreline Management Act Permit

A Shoreline Permit is required on all projects of $2,500 or more that are located on the water or shoreline area. Shorelines are lakes of reservoirs of 20 acres or greater, streams with a mean annual flow of 20 cubic feet per second or greater, marine waters, and an area within 200 feet of the ordinary high water mark. Areas within the City that are classified as shoreline are those areas along Lake Lacamas, Washougal River, Little Washougal River, and Columbia River.

2.3.9 Floodplain Development Permit

Local governments that are participating in the National Flood Insurance Program are required to review projects (including water system facilities) in a mapped flood plain and impose conditions to reduce potential damage from flood water. A Floodplain Development Permit is required prior to construction.

2.3.10 Hydraulic Project Approval

Under Washington Administrative Code (WAC) 220-110, the Washington State Department of Fish and Wildlife requires a hydraulic project approval (HPA) for activities that will "use, divert, obstruct, or change the natural flow or bed" of any waters of the state. For City activities such as pipeline crossings of streams or outfall and intake improvements, an HPA will be required, and must include provisions necessary to minimize project specific and cumulative impacts to fish.

Because of ESA listings throughout Washington, the Washington State Department of Fish and Wildlife and the NMFS revised the Hydraulic Code to protect species listed as threatened or endangered. The revisions to the code specifically aimed to, "incorporate up-to-date fish science technology, simplify the permitting of certain types of projects, improve procedural and administrative requirements to better align with statutory changes and, establish a structure for adaptive management that responds to changing science and technology and/or the results of effectiveness monitoring".

If NMFS determines that the revisions are sufficient to protect listed species, the State hopes the revised Code will constitute an accepted Habitat Conservation Plan under Section 10 of the ESA. If the Habitat Conservation Plan is approved, NMFS may issue an Incidental Take Permit allowing incidental take of a listed species if the permittee has complied with the Habitat Conservation Plan. This Incidental Take Permit expires after an agreed upon period of time, and may then be revised by NMFS.

2.3.11 Local Permits

The City has agreements with Clark County for the construction and maintenance of facilities in their respective rights-of-way. Under these agreements, an Encroachment Permit is issued that specifies construction standards such as traffic control, work hours, and safety issues, as well as design and restoration standards.

2.4 WATER RIGHTS

A water right is the legal authorization to use a specified amount of public water for a certain beneficial purpose. Washington State law requires that permission in the form of a water right permit or certificate be granted for most appropriations of public water. Water rights are issued by DOE and are required to ensure proper allocation and management of water resources. The following sections provide definitions of key terms with regards to water rights.

2.4.1 Water Right Claim

A water right claim is a statement of claim to water use that began before the State Water Codes were adopted and is not covered by a permit or certificate. A claim may represent a valid water right if it describes the use of a surface water source that began before 1917 or the use of groundwater source that began before 1945. It can also represent a water right claim that was filed with the State during an open filing period designated under RCW 90.14, or is covered by the groundwater exemption.

2.4.2 Water Right Permit

A water right permit is issued by the State for water right applicants to begin developing their water right. A water right is developed when the applicant follows the provisions outlined in their permit such as using the water for the purposes and limits stated in the permit. A water right permit will remain in effect until the water right certificate is issued, if all terms of the permit are met, or the permit is canceled.

2.4.3 Water Right Certificate

A water right certificate is issued by DOE to certify that the water user has the authority to withdraw a specific amount of water under certain conditions. The conditions are based on the beneficial use of the water under the water right permit. The water right certificate is a legal document recorded at the county auditor's office. Issuance of the water right certificate is the final step in obtaining a water right.

2.5 REGULATORY AGENCIES

The above regulations, permits, and programs, are administered by various local, state, and federal agencies. The history, purpose, and authority of these agencies are discussed below.

2.5.1 United States Environmental Protection Agency

The stated mission of the USEPA is to protect human health and to safeguard the natural environment upon which life depends. The USEPA's purpose includes protecting all Americans from significant human health risks, ensuring that national environmental efforts are based on the best available scientific information, ensuring that federal laws are enforced fairly, and that the environmental protection contributes to making our communities and ecosystems diverse, sustainable, and economically productive. DOE currently administers the SRF loans for the USEPA.

2.5.2 United States Fish and Wildlife Service

Under the ESA, USFWS is responsible for the protection of all non-marine life including birds, mammals, and non-anadomous fish, including bull trout and sea-run cutthroat. Although USFWS may choose to invoke the blanket prohibitions of Section 9, the "threatened" status of Bull Trout allows more flexibility to establish regulations designed to protect these species. These regulations, known collectively as Section 4(d) rule, online activities likely to result in a "take" of a threatened species, as well as exempted activities.

2.5.3 The National Marine Fisheries Service

Under the ESA, the NMFS is responsible for the protection of marine life, including anadromous salmon such as the Columbia River Chinook, Chum, and Steelhead. When a species is listed as "endangered" the prohibitions against "take" of the species are immediate under Section 9 of the ESA of the Act. Although NMFS may choose to invoke the blanket prohibitions of Section 9, the "threatened" status of the Columbia River Chinook, Coho, Chum, and Steelhead allows more flexibility to establish regulations designed to protect these species. These regulations, known collectively as a Section 4(d) rule, outline activities likely to result in a "take" of a threatened species, as well as exempted activities. The final 4(d) Rule was adopted on June 20, 2000.

2.5.4 United States Army Corps of Engineers

Under Section 404 of the CWA, the Corps is authorized to regulate discharge of fill and dredged material to waters of the United States, including wetlands. A similar review process is employed for projects with the potential to impact navigable waters, including the Columbia River, under Section 10 of the Rivers and Harbors Act of 1899. This process applies to any work on outfalls to the Columbia River. The Corps employs a system of General or Nationwide Permits for blanket authorization of activities such as utility lines that have minimal adverse impact on the environment. In situations where projects are large and complex, or adverse impact is probable, the Corps may issue an Individual Permit after reviewing an alternatives analysis. Enforcement actions may be brought by the Corps or the USEPA. Activities subject to Corps jurisdiction require NEPA and ESA review and consultation.

2.5.5 Washington State Department of Health

DOH has three primary functions: to regularly assess the State's health needs and resources; to develop and implement sound public policy; and to ensure the capacity of public health agencies to manage daily operations and respond to public health emergencies. The DOH was granted full authority and responsibility for the regulation and enforcement of the SDWA by the federal government in 1976. DOH also publishes guidelines for the preparation of water system plans, water conservation programs, design and drinking water quality standards, and watershed control programs. Water system comprehensive plans must be reviewed and approved by DOH. Construction plans and specifications must also be reviewed by DOH unless they are the transmission or distribution improvements included in the Water System Comprehensive Plan, Capital Improvement Program.

2.5.6 Washington State Department of Ecology

The mission of the DOE Water Quality Program is to protect, preserve, and enhance the State's surface and ground water quality and to promote the wise management of water for the benefit of current and future generations. DOE performs various functions under State and federal authority and has both local and regional offices. DOE oversees the allocation of water rights.

2.5.7 Washington State Department of Fish and Wildlife

Under the updated Hydraulic Code Rules WAC 220-660, and RCW 75.20, any form of work that uses, diverts, obstructs, or changes the natural flow or bed of any fresh water of the State requires hydraulic project approval from the Department of Fish and Wildlife. Approval would be required for all City construction projects that cross or otherwise take place in streams or shorelines.

2.5.8 Watershed Resource Inventory Area

Under WAC 173-500-040, Washington State was divided into 62 geographic areas, defined on the basis of surface water resource. These 62 geographic areas are defined as Water Resource Inventory Areas (WRIAs). The purpose of WRIA is to implement effective planning involving all jurisdictions that fall within WRIA, including county, city, and other local, state, and national agencies.

The City of Camas and the Jones and Boulder Creek watersheds reside within WRIA 28. The City owns and controls a majority of the Jones and Boulder Creek watersheds, Figure 1.2, which are both tributaries of the Washougal River. The City is an active participant in regional watershed planning efforts.

2.5.9 Local Health Departments

The Clark County Department of Health is the local health department governing the City. In general, local health departments may adopt and enforce local regulations when they are consistent with and more stringent than state regulations.

2.5.10 County Planning Policies

City planning policies should be consistent with those of Clark County. Accordingly, this Plan will require approval by Clark County.

2.6 CITY POLICIES

Planning policies are important in guiding the development of a water system. The City has adopted many resolutions regarding water system planning that are included in the City Code.

2.6.1 Related Documents

The City of Camas recognizes that planning activities of governmental entities can affect the water utility. These include several regional and local plans of the southwest region of Washington, such as Clark County. Some related plans affect how Camas operates its water system and how it plans to meet future growth. The following section summarizes these related plans.

2.6.2 Regional Planning Documents

2.6.2.1 Clark County Coordinated Water System Plan

Amended and adopted in 2012, the Coordinated Water System Plan (CWSP) serves as a primary planning document for water purveyors within Clark County. The CWSP was developed to fulfill the requirements of the 1977 Public Water System Coordination Act (RCW 70.116) and the 1971 Water Resource Act (RCW 90.54). The plan is in accordance with the Lewis and Salmon-Washougal Water Resources Management Program rules (WAC 173-527 and WAC 173-528). These acts work together to create a framework for water utilities, which allows for coordinated planning and construction programs among adjacent water utilities. Also, these acts allow utilities in a specified geographical area to reserve water rights required to meet projected municipal and industrial needs for a 50 year period. In order for reservation of water rights and coordination of water system planning to occur, a CWSP is required to be developed.

A Clark County Water Utility Coordinating Committee (WUCC) was created in 1977 and requested that the DOH assess the need for a designation of a Critical Water Supply Service Area. Such designation represents the first step toward the development of a CWSP. The assessment, which was completed in 1980, addressed problems within the county related to inadequate water quality, unreliable service, and the lack of coordinated planning by the water utilities. Based on the findings of the assessment, the County Commissioners declared Clark County a Critical Water Supply Service Area. Following that determination, development of the 1983 CWSP was initiated.

The Coordination Act requires that the CWSP be reviewed and updated by the water utility coordinating committee, if the water utility coordinating committee feels it necessary; the last update occurring in 2012. The update serves as the regional supplement to local water system plans that have been or will be approved by DOH.

The 2012 CWSP:

- Addresses local legislative and CWSP policies.
- Updates water utility service area boundaries.
- Requires consistent water utility design standards.
- Adopts a utility service review procedure.
- Establishes a satellite system management agency.
- Assesses water resources.
- Reviews water supplies.

The 2012 CWSP addressed recent changes to Washington State's satellite system management agency regulations and the Lewis and Salmon-Washougal Water Resources Management Program rules.

2.6.2.2 Clark County Comprehensive Plan (2015 - 2035)

In response to rapid growth and growth-related pressures in the late 1980s, the State Legislature enacted the Washington State GMA to establish a framework for comprehensive planning efforts by local governments to accommodate anticipated growth and development. Under the GMA, each county is required to adopt a comprehensive plan and to do so in consultation with its cities.

The intent of the comprehensive plan is to build on the Community Framework Plan and the 20 Year Plan revised in 1997, 2004, 2007, and 2016 to present a clear vision for Clark County's future through 2035. The plan includes comprehensive planning elements addressing issues of land use, housing, rural and natural resources, environmental goals, transportation, capital facilities and utilities, parks and open space, historic preservation, economic development, school policies and goals, community design, annexation, Shoreline Master Program goals and policies, and procedures for planning for a twenty year planning horizon. For each element included there is an introduction, a discussion of that element's relationship to other elements, a description of existing conditions, estimates and projections of future needs, and goals and policies. Additionally, the plan contains strategies for implementation of these goals and policies.

2.6.2.3 Clark County Public Utilities Water System Plan

Clark Public Utilities 2011 Water System Plan (CH2M Hill) evaluates the long-term water supply needs and resources available for Clark Public Utilities (CPU). The following studies and investigations are included in the CPU Plan: an inventory of existing wells, water supply systems, and interties in the County; an analysis of the population, history, and water requirements to the year 2029; and supplies to serve future water needs. Future supplies are expected to come from CPU's South Lake Wellfield.

2.6.2.4 Metropolitan Transportation Plan for Clark County

The Southwest Washington Regional Transportation Council is the region's principal transportation planning organization. As a means to link transportation and land use, the Council periodically produces a regional transportation plan for the metropolitan area of Clark County. The plan is developed through a coordinated process between local jurisdictions in order to develop regional solutions to transportation needs for the next 20 years and to direct the metropolitan transportation planning process.

The demographic analysis and water demand projections, documented in Chapter 5, were developed based on the best available information at the time, 2013, which was the Regional Transportation Plan (RTP) for Clark County, 2011. In order to establish transportation needs over the 20-year planning period, the Council used a regional travel forecasting model. The model is based on historic and future demographic data allocated by Clark County to 665 individual transportation analysis zones (TAZs) within Clark County. Each TAZ was populated with 2010 and future (2035) population, household, and employment demographic data. Historic demographic data was obtained from Census 2010 and future data was based on the results of forecasts performed by the Washington State Office of Financial Management.

2.6.2.5 City of Vancouver Comprehensive Water System Plan

The City of Vancouver's Comprehensive Water System Plan is updated every six years; most recently in 2015. The purpose of the plan is to develop a planning strategy for the city's retail water service area by evaluating the existing system and its ability to meet the anticipated requirements for water source, quality, transmission, storage, and distribution over a twenty-year planning period. Water system improvements were identified to meet changes in regulatory impacts, and population growth, as well as infrastructure repair and replacement. The plan also identified planning level costs of the improvement projects and provided a financial plan for funding the projects. The plan was prepared in accordance with DOH WAC 246-290 requirements

2.6.2.6 City of Washougal Water System Plan Update

The City of Washougal's Water System Plan Update was completed in 2015. The Plan states its purpose "is to document the City of Washougal's water system infrastructure and evaluate the system's physical and financial adequacy to provide water to existing customers and projected growth within the water service area. This plan includes an inventory of existing facilities, establishing criteria for water system analysis and analyzing the hydraulic capacity of the system, developing a capital improvement program (CIP) based on the hydraulic analysis and developing a financial plan to fund the proposed CIP and assess existing revenue and expenses. This plan also includes an assessment of the

City of Washougal's groundwater resources, water rights and water use efficiency program." The plan was prepared in accordance with DOH WAC 246-290 requirements.

2.6.2.7 Salmon-Washougal and Lewis Watershed Management Plan (Lower Columbia Fish Recovery Board, July 21, 2006)

The Watershed Management Act (RCW Chapter 90.82) provides a framework to address and resolve water resource issues in each of the state's 62 WRIAs. Planning units created for each WRIA are responsible for developing a watershed plan. The planning units consist of citizens, tribes, interest groups, and government agencies where appropriate. Camas's water system boundaries and the boundaries of surrounding water providers are within the Salmon-Washougal and Lewis watersheds (WRIAs 27 and 28). The Salmon-Washougal and Lewis Watershed Management Plan (WRIA Plan) was adopted in 2006. The WRIA Plan addresses a range of issues related to water resources, including water supply, stream flow management, water quality, and fish habitat. It reviews alternative approaches for managing water resources in the area and recommends select strategies for implementation.

The Salmon-Washougal and Lewis Water Resources Management Program rules were adopted in 2008 (WAC 173-527 and WAC 173-528). These rules were based on the WRIA Plan and had five key elements:

- Setting Instream Flows,
- Closing sub-basins to future withdrawals,
- Designating "regional supply areas" for future water supply,
- Establishing reservations for water for future use, and
- Specifying conditions of use for access to the water reserves.

2.6.2.8 City of Camas 2010 Water System Comprehensive Plan (Gray & Osborne, Inc.)

Camas' Water System Comprehensive Plan was developed to meet the City of Camas' water system needs for a 20-year planning period. The plan was prepared in accordance with DOH WAC 246-290 requirements and includes:

- A water system description.
- Historical and future water use.
- Service area population and water demand projections.
- Water quality and Safe Drinking Water Act impacts.
- A water system analysis, including a computer simulation model.
- CIP.

The base 6-year CIP includes pipeline, pumping, control, storage, and source improvements. These improvements include the development of multiple well sites and future sources, developing or replacing storage reservoirs throughout the system, transmission and distribution improvements, and booster station improvements. New wells will provide 4,350 gpm of supplies within the 20-year planning period. The elements and the direction of Camas' plan were consistent with activities and plans of this WSP.

2.6.2.9 Jones and Boulder Creek Watershed Forest Management Plan

The City of Camas Boulder Creek and Jones Creek watershed consists of roughly 1,700 acres of forest where the City collects its water. There has been minimal amount of work done in the area to keep it managed. The largest work was in 2011 when AKS Engineering & Forestry (AKS) performed a timber inventory. This document summarizes the work that was done so that the City could periodically receive timber income while still protecting and maintaining water quality. The contents consists of an assessment of existing resources, a timber harvesting plan, an access and road plan, and implementation methods, guidelines and management recommendations.

2.7 DRAFT POLICIES AND CRITERIA

The City manages its water utility in accordance with established water system policies. The policies provide a consistent framework for the design, operation, maintenance, and service of the water system for appropriately implementing programs, designing new infrastructure, and serving additional customers. The policies and planning considerations set forth herein pertain solely to the water system; the City has additional land use, development, and finance policies that may specify additional requirements for development or extension of a water service. Table 2.3 summarized the City of Camas Service and Extension Policies.

The following documents were reviewed for this update of the City's water policies:

- City of Camas Municipal Code (CMC).
- City of Camas 2010 Water System Plan (2010 WSP).
- City of Camas Design Standards (City Design Standards).
- City of Camas Comprehensive Plan 2004 (2004 Comp Plan).
- Clark County Coordinated Water System Plan (CWSP).
- Clark County Coordinated Water System Minimum Standards & Specifications (CWSP MSS) (Appendix V-A to the CWSP).
- Clark County Code (CCC).
- Revised Code of Washington (RCW).
- Uniform Plumbing Code (UPC).
- International Fire Code (IFC).

Table 2.3 Service and Extension Policies
Water System Plan Update
City of Camas

Policy Name	City of Camas Policy and Criteria	Reference	Action Items
Duty to Serve	The City will exercise reasonable diligence and care to furnish and deliver a continuous and sufficient supply of pure water to the customer, and to avoid any shortage or interruption of delivery of same The City will meet all regulatory requirements for management of its water system and provision of water to its customers, including water quality, system pressure, and adequate supply.	CMC 13.16.010, 2016 WSP	
Government Consistency	The City's Water System Comprehensive Plan will be consistent with local, county, and state land use authorities and plans and will comply with the Washington State Growth Management Act.	2019 WSP	
Retail Water Service Area	The City will provide water service to all customers within its Retail Water Service Area meeting the City's requirements.		City to update text to be consistent with Comp Plan.
Future Water Service Area	The City's future water service area shall be determined through the Coordinated Water System Plan and adopted through the "Interlocal Agreement for Adjusting or Confirming Future Water Service Area Boundaries Between The Cities of Battle Ground, Camas, Ridgefield, Vancouver, and Washougal, and Clark Public Utilities".	2019 WSP	
Condition of Service	It is unlawful for any person, except duly authorized city employees, to make connections with any water main or water pipe belonging to the municipal water supply system, without first obtaining written permission to do so from the public works director or his designated representative.	CMC 13.32.030	
Annexation	Annexation to the City is required as a condition of the City's provision of water service for City and UGA Customers.		City to review and update language
Service to customers outside of UGA boundary	The City will continue to provide water service to [existing] customers outside of the City's Urban Growth Area (UGA) Boundary but within the established Water Service Area. The City is not required to provide fire flow to such customers. The City reserves the right to deny service to new customers outside the UGA that do not meet City requirements.	2010 WSP	City to review highlighted text.
Water Main Extensions	A. Extensions to water mains will be made only upon proper petitions to the City. The City shall have the right to reject such petitions or enter into contract with the petitioners under such conditions as the City may elect. B. All water main extensions installed, whether within or without the corporate limits of the City, shall be ~~six~~ [eight] inches in diameter or larger. C. All extensions of mains required to serve new customers shall be constructed at the expense of such customers. All extensions shall extend to and across the full width of the property served with water. No property shall be served with City water unless the water main is extended to the extreme boundary limit of the property line extending the full length of the front footage of the property.	CMC 13.48.010, 2016 WSP recommended change	City to review and update "to and through" language

Table 2.4 Service and Extension Policies
Water System Plan Update
City of Camas

Policy Name	City of Camas Policy and Criteria	Reference	Action Items
Oversizing	The City Council may enter into a development agreement pursuant to RCW 36.70(b).170 whereby it agrees to set aside and reserve capacity in the municipal water system for a prospective development. Such development agreement shall be permitted only if the city council makes a specific finding that the public good and general welfare will be benefited by such agreement.	CMC 13.12.085 (A)	
	If in the judgment of the water department of the city, it is in the best interest of the City and of the general area where a new main is contemplated to install a larger main than that required by the immediate development, the city may install such larger main and shall pay the increased difference in cost between installation of the smaller and of the larger main. The City may participate to the extent permitted by law, through SDC credits, Local Improvement District (LIDs), or other payback agreements to assist in the financing of such improvements. • Water system extensions needed to serve new development shall be built prior to or simultaneous with such development, according to the size and configuration identified by the Comprehensive Water Plan as necessary to serve future planned development. • The location and design of these facilities shall give full consideration to the ease of operation and maintenance of these facilities by the City. • Wherever any form of City finance is involved in a water line extension, lines that promote a compact development pattern will be favored over lines traversing large undeveloped areas where future development plans are uncertain.	CMC 13.48.010 (C), 2016 WSP	City to review and update to be consistent with current practices.
Latecomer Agreements	The City may choose to allow reimbursement contracts in exchange for permission to develop and allow for reimbursement to the initial developer by future users in the area who will benefit from the system expansion. The developer must be willing to front the initial expense of system expansion.		
Satellite Management Area	The City may assume the operation of a water district or private water system within the City limit, at the water system's request, if the following conditions are met and subject to approval of the City Council: 1. The district or private system is adjacent to or within the City's current or future RWSA as identified in the City's comprehensive plan. 2. The assumption of the district or private system is permitted by State law. 3. The district's or private system's facilities meet the City's performance criteria and engineering standards, or a plan is in place to assure that they will be brought up to City standards without adversely impacting City's existing customers financially or with regard to level of service. 4. Any extension of the City's system to connect the newly accepted system will be paid by the district or private system. 5. The City shall require the district or private system to transfer the ownership of its water supply sources and associated water rights to the City. Water rights must be successfully transferred to the City and approved for municipal water use by the DOE prior to commitment from the City for water service.	2019 WSP	City to review and update to be consistent with current practices

Table 2.5 Service and Extension Policies
Water System Plan Update
City of Camas

Policy Name	City of Camas Policy and Criteria	Reference	Action Items
Developer Extensions outside of City UGA Boundary	The City will provide water service to developer extensions outside the City's existing UGA but within the established Retail Water Service Area whenever reasonably possible. Developer extensions shall adhere to the established SDC.	2010 WSP	
New Customers with Existing Wells	Developer extensions shall adhere to the established SDC and shall abandon all private wells and relinquish associated water rights to the City as a provision of the SDC. Water rights procured in this manner will be used to accommodate growth in the Retail Water Service Area.	2010 WSP	
Metering	All services to the water system shall be metered.	CMC 13.40.010 (A)	
Source Metering	All supply sources will be metered either at individual wells or at a common flow meter.	2019 WSP	

EXISTING SYSTEM

3.1 INTRODUCTION

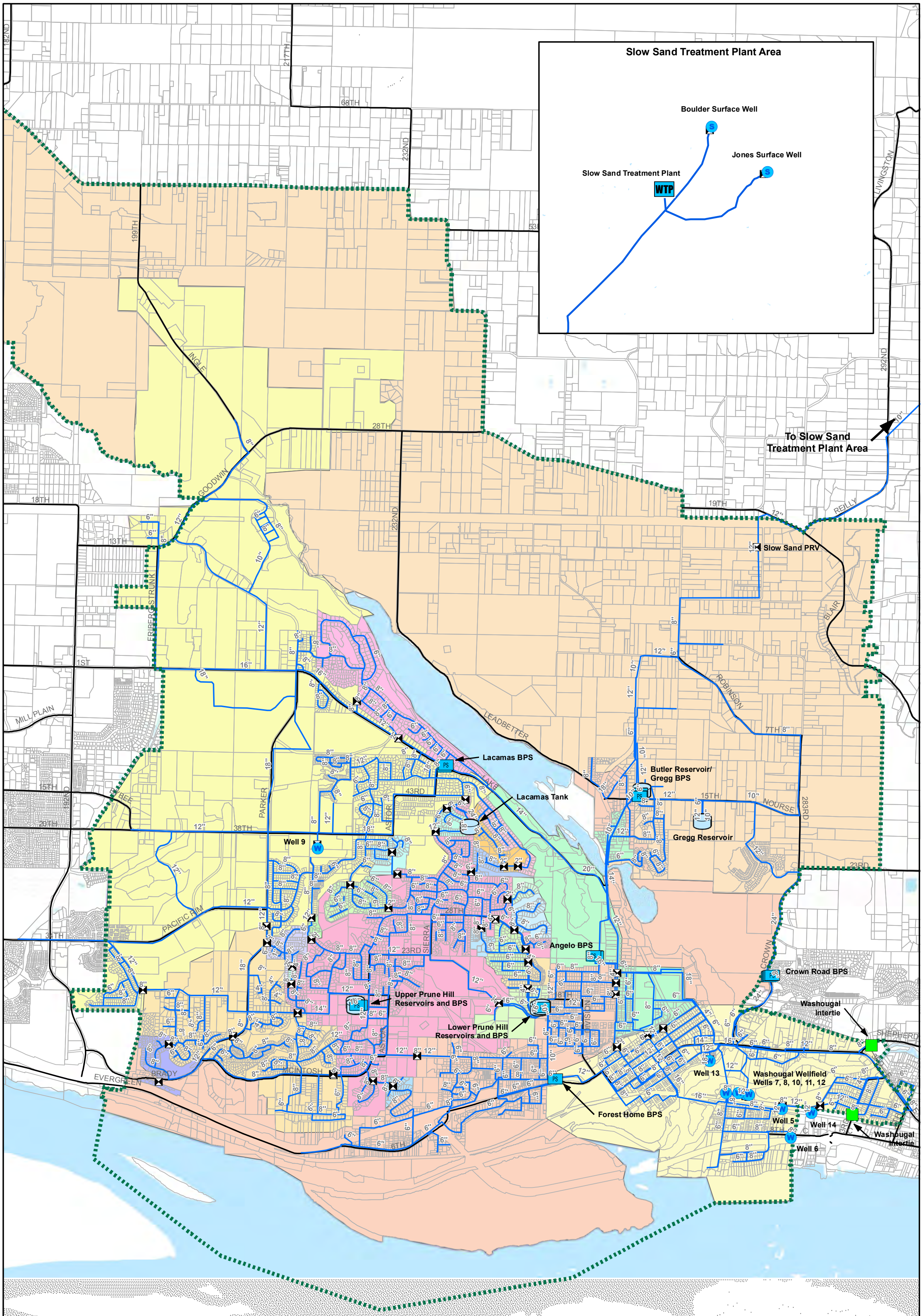
The City of Camas, WA (City) owns and operates a multi-source municipal water system (Washington State Department of Health (DOH) System Number 108002), which includes supply, treatment, storage, and distribution of potable water to residential and commercial customers. Service is provided to customers across 5 major pressure zones and 18 subzones. The locations of pressure zones and key elements of the water system are shown in Figure 3.1. The hydraulic profile of the City's water system is shown in Figure 3.2A and 3.2B. This chapter reviews all of the system components incorporated in the water supply system and provides a brief summary of each facility as shown below:

- Pressure Zones.
- Sources of Supply.
- Water Treatment.
- Storage Facilities.
- Transmission and Distribution Facilities.
- Booster Pumping Stations.
- Interties.
- Supervisory Control and Data Acquisition (SCADA).

3.2 PRESSURE ZONES

The City has five main areas that serve as pressure zones in the system, these are the 343 Zone - Butler, the 455 Zone - Lower Prune Hill (LPH), the 852 Zone - Upper Prune Hill (UPH), the 544 Zone - Lacamas, and the 542 Zone - Gregg, named for the reservoir that serves the area. Subzones are supplied through pressure reducing valves (PRVs) and are typically associated with a specific development. The 852 Zone serves 17 subzones while the 544 Zone serves the only other subzone. The maximum and minimum elevation served within each zone is shown Table 3.1.

The 343 Zone – Butler is unique in that customers are not served directly from the Zone. Customers are served from the subzones: 343 Zone - Downtown via the 343 Zone – Butler and 343 Zone - Cemetery (also known as the Upper Zone), which is supplied mainly from the 455 Zone – LPH.



Legend

- Camas Water Boundary
- Waterbody
- PRV
- Intertie
- Potable Wells
- Surface Water Supplies
- Slow Sand Treatment Plant
- Pump Station
- Water Tank
- Existing Water Main
- Pressure Zones

Feet 0 2,000 4,000

carollo

SYSTEM FACILITY MAP

FIGURE 3.1

CITY OF CAMAS
WATER SYSTEM PLAN UPDATE

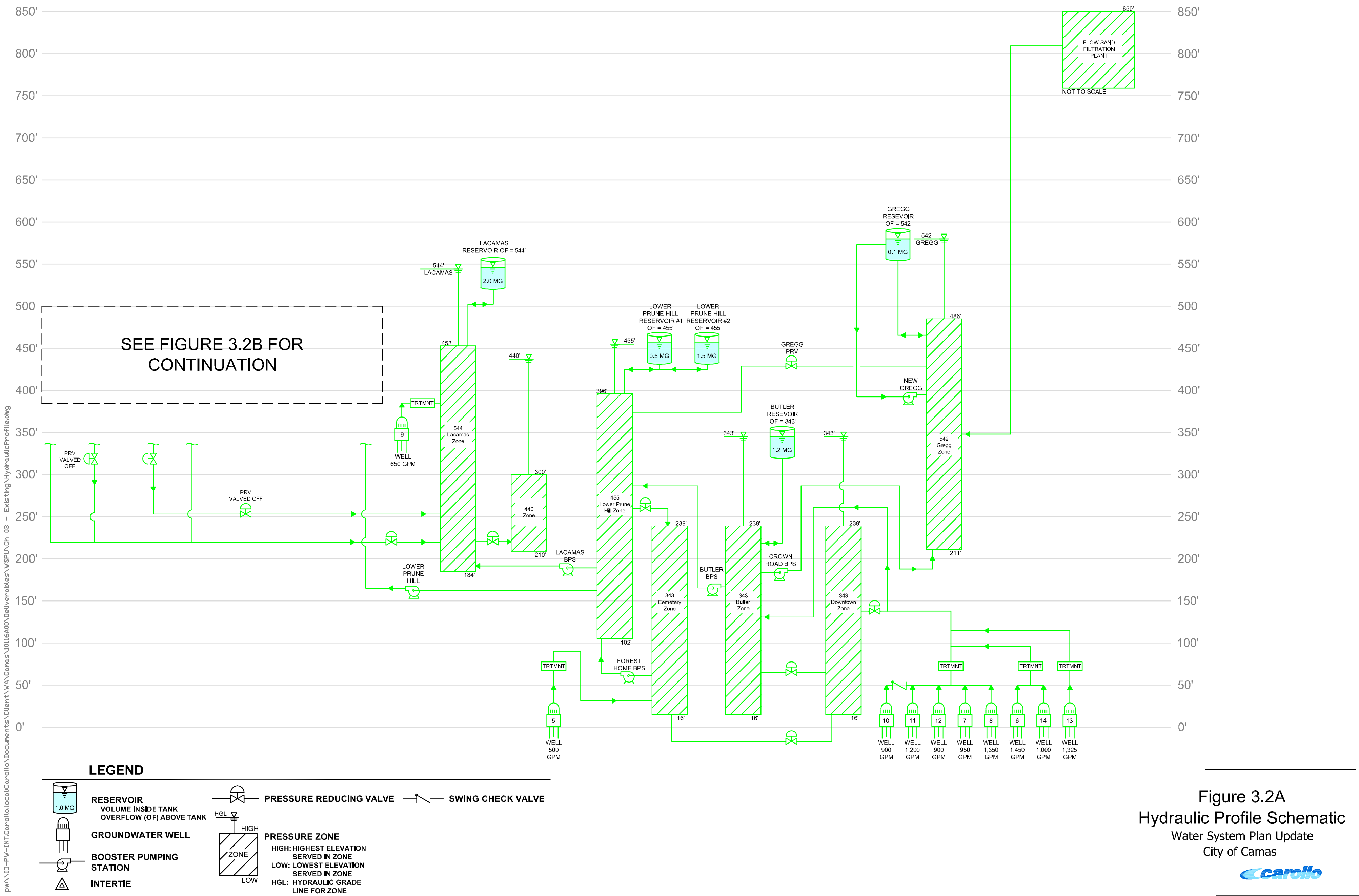


Figure 3.2A
Hydraulic Profile Schematic
Water System Plan Update
City of Camas

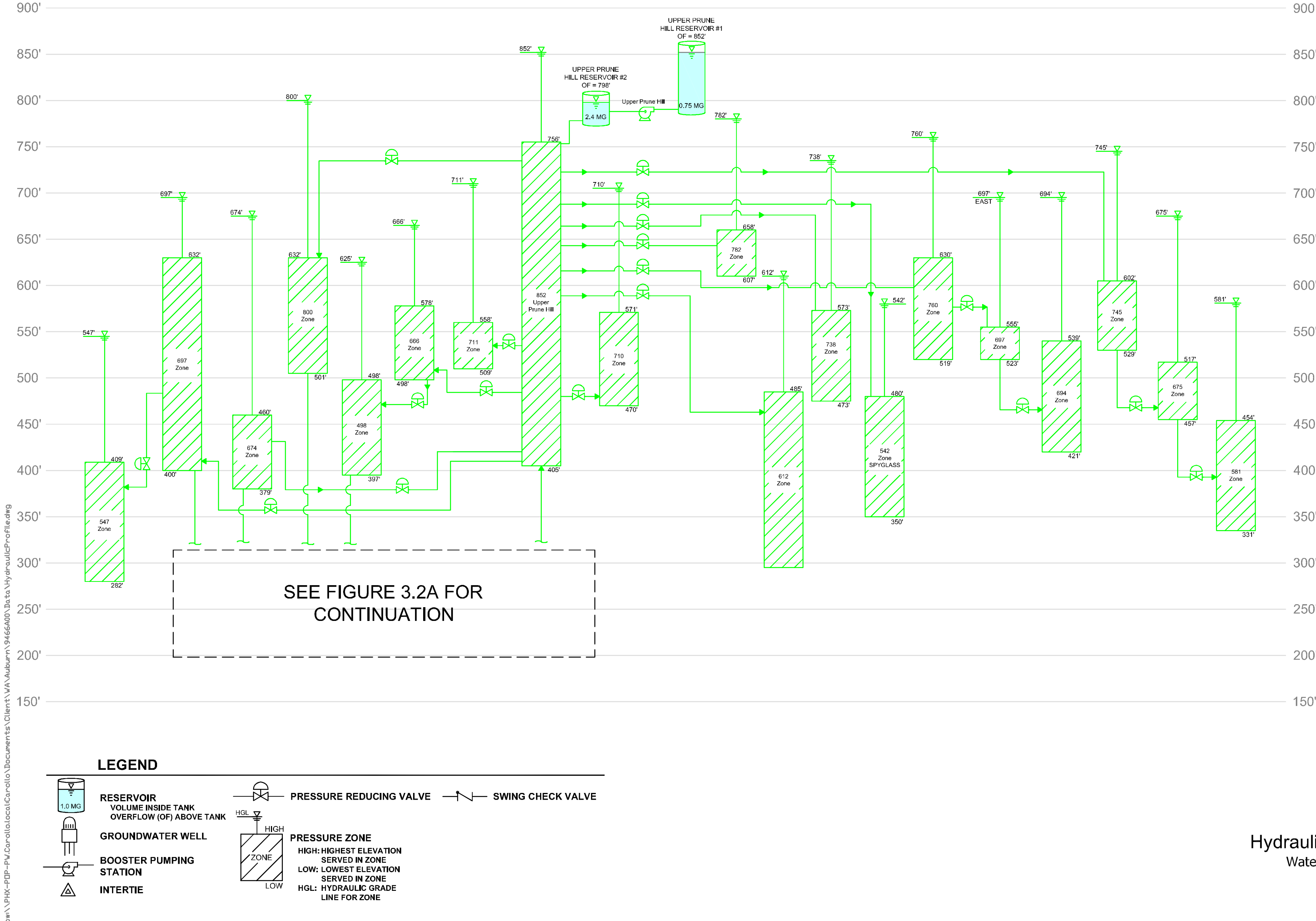


Figure 3.2B
Hydraulic Profile Schematic
Water System Plan Update
City of Camas

Table 3.1 Pressure Zones Water System Plan Update City of Camas			
Zone ID[1] (ft)	**Name**	**Minimum Elevation (ft)[2,3]**	**Maximum Elevation (ft)[2,3]**
343 - Butler		16	239
455 - LPH		102	396
542 - Gregg		211	486
544 - Lacamas		184	453
440 - Lacamas Shores		209	300
852 - UPH		405	756
542 - Spyglass		350	480
547		282	409
581		331	454
612		399	485
625		397	498
666		498	578
674		379	460
675		457	517
694		421	539
697		400	632
697 - East		523	555
710		470	571
711		509	558
738		473	573
745		529	602
760		519	630
782		607	658
800		501	632

Notes:
(1) Zone ID is based on hydraulic grade line (HGL).
(2) Elevation data based on interpolation of 2-ft contours.
(3) Location of service connections based on model node location.

3.3 SOURCES OF SUPPLY

The City currently obtains its water from ten groundwater wells and two surface water sources. Nine of the ten groundwater sources are located in the downtown area, in the Butler 343 Zone, and Well 9 is located in the Lacamas 544 Zone. The City's seasonal surface water sources are from Jones and Boulder Creeks to the north of the City as shown in Figure 3.1.

3.3.1 Surface Water Sources

Jones Creek has been providing the City of Camas with water since 1913. The Boulder Creek source was added in 1931. The intakes at Boulder and Jones Creeks consist of small settling basins and screens. Surface water sources may be operated between November 1st and May 15th. Seasonal raw water from the Boulder and Jones Creek intakes is conveyed to the recently constructed slow sand filtration treatment plant (SSF Plant) where the water is filtered prior to chemical treatment and discharge to the distribution system.

The SSF Plant has the capacity to treat the entire permitted flow of 1,570 gallons per minute (gpm) from the City's surface water sources. The surface water sources have lower operating expenses because they can provide flow toward two pressure zones without pumping, and have low silica content, which makes these sources more desirable to light industrial customers and their water quality sensitive industrial processes. However, these surface water sources are not available during peak water demand months. The City calls its groundwater sources only after demands cannot be met by production from the SSF Plant.

3.3.2 Groundwater Sources

The City currently operates ten groundwater wells. All of these wells are located in the 343 Zone with the exception of Well 9. Wells 7, 8, 10, 11, and 12 are located on SE 6th Avenue, in the eastern downtown area, and are referred to as the Washougal Wellfield. Wells 6 and 14 are located farther east along SE 6th Avenue near the Camas/Washougal border. The wellfield supply is conveyed across the Washougal River via a 14-inch steel line under the river and a 24-inch ductile iron pipe on a bridge over the river. The two pipes join and an 18-inch transmission line carries water from the Washougal Wellfield up toward the Angelo Booster Station. Well 5 is located south of Well 6 on SE 8th Street. Well 13 is located in the downtown 343 Zone on SE Cramer Lane. Well 9 is located in the 544 Zone on NW 38th Avenue near Parker Street. Table 3.2 lists the City's groundwater sources and their capacities. The City is currently investigating additional groundwater sources within its service area in anticipation of future demands.

Several of the City's groundwater sources must be operated with a booster pumping station in service to prevent over pressurization:

- When Well 5 is called into service, the Forest Home Booster Station must also be called on to prevent over pressurization of the downtown zone.
- Washougal Wellfield operations are matched by pumping at the Angelo Booster Station. For each well that is called on at the wellfield, for up to four total wells, a corresponding pump must be called on at the Angelo Booster Station.
- In addition, there are piping restrictions that prevent the City from operating Well 6 and Well 14 at the same time.

The J.D Currie Youth Camp (Camp Currie) Well was small shallow well with a hand pump that served the camp. The City has taken over Camp Currie and upgraded the well with a new pumping system, with electricity, concrete landing and a new yard hydrant. The City maintains the well and monitors it per DOH schedule. The City also previously operated a well at Camp Lacamas Retreat and Conference Center. The City has extended water service to Camp Lacamas and the well has been abandoned.

Table 3.2 Groundwater Sources
Water System Plan Update
City of Camas

	Depth (feet)	Rated Capacity (gpm)	Motor (hp)(1)	Casing (inch)	Control Valve	Auxiliary Power
Well 5	71	500	75	8	3-inch waste valve	No
Well 6	85	1,000	150	16	4-inch waste valve	No
Well 7	84	950	100	14	3-inch waste valve	No
Well 8	87	1,350	150	14	4-inch waste valve	Yes
Well 9	253	650	100	16	4-inch waste valve	No
Well 10	92	900	200	16	8-inch	No
Well 11	105	1,200	200	16	8-inch	Yes
Well 12	106	900	200	16	8-inch	Yes
Well 13	102	1,325	200	20	8-inch	Yes
Well 14	85	1,000	200	20	8-inch	Yes
Total Groundwater Source Capacity				**10,255 gpm**		

Note:
(1) hp - horsepower.

3.4 WATER TREATMENT

The City currently has approximately 15.5 million gallons per day (mgd) of total source water treatment capacity. A discussion of the treatment facilities is provided in the following sections. A summary of treatment facilities is provided in Table 3.3 and facility locations are shown in Figure 3.1.

3.4.1 Surface Water

The City's surface water is chlorinated and filtered. Chlorination of the surface water occurs at the City's slow sand facility with .840 sodium hypochlorite. The distance between the slow sand plant and the first customer provides 2.5 hours of contact time.

In 2013 the City began construction of the SSF Plant. This plant has a design capacity of 1,570 gpm and filter beds are comprised entirely of sand. The City also treats with sodium fluoride for dental benefits.

3.4.2 Groundwater

Treatment of the City's groundwater sources includes on-site chlorination, fluoridation, and caustic soda addition. A single chemical feed facility provides treatment for Wells 7, 8, 10, 11, and 12 due to their close proximity to one another. Water from Wells 6 and 14 are treated at the Well 14 site. The remaining wells each have individual treatment facilities at the well locations. Fluoridation always occurs downstream of the well pump and sodium fluoride is used at all facilities. Sodium hydroxide, also known as caustic soda, is added for corrosion control at each of the treatment facilities with the exception of Well 9 due to natural pH. The existing treatment facilities for the City's sources are shown in Table 3.3. The residual chlorine target for all facilities is 0.8 milligrams per liter (mg/L) with alarms if the concentration is above 2 mg/L or below 0.2 mg/L. The fluoridation target for all facilities is 0.7 mg/L for all facilities with alarms if the concentration is above 2.5 mg/L or below 0.25 mg/L.

Table 3.3 Treatment Facilities
Water System Plan Update
City of Camas

Treatment Facility	Sources Treated	Filtration	Chemical Addition
Slow Sand Filtration Treatment Plant	Boulder Creek, Jones Creek	Yes	Sodium Hypochlorite Sodium Fluoride Hydroxide
Washougal Wellfield Site 519	Well 7, Well 8, Well 10, Well 11, and Well 12	No	Sodium Hypochlorite Sodium Hydroxide Sodium Fluoride
Well 14 Site 518	Well 6 and Well 14	No	Sodium Hypochlorite Sodium Hydroxide Sodium Fluoride

Table 3.3 Treatment Facilities Water System Plan Update City of Camas			
Treatment Facility	**Sources Treated**	**Filtration**	**Chemical Addition**
Well 13 Site	Well 13	No	Sodium Hypochlorite Sodium Hydroxide Sodium Fluoride
Well 9 Site	Well 9(1)	No	Sodium Hypochlorite Sodium Fluoride
Well 5 Site	Well 5	No	Sodium Hypochlorite Sodium Hydroxide Sodium Fluoride

Note:
(1) Well 9 pH is above the treatment limit.

3.4.3 Groundwater Under the Direct Influence of Surface Water

The federal definition of ground water under the direct influence of surface water (GWI) is a groundwater source located near a surface water such that it has significant occurrence of contamination from pathogens such as Giardia lamblia which is not normally found in groundwater. A GWI receives direct surface water recharge and is subject to rapid changes in water characteristics that correlate to surface water conditions. Sources determined as GWI are required to achieve 99.9 percent removal of Giardia lamblia and viruses by filtration and disinfection.

A hydraulic connection to nearby surface water is a potential GWI source. In order to determine if a hydraulic connection exists, a water system may conduct a hyrdogeologic investigation or use the water quality monitoring (WQM) method. The WQM method requires monitoring the groundwater and surface water source for 1 year for temperature and conductivity. If a significant correlation is determined from statistical analysis of the data, then the source is determined to be hydraulically connected to surface water. Less demanding requirements are required for hydraulically connected sources. These include eliminating the surface water influence, developing an alternate source, meet criteria to remain unfiltered, or install filtration.

A microscopic particulate analysis (MPA) is conducted in order to determine if a groundwater source is a GWI source. The City has completed MPA testing on Wells 6, 7, 8, 10, 11, 12, and 14 which indicate that these sources are hydraulically connected to surface water. Therefore, these sources are required by DOH to achieve a contact time (CT) of 6. An evaluation by Pacific Groundwater Group in 2006 states that Well 13 is not under the direct influence of surface water, but is hydraulically connected to surface water. Wells 5 and 9 are not hydraulically connected to surface water, so no CT is required.

3.5 STORAGE FACILITIES

The City currently operates seven storage facilities with a combined total of 8.45 million gallons (MG). A discussion of each storage facility is provided in the following sections. A summary of the storage facilities is provided in Table 3.4. A map showing the location of the key elements of the City's water system is provided as Figure 3.1.

3.5.1 Butler Reservoir

The Butler Reservoir consists of two adjacent, partially buried concrete reservoirs. The two reservoirs share a common wall, with the north half being constructed in 1913, and the south half being completed in 1923. The reservoirs are covered and have a total storage capacity of 1.2 MG. The base elevation of the reservoir is approximately 328 feet and the overflow elevation is 343 feet. The entire capacity of the Butler Reservoir is usable storage. The Butler Reservoir is shown in Figure 3.3.

BUTLER RESERVOIR

FIGURE 3.3

CITY OF CAMAS
WATER SYSTEM PLAN UPDATE

Under normal operating conditions, the Butler Reservoir is supplied through 6,420 lineal feet of 12-inch cast iron transmission main. This transmission main connects with the 18-inch main from Wells 6, 7, 8, 10, 11, 12, 13, and 14 at NE 22nd Avenue and NE Everett Street.

3.5.2 Gregg Reservoir

The Gregg Reservoir, a 100,000 gallon capacity steel standpipe, was constructed in 1978. It has a base elevation of approximately 472 feet, an overflow elevation of 542 feet, and is the only storage facility for the 542 Zone. The reservoir provides equalization and operational storage for the 542 Zone, but does not provide fire suppression storage. The Gregg Reservoir is supplied by the Gregg Booster Station and the Crown Road Booster Station. The Gregg Reservoir is shown in Figure 3.4.

3.5.3 Lacamas Reservoir

The Lacamas Reservoir, constructed in 1993, has a total capacity of 2.0 MG. It has a base elevation of approximately 504 feet, and an overflow elevation of 544 feet. The Lacamas Reservoir is a ground level reservoir. The Lacamas Reservoir is primarily supplied from the LPH Zone via the Lacamas Booster Station or from the newly constructed Well 9. PRV stations from the Upper Prune Hill zone can also provide fire flow to the Lacamas Zone. The Lacamas Reservoir is shown in Figure 3.5.

3.5.4 Lower Prune Hill Reservoirs

Storage in the LPH Zone is provided by two concrete ground level reservoirs with overflow elevations of 455 feet. The first reservoir was constructed in 1935 and has a total capacity of 0.5 MG. A second, 1.5 MG reservoir was added to the same site in 1971. The reservoirs are plumbed together to act as one reservoir, and both have a base elevation of approximately 432 feet. The Low Prune Hill Reservoirs are shown in Figure 3.6.

Storage in the LPH Reservoirs is accessible via gravity to the 455 Zone, or is pumped to the UPH Zone through the LPH Booster Station. Under normal system operation, water from the SSF Plant supplies the 455 Zone and the reservoirs. The 455 Zone can also be supplied through pumping from the 343 Zone via the Forest Home, Butler, and Angelo Booster Stations. The LPH Reservoirs can also supply the 544 Zone through the Lacamas Booster Station. When SSF is running the surface water can supply the 544 Zone through Lacamas Booster Station.

3.5.5 Upper Prune Hill Standpipe and Reservoir

The UPH Reservoir 1 and Reservoir 2 were constructed in 1971 and 2001, respectively. Reservoir 1 has an overflow elevation of 852 feet, stands 100-feet tall, and has a total capacity of 0.75 MG. This reservoir sets the HGL for the 852 Zone. The Upper Prune Hill Reservoirs are shown in Figure 3.7.

GREGG RESERVOIR

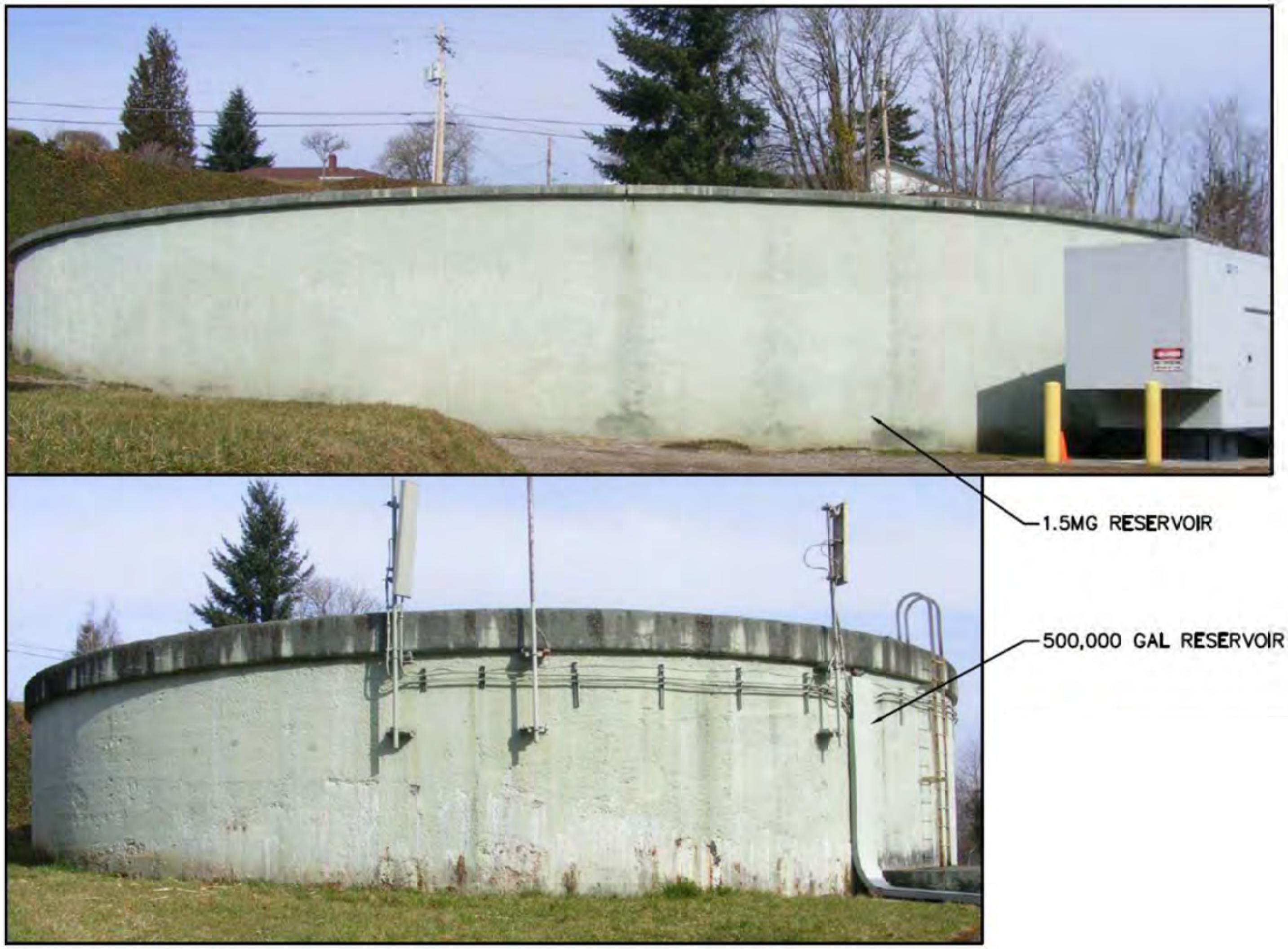
FIGURE 3.4

CITY OF CAMAS
WATER SYSTEM PLAN UPDATE

LACAMAS RESERVOIR

FIGURE 3.5

CITY OF CAMAS
WATER SYSTEM PLAN UPDATE



LOWER PRUNE HILL RESERVOIRS

FIGURE 3.6

CITY OF CAMAS
WATER SYSTEM PLAN UPDATE

UPH Standpipe

UPH Reservoir

UPPER PRUNE HILL RESERVOIRS

FIGURE 3.7

CITY OF CAMAS
WATER SYSTEM PLAN UPDATE

The UPH Reservoir 2 is below the HGL of the 852 Zone and serves the zone by pumping through the UPH booster pump station (BPS) to the UPH Reservoir 1. It has an overflow elevation of 816 feet, stands 64-feet tall, and has a total capacity of 2.4 MG. The booster station has a total pumping capacity of 2,900 gpm. Including the standpipe and reservoir, the 852 Zone is supplied by the LPH BPS, 12-inch transmission line, and 16-inch Ostenson Canyon transmission line.

Table 3.4 Existing Storage Facilities
Water System Plan Update
City of Camas

Reservoir	Capacity (MG)	Diameter (ft)	Base Elevation (ft)	Overflow Elevation (ft)	Year Constructed and Type
Butler	1.2	100x100	328	343	1913, Concrete
Lower Prune Hill No. 1	0.5	61	432	455	1935, Concrete
Lower Prune Hill No. 2	1.5	105	432	455	1971, Concrete
Upper Prune Hill No. 1	0.75	36	752	852	1971, Steel
Upper Prune Hill No. 2	2.4	90	748	798	2002, Steel
Gregg	0.10	16	472	542	1978, Steel
Lacamas	2.0	84	496	544	1993, Steel

3.6 TRANSMISSION AND DISTRIBUTION FACILITIES

Transmission and distribution facilities allow the water supply to reach the City's customers. These facilities include water pipelines, BPS, and pressure reducing stations that allow water to flow between pressure zones, from one hydraulic grade to another. BPS are discussed separately in Section 3.7.

3.6.1 Piping System

The City owns over 143 miles of pipelines in its water transmission and distribution system. An inventory of existing pipelines in the system, as reported from the City's hydraulic model, is summarized in Table 3.5. The system is predominately looped and located within public rights-of-way, giving the City access for repairs and maintenance. The City replaces aging and undersized pipes to serve the City's growing demands on an ongoing basis. Pipe materials within the City currently include the following:

- Cast Iron (CI) Pipe

- Polyvinyl chloride (PVC) Pipe
- Ductile Iron (DI) Pipe
- Steel (ST) Pipe

Table 3.5 Pipe Diameter and Material
Water System Plan Update
City of Camas

Diameter	DI (feet)	CI (feet)	ST (feet)	PVC (feet)	Unknown	Total (feet)	Percent
6-inch	75,515	68,503	21,669	0	19,732	185,418	25%
8-inch	147,780	19,424	8,355	0	94,704	270,263	36%
10-inch	6,025	0	4,447	0	28,384	38,855	5%
12-inch	69,169	24,030	2,501	0	69,046	164,746	22%
14-inch	5,278	0	7,658	5,037	2,685	20,658	3%
16-inch	9,315	556	0	0	1,234	11,105	1%
18-inch	40,745	77	181	0	1,485	42,488	6%
20-inch	0	0	0	1,859	0	1,859	< 1%
24-inch	494	0	21,669	0	20,733	21,227	3%
Total	**354,321**	**112,589**	**44,810**	**6,895**	**238,004**	**756,619**	**100%**
Percent	47%	15%	6%	1%	31%	100%	

3.6.2 Pressure Reducing Stations

In order to operate on the sixteen pressure zones, the City maintains numerous pressure reducing stations as shown in Table 3.6 and Figure 3.1. In most cases, there are two PRVs at each station. The smaller valve operates to provide the average daily demand to the zone that it serves. The larger valve, which is generally set five pounds per square inch (psi) lower than the small valve, is primarily used for fire protection or large demand situations. The City's PRVs have pressure sustaining features, which are set to ensure that upstream pressures are maintained. The City has a contract with GC Systems to service the 68 PRVs located within the water system. This contract allows GC Systems to perform general maintenance and ensure that the valves are operating correctly, both on an individual and system-wide level.

Table 3.6 Pressure Reducing Valves
Water System Plan Update
City of Camas

PRV Station	PRV Model ID	Size (in)	Downstream Zone	Downstream Setting (psi)	Upstream Pressure (psi)
NW McIntosh	PRV-1	6	697	45	120
	PRV-2	2	697	50	120
NW Payne Rd. and 18th	PRV-3	8	544	Closed	Closed
	PRV-4	4	544	Closed	Closed
NW 16th Ave. and Klickitat	PRV-5	10	697	30	105
	PRV-6	4	697	40	105
NW Ivy and Fargo	PRV-7	4	623	50	90
NW 22nd and Fargo	PRV-8	4	697	65	130
NW 19th Ave. and Fargo St.	PRV-9	4	694	75	157
NE 21st and Everett	PRV-10	8	343	45	110
NE 19th and Everett	PRV-11	6	343	40	110
NW 32nd Circle	PRV-12	8	680	25	120
	PRV-13	2	680	30	120
NW Brady Rd. Deer Creek	PRV-14	8	547	25	105
	PRV-15	3	547	30	105
NW Parker St. and Linear	PRV-16	8	544	Closed	Closed
NW Astor and 36th	PRV-17	8	612	55	90
	PRV-18	2	612	60	90

Table 3.6 Pressure Reducing Valves
Water System Plan Update
City of Camas

PRV Station	PRV Model ID	Size (in)	Downstream Zone	Downstream Setting (psi)	Upstream Pressure (psi)
NW 43rd and Sierra	PRV-19	8	544	30	190
NW 23rd Ave. and Fargo St.	PRV-20	4	760	40	130
NW Logan St. off NW 28th	PRV-21	6	782	50	90
	PRV-22	2	782	55	90
NW 31st and NW Dahlia Dr.	PRV-23	6	544	Closed	Closed
	PRV-24	2	544	Closed	Closed
NW 29th Ave. and NW Astor St.	PRV-25	2	800	58	90
	PRV-26	6	800	53	90
NW Sierra Dr. and NW 38th Ave.	PRV-27	6	711	35	115
	PRV-28	2	711	40	115
Currawong Ct. and NW 40th Ave.	PRV-29	6	694	75	145
	PRV-30	2	694	80	145
NW 23rd Ave. and Iris	PRV-31	8	685	58	130
	PRV-32	2	685	63	130
NW Julia St.	PRV-33	8	544	30	150
	PRV-34	2	544	Closed	Closed
SE Fern Ridge Dr.	PRV-35	2	547	40	110
	PRV-36	8	547	35	110

Table 3.6 Pressure Reducing Valves
Water System Plan Update
City of Camas

PRV Station	PRV Model ID	Size (in)	Downstream Zone	Downstream Setting (psi)	Upstream Pressure (psi)
NE 6th and NE Hayes St	PRV-37	4	343	80	94
	PRV-38	12	343	70	94
East End Walden	PRV-41	2	440	32	84
	PRV-42	6	440	22	84
West End Walden	PRV-43	1.5	440	72	118
	PRV-44	6	440	65	118
NE 6th and Joy Goot Park	PRV-45	6	343	65	92
	PRV-46	3	343	123	138 opens at 115
NE 6th and Joy	PRV-47	10	343	123	138 opens at 110 (for Fire Flow)
Lake Ridge Lower	PRV-48	2	581	55	98
	PRV-49	6	581	50	98
Lake Ridge Middle	PRV-50	2	675	63	91
	PRV-51	6	675	58	91
Lake Ridge Upper	PRV-52	2	745	68	123
	PRV-53	6	745	63	123
Spyglass (Upper PRV in View Ridge)	PRV-54	2	686	30	100
	PRV-55	6	686	25	100

Table 3.6 Pressure Reducing Valves
Water System Plan Update
City of Camas

PRV Station	PRV Model ID	Size (in)	Downstream Zone	Downstream Setting (psi)	Upstream Pressure (psi)
Spyglass (Lower PRV in View Ridge)	PRV-56	2	505	35	110
	PRV-57	6	505	40	110
Drewf's Farm Upper	PRV-58	2	738	50	63
	PRV-59	6	738	45	63
Drewf's Farm Lower	PRV-60	2	710	60	130
	PRV-61	6	710	55	130
NW Ivy and Ostenson Canyon	PRV-62	2	677	65	140
	PRV-63	6	677	60	140
NW 24th Ave and NW Brady Rd	PRV-64	6	625	70	124
	PRV-65	2	625	75	124
NW Larkspur St	PRV-66	6	625	45	132
	PRV-67	2	625	50	132
Larkspur Summit	PRV-68	6	666	40	141
Well Field East		4	343	Closed	Closed
Larkspur Summit		12	343	Closed	Closed

Table 3.6 Pressure Reducing Valves
Water System Plan Update
City of Camas

PRV Station	PRV Model ID	Size (in)	Downstream Zone	Downstream Setting (psi)	Upstream Pressure (psi)
NE Shepherd Road – Washougal Intertie		8	Washougal Water System	124	150
		1.5	Washougal Water System	115	150
SE 3rd and Whitney – Washougal Intertie		8	Washougal Water System	Closed	Closed
		1.5	Washougal Water System	Closed	Closed

3.7 BOOSTER PUMPING STATIONS

The City currently operates eight booster pumping stations to move water between pressure zones.

3.7.1 Butler Booster Station

The Butler Booster Station is located at the Butler Reservoir site and pumps from the 343 Zone to the 455 Zone. The Butler Booster Station has one end suction centrifugal 50-hp pump and one end suction centrifugal 40-hp pump that are capable of supplying 800 and 600 gpm, respectively. When the New Gregg Booster Station is called on one of the Butler pumps is also turned on to feed the 14-inch suction line of the New Gregg Booster Station. This station does not have capacity for an additional pump. Figure 3.8 shows the interior of the Butler Booster Station and capacity details are summarized in Table 3.7.

3.7.2 New Gregg Booster Station

The New Gregg Booster Station is also located at the Butler Reservoir site and pumps water from the 455 Zone to the 542 Zone. The New Gregg Booster Station is equipped with two 100-hp double end suction split case pumps, each with a capacity of 1,500 gpm. In 2013 a third 500 gpm pump was added for domestic service and to maintain the level in the Gregg Reservoir. The two larger pumps are typically only called on when fire flow demands occur. The New Gregg Booster Station has suction side flow limitations due to insufficient head provided by the Butler Reservoir. When the New Gregg Booster Station is called on a pump in the Butler Booster Station must also be called on to supply adequate pressure for the Station's 14-inch suction line. Figure 3.9 shows the interior of the New Gregg Booster Station and capacity details are summarized in Table 3.7.

3.7.3 Forest Home Booster Station

The Forest Home Booster Station, located at 418 NW 10th Avenue, pumps from downtown in the Downtown 343 Zone to the 455 Zone. This station contains one pump at a rated capacity of 1,000 gpm. When Well 5 is called into service, this booster station is also called on to prevent over-pressurization of the Downtown 343 Zone. Figure 3.10 shows the Forest Home Booster Station and capacity details are summarized in Table 3.7.

BUTLER BOOSTER PUMP STATION

FIGURE 3.8

CITY OF CAMAS
WATER SYSTEM PLAN UPDATE

NEW GREGG BOOSTER PUMP STATION

FIGURE 3.9

CITY OF CAMAS
WATER SYSTEM PLAN UPDATE

FOREST HOME BOOSTER PUMP STATION

FIGURE 3.10

CITY OF CAMAS
WATER SYSTEM PLAN UPDATE

3.7.4 Lower Prune Hill Booster Station

The Lower Prune Hill Booster Station is located at the Lower Prune Hill Reservoir site and pumps water from the 455 Zone to the 852 Zone. This pump station contains three pumps at a total rated capacity of 2,500 gpm. This station has does not have capacity for an additional pumping unit. The Lower Prune Hill Booster Station is shown in Figure 3.11 and capacity details are summarized in Table 3.7.

3.7.5 Lacamas Booster Station

The Lacamas Booster Station, located at 4620 NW Sierra Street, pumps water from the 455 Zone to the 544 Zone. This station has two 25-hp turbine pumps that are capable of supplying 500 gpm each and one 100-hp turbine pump equipped with a VFD capable of supplying up to 1,500 gpm. The VFD is required for the largest pump due to suction side limitations. A fourth pump pedestal is provided in the booster station for future expansion. The Lacamas Booster Station is shown in Figure 3.12 and capacity details are summarized in Table 3.7.

3.7.6 Angelo Booster Station

The Angelo Booster Station is located at Fallen Leaf Park and is the primary booster station supplying the 455 Zone. It pumps from the 18-inch transmission main in the 343 Zone to serve the 455 Zone and feeds the suction side of the Lacamas Booster Station. This station has four 75-hp split case double end suction pumps capable of pumping 1,000 gpm each. A selected well is called on with the first pump of the Angelo Booster station to provide adequate suction side supply. If additional wells are called on to meet demand a corresponding pump is also called on at the station to prevent over pressurization of the 343 Zone. The Angelo Booster Station is shown in Figure 3.13 and capacity details are summarized in Table 3.7.

3.7.7 Upper Prune Hill Booster Station

The Upper Prune Hill Booster Station is located at 2822 NW 18th Avenue and is used to maintain level in the Upper Prune Hill Standpipe, which sets the HGL for the 852 Zone. This station has four pumps with two 20-hp split case double end suction pumps capable of providing 750 gpm each and two 40-hp split case double end suction pumps capable of providing 1,400 gpm each. The Upper Prune Hill Booster Station suction line is fed from the 2.4 MG reservoir. The 2.4-MG reservoir is fed from the Lower Prune Hill BPS. The Upper Prune Hill Booster Station is shown in Figure 3.14 and capacity details are summarized in Table 3.7.

LOWER PRUNE HILL BOOSTER PUMP STATION

FIGURE 3.11

CITY OF CAMAS
WATER SYSTEM PLAN UPDATE

LACAMAS BOOSTER PUMP STATION

FIGURE 3.12

CITY OF CAMAS
WATER SYSTEM PLAN UPDATE

ANGELO BOOSTER PUMP STATION

FIGURE 3.13

CITY OF CAMAS
WATER SYSTEM PLAN UPDATE

UPPER PRUNE HILL
BOOSTER PUMP STATION

FIGURE 3.14

CITY OF CAMAS
WATER SYSTEM PLAN UPDATE

3.7.8 Crown Road Booster Station

The Crown Road Booster Station is the City's newest booster station and is located at 3700 SE Crown Road and pumps from the 343 Zone to the 542 Zone. This station has two pumps capable of providing 800 gpm each for a total station capacity of 1,600 gpm. Pedestals are provided for two additional pumping units within the station. When the station is called into service a selected well is called on simultaneously to provide sufficient suction side supply. The Crown Road Booster Station is shown in Figure 3.15 and capacity details are summarized in Table 3.7.

Table 3.7 Booster Pump Station Summary
Water System Plan Update
City of Camas

	No. of Pumps	Rated Capacity (gpm)	Year Constructed
Butler	2	1,400	1948(1)
Forest Home	1	1,000	1949(2)
Gregg	3	3,500	2003
Lower Prune Hill	3	2,500	1971(3)
Lacamas	3	2,500	1993
Angelo	4	4,000	2001
Upper Prune Hill	4	2,900	2002
Crown Road	2	1,600	2011

Notes:
(1) Pumps were replaced in 1998.
(2) Pump was replaced in 1999.
(3) Pumps were replaced in 2002 and 2004.

3.8 INTERTIES

The City currently has an emergency intertie agreement with the City of Washougal. The City has two one-way PRV interties with Washougal, located on SE Shepherd Road and at the intersection of SE 3rd Street and Whitney Street. These interties provide water from the City of Camas to the City of Washougal under low pressure conditions. A physical intertie does not exist with Vancouver, but the City has an agreement for emergency use of two fire hydrants located at SE 1st and Friberg for firefighting purposes. Intertie agreements are provided in Appendix C.

CROWN ROAD
BOOSTER PUMP STATION

FIGURE 3.15

CITY OF CAMAS
WATER SYSTEM PLAN UPDATE

3.9 SCADA

The City has a SCADA system with master control located at the City Operations Center. The system uses programmable control software, which can be controlled by a personal computer at the operations center, or from remote by a modem connected to a remote computer. The system monitors reservoir levels, well status, well flow rate, booster pump flow rates, pump status, run time, power usage, and alarm conditions. The system is able to record and display trending data for everything the City monitors. The City continually rotates well and booster pump calls to exercise the pumps and to evenly distribute wear on the pumps.

OPERATION AND MAINTENANCE

4.1 WATER SYSTEM MANAGEMENT AND PERSONNEL

The water system is operated and maintained by the City of Camas (City) staff, with contractors provided services that City staff are not trained or equipped to perform. The organization of the City's water utility is shown in Figure 4.1. The City is governed by a mayor and seven council members, all of which are elected officials. The Public Works Director reports to the mayor and council and directs the City's utilities, including water. The City's organization combines water and sewer operation to furnish domestic water and sanitary sewage disposal service to industrial, commercial, and residential areas within the City and surrounding areas. The Utility Manager directs the water system operations, supervising a Water Supply Operator, Lead Maintenance Worker, and maintenance crews. The Engineering Department is responsible for engineering services, including capital planning, project implementation, development review, and operational support. The Finance Department is responsible for all utility billing and accounting.

4.1.1 Operator Certification

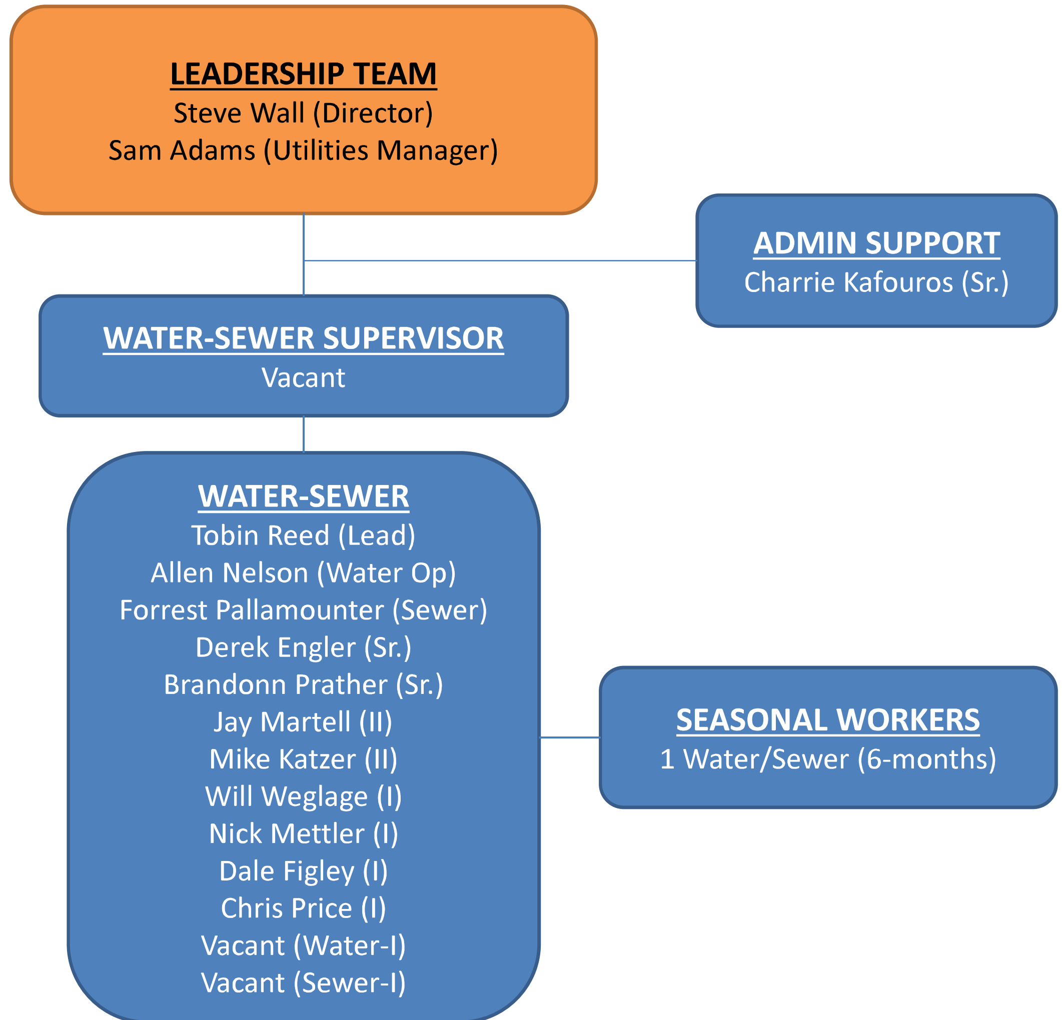
The City's operators are experienced and well trained, exceeding the minimum state requirements (Washington Administrative Code [WAC] 246-292-050). As a Class 3 system (population between 15,000 and 50,000 people) the City is required to have at a minimum, a Water Treatment Plant Operator (WTPO) Level 3, a Water Distribution Manager (WDM) Level 3, and a cross-connection control specialist (CCS). The City certified operators are shown in Table 4.1. As staff change, the Water Works Certification Board is notified of any changes to the mandatory or supporting certificated personnel.

4.1.2 Professional Growth and Training

The City provides opportunities for its staffs' professional growth and training; planning for approximately 25 hours per year of professional growth and training for each employee. Through these activities, City staff are able to obtain the required continuing education unit (CEU) requirements for their operators' certifications. City staff are regular attendees of training programs sponsored by both Washington Environmental Training Resources Center (WETRC) and the Pacific Northwest Section of the American Water Works Association (AWWA). The professional growth requirement may also be met by advancement by examination or certification by examination to a different classification.

Table 4.1 Certified Operators Water System Plan Update City of Camas					
		Certification			
Name	**Title**	**WDM**	**WTPO**	**Cert. Number**	**CCCS**
Tobin Reed	Lead	2	2	10297	Yes
Brandon Prather	Senior	2	2	11124	
Derek Engler	Senior	2		11703	
Allen Nelson	Water Operator	3	3	8187	Yes
Will Weglege	MW1	1		12451	
Jay Martell	MW2	2		14246	
Charrie Kafouros	Backflow Coordinator			14147	

WATER-SEWER DEPARTMENT - 2019 ORGANIZATIONAL CHART



ORGANIZATIONAL CHART

FIGURE 4.2

CITY OF CAMAS

WATER SYSTEM PLAN UPDATE

4.2 ROUTINE SYSTEM OPERATING PROCEDURES AND PREVENTATIVE MAINTENANCE

Basic system operation is described in Chapter 3 – Existing System and Chapter 9 - System Analysis. Detailed documentation of the system operation procedures and preventive maintenance can be found in the City's Operations and Maintenance (O&M) Manual. The manual provides detailed information on operator certification and training, water quality monitoring, operation and control, cross-connection control, and emergency planning/response. Routine operating procedures and preventative maintenance aspects of the O&M Manual are summarized below.

4.2.1 Routine Operating Procedures

The City updated its O&M Manual in 2016 to reflect recent changes in the system and capture the institutional knowledge of retiring operators. The O&M Manual provides the following kinds of operation and control information for wells, reservoirs, pump stations, and pipelines:

- Facility/process components, such as booster pumps, Supervisory Control and Data Acquisition (SCADA) telemetry, valves, chemical metering pumps, storage tanks, etc.;
- Description of facilities/processes, including area served and relationship to other facilities/processes;
- Operation and control, including set points and chemical usage guidelines;
- Guidance on performing maintenance activities such as cleaning, pump isolation, and meter/pump calibration;
- Alarm responses;
- Emergency operation, including use of safety equipment (i.e., emergency showers and eyewash, etc.) and facility operations on auxiliary power.

To aid in accessing the detailed information, the O&M Manual provides annotated pictures identifying all facility equipment.

A hard copy of the O&M Manual is kept at the City's operations center and is available electronically on the City's network. The slow sand filtration plant operations and control are documented in a separate O&M manual that is kept onsite at the plant and available electronically on the City's network.

4.2.2 Preventive Maintenance

The City staff are responsible for daily operation of the City's surface water sources, wells, treatment facilities, booster stations, pressure reducing valves (PRVs), storage facilities, and distribution system. In addition to daily operation, they also perform preventative maintenance on the system based on City goals. These preventative maintenance goals help the City maintain its assets at an acceptable level of risk, while meeting the City's desired level of service goals. An activity's complexity and level of effort is generally greater the less frequently it is performed. Daily and weekly activities can likely be completed in an hour or less. In general, activities are intended to be grouped (i.e., weekly, semi-weekly, monthly, and quarterly during a single visit) to reduce inefficiencies in travel and site setup (i.e., traffic control at PRVs, etc.). Some activities may take several days and require specialized contractors.

Daily preventative maintenance focuses on inspections of the general condition and function of the facilities and maintaining and recording chemical levels. Frequency of inspections is based on industry practices and professional judgement. Weekly and monthly maintenance activities include more detailed inspections and cleaning of assets, as well as maintenance of the surface water sources. Annual preventative activities includes basic maintenance of equipment (i.e., oil and filter changes, exercising infrequently used valves and pumps, cleaning cooling systems on generators, etc.). All activities are completed to the extent possible based on available staff and resources.

4.3 CONDITION ASSESSMENT

4.3.1 Booster Pump Stations and Supply Wells

A high-level condition assessment was prepared for the City's water system facilities. The assessment included review of information for the existing facilities and inspection of the facilities on January 5 and 6, 2016. The assessment included each supply well and booster pump station (BPS). The City's storage reservoir, PRV stations, and piping were not included in the assessment.

Overall, the City's booster pump stations and supply wells were found to be in generally good condition. The facilities have been well-maintained with regularly scheduled maintenance and Capital Improvement Program (CIP) work being performed. Electrical equipment condition was the most common deficiency observed, primarily due to equipment age.

The conditions assessment recommended improvement projects based on the existing condition and are shown in Table 4.2. Improvement projects have been separated into booster pump station improvements, which are denoted "RP-" and supply projects, which are denoted "RS-". Each project has been scheduled based on the results of the condition and Remaining Useful Life (RUL) assessments. Projects with similar timing are ordered based on the criticality or consequence of failure. As seen in the table, the total condition assessment CIP estimate is anticipated to cost $1,369,000. It is anticipated that future project designs will further revise the cost estimates and prioritization of projects for the longer-term CIP items

The cost estimates presented in this section are opinions developed from bid tabulations, cost curves, information obtained from previous studies, City estimates, and Carollo Engineers' experience on other projects. The cost estimates have been prepared for general planning purposes and for guidance in project evaluation and implementation. Final costs of a project will depend on actual labor and material costs, competitive market conditions, final project scope, implementation schedule, and other variable factors.

All costs are in 2016 dollars, and are based on an Engineering News Record Construction Cost Index (ENR CCI) 20-City Average of 10379 (July, 2016). Cost estimates were developed using a Class 4 budget estimate, as established by the American Association of Cost Estimators. This level of estimate is used for budgeting and feasibility studies and assumes a 1 percent to 15 percent level of project definition. The expected accuracy range is -30 percent to +50 percent, meaning the actual cost should fall in the range of 30 percent below the estimate to 50 percent above the estimate.

4.3.2 Reservoirs

The City has previously assessed the condition of its reservoirs. The City's reservoirs are generally in good condition. The following projects were planned as part of the 2010 Water System Plan:

- The Butler Reservoir, the City's oldest reservoir, has reached the end of its usable life. The City intends to abandon the Butler Reservoir as soon as a replacement is constructed in the 343 Zone.
- The City's second oldest reservoir, the 0.5 million gallons (MG) reservoir at the Lower Prune Hill reservoir site is also reaching the end of its usable life. Replacement of the reservoir was recommended in the 2010 Water System Plan, which will include significant site and foundation work.

Table 4.2 Condition and Strategic Replacement CIP Summary
Water System Plan Update
City of Camas

Project Name	Project ID	Project Type	Estimated Cost	Short-term (2016-2021)	Medium-Term (2022 - 2025)	Long-Term (2026-2036)	Project Description
Replace or Refurbish Lacamas BPS Pumps and Motors	RP - 1	Strategic Replacement	$80,000	$80,000			Replace or refurbish pumps 1, 2, and 3
Replace or Refurbish Butler BPS Pumps and Motors	RP - 2	Strategic Replacement	$60,000	$60,000			Replace or refurbish pumps 1 and 2
Replace or Refurbish Angelo BPS Pumps and Motors	RP - 4	Strategic Replacement	$140,000	$140,000			Replace or refurbish pumps 1, 2, 3, and 4
Lower Prune Hill BPS Discharge Header Improvements	RP - 5	Condition	$5,000	$5,000			Add lateral support to the pump discharge header
Crown Road BPS Standby Generator Modifications	RP - 6	Condition	$5,000	$5,000			Remove vent caps and install new vent piping for the emergency generator's diesel tank as part of routine maintenance
Upper Prune Hill BPS Discharge Header Improvements	RP - 7	Condition	$5,000	$5,000			Add lateral support to the pump discharge header
Replace or Refurbish Upper Prune Hill BPS Pumps and Motors	RP - 8	Strategic Replacement	$110,000		$110,000		Replace or refurbish pumps 1, 2, 3, and 4
Replace or Refurbish Gregg BPS Pumps and Motors	RP - 9	Strategic Replacement	$80,000		$80,000		Replace or refurbish pumps 1 and 2
Replace or Refurbish Lower Prune Hill BPS Pumps and Motors	RP - 10	Strategic Replacement	$125,000		$125,000		Replace or refurbish pumps 1, 2, and 3
Replace or Refurbish Crown Road BPS Pumps and Motors	RP - 11	Strategic Replacement	$75,000			$75,000	Replace or refurbish pumps 1 and 2
Replace or Refurbish Gregg BPS Pump 3 and Motor	RP - 12	Strategic Replacement	$30,000			$30,000	Replace or refurbish pump 3
Lower Prune Hill BPS Electrical Equipment Replacement	RP - 13	Condition	$42,000			$42,000	Replace remote terminal unit (RTU) and general maintenance for motor control center (MCC)
Lacamas BPS Generator Maintenance	RP - 14	Condition	$3,000			$3,000	The generator at the Lacamas BPS requires general maintenance. Rust on the enclosure and exhaust pipe were observed during the condition assessment
Lacamas BPS Electrical Maintenance & Testing	RP - 15	Condition	$5,000			$5,000	
Upper Prune Hill BPS Electrical Equipment Replacement	RP - 16	Condition	$43,000			$43,000	MCC and RTU require general maintenance
Butler BPS Motor Starter Replacement	RP - 17	Condition	$3,000			$3,000	The motor starter(s) at the Butler BPS were recommended for replacement during the condition assessment

Table 4.2 Condition and Strategic Replacement CIP Summary
Water System Plan Update
City of Camas

Project Name	Project ID	Project Type	Estimated Cost	Short-term (2016-2021)	Medium-Term (2022 - 2025)	Long-Term (2026-2036)	Project Description
Butler BPS Check Valve Replacement	RP - 19	Condition	$2,000				The check valve(s) at the Butler BPS were recommended for replacement during the condition assessment
Booster Pump Station Projects (RP) Total			**$813,000**	**$295,000**	**$315,000**	**$203,000**	
Well 8 Pump Rehabilitation	RS - 01	Strategic Replacement	$29,000	$29,000			Well casing, motor, and pump rebuild
Well No. 9 Rehabilitation	RS - 02	Strategic Replacement	$29,000	$29,000			Well casing, motor, and pump rebuild
Well 9 Analyzers	RS - 03	Condition	$13,000	$13,000			pH, Chlorine, Fluoride
Well 6 Electrical Improvements	RS - 05	Condition	$4,000	$4,000			Replace Starter cabinet
Well 7 General Improvements	RS - 06	Condition	$5,000	$5,000			Replace motor pedestal grout and install two additional anchor bolts
Well No. 10 Rehabilitation	RS - 07	Strategic Replacement	$29,000		$29,000		Well casing, motor, and pump rebuild
Well No. 11 Rehabilitation	RS - 08	Strategic Replacement	$29,000		$29,000		Well casing, motor, and pump rebuild
Well No. 12 Rehabilitation	RS - 09	Strategic Replacement	$29,000		$29,000		Well casing, motor, and pump rebuild
Well 6 Telemetry Improvements	RS - 10	Condition	$40,000		$40,000		Replace RTU
Washougal Wellfield Salt Storage Building Improvements	RS - 11	Condition	$75,000		$75,000		Replace existing storage building and provide anchorage for the two NaOH storage tanks
Well No. 13 Rehabilitation	RS - 12	Strategic Replacement	$29,000			$29,000	Well casing, motor, and pump rebuild
Well No. 14 Rehabilitation	RS - 13	Strategic Replacement	$29,000			$29,000	Well casing, motor, and pump rebuild
Well 7 Electrical Improvements	RS - 14	Condition	$11,000			$11,000	Replace Panelboard and Starter Cabinet
Well 8 Electrical improvements	RS - 15	Condition	$4,000			$4,000	Replace Starter cabinet

Table 4.2 Condition and Strategic Replacement CIP Summary
Water System Plan Update
City of Camas

Project Name	Project ID	Project Type	Estimated Cost	Short-term (2016-2021)	Medium-Term (2022 - 2025)	Long-Term (2026-2036)	Project Description
Washougal Wellfield Disinfection Improvements	RS - 16	Condition	$150,000			$150,000	Replace the chlorine system for the Washougal Wellfield treatment facility
Well 11 and 12 Mechanical Improvements	RS - 17	Condition	$3,000			$3,000	Tie rods across flexible coupling at pump discharge to prevent flexing. Air release is locating on discharge header for wells 11/12 rather than for each well.
Well 11 and 12 Electrical Maintenance	RS - 18	Condition	$3,000			$3,000	MCC requires general maintenance
Well No. 6 Rehabilitation	RS - 19	Strategic Replacement	$29,000			$29,000	Well casing, motor, and pump rebuild
Well No. 7 Rehabilitation	RS - 20	Strategic Replacement	$29,000			$29,000	Well casing, motor, and pump rebuild
Well 9 Electrical Improvements	RS - 21	Condition	$45,000			45,000	Replace Starter cabinet and RTU
Supply Projects (RS) Total			**$556,000**	**$22,000**	**$202,000**	**$332,000**	
Total All Projects			**$1,369,000**	**$317,000**	**$404,000**	**$535,000**	

4.4 EMERGENCY RESPONSE PROGRAM

The City has a Disaster Manual, which identifies the emergency response functions within the City using an “all hazards” approach. Within the City’s emergency response framework, the City has developed a Water System Emergency Response Plan that is documented in Chapter 5 of its O&M Manual. It defines risks, water system roles and responsibilities during an emergency, communication procedures, personal safety, alternative water sources, equipment replacement procedures, property protection procedures, and water sampling and monitoring procedures. The Emergency Response Plan also describes alternative system operations for the interruption of each major water supply facility (i.e., loss of a well, reservoir, or booster pump station). Further, it documents an incident specific response plan for major risks, such as drought, earthquake, flood, etc. The Emergency Response Plan is provided in Appendix E.

4.5 CROSS-CONNECTION CONTROL PROGRAM

As required by WAC 246-290-490, cross-connection control, utilities have the responsibility to protect customers from water contamination due to cross-connections. A cross-connection is any actual or potential physical connection between a public water system or the consumer's water system and any source of non-potable liquid, solid, or gas that could contaminate the potable water supply by backflow. City Ordinance 10504 addresses cross-connections and their prevention, which can be found as part of the Camas Municipal Code under Water Use Regulations 13.32.

This ordinance and corresponding Municipal Code provide the City’s water department the ability to protect the water supply from contamination by prohibiting cross-connections, requiring backflow prevention devices, establishing fees for the inspection of cross-connection assemblies, and adopting State standards for cross-connection regulations. The ordinance and corresponding Municipal Code provides procedures for the abatement of cross-connections and the installation of backflow prevention devices.

The City has two employees certified as cross-connection control specialists. The City’s cross-connection control program and records are continually updated and information of each cross-connection device are on file with the City. The Public Works Department and the Building Department coordinate notification to customers who have devices that need to be tested. The City’s backflow program management software will be upgraded from Backflow Prevention Management Software to XC2 in 2019, which will allow for higher efficiency when entering test report data and sending notifications to water customers regarding their backflow devices.

The City maintains the following information on file for its cross-connection control program:

- Date of last inspection.
- Results of inspection.
- Recommended protection.
- List of approved assemblies.
- Test and maintenance reports.
- List of certified testers.
- Customer account number, billing address, service address, phone numbers, device history and maintenance records.

The City's Cross-Connection Control Program requires the inspection of backflow prevention devices at the time of installation. These devices are also scheduled to be inspected annually after installation, after the device is repaired, after the device is relocated or reinstated, and as necessary if tests indicate repeated failure.

Owners of backflow prevention devices are notified by mail that their devices are due for inspection. An example of the backflow prevention postcard that is sent out to owners is shown in Figure 4.2. However, it is the responsibility of the customer to see that their device is tested. Failure to provide the City with a backflow prevention device inspection report from a certified cross-connection control specialist will result in the customer's water service being terminated. This termination is then reported to the Washington State Department of Health (DOH).

The cross-connection control specialist and assistant host an informational backflow booth at the City's annual Camas Days event to educate consumers. They answer questions regarding backflow and provide general knowledge to the public on the issues. Updated informational brochures with current contact information are distributed at the event, online, and at various City facilities.

City of Camas
WASHINGTON
1620 SE 8th Ave. Camas, WA 98607

Current Water Customer
«MAIL_ADDR1»
«MAIL_ADDR2»
«CITY_STATE» «POSTAL_ZIP»

ANNUAL BACKFLOW PROTECTION DEVICE TESTING

Our records indicate that the backflow prevention device(s) at your address is (are) due for testing. It is imperative that each assembly is working properly to safeguard your health and the health of others. Washington State Law (WAC 246-290-490) requires annual testing of backflow prevention assemblies. The testing is to be performed by a Washington State Certified Tester. Please have your assembly tested within 30 (thirty) days. A list of State Certified Backflow Testers has been included on the back of this postcard. Backflow Testers are private contractors and their fees are not regulated by the City of Camas.

Thank you for helping us to preserve our water quality. If you have questions or need information on assemblies at your location, please call the Backflow Hotline at (360) 817-1569 and leave a message. You will receive a return call as soon as possible.

Tobin Reed,
Lead Utility Maintenance Worker

ANNUAL BACKFLOW PROTECTION DEVICE TESTING NOTIFICATION

FIGURE 4.2
CITY OF CAMAS
WATER SYSTEM PLAN UPDATE

4.6 CUSTOMER COMPLAINT RESPONSE REPORTING

Customers interact with the City through a variety of methods. Customer service representatives are available by phone and through an online Utility Service Request system on the City's website. Customer service agents are trained to answer typical questions and route service requests (complaints) to the appropriate department (Operations, Finance, Engineering, etc.). Calls are tracked by customer service agents and the resulting activities are documented in the maintenance management system if a work order is issued. The finance department also tracks billing related requests.

City operators also routinely interact with customers during maintenance activities. Often, these interactions are directly related to ongoing system maintenance such as hydrant flushing, and customer inquiries or concerns are resolved on the spot. Operators direct additional requests to customer service representatives, as needed.

4.7 RECORD KEEPING AND REPORTING

The City maintains detailed records of the water system. Substantial record keeping activities are required to record and report customer water usage, water production, water quality information, and maintenance activities. All recordkeeping and reporting follows DOH regulations as specified in WAC 426-290-480.

The City's finance department is responsible for billing customers for water use. The billing records include customer account data for classes of customers, water use, billing, service, and comments. Water production for the City's surface water sources and wells are tracked in real time via SCADA, which maintains approximately a year of historical data. Operators record production daily and report the production monthly to DOH. Based on these records and water consumption records, the City develops and submits an annual Water Use Efficiency Report to DOH.

The City conducts substantial water quality testing, as summarized in Chapter 7. Hard copies of the water quality laboratory reports from the testing are kept at the City. In addition, analytical laboratories also submit reports directly to DOH. This data is summarized annually in the City's consumer confidence report that is available on its website.

The City maintains a maintenance management system to manage work order requests and document maintenance activities. Historically, the City has recorded work efforts on hard copy maintenance cards that are available for reference to City staff.

The City submits all required construction completion reports to DOH. Construction completion reports for distribution main projects are maintained on file at the City and are available upon request by DOH.

4.8 PIPELINE REPAIR AND REPLACEMENT

The City currently has a modest water main repair and replacement (R&R) program to address O&M and capacity concerns as opportunities arise, such as during redevelopment or in conjunction with other utility projects. While much of the City's distribution system was constructed after 1990, the distribution near downtown was constructed in the 1950s and early 1960s and is expected to begin reaching the end of its useful life during the next 20 years.

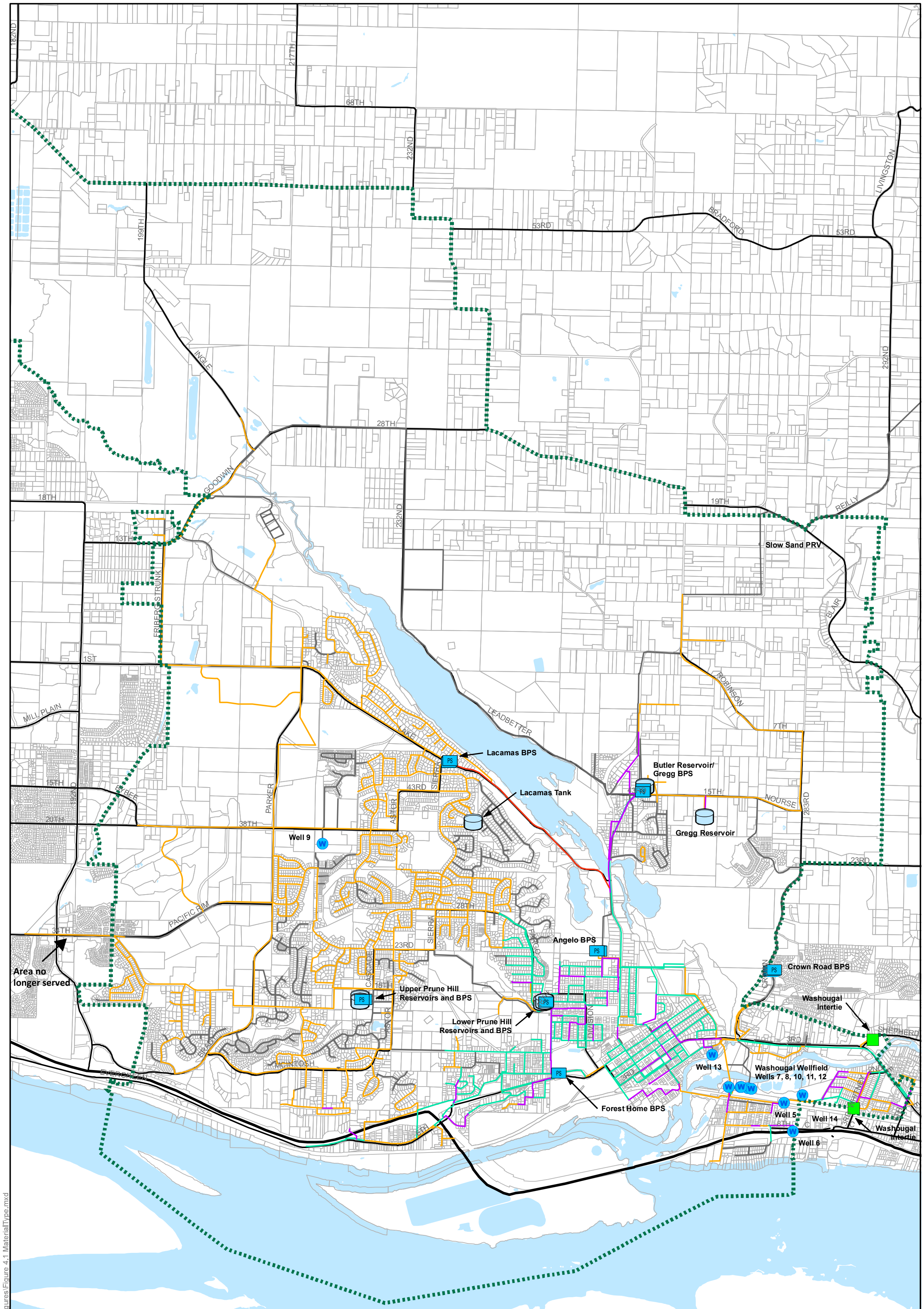
Useful life is the length of time that a pipe is anticipated to remain in service. Useful life depends largely on the pipe material, but can also depend on soil conditions, water constituents, and installation. When a pipe is in service beyond its useful life, the increasing costs of maintenance associated with a failing pipe typically exceed the cost of replacement. Useful life analyses do not predict exactly when and where failures will occur, rather it is a method to identify the pipes for inclusion in an ongoing (R&R) program.

RUL is simply the period of time remaining before the end of useful life is reached. A pipeline replacement schedule can be developed by looking at the remaining useful life of all the pipes in the distribution system. This replacement schedule is often reported in terms of average annual feet of pipe replacement over a ten-year replacement period due to limitations in historical installation records and difficulties in assessing the impact of environmental conditions and other factors limiting useful life. Within a given replacement period, pipes near or exceeding their useful life should be prioritized based on the criticality of the pipe to the system. For example, a large diameter transmission main or pipes that can be included in redevelopment or transportation projects may be a higher priority. By incorporating criticality, the City will be able to address existing priorities and adapt to changing priorities while maintaining an annual replacement program.

4.8.1 Pipe Material and Age

Pipe material and age are key data needed for an RUL analysis. Pipe material was available from the City's records. The information was reviewed by City staff and recent replacement projects were incorporated into the data. As a rule of thumb, pipes installed before or during the 1970s were classified as cast iron (CI) pipe, and pipes installed after the 1970s were classified as ductile iron (DI) pipe. Pipe material is shown graphically in Figure 4.3. Table 4.3 presents the total length of pipe in the City according to the decade installed and material type.

Pipe age was provided by City staff using the best available information. Generally, older pipes installed before the 1980s were assigned an installation decade (i.e., 1950s, 1960s, 1970s, etc.), as the exact year of installation was unknown. The resulting pipe age is shown graphically in Figure 4.4. The City has an ongoing major GIS update that is revising its asset inventory.



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Legend

- Highway 14
- Water Service Area
- Waterbody
- Intertie
- Potable Wells
- Surface Water Supplies
- Slow Sand Treatment Plant
- Pump Station
- Water Tank

Water Mains by Material

- Cast Iron
- Ductile Iron
- PVC
- Steel
- Unknown

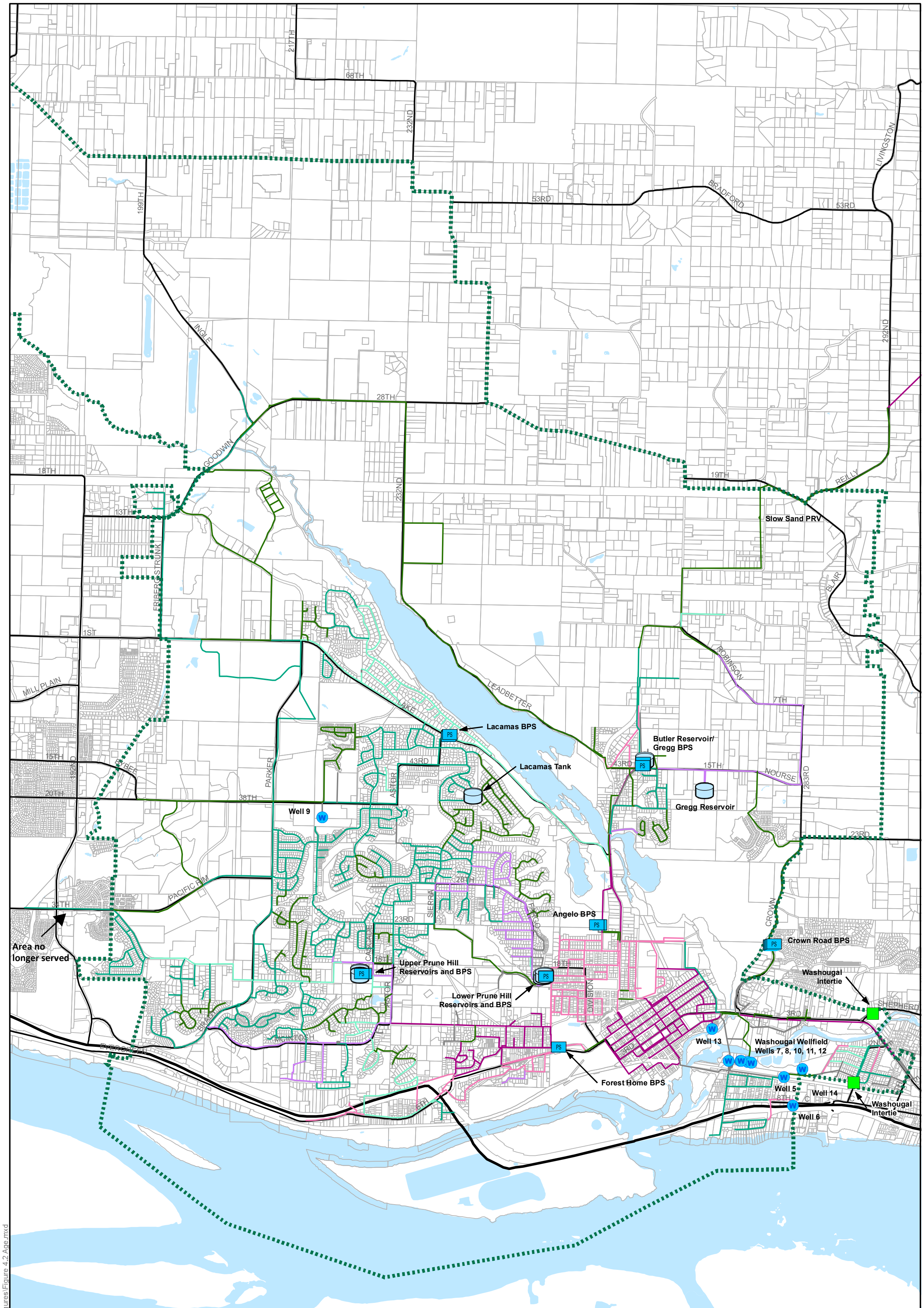
0 2,000 4,000 Feet

carollo

WATER MAINS BY MATERIAL

FIGURE 4.3

CITY OF CAMAS
WATER SYSTEM PLAN UPDATE



Legend

- Highway 14
- Water Service Area
- Waterbody
- Intertie
- Potable Wells
- Surface Water Supplies
- Slow Sand Treatment Plant
- Pump Station
- Water Tank

Water Mains by Age
- 1950s
- 1960s
- 1970s
- 1980s
- 1990s
- 2000s
- Unknown

Feet
0 2,000 4,000

WATER MAINS BY AGE

FIGURE 4.4

CITY OF CAMAS
WATER SYSTEM PLAN UPDATE

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carollo

**Table 4.3 Pipe Length by Decade Installed and Material Type
Water System Plan Update
City of Camas**

Decade Installed	1950-1959	1960-1969	1970-1979	1980-1989	1990-1999	2000-2010	2011-2014	Total by Material
CI	126,000	47,800	12,200	0	0	0	0	186,000
DI	0	0	63,900	50,500	232,000	99,500	73,700	519,600
PVC	0	0	0	6,900	0	0	0	6,900
Steel	11,600	19,800	1,700	800	3,200	4,600	800	42,500
Total by Decade	137,600	67,600	77,800	58,200	235,200	104,100	74,500	755,000

4.8.2 Useful Life

Useful life in combination with pipe age provides the basis for the RUL calculations. The estimated useful life of each pipe material based on industry standards and City staff knowledge, as presented in Table 4.4. The City chose a 75 year useful life for CI pipes, polyvinyl chloride (PVC) and steel pipes. Cast iron and steel useful life were conservatively selected at the lower end of the typical range. The PVC useful life is within industry ranges; however, it has little overall impact given less than 1 percent of the system is PVC. DI pipes were considered to have an 85 year useful life, which was the median of the industry range. It is important to note that the actual useful life of an individual pipe can vary widely due to soil, groundwater, and installation conditions. It is recommended that the condition of pipes being replaced be noted for consideration in future analyses, which will increase the accuracy of the useful life estimates.

**Table 4.4 Useful Life of Pipes
Water System Plan Update
City of Camas**

Pipe Material	Useful Life (yrs)
CI	75
DI	85
PVC	75
Steel	75

4.8.3 Remaining Useful Life Analysis

RUL is defined as the length of time left before a pipe's maintenance costs will likely exceed its cost of replacement. Pipe age, material type, and chosen useful life for each pipe material were used to determine the RUL of the City's pipes. The useful life of each pipe was calculated based on the installation year and the material specific useful life. The period of time between the end of the useful life and today is the RUL. For example, a DI pipe installed in 2000 has a useful life of 85 years, where it will reach the end of its useful life by 2085. From the current year, 2016, this DI pipe's RUL would be 69 years. RUL were combined by decade, which was considered appropriate level of detail given the analyses assumptions. This level of detail is sufficient for use in an R&R program.

Where pipe age was unknown, the age was conservatively assumed to be constructed in the 1950s for CI pipe and 1970s for DI pipe. Where pipe material was unknown, pipes installed before or during the 1970s were assumed to be CI pipe, and pipes installed after the 1970s were assumed to be DI pipe. Where neither pipe age nor material were known, the pipes was assumed to be a 1950s CI pipe.

The replacement decade for each category of pipe is presented in Table 4.5. The City's oldest piping, which are anticipated to reach the end of its usable life by the 2020s, are raw water lines from the surface water sources and the transmission main to Butler reservoir. The City is currently repairing/lining the raw water line from the slow sand filtration plant to the system that is in poor condition. Therefore, it is anticipated that the remainder of the raw water line will likely need some level of repair or replacement in the short to medium-term. Butler Reservoir and its transmission main (12,500 feet of 12-inch piping) should be abandoned if the proposed 343 Cemetery Reservoir is constructed. However, if the Butler Reservoir remains in service, the City should consider R&R of this piping in the mid- to long-term.

Much of the City's CI piping is anticipated to reach the end of its useful life by end of the planning period (2035). The majority of the City's CI pipe was installed in two periods: before 1955 and 1959 to 1960. It is recommended that the pipes installed on or before 1955, about 50,000 linear feet, be replaced in the 2020s. Replacement of those installed between 1959 and 1960, approximately 123,000 linear feet, are recommended to be replaced in the 2030s. Additionally, replacement of the majority of steel pipe, approximately 30,000 linear feet, is recommended in the 2030s. City's DI pipe along with some of the newer CI, PVC, and Steel pipe is not anticipated to reach the end of its useful life until after the planning period.

Table 4.5	Remaining Useful Life Water System Plan Update City of Camas			
Replacement Decade	**2020-2030**	**2030-2040**	**2040 or Later**	**Total by Material**
CI	50,000	122,900	13,100	**186,000**
DI	0	0	519,500	**519,500**
PVC	0	0	6,900	**6,900**
Steel	0	30,500	12,000	**42,500**
Total by Decade	**50,000**	**153,400**	**551,500**	**754,900**

Figure 4.5 presents the total length of pipe reaching the end of its assumed useful life by decade. The location of these pipes is shown in the map in Figure 4.6. The pipe recommended for replacement represents the majority of the City's downtown and surrounding areas. Pipes reaching their RUL serve all types of customers, including commercial, industrial, and residential customers. Pipes that exceed their useful life will continue to provide service, but are at a greater risk for pipe breaks and may have increased leakage. Therefore, replacement should be prioritized to base on criticality to the system to best manage the aging distribution infrastructure within the City's available budget.

4.8.4 Pipeline R&R Program

During the short and medium-term, it is recommended that the City maintain an annual R&R program to address localized issues or to participate in joint projects that cost-effectively replace aging piping. A programmatic approach is not recommended for the 50,000 feet of pipe to be replaced in the 2020s, but is recommended in the future. Due to its 37,500 feet length, a one-time CIP project is recommended to address the remaining raw water piping. As previously mentioned, the 12,500 feet of 2020s piping associated with the Butler Reservoir will likely be abandoned, rather than repaired and replaced.

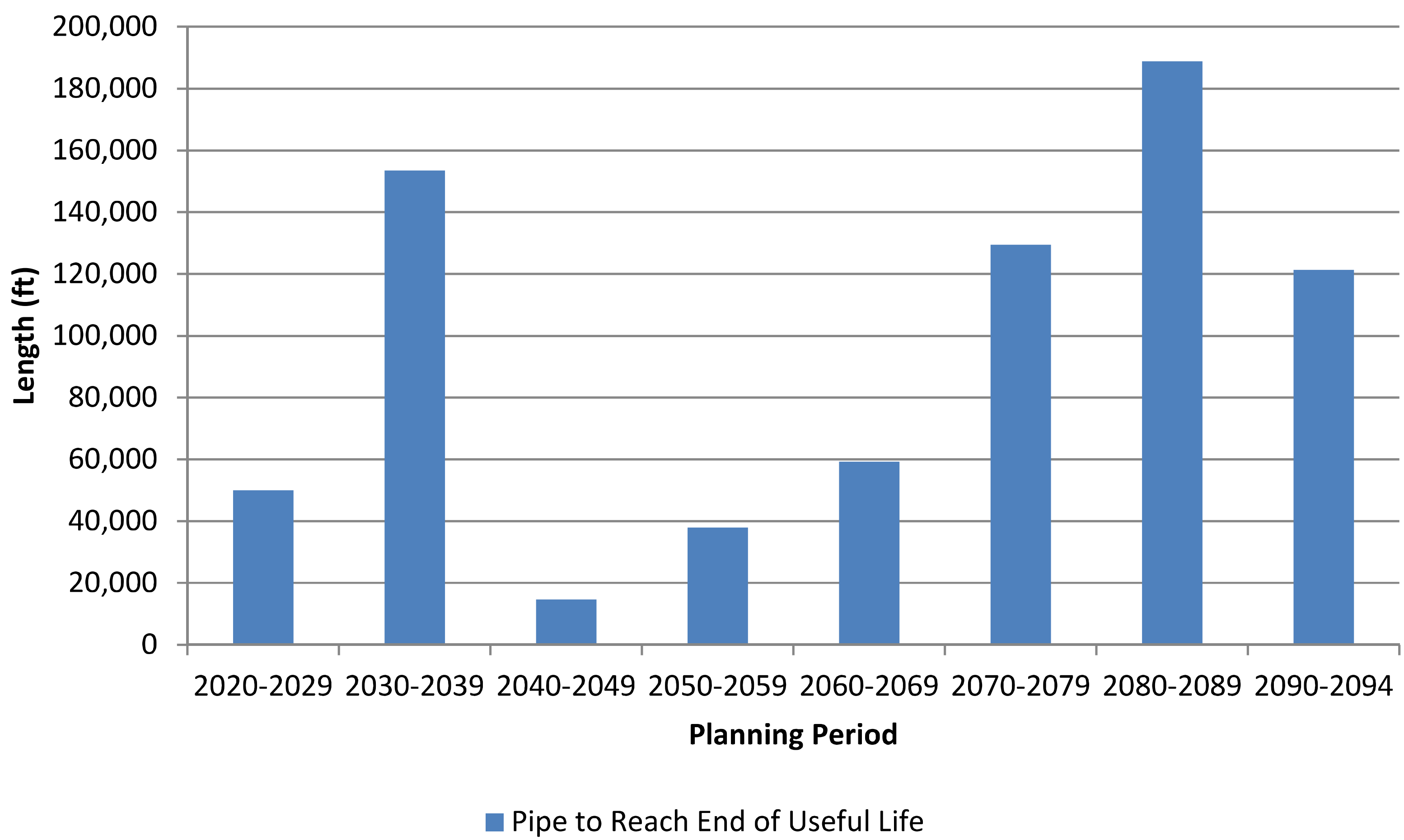
The City water main R&R program will need to be expanded during the long-term planning horizon (late 2020s and 2030s) to address aging infrastructure near downtown that is anticipated to reach the end of its usable life in the 2030s. Approximately 15,300 linear feet of pipe per year would need to be replaced in the mid– to long-term. Small diameter mains (2-inch to 6-inch) should be upsized to 8-inch to meet current City standards. To gain economies of scale, the City should consider geographically concentrated projects that incorporate other utilities, such as sewer main R&R and roadway resurfacing.

4.9 O&M IMPROVEMENTS

The City has a well operated and maintained system. Condition Assessments identified repair and replacement projects for above ground assets (i.e., pump stations, wells, and reservoirs, etc.). The majority of projects were necessary due to aging electrical equipment and normal replacement of pumps and motors. The City plans to replace two reservoirs, built prior to 1940, that have reached the end of their usable life. A PRV study is recommended to evaluate settings, condition, and address normal, minor maintenance issues.

The RUL of the City's water mains were estimated to aid in planning for an annual pipeline repair and replacement program. The RUL analysis and recent operation challenges indicate that the City's surface water transmission mains are likely reaching the end of their usable life. It is anticipated that the piping in Downtown and surrounding areas will begin to reach the end of their life in the long-term planning horizon (2025 – 2035). The City's long-term goal is to create a risk prioritized water infrastructure rehabilitation program that addresses above and below ground assets. However, at this time, the City's financial resources are focused on meeting the rapid growth occurring in Camas.

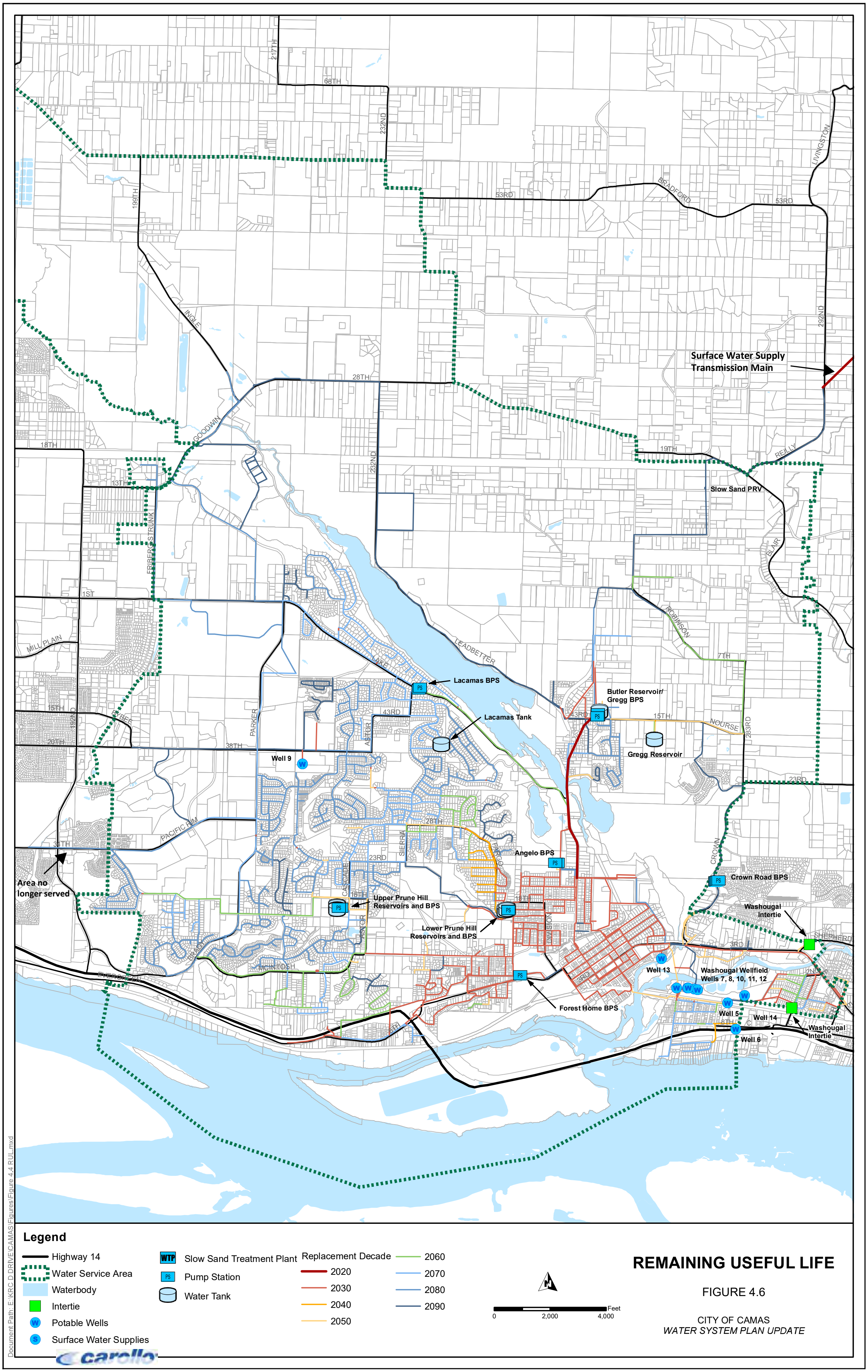
To gain economies of scale during the replacement, the City should consider geographically concentrated projects that incorporate other utilities, such as sewer main R&R and roadway resurfacing.



LENGTH OF PIPE REPLACEMENT BY DECADE

FIGURE 4.5

CITY OF CAMAS
WATER SYSTEM PLAN UPDATE



REMAINING USEFUL LIFE

FIGURE 4.6

CITY OF CAMAS
WATER SYSTEM PLAN UPDATE

Chapter 5

WATER REQUIREMENTS

Projecting realistic future water requirements, i.e. demand, is necessary for planning infrastructure projects and securing adequate water supply to meet future growth. Future water demands are a key component of the water system analyses presented in this Plan and in the City of Camas' (City's) Capital Improvement Program (CIP). Accurate demand projections require a thorough review of historical water use, predicting where and how much growth will occur, and estimating the future water use for existing and new customers.

Historical data provides the City's unique water use over a long period of time, which captures the range of water use due to weather, economic conditions, conservation practices, and other factors. This Chapter presents an analysis of historical water use from 2008 to 2015 based on customer billing and production records. These data provide information on the City's different types of customers, as well as water use parameters on an average annual basis, seasonally, and for the maximum day. Historical water use patterns and parameters were established from these data to predict future water use for existing and new customers.

Demographic projections were used to predict where and how much demand will occur in the water system. The demographic projections were developed based on the City's comprehensive planning. Future customer accounts were developed based on existing customer accounts and the demographic growth rates of each Service Area. The resulting future accounts were converted to projected demands using the historical water use patterns and parameters.

Demand projections were generated for the planning period of 2015 to 2035 for the City's established Retail Water Service Area (RWSA). The projections were divided into three planning scenarios:

- Short-term, 6-year (2015 - 2021).
- Medium-term, 10-year (2022 - 2025).
- Long-term, 20-year (2026 - 2035).

Dividing the planning period into three scenarios aids in the development and phasing of improvement projects and the CIP, as well as being consistent with Washington Department of Health (DOH) requirements.

Demand projections were expressed as Equivalent Residential Units (ERUs), average day demand (ADD), and maximum day demand (MDD). One ERU is defined as the average quantity of water beneficially used by one average, full-time, single-family residence per day. The quantity of water used by other customer classes, and by the whole system, can be expressed in terms of ERUs. The ADD is typically used in operational evaluations. It is calculated by dividing the total water produced by the number of days per year (2008 and 2012 were leap years and include 366 days per year). The MDD represents the single largest day water demand during the year and is a key parameter for infrastructure sizing.

Changes in water use, conservation activities, system growth, and other factors may result in higher or lower than projected water use. Planning for the potential changes allows the City to better manage potential risks from these changes. For example, lower than projected water use may be a concern for the City's financial planning, while higher than projected water use may be a concern for water supply planning. Therefore, three demand scenarios were developed: Low, Medium, and High demand scenarios. The low demand scenario represents future demand with conservation; the high demand scenario generally reflects the highest demands in the last eight years; the medium demand scenario is a conservative projection between the low and high projections. Details on the historical water use, demographic projections, and demand calculations used to develop these projections are presented in this Chapter.

5.1 HISTORICAL WATER USE

Historical water use data, i.e., consumption data, were obtained from City records to characterize the demands of the City's customers. Annual water use data for the years 2008 to 2015 were used to develop historical demand patterns and parameters, which represent current and likely future water use. Two key demand parameters were generated from the data: typical water use per customer class, and typical water use per ERU. These parameters were used as the basis of future demand projections.

5.1.1 Historical Accounts

The City customers were divided into six customer classifications. These customer classes are:

- City Accounts.
- Commercial.
- Industrial.
- Irrigation.
- Multifamily Residential (MFR).
- Single-family Residential (SFR).

The number of accounts for each customer class is summarized in Table 5.1. As seen in the table, SFR makes up approximately 89 percent of accounts. The total number of accounts has increased by approximately 32 percent from 2008 to 2015 due to growth and development in the City.

Table 5.1	Historical Number of Accounts by Customer Class Water System Plan Update City of Camas						
Year	**SFR**	**MFR**	**Commercial**	**Industrial**	**City**	**Irrigation**	**Total**
2008	4,205	159	163	27	37	121	**4,712**
2009	4,518	237	174	28	49	129	**5,135**
2010	4,851	250	182	28	48	133	**5,492**
2011	5,194	257	189	28	35	145	**5,848**
2012	5,523	271	217	33	52	151	**6,247**
2013	6,002	305	217	34	55	160	**6,773**
2014	6,499	342	237	36	56	175	**7,345**
2015	7,157	369	244	38	57	179	**8,044**
Avg.	5,494	274	203	32	49	149	**6,200**
Avg. Percent Per Class	89.0%	4.6%	3.0%	0.5%	0.7%	2.2%	

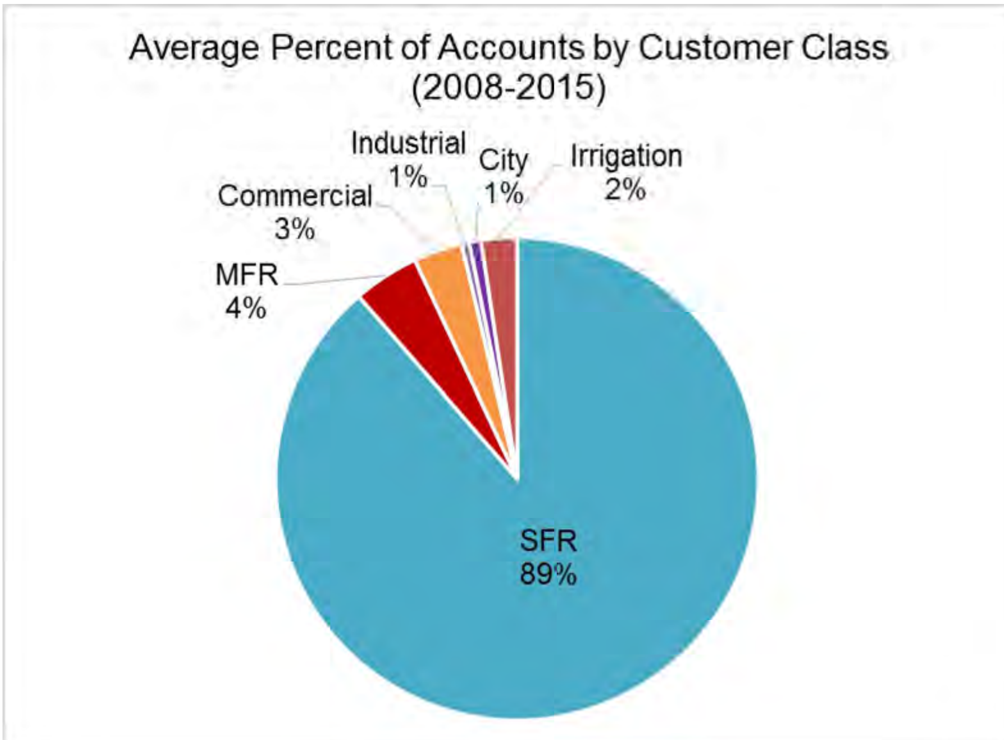
The City's top ten water users, herein termed "Large Users," were also evaluated in this study. The Large Users class includes the following customers: Wafertech Industries, Linear Technologies, Georgia Pacific Mill, Camas School District, the City of Camas, Underwriter's Labs, SE Incorporated, Sharp Electronics, Bodycote, and Karcher North America. These customers are the largest water users in their Service Areas, which warrants careful consideration. Therefore, individual demand projections were developed for each Large User to provide additional accuracy in the demand projections, as well as the system analyses. The development of the Large User demand projections is detailed in Section 5.6.2.

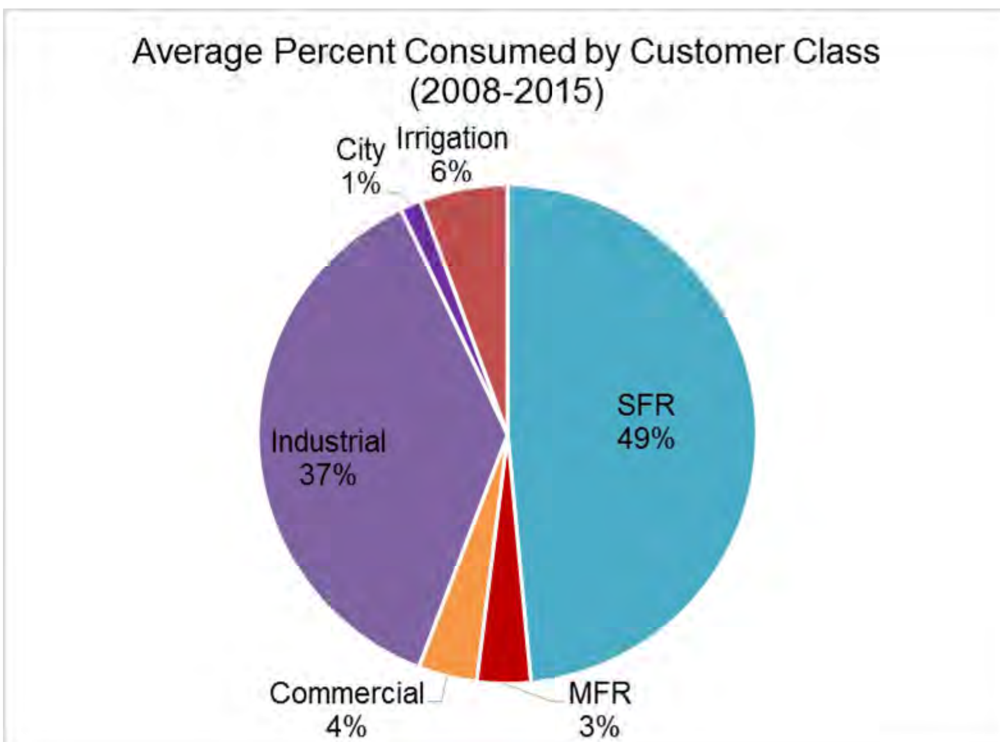
5.1.2 Historical Consumption

The City’s historical annual water consumption was provided for each customer class based on City billing data, as presented in Table 5.2 in units of million gallons per day (mgd). The table also includes the average, 75th percentile, and 3-year average statistics on historical consumption. Notably, total demand has increased over the 2008 to 2015 period for every customer class except City. This increase is due to the increase in number of connections shown in Table 5.1.

Table 5.2	Historical Water Demand by Customer Class (mgd) Water System Plan Update City of Camas						
Year	**SFR**	**MFR**	**Commercial**	**Industrial**	**City**	**Irrigation**	**Total**
2008	1.46	0.10	0.13	1.17	0.04	0.15	**3.05**
2009	1.62	0.11	0.13	1.12	0.06	0.15	**3.18**
2010	1.47	0.11	0.12	1.19	0.03	0.12	**3.05**
2011	1.49	0.12	0.11	1.22	0.03	0.18	**3.16**
2012	1.59	0.11	0.13	1.21	0.04	0.19	**3.28**
2013	1.66	0.12	0.12	1.21	0.04	0.19	**3.34**
2014	1.60	0.11	0.12	1.34	0.05	0.22	**3.43**
2015	1.84	0.12	0.14	1.29	0.08	0.28	**3.76**
Avg.	1.59	0.11	0.12	1.22	0.05	0.19	**3.28**
75th Percentile	1.63	0.12	0.13	1.24	0.05	0.20	**3.37**
3-Year Avg.	1.70	0.12	0.13	1.28	0.05	0.23	**3.51**

The average percentage of accounts and annual water consumption by customer class from 2008 to 2015 are presented in Figure 5.1. Comparing accounts and water consumption illustrates the differences in water use between the customer classes. As seen in these figures, SFR customers represent 89 percent of the accounts, yet only comprise 49 percent of the demand. By contrast, industrial customers represent less than one percent of the accounts, but account for 37 percent of the total demand. This difference in proportional water use was quantified by comparing the historical water use per account for each customer class (in Table 5.3), as described in the Section 5.1.3.





DISTRIBUTION OF WATER CONSUMPTION AND ACCOUNTS BY CUSTOMER CLASS

FIGURE 5.1

CITY OF CAMAS

WATER SYSTEM PLANT UPDATE

5.1.3 Water Use per Account and Equivalent Residential Units

The demand of each customer class can be expressed in terms of ERUs for forecasting and planning purposes. As discussed previously, one ERU is defined as the average quantity of water beneficially used by one average, full-time, single-family residence per day. Importantly, the ERU calculation is based on historical consumption (i.e., billing records) and therefore does not include distribution system leakage.

Table 5.3 shows the historical annual average water consumption by customer classification. The table also includes the average, 75th percentile, and 3-year average consumption statistics. Based on the data from 2012 through 2015, the average quantity of water used by one typical, full-time single-family residence ERU is equal to 260 gallons per day (gpd). From 2008 through 2015, the 75th percentile of water consumption per ERU was 315 gpd.

Table 5.3 Historical Annual Water Use per Account (gpd/account)
Water System Plan Update
City of Camas

Year	SFR	MFR	Commercial	Industrial	City	Irrigation
2008	348	651	781	43,273	994	1,273
2009	358	468	736	40,100	1,127	1,149
2010	304	450	634	42,480	718	914
2011	288	465	608	43,617	887	1,235
2012	288	419	582	36,743	819	1,275
2013	277	400	565	35,573	693	1,185
2014	246	324	514	37,180	842	1,232
2015	258	326	584	34,066	1,382	1,585
3-Year Avg.	**260**	350	555	35,606	972	1,334
Avg.	**290**	417	616	38,718	936	1,244
75^{th} Percentile	**315**	466	659	42,679	1,027	1,274
ERUs per Account(1)	**1.0**	**1.5**	**2.1**	**135.7**	**3.3**	**4.1**

Notes:
(1) ERUs per Account based on 75th percentile of annual water consumption.

Compared to other utilities evaluated by Carollo Engineers, the City's water use per SFR account appears slightly high, possibly indicating larger properties requiring irrigation or lower than usual replacement rates of high-flow appliances and fixtures. Additionally, the City's MFR water use per account appears low, possibly due to a higher percentage of low-density MFR accounts (such as tri-plexes or quad-plexes), or due to monitoring MFR irrigation needs in separate irrigation meters (under the "Irrigation" customer category).

Calculating the City's water use in terms of ERUs provides a means to express water use by non-residential customers as an equivalent number of SFR accounts. The ERUs per account for MFR and all non-residential accounts are obtained by dividing the average water use per account for each customer class by the ERU water use. For example, the average Commercial account uses approximately 2.1 times the water use of an average SFR account; therefore, each Commercial account is equivalent to 2.1 ERUs. Table 5.3 presents the ERUs per account for each customer class based on 75th percentile of historical water use. The number of ERUs per account ranges from 1.5 for MFR accounts to 135.7 for Industrial accounts.

5.2 SEASONAL DEMANDS

The pattern of water consumption differs between the customer classes. Water use increases significantly during the summer when daylight hours are longer and lawn and landscape watering is prominent. Other outdoor uses, including car washing and recreation, are also at their highest during summer months. Figure 5.2 presents average total monthly consumption by customer class from 2008 through 2015. Note that, with some exceptions, the City conducts bi-monthly meter reading; therefore the water consumption was averaged between months to better reflect the actual water consumed in the month.

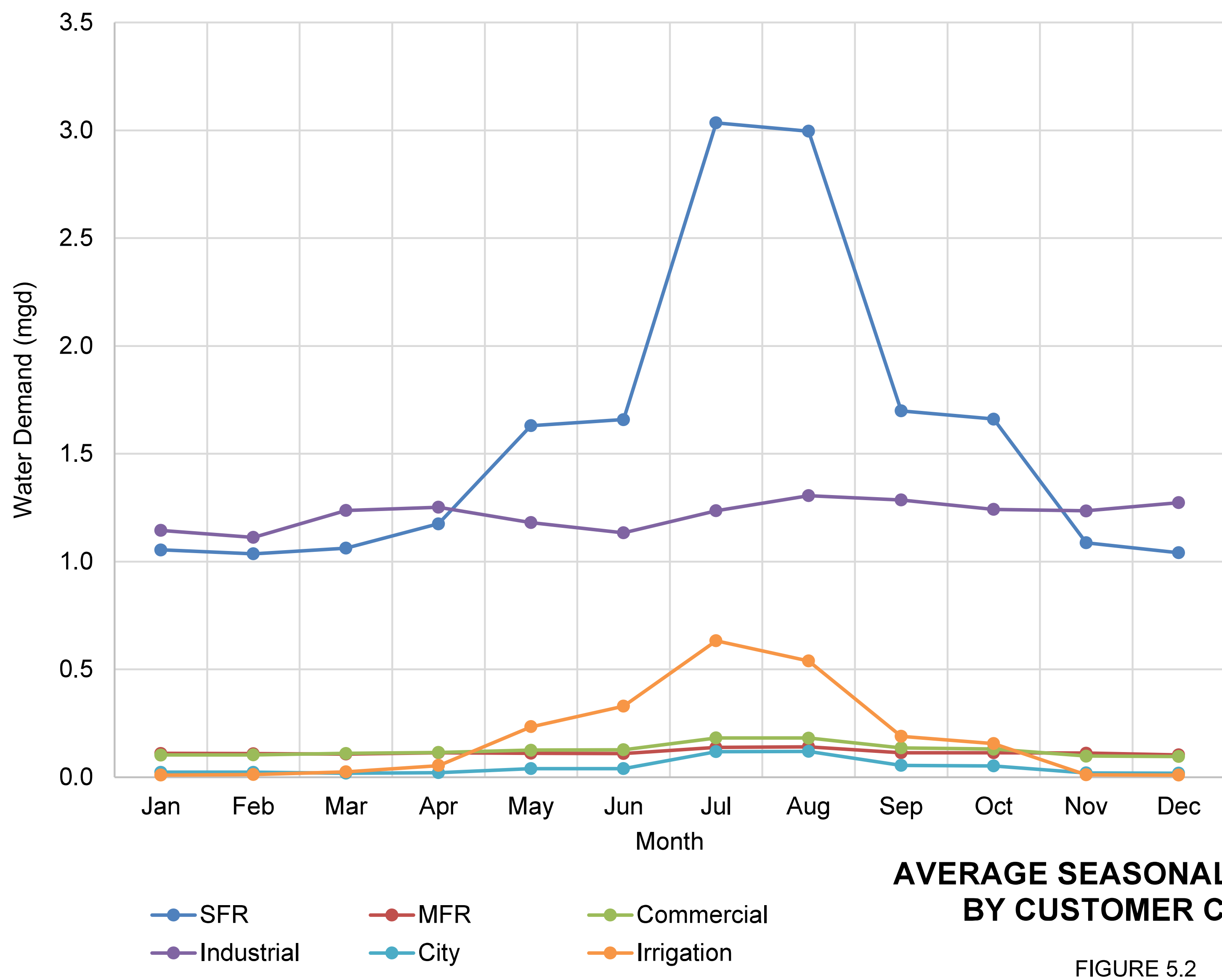
As seen in Figure 5.2, SFR and irrigation accounts show a significant peak in total consumption during the summer months. By contrast, industrial users do not demonstrate significant seasonal variation in demand. These monthly variations in demand for each customer class can be used to target water use efficiency efforts and/or to project future water-use patterns for planning purposes.

5.3 HISTORICAL PRODUCTION

The historical average and maximum water demands are important parameters when performing system and supply analyses. The term “water demand” refers to all the water requirements of a system including metered customers, unmetered water use, and unaccounted-for water such as leakage. For this reason, the City’s production data, which accounts for all water demand, was used to calculate the ADD and MDD for each year. Additionally, historical production allows the City to track system-wide demands on a daily basis, rather than monthly or bi-monthly billing records.

5.3.1 Distribution System Leakage

Distribution System Leakage (DSL) represents the difference between production and documented water use (retail and authorized unmetered). It may include inaccurate master and service connection meters, unaccounted-for non-revenue water use, pipeline leakage, and unauthorized use. DSL does not include authorized water usage such as water used for fire protection, flushing, construction, and other maintenance and operations practices. However, to be credited, this usage must be metered or estimated using credible means.



AVERAGE SEASONAL DEMAND BY CUSTOMER CLASS

FIGURE 5.2

CITY OF CAMAS
WATER SYSTEM PLANT UPDATE

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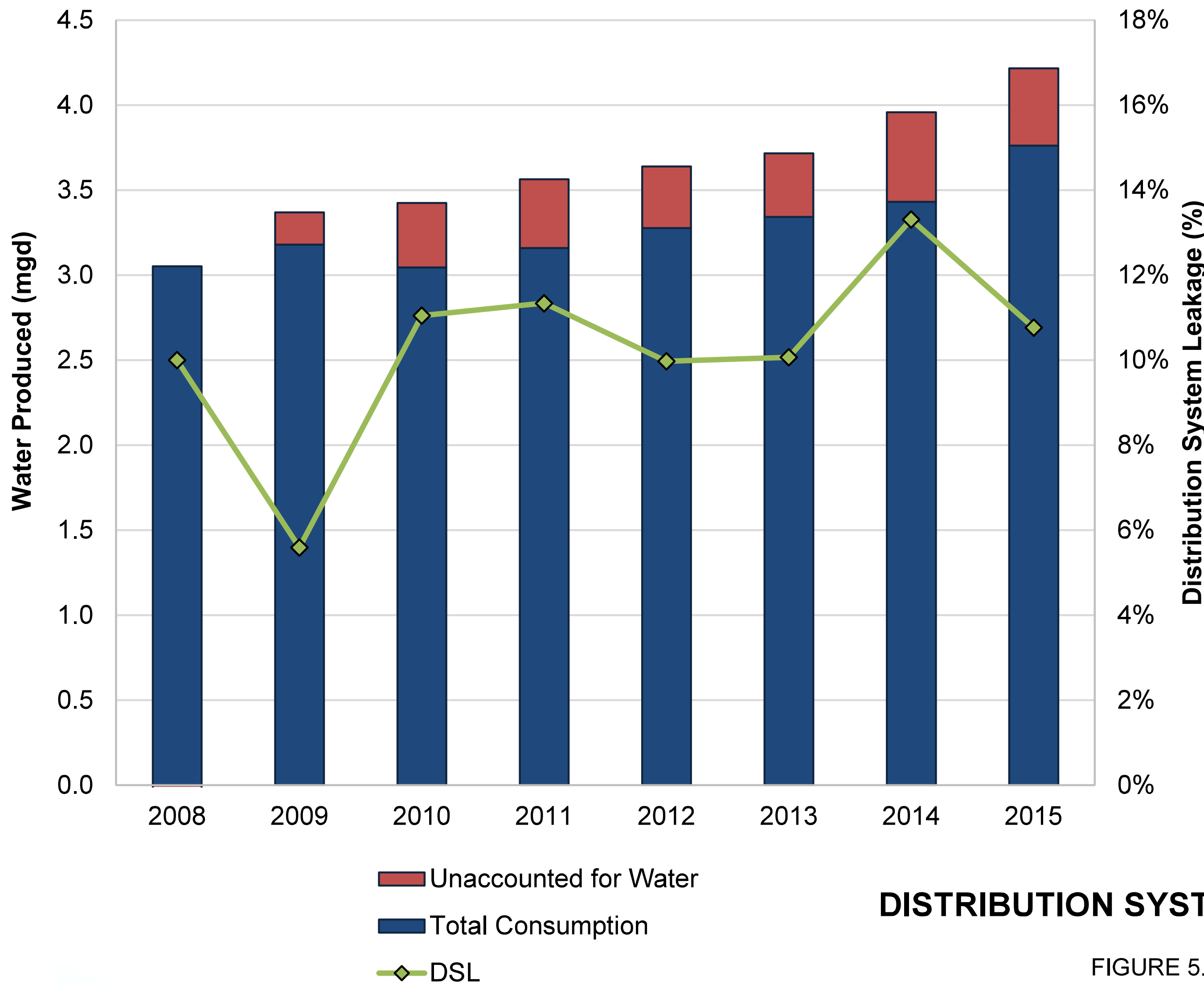
DSL is calculated as the difference between the total amount of water produced and the sum of water sold and authorized unmetered water usage. The City's total water production and consumption in millions of gallons, or MG, as well as estimates of DSL for 2008 through 2015 are shown in Table 5.4 and presented graphically in Figure 5.3. The City's average annual DSL over the period was 10.3 percent.

**Table 5.4 Historical Distribution System Leakage
Water System Plan Update
City of Camas**

Year	Total Production (MG)	Total Consumption (MG)	Unaccounted for Water (MG)	DSL (%)
2008[(1)]	1,086	1,117	-31	10.0%
2009	1,230	1,161	69	5.6%
2010	1,250	1,112	138	11.1%
2011	1,301	1,153	147	11.3%
2012	1,332	1,199	133	10.0%
2013	1,357	1,220	137	10.1%
2014	1,445	1,253	192	13.3%
2015	1,539	1,373	166	10.8%
			Average	**10.3%**

Notes:

(1) In 2008, the total consumption reported by the City exceeded the total reported production. Therefore, these data are considered erroneous and a DSL of 10.0% was assumed instead for 2008 to be consistent with other years in this period.



DISTRIBUTION SYSTEM LEAKAGE

FIGURE 5.3

CITY OF CAMAS
WATER SYSTEM PLANT UPDATE

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5.3.2 Historical Average and Maximum Demands

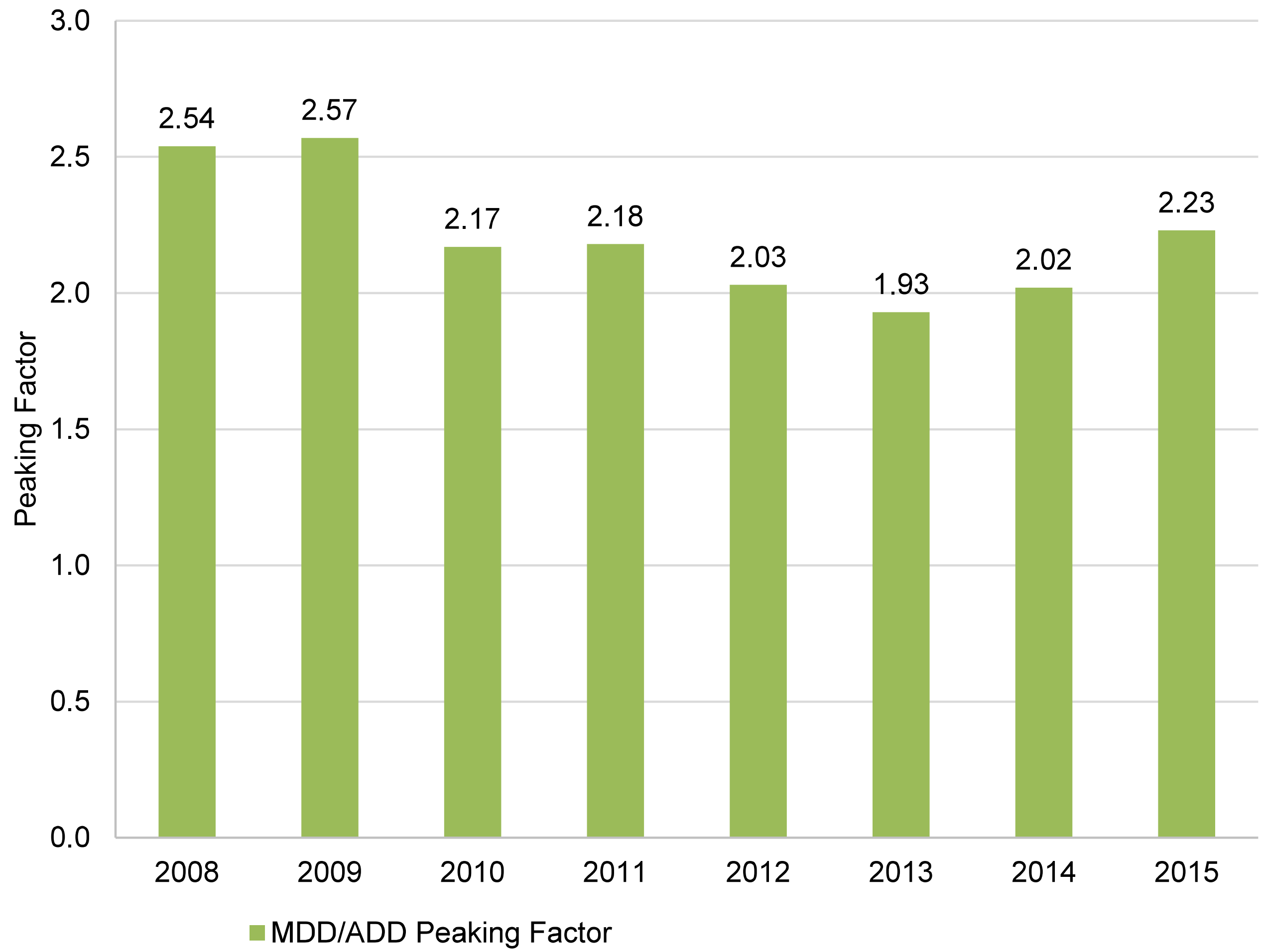
The City produces water for its customers through ten wells and two surface water sources. Table 5.5 presents the ADD and MDD (based on production) for the period of 2008 through 2015. The average annual water produced from 2008 through 2015 was 1,317 million gallons per year. The average ADD over the period was 3.61 mgd. The annual ADD trends strongly upward over this period, reflecting the growing number of City water customers.

Table 5.5 Historical Average Production, Maximum Day Demand, and Peaking Factor
Water System Plan Update
City of Camas

Year[1]	Date of MDD	MDD (mgd)	ADD (mgd)	Peaking Factor
2008	8/16	7.55	2.97	2.54
2009	7/31	8.65	3.37	2.57
2010	8/15	7.42	3.42	2.17
2011	8/20	7.76	3.56	2.18
2012	8/16	7.39	3.64	2.03
2013	7/27	7.19	3.72	1.93
2014	8/9	7.99	3.96	2.02
2015	7/4	9.40	4.22	2.23
	3-year Avg.	**8.19**	**3.96**	**2.06**
	75th Percentile	**8.48**	**3.90**	**2.46**
	Maximum	**9.40**	**4.22**	**2.57**

The MDD is a key benchmark for supply capability, pump station discharge rates, reservoir capacity, and pump sizes. The MDD is the highest production in one day in a given year, and usually occurs during the summer when irrigation is prevalent. Table 5.5 presents the historical MDD from 2008 to 2015. MDD is less dependent on indoor water use (which drives the ADD), and more dependent on irrigation. The highest MDD value (9.40 mgd) occurs in 2015, which had record-setting high temperatures and low rainfall. The next highest MDD occurred in 2009, six years earlier.

The last column of Table 5.5 presents the historical MDD to ADD peaking factor, which normalizes the historical data to compare between years. The peaking factor is also a key parameter in developing the future MDD projections, as discussed later in this chapter. The maximum peaking factor of 2.57 occurred in 2009 and the minimum peaking factor of 1.93 occurred in 2013. The MDD to ADD peaking factor over the period is shown graphically in Figure 5.4. Figure 5.4 illustrates the variability in the peaking factor over the period. Section 5.6.4 discusses the peaking factor to be used for future projections.



MDD/ADD PEAKING FACTOR

FIGURE 5.4

CITY OF CAMAS
WATER SYSTEM PLANT UPDATE

5.4 DEMOGRAPHIC FORECAST

Demand projections depend on the future number of customers to be served by the City's water system. Thus, demographic forecasts of future population and employment must be made to establish an estimate of the future number of customers. A demographic analysis consistent with regional growth planning was performed to estimate the number and type of the future customer accounts served by the City's water system. Converting the number of accounts into demand projections is discussed in Section 5.6.

5.4.1 Land Use

Land use designations and regulations provide important information in determining future water requirements. Land use determines the area available for various types of development including both SFR and MFR development, as well as commercial and other types of land use that provide the economic base necessary to support residential development.

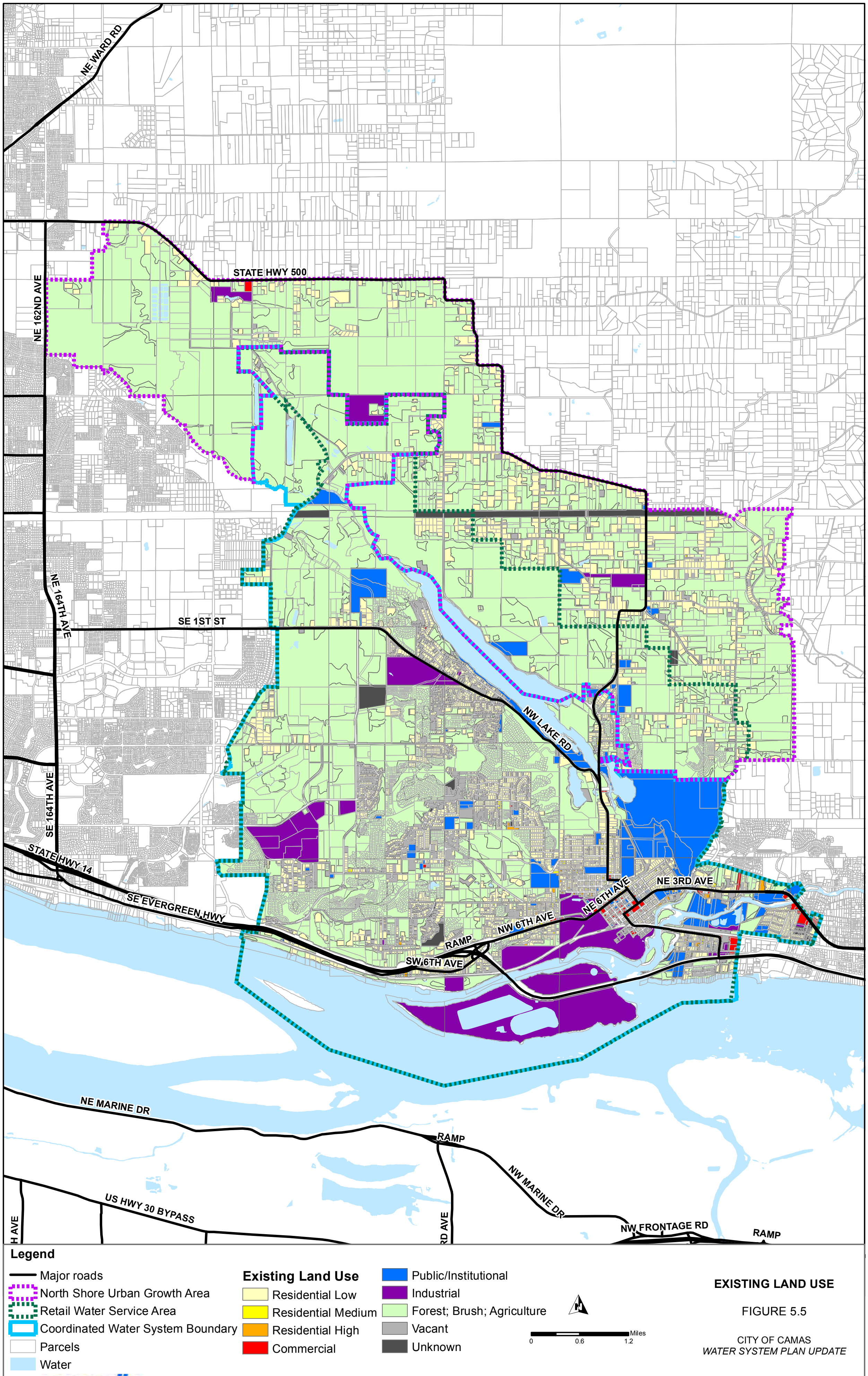
5.4.1.1 <u>Existing Land Use</u>

Figure 5.5 depicts the best available data on existing land use from Clark County GIS data developed for the 1994 Growth Management Act. Because these GIS data are not up-to-date, existing water customers were derived using the City's up-to-date meter data. Each metered account was assigned an address and one of the six customer classes. Using GIS, these metered accounts were geocoded to correspond to a geographic location within a Service Area.

Note that in Figures 5.5, 5.6, and 5.7, the North Shore Urban Growth Area (UGA), or North Shore UGA, refers to the entirety of Service Area 542, but only the portion of this area within the RWSA is incorporated into the demand projections. Note that in Figures 5.5, 5.6, and 5.7, City services in Vancouver, Washington were not included in the demographic forecast.

5.4.1.2 <u>Future Land Use</u>

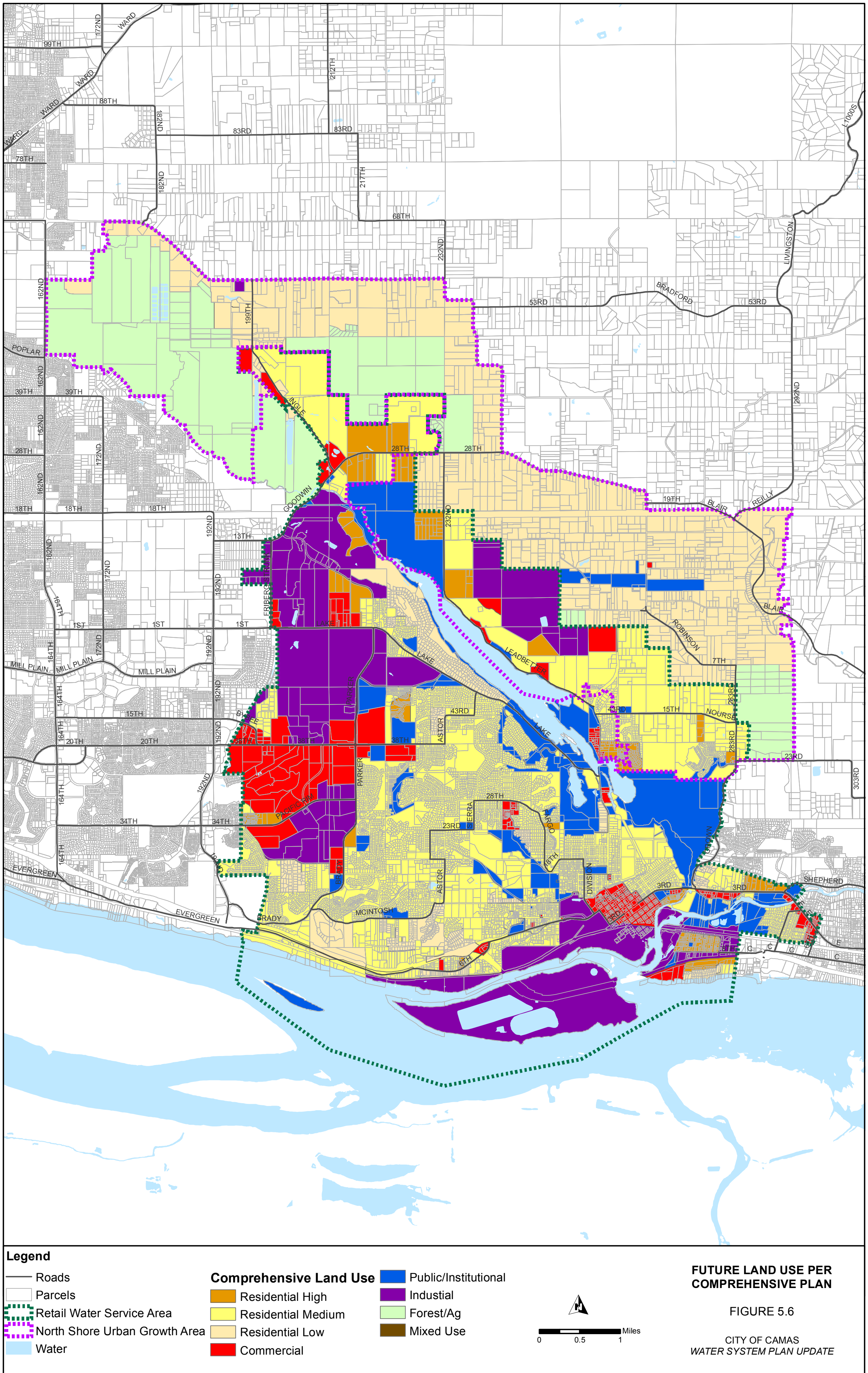
Future land use designations were obtained from the City's 2035 Comprehensive Plan (Camas 2016). These future land use designations are depicted in Figure 5.6. The future land use designations are used to evaluate the 20-year development conditions as described below.



EXISTING LAND USE

FIGURE 5.5

CITY OF CAMAS
WATER SYSTEM PLAN UPDATE



FUTURE LAND USE PER COMPREHENSIVE PLAN

FIGURE 5.6

CITY OF CAMAS
WATER SYSTEM PLAN UPDATE

carollo

5.4.2 Demographic Growth Rates

The demographic forecasts include an estimated rate of growth and a low and high development cap in each Service Area. In 2035, The City is expected to have a population of 34,098 people, and 11,255-person increase from the 2015 population of 22,843 (Camas 2035, 2016). Rates of growth were based on housing and employment estimates per Transportation Analysis Zones (TAZs) for the City. Camas's water system has five Service Areas encompassing 65 different TAZs. Each Service Area contains multiple TAZs and the boundaries do not coincide. The percentage of each TAZ within each Service Area was estimated using GIS. To estimate the rates of growth in each Service Area, the existing and projected households and employees for each TAZ were allocated to the Service Area in which they lie according to the percentage of their area in that Service Area. A map of the TAZs and Service Areas is shown in Figure 5.7.

Two scenarios were considered for build-out capacity:

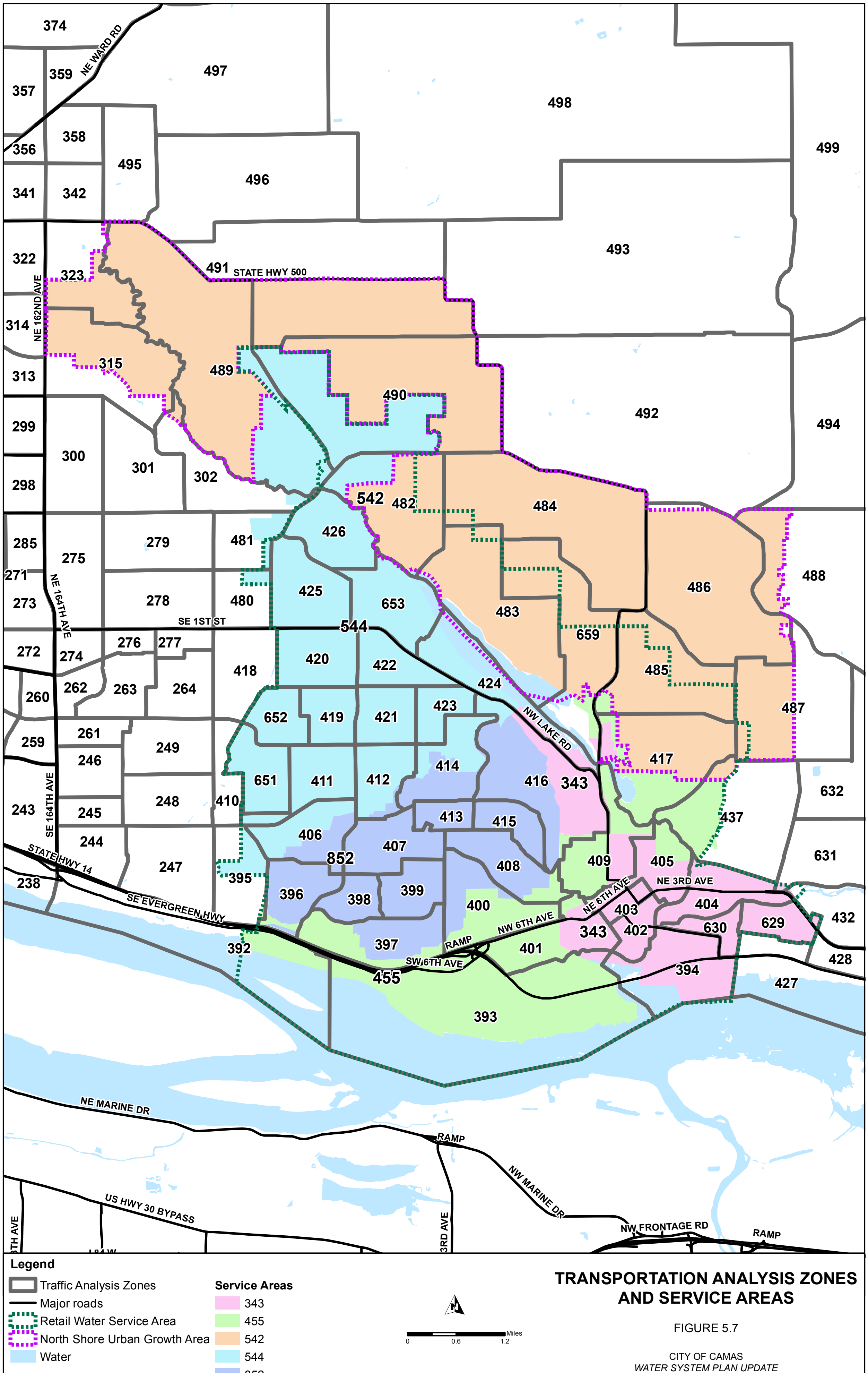
- High Growth Scenario: this scenario assumes full development of the City according to the City's Comprehensive Plan representing maximum allowable buildout in 2035.
- Low Growth Scenario: this scenario assumes development of all currently vacant and underutilized lots according to the Comprehensive Plan; however, currently developed properties do not redevelop according to the Comprehensive Plan.

These growth scenarios establish a limit on demographic growth within each Service Area. To estimate households and employees from land use data, the following employee and household density assumptions were used based on the 2015 Clark County Buildable Lands Report:

- SFR: 6 households per acre.
- MFR: 18 households per acre.
- Commercial/City: 20 employees per acre.
- Industrial: 9 employees per acre.

When the projected number of households or employees within a Service Area reached these density limits, no more households or employees were added and household or employee growth within that Service Area was considered "capped."

The final household and employee growth rates were calculated for each Service Area based on the low and high growth scenarios. Medium growth scenario growth rates were calculated as the average between the low and high growth scenarios. Table 5.6 summarizes overall growth within the Service Area for each of the planning years from 2015 to 2035. The table presents total growth compared to 2015 for each of the planning years, and the average annual growth rate.



TRANSPORTATION ANALYSIS ZONES AND SERVICE AREAS

FIGURE 5.7

CITY OF CAMAS
WATER SYSTEM PLAN UPDATE

Table 5.6 Retail Water Service Area Demographic Growth Rates
Water System Plan Update
City of Camas

Service Area	Demographic Growth Type	2021			2025			2035		
		L	M	H	L	M	H	L	M	H
343	Households (overall)	3.7%	3.7%	3.7%	6.2%	6.2%	6.2%	12.4%	12.4%	12.4%
	Employees (overall)	1.4%	1.4%	1.4%	2.3%	2.3%	2.3%	4.5%	4.6%	4.6%
455	Households (overall)	16.0%	16.0%	16.0%	26.7%	26.7%	26.7%	35.4%	44.4%	53.3%
	Employees (overall)	0.8%	0.8%	0.8%	1.3%	1.3%	1.3%	2.6%	2.6%	2.6%
542 Non-Sewer[1]	Households (overall)	58.8%	58.8%	58.8%	97.9%	97.9%	97.9%	195.8%	195.8%	195.8%
	Employees (overall)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
544	Households (overall)	15.0%	15.0%	15.0%	24.9%	24.9%	24.9%	49.9%	49.9%	49.9%
	Employees (overall)	15.3%	15.3%	15.3%	25.5%	25.5%	25.5%	46.8%	48.9%	51.0%
852	Households (overall)	10.5%	10.5%	10.5%	17.5%	17.5%	17.5%	18.4%	26.7%	35.0%
	Employees (overall)	5.2%	5.2%	5.2%	8.6%	8.6%	8.6%	11.6%	14.4%	17.3%
Overall[2]	Households (overall)	13.1%	13.1%	13.1%	21.8%	21.8%	21.8%	34.3%	38.9%	43.6%
	Employees (overall)	7.5%	7.5%	7.5%	12.5%	12.5%	12.5%	22.5%	23.7%	24.9%
	Households (average annual growth since 2015)	2.2%	2.2%	1.4%	2.2%	2.2%	1.6%	1.7%	1.9%	2.2%
	Employees (average annual growth since 2015)	1.2%	1.2%	1.2%	1.2%	1.2%	1.3%	1.1%	1.2%	1.2%

Notes:
(1) Demographic growth projections were not developed for the 542 Sewer section of Service Area 542, since the 542 Sewer ERU projections were obtained from the City's Sewer Master Plan, as described in Section 5.4.3. See Table 5.10 for ERU projections in the entire Service Area 542.
(2) The overall demographic growth rates presented in this table include only the Service Areas listed, and do not include households nor employees located in the 542 Sewer section of Service Area 542.

The City currently serves several accounts located outside the RWSA based on agreements with adjacent purveyors. These accounts were not grown as expansion of water service in this area is not expected, per the definition of the RWSA. Instead, their 2015 demands were held constant over the entire 20-year planning period.

5.4.3 Service Area 542 Projections

Some exceptions to the methods for projecting growth described in the previous sections were made in Service Area 542. Previous growth projections were developed for this area as part of the City's sanitary sewer planning. Much of Service Area 542 lies within the North Shore UGA Sewer Basins I-IV, as delineated in the City's Sewer Master Plan. For the region of Service Area 542 inside these basins, the ERU projections developed in the Sewer Master Plan were used. The methods used to project growth and development for all other Service Areas were applied exclusively to properties within the RWSA but outside these sewer basins. These two sections of Service Area 542 are referred to as 542 Sewer and 542 Non-Sewer, respectively, to reflect their distinct methods for projecting growth. Additionally, Camas Meadows Golf Course in Service Area 544 was identified as being contained within the North Shore UGA Sewer Basins I-IV. Meters and land corresponding to this property were consequently excluded from Service Area 544 growth and buildout projections.

5.5 PROJECTED NUMBER OF CONNECTIONS

Once growth rates were established, the number of existing accounts was grown by the low, average, and high Service Area growth rates for each Service Area. Existing residential accounts were grown by the estimated household growth rates for each Service Area; existing non-residential accounts were grown by the estimated employment growth rates for each Service Area.

Table 5.7 summarizes the projected number of accounts for each Service Area, excluding Large Users. The projected number of future accounts was then used to develop ERUs and demand projections.

Table 5.7 Account Projections
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City of Camas

Service Area	Account Type	Accounts - 2015	Accounts - 2021			Accounts - 2025			Accounts - 2035		
			Low	Med	High	Low	Med	High	Low	Med	High
343	L. Users(1)	13	13	13	13	13	13	13	13	13	13
	COM	169	171	171	171	173	173	173	177	177	177
	IND	3	3	3	3	3	3	3	3	3	3
	IRR	35	35	35	35	35	35	35	35	35	35
	MFR	156	162	162	162	166	166	166	175	175	175
	SFR	1,053	1,092	1,092	1,092	1,118	1,118	1,118	1,183	1,183	1,183
	Total	1,416	1,463	1,463	1,463	1,495	1,495	1,495	1,573	1,573	1,573
455	L. Users	4	4	4	4	4	4	4	4	4	4
	COM	10	10	10	10	10	10	10	10	10	10
	IND	1	1	1	1	1	1	1	1	1	1
	IRR	11	11	11	11	11	11	11	11	11	11
	MFR	132	153	153	153	167	167	167	179	191	202
	SFR	1,150	1,334	1,334	1,334	1,457	1,457	1,457	1,557	1,660	1,764
	Total	1,304	1,509	1,509	1,509	1,646	1,646	1,646	1,758	1,873	1,989
542 Non-Sewer(2)	L. Users	4	4	4	4	4	4	4	4	4	4
	COM	11	11	11	11	11	11	11	11	11	11
	IND	-	-	-	-	-	-	-	-	-	-
	IRR	6	6	6	6	6	6	6	6	6	6
	MFR	1	2	2	2	2	2	2	3	3	3
	SFR	295	435	435	435	529	529	529	764	764	764
	Total	313	454	454	454	548	548	548	784	784	784
544	L. Users	24	24	24	24	24	24	24	24	24	24
	COM	21	24	24	24	26	26	26	31	31	32
	IND	4	5	5	5	5	5	5	6	6	6

Table 5.7 Account Projections
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City of Camas

Service Area	Account Type	Accounts - 2015	Accounts - 2021			Accounts - 2025			Accounts - 2035		
			Low	Med	High	Low	Med	High	Low	Med	High
	IRR	33	156	156	156	156	156	156	156	156	156
	MFR	17	20	20	20	21	21	21	25	25	25
	SFR	1,553	1,785	1,785	1,785	1,940	1,940	1,940	2,328	2,328	2,328
	Total	1,628	1,990	1,990	1,990	2,149	2,149	2,149	2,546	2,547	2,547
852	L. Users	12	12	12	12	12	12	12	12	12	12
	COM	7	7	7	7	8	8	8	8	8	8
	IND	1	1	1	1	1	1	1	1	1	1
	IRR	72	22	22	22	22	22	22	22	22	22
	MFR	50	55	55	55	59	59	59	59	63	68
	SFR	3,071	3,394	3,394	3,394	3,609	3,609	3,609	3,635	3,891	4,148
	Total	3,201	3,479	3,479	3,479	3,698	3,698	3,698	3,725	3,985	4,246
Total	L. Users	57	57	57	57	57	57	57	57	57	57
	COM	218	224	224	224	228	228	228	237	237	238
	IND	9	10	10	10	10	10	10	11	11	11
	IRR	157	230	230	230	230	230	230	230	230	230
	MFR	356	391	391	391	415	415	415	442	458	474
	SFR	7,122	8,040	8,040	8,040	8,653	8,653	8,653	9,468	9,827	10,186
	Grand Total	**7,862**	**8,895**	**8,895**	**8,895**	**9,535**	**9,535**	**9,535**	**10,387**	**10,763**	**11,139**

Notes:
(1) All City accounts are included in the Large Users class. Large User accounts were not grown - the number of Large User accounts in each service area over the entire planning period was assumed to be equal to the 2015 number of accounts. Instead, independent growth projections were developed for each large user and used to project Large User demands, as described in Section 5.6.2.
(2) Account projections were not developed for the 542 Sewer section of Service Area 542, since the 542 Sewer ERU projections were obtained from the City's Sewer Master Plan. See Table 5.10 for ERU projections in the entire Service Area 542.

5.6 PROJECTED WATER DEMAND

Projecting future water demand is one of the key elements of the water system planning process. Identification of system improvements such as supply, pumping, storage, and piping requirements are all related to demand projections. This section summarizes the ERU, ADD, and MDD projections, as well as the potential range in future demands associated with various factors, such as water use per ERU, DSL, and demographic growth rate.

5.6.1 Potential Range in Future Water Demand

Numerous factors and assumptions affect the accuracy of projected future water demands. Recognizing that certain assumptions built into the demand projections will vary in the future, the projections were developed for low, medium, and high demand scenarios to provide a range in demands that may be experienced in the future.

The variables considered in developing the range of demand projections are summarized in Table 5.8 and are discussed below.

- **Future Water Accounts:** The future water accounts are presented in Table 5.7 and were used for their corresponding demand scenario (low, medium, and high).
- **Water Use per ERU:** Water use per ERU for the low and medium demand projections are based on the average water use per ERU over the last three years (2013 to 2015), 260 gallons per day per equivalent residential unit (gpd/ERU), and reflect the City's conservation goals. The high demand projection was based on 75th percentile of the historical data presented in Table 5.3, which equals 315 gpd/ERU.
- **ERUs per Account:** The historical ERUs per account by customer class presented in Table 5.3 were used to project the future demands. These ERU per Account values were based on the 75th percentile of the historical data and a water use per ERU value of 315 gpd/ERU to be conservative.
- **Distribution System Leakage:** DSL varied between 5.6 and 13.3 percent of the City's total production between 2008 and 2015. For the low and medium demand scenarios, a DSL of 10 percent was selected to represent the City's conservation goals. For the high demand scenario, the average DSL observed from 2008 to 2015 of 10.3 percent was used.
- **Maximum Day/Average Day Peaking Factor:** Due to the high projected demands for the City's largest water users (described in the following section), and the lack of summer peaking of industrial users (which comprise most Large Users), the MDD/ADD peaking factor was not applied to Large Users to avoid overly conservative demand projections. Therefore, MDD/ADD peaking factors were developed for all customers excluding the largest users from the historical data to be used for the

demand projections herein. The MDD/ADD peaking factor for all customers excluding Large Users varied from 2.48 to 3.58 between 2008 and 2015. For the low demand projection, the average peaking factor over the most recent three year period (2013 to 2015) of 2.74 was used. For the medium demand projection, the average peaking factor observed from 2008 to 2015, 2.95, was used. For the high demand projection, the 75th percentile peaking factor from 2008 to 2015, 3.43, was used.

Large Users were based on individual demand projections that are presented in the following sections.

Table 5.8 Demand Projection Parameters
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Demand Scenario	Demographic Growth Scenario	Water Use per ERU (gpd/ERU)	Distribution System Leakage (%)	Maximum Day Peaking Factor
Low	Low	260	10.0%	2.74
Medium	Average of High and Low	260	10.0%	2.95
High	High	315	10.3%	3.43

5.6.2 Large Users Demand Forecast

The City's top 10 water users, or Large Users, were identified by the City as presented in Section 5.1.1. Low, medium, and high demand forecasts were created for each Large User based on historical water use data from 2008 through 2015.

The low demand scenario projections assume that each Large User's annual water demand is held constant over the entire planning period at the maximum demand observed by the user during the 2008 to 2015 period. The Large Users high demand scenario projections assume that each user's demands increased at a constant rate equal to that user's average rate of annual increase in demand over the most recent three year period (2013 to 2015). The medium demand scenario is an average of the low and high demand projections.

Notably, demand projections for some Large Users were developed differently. Wafertech Industries and Linear Technologies are not expected to expand and subsequently increase demand, per City staff. Similarly, recent budget cuts applied to the City of Camas and Camas School District limit the amount of water to be used for irrigation purposes in the future. Consequently, the demand projections for these four Large Users calculated under the low demand scenario were used for all demand scenarios, as significant increases in water demand are not expected over the planning period. Additionally, SE Incorporated did not contribute any water demand until 2013, so limited data is available for establishing demand projections. In this case, annual increases in water demand were assumed to match the annual rate of increase in demand over the most recent three year period (2013 to 2015) for all Large Users combined: approximately 4 percent. Lastly, both Karcher North America and Georgia Pacific Mill demonstrated a decline in average demand over the 2008 to 2015 period. For these two users, the annual average rate of increase in demand from 2008 to 2015 was used to develop the low demand scenario instead of the maximum observed demand.

The City does not expect any new Large Users to contribute demand in the immediate future. However, the City has requested Large Users projections include a 0.5 mgd "block" for future industrial clients. This 0.5 mgd was added to the Large Users demand projections in 2021 - the end of the short-term planning period - as it is unlikely any new Large Users will contribute to demand within this planning period.

The Large Users demand projections are presented in Table 5.9. For each Large User, Table 5.9 provides the Service Area, 2015 demand, and the projected 2021, 2025, and 2035 demands.

5.6.3 Projected ERUs

Future water system demands are based on projected ERUs, which in turn are based on the projected water consumption by customer classification and the projected number of accounts discussed earlier in this chapter. Table 5.10 shows the projected ERUs for the City's individual Service Areas over the planning period under each growth scenario. The projected number of ERUs for each Service Area was calculated by multiplying the projected number of accounts, provided in Table 5.7, by the number of ERUs per account, as summarized in Table 5.3, for each customer class. The total ERUs in Service Area 542 includes the projected ERUs based on the City's sewer projections for ERUs in this area.

To incorporate the unique demand projections for Large Users, the Large Users projections were also converted to ERUs and incorporated into the total ERUs for each Service Area.

5.6.4 Projected Average Day and Maximum Day Demands

ADD projections were determined by multiplying the total number of projected ERUs per Service Area by the appropriate water use per ERU for each demand scenario, as listed in Table 5.8. Additionally, the ADD projections incorporate the assumptions for DSL and the unique Large Users demand projections. To develop MDD projections, the ADD projections for all customers other than Large Users were multiplied by the peaking factors shown in Table 5.8 for each demand scenario (as Large Users show limited seasonal peaking).

Tables 5.11 and 5.12 show the projected ADD and MDD, respectively, under the low, medium, and high demand scenarios. These projections, as well as historical ADD and MDD, are visually depicted in Figure 5.8.

Table 5.9 Large Users Demand Projections
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City of Camas

Large User	Service Area	Demand - 2015 (mgd)	Demand - 2021 (mgd)			Demand - 2025 (mgd)			Demand - 2035 (mgd)		
			Low	Med	High	Low	Med	High	Low	Med	High
Wafertech Industries	544	0.750	0.750	0.750	0.750	0.750	0.750	0.750	0.750	0.750	0.750
Linear Technologies	544, 852	0.274	0.283	0.283	0.283	0.283	0.283	0.283	0.283	0.283	0.283
Georgia Pacific Mill	343, 455	0.218	0.211	0.256	0.301	0.206	0.281	0.356	0.195	0.345	0.495
Camas School District	All	0.096	0.096	0.096	0.096	0.096	0.096	0.096	0.096	0.096	0.096
City of Camas	All	0.079	0.079	0.079	0.079	0.079	0.079	0.079	0.079	0.079	0.079
Underwriter's Labs	544	0.032	0.032	0.054	0.076	0.032	0.069	0.106	0.032	0.106	0.179
SE Incorporated	All[(1)]	0.014	0.016	0.019	0.022	0.017	0.020	0.022	0.021	0.023	0.025
Sharp Electronics	544, 852	0.017	0.016	0.020	0.024	0.016	0.020	0.024	0.015	0.020	0.024
Bodycote	544	0.013	0.014	0.016	0.019	0.014	0.018	0.022	0.014	0.022	0.031
Karcher North America	544	0.014	0.013	0.017	0.021	0.012	0.019	0.025	0.011	0.023	0.035
Total (Current Large Users)	**-**	**1.51**	**1.51**	**1.59**	**1.67**	**1.51**	**1.63**	**1.76**	**1.50**	**1.75**	**2.00**
Total (Including Future Large Users)	**-**	**1.51**	**2.01**	**2.09**	**2.17**	**2.01**	**2.13**	**2.26**	**2.00**	**2.25**	**2.50**

Notes:
(1) SE Incorporated was not mapped to a specific Service Area; its demand is assumed to be distributed equally among all five Service Areas.

Table 5.10 ERU Projections
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Service Area	ERUs - 2015	ERUs - 2021			ERUs - 2025			ERUs - 2035		
		Low	Med	High	Low	Med	High	Low	Med	High
343	2,480	2,742	2,901	2,829	2,762	3,023	3,018	2,810	3,326	3,482
455	1,695	1,990	2,044	2,015	2,129	2,217	2,210	2,237	2,530	2,696
542(1)	417(2)	2,042	2,044	2,025	3,247	3,248	3,228	7,007	7,005	6,984
544	5,714	7,478	7,571	6,733	7,646	7,798	7,001	8,064	8,366	7,678
852	4,051	4,493	4,493	4,330	4,716	4,709	4,543	4,748	4,989	5,081
Total	**14,357**	**18,745**	**19,053**	**17,932**	**20,501**	**20,995**	**19,999**	**24,866**	**26,216**	**25,920**

Notes:

(1) Service Area 542 henceforth includes ERUs from 542 Non-Sewer projections, developed per the method described in Section 5.4.2, and 542 Sewer projections from the City's Sewer Master Plan.

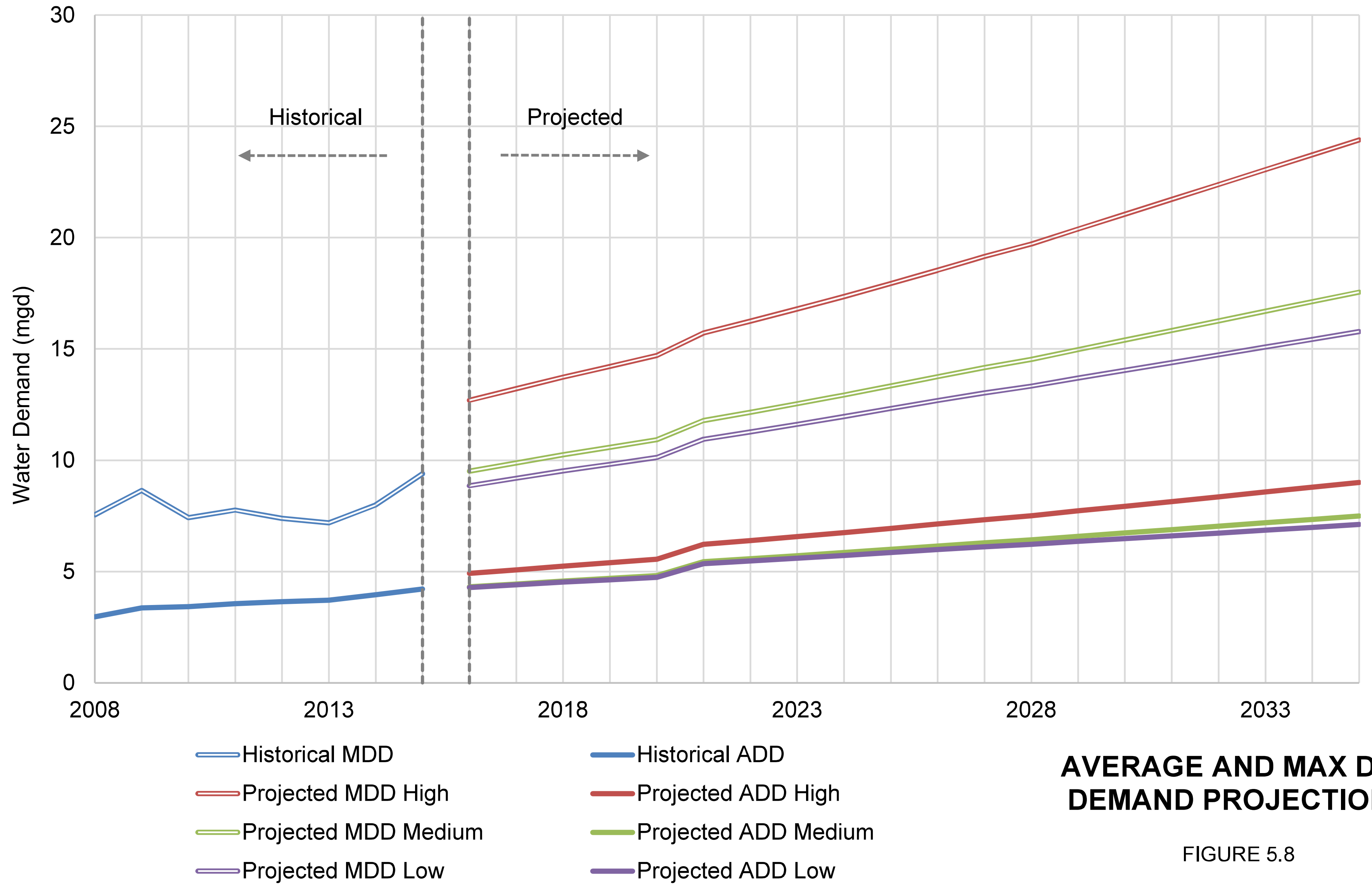
(2) This value only includes 542 Non-Sewer ERUs, since City's Sewer Master Plan did not include the 542 Sewer ERUs in the year 2015.

Table 5.11 Average Day Demand Projections Water System Plan Update City of Camas

Service Area	2015 ADD (mgd)	ADD - 2021 (mgd)			ADD - 2025 (mgd)			ADD - 2035 (mgd)		
		Low	Med	High	Low	Med	High	Low	Med	High
343		0.78	0.83	0.98	0.79	0.86	1.05	0.80	0.95	1.21
455		0.57	0.58	0.70	0.61	0.63	0.77	0.64	0.72	0.94
542		0.58	0.58	0.70	0.93	0.93	1.12	2.00	2.00	2.43
544		2.14	2.17	2.34	2.19	2.23	2.43	2.31	2.39	2.67
852		1.29	1.29	1.50	1.35	1.35	1.58	1.36	1.43	1.76
Total	**4.22**	**5.36**	**5.45**	**6.23**	**5.86**	**6.01**	**6.95**	**7.11**	**7.50**	**9.00**

Table 5.12 Maximum Day Demand Projections Water System Plan Update City of Camas

Service Area	2015 MDD (mgd)	MDD - 2021 (mgd)			MDD - 2025 (mgd)			MDD - 2035 (mgd)		
		Low	Med	High	Low	Med	High	Low	Med	High
343		1.66	1.82	2.47	1.68	1.88	2.57	1.74	2.01	2.80
455		1.38	1.50	2.08	1.49	1.63	2.27	1.58	1.86	2.74
542		1.54	1.68	2.34	2.49	2.70	3.78	5.44	5.90	8.27
544		3.30	3.48	4.31	3.43	3.64	4.55	3.76	4.04	5.14
852		3.06	3.30	4.52	3.24	3.49	4.79	3.26	3.73	5.44
Total	**9.40**	**10.95**	**11.79**	**15.72**	**12.33**	**13.35**	**17.94**	**15.78**	**17.55**	**24.39**



AVERAGE AND MAX DAY DEMAND PROJECTIONS

FIGURE 5.8

CITY OF CAMAS
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WATER USE EFFICIENCY

The City of Camas (City) promotes efficient water use to conserve and protect their existing water supplies for present and future residents. The City promotes water conservation and efficient use of water through a variety of activities that encompass their Water Use Efficiency (WUE) Program. The program encourages water conservation and utilizes continued improvements to reduce leakages and water loss in the City's system. This chapter details both the City's existing and future WUE programs.

6.1 WUE PROGRAM BACKGROUND

In 2003, the Washington State Legislature passed the Engrossed Second Substitute House Bill 1338, known as the Municipal Water Law or the WUE rule, to address the increasing demand on Washington's water resources. This law established that all municipal water suppliers (MWS) must use water more efficiently in exchange for water right certainty and flexibility to help them meet future demand.

The WUE rule, which became effective on January 22, 2007, emphasizes the importance of measuring water use and evaluating the effectiveness of the water supplier's WUE program. The intent is to minimize water withdrawals and water use by implementing water saving activities and adopting policies, resolutions, ordinances, or bylaws. This chapter follows the guidelines set forth in the Water Use Efficiency Guide Book, Third Edition, (January 2017) as well as the Water System Planning Handbook (April 1997).

6.1.1 Current WUE Program

The City's current WUE Program was established as part of the 2010 Water System Plan (2010 WSP). Per the Washington Administrative Code (WAC) 246-290-830(4)(a), all water purveyors with 1,000 or more connections were required to set efficiency goals through a public process. The established goals promote water use efficiency for internal operations and for water customers. The current WUE Program goals were established in the 2010 WSP and re-established in 2013:

- **Demand-Side Goal:** Reduce customer consumption per equivalent residential units (ERU) by 1 percent or approximately 2 gallons per day (gpd) per year over the next 6 years.
- **Supply-Side Goal:** Continue to reduce distribution loss to at or below 10 percent for the next 5 years.

The following summarizes the current program.

6.1.1.1 Supply-Side Measures

The City implements the following supply-side measures as part of their WUE Program. A number of these measures are mandated by Washington State Department of Health (DOH) per the Water Use Efficiency Guidebook. The following summarizes the City's supply-side measures:

1. Record and monitor supply source production (Mandatory).
2. Record and monitor customer demands through customer water meters (Mandatory).
3. Test and calibrate industrial and commercial meters annually (Mandatory).
4. Replace customer water meters with enhanced advanced meter reading (AMR) meters. Nearly 60 percent of customer meters have been upgraded to the new AMR meters. Once complete, the City will regularly test and repair residential meters per manufacturer recommendations.
5. Perform annual leak detection surveys through a private contractor. Hydrants and valves are checked as part of leak detection surveys (Mandatory).
6. Replace or replace old distribution system piping with defects as budget allows.
7. Reclaimed Water: Treated wastewater is used for wash down and process use and for landscape irrigation at the wastewater treatment plant (WWTP) (Mandatory to evaluate reclaimed water).

6.1.1.2 Demand-Side Measures

The City implements a number of demand-side measures that the meet the DOH requirement for 6 water use efficiency measures. These measures are similar to many of the example water use efficiency measures presented in Appendix B of the Water Use Efficiency Guidebook. The City provides an overview of their water use efficiency activities on their Water Services website (http://www.ci.camas.wa.us/index.php/pwwater). The City's various public outreach activities meet the DOH requirement for educating customers about water use efficiency. The following provides a summary of the City's demand-side measures:

1. Include water consumption history on customer's utility bills.
2. City staff alert and visit customers where customer leaks are identified.
3. Promote installation of smart controllers and irrigation timers for the school district and industrial users

4. Educate the public on conservation and water-saving devices at community events and on the City website (http://www.ci.camas.wa.us/images/DOCS/WATER_SEWER/REPORTS/waterconservation.pdf).

5. Distribute water-saving devices such as shower timers at community events.

6. Require xeriscaping and Low Impact Development (LID) to reduce irrigation requirements for new developments.

7. Work with developers to evaluate their irrigation systems to incorporate drip systems or micro sprayers.

8. Promote odd/even day and late night or early morning irrigation for all customers.

The above supply and demand side WUE measures are effective in encouraging WUE for the water system. Additional measures will be evaluated if new opportunities arise for WUE.

6.1.2 Distribution System Leakage

Distribution system leakage (DSL) is a significant element of supply-side WUE requirements. DSL above 10 percent on a 3-year rolling average is considered excessive and necessitates the creation of a water loss control action plan. DSL is the difference between total water production and documented water use (retail and authorized unmetered). The estimate of DSL is dependent on the accuracy of meter readings for supply and customer meters and the accuracy of tracking authorized unmetered use for activities such as fire hydrant flushing. Table 6.1 presents the City's reported 3-year rolling average DSL from 2014 through 2016. The City has consistently maintained DSL below their WUE program goal and DOH standard of 10 percent.

Table 6.1 Distribution System Leakage (3-year Rolling Average)
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Year	3 Year Rolling Average DSL (%)
2014	8.7%
2015	8.7%
2016	9.1%
2017	9.6%

The DSL in Table 6.1 differs from that calculated in Chapter 5 – Water Requirements in 2014 and 2015, where Chapter 5 typically has less authorized consumption and higher DSL. Note, 2016 and 2017 data was not available for use in Chapter 5 at the time of its completion. The City is not able to account for the differences, since the Lead Operator completing the reports has retired; however, it is believed to be related to year end meter reading. The City will conduct a water audit in 2018 using the American Water Works Association (AWWA) Water Audit methodology. The AWWA mythology will provide the City with a robust framework to understand the components of water loss and document data sources. The 2018 Water Audit can be found in Appendix L. If the AWWA Water Audit finds DSL greater than 10 percent, then the City will develop a Water Loss Control Action Plan.

6.1.3 Historical Effectiveness of Current WUE Program

The City's current WUE Program includes measures for residential, irrigation, commercial, and industrial customers. The effectiveness of the City's program in meeting their WUE goals can be evaluated considering system-wide water use trends.

The 2010 WSP used a planning ERU of 296 gpd based on average residential use from 2004 to 2007. The current planning ERU value of 260 gpd was based on the average of water use from 2013 to 2015. This equates to a decrease of 4.5 gpd, or 1.6 percent annually over the eight year period, above the City's goal of 1 percent, or approximately 2 gpd per year.

Annual water use per account from 2008 to 2015 was detailed previously in Section 5.1.3. Water use across for the City's single-family residential, multi-family residential, commercial, and industrial accounts have all shown decreases since 2008. Single-family residential, commercial and industrial water use per account have all decreased over 20 percent since 2008, or over 2.5 percent per year. The City believes these decreases were in part from the WUE Program. It is acknowledged that other factors may have played a prominent role, such as weather and economic conditions.

The City does not track staff time or project costs associated with WUE. The supply-side WUE measures, such as metering and leak detection, are core activities of the Utility and are funded through Utility Capital Improvement and operations and maintenance (O&M) funds. The City estimate it dedicates approximately 0.5 full-time-equivalents (FTE) of staff time to conduct demand side measures across its Water Utility, Finances department, and development services staff. It is not possible to estimate the impact of demand-side measures on water use; therefore, no cost per gallon can be calculated.

Water consumption in City billing is based on $1.86 per one hundred cubic feet or 0.2 cents per gallon. Based on other Washington State Utilities, costs for WUE activities are similar to the City's production costs.

As shown in Table 6.1, the City's WUE Program efforts have been effective at keeping DSL below the program goal of 10 percent.

6.2 FUTURE WUE PROGRAM

The City plans to continue its efforts to encourage efficient water use. Going forward, the program will continue to focus on measures targeted at residential customers. The WUE Program goals established in 2013, which have been maintained, are:

- **Demand-Side Goal:** Reduce customer consumption per ERU by 1 percent or approximately 2 gpd per year over the next 6 years.
- **Supply-Side Goal:** Continue to reduce distribution loss to at or below 10 percent for the next 5 years.

Public comment on the future WUE program was taken at the October 7, 2019 City Council Meeting. An agenda and minutes for the meeting are provided in Appendix D.

6.2.1 Mandatory Measures

The WUE Program includes supply side measures that the City implements to understand and control leakage including new meters and leak detection surveys. The City's WUE Program will continue to meet the following mandatory measures in the future:

- Install production (source) meters.
- Install consumption (service) meters.
- Perform meter calibration.
- Implement a water loss control action plan to control leakage if the 3-year rolling average exceeds 10 percent.
- Educate customers about water use efficiency practices.
- Evaluate rates that encourage water demand efficiency, as discussed in a subsequent section.
- Evaluate reclamation opportunities, as discussed in a subsequent section.

6.2.1.1 Rate Structure

The City's current rate structure bills customers on a uniform volumetric charge. In 2010, the City added a consumption based element to sewer rates based on average winter water consumption, which was thought to encourage water efficiency. The City will reevaluate a more aggressive rate structure, such as inclined block rates, in future rate studies.

6.2.1.2 Reclaimed Water

Per WAC 246-290-100 and WUE requirements, water systems with over 1,000 connections must evaluate reclaimed water opportunities. As mentioned previously, the City currently uses treated wastewater at the WWTP. In addition, the City is currently (2017) working with one of their large industrial water users to evaluate opportunities for reuse of reclaimed water. If requested, the City is open to extending the reclaimed system to serve private customers.

6.2.2 Future WUE Program Supply-Side Measures

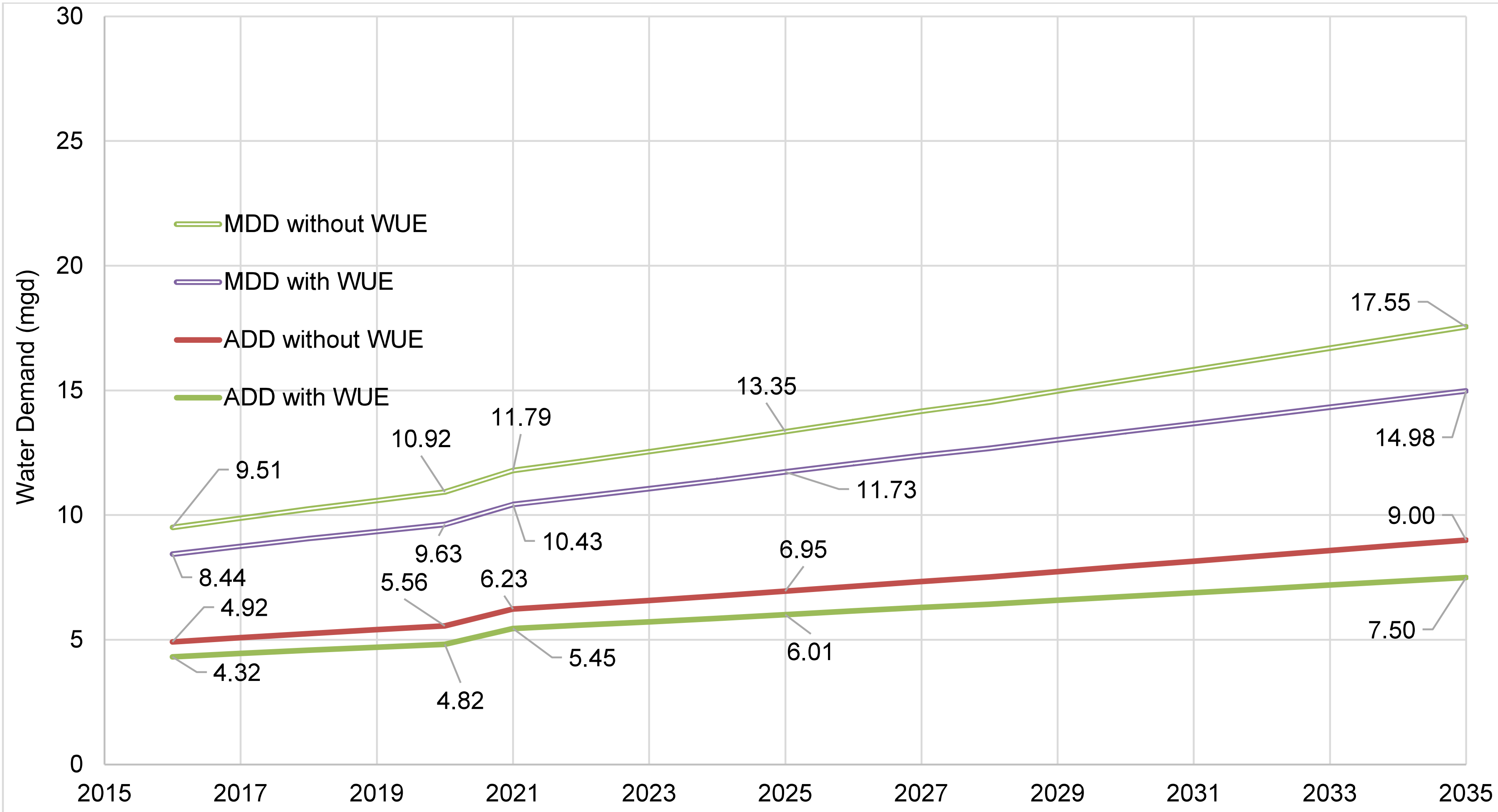
The City will continue their existing program for replacement of customer water meters. The AMR meter provides operational benefits, reduces data error and helps identify customer-side leaks. Continued installation of AMR meters is expected to enhance meter accuracy, leak detection and customer education through the detailed water use data and statistics provided by the AMR system.

6.2.3 Future WUE Program Demand-Side Measures

The City will continue the existing program measures described in Section 6.1. The City exceeds the minimum DOH requirement of 6 WUE measures.

6.2.4 Projected Demands with WUE Goals

The projected water demands considering the water savings from the City's WUE Program were represented with the low demand scenario presented in Chapter 5. Projected demands with WUE savings were compared to the medium demand projection. The low demand projection assumes a 2015 demand of 245 gallons per day per equivalent residential unit (gpd/ERU) while the medium demand projections assumes a 2015 demand of 260 gpd/ERU. The low demand projection also assumes the WUE Program will help to reduce the maximum day demand (MDD) to average day demand (ADD) peaking factor by approximately 8.1 percent. Both demand projections assume the City maintains DSL at 10 percent. Table 6.2 presents the projected ADD and MDD with and without the WUE Program for the 20-year planning period. The projected demands with the WUE Program are also shown in Figure 6.1. For ADD, WUE measures are projected to provide a reduction of 0.78 million gallons per day (mgd), or 9.1 percent, by 2035. For MDD, WUE measures are projected to provide a reduction of 2.57 mgd, or 14.7 percent, by 2035.



PROJECTED DEMANDS WITH WATER USE EFFICIENCY

FIGURE 6.1

CITY OF CAMAS
WATER SYSTEM PLAN UPDATE

Table 6.2 WUE Demand Projections Water System Plan Update City of Camas				
Demand Scenario	**2035 Projection with WUE (mgd)**	**2035 Projection without WUE (mgd)**	**Water Savings (mgd)**	**Percent Savings**
ADD	6.82	7.50	0.78	9.1
MDD	14.98	17.55	2.57	14.7

6.2.5 Future WUE Program Effectiveness

The effectiveness of the existing WUE program was evaluated using system-wide water use data. Measuring the effectiveness of the City's future WUE Program against the established goals could be similarly evaluated using system-wide water use data. Estimating the water savings directly resulting from the City's WUE Program in a single year is difficult. Therefore, long-term trends should be use to more clearly show the impact of the City's WUE Program.

Once AMR is implemented, the City will consider targeted public education programs to customers in a particular area or user profile, such as heavy irrigators. Using AMR, the City can estimate overall usage, irrigation usage and peak water use rates.

The first step would be to establish a baseline from historical information. The second step is to evaluate the resulting water use after promoting WUE through targeted activities and events to customers. It is recommended that water use be tracked for at least a year to identify trends. Some consideration would need to be given to variations in weather and economic conditions. Another method would be to perform the same before/after water use analysis for WUE Program participants who volunteer and provide their address. The resulting information would be valuable for the City to correlate its WUE Program efforts with direct water savings for its customers.

6.2.6 Budget

The City recognizes the importance of continuing their WUE measures and considers it a core function of the Utility. The WUE program provides cost savings through demand reduction and reduction in DSL. Continuing the WUE Program can assist the City in meeting peak demands and avoiding curtailment periods. The City will continue level of effort for demand-side measures; approximately 0.5 FTE of staff time across its Water Utility, finances department, and development services department. Due to AMR capabilities, it is anticipated that the City will further personalize water use communications with customers without increasing staff effort. Future supply-side WUE measures will be funded, as appropriate, through the Capital Improvement and O&M funds. If AMR detects a large numbers of existing and new leaks, the City will evaluate the need for additional personnel in its meter maintenance group to address leaks.

6.3 WATER SHORTAGE PLAN

City ordinances, CMC Chapter 13.14, have been created that allow the City to impose restrictions during a water shortage. They define five stages of water emergencies:

- Stage I – Anticipated Water Shortage.
- Stage II – Serious Water Shortage.
- Stage III - Critical Water Shortage.
- Stage IV – Emergency Water Shortage – Mandatory Outdoor Restrictions and Indoor Conservation.
- Stage V – Regional Disaster - Water Rationing.

The public works director is responsible for declaring and implementing the water shortage plans. Stages I or II implement voluntary reductions in water use for customers and some City watering reductions. Stages III and IV further regulate or prohibit nonessential uses of water. Up-to-date details on the Water Shortage can be found in CMC Chapter 13.14.

WATER QUALITY

7.1 INTRODUCTION

The City of Camas (City) is defined as a Group A – Community Water System and must comply with the drinking water standards of the federal Safe Drinking Water Act (SDWA) and its amendments, as regulated by the United States Environmental Protection Agency (USEPA). The Washington State Department of Health (DOH) adopted the updated federal standards under Washington Administrative Code (WAC) 246-290, of which the most recent version became effective April 8, 2016.

The quality of the City's drinking water sources is of primary concern to the City. The City's water is supplied by groundwater aquifers and surface water sources (Jones and Boulder Creeks), which are tested regularly for the presence of contaminants at frequencies prescribed by DOH regulations. The City is in compliance with all DOH reporting requirements, including publication and distribution of an annual Water Quality Report that keeps consumers informed as to the quality of the City's water supply and water delivery systems.

This chapter includes the following components:

- Description of current drinking water quality regulations.
- Summary of anticipated future regulations.
- Summary of current monitoring programs.
- Summary of the City's compliance with USEPA and DOH regulations.
- Recommendations.

This chapter utilizes information from the DOH's website for Drinking Water Regulation and Compliance , the USEPA's website for regulations under the SDWA , the City's annual Water Quality Reports (included in Appendix E), and the City's 2012 through 2015 water quality data.

7.2 OVERVIEW OF REGULATORY REQUIREMENTS

The SDWA of 1974, amended in 1986 and 1996, established specific roles for the federal government, state government, and water system purveyors, with respect to water quality monitoring. The USEPA is authorized to develop national drinking water regulations and oversee the implementation of the SDWA. State governments are expected to adopt the federal regulations and accept primary responsibility or "primacy" for administration and enforcement of the Act. States can also regulate contaminants and set advisory levels. Public water system purveyors are assigned the day-to-day responsibility of meeting regulations by incorporating monitoring, record-keeping, and sampling procedures into their operation and maintenance programs.

Applicable SDWA regulations are summarized in Table 7.1 and are divided into those that address source water quality, surface water treatment, distribution system water quality, and system-wide requirements, respectively. Monitoring requirements under each rule are noted herein.

Table 7.1 Drinking Water Regulations Water System Plan Update City of Camas

Rule	CFR	WAC 246-290	Affected Contaminants	Publication Date of Final Rule
Source Water Quality				
National Primary and Secondary Drinking Water Standards	See below	Part 4, 300, 310, and 320	Bacteriological, IOC, VOC, SOC, Asbestos, Radionuclides, Trihalomethanes, Lead/Copper, Phase II/V	Phases I through V promulgated 1987 through 1992
Radionuclide Rule	40 CFR 141.15 141.25 141.26	Part 4, 300(9) 310(6), and 320	Radionuclides	Promulgated April 4, 1997
Arsenic Rule	40 CFR 141.23 141.24 141.16	Part 4, 300(3) and 310(3)	Arsenic	Promulgated February 2002 Compliance by January 23, 2006
Unregulated Contaminants Monitoring Rule	N/A		Various contaminants considered for future regulations	UCMR 1 promulgated 1999
				UCMR 2 promulgated 2007
				UCMR3 promulgated May 2, 2012
Groundwater Rule		Part 4, 300(3) and 320(2)	Fecal indicators in groundwater	Promulgated January 8, 2007

Table 7.1 Drinking Water Regulations Water System Plan Update City of Camas				
Rule	**CFR**	**WAC 246-290**	**Affected Contaminants**	**Publication Date of Final Rule**
Surface Water Treatment Rules				
Information Collection Rule	40 CFR, Part 141, Subpart M	Part 6, Subparts A and B	Large Surface Water Systems: Bacteriological, DBP, IOCs	Promulgated June 18, 1996
Interim Enhanced Surface Water Treatment Rule (ESWTR)	63 FR 69478	Part 6, Subparts A and B	Large Surface Water Systems: Bacteriological, incorporate *Cryptosporidium* into watershed plans	Promulgated November 1998
Long Term 1 Enhanced Surface Water Treatment Rule	40 CFR, Parts 9, 141, 142 67 FR 1812	Part 6, Subparts A and B	Bacteriological, *Cryptosporidium*	Promulgated February 13, 2002, compliance by March 15, 2005
Long Term 2 Enhanced Surface Water Treatment Rule	40 CFR Parts 141, 142 68 FR 47639	Part 6, Subparts A and B	Bacteriological	Promulgated in 2006
Filter Backwash Recycling Rule	40 CFR Parts 9, 141, 142 66 FR 31086	Part 6, Subparts A and B	Bacteriological	Promulgated August 7, 2001, compliance by December 8, 2003
Distribution System Water Quality				
Revised Total Coliform Rule		Part 4, 300, 310(2), 320	Total coliform bacteria	Promulgated February 13, 2013 Compliance by April 2016
Lead and Copper Rule	40 CFR 141.86 141.87 141.88	Part 4, 300(4) and 310(3)	Lead and Copper	Promulgated January 12, 2000 Revised December 4, 2013
Stage 1 Disinfectants/ Disinfection Byproducts Rule	40 CFR, Parts 9, 141, 142 63 FR 69390	Part 4, 300, 310, and 320	Trihalomethanes, haloacetic acids, chlorite, bromate, and disinfectant residuals	Promulgated February 16, 1999

Table 7.1 Drinking Water Regulations Water System Plan Update City of Camas				
Rule	CFR	WAC 246-290	Affected Contaminants	Publication Date of Final Rule
Stage 2 Disinfectants/ Disinfection Byproducts Rule	40 CFR, Parts 9, 141, 142 71 FR 388	Part 4, 300, 310, and 320	Trihalomethanes and haloacetic cids	Promulgated January 4, 2006 Effective March 6, 2006
System-Wide Requirements				
Consumer Confidence Report Rule	40 CFR 141 Part O	Part 7, Subpart B	Reporting only	Published August 19, 1998
Public Notification Rule	40 CFR 141 Part Q	Part 4, 320	Reporting only	Promulgated 2000
Operator Certification Rule		WAC 246-292	N/A	Effective January 4, 2014

7.3 SOURCE WATER QUALITY

Historically, the City has relied on groundwater supplies from wells and surface water diversions. All of the City's sources are treated with chlorine and fluoride. Surface water is also treated via a slow sand filtration plant. Regulations that address source water quality for groundwater and surface water systems are described herein.

7.3.1 National Primary and Secondary Drinking Water Standards

National Primary Drinking Water Standards are currently set for 92 contaminants. Maximum contaminant levels (MCLs) and maximum contaminant level goals (MCLGs) have been established for 83 contaminants, while the remaining nine have treatment technique requirements. A constituent's MCL is generally based on its public health goal (PHG), which is the level of a contaminant in drinking water below which there is no known expected health risk. Regulated constituents include microbial contaminants, inorganic chemicals (IOCs), volatile organic compounds (VOCs), synthetic organic chemicals (SOCs), radionuclides, and disinfection by-products (DBPs). Regulations affecting DBPs are discussed below in the distribution system water quality section.

The USEPA regulates most of the chemical contaminants through the rules known as Phases I, II, IIb, and V. The USEPA issued the four rules regulating 69 contaminants over a five-year period as it gathered, updated, and analyzed information on each contaminant's presence in drinking water supplies and its health effects. The Phase I Rule was promulgated July 8, 1987 and included eight VOCs. The Phase II and IIb Rules (published January 30 and July 1, 1991) updated or created new limits for 38 contaminants. The Phase V Rule (published July 17, 1992), set standards for 23 additional contaminants.

These rules form the basis of the DOH regulations, WAC 246-290. Since the Phase V Rule, MCLs for additional contaminants have been established through new regulations and must be adopted by the DOH.

The USEPA has also established secondary standards for 15 contaminants to address the aesthetic quality of drinking water; these secondary standards have also been adopted within the WAC. Because the federal standards primarily address taste and odor, rather than health issues, they are often used only as a guideline. For new community water systems, the DOH requires treatment for secondary MCL exceedances under WAC 246-290-320 (3)(d). For other public water systems, the WAC stipulates that the required follow-up action be determined by the DOH based on the degree of consumer acceptance of the water quality and their willingness to bear the cost of meeting the secondary standard.

Current primary and secondary MCLs for inorganic and organic constituents, respectively, are documented in the following subsections.

7.3.2 Inorganic Chemicals

Regulated IOCs include elemental metals such as mercury, arsenic, and iron. Some non-metallic constituents such as chloride, fluoride, and sulfate are also included in this category. Physical properties of IOCs that affect water quality in this category include turbidity, specific conductivity, total dissolved solids, and color. WAC 246-290-310 specifies primary and secondary MCLs for IOCs, which are summarized in Table 7.2 and Table 7.3 respectively.

Table 7.2 Primary MCLs for Inorganic Chemicals
Water System Plan Update
City of Camas

Chemical	Primary MCL (mg/L)(1)
Antimony (Sb)	0.006
Arsenic (As)	0.01
Asbestos	7 million fibers/liter (length > 10 microns)
Barium (Ba)	2.0
Beryllium (Be)	0.004
Cadmium (Cd)	0.005
Chromium (Cr)	0.1
Copper (Cu)	1.3(2)
Cyanide (HCN)	0.2
Fluoride (F)	4.0
Lead (Pb)	0.015(2)
Mercury (Hg)	0.002
Nickel (Ni)	0.1

Table 7.2	Primary MCLs for Inorganic Chemicals Water System Plan Update City of Camas
Chemical	**Primary MCL (mg/L)[1]**
Nitrate (as N)	10.0
Nitrite (as N)	1.0
Selenium (Se)	0.05
Sodium (Na)	20[3]
Thallium (Tl)	0.002

Notes:
(1) Source: State DOH Drinking Water Regulations (246-290-310), effective March 2012.
(2) Lead and copper have established ALs, rather than MCLs. These are discussed further in the lead and copper rule (LCR), under the *Distribution System Water Quality* section.
(3) USEPA has established a recommended level of 20 milligrams per liter (mg/L) for individuals that have restrictions on daily sodium intake. This is not an enforceable standard.

Table 7.3	Secondary MCLs for Inorganic Chemicals Water System Plan Update City of Camas
Chemical	**Primary MCL (mg/L)[1]**
Aluminum	0.05 to 0.2 mg/L
Chloride	250 mg/L
Color	15 (color units)
Copper	1.0 mg/L
Corrosivity	Non-corrosive
Fluoride	2.0 mg/L
Foaming Agents	0.5 mg/L
Iron	0.3 mg/L
Manganese	0.05 mg/L
Odor	3 threshold odor number
pH	6.5-8.5
Silver	0.10 mg/L
Sulfate	250 mg/L
Total Dissolved Solids	500 mg/L
Zinc	5 mg/L

Notes:
(1) Source: State DOH Drinking Water Regulations (246-290-310), effective March 2012.

7.3.2.1 Monitoring Requirements

The City has a waiver for IOC testing that reduces the frequency to once every nine years for all its wells. The next IOC samples are required in 2020.

7.3.2.2 Compliance

The City complies with the requirements for monitoring IOCs, and has not exceeded any water quality requirements. Water quality data for inorganic chemicals from 2012-2015 is presented in Table 7.4.

Table 7.4 Inorganic Chemicals Monitoring Results
Water System Plan Update
City of Camas

Contaminant	Maximum Contaminant Level Goal	Maximum Contaminant Level	2012	2013	2014	2015
Fluoride (mg/L)	1	4	0.56 - 0.96	0.58 - 1.09	0.62 - 1.1	0.6 - 0.96
Nitrates (mg/L)	10	10	0.44 - 1.56	0.43 - 1.11	0.41 - 1.22	0.57 - 1.6
Other Substances						
Total Hardness (ppm)	0	0.015	34	34	34	34
Turbidity (NTU)	0	1.3	0.32	0.32	0.28	0.28

7.3.3 Volatile Organic and Synthetic Organic Compounds

VOCs are manufactured, carbon-based chemicals that vaporize quickly at normal temperatures and pressures. VOCs include many hydrocarbons associated with fuels, paint thinners, and solvents. This group does not include organic pesticides, which are regulated separately as SOCs. VOCs are divided into the two following groups:

- Regulated VOCs that have been determined to pose a significant risk to human health.
- Unregulated VOCs for which the level of risk to human health has not been established.

There are currently 21 regulated VOCs and 33 regulated SOCs. A list of these compounds and their MCLs is included in Table 7.5.

Table 7.5 Regulated Volatile and Synthetic Organic Chemicals
Water System Plan Update
City of Camas

Organic Chemical	Federal Regulation	Primary MCL (mg/L)(1)	Organic Chemical	Federal Regulation	Primary MCL (mg/L)(1)
Volatile Organic Chemicals (VOCs)					
Vinyl chloride	Phase I	0.002	Monochlorobenzene	Phase II	0.1
Benzene	Phase I	0.005	Ortho-Dichlorobenzene	Phase II	0.6
Carbon Tetrachloride	Phase I	0.005	Styrene	Phase II	0.1
1,2-Dichloroethane	Phase I	0.005	Tetrachloroethylene	Phase II	0.005
Trichloroethylene	Phase I	0.005	Toluene	Phase II	1
Para-Dichlorobenzene	Phase I	0.075	Trans-1,2-Dichloroethylene	Phase II	0.1
1,1-dichloroethylene	Phase I	0.007	Xylenes (total)	Phase II	10
1,1,1-Trichloroethane	Phase I	0.2	Dichloromethane	Phase V	0.005
Cis-1,2-Dichloroethylene	Phase II	0.07	1,2,4-Trichloro-benzene	Phase V	0.07
1,2-Dichloropropane	Phase II	0.005	1,1,2-Trichloroethane	Phase V	0.005
Ethylbenzene	Phase II	0.7	Chlorobenzene		0.07
Synthetic Organic Chemicals (SOCs)					
Arochlor	Phase II	0.002	Benzo(a)pyrene	Phase V	0.0002
Atrazine	Phase II	0.003	Dalapon	Phase V	0.2
Carbofuran	Phase II	0.04	Di(2-ethylhexyl) adipate	Phase V	0.4
Chlordane	Phase II	0.002	Di(2-ethylhexyl) phthalate	Phase V	0.006
Dibromochloro-propane	Phase II	0.0002	Dinoseb	Phase V	0.007
2,4-D	Phase II	0.07	Diquat	Phase V	0.02
Ethylene dibromide	Phase II	0.00005	Endothall	Phase V	0.1
Heptachlor	Phase II	0.0004	Endrin	Phase V	0.002
Heptachlor epoxide	Phase II	0.0002	Glyphosate	Phase V	0.7
Lindane	Phase II	0.0002	Hexachlorobenzene	Phase V	0.001
Methoxychlor	Phase II	0.04	Hexachloro Cyclopentadiene	Phase V	0.05
Polychlorinated biphenyls (PCBs)	Phase II	0.0005	Oxamyl (vydate)	Phase V	0.2
Pentachlorophenol	Phase II	0.001	Picloram	Phase V	0.5
Toxaphene	Phase II	0.003	Simazine	Phase V	0.004
2,4,5-TP	Phase II	0.05	2,3,7,8-TCDD (dioxin)	Phase V	$3x10^{-8}$

Notes:
(1) 40 CFR 141.61(a) and (c); adopted by State DOH, effective April 1999.

7.3.3.1 Monitoring Requirements

Per DOH requirements, VOCs and SOCs must be sampled once every three years, unless a waiver is in place. State waivers requiring no monitoring have been issued for dioxin, endothal, diquat, glyphosate, and insecticides. Additionally, the state grants a waiver if a chemical is not in use or previous monitoring indicates contamination would not occur. The City must apply for waivers through DOH. There are two types of waivers, risk-based or area-wide. The risk-based waiver requires a susceptibility analysis and DOH charges a fee for these waivers (purchased waivers). Area-wide waivers are issued if a chemical is not used within a region, thus DOH does not charge for these waivers. While the state issues both types of waivers, an area-wide waiver is referred to as a “State waiver.” A waiver is in place for two years, during which time there are no requirements for monitoring. However, once a waiver expires, monitoring frequency for VOCs and SOCs is one sample every three years.

Quarterly sampling of VOCs is required for the Washoughal wellfield. Well 13 has a six-year waiver ending December, 2019. All other wells have statewide state issued waivers. The City has waivers that reduce required sampling frequencies to once every nine years for pesticides and soil fumigants for all wells Herbicides.

7.3.3.2 Compliance

A review of the City’s 2007 to 2013 water quality data shows that all of the City’s source wells test below the VOC or SOC MCLs, or are not detected at all.

7.3.4 Radionuclides

In December 2000, the USEPA announced updated standards for radionuclides. This rule became effective December 2003. All community water systems are required to meet the MCLs listed in Table 7.6 and requirements for monitoring and reporting. All systems were required to complete initial monitoring and phase in the monitoring requirements between December 8, 2003 and December 30, 2007. Initially, utilities were required to undergo four consecutive quarters of monitoring for gross alpha, combined radium-226/-228, and uranium. Only systems that were considered “vulnerable” were required to monitor for gross beta (quarterly samples), tritium, and strontium-90 (annual samples). The initial monitoring was used to determine if the system would have to perform reduced or increased monitoring.

Table 7.6 Regulated Radionuclides Water System Plan Update City of Camas	
Radionuclide	**MCL[1]**
Radium – 226	3 pCi/L
Combined Radium – 226 and 228	5 pCi/L
Uranium	30 μg/L
Gross Alpha (excluding Uranium)	15 pCi/L
Beta Particle and Photon Radioactivity	4 millirem/year[2]
Tritium	20,000 pCi/L[2]
Strontium-90	8 pCi/L[2]

Notes:
(1) Environmental Protection Agency, 40 CFR 141.66.
(2) According to USEPA 40 CFR 141.66, “average annual concentration of beta particle and photon radioactivity from man-made radionuclides in drinking water must not produce an annual dose equivalent to the total body or any internal organ greater than 4 millirem/year.” The MCLs for tritium and strontium-90 are assumed to produce body organ doses equivalent to 4 millirem/year.

7.3.4.1 Monitoring Requirements

The WAC states “The purveyor may omit analysis for radium-226 and radium-228 if the gross alpha particle is less than five picocurie per liter (pCi /L).” The City is required to sample for radium-228 once every three years at Well 9 and once every six years at all other wells. Gross alpha monitoring is required once every three years at Well 9 and once every six years at all other wells. The USEPA has adopted a new schedule of sampling once every three years that has not yet been adopted by DOH. In Washington State, natural occurrence levels of the regulated radionuclides have generally been quite low.

7.3.4.2 Compliance

The City is in full compliance with the monitoring requirements and has no exceedances to date.

7.3.5 Arsenic Rule

In January 2001, the USEPA promulgated a new standard that requires public water systems to reduce arsenic levels in drinking water. The final rule became effective in 2002 and required compliance by 2006. The rule applies to all community water systems and non-transient, non-community water systems, regardless of size. The rule not only establishes an MCL for arsenic (0.010 mg/L), based on a running annual average (RAA) of quarterly results and an MCLG for arsenic (zero), but also lists feasible and affordable technologies for small systems that can be used to comply with the MCL. However, systems are not required to use the listed technologies in order to meet the MCL.

Initial monitoring of arsenic required groundwater systems to take one sample between 2005 and 2007. Monitoring requirements decreased to one sample every three years (for groundwater systems) if the initial result is less than the MCL. Monitoring requirements increased to quarterly samples if the initial results were greater than the MCL. Each entry point to the distribution system should have been tested, unless otherwise specified by the State.

The arsenic rule has been adopted by the Washington DOH as a revision to the arsenic MCL under WAC 249-290-310.

7.3.5.1 Monitoring Requirements

Monitoring requirements are once every three years, per requirements for IOCs. Arsenic must be monitored at each entry point to the distribution system as part of the IOC monitoring framework. If any sampling point is in violation of an MCL, the system is in violation.

7.3.5.2 Compliance

The City is in full compliance with the monitoring requirements and has no exceedances to date.

7.3.6 Surface Water Treatment Rules

7.3.6.1 Surface Water Treatment Rule

On December 31 1990, USEPA promulgated the Surface Water Treatment Rule (SWTR) to establish filtration and disinfection as a drinking water treatment technique in lieu of MCLs for Giardia lamblia, viruses, HPC bacteria, Legionella, and turbidity. The SWTR is based on the premise that all surface water and groundwater under the influence of surface water (GWI) are at risk of microbiological contamination and the previous requirements were inadequate to prevent waterborne disease outbreaks. The SWTR requires 99.9 percent (3 log) removal and/or inactivation of Giardia cysts, and 99.99 percent (4 log) removal and/or inactivation of viruses. To meet these requirements, surface water systems must disinfect according to strict requirements, must filter water unless certain source water-quality and site-specific conditions are met, and must be operated by qualified personnel. To avoid the filtration requirement, the following criteria must be met:

1. Ninety percent of the samples taken from the source water must have fewer than 100 total coliform bacteria per 100 milliliters (mL) and fewer than 20 fecal coliform bacteria per 100 mL.
2. The turbidity level prior to disinfection must not exceed 5.0 nephelometric turbidity unit (NTU).
3. Giardia and virus inactivation requirements must be met, providing redundant disinfection components and maintaining required disinfection residuals.

4. An approved watershed control program must be implemented with annual onsite inspections.
5. Total Coliform Rule (TCR) requirements in the distribution system and Triahalomethanes (THM) requirements must be met.
6. The water system must be free of waterborne disease outbreaks.
7. The purveyor must have alternative operating plans to address high turbidity levels and other water quality issues.

Utilities that use unfiltered water must maintain a disinfectant residual throughout the water distribution system. At entry points to the distribution system, residual disinfectant concentrations cannot be <0.2 mg/L for more than 4 hours. At distribution system sample locations, residual disinfectant concentrations cannot be undetectable in greater than 5 percent of samples in a month, for any 2 consecutive months. Heterotrophic plate count (HPC) ≤ 500/mL is deemed to have detectable residual disinfectant.

GWI is regulated by the SWTR. The intent is to provide the same level of treatment for groundwater sources that are at risk for contamination by pathogens as surface water supplies. Examples of water sources that may be classified as GWI are shallow wells, springs, infiltration galleries, and Ranney wells.

7.3.6.2 Long Term 2 Enhanced Surface Water Treatment Rule

The Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR) is intended to address a number of deficiencies in the original 1990 SWTR, including the following:

1. Cryptosporidium is not addressed in the SWTR.
2. Pathogen reduction may not be adequate in poorer quality waters.
3. Virus disinfection requirements may be greater than indicated in the SWTR.
4. Disinfectants and Disinfection Byproducts Rule (DBPR) may undermine the SWTR by causing utilities to reduce disinfectant residuals.

USEPA developed the ESWTR in two stages. The proposed Interim Enhanced Surface Water Treatment Rule (Interim ESWTR) was published in the Federal Register on 29 July 1994. USEPA finalized the Interim ESWTR and Stage 1 DBPR in November 1998, as required by the 1996 Amendments to the SDWA, Section 1412(b)(2)(C). The final rules resulted from formal regulatory negotiations with a wide range of stakeholders that took place in 1992-93 and 1997. On 16 January 2001, USEPA published final revisions to the Interim ESWTR and Stage 1 DBPR. The Long Term 1 Enhanced Surface Water Treatment Rule (LT1ESWTR) was promulgated in February 2002 and builds on the requirements of the SWTR. The LT1ESWTR specifies treatment requirements to address Cryptosporidium and other microbial contaminants in public water systems serving less than 10,000 persons.

The LT2ESWTR proposed rule was promulgated in August 2003 and published in the Federal Register on January 5, 2006. The LT2ESWTR requires public water systems (PWSs) that use surface water or groundwater under the direct influence of surface water to monitor their source water (influent water prior to treatment) for *Cryptosporidium, E. coli*, and turbidity for a period of two years starting six months after the rule is finalized. Based on the results of this monitoring, water systems will be classified in one of four risk bins. Systems classified in higher risk bins must provide 90 to 99.7 percent (1.0 to 2.5 log) additional reduction of Cryptosporidium levels. The regulation specifies a range of treatment and management strategies, collectively termed the "microbial toolbox," that systems may select to meet their additional treatment requirements. All unfiltered systems must provide at least 99 or 99.9 percent (2 or 3-log) inactivation of Cryptosporidium, depending on the results of their monitoring.

7.3.6.3 <u>Monitoring requirements</u>

Monitoring requirements are dictated by source water quality and the selected treatment processes. The City has recently completed construction of a new Slow Sand Filtration Treatment Plant for its surface water sources. The City's surface water sources have been listed as Bin 1 sources for cryptosporidium removal and do not require additional treatment beyond slow sand filtration. Specific treatment objectives and monitoring for the slow sand facility include:

- Turbidity reduction as required for slow sand filtration processes, providing finished water turbidity less than one NTU in 95 percent of samples each month and no turbidity samples greater than five NTU.
- Provide 3-log giardia removal and inactivation through a combination of 2-log removal by filtration and 1-log inactivation by chlorine disinfection.
- Provide a total 4-log virus inactivation and removal through filtration and disinfection.
- Provide a continuous free chlorine residual of not less than 1.0 mg/L entering the distribution system at the water quality station and pressure reducing valve (PRV) vault at NE 277th Avenue and NE 14th Street.
- Provide treated water pH of 7.5 plus or minus 0.2 units (if the optional caustic feed system is installed and used for pH adjustment).
- Provide a fluoride residual of 0.7 mg/L.

7.3.6.4 <u>Compliance</u>

The City has constructed a new slow sand filtration treatment plant that is in full compliance with all surface water treatment rules.

7.3.6.5 Filter Backwash Recycling Rule

The Filter Backwash Recycling Rule (FBRR) regulates the recycling of filter backwash water within the treatment process of public water systems. The purpose of the rule is to require systems to review their recycle practices and, where appropriate, work with the DOH to make any necessary changes to recycle practices that may compromise microbial control. The City's slow sand filter backwash water is wasted to a detention pond rather than recycled to the head of the plant and thus the FBRR does not apply.

7.3.7 Groundwater Rule

The USEPA enacted the final Groundwater Rule (GWR) January 8, 2007, for the purpose of providing increased protection against microbial pathogens in public water systems that use untreated groundwater. The GWR will apply to public water systems that serve groundwater as well as to any system that mixes surface and groundwater, if the groundwater is added directly to the distribution system and is provided to customers without providing disinfection contact time.

To implement the GWR, the USEPA is taking a risk-based approach to protect drinking water from groundwater sources that have been identified as being at the greatest risk of fecal contamination. This strategy includes four primary components:

1. **Sanitary Surveys**. Sanitary surveys must be conducted every three years and meet the provisions of the 1998 Interim ESWTR as it relates to populations served. In addition, the sanitary survey shall implement the eight elements of the USEPA/State Joint Guidance on Sanitary Surveys. These elements relate to source protection; identification of the physical components and their condition; and description and implementation of programs for treatment, distribution, storage, pumping, monitoring, operation and maintenance; and operator certification.
2. **Source Water Monitoring**. Source water monitoring is triggered when a system does not sufficiently disinfect drinking water to achieve 4-log (99.99 percent) virus removal and identifies a positive routine sample during its TCR monitoring and hydrogeologic sensitivity assessment monitoring (at the State's discretion) targeted at high-risk systems. Once a total coliform-positive sample is found within a distribution system, the system is required to collect one source water sample per source and monitor for a fecal indicator. Washington State may choose to issue a waiver if the groundwater source has a hydrogeologic barrier.
3. **Corrective Action**. Corrective action is required for any system with a significant deficiency or evidence of source water fecal contamination. Corrective actions must be taken by "groundwater systems that have a significant deficiency or have detected a fecal indicator in their source water." USEPA guidelines recommend that corrective actions take place within 90 days, or longer if approved by the State. The problem should be solved by eliminating the contaminate source, correcting the significant deficiencies, or providing an alternate source of water supply.

4. **Compliance Monitoring**. Compliance monitoring ensures that treatment technology installed to treat drinking water reliably achieves 4-log virus inactivation. Compliance monitoring applies to all groundwater systems that disinfect as a corrective action. Systems serving greater than 3,300 individuals must continuously monitor their disinfection treatment process. If disinfection concentrations are below the required level, the system must restore disinfection concentration within 4 hours.

The compliance date for triggered source water monitoring and the associated corrective actions, as well as compliance monitoring, was December 1, 2009. Initial sanitary surveys should have been completed by December 31, 2012. However, for community water systems that have been identified by the State as outstanding performers (generally those that have treatment that provides 4-log virus inactivation or removal at all sources), the initial sanitary survey must be completed by December 31, 2014.

Many of the requirements of the GWR are determined by the individual state agencies. The requirements of the GWR were adopted by the Washington DOH into WAC 246-290 in November 2010. In addition, the DOH has provided a Fact Sheet for Group A utilities with recommended actions to prepare for the GWR. These actions include the following:

- Correct deficiencies from the last sanitary survey.
- Install a sample tap at each wellhead.
- Know specifically where each well's water goes. Triggered source water monitoring will require monitoring of all sources, unless it can be shown that the area of concern in the distribution system is only served by a limited number of sources.
- Update the emergency response plan, to be ready to provide alternate water, if needed.
- If currently treating groundwater from a well, contact the regional office engineer to confirm whether you currently achieve 4-log virus inactivation. Systems that treat to this level will not be required to conduct triggered source water monitoring, but will instead be required to meet treatment technique monitoring requirements.

7.3.7.1 Monitoring Requirements

The DOH is not requiring all systems to perform assessment monitoring. In addition, DOH has indicated that the sanitary surveys completed under the GWR will not differ significantly from those currently required.

Triggered source water monitoring is required at all sources if a distribution system sample tests positive for total coliform (as collected under the total coliform regulations). The federal GWR includes a provision that positive coliform samples attributed to a distribution system source will not trigger source water monitoring. The DOH has not yet decided on the criteria for determining whether a sample can be attributed to the distribution system but may not require triggered source monitoring if they document in writing that the coliform positive sample was attributed to a distribution system deficiency. Source water monitoring will be required at fewer sources if systems can demonstrate the sources impacting each TCR sample site. However, such a plan would need to be pre-approved by the DOH.

The federal GWR also allowed for reduced source water monitoring after 12 non-detect samples. The DOH has not yet established a reduced monitoring standard.

7.3.7.2 Compliance

The City completed its sanitary survey in 2014. No reduction in monitoring resulted from the survey. The City is in full compliance at this time.

7.3.8 Unregulated Contaminant Monitoring Rule

The 1986 amendments to the SDWA require public water systems to monitor for unregulated contaminants every five years and submit these data to the states. The intent of this program is to gather scientific information on unregulated contaminants to determine if regulations are required to protect human health. Both the 1993 and 1996 amendments to the act added new lists of contaminants, which led the USEPA to develop a revised program for monitoring. The new program became known as the Unregulated Contaminant Monitoring Regulations (UCMR 1999). The new UCMR program began in 2001, and produces a new list of unregulated contaminants for monitoring every five years.

Under the UCMR program, USEPA asks large systems to take two sets of samples for unregulated contaminants at six-month intervals. There are two tiers of contaminants in UCMR 1; List 1 - Assessment Monitoring, and List 2 - Survey Screening. List 1 contaminants are sampled by all water systems serving over 10,000 people. There are 10 List 1 contaminants, consisting of flame-retardants and other priority contaminants (USEPA Method 527), and some explosives (USEPA Method 529). List 2 contaminants are analyzed using less common analytical techniques, and only a portion of the purveyors required to test for List 1 contaminants are required to test for List 2. List 2 contaminants include Acetanilide pesticides and degraded products (USEPA Methods 525.2 and 535), and Nitrosoamines/NDMA (USEPA Method 521).

The second cycle (UCMR 2) of monitoring was published in the Federal Register on January 4, 2007. The UCMR 2 required monitoring for 25 contaminants using five analytical methods during 2008- 2010. The third cycle (UCMR 3) of monitoring was published on May 2, 2012. UCMR 3 requires monitoring for 30 contaminants: 28 chemicals, and 2 viruses. Monitoring is to occur during 2012 to 2016, and the third cycle UCMR 3 requires laboratories have USEPA approval to analyze public water supply samples.

7.3.8.1 Monitoring Requirements

The City has conducted monitoring of the unregulated contaminants for UCMR 1, 2, and 3. UCMR 3 testing was completed with results published in the 2015 Water Quality Report.

7.3.8.2 <u>Compliance</u>

The City is in compliance with the UCMR testing requirements.

7.4 DISTRIBUTION SYSTEM WATER QUALITY

Regulations that address distribution system water quality are described herein.

7.4.1 Total Coliform Rule

Coliform bacteria describe a broad category of organisms routinely monitored in potable water supplies. Though not all coliform bacteria are pathogenic in nature, they are relatively easy to identify in laboratory analysis. If coliform bacteria are detected, then pathogenic organisms may also be present. Bacterial contamination in a water supply can cause a number of waterborne diseases; therefore, these tests are strictly monitored and regulated by DOH.

The TCR specifies two types of MCL violations, “monthly” and “acute.” A purveyor is required to notify both DOH and system consumers if either a monthly or acute MCL violation occurs. The TCR also requires secondary disinfection in accordance with the following:

- A minimum disinfectant residual of 0.2 mg/L free chlorine or 0.5 mg/L chloramines measured as total chlorine must be continually present at the entrance of the distribution system, with a detectable chlorine residual maintained throughout the distribution system.
- A sample with HPCs less than 500 colony forming units per 100 mL is assumed to carry the required minimum residual.

The original 1989 TCR rule was revised on February 13, 2013. Water systems must comply with the requirements of the Revised Total Coliform Rule (RTCR) by April 1, 2016. The revision requires public water systems that are vulnerable to microbial contamination to identify and fix problems; and establishes criteria for systems to qualify for and stay on reduced monitoring, which could reduce water system burden and provide incentives for better system operation. The rule changes associated with the RTCR are summarized below.

- Monitoring Changes: The RTCR links monitoring frequency to water quality and system performance.
- Public Notification Changes: The RTCR requires public notification when an *E. coli* MCL violation occurs, or when a utility fails to conduct the required assessment and corrective action.

- MCL Changes and Treatment Technique Violation: The RTCR replaces the MCL and MCLG for total coliforms with a MCL and MCLG for *E. coli*, as well as a treatment technique for coliforms.
- New Assessment Requirements: As part of the new treatment technique requirements, all utilities must conduct an assessment to find and fix any vulnerabilities when a treatment technique trigger occurs. Systems must conduct a Level 1 assessment or a more complex Level 2 assessment depending on the level of concern raised by the results of total coliform sampling.
- Corrective Action Requirements: Utilities are responsible for correcting any sanitary defects found through Level 1 or Level 2 assessments within 30 days or on a schedule approved by the DOH if this timeframe is not possible.

7.4.1.1 Monitoring Requirements

Monitoring requirements are described in the City's coliform monitoring plan (CMP). The City currently collects 30 samples per month from 26 locations based on a residential population of 27,111 as provided by the DOH Water Quality Monitoring Schedule as of October, 2016.

7.4.1.2 Compliance

Within the last ten years the City has had two total coliform exceedances; one total coliform exceedances in 2015 and one total coliform exceedance in 2007. All follow-up tests were negative, and no public notification was required. The City is currently in full compliance with the TCR and its RTCR compliant CMP can be found in Appendix E.

7.4.2 Stage 1 Disinfectants and Disinfection Byproducts Rule

The Stage 1 DBPR was promulgated in December 1998 and regulates the concentration of disinfectants such as chlorine, chlorine dioxide, and chloramines, which are oxidants used to control waterborne disease. The DBPR also regulates DBPs such as THMs and Haloacetic acids (HAAs), bromate, and chlorite. DBPs are formed when disinfectants used to control microorganisms react with natural organic matter in water.

The MCLs for THMs and HAAs are 0.080 and 0.060 mg/L, respectively. The four regulated trihalomethanes are chloroform, bromodichloromethane, dibromochloromethane, and bromoform. The five regulated HAAs are monochloroacetic acid, dichloroacetic acid, trichloroacetic acid, monobromoacetic acid, and dibromoacetic acid. Compliance with the THM and HAA MCLs is based on a system-wide RAA of quarterly samples taken in the distribution system. The Stage 1 DBPR also introduced a maximum residual disinfectant level (MRDL) of 4 mg/L for free chlorine, based on an RAA of samples collected concurrent with TCR monitoring.

7.4.2.1 Monitoring Requirements

Monitoring locations under the Stage 1 DBPR were initially identified in an Initial Distribution System Evaluation (IDSE) prepared by the City in 2004. The City's IDSE explains that the chlorine and chloramines are monitored as part of the CMP, which currently tests at 40 sites system wide. The City monitors quarterly for disinfectant residuals at each of these locations. Additionally, the IDSE identifies nine locations representing the longest detention time corresponding to each water treatment plant. The IDSE notes that because the City does not use ozone or chlorine dioxide, monitoring for bromated or chlorite is not necessary. Monitoring for DBPs included a THM and HAA sample from each site quarterly.

7.4.2.2 Compliance

The City meets the requirements of the Stage 1 DBPR.

7.4.3 Stage 2 Disinfectants and Disinfection Byproducts Rule

The Stage 2 DBPR was promulgated by the USEPA on January 4, 2006. The key provisions of the Stage 2 DBPR consist of:

- An IDSE to identify distribution system locations with high DBP concentrations. Further information is provided below.
- Site-specific locational running annual average (LRAAs) instead of system-wide RAAs to calculate compliance data. LRAAs will strengthen public health protection by eliminating the potential for groups of customers to receive elevated levels of DBPs on a consistent basis.

The MCLs for THM4 and HAA5 remain unchanged from the Stage 1 DBPR at 0.080 and 0.060 mg/L, respectively, although they will now be calculated as LRAAs.

The IDSE is the first step in Stage 2 DBPR compliance. Its intent is to identify sampling locations for Stage 2 DBPR compliance monitoring that represents distribution system sites with high THM and HAA levels. For systems serving more than 500 people, three options were available for the IDSE:

- 40/30 Waiver, which allows systems with no samples exceeding THM and HAA concentrations of 40 and 30 micrograms per Liter (µg/L), respectively, during eight consecutive quarters to apply to waive the IDSE requirements.
- Standard Monitoring Program (SMP), which involves a one-year distribution system monitoring effort to determine locations that routinely show high THM4 and HAA5 concentrations.
- System-Specific Study (SSS), based on historical data and a system model.

The Washington DOH adopted the Stage 2 DBPR on January 4, 2010.

7.4.3.1 Monitoring Requirements

The City was approved for a 40/30 waiver in 2006 and is currently required to collect two samples per year for THM and HAA5.

7.4.3.2 Compliance

The City is in compliance with monitoring requirements for the Stage 2 DBPR. Since April 2012, there have been no samples exceeding the MCL for THM or HAA5 as shown in Table 7.7. The results represent the range of samples from all sources sampled in a particular year.

Table 7.7 Disinfection Byproducts Rule Monitoring Results
Water System Plan Update
City of Camas

Contaminant	Maximum Contaminant Level Goal	Maximum Contaminant Level	2012	2013	2014	2015
Haloacetic Acids (µg/L)	48	60	1.2 - 7.4	1.1 - 3.7	1.5 - 4.2	9.6
Total Trihalomethanes (µg/L)	60	80	1.2 - 1.4	1.5 - 9.7	5.7 - 7.2	4.1 - 15

7.4.4 Lead and Copper

In 1991, the USEPA promulgated the Federal Lead and Copper Rule (LCR). Washington State adopted this rule in 1995 with minimal changes. The LCR is intended to reduce the tap water concentrations that can occur when corrosive source water causes lead and copper to leach from water meters and other plumbing fixtures. Possible treatment techniques to reduce lead and copper leaching include addition of soda ash or sodium hydroxide to the source water prior to distribution.

The LCR establishes an action level (AL) of 0.015 mg/L for lead and 1.3 mg/L for copper, based on the 90th percentile level of tap water samples. The most recent revisions (2007) added the following requirements (required as of December 10, 2009):

1. Monitoring. The rule adds a new reduced monitoring requirement, which prevents water systems above the lead AL to remain on a reduced monitoring schedule.
2. Treatment. Water systems must provide advanced notification and gain the approval of the primacy agency for intended changes in treatment or source water that could increase corrosion of lead.
3. Consumer notification. All utilities must now provide a notification of tap water monitoring results for lead to owners and/or occupants of homes and buildings who consume water from the taps that are part of the utility's sampling program.

4. Lead service line replacement. Utilities must reconsider previously "tested-out" lines when resuming lead service line replacement programs. This provision only applies to systems that have:
   a. Initiated a lead service line replacement program.
   b. Complied with the lead AL for two consecutive monitoring periods and discontinued the lead service line replacement program.
   c. Subsequently been re-triggered into lead service line replacement.
   d. All previously "tested-out" lines would then have to be tested again or added back into the sampling pool and considered for replacement.

An AL exceedance is not a violation but can trigger other requirements that include water quality parameter monitoring, corrosion control treatment, source water monitoring/treatment, public education, and lead service line replacement.

Samples must be collected at cold water taps in homes/buildings that are at high risk of lead/copper contamination as identified in 40 CFR 141.86(a). The number of sample sites is based on system size.

7.4.4.1 Monitoring Requirements

The City must collect 30 samples every three years, based on the standard monitoring schedule. The most recent set of customer tap samples were collected during September 2015.

7.4.4.2 Compliance

The City is installing a corrosion control system in the Slow Sand Filtration Plant to comply with the LCR. It is anticipated that corrosion control will require caustic soda and CO2 addition. This system is anticipated to be online in 2019. The City's monitoring results indicate that the City is in compliance with the requirements of the LCR. The City's LCR monitoring results for 2012 and 2015 are presented in Table 7.8. Results represent the 90th percentile of all samples taken within a given period.

Table 7.8 Lead and Copper Rule Monitoring Results
Water System Plan Update
City of Camas

Contaminant	Maximum Contaminant Level Goal (mg/L)	Action Level (mg/L)	2012 Result (mg/L)	2015 Result (mg/L)
Lead	0	0.015	0.0033	0.0026
Copper	0	1.3	0.56	0.61

7.5 WATER QUALITY MONITORING PROGRAM

Federal regulations related to system-wide requirements are discussed herein.

7.5.1 Consumer Confidence Report

The Consumer Confidence Report (CCR) Rule was finalized on September 19, 1998. Each July, community water systems must provide an annual report to customers providing information as to the quality of their drinking water supply. These reports are referred to as "Consumer Confidence Reports" or CCRs. These reports let customers know whether their water meets state and federal drinking water standards. The CCR includes information on the water source, the regulated and unregulated contaminants that have been detected during the year, and their concentrations. The report also provides information on DBPs or microbial contaminants and the potential health effects of the contaminants at concentrations greater than the MCL. The likely source of the contaminants is identified, and a summary of any violations in monitoring, reporting, or record-keeping is included. The reports can assist customers with special health needs to make informed decisions regarding their drinking water. CCRs provide references and telephone numbers as to health effects data and available information about the water system in general.

7.5.1.1 Compliance

The City issues an annual *Water Quality Report*, which includes a basic description of drinking water contaminants, source description, and annual water quality results. The 2016 *Water Quality Report* is included in Appendix E.

7.5.2 Public Notification Rule

The Public Notification Rule (PNR) requires that public water systems notify their customers when they violate USEPA or State regulations (including monitoring requirements) or otherwise provide drinking water that may pose a risk to consumers' health. The original public notification requirements were established in the SDWA; the revised PNR was promulgated in 2000 as required by the 1996 SDWA amendments.

The PNR establishes three notification levels:

- Immediate Notice (Tier 1): In a situation where there is the potential for human health to be immediately impacted, notification is required within 24 hours.
- Notice as Soon as Possible (Tier 2). In a situation where an MCL is exceeded or water has not been treated properly, but there is no threat to human health, notification is required as soon as possible and within 30 days.
- Annual Notice (Tier 3). In a situation where a standard is violated that does not directly impact human health, notice must be provided within one year, likely within the system's CCR.

Notification requirements are described in the City's Emergency Response Plan (ERP), available through City Staff. The ERP includes protocol for notifying the DOH and the public when a positive detection of VOCs/SOCs, IOCs, physical characteristics, or bacteriological presence is determined. The ERP maintains current phone numbers and contact information to all relevant utilities, contractors, government agencies, and local cable and radio stations.

7.5.2.1 Compliance

Because the City has never had a Tier 1, 2, or 3 violation, no notifications under the PNR have been required.

7.5.3 Operator Certification

The 1996 SDWA amendments require that states develop and implement an operator certification program. Final guidelines were published in February 1999. The regulations set out minimum guidelines for such a certification program including operator classification and qualifications. These sections of the regulation require that:

- Each treatment facility and/or distribution system is placed under the direct supervision of a certified operator.
- Operator certification must be equal to or greater than the system classification being operated.
- At least one certified operator is available on every shift.
- Operators must sit for, and pass, a validated exam demonstrating skills, knowledge, ability, and judgment necessary for the system classification.
- Each operator must have a high school diploma, GED, or state-approved experience and training.

While the responsibility for developing the program lies with DOH, individual systems must bring all operators up to the level of certification as required. The "grandparenting" clause of the regulation will address existing operators; however, new operators will be required to meet the guidelines of the legislation. Washington State issued revised operator certification guidelines in December 2000 (WAC 246-292). A grandparenting clause is also present in this regulation. However, because this clause expired in 2002, full compliance was required by that date.

On December 4, 2013, the DOH adopted the proposed rule changes for the Waterworks Operator Certification rule. The changes of the rule include strengthening the state's authority to enforce regulations, clarify authority to certify Backflow Assembly Testers (BATs) and Cross Connection Control Specialists (CCSs), and other updates to reflect current program practices, move requirements from guidelines into rules, and improve language and readability. Adopted changes pertinent to PWSs include the following:

- Requires purveyors to designate an operator in responsible charge for each operating shift and each major segment of the system, if applicable.
- Requires purveyors to designate and report all mandatory positions to the department within 30 days of starting operations or when a position is vacated.
- Purveyors shall not require operators to perform work that is beyond their skills, abilities, or level of certification.
- Additional requirements for operators, CCSs, and BATs are included.

7.5.3.1 Compliance

Operation, maintenance, cross-connection control, and water quality monitoring functions for the City are accomplished under the direction of the Water/Sewer Superintendent. As a Group A water system, the City presently meets minimum staff certification requirements. To ensure compliance in the future, all certified staff is provided the necessary expenses and leave time to attend classes and seminars in order to meet requirements for certification renewal. Further details on operator certifications are described in Chapter 4.

7.6 FUTURE REGULATORY REQUIREMENTS

Anticipated future regulatory requirements are summarized in Table 7.9. This table includes ongoing programs to introduce new regulatory requirements, under the UCMR and the Contaminant Candidate List (CCL), as well as specific rules and regulations currently under consideration. The City does not anticipate issues with meeting future regulatory requirements based on the limited available information. The City will revisit each proposed rule when specific requirements are published. A brief description of anticipated requirements under each rule is provided herein.

Table 7.9 Future Regulatory Requirements Water Quality Analysis City of Vancouver		
Proposed Rule	**Affected Contaminants**	**Proposed Publication Date(1)**
Unregulated Contaminant Monitoring Regulations	Unregulated Contaminants	UCMR 4 - unknown
Contaminant Candidate List	Unregulated Contaminants	CCL4 - unknown
Radon Rule	Radon	Unknown
Perchlorate	Perchlorate	Unknown
Lead and Copper Rule Revisions	Lead Copper	Unknown
Carcinogenic VOC Rule	cVOCs	Unknown

Notes:

(1) Effective and compliance dates were obtained from the Federal Register and USEPA's Drinking Water Hotline and represent the best information available as of the date of this report.

7.6.1 Unregulated Contaminant Monitoring Rule

The USEPA UCMR is used to collect occurrence data for contaminants suspected to be present in drinking water, but do not yet have health-based standards. The current UCMR was discussed in Section 7.3.8. The UCMR is updated every five years; however, no issue date for UCMR 4 has been published by the USEPA at this time.

7.6.2 Contaminant Candidate List

The CCL aids in priority setting for the drinking water program. The USEPA conducts research on the following for CCL contaminants: health effects; analytical methods; treatment technologies, effectiveness, and costs; and occurrence. The third CCL (CCL3) was published in October 2009 and includes 104 chemicals or chemical groups and 12 microbiological contaminants that are known or anticipated to occur in public water systems. The list includes chemicals used in industry, pesticides, waterborne pathogens, DBPs, and biological toxins. The USEPA is currently requesting nominations for chemical and microbial contaminants for possible inclusion in the fourth CCL.

7.6.3 Radon Rule

Radon is a naturally occurring radioactive gas that may cause cancer and may be found in drinking water and indoor air. The first proposed radon MCL of 300 pCi/L was proposed in August 2000. An alternative MCL of 4,000 pCi/L with implementation of a Multimedia Mitigation Program targeted at reducing indoor-air risks has also been proposed. Final determination on a regulatory requirement for radon is still underway.

7.6.4 Perchlorate

The USEPA made a preliminary determination in late 2008 to not set an MCL for perchlorate. In the USEPA's *Interim Drinking Water Health Advisory for Perchlorate* released in December 2008, it is stated that a perchlorate concentration below 15 parts per billion (ppb) would be sufficient to protect subpopulations. The contaminant was slated to be part of UCMR 2, however, public comments asserting that no new information would be gained from additional monitoring were heeded, and the contaminant was removed from consideration. In early 2011, USEPA reversed course and decided to initiate the process for developing a national primary drinking water regulation for perchlorate. The USEPA is still in the process of publishing a proposed regulation; no confirmed date is available from the USEPA at this time.

7.6.5 Revisions to the Lead and Copper Rule

Stakeholder meetings were held twice in 2014 to discuss the long-term revisions that will replace the short-term revisions promulgated in 1999. Items subject to revision will be tiering criteria, service line replacement, corrosion controls, and water quality parameters. It is unknown when these revisions will be finalized.

7.6.6 Carcinogenic Volatile Organic Compounds (cVOC) Rule

The USEPA announced in February 2011 that it plans to develop one national primary drinking water regulation covering up to 16 carcinogenic volatile organic compounds. The following eight compounds are already regulated: benzene, carbon tetrachloride, trichloroethylene (TCE), vinyl chloride, 1,2-dichloroethane, tetrachloroethylene (PCE), 1,2-dichloropropane, and dichloromethane. The following eight potential contaminants are on the CCL3: 1,1-dichloroethane, 1,2-butadiene, aniline, benzyl chloride, nitrobenzene, oxirane methyl, 1,2,3-trichloropropane, and urethane. The USEPA may add, drop, or substitute other contaminants into the rule as additional information becomes available. The USEPA website provides little information on this rule, but does project publication of the rule in February 2018.

7.7 SUMMARY AND RECOMMENDATIONS

The City seeks to maintain high water quality for its customers from the source to the tap. In addition, the City complies with all DOH monitoring and reporting requirements. Therefore, no recommendations were identified in evaluating the City's water quality program.

Chapter 8

WATER RESOURCES

The City of Camas (City) has diverse water supply sources, including wells and surface water supplies. To meet future demands, the City will be required to fully use its water resources and develop new sources to continue to provide a high level of service. The City currently receives its water from 10 wells and two surface water diversions. This chapter presents an evaluation of these supplies to identify any future deficiencies in the City's water rights or in the ability of its supplies to produce reliable water at the levels needed to meet future demands. These deficiencies are addressed by the City's water supply strategy summarized in this chapter.

8.1 WATER RIGHT ANALYSIS

The City relies upon its groundwater wells and surface water sources to meet its current supply needs. Water rights for these sources are administered by the Washington State Department of Ecology (DOE). Source water protection is regulated by the Washington State Department of Health (DOH). This section summarizes the City's existing water rights and analyzes the ability of the rights to meet the City's projected demand.

The City obtains its water from two surface water sources and ten wells. Eight of the nine groundwater sources are located in the City's "Lower Washougal Wellfield", commonly referred to as the Washougal Wellfield, in the lower Washougal floodplain near downtown Camas. The remaining well (Well 9) is located in the uplands about 2 miles north of the Columbia River and 1.5 miles west of Lacamas Lake. The City's Boulder and Jones Creek surface water diversions are located in the headwaters of the Washougal River drainage.

The City has diverted water from Jones Creek since 1913 and from Boulder Creek since 1931. Traditionally, the surface water sources were the City's primary water sources and operated continuously for 24 hours per day with the wellfield being used to meet higher summer peaks. In looking at ways to meet its future demands, the City realizes the importance of protecting the streams and rivers of the region, and understands that there is no opportunity for expansion of the surface water diversions. The City decided to meet future water supply needs with ground water, and the most promising area for future supply has been identified as the productive Pleistocene Alluvial Aquifer (PAA) system in the lower Washougal floodplain.

With the issuance of 4 new groundwater permits in 2008 came the requirement that the City cease their surface water operations between May 15 and October 31 of each year. The requirement further stated that "At the State's discretion, the water rights associated with these diversions will be placed into the State's Trust Water Program as permanent, seasonal donations". In 2015 the City attempted to place the rights into the Trust Program but was advised by DOE that the action was not strictly necessary provided they agreed to operate the surface water system consistent with the intent of the agreement.

Today, the City's focus is on developing new groundwater sources under its existing and applied for water right permits.

8.1.1 Water Rights Summary

The City's water system (DOH ID 108002) currently has two water right claims which have been modified by Certificates of Change, eight certificated water rights, and four water right permits. A summary of the City's water rights is provided in Table 8.1. Copies of the water right certificates for each well are included in Appendix G. The City's 2015 Water Facility Inventory (WFI) is provided in Appendix F. Note, Ecology extended the development schedule on the Parkers Landing and Wastewater Treatment Plant site water right permits to 2020 upon the City's request in November of 2015. The City's current plan for developing the wells is presented in Section 8.4.

The City has limitations on its water rights that are poorly documented and complicate the calculation of total instantaneous water right (Qi) and annual water right (Qa).

- Jones and Boulder Creek surface water sources may only be operated seasonally from May 15 through October 31. The Qa for periods outside of the operating time window are used to maintain instream flow in the Creeks (not for City use). The original water rights have not been modified to reflect the change in operation.
- Water Right permits and certificates with priority dates before 1979 were limited by DOE to a "total Qa of 5,750 acre-feet per year (AFY)". Those rights are shaded green in Table 8.1.
- The modifications of the City's water right claims resulted in the recognition of an additional 550 AFY which increased the total Qa to 6,300 acre-feet/year with priority dates before 1979.
- Well 9 is considered an alternative water right with a non-additive Qa. The permit does not increase the cumulative annual total of all rights but does increase the Qi.

The City's resulting water rights equate to Qi of 14,045 gallons per minute (gpm) (20.2 million gallons per day [mgd]), primary Qa of 11,090 AFY (9.89 mgd), and alternative Qa of 210 AFY (0.3 mgd).

Table 8.1 Water Right Summary

Source	ID Number	Priority Date	Instantaneous Qi (gpm)	Annual Qa (AFY)
Claims				
Well 1	G2-CV1-2P159 (121022)	06/11/74	900	320(1)
Well 2	G2-CV1-2P160 (121023)	06/11/74	900	230(1)

Table 8.1 Water Right Summary				
Well 10	Claims transferred from Wells 1 and 2(6)			
Well 12	Claims transferred from Wells 1 and 2(6)			
Certificates				
Boulder Creek(7)	S 712	08/22/23	1,120 (2.5 cfs)	977 (2) (P)
	CS2-SWC 712			843 P (Instream Flow)
Jones Creek(7)	S 711	09/05/30	450 (1.0 cfs)	393(3) (P)
	CS2-SWC 711			337 P (Instream Flow)
Well 3	G 85-A	07/21/45	1,200	118 (P)
Well 4	G 4072-A	02/12/59	1,325	1,208 (P)
Well 5	G 6636-A	03/22/68	600	920(4) (P)
Well 6	G 6635-A	03/22/68	1,500	2,400(4) (P)
Well 7	G2-00501	03/22/71	1,000	530(5) (P)
Well 8	G2-24400	02/04/77	900	530(5) (P)
Well 11	Water Right transferred from Well 3(5)			
Well 13	Water Right transferred from Well 4(5)			
Permits				
Well 9	G2-27384	08/13/86	650	210 (A)
Washougal Wellfield Permit	G2-30144	08/13/86	500	2,150 (P)
Well 14 (Anderson Site)	G2-30145	08/13/86	1,000	880 (P)
Parkers Landing	G2-30146	08/13/86	1,000	880 (P)
Treatment Plant Well	G2-30147	08/13/86	1,000	880 (P)
Total			**14,045 gpm**	**11,090 (P)** **210 (S)**
Pending Applications				
Camas Meadows	G2-30019		1,000	1,200
Fire Station	G2-30018		350	300
Steigerwald Regional Supply (8)	G2-30528		17,213	13,555

Table 8.1 Water Right Summary
Notes: (1) Claims are considered valid until proven otherwise through an adjudication process. (2) This source was formerly known as the Little Washougal River. The certificate refers to an instantaneous quantity (Qi) and does not specify an annual withdrawal. A DOE Report of Examination for Well No. 7 (G2-00501) summarizes existing water rights, including 1,820 AFY for Boulder Creek (S 712), based on continuous withdrawal at the instantaneous right specified. (3) The certificate refers to an instantaneous quantity (Qi) and does not specify an annual withdrawal. A DOE Report of Examination for Well No. 7 (G2-00501) summarizes existing water rights, including 730 AFY for Jones Creek (S 711), based on continuous withdrawal at the instantaneous right specified. (4) The Permit and Report of Examination preceding this certificate limited water rights to “the total quantity withdrawn or diverted from all sources is not to exceed 3,300 AFY.” (5) The Permit and Report of Examination preceding this certificate limited water rights to “the total quantity withdrawn or diverted from all sources is not to exceed 5,750 AFY.” (6) Well 10, 11, and 12 were installed to replace Well 1, 2 and 3, which have failed due to collapsed well casings; see Pacific Groundwater Group report dated June 9, 2003. Well 13 replaced Well 4 after Well 4 was determined to be groundwater under the influence of surface water; see Pacific Groundwater Group report dated August 14, 2006. G2-CV1-2P160 which is now associated with Well 10 allowed for seasonal between May 1st and August 31st. Year-round operation of Well 10 is authorized under Permit G2-30144 for the Washougal Wellfield. (7) See DOE agreement that limits withdrawal from the surface water sources from May 15 through October 31. (8) Joint application with City of Camas and City of Washougal (9) (P) = Primary water right, additive to other rights. (10)(A) = Alternative water right, not additive or considered when summing a cumulative total of all rights.

8.1.2 Water Rights Analysis

The City’s water rights were compared to current (2015), 10-year (medium-term, 2025) and 20-year (long-term, 2035) production to establish water right excess or deficiency. Both Qi and Qa were considered and are summarized in Table 8.2 and Table 8.3, respectively. Note, the Plan was started in late 2016, where 2015 was the last full year of record and used in the analyses. The City’s Water Rights Self-Assessment is provided in Appendix H and includes the latest 2018 information.

The City currently has surplus water rights based on the actual well pumping in 2015, which was considered to be the existing condition. Note, the reported values reflect the pumping over the entire year, where not all wells were pumped at the same time.

Table 8.2 Instantaneous Water Rights (Qi) Summary

Year	Future Forecasted Source Production (gpm)(1)	Instantaneous Water Right (Qi) (gpm)	Surplus/Deficiency (gpm)
2015	11,395 2	14,045	2,650
2025	13,300	14,045	745
2035	17,770	14,045	-3,725

Table 8.2 Instantaneous Water Rights (Qi) Summary			
Year	Future Forecasted Source Production (gpm)(1)	Instantaneous Water Right (Qi) (gpm)	Surplus/Deficiency (gpm)

Notes:
(1) Future values based on the high maximum day demand (MDD) demand projection scenario.
(2) Summation of maximum instantaneous yield from each water right in 2015.

Table 8.3 Instantaneous Water Rights (Qa) Summary			
Year	ADD - High Scenario (AFY)	Annual Water Right (Qa) (AFY)	Surplus/Deficiency (AFY)
2015	4,723 2	11,090	6,367
2025	7,780	11,090	3,310
2035	10,080	11,090	1,010

Notes:
(1) Future values based on high average day demand (ADD) demand projection scenario.
(2) Based on actual 2015 annual production data.

For the future water rights evaluation, the forecasted source production was based on the high demand projection scenario. The high demand scenario generally reflects the water use rates from the period of highest demands in the last eight years, as presented in Chapter 4. Use of the highest projected demands is intended to ensure the City has sufficient physical supplies to meet demands and provide sufficient time for in phasing in new supplies, which is typically a multi-year process.

The City is expected to have a sufficient Qi through the next 10 years. The City is expected to have a Qi deficiency starting in 2027 and increasing to -3,725 gpm (-3.3 mgd) in 2035, which equates to approximately 27 percent of the existing Qi. As described in the water supply strategy later in this chapter, the City plans to meet this deficiency by a combination of developing all of its existing water rights, developing pending city groundwater rights (the Fire Station water right), and using the Steigerwald Regional Supply Source with the City of Washougal (pending water right). Additionally, the City will continue to encourage water use efficiency including the reduction of irrigation use, which is a major driver for the relatively high projected maximum day demand (MDD).

8.2 ABILITY TO PUMP

The City will have sufficient Qa for the next 20 years. However, a relatively small percentage of Qa is remaining in 2035. Therefore, it is recommended the City begin to pursue new Qa sources before the end of the study period. Ability to pump

In addition to water rights, the City further evaluated each source's actual supply capacity or "Ability to Pump". The Ability to Pump comprehensively considers physical, water quality, and regulatory limitations. The resulting total Ability to Pump was compared to demands to determine supply excess or deficiency. Supply improvements are proposed to eliminate all deficiencies. As with the water right evaluation, the supply evaluation considered both MDD and average day demand (ADD) conditions. Further, the Ability to Pump was evaluated for three supply scenarios:

- Standard (all supplies).
- Reliability (only supplies with backup power).
- Redundancy (largest source out-of-service).

8.2.1 MDD Ability to Pump

The MDD Ability to Pump represents the City's Ability to Pump during the peak water use period, typically late-July through mid-August. The standard scenario represents the City's ability to meet MDD with all sources pumping continuously (24 hours per day). This represents the maximum quantity of water that can be produced. The redundancy scenario represents the City's ability to meet MDD with the single largest source offline. The reliability scenario represents the City's ability to meet MDD during a widespread power outage where only supplies with auxiliary power are considered. Demands above the MDD (such as peak hour demands or fire flow) are met from storage and are evaluated in Chapter 9.

The City's existing MDD Ability to Pump is tabulated in Table 8.4. The table quantifies the following components:

- Instantaneous Water Right (Qi): The sum of instantaneous water rights or contractual maximum at each source.
- Pumping Capacity: The pump or physical capacities at each source.
- Treatment Capacity: The available treatment capacity for each applicable source.
- Operational Limitations: Limitations due to water quality in sources without treatment, well field water right limitations (rather than a well specific Qi), and aquifer limitations.
- Auxiliary Power: Source is considered to be reliability if backup power (onsite generator or quick connects).

The City's existing Ability to Pump is approximately 9,300 gpm (13.4 mgd) in the standard scenario and approximately 7,900 gpm (161.4 mgd) in the redundancy scenario. Improvements to existing well capacity may increase supply by 1,145 gpm to approximately 10,475 gpm by resolving operational challenges with Well 5, physical capacity issues in Well 6, and minor changes in Wells 7 and 8. The future construction of the Parkers Landing and Treatment Plant wells add an additional 2,000 gpm of MDD Ability to Pump and resolve the majority of differences between the instantaneous water right and rated source capacity. Additional Auxiliary power is needed for Washougal Wellfield (Wells 5, 6, 7, 9, and 10) to increase the reliable Ability to Pump. Note, the City's surface water sources, Jones and Boulder Creek, cannot be used in the summer per water right; therefore, they were not included in the MDD Ability to Pump analysis.

8.2.1.1 MDD Supply Analysis

The MDD Ability to Pump was compared with the projected MDD for the planning period to evaluate if the City has sufficient supply, as shown in Figure 8.1 and Table 8.5. The top green line represents the maximum instantaneous supply allowed by the City's existing water rights. The solid and dashed red lines represent the existing MDD ability to pump for the standard and redundancy scenarios, respectively. The solid orange line represents the reliability scenario. The demand projections are shown for the high, medium (thicker dashed purple line in Figure 8.1), and low scenarios. Although the high demand projection scenario was used to determine water rights deficiencies, the combination of the high demand scenario and the redundancy supply scenario was considered to be overly conservative. Therefore the medium demand projection scenario is used to determine supply Ability to Pump deficiencies and is presented in Table 8.5. The demands shown in column 2 of Table 8.5 include not only retail demands (medium scenario), but also 830 gpm to replenish fire storage, per DOH recommendations.

The City currently has sufficient supplies to meet the projected demands through 2022 for the standard scenario (solid red line in Figure 8.1). However, the City is anticipated to exceed the MDD Ability to Pump by 2018 for the redundancy scenario (dashed red line in Figure 8.1)). The City will need an additional approximately 3,690 gpm of supplies to meet the standard scenario by the end of the planning period. Considering redundancy (largest source out of service), the City will need an additional 5,040 gpm of redundant supplies by the end of the planning period to avoid a deficiency. To meet the City's reliability goals, all source would require backup power by the end of the planning period.

8.2.2 ADD Ability to Pump

The ADD Ability to Pump evaluation confirms the ability of the City to supply its demand throughout the year. The ADD was used to represent the average conditions expected to occur. Similar to the MDD Ability to Pump evaluation, standard, redundancy, and reliability scenarios were considered for ADD.

The City's existing Ability to Pump is tabulated for the standard scenario in Table 8.6 that consists of the following components:

- Annual Water Right (Qa): The sum of Primary annual water rights or contractual limitations at each source.
- Rated Source Capacity: The pump or physical capacities at each source.
- Treatment Capacity: The available treatment capacity for each applicable source.
- Operational Capacity: Limitations due to water quality in sources without treatment, well field water right limitations, and aquifer limitations.
- Auxiliary Power: Source is considered to be reliability if backup power (onsite generator or quick connects).

Table 8.4 Maximum Day Demand Ability to Pump Summary

Source	Instantaneous Water Right (gpm)	Rated Source Capacity (gpm)	Treatment Capacity Limitations (gpm)	Operational Capacity (gpm)	Auxiliary Power (Reliability)	Ability to Pump (gpm)	Reliable Ability to Pump (gpm)	Redundancy - Largest Source Out-of-Service
Boulder Creek	0(1)	0(1)		0(1)	Yes	0	0	0
Jones Creek	0(1)	0(1)		0(1)	Yes	0	0	0
Well 5	600	500		0(2)	No	500	0	500
Well 6	1,500	1,000			No	1,000	0	1,000
Well 7	1,000	950			No	950	0	950
Well 8	900	1,350		1,350(3)	Yes	1,350	1,350	0
Well 9	650	650(4)			No	650	0	650
Well 10	900	900			No	900	0	900
Well 12	1,200	1,200			Yes	1,200	1,200	1,200
Well 11	900	900			Yes	900	900	900
Well 13	1,325	1,325			Yes	1,325	1,325	1,325
Well 14	1,000	1,000			Yes	1,000	1,000	1,000
Washugal Wellfield Right	500	Used at Well 8				NA	NA	NA
Parkers Landing	1,000	0 5						
Treatment Plant Well	1,000	0 5						
Total	**12,975**	**9,775**				**9,775**	**5,775**	**8,430**

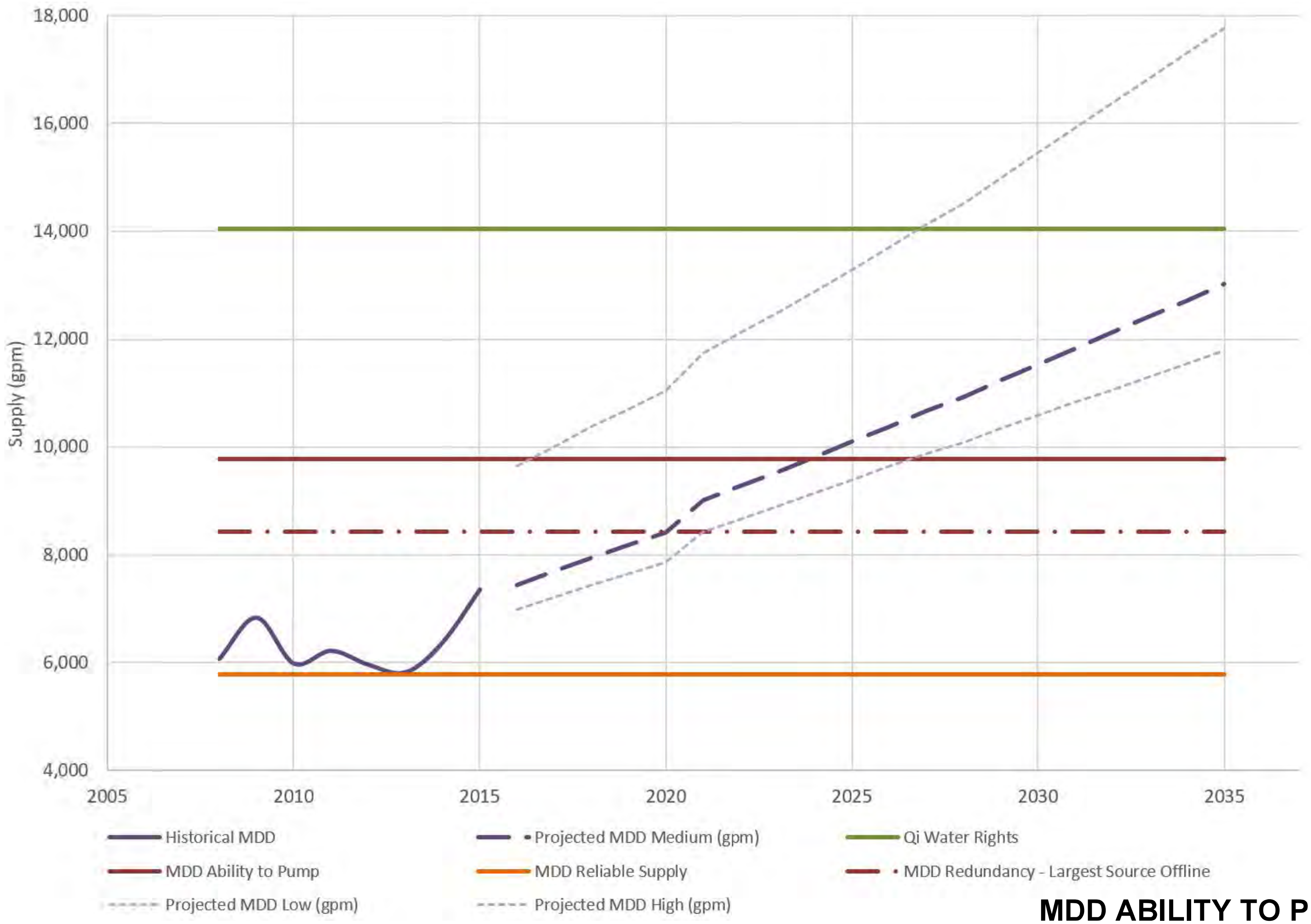
Notes:

(1) Water rights do not allow use of the surface water sources during the summer; therefore, it is not considered for the MDD evaluation.
(2) Forest Home booster pump station (BPS) must be on to prevent over pressurization of 343 Downtown Zone during Well 5 operation.
(3) The Washougal Wellfield instantaneous water right of 500 gpm is currently exercised at Well 8.
(4) High Silica content requires valving in distribution system.
(5) City has water right permit, but has delayed well construction until required to meet customer demand.

Table 8.5 **MDD Ability to Pump Analysis**

Year	MDD + Fire Flow Replenishment (gpm)[1]	Existing MDD Ability to Pump (gpm)	Surplus/ Deficiency (gpm)	Redundancy	Surplus/ Deficiency (gpm)	Reliability	Surplus/ Deficiency (gpm)
2021	9,020	9,775	755	8,425	-595	5,775	-3,245
2025	10,100	9,775	-325	8,425	-1,675	5,775	-4,325
2035	13,020	9,775	-3,245	8,425	-4,595	5,775	-7,245

Notes:
(1) Column 2 demands include retail demands plus 830 gpm to replenish fire storage, per DOH recommendations.



MDD ABILITY TO PUMP

FIGURE 8.1

CITY OF CAMAS
WATER SYSTEM PLAN UPDATE

Table 8.6 Annual Ability to Pump Summary

Source	Annual Water Right (gpm)	Rated Source Capacity (gpm)	Treatment Capacity Limitations (gpm)	Operational Capacity (gpm)	Auxiliary Power (Reliability)	Ability to Pump (gpm)	Reliable Ability to Pump (gpm)	Redundancy - Largest Source Out-of-Service (gpm)
Boulder Creek	606	1,120	1,120		Yes	606	606	606
Jones Creek	244	450	450		Yes	244	244	244
Well 5	570	500		0[(1)]	No	0	0	0
Well 6	1,488	1,000			No	503	503	0
Well 7	329	950			No	329	329	0
Well 8	329	1,350		736[(2)]	Yes	736	736	736
Well 9	0	650		0[(3)]	No	0	0	0
Well 10	198	900		0[(4)]	No	0	0	0
Well 12	73	1,200		765[(2)]	Yes	73	73	73
Well 11	143	900			Yes	765	765	765
Well 13	749	1,325			Yes	749	749	749
Well 14	546	1,000		850[(2)]	Yes	850	0	850
Washugal Wellfield Right	1,333	Used at Wells 8, 12, and 14				NA [4]		
Parkers Landing	546	0				0		

Table 8.6 Annual Ability to Pump Summary

Source	Annual Water Right (gpm)	Rated Source Capacity (gpm)	Treatment Capacity Limitations (gpm)	Operational Capacity (gpm)	Auxiliary Power (Reliability)	Ability to Pump (gpm)	Reliable Ability to Pump (gpm)	Redundancy - Largest Source Out-of-Service (gpm)
Treatment Plant Well	546	0				0		
Total	**8,432**	**11,400**				**4,860**	**4,020**	**4,010**

Notes:

(1) Forest Home BPS must be on to prevent over pressurization of 343 Downtown Zone when Well 5 is run. Well 5 is used as a seasonal source due to this operational complexity.

(2) The Washougal Wellfield annual water right of 1,333 gpm is anticipated to be exercised at Well 8, 12, and 14; however, actual well use will vary due to operational & maintenance needs.

(3) Well 9 is typically used to meet summer demands. Alternative annual water right (210 AFY) typically does not allow for winter pumping. High Silica content requires valving in distribution system.

(4) Well 10 may only be used between May 1st and August 31st per its water right.

(5) The Washougal Wellfield annual water right has been allocated to individual wells.

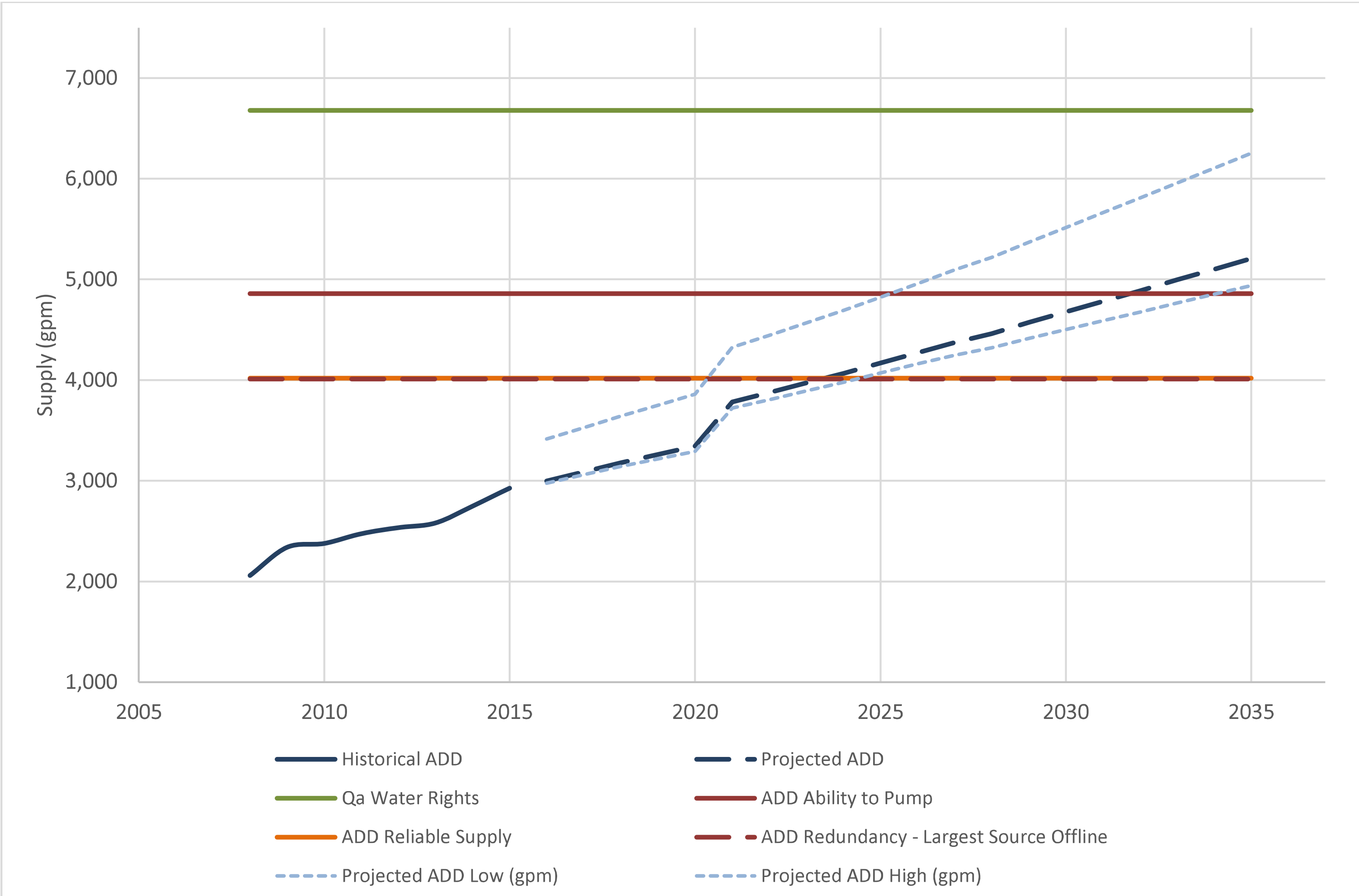
Similar to the MDD Ability to Pump evaluation, the City's wells have the pumping or physical capacity to use their entire water rights. Seasonal water right limitations the ADD Ability to Pump to approximately 4,855 gpm. Considering the largest source out-of-service (Well 14), the ADD Ability to Pump drops to 4,005 gpm. The City's annual restrictions for water rights with priority dates before 1979 account for the majority of differences between the Qa and rated source capacity (see above water right analysis for additional detail). The City's existing sources have sufficient capacity to produce their full annual water right. Additional annual supplies may come from the undeveloped Well 17, Parkers Landing Well, and Treatment Plant Well, and Steigerwald supply. Note, the City's surface water sources, Jones and Boulder Creek, are included in the ADD Ability to Pump analysis.

8.2.2.1 ADD Supply Analysis

Similar to the MDD, the ADD Ability to Pump was compared with the projected medium ADD scenario for the planning period to evaluate if the City has sufficient supply, as shown in Figure 8.2 and Table 8.7. This Figure uses the same coloring as Figure 8.1, where the green line represents the Primary Qa, rather than the Qi. Consistent with the MDD ability to pump, the medium demand scenario was used to determine deficiencies and is presented in Table 8.7. The City currently has sufficient supplies to meet the projected demands throughout 2032 for the standard scenario (solid red line) and 2024 for the redundancy scenario (dashed red line). The City will need an additional approximately 350 gpm of supplies to meet the standard scenario and 1,200 gpm for the redundancy scenario. It is anticipated that projects to address the MDD Ability to Pump deficiencies, which occur earlier in the planning period, will also address the ADD Ability to Pump deficiencies. To meet the City's reliability goals, all sources will require backup power by the end of the planning period.

Table 8.7 ADD Ability to Pump Analysis

Year	ADD (gpm)	Existing ADD Ability to Pump (gpm)	Surplus/ Deficiency (gpm)	Redundancy	Surplus/ Deficiency (gpm)	Reliability	Surplus/ Deficiency (gpm)
2021	3,790	4,860	1,070	4,010	220	4,020	230
2025	4,170	4,860	690	4,010	-160	4,020	-150
2035	5,210	4,860	-350	4,010	-1,200	4,020	-1,190



ADD ABILITY TO PUMP

FIGURE 8.2

CITY OF CAMAS
WATER SYSTEM PLAN UPDATE

8.3 INTERTIES

Interties provide a tool that water utilities use to move water between systems to meet supply needs, increase reliability, and respond to emergencies. The City has interties with the City of Vancouver and the City of Washougal. The City of Vancouver Intertie, located at SE 192nd Ave and 41st Drive, provides service to the River Gateway development. The Washougal Interties provide emergency supply to the City.

In the future, the City plans to develop the Steigerwald Regional Supply Source jointly with the City of Washougal. The City anticipates there will be opportunities for future wholesale and/or emergency interties with the City of Washougal as part of the project.

8.4 WATER SUPPLY STRATEGY

The City requires additional supplies to provide the sought level of service during the planning period, where deficiencies occur starting in 2018 for the redundancy MDD scenario. The City will need to provide a minimum additional supply of 5,040 gpm MDD Ability to Pump by the end of the planning period. The City’s water supply strategy has four parts:

- Washougal Wellfield Renewal.
- Construct Wells for Existing Water Rights.
- Secure Additional Water Sources.
- Continue a Water Use Efficiency (WUE) Program.

The improvements are grouped by planning horizons: short-term (2017-2021), medium-term (2022-2025), and long-term (2026-2035).

8.4.1 Washougal Wellfield Renewal

Improved pumping from existing well facilities to achieve their full water right can provide additional future supply. The Ability to Pump Analysis identified that 1,175 gpm (1.7 mgd) of MDD supply can be obtained through improved pumping from Well 6, as well as minor increases from Well 7 and Well 8. While the pumping capacity will increase, the improved wells will not increase the ADD Ability to Pump due to water right restrictions. The Washougal Wellfield Renewal effectively delays the need for Steigerwald Regional Supply Source.

Potential improvements to these existing supply faculties may include the following.

- The City is currently upsizing the pipeline between Well 6 and Well 14, which resolves an existing transmission deficiency that restricts Well 6 pumping. This project was assumed to be complete in all analyses.
- Increase the yield of Well 6 to 1,500 gpm (an additional 500 gpm) to make full use of its instantaneous water right. This may require a hydrogeological study to determine the most cost-effective approach to well redevelopment.

- The City may improve pumping capacity of Well 7 and Well 8 as part of future regular pump maintenance/replacement. This will provide an additional 75 gpm of MDD Ability to Pump.
- Install backup power for Wells 5, 6, 7, 9, and 10 to increase reliability of the wellfield.

It is anticipated that all new supplies will have backup power available. Installation of backup power at the Washougal Wellfield will make the City's supplies fully reliable.

The City's supply sources are in good condition. To maintain the supply facilities, the City has an ongoing operation and maintenance (O&M) program. Repair and replacement (R&R) activities will be triggered by components reaching the end of their usable life. Additional information on the City's O&M and R&R programs is presented in Chapter 4.

8.4.2 Construct Wells for Existing Water Rights

City has existing water right permits for wells at Parkers Landing and Treatment Plant. Construction of these wells is anticipated in the 2020 and the medium-term planning horizon, respectively, to meet customer demand. The completion of these water rights will increase the Ability to Pump buy 2,000 gpm during the MDD and 1,092 gpm during the ADD. The hydraulic analysis, presented in Chapter 9, indicates that distribution system improvements will be needed to convey the new supplies to the wider system.

8.4.3 Secure Additional Water Sources

The City is actively pursuing new water sources to meet future deficiencies and to improve supply redundancy. During the planning period, the City plans to develop its existing water rights (Treatment Plant Well and Parkers Landing Well) and is designing Well 17 (Water Right Application G2-30019) near the North Shore area to better serve this area of future growth. Well 17 is expected to yield 500 gpm. The City has recently purchased the Owahou Water Rights to help offset in-stream impacts from this future water right. Additionally, the City has applied for a new well near Fire Station # 42 - 4321 NW Parker St - (Water Right Application G2-30018, Well 18) in the 544 Pressure Zone. The Fire Station Well water right application provides for 350 gpm of instantaneous supply and 300 AFY of annual supply from an 12-inch well. Hydrogeological investigations indicate that Well 18 is not viable; therefore, he City is exploring alternate locations for this well.

In the long-term, the City anticipates obtaining supply from the future Steigerwald Regional Supply Source (Water Right Application G2-30528), as discussed in the Detailed Implementation Plan (Lower Columbia Fish Recovery Board 2008) for the Salmon-Washougal and Lewis Watershed Water Resource Inventory Areas (WRIAs). Under Washington Administrative Code (WAC) 173-500-040, WRIAs were formalized and the DOE was given responsibility for the development and management of these planning boundaries. The Salmon-Washougal and Lewis Watershed Management Plan WRIAs 27 and 28 (Lower Columbia Fish Recovery Board 2006) and subsequent Detailed Implementation Plan were created to address a range of issues related to water resources, including water supply, stream flow management, water quality, and fish habitat. The City of Camas and the Jones and Boulder Creek surface water supply watersheds reside within WRIA 28.

The completion of WRIA 27 and 28 watershed plans in 2008 eliminated the water rights reservation established by WAC 173-592 and replaced them with regional water supply areas and some stream allocations in WAC 173-527 for the Lewis River Basin (WRIA 27) and WAC 173-528 for the Salmon Creek-Washougal River Basin (WRIA 28).

The Watershed Management Plan discusses the regional water supply areas for Camas, which was designated as the Steigerwald area near Washougal. DOE has designated water supplies near the City as "Instream Flow with Closures and Reserves." This designation limits the ability of the City to obtain new water rights outside of the regional water source.

The Steigerwald Regional Supply Source will be jointly developed with the City of Washougal. The Cities have applied for a joint water right (Water Right Application G2-30528) for 17,213 gpm of instantaneous water rights and 13,555 AFY of annual water right. The Place of Use has been designated as both the City's and Washougal's water service area. It is anticipated that the supply source will include ten 20-inch diameter wells with individual well yields of 2,000 gpm or more. As an entirely new supply source, the City's will need to permit, design, and construction the proposed wells and related facilities, such as disinfection, auxiliary power, and potentially treatment. To convey the water, the City will need several miles of transmission main.

Additionally, the City may consider purchasing water rights from Georgia Pacific, if available, to develop an additional future water source closer to the City's water system.

8.4.4 Continue a Water Use Efficiency Program

The final element of the City's supply strategy is to continue to reduce demand through its water use efficiency program. The City has observed declining per account water use for over a decade. The observed drop in the water use and MDD peaking factor can be attributed in part to the City's water use efficiency program, which is summarized in Chapter 6. WUE gains, including reductions in distribution system leakage, may delay the need for new supplies presented below.

8.4.5 Summary of Improvements

The City water supply strategy largely continues previously planned water supply projects. These new water sources will be required in the planning period to provide redundant supply to its customers. In addition to previously planned projects, the City anticipates completing the Washougal Wellfield Renewal Project to increase the ability to pump and reliability of the wellfield. These projects include:

1. Well 17 (CIP Project SR-6).
2. Well 15 - Parkers Landing Site (CIP Project SR-7).
3. Well 16 - Treatment Plant Site (CIP Project SR-9).
4. Well 18 - Fire Station Site at a new location (CIP Project SR-9).

5. Washougal Wellfield Renewal Project: Full use of Well 6. Backup power will be added to Wells 5, 6, 7, 9, and 10.
6. Steigerweld Regional Supply (CIP Project SR-11).

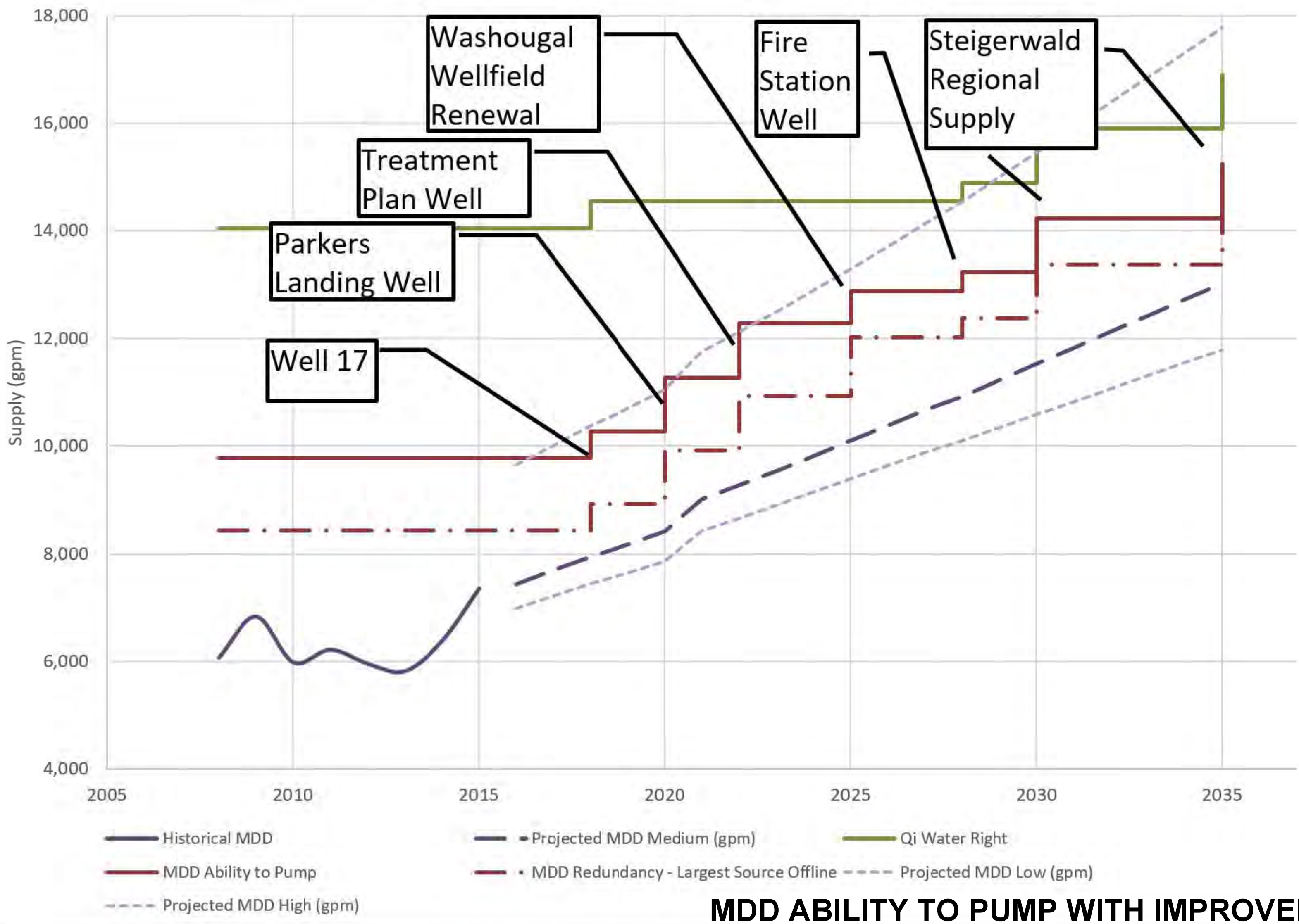
Tables 8.2 and 8.3 describe each improvement, timing, increase in supply, and resulting Ability to Pump after project completion. By the end of the planning period, the proposed new wells and Washougal Wellfield Renewal Project are expected to effectively make full use of the City's existing and proposed water rights. The addition of the Washougal Wellfield Renewal Project delays the City's need for new regional supplies from the Steigerweld Regional Supply until approximately 2030. It is anticipated the supplies will be constructed in phases to meet expected demand growth and spread out the significant capital costs. For planning purposes, it was assumed that Steigerwald supplies would be developed one well at a time, where the City's portion of each well would be 1,000 gpm (half of the proposed 2,000 gpm well). Water rights were assumed to be proportional to the pending water right.

The increase in ability to pump for these improvements are shown in Figure 8.3 and 8.4 for MDD and ADD, respectively. To maintain redundant MDD Ability to Pump, the City will need to develop up to 5 new wells (Wells 6, 15, 16, 17, and 18) in the next decade. Therefore well development is anticipated to be a major element of the City's CIP. Note, the ADD Ability to Pump does not increase from the Washougal Wellfield Renewal project due to water right restrictions.

The supply improvements allow the City to meet the high ADD projection; however, the City cannot reasonably meet the high MDD projections, which conservatively reflects both unusually high base and peak water use. Therefore, it is recommended that they continue its water use efficiency program efforts to reduce the risk of very high peak demands.

Table 8.8 Supply Improvements - ADD Ability to Pump					
Improvement	**Timing**	**Additional Supply (gpm)**	**ADD Ability to Pump (gpm)**	**Reliable ADD Ability to Pump (gpm)**	**Redundant ADD Ability to Pump (gpm)**
	Existing		4,860	4,020	4,010
Construct Well 17	2018	275	5,135	4,295	4,285
Construct Parkers Landing Well	2020	546	5,681	4,841	4,831
Construct Treatment Plant Well	Medium-term	546	6,227	5,387	5,377
Washougal Wellfield Renewal	Medium-term	-	6,227	6,227	6,209
Construct Fire Station Well	Long-term	186	6,413	6,413	6,395
Steigerwald Phase 1	Long-term	489	6,903	6,903	6,885
Steigerwald Phase 2	Long-term	489	7,392	7,392	7,374

Table 8.9 Supply Improvements - MDD Ability to Pump					
Improvement	**Timing**	**Additional Supply (gpm)**	**MDD Ability to Pump (gpm)**	**Reliable MDD Ability to Pump (gpm)**	**Redundant MDD Ability to Pump (gpm)**
	Existing		9,775	5,775	8,425
Construct Well 17	2018	500	10,275	6,275	8,925
Construct Parkers Landing Well	2020	1,000	11,275	7,275	9,925
Construct Treatment Plant Well	Medium-term	1,000	12,275	8,275	10,925
Washougal Wellfield Renewal	Medium-term	610	12,885	11,925	12,025
Construct Fire Station Well at a new location	Long-term	350	13,235	12,275	12,375
Develop Steigerwald Phase 1	Long-term	1,000	14,235	13,275	13,375
Develop Steigerwald Phase 2	Long-term	1,000	15,235	14,275	14,375

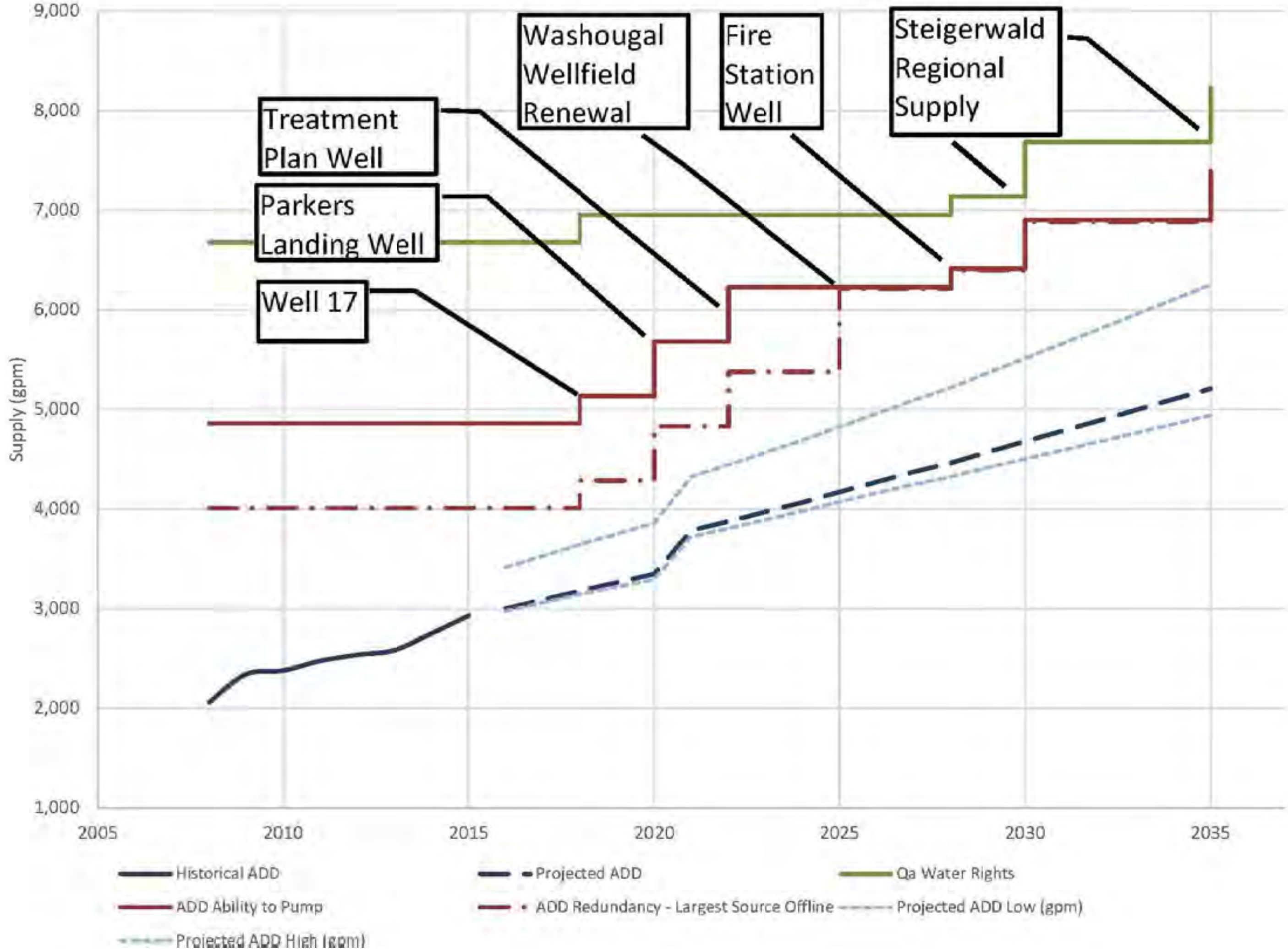


MDD ABILITY TO PUMP WITH IMPROVEMENTS

FIGURE 8.3

CITY OF CAMAS
WATER SYSTEM PLAN UPDATE

carollo



ADD ABILITY TO PUMP WITH IMPROVEMENTS

FIGURE 8.4

CITY OF CAMAS
WATER SYSTEM PLAN UPDATE

8.5 GROUNDWATER MANAGEMENT

The City's wellhead protection plan was updated as part of the Plan. Section 1428 of the 1986 Amendments to the Federal Safe Drinking Water Act (SDWA) mandates that each state develop a wellhead protection program and that all federally defined public water systems (in Washington, Group A systems) using groundwater as its source implement a wellhead protection plan. In July 1994, the WAC addressed requirements for Group A public water systems (WAC 246-290) and was modified to include mandatory wellhead protection measures. The legislative authority to require wellhead protection (WHP) planning can be found in the Revised Code of Washington (RCW) Chapters 43.20.050, 70.119A.060, and 70.119A.080.

8.5.1 Wellhead Protection Program

The overall goal of the state WHP program is to prevent the contamination of groundwater used by Group A public water systems. This is to be accomplished by providing management zones around public wells, identifying existing groundwater contamination sources, and managing potential sources of groundwater contamination prior to their entry into the drinking water system. Under the WAC, local public water systems have the primary responsibility for developing and implementing local wellhead protection plans (WHPP). However, due to the limited jurisdictional and regulatory authority afforded most purveyors, coordination with other local, State, and Federal agencies is essential to the successful implementation of a WHPP.

The DOH has developed regulations that require Group A water systems using groundwater sources to develop and implement the WHPP (WAC 246-290-135). The objective is to prevent releases of contaminants to groundwater in areas that contribute water to the public supply systems. The City's Well Head Protection Report is included in Appendix I.

The basic elements of a WHPP include:

- Assessment of initial groundwater susceptibility for each water supply source.
- Delineation of the WHP area that directly contributes groundwater to each water supply well.
- Inventory of land uses and identification of potential sources of contamination within each wellhead protection area (WHPA).
- Documentation of notification to owner/operators of known or potential hazards.
- Development of spill prevention plans and water contingency plans that minimize or eliminate the possibility of contamination to the groundwater supply and also development of options for maintaining water supply in the event the aquifer contributing to a source is contaminated.

The State of Washington WHPP applies to the City's wells.

8.5.2 Wellhead Protection Area

The updated WHPP developed WHPA using the City's wells, including the recent Well #14 and future Parkers Landing and Treatment Plant wells. Capture zones for the Lower Washugal Wellfield were estimated using a calibrated groundwater flow model, MODFLOW. The model simulations assumed that the City would exercise all of their existing and two future wells. This assumption provides for a fairly conservative assessment of the capture zone extent. In addition, a high-end pumping was assumed for the nearby Georgia Pacific Wellfield.

8.5.3 Existing and Potential Contamination Hazard Identification

The City performed a risk assessment within the modeled capture zones. The inventory of potential contamination sources within the WHPA was performed according to the DOH publication: "*Inventory of Potential Contaminant Sources in Washington's Wellhead Protection Areas (1993)*." Potential contaminant risks that lie within the vicinity of Camas' Lower Washougal Well-field were investigated and mapped using data from two sources. The first, a parcel data-base that contains information on land use and zoning, was provided by Clark County 2016. The second contains data from the DOE's Facility / Site database, including state cleanup sites, federal superfund sites, hazardous waste generators, solid waste facilities and underground storage tanks. The information from these sources were classified and plotted on GIS coverages to assess whether existing and potential contaminant sources were located within the vicinity of Camas' production wells and WHPA delineations2.

Table 3 in Appendix A of the Wellhead Protection Plan summarizes known environmental sites of potential concern within the Lower Washougal Wellfield wellhead protection capture zones. Thirty-six contaminant sources of potential concern to the water supply were identified within the Lower Washougal wellfield capture zone.

8.5.4 Protection Strategies and Implementation Tasks

As described in the WHPP, the nine shallow wells within the Lower Washougal wellfield are most susceptible to contaminant risks given the hydrogeology and land surface activities. The capacity of the most productive wells in the Lower Washougal wellfield is about 1,300 gpm. If the supply from one of these wells was lost or compromised, the City would have to rely on a combination of the other sources to meet summer time peak demands (other wells, interties, and emergency use of surface water sources).

Additional risks to the City's supply arises from the fact that five of the City's wells (Wells 7, 8, 10, 11, and 12) are clustered in close proximity to each other (Figure 5). Several, if not all, of these wells could be impacted by a single contaminant release, such as a major railroad spill. Depending on the nature of impact to the wells, the City could perform immediate mitigation with changes in well pumping, treatment, blending of waters between wells, and other operational changes to meet demands; however, should multiple wells become impacted, the City may not be able to support the City's entire water demand on a sustainable basis, particularly during the high demand summer months. If multiple wells are impacted, the City may need to institute short-term rationing and pursue expedited drilling of additional wells.

Chapter 9

SYSTEM ANALYSIS

9.1 INTRODUCTION

The City of Camas' (City) water distribution system was evaluated for its ability to meet the City's performance criteria under 2021, 2025, and 2035 future conditions using the medium demand projection scenario described in Chapter 5. The distribution system was evaluated for its pumping reliability and redundancy and the availability of storage using a desktop system analysis. Service pressures and available fire flows for both maximum day demand (MDD) and average day demand (ADD) conditions were evaluated using the City's updated hydraulic model.

This chapter presents the results of the system analysis and discusses in detail recommended improvements to meet the City's level of service goals. These recommendations form the basis of the City's capital improvement program (CIP) outlined in Chapter 10. Many supply, pumping, storage, and pipeline improvements will be necessary during the planning horizon to meet the City's projected substantial growth in water demand. The recommended supply, pumping, and storage improvements are summarized graphically on Figure 9.7. Pipe improvements as well as the location of supply, pumping, and storage improvements are shown on Figure 9.12 through Figure 9.13. All recommended improvements are summarized in Table 9.11 through Table 9.15.

9.2 SERVICE AREAS

For the pumping and storage analyses, the City's distribution system was divided into five sections referred to as "service areas". Each service area has its own supply and storage facilities and was evaluated against the City's pumping and storage criteria independently. The five service areas, which are shown on Figure 9.1 are:

1. 343 Service Area. Consists of the Butler, Cemetery, and Downtown 343 pressure zones.
2. 455 Service Area. Consists of the 455 Pressure Zone.
3. 542 Service Area. Consists of the 542 Pressure Zone. By 2025 the City intends to connect the 542 Pressure Zone and 544 Pressure Zone with a new transmission main around the north end of Lacamas Lake. Therefore, starting in 2025, the 542 Service Area will become part of the 544 Service Area. This combined service area is referred to as the 542/544 Service Area in this chapter.

4. 544 Service Area. Consists of the 544 Pressure Zone and its pressure reducing valve (PRV)-fed 440 subzone. Starting in year 2025 it will become part of the 542/544 Service Area.

5. 852 Service Area. Consists of the 852 Zone and its many PRV-fed subzones.

The existing supply, pumping, and storage infrastructure and their capacities are shown for each service area in Figure 9.2. This figure also indicates the total well capacity (Q_{IN}) and booster pump station (BPS) capacity (BPS_{IN}) for each service area.

9.3 PUMPING ANALYSIS

9.3.1 Pumping Criteria

For this water system plan update, the City updated its pumping reliability and redundancy criteria as described below. The capacity of pumping into each of the City's service areas was evaluated against the following criteria.

1. Pumping Reliability. Wells and booster pumps with back-up power should be capable of supplying MDD for the water system while concurrently replenishing fire suppression storage within 72 hours.

2. Pumping Redundancy. With the largest pump in each booster pump station out of service, the remaining pumps should provide MDD whole concurrently replenishing fire suppression storage within 72 hours.

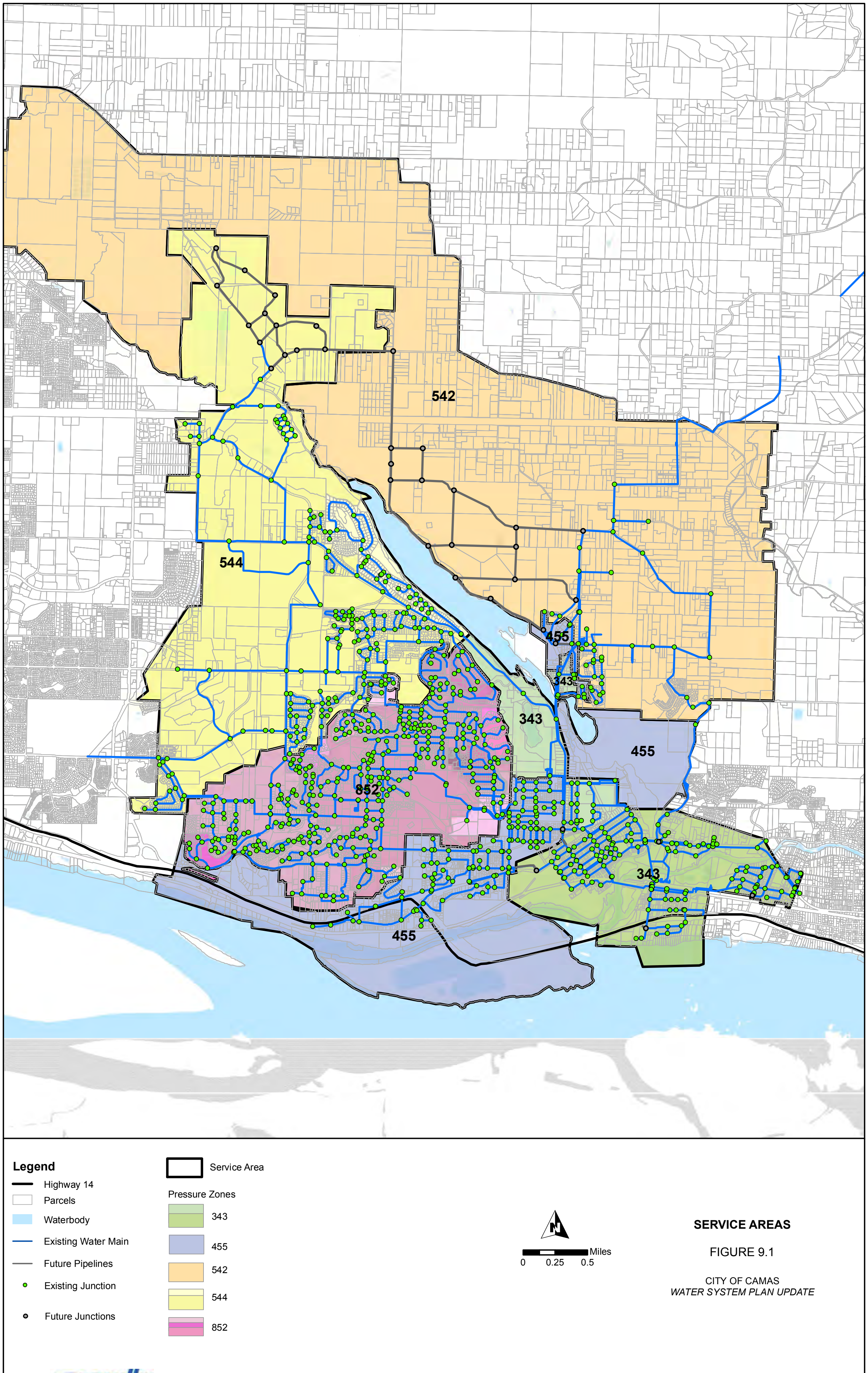
The City's pumping criteria only address MDD conditions. During the winter and average day demand (ADD) conditions, the City operates their slow sand filter that supplies the 542 Zone, offering increased supply redundancy. If the City meets their MDD pumping reliability and redundancy goals, they will by default also be able to supply ADD reliably and redundantly.

9.3.2 Pumping Reliability

The City's water system was evaluated against its pumping reliability criterion for each of the service areas and each planning year. The results of this analysis are presented in Table 9.1 where the surplus/(deficit) reliable supply is the difference between the total pumping requirement, and the net service area supply. Results for year 2035 are shown graphically in Figure 9.3. Four of the City's wells (6, 7, 9, and 10), and two of its booster pump stations (Forest Home and Butler) do not have backup power. These pumps are shown as red in Figure 9.3. As indicated by orange in Figure 9.3, the Angelo BPS has backup power, but not enough to run at full capacity. The capacities shown next to each well or BPS in Figure 9.3 are their reliable capacities.

With only its reliable pumps in operation, the City can only meet 2021 MDD in the 542 and 852 service areas. Demands in the other three service areas cannot be met. By 2035, all service areas are deficient.

In order to meet the pumping reliability criteria, back-up power sources able to provide full capacity are needed at all existing wells and BPSs as well as all future wells and BPSs.



SERVICE AREAS

FIGURE 9.1

CITY OF CAMAS
WATER SYSTEM PLAN UPDATE

Figure 9.2 Existing System Pumping and Storage Capacities

Excel graphic of system showing pumping capacities

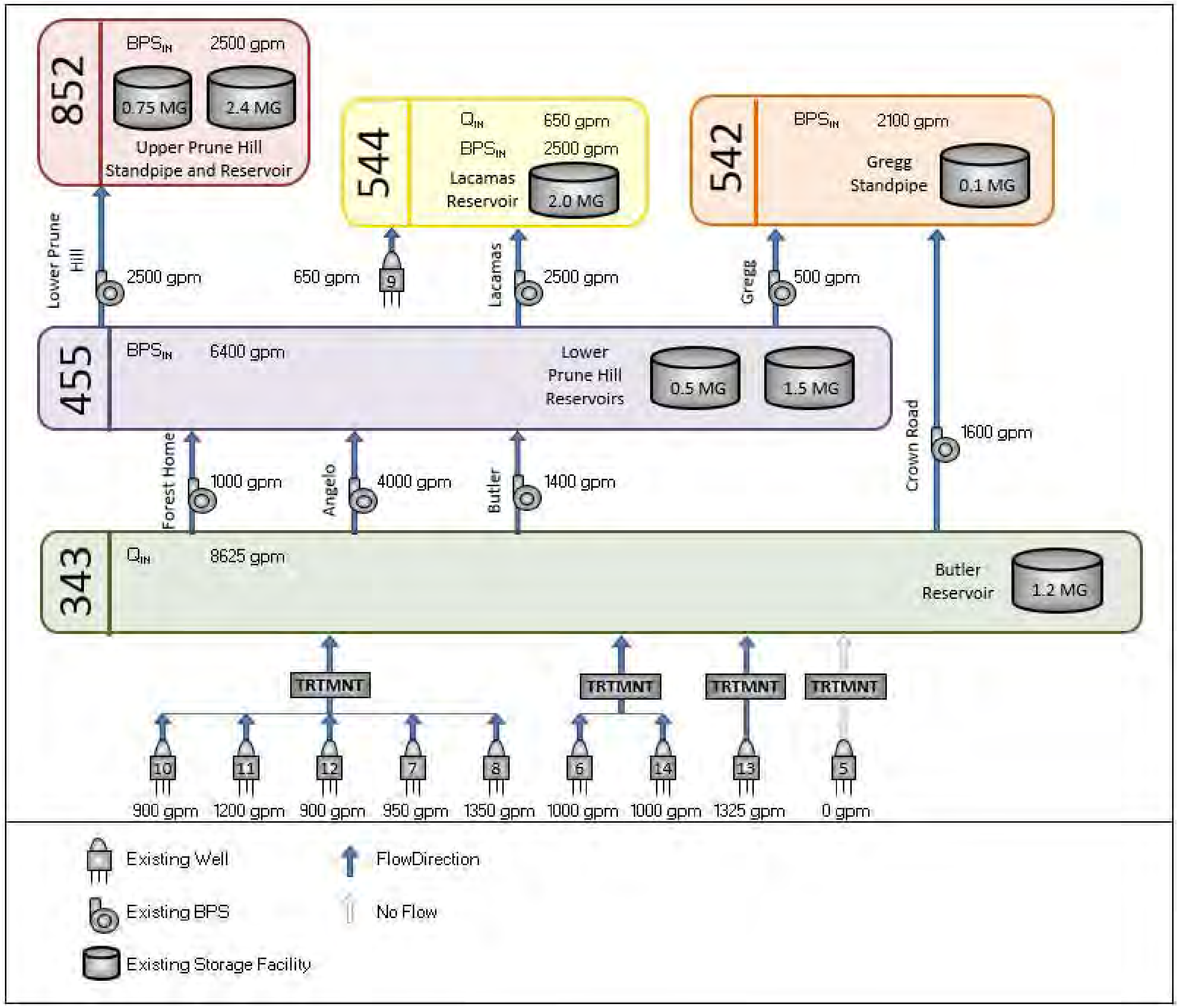
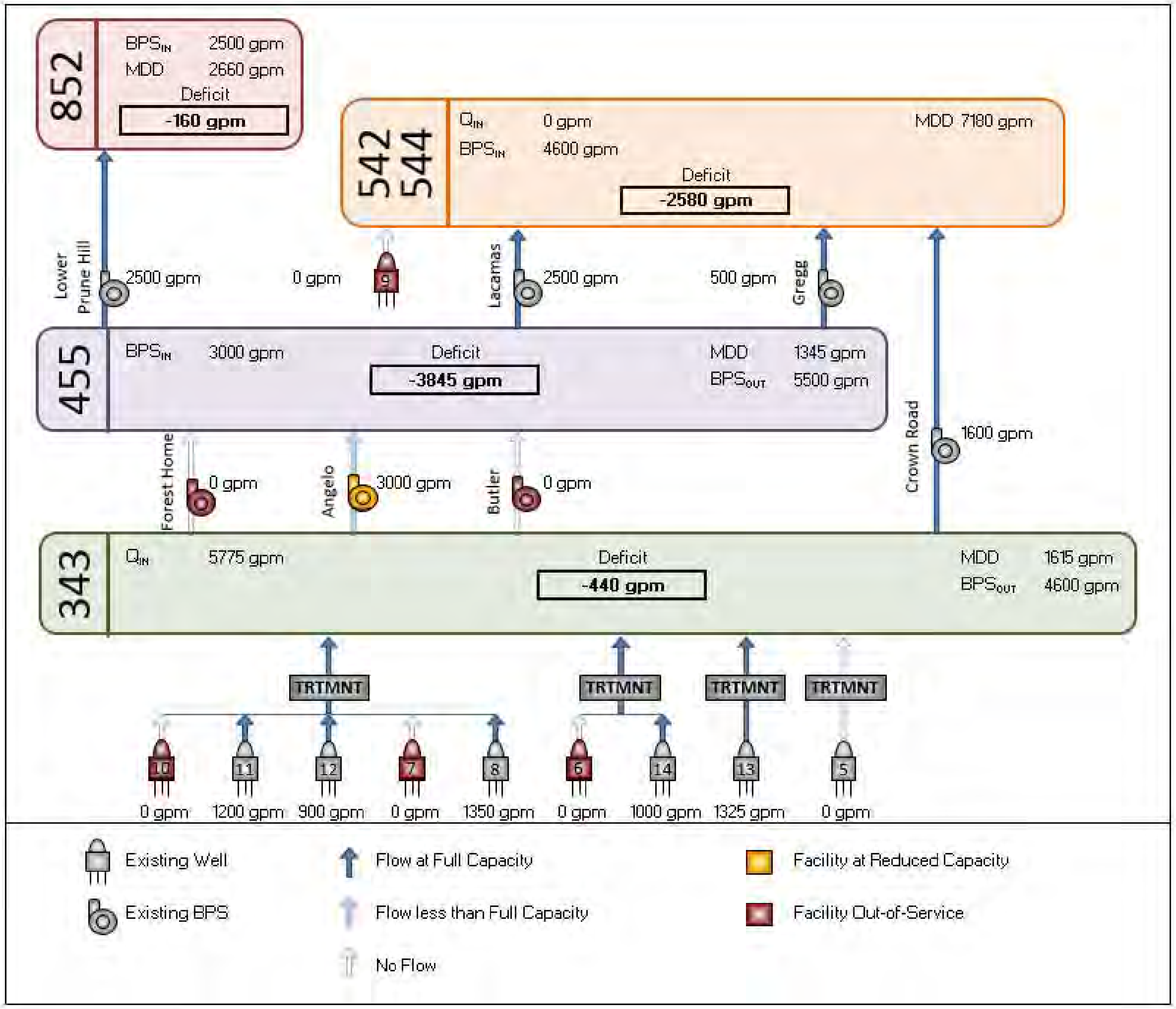


Table 9.1 Pumping Reliability Analysis
Water System Plan
City of Camas

Service Area	**343**			**455**			**542**	**544**	**542/544[(1)]**	**542/544**	**852**		
Year	**2021**	**2025**	**2035**	**2021**	**2025**	**2035**	**2021**	**2021**	**2025**	**2035**	**2021**	**2025**	**2035**
MDD of Service Area (gpm)	1,265	1,305	1,395	1,040	1,130	1,290	1,165	2,415	4,405	6,900	2,290	2,425	2,590
Fire Storage Volume (gal)	960,000	960,000	960,000	240,000	240,000	240,000	960,000	1,200,000	1,200,000	1,200,000	300,000	300,000	300,000
Fire storage Replenishment Flow (gpm)	220	220	220	55	55	55	220	280	280	280	70	70	70
Total Pumping Requirement	**1,485**	**1,525**	**1,615**	**1,095**	**1,185**	**1,345**	**1,385**	**2,695**	**4,685**	**7,180**	**2,360**	**2,495**	**2,660**
Reliable Well Capacity (gpm)	5,775	5,775	5,775	0	0	0	0	0	0	0	0	0	0
Reliable BPS Capacity	0	0	0	3,000	3,000	3,000	2,100	2,500	4,600	4,600	2,500	2,500	2,500
Booster Pumping Into Service Area to meet MDD (gpm)	0	0	0	3,000	3,000	3,000	1,385	2,500	4,595	4,600	2,360	2,495	2,500
Booster Pumping Out of Service Area (gpm)	4,385	4,600	4,600	4,845	5,490	5,500	0	0	0	0	0	0	0
Net Service Area Reliable Supply	**1,390**	**1,175**	**1,175**	**(1,860)**	**(2,490)**	**(2,500)**	**1,385**	**2,500**	**4,595**	**4,600**	**2,360**	**2,495**	**2,500**
Surplus/(Deficit) Reliable Supply (gpm)	**95**	**(350)**	**(440)**	**(2,955)**	**(3,675)**	**(4,005)**	**0**	**(195)**	**(90)**	**(2,580)**	**0**	**0**	**(160)**

Notes:
(1) By 2025 the City intends to connect the 542 Pressure Zone and 544 Pressure Zone with a new transmission main around the north end of Lacamas Lake creating a combined 542/544 Pressure Zone.

Figure 9.3   2035 Pumping Reliability Deficits



9.3.3 Pumping Redundancy

The City's water system was also evaluated against its pumping redundancy criterion for each of the service areas and each planning year. The City's policy is to supply MDD and replenish fire suppression storage within 72 hours with its firm BPS capacity (largest pump in each booster station out of service). The results of this analysis are presented in Table 9.2, where the surplus (deficit) supply is the net service area firm supply minus the total pumping requirement. Figure 9.4 shows the 2035 results graphically, and the firm capacity of each BPS.

As shown in Table 9.2, by 2021 none of the service areas have adequate firm BPS capacity to meet MDD. The City will need to increase its BPS capacity to all service areas in order to meet its pumping redundancy criteria.

9.3.4 Pumping Recommendations

In addition to the supply improvements described in Chapter 8, to meet its pumping reliability and redundancy goals, the City needs to increase its reliable and redundant pumping capacities to each service area.

Figure 9.4 shows that the 852 and 455 service areas each have a deficit of approximately 1,000 gallons per minute (gpm) by 2035. As shown in Figure 9.5 1,000 gpm of additional firm pump capacity is needed for the 852 Service Area, but a total of 2,000 gpm of additional firm pump capacity is required for the 455 Service Area because in addition to the 1,000 gpm of unmet demand in the 455 Service Area, the 1,000 gpm deficit for the 852 Service Area must be pumped up from the 343 Zone to the 455 Zone before being pumped into the 852 Zone.

Due to its condition, the City intends to replace the existing Forest Home BPS with a new pump station. This new pump station should have a firm capacity of approximately 2,000 gpm. The additional 1,000 gpm flow of the new Forest Home BPS will wheel the 1,000 gpm of additional flow needed for the 852 Zone through the 455 Zone. Approximately 1,000 gpm of additional firm booster pumping capacity will need to be built at Angelo BPS or a new BPS to the 455 Zone. Additionally, as shown in Figure 9.5, the City intends to construct the 500-gpm Well 17 in the 544 Zone by 2021.

In 2021 the 542 Zone is less than 100 gpm deficient, therefore it is recommended that improvements to this zone can be pushed out until 2025 when the combined 542/544 Service Area will require an additional 1,200 gpm of booster pumping capacity after the installation of Well 17 to meet MDD. The Crown Road Pump Station was designed to accommodate two future pumps. It is recommended that the Crown Road Pump Station's capacity is expanded by 1,600 gpm before 2025. Further expansions of approximately 2,000 gpm will be necessary at Crown Road or at a new BPS supplying the 542/544 Service Area by 2035. It is recommended that this BPS be located in a place like Crown Road where it can pump directly from the Butler 343 Zone to the 542 Zone to avoid having to construct multiple pump stations to pump to the 455 Zone and then to the 542/544 Zone.

Table 9.2 Pumping Redundancy Analysis
Water System Plan
City of Camas

Service Area	**343**			**455**			**542**	**544**	**542/544[1]**	**542/544**	**852**		
Year	**2021**	**2025**	**2035**	**2021**	**2025**	**2035**	**2021**	**2021**	**2025**	**2035**	**2021**	**2025**	**2035**
MDD of Service Area (gpm)	1,265	1,305	1,395	1,040	1,130	1,290	1,165	2,415	4,405	6,900	2,290	2,425	2,590
Fire Storage Volume (gal)	960,000	960,000	960,000	240,000	240,000	240,000	960,000	1,200,000	1,200,000	1,200,000	300,000	300,000	300,000
Fire storage Replenishment Flow (gpm)	220	220	220	55	55	55	220	280	280	280	70	70	70
Total Pumping Requirement	**1,485**	**1,525**	**1,615**	**1,095**	**1,185**	**1,345**	**1,385**	**2,695**	**4,685**	**7,180**	**2,360**	**2,495**	**2,660**
Well Capacity (gpm)	8,625	8,625	8,625	0	0	0	0	650	650	650	0	0	0
Firm BPS Capacity				3,600	3,600	3,600	1,300	1,000	2,300	2,300	1,750	1,750	1,750
Booster Pumping Into Service Area (gpm)	0	0	0	3,600	3,600	3,600	1,220	1,000	2,300	2,300	1,750	1,750	1,750
Booster Pumping Out of Service Area (gpm)	4,400	4,400	4,400	3,250	3,250	3,250	0	0	0	0	0	0	0
Net Service Area Firm Supply	**4,225**	**4,225**	**4,225**	**350**	**350**	**350**	**1,220**	**1,650**	**2,950**	**2,950**	**1,750**	**1,750**	**1,750**
Surplus/(Deficit) Supply (gpm)	**2,740**	**2,700**	**2,610**	**(745)**	**(835)**	**(995)**	**(85)**	**(1,045)**	**(1,735)**	**(4,230)**	**(610)**	**(745)**	**(910)**

Notes:
(1) By 2025 the City intends to connect the 542 Pressure Zone and 544 Pressure Zone with a new transmission main around the north end of Lacamas Lake creating a combined 542/544 Pressure Zone.

Figure 9.4 2035 Pumping Redundancy Deficits

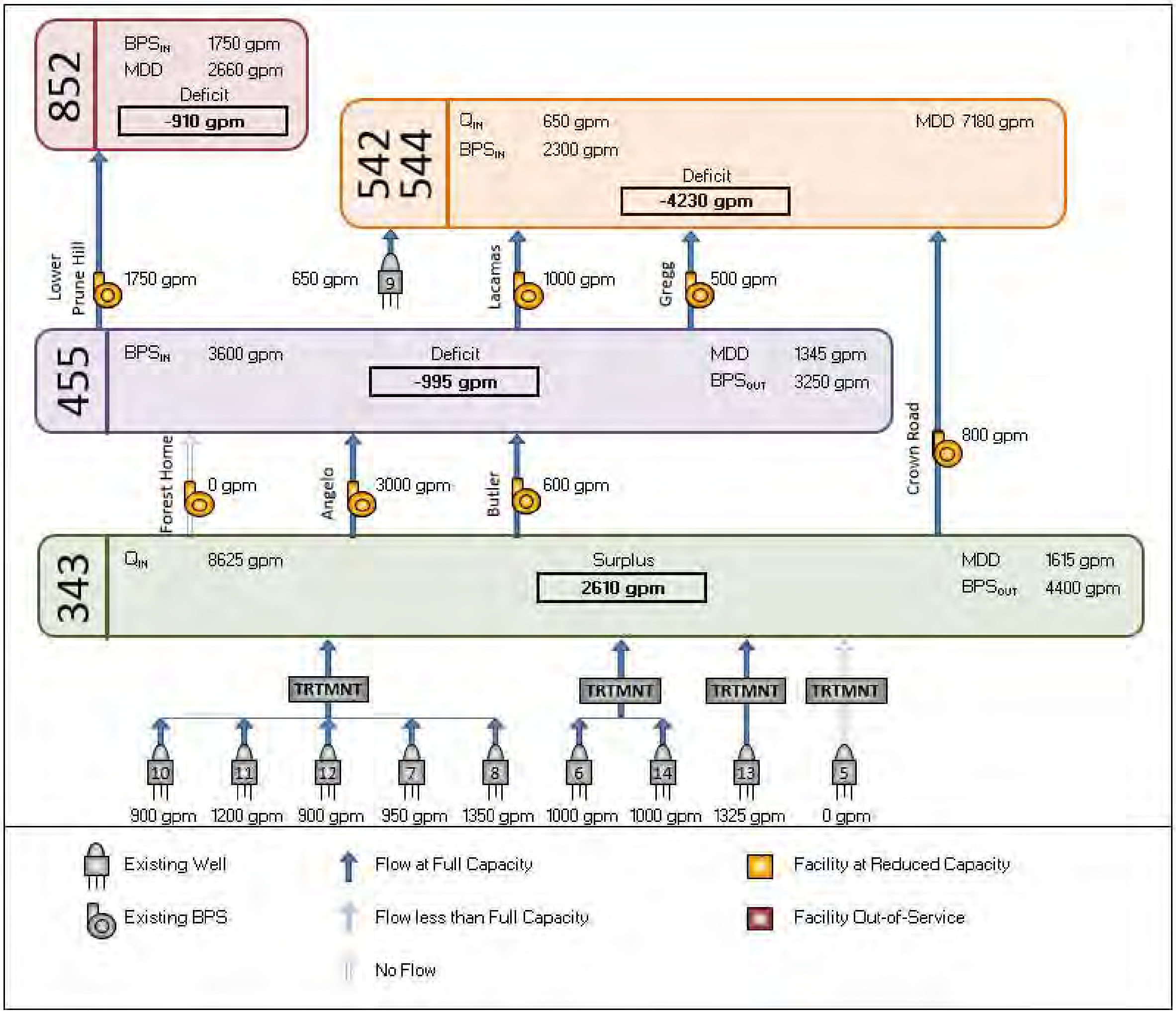
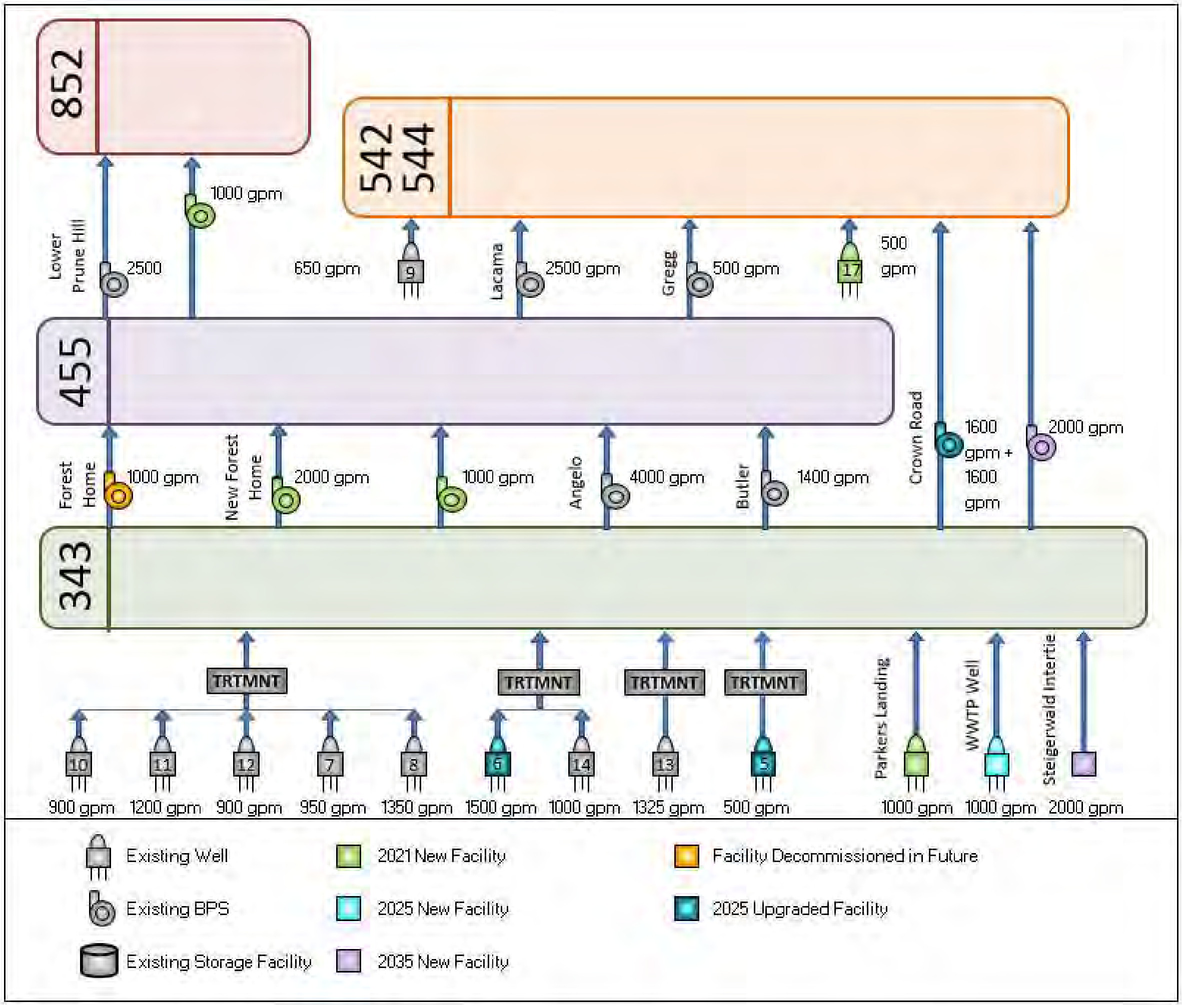


Figure 9.5 BPS Improvement Recommendations



9.4 STORAGE ANALYSIS

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

9.4.1 Storage Components and Governing Criteria

Following the Washington State Department of Health (DOH) storage volume requirements (WAC 246-290-235(3)) and the Water System Design Manual, Chapter 9, the five components of storage listed below and illustrated in Figure 9.6 must be considered for any water system:

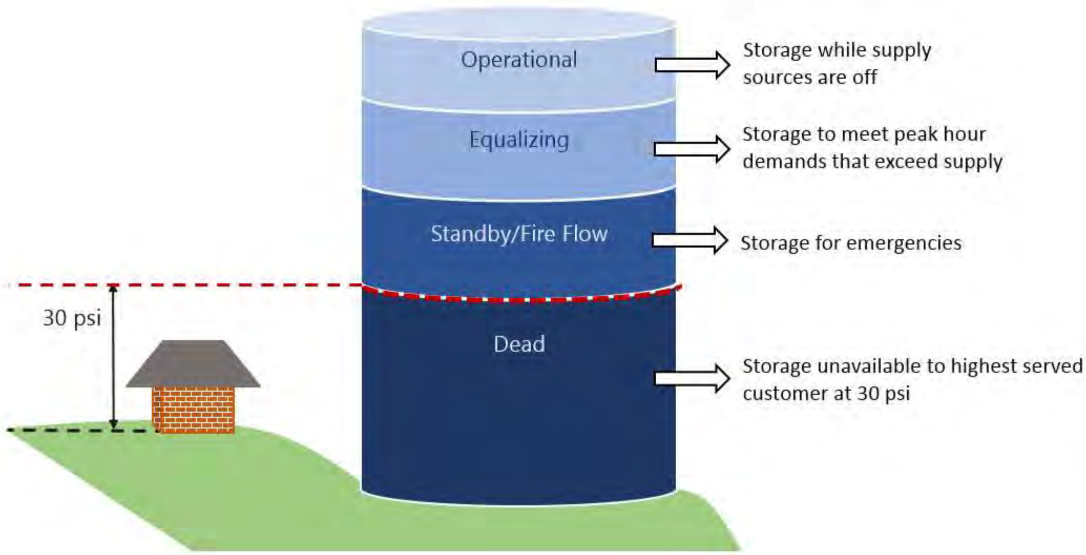
1) Operational storage.
2) Equalizing storage.
3) Standby storage.
4) Fire Suppression storage.
5) Dead storage.

DOH requires that operational and equalizing storage are available to all customers at a residual pressure of at least 30 pounds per square inch (psi) under peak hour demand (PHD) flow conditions. The City has an increased level of service goal to provide standby and fire suppression storage to all customers at a residual pressure of at least 30 psi under MDD, which is above the DOH requirement of 20 psi. Therefore, all tank volumes above the 30 psi hydraulic grade line (HGL) are considered available storage. Dead storage is the volume in the tank that cannot be used to serve the highest customer in the water system with a pressure of at least 30 psi.

9.4.1.1 Operational Storage

Operational storage is the band of storage within each reservoir that is utilized during periods of average demand. It is typically estimated based on the volume of water each reservoir drops prior to calling on the supply sources, and is measured as the volume of water stored between the pump call-off and pump call-on levels.

Figure 9.6 Storage Components



9.4.1.2 <u>Equalizing Storage</u>

Equalizing storage is the volume needed to satisfy PHD. It should be available at 30 psi to all service connections. Equalizing storage volume requirements can be calculated using the following equation from the DOH Water System Design Manual:

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

Where: ES = Equalizing Storage component, in gallons

PHD = Peak hourly demand, in gpm

MDD = Sum of all installed and active source of supply capacities, except emergency sources of supply, in gpm

9.4.1.3 <u>Fire Suppression Storage</u>

Storage for emergencies is comprised of fire suppression storage and standby storage. For the City's water system, these two components of storage are nested, which means that the volume of storage reserved for emergencies consists of whichever requirement is greater between fire suppression storage or standby storage.

Fire suppression storage is the volume of storage required to deliver fire flows as prescribed by local fire protection authorities. Since a fire can occur at any time during the day, the fire suppression storage must be in addition to the equalizing and operational storage. City policy states that fire suppression storage should be available at 30 psi.

The maximum fire flow requirements and durations for each service area are provided in Table 9.3.

Table 9.3 Fire Suppression Storage Requirements
Water System Plan
City of Camas

Service Area	Largest Fire Flow Requirement (gpm)	Fire Flow Duration (minutes)	Fire Suppression Storage Required (MG)
343	4,000	240	0.96
455	2,000	120	0.24
542	4,000	240	0.96
544	5,000	240	1.2
852	2,500	120	0.3

9.4.1.4 <u>Standby Storage</u>

Standby storage is the volume of storage required to supply reasonable system demands during a system emergency, such as disruption of the water supply. Disruptions could be caused by transmission pipeline or equipment failure, power outage, valve failure, or other system interruptions. The computation of emergency/standby storage requirements includes consideration of reasonable system disruptions that can be expected to occur within normal planning contingencies, and does not consider major system emergencies, such as earthquakes, that result in shutdown of water supplies and multiple distribution system breaks. These types of emergencies should be covered under emergency system operation planning.

The City's standby storage policy is that the reservoirs in the water system should have enough standby storage to supply 200 gallons per equivalent residential units (ERU). City policy states that this storage should be available to the highest customer in the service area at 30 psi.

9.4.2 Available Storage

The Camas Water System has seven storage tanks with a total capacity of 8.45 MG. However, the available storage excluding dead storage is 6.64 MG as shown in Table 9.4 and described below.

The dead storage corresponds to the volume of the tank that is effectively unusable. The storage volume is considered dead if it is located below the outlet pipe and cannot be withdrawn, due to dynamic losses in the distribution system, or if it is located below the lowest water surface elevation that meets the minimum design pressure of 30 psi.

The available storage in each service area is controlled by the elevation of the highest customer in the system and the HGL required to serve that customer with a pressure of at least 30 psi. Table 9.4 shows the highest service elevation and the amount of available storage in each service area.

9.4.3 Required Storage

The operational, equalizing, fire suppression, and standby storage requirements are summarized in Table 9.4 for each service area and each planning year. The total required storage is the sum of operational, equalizing and the maximum between fire suppression and standby storage.

The 343 Service Area has a small (0.1 MG) storage deficit in all planning years. The 455 and 852 service areas both have storage surpluses throughout the planning period. The 542 and 544 service areas have storage deficits in all planning years with a storage deficit of approximately 3 MG for the combined 542/544 service area in 2035.

Table 9.5, Table 9.6, and Table 9.7 list the parameters used in the calculations of operational, equalizing, and standby storage, respectively.

Table 9.4 Storage Analysis Results
Water System Plan
City of Camas

Service Area	**343**			**455**			**542**	**544**	**542/544[1]**		**852**		
Planning Year	**2021**	**2025**	**2035**	**2021**	**2025**	**2035**	**2021**	**2021**	**2025**	**2035**	**2021**	**2025**	**2035**
Available Storage													
Total Storage (MG)	1.20	1.20	1.20	2.00	2.00	2.00	0.10	2.00	2.10	2.10	3.15	3.15	3.15
Highest Customer	239	239	239	362	362	362	440	450	450	450	756	756	756
Available Storage above 30 psi (MG)	**1.20**	**1.20**	**1.20**	**2.00**	**2.00**	**2.00**	**0.05**	**1.03**	**1.08**	**1.08**	**2.36**	**2.36**	**2.36**
Required Storage Components													
Operational Storage (MG)	0.24	0.24	0.24	0.22	0.22	0.22	0.01	0.25	0.26	0.26	0.32	0.32	0.32
Equalizing Storage (MG)	0.13	0.14	0.14	0.11	0.12	0.14	0.13	0.23	0.43	0.66	0.23	0.24	0.25
Fire Suppression Storage (MG)	0.96	0.96	0.96	0.24	0.24	0.24	0.96	1.20	1.20	1.20	0.30	0.30	0.30
Standby Storage (MG	0.58	0.61	0.67	0.41	0.44	0.51	0.41	1.51	2.21	3.07	0.90	0.94	1.00
Total Required Storage (MG)	**1.33**	**1.34**	**1.34**	**0.74**	**0.78**	**0.86**	**1.10**	**2.00**	**2.91**	**4.00**	**1.44**	**1.50**	**1.57**
Storage Surplus/(Deficit) (MG)	**(0.1)**	**(0.1)**	**(0.1)**	**1.3**	**1.2**	**1.1**	**(1.1)**	**(1.0)**	**(1.8)**	**(2.9)**	**0.9**	**0.9**	**0.8**

Notes:
(1) By 2025 the City intends to connect the 542 Pressure Zone and 544 Pressure Zone with a new transmission main around the north end of Lacamas Lake creating a combined 542/544 Pressure Zone.

Table 9.5 Operational Storage Calculations
Water System Plan
City of Camas

Service Area	**343**	**455**			**542**	**544**	**852**		
Storage Facility	**Butler Reservoir**	**Lower Prune Hill Reservoir #1**	**Lower Prune Hill Reservoir #2**	**Total**	**Gregg Reservoir**	**Lacamas Reservoir**	**Upper Prune Hill Standpipe**	**Upper Prune Hill Reservoir**	**Total**
Storage Capacity (MG)	1.2	0.5	1.5	2.0	0.1	2.0	0.75	2.4	3.15
Elevation of Overflow (ft)	343	455	455		542	544	852	798	
Base of Tank (ft)	328	432	432		472	496	752	748	
Nominal Diameter (ft)	117	61	105		16	84	36	90	
Operating Band	3.0	2.5	2.5		10.0	6.0	10.0	5.0	
Operating Volume (gal)	240,000	54,000	163,000	217,000	14,000	250,000	75,000	240,000	315,000
Percent of Total Storage	20%	11%	11%	11%	14%	13%	10%	10%	10%

Table 9.6 Equalizing Storage Calculations
Water System Plan
City of Camas

Service Area	343			455			542	544	542/544[1]		852		
Planning Year	**2021**	**2025**	**2035**	**2021**	**2025**	**2035**	**2021**	**2021**	**2025**	**2035**	**2021**	**2025**	**2035**
MDD (gpm)	1,265	1,305	1,395	1,040	1,130	1,290	1,165	2,415	4,405	6,900	2,290	2,425	2,590
PHD (gpm)	2,140	2,205	2,345	1,800	1,945	2,200	2,015	3,955	7,285	11,285	3,800	4,010	4,280
Equalizing Storage (gal)	131,000	135,000	143,000	114,000	122,000	137,000	128,000	231,000	432,000	658,000	227,000	238,000	254,000

Notes:
(1) By 2025 the City intends to connect the 542 Pressure Zone and 544 Pressure Zone with a new transmission main around the north end of Lacamas Lake creating a combined 542/544 Pressure Zone.

Table 9.7 Standby Storage Calculations
Water System Plan
City of Camas

Service Area	343			455			542	544	542/544[1]		852		
Planning Year	**2021**	**2025**	**2035**	**2021**	**2025**	**2035**	**2021**	**2021**	**2025**	**2035**	**2021**	**2025**	**2035**
ERUs	2,900	3,025	3,325	2,045	2,215	2,530	2,045	7,570	11,050	15,370	4,495	4,710	4,990
Standby Storage (gal)	580,000	605,000	665,000	409,000	443,000	506,000	409,000	1,514,000	2,210,000	3,074,000	899,000	942,000	998,000

Notes:
(1) By 2025 the City intends to connect the 542 Pressure Zone and 544 Pressure Zone with a new transmission main around the north end of Lacamas Lake creating a combined 542/544 Pressure Zone.

9.4.4 Storage Recommendations

The most immediate storage need is in the 544 Service Area. The City is in the process of siting and designing a new 2.0 MG tank. An ideal location for this tank is near the corner of NW 18th Ave and Tidland St.

The City's next storage priority will be to replace the Butler Reservoir. Although the 343 Service Area has only a small storage deficit, the City plans to decommission the Butler Reservoir within the 20-year planning period due to its condition. It is recommended that a slightly larger tank with a capacity of 1.5 MG be constructed on Cemetery Hill. This is a hydraulically advantageous location due to its proximity to the Washougal Well Field wells. If the City cannot locate the tank at the cemetery, installing a new tank at the Crown Road BPS site or at the Butler site should be considered.

Finally, by 2035 additional storage will be required for the North Shore Area. We recommend a 1.0 MG storage facility be constructed at the site of the existing Gregg Standpipe. This location is hydraulically ideal due to its proximity to the Crown Road and Gregg BPSs.

9.4.5 Summary of Recommended Supply, Pumping and Storage Improvements

All of the recommended supply, pumping, and storage improvement projects are summarized in Figure 9.7.

9.5 HYDRAULIC MODEL UPDATE

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

The City maintains the hydraulic model of their distribution system in InfoWater by Innovyze. For the purpose of the system analysis, the City's model was updated using data provided by the City.

9.5.1 Physical Features Update

City staff to verified pressure zone boundaries. The pressure zone boundaries were updated in the model by permanently closing or opening pipes to match the correct pressure zone configuration of the water system. Also, corrections were made to pressure zone assignments for all pipes and junctions.

Pipe diameters and PRV settings were verified and corrected in the model to match a map provided by the City. The piping configuration at Well 6 and 14 was updated to match drawings of system improvements that the City is currently undertaking.

9.5.1.1 Butler/Gregg Booster Pump Station Site Updates

The model configuration at the site of the Butler and Gregg BPSs was updated to match record drawings of the pipe and valve configuration. A valve was added to the model to represent the PRV within the Old Gregg BPS building that supplies water to the 455 Zone from the 542 Zone. This PRV will be in operation when the City's slow sand filter that supplies the 542 Zone is online during the winter.

9.5.1.2 Upper Prune Hill Reservoir Site Updates

The original model was not configured to run in extended period simulation at the Upper Prune Hill Reservoir site. The Upper Prune Hill Reservoir altitude valve and pipes were added to the model to match the site's configuration as shown on the City's SCADA system.

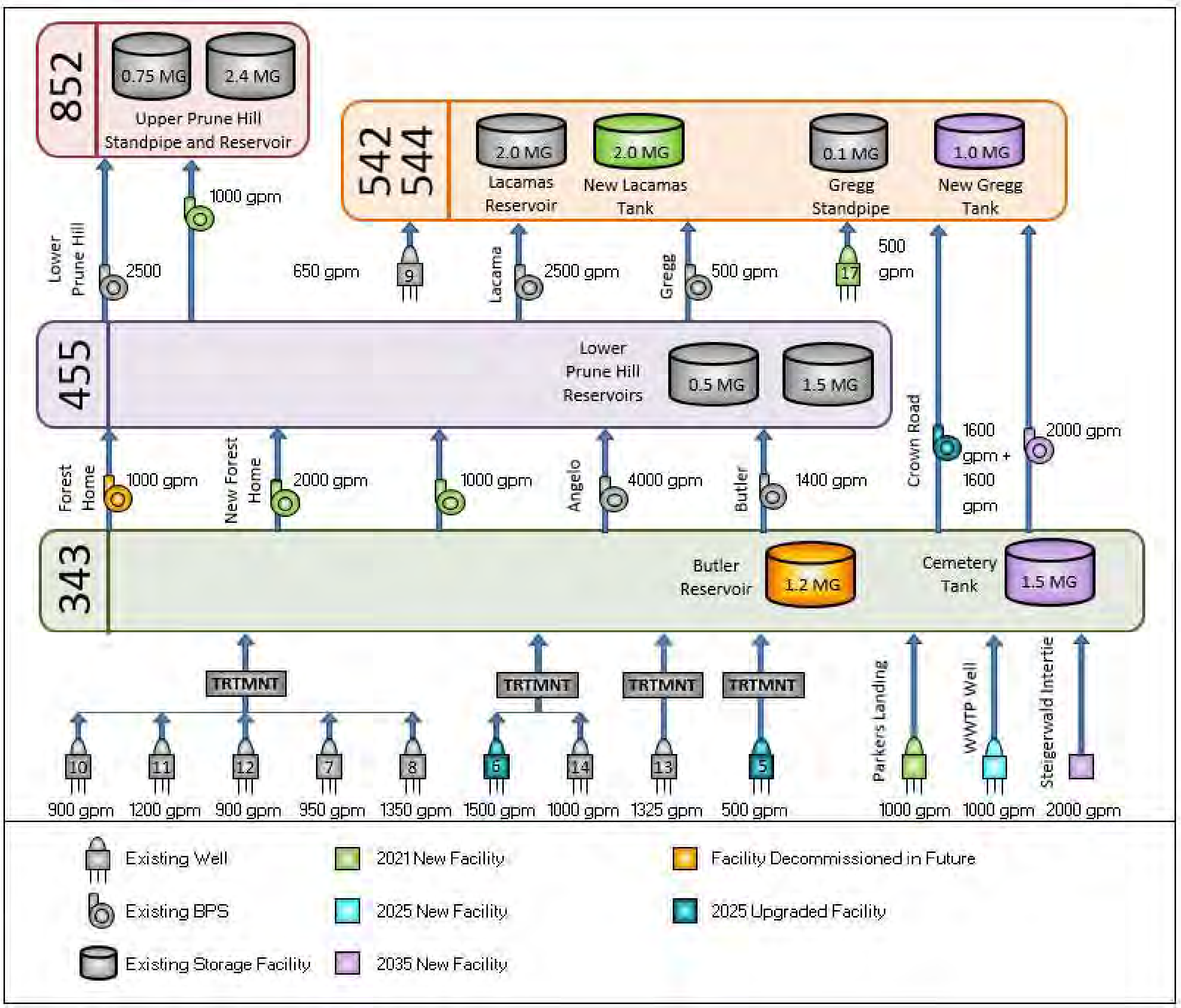
9.5.1.3 Reservoir Levels

For the fire flow scenarios, reservoir levels in the model were set to match the bottom of the fire suppression storage component as determined by the storage analysis.

9.5.1.4 Operational Settings

Summer and winter operational settings for wells, pump stations, and valves were updated to reflect the latest information provided by the City.

Figure 9.7 Recommended Supply, Pumping, and Storage Improvements



9.5.2 Future Expansion

Within the planning period the City expects significant expansion of the water system in the North Shore area. Future pipelines were added to the model in the North Shore area to match the transportation corridors delineated on a map provided by the City. The future Green Mountain development was already included in the model before this update began.

In the future the City wants to connect the 542 and 544 zones and combine them as one pressure zone. In past planning documents two methods were identified for connecting the two zones.

1. The first method is to construct a transmission main along the north side of Lacamas Lake that connects the two zones.
2. The alternative method consisted of connecting the two zones hydraulically by converting the existing 455 Zone transmission mains along NE Everett St and NW Lake Rd to 544 Zone mains and bypassing the Gregg and Lacamas BPSs.

The second method would require the NE Everett St and NW Lake Rd transmission mains to be operated as a 544 Zone main in the winter when supply comes from the City's slow sand filter in the 542 Zone, and as a 455 Zone main in the summer when supplies come predominantly from the 343 Zone wells. For the sake of operational simplicity, the City has decided to move forward with the first method of connecting the 542 and 544 zones through a transmission main around the north side of Lacamas Lake. The City plans to construct the transmission mains needed to connect these two zones by 2025.

Despite a wide range of elevations in the North Shore area, the City plans to serve all North Shore customers through the 542/544 Pressure Zone. As a result, many customers will require individual or community PRV stations to provide adequate service pressures.

9.5.3 Demand Allocation

The medium scenario future demand requirements for years 2021, 2025, and 2035, as presented in Chapter 5, were allocated to the model. First, large user demands for each planning year were allocated to the model nodes located closest to the large users. City of Camas and Camas School District demands were divided up and allocated to model nodes representing City facilities and City schools. The proportion of the demand assigned to each node was based on 2015 metered billing data.

To assign demands representing the remainder of the City's customers, demand factors were developed for each customer class based on 2015 billing data. The demand factors are shown in Table 9.8. Using GIS, each meter was assigned a demand based on its customer class and then this demand was assigned to the closest node in the model using GIS geocoding software.

All non-large user 2015 demands in the model were grown by a multiplication factor unique to each pressure zone to represent the demand for future planning years. The only exception to this method was the 542/544 Zone where growth is expected to occur by water system expansion in the North Shore area, rather than development infill. For the North Shore area, demand projections were allocated to model nodes based on land use.

Table 9.8 Customer Class Demand Factors
Water System Plan
City of Camas

Customer Class	Demand per Meter (gpd)	Demand per Meter (gpm)
Single-family	260	0.181
Multi-family	350	0.243
Commercial	502	0.349
Industrial	3,112	2.161
Irrigation	767	0.532

9.5.4 Calibration Verification

The City's hydraulic model was most recently updated and calibrated in 2013. A full recalibration of the model was not included in the water system plan development scope, however, hydrant flow tests were performed at six locations throughout the City's distribution system and model calibration was verified using this data. Details on the model calibration verification can be found in Appendix J.

9.5.5 Fire Flows

The City has three general levels of fire flow requirements that are listed in Table 9.9. All new residential buildings within the City are required to have sprinklers. Residential buildings with sprinklers require a fire flow of 500 gpm. Residential buildings without sprinklers must have fire flows of at least 1,000 gpm. Non-residential buildings require 1,500 gpm of fire flow.

Note: City utility is responsible for dictating the general fire flows for future land use planning which had been developed in collaboration with the Fire Marshal. The Fire Marshal is responsible for dictating the specific fire flow requirements at the time of development. The City evaluates the ability to serve each new connect before utility permit is issued, where the developer is responsible for making improvements to meet site specific fire flows, as necessary.

Table 9.9 Fire Flow Requirements Water System Plan City of Camas	
Customer Class	**Fire Flow Demand (gpm)**
Residential with Sprinklers	500
Residential without Sprinklers	1,000
Non-residential	1,500

The City does not have a record of which houses have sprinklers and which do not. Therefore, for the purpose of the system analysis all existing residential areas were assumed to require 1,000 gpm of fire flow. Future residential neighborhoods such as Green Mountain were assigned a fire flow of 500 gpm, because all of those homes will have sprinklers. Two neighborhoods that were identified as receiving less than 1,000 gpm of fire flow were confirmed by City staff as having sprinklers and requiring 500 gpm of fire flow.

Fire flow requirements above 1,500 gpm for specific facilities such as schools, industrial facilities, and churches were identified and assigned fire flow requirements by City staff. The City's fire flow requirements as they were assigned to each node in the model are shown in Figure 9.8.

9.6 DISTRIBUTION SYSTEM ANALYSIS

The updated model was used to evaluate the distribution system under future demand conditions. The distribution system was evaluated against two performance criteria: minimum pressure and minimum fire flow. Areas not meeting the criteria are considered deficient and system improvements are identified to achieve the required level of service.

9.6.1 Evaluation Criteria

The distribution system was evaluated for the following criteria, which match the requirements of the DOH Design Manual and WAC 246-290.

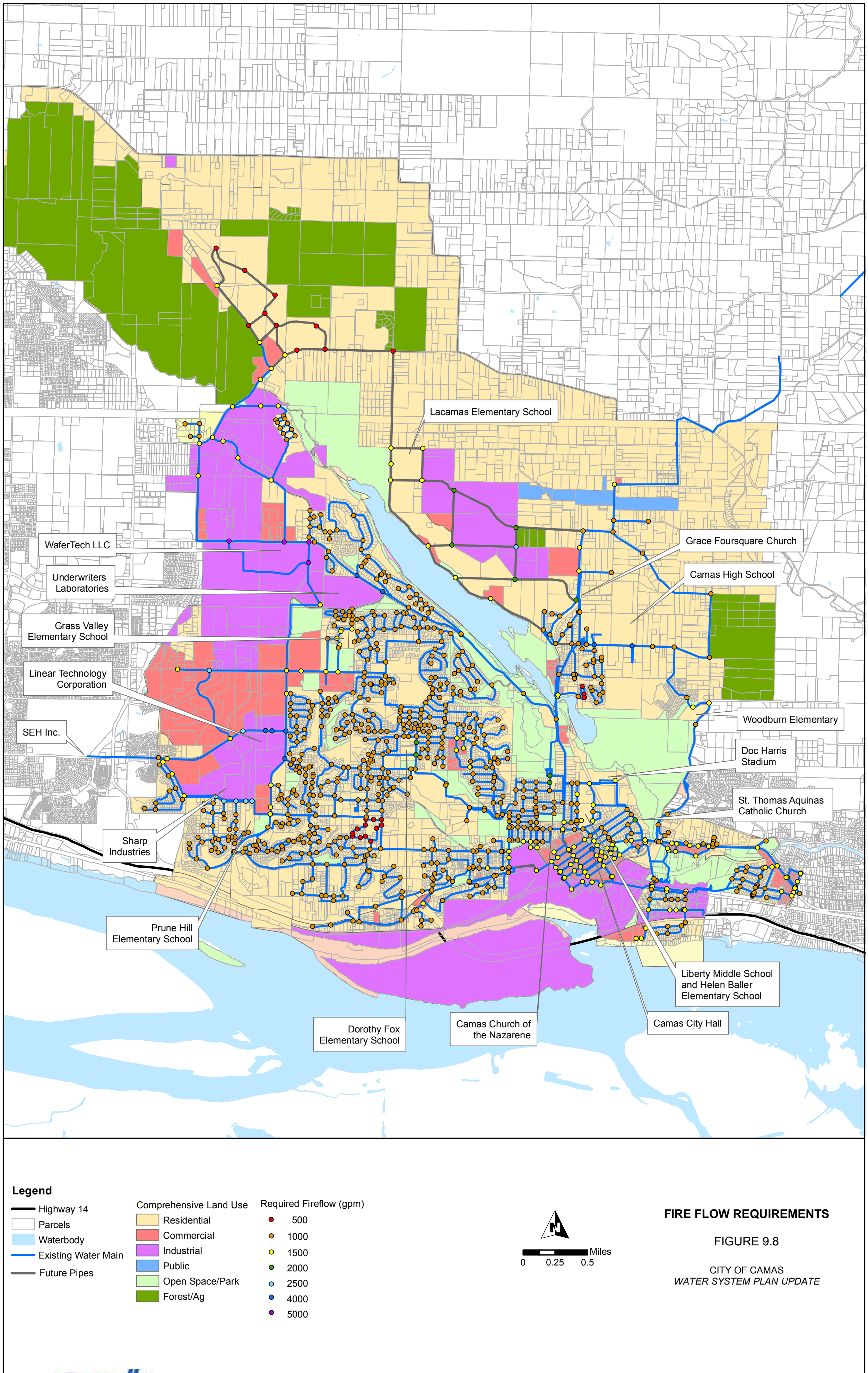
1. PHD Pressure. Minimum allowed pressure is 30 psi during PHD.
2. Available Fire Flow. While delivering the required fire flow during MDD conditions, system pressures must remain above 20 psi.

9.6.2 Supply Improvements

Because the City expects significant growth, the City's existing supplies do not have enough capacity to meet projected future demands. The hydraulic model will not run in a condition where demands exceed supply. Therefore, it was necessary to add future supply improvements to the model before the model could be run to identify pressure and fire flow deficiencies. All of the supply and booster pumping improvement projects identified by the water resource analysis in Chapter 8 and pumping analysis in Section 9.3 of this chapter as well as required transmission main improvements associated with these supply projects were added to the model before identifying pressure and fire flow deficiencies. These supply projects were included in the model with their capacity and timing dictated by what was recommended in the supply and pumping analyses. However, the City may choose to implement other projects recommended in Section 9.6.4 to reach the same level of service.

9.6.2.1 2021 Supply Improvements

The supply improvements recommended to be implemented before the year 2021 include development of Well 17 (S-1 on Figure 9.9) with a capacity of 500 gpm in the 544 Zone near NW Lake Road and development of Parkers Landing Well (S-2 on Figure 9.9) with a capacity of 1,000 gpm near SE 11th Ave and Front Street. Additional supply from Parkers Landing Well requires transmission main upsize projects S-2 and D-2.



FIRE FLOW REQUIREMENTS

FIGURE 9.8

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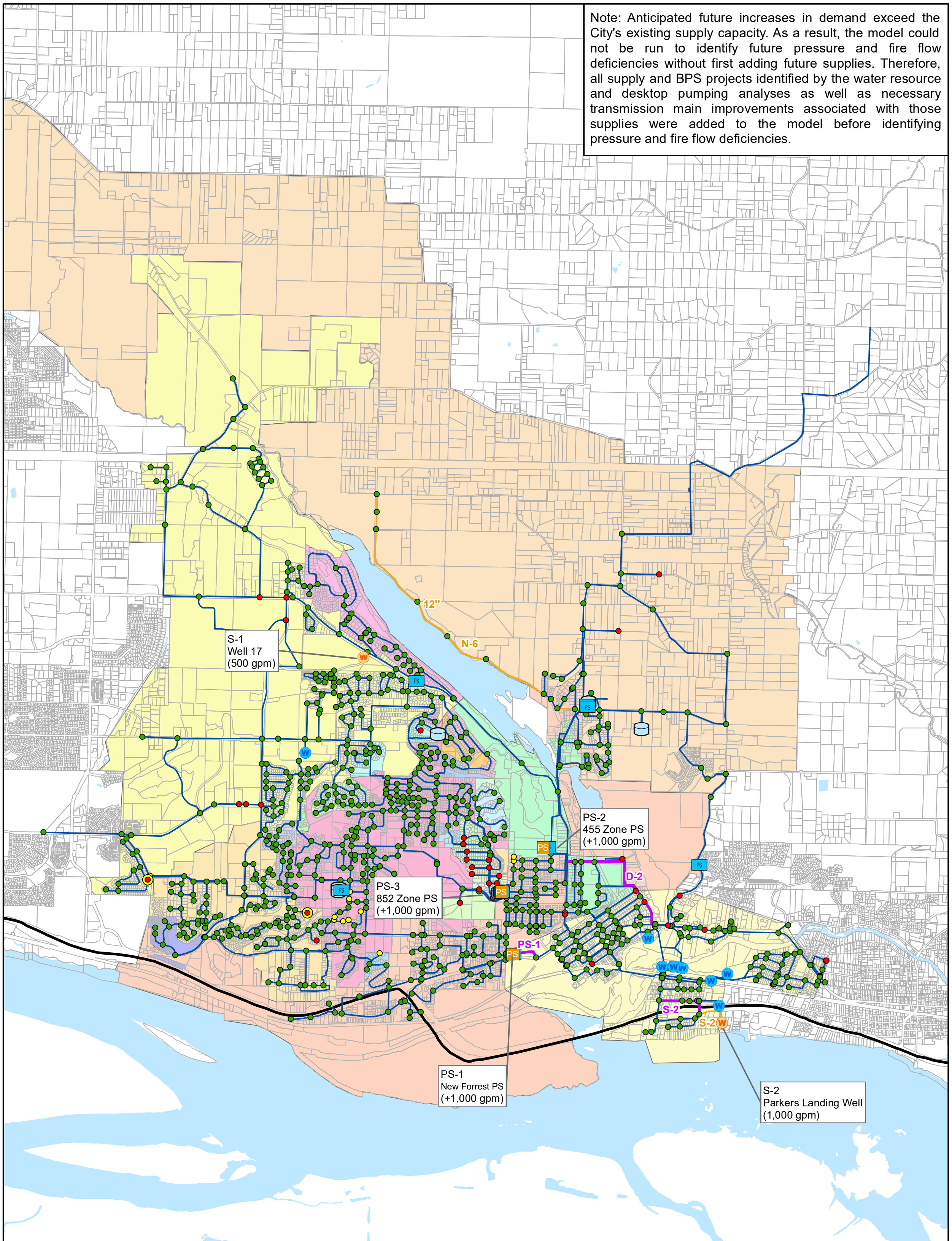

Legend

- Highway 14
- Parcels
- Waterbody
- Upsized Pipelines
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- Existing Pump Station
- Existing Water Tank
- Pump Station Capacity Improvements
- Well Improvements
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- PHD Minimum Pressure (< 30 psi)
- Fire Flow Residual Pressure < 20 psi and PHD Minimum Pressure < 30 psi
- Fire Flow Residual Pressure (> 20 psi) and PHD Minimum Pressure (> 30 psi)

Primary Pressure Zones

343, Downtown 343, 455, Nuga 542, 544, 852

Sub Pressure Zones

440, 666, 711, 542, 674, 738, 547, 675, 745, 581, 694, 760, 612, 697, 782, 625, 710, 800

Miles
0 0.25 0.5

2021 PHD PRESSURE AND FIRE FLOW DEFICIENCIES

FIGURE 9.9

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WATER SYSTEM PLAN UPDATE

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The pumping analysis identified the need for additional pumping capacity to the 455 and 852 zones by 2021 to meet redundancy criteria. PS-1 is a project to replace the 1,000 gpm Forest Home Pump Station with a new 2,000 gpm pump station. This improvement should coincide with upsizing the pipe feeding the pump station. Additional pumping to the 455 Zone was modeled as a 1,000-gpm expansion to the Angelo BPS. For 2021, the model includes an additional pump in the Lower Prune Hill BPS with a 1,000-gpm capacity.

9.6.2.2 2025 Supply Improvements

Additional supply improvements required by 2025 according to the redundancy criteria of the water resources and pumping analyses include the 1,000-gpm Wastewater Treatment Plant (WWTP) Well (S-3 on Figure 9.10) and associated transmission main improvements, and the project to increase the yield of Well 6 from 1,000 gpm to 1,500 gpm (S-4 on Figure 9.10).

By 2025 an additional 2,000 gpm of pumping capacity is required for the 542/544 Zone. This can be accomplished by expanding the capacity of the Crown Road Booster Pump Station (PS-4 on Figure 9.10).

9.6.2.3 2035 Supply Improvements

Between 2025 and 2035 the Steigerwald Regional Water Source that will be supplied through an intertie in the southwest corner of the City's water system is planned to be brought online to supply an additional 2,000 gpm. The intertie and corresponding transmission main improvements are labelled on Figure 9.11 as S-5.

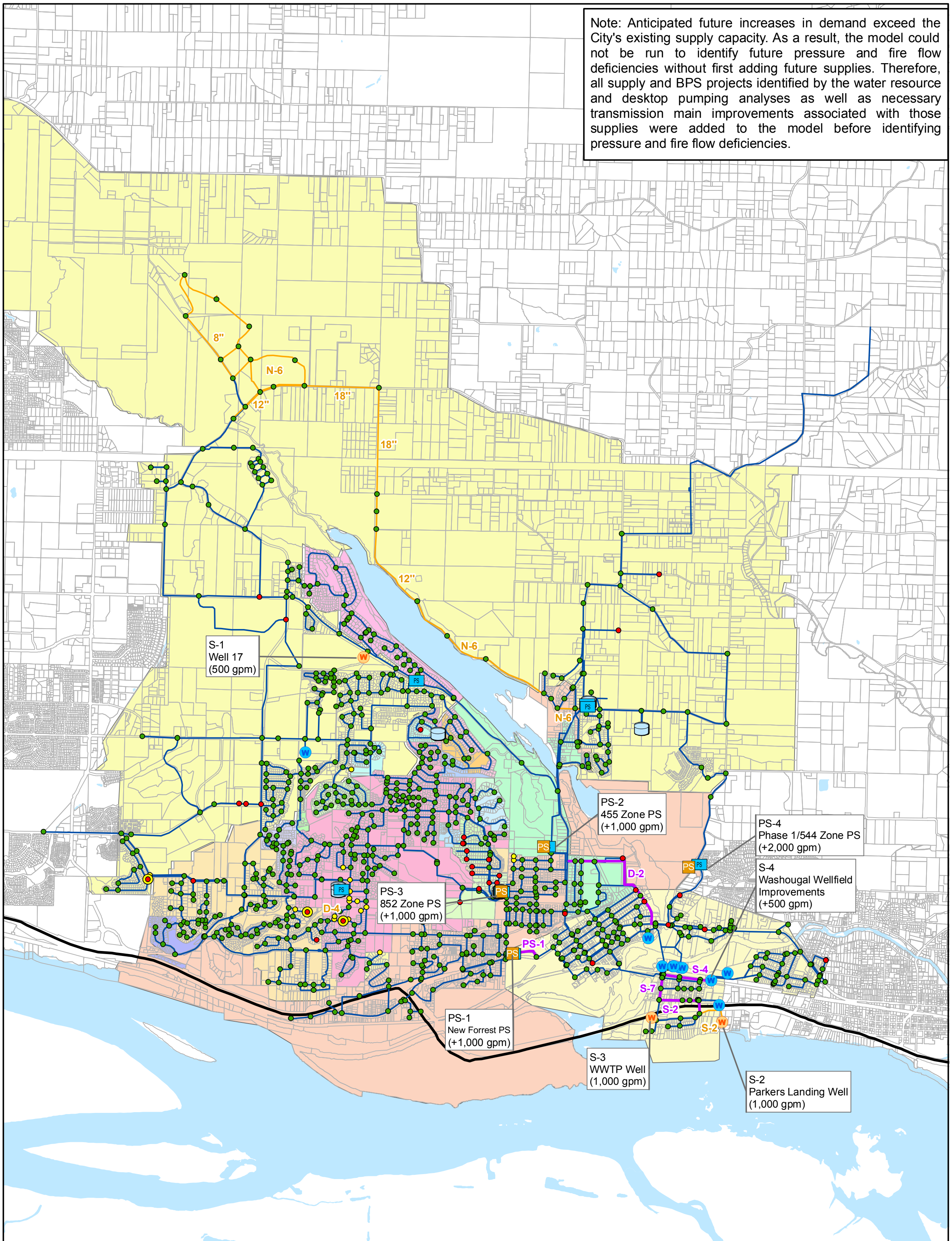
The 542/544 Zone requires an additional 2,000 gpm of pumping into the zone over 2025 levels. It is recommended that a new BPS be constructed at the Crown Road site. In order to convey the additional supply, the transmission main along Woodburn Drive and SE 277th Ave will need to be upsized from 12 inches to 24 inches in diameter.

9.6.3 Identified Deficiencies

Peak hour pressure and max day fire flow deficiencies are displayed on Figure 9.9 through Figure 9.11 organized by planning year. Pressure deficiencies are identified by yellow nodes and fire flow deficiencies are identified by red nodes.

9.6.3.1 2021 Deficiencies

For the 2021 peak hour demand scenario, the model identifies four areas with low pressures. Going from east to west in Figure 9.9, the first area consists of residential customers on the north end of Couch St that experience low pressures due to their elevation. Next, several high elevation nodes near the Upper Prune Hill Standpipe experience pressures below 30 psi during peak demand periods. Additionally, a single high elevation node in the 697 Zone and two nodes directly downstream of a PRV from the 697 Zone to the 544 Zone stand out for low pressure.



Legend

- Highway 14
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- Existing Pump Station
- Existing Water Tank
- New Supply Intertie
- Pump Station Improvements
- Well Improvements
- Fire Flow Residual Pressure (< 20 psi)
- PHD Minimum Pressure (< 30 psi)
- Fire Flow Residual Pressure < 20 psi and PHD Minimum Pressure < 30 psi
- Fire Flow Residual Pressure (> 20 psi) and PHD Minimum Pressure (> 30 psi)

Primary Pressure Zones

343, Downtown 343, 455, 544, 852

Sub Pressure Zones

440, 666, 711, 542, 674, 738, 547, 675, 745, 581, 694, 760, 612, 697, 782, 625, 710, 800

Miles
0 0.25 0.5

2025 PHD PRESSURE AND FIRE FLOW DEFICIENCIES

FIGURE 9.10

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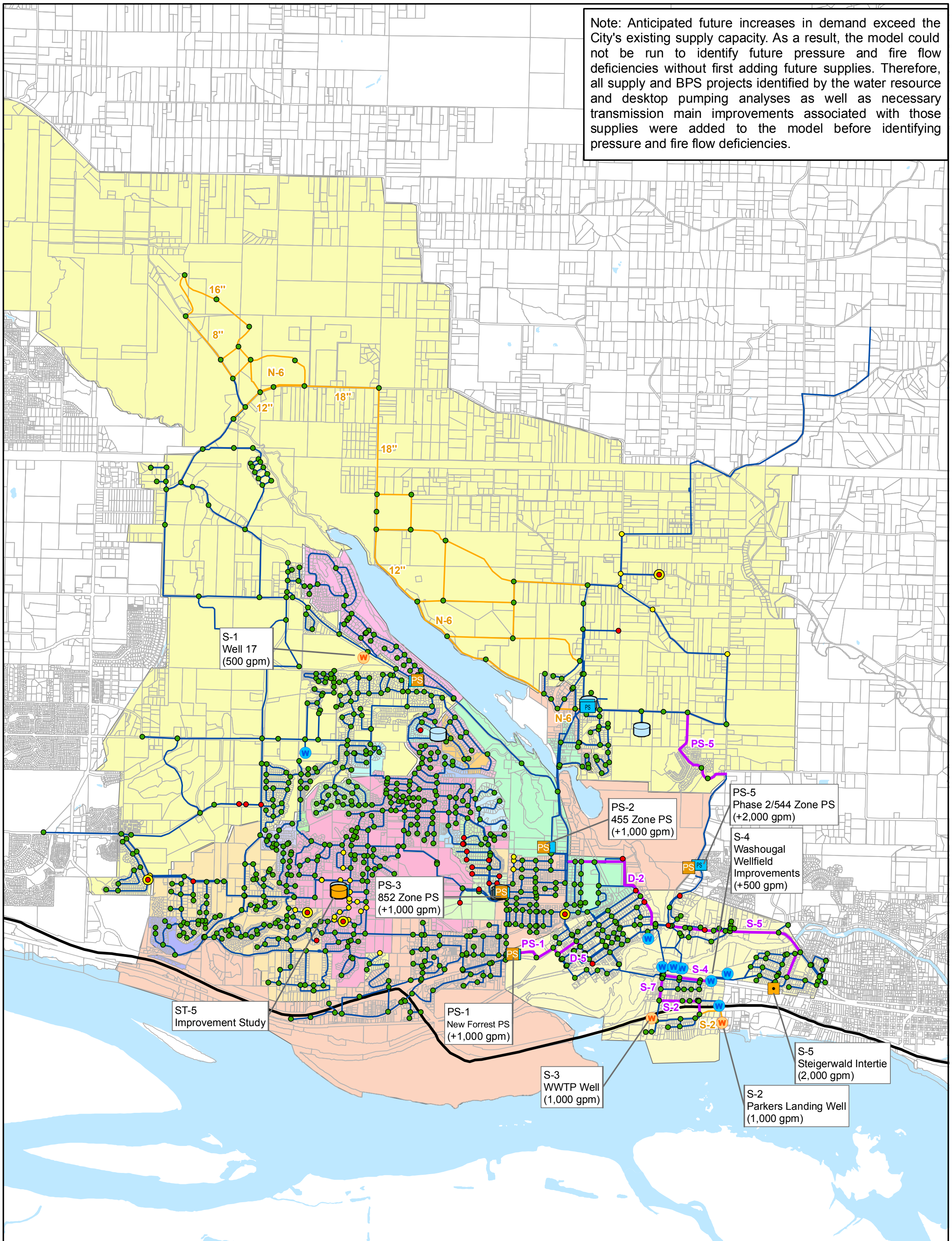

Legend

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- Fire Flow Residual Pressure (> 20 psi) and PHD Minimum Pressure (> 30 psi)

Primary Pressure Zones

343, Downtown 343, 455, 544, 852

Sub Pressure Zones

440, 666, 711, 542, 674, 738, 547, 675, 745, 581, 694, 760, 612, 697, 782, 625, 710, 800

Miles
0 0.25 0.5

2035 PHD PRESSURE AND FIRE FLOW DEFICIENCIES

FIGURE 9.11

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Figure 9.9 also shows fire flow deficiencies where the required fire flows cannot be met while maintaining system pressures above 20 psi. Some of the fire flow deficiencies occur where industrial customers require elevated fire flows. Many fire flow deficiencies are also shown occurring in small zones that are fed by PRVs. These can likely be resolved by adjusting the settings of the PRVs that feed the zones. Many other fire flow deficiencies that appear on Figure 9.9 occur at the end of dead-end mains where looping can improve fire flow availability.

9.6.3.2 2025 Deficiencies

Model results for the 2025 scenario are presented on Figure 9.10. Compared to the 2021 scenario, very few new deficiencies emerge as a result of increasing demands. A few more Upper Prune Hill nodes appear as having low pressure and one node in this area experiences low fire flow. The only other fire flow deficiency that appears in 2025 is along NW 18th Ave.

Connecting the 542 and 544 pressure zones with a new 18-inch transmission main around the north side of Lacamas Lake improves available fire flow at the intersection of NW Lake Rd and NW Parker St.

9.6.3.3 2035 Deficiencies

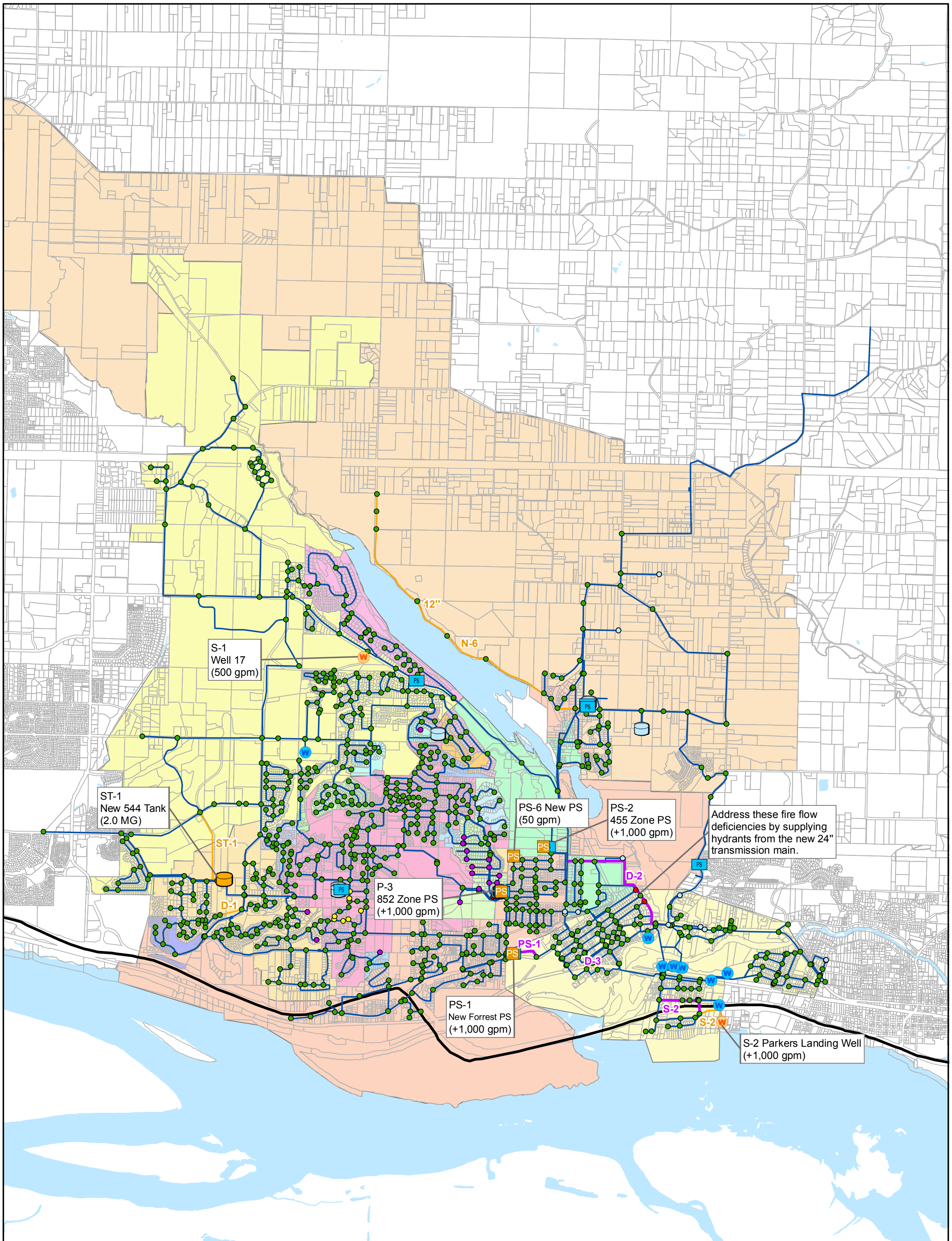
For the 2035 scenario, on Figure 9.11 we see an expansion of the Prune Hill area experiencing low pressure. Also customers in the NE part of the system along SE Robinson Rd begin experiencing low pressures due to increasing demands in the North Shore.

9.6.4 Recommended Distribution System Capacity Improvements

This section describes the capacity improvements recommended to address pressure and fire flow deficiencies. Programmatic improvements are described first, followed by a description of the individual projects required for each of the planning years. The recommended improvements are shown on Figure 9.12 through Figure 9.14. These figures also show the pressure and fire flow results after implementation of the improvement projects. Each recommended improvement is also listed in Table 9.11 through Table 9.14.

9.6.4.1 Upper Prune Hill Pressure Improvements Study

The area surrounding the Upper Prune Hill Standpipe experiences pressure deficiencies due to high elevation. According to the model, with the current operational settings of the Lower and Upper Prune Hill Pump Stations, the Upper Prune Hill Standpipe does not provide sufficient pressure to the surrounding customers. These junctions will not meet the 30 psi minimum pressure criteria regardless of what kind of pipeline improvements are added. It is recommended that a study be performed to evaluate solutions to these pressure deficiencies.



Legend

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- Well Improvements
- Fire Flow Residual Pressure (< 20 psi)
- PHD Minimum Pressure (< 30 psi)
- Fire Flow Residual Pressure (> 20 psi) and PHD Minimum Pressure (> 30 psi)
- Deficiency Addressed by Dead-end Looping Program
- Deficiency Addressed by PRV Zone Study Program

Primary Pressure Zones

343	Downtown 343
455	Nuga 542
544	
852	

Sub Pressure Zones

440	666	711
542	674	738
547	675	745
581	694	760
612	697	782
625	710	800

Miles
0 0.25 0.5

2021 PHD PRESSURE AND FIRE FLOW RESULTS WITH RECOMMENDED IMPROVEMENTS

FIGURE 9.12

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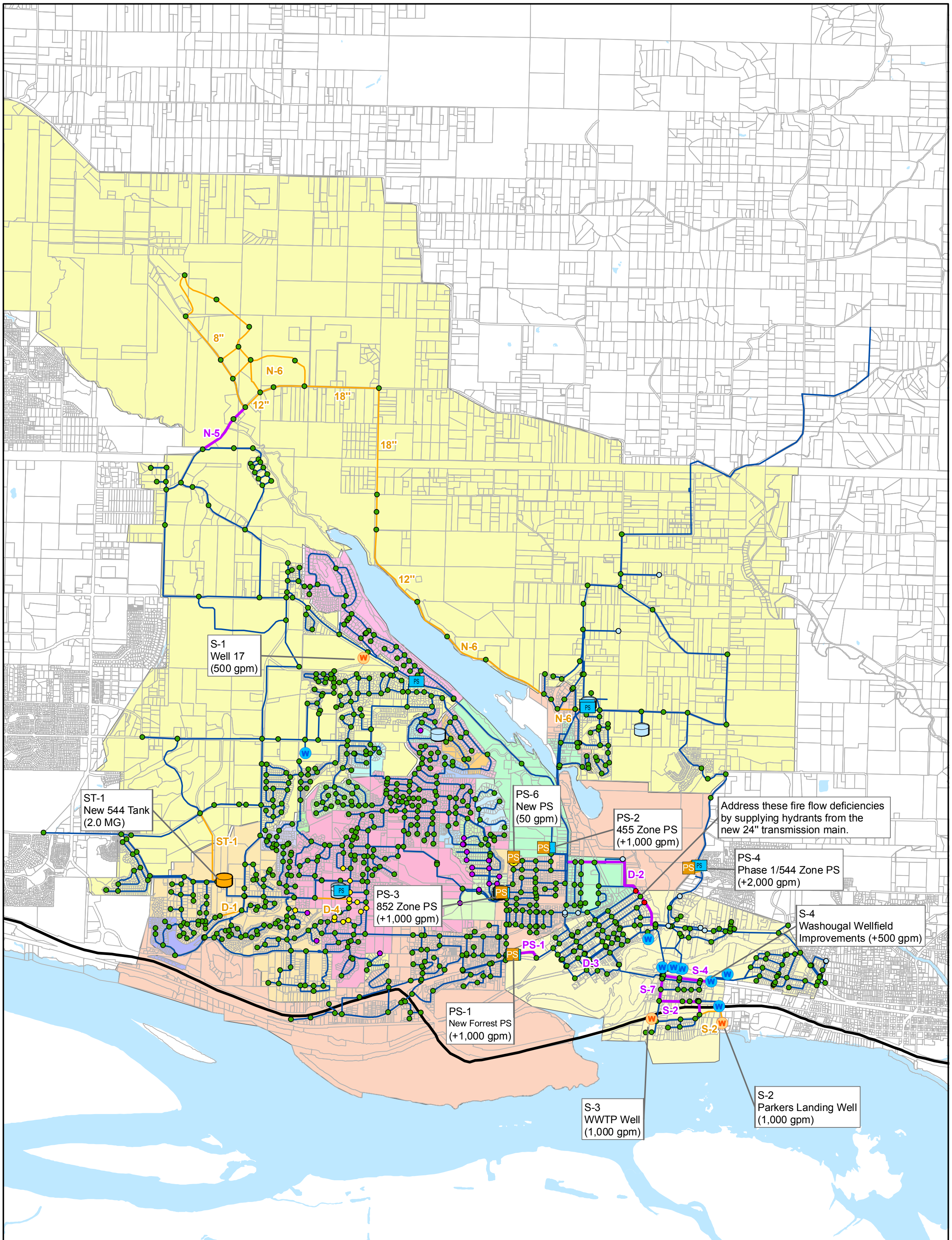

Legend

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- Existing Pump Station
- Existing Water Tank
- New Supply Intertie
- Future Storage
- Pump Station Improvements
- Well Improvements
- Fire Flow Residual Pressure (< 20 psi)
- PHD Minimum Pressure (< 30 psi)
- Fire Flow Residual Pressure < 20 psi and PHD Minimum Pressure < 30 psi
- Fire Flow Residual Pressure (> 20 psi) and PHD Minimum Pressure (> 30 psi)
- Deficiency Addressed by Dead-end Looping Program
- Deficiency Addressed by PRV Zone Study Program

Primary Pressure Zones

343, Downtown 343, 455, 544, 852

Sub Pressure Zones

440	666	711
542	674	738
547	675	745
581	694	760
612	697	782
625	710	800

N

0 0.25 0.5 Miles

2025 PHD PRESSURE AND FIRE FLOW RESULTS WITH RECOMMENDED IMPROVEMENTS

FIGURE 9.13

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WATER SYSTEM PLAN UPDATE

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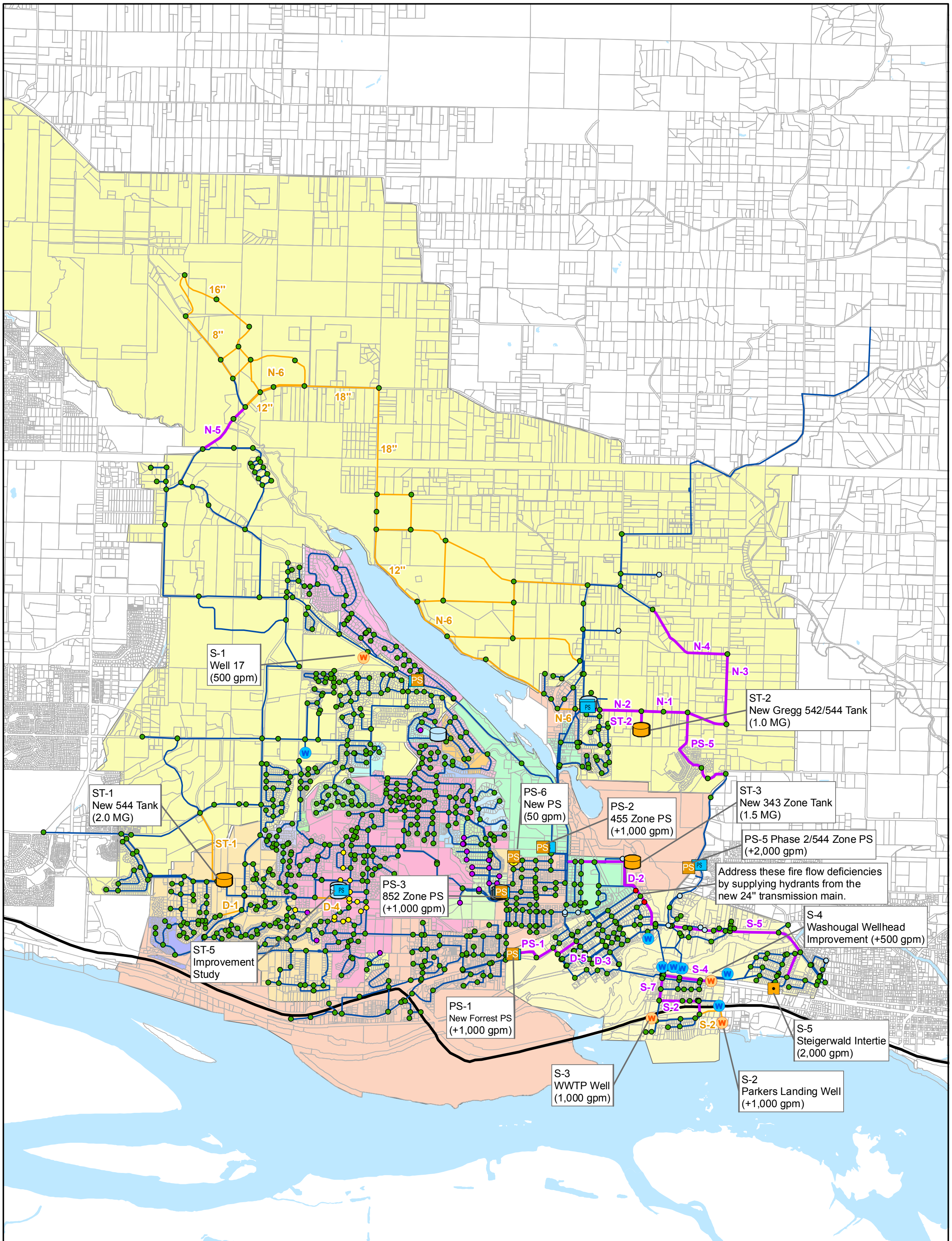

Legend

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- Fire Flow Residual Pressure < 20 psi and PHD Minimum Pressure < 30 psi
- Fire Flow Residual Pressure (> 20 psi) and PHD Minimum Pressure (> 30 psi)
- Deficiency Addressed by Dead-end Looping Program
- Deficiency Addressed by PRV Zone Study Program

Primary Pressure Zones

343	Downtown 343
455	
544	
852	

Sub Pressure Zones

440	666	711
542	674	738
547	675	745
581	694	760
612	697	782
625	710	800

N

Miles
0 0.25 0.5

2035 PHD PRESSURE AND FIRE FLOW RESULTS WITH RECOMMENDED IMPROVEMENTS

FIGURE 9.14

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WATER SYSTEM PLAN UPDATE

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There are several feasible options to address this issue:

1. Optimize pump and valve controls so that the Upper Prune Hill Standpipe level does not fall below that required by the surrounding area to provide 30 psi of pressure. This will likely require having the pumps operate within a smaller and higher operating band.
2. Create a small pressure zone with a booster pump station (with appropriate surge controls) to serve the few streets with low pressures. Possibly include a check valve to deliver fire flow into the region (so the booster pump doesn't need to be sized to handle fire demands).
3. Install individual pumps for each service connection. The individual booster pump will be owned and operated by the City allowing for close management and control. The City has extensive experience in operating and maintaining facilities on customer properties from its over 5,000 wastewater septic tank effluent pump stations.

9.6.4.2 **PRV Zone Study Program**

Many of the nodes experiencing fire flow deficiencies are in sub-zones served by PRV. To address these deficiencies, it is recommended that the City conduct a PRV zone study to optimize their PRV settings to allow fire flows to enter the zones at adequate pressure. Areas that should be included in the PRF zone study are marked by purple nodes.

9.6.4.3 **Dead-end Looping Program**

Many other fire flow deficiencies occur on dead-end mains. Additional flows can be supplied to these nodes by looping or by upsizing the single pipe feeding the node. These nodes are identified on Figure 9.12 by their light blue color. It is recommended that the City investigate each of these areas individually to determine if looping or pipe upsizing is the best alternative to address the deficiency.

9.6.4.4 **2021 Improvements**

As recommended by the storage analysis, a new 544 Zone tank was added to the model for the 2021 scenario. The City is looking into locating this tank near the corner of NW 18th Ave and NW Tidland St. Installing a new storage tank at this location with its supply main routed through the Sharp Industries utility corridor and connecting to the distribution system at NW Pacific Rim Blvd as shown on Figure 9.12, eliminates all fire flow and pressure deficiencies in the existing 544 Zone.

The City also considered locating the new 544 Zone tank near Green Mountain. However, modeling results showed that the system would not be able to keep a Green Mountain tank full due to headlosses between the 544 Zone supplies and the tank. The model showed that there would be approximately 10 feet of difference in water level between the existing Lacamas Reservoir and the Green Mountain Tank during MDD.

Projects D-1, PS-6, and D-3 as shown on Figure 9.12 eliminate 2021 pressure and fire flow deficiencies. Installing D-1 increases looping to provide additional fire flow along NW 18th Ave. Project PS-6, which was also listed in the City's 2010 Plan, involves installing a 50-gpm pump to supply high elevation customers along Couch St. D-3 consists of upsizing 200 feet of pipe from 2-inch diameter to 8-inch diameter to eliminate the downtown fire flow deficiency.

The hydrants serving customers with large fire flow requirements along NE Oak St in the 343 Zone should be supplied by the new 24" transmission main that passes through that area to better meet the City's criteria.

9.6.4.5 <u>2025 Improvements</u>

Improvement D-4 consists of a new pipe along NW 16th Ave to resolve the fire flow deficiency in upper prune hill. This project should be reviewed in conjunction with the Upper Prune Hill pressure improvements study.

N-5 improves transmission between the 544 Zone and the North Shore area. This project contributes to increased fire flow at NW Lake Rd and NW Parker St.

9.6.4.6 <u>2035 Improvements</u>

By 2035 two storage facility projects are recommended. The first is a new tank for the 343 Zone to replace the Butler Reservoir (ST-3 on Figure 9.13). The City has discussed locating this tank near the cemetery. The cemetery is an ideal location for this tank because it would not require any additional transmission main improvements. If the City cannot locate the tank at the cemetery, installing a new tank at the Crown Road BPS site or at the Butler site should be considered. Installing a new tank at the Butler site will likely require over 6,000 feet of transmission main improvements along NE Everett St.

An additional 1 MG of storage is required for the 544/542 Zone in 2035 beyond what the New Lacamas Tank provides Constructing a new 1.0 MG reservoir next to the 0.1 MG Gregg Standpipe (ST-2 on Figure 9.13) is recommended due to its location near the Crown Road BPS, which will supply the majority of the summer 542/544 Zone demands.

Project D-5 is recommended to improve transmission of supply from the SE portion of the system to the 455 Zone and help to avoid over-pressurizing the downtown area.

Projects N-1 through N-4 in the NE corner of the water system are required to address low pressures along SE Robinson Rd and convey flows from the expanded Crown Road PS to the North Shore expansion area.

9.6.5 Average Day Demand Simulation

The City's supply strategy varies seasonally. Surface water rights for their Boulder and Jones intakes can only be used during the winter months. These supplies are treated at the

City's slow sand filtration plant and conveyed to the 542 Zone. However, during the summer most of the City's supply comes from wells in the 343 Zone.

Model scenarios for both MDD and ADD were built to simulate both summer and winter supply strategies. During the winter, the Old Gregg BPS PRV conveys excess supply from the 542 Zone to the 455 Zone and the Butler PRV conveys excess supply in the 455 Zone to the 343 Zone. The model parameters for these valves are list in Table 9.10.

Table 9.10 Butler Site PRV Settings
Water System Plan
City of Camas

Valve	Control Reservoir	Reservoir Condition	Valve Setting
Old Gregg PRV	Gregg Standpipe	Above 65 ft	66 psi
Old Gregg PRV	Gregg Standpipe	Below 62 ft	40 psi
Butler PRV	Lower Prune Hill Reservoir 1	Above 22 ft	106 psi
Butler PRV	Lower Prune Hill Reservoir 1	Below 19.5 ft	80 psi

With implementation of the recommended improvements described previously in this chapter, no deficiencies were identified for the ADD scenario.

Table 9.11 Supply Improvements Water System Plan City of Camas

Project No.	Year	Project Description	Capacity/ Length	Location	Purpose
S-1	2021	Well 17	500 gpm	NW Lake Rd and NW Leadbetter Dr	To meet 2021 Demands
S-2	2021	Parkers Landing Well Transmission main upsize for Parkers Landing Well	1,000 gpm 3,240 ft of 16-in pipe	Front St and SE 11th Ave	To meet 2021 Demands
S-3	2025	WWTP Well Transmission main upsize for WWTP Well	1,000 gpm 1,160 ft of 16-in pipe	SE Polk St and SE 11th Ave	To meet 2025 Demands
S-4	2025	Well 6 capacity upgrades	+500 gpm	Along SE 6th Ave	To meet 2025 Demands
S-5	2035	Steigerwald Intertie Transmission main upsize for Steigerwald Intertie	2,000 gpm 6,190 ft of 16-in pipe	NE 3rd Ave	To meet 2035 Demands

Table 9.12 North Shore Transmission Main Improvements Water System Plan City of Camas

Project No.	Year	Project Description	Capacity/ Length	Location	Purpose
N-1	2035	SE 15th St. transmission main upsize.	1,730 ft of 24-in pipe	From Gregg Reservoir to SE 283rd Ave	Improve conveyance through 544 Zone
N-2	2035	NE 43rd Ave transmission main upsize	1,560 ft of 18-in pipe	From Gregg Reservoir to NE Garfield St	Improve conveyance through 544 Zone
N-3	2035	SE 283rd Ave transmission main upsize	2,640 ft of 18-in pipe	From SE 15th St to SE 7th St	Improve conveyance through 544 Zone

**Table 9.12 North Shore Transmission Main Improvements
Water System Plan
City of Camas**

Project No.	Year	Project Description	Capacity/ Length	Location	Purpose
N-4	2035	SE Robinson/SE 7th St transmission main upsize	3,620 ft of 18-in pipe	From SE 271st Ct to SE 283rd Ave	Improve conveyance through 544 Zone
N-5	2035	NE Goodwin Road	2,270 ft of 18-in pipe	From NE Ingle Rd to NW Camas Meadows Dr	Improve conveyance through 544 Zone

**Table 9.13 Distribution System Improvements
Water System Plan
City of Camas**

Project No.	Year	Project Description	Capacity/ Length	Location	Purpose
D-1	2021	New transmission main connecting NW 11 Cir to NW Brady Rd.	830 ft of 8-in pipe	From NW 11 Cir to NW Brady Rd.	Provide fire flow along NW 18th Ave
D-2	2021	Transmission main upsize for Washougal wellfield.	5,110 ft of 24-in pipe	Along NE Oak St and NE 22nd Ave	To meet 2021 Demands
D-3	2021	NE Birch St upsized transmission main	200 ft of 8-in pipe	From NE 3rd Ave to Railroad	Provide fire flow
D-4	2025	New transmission main along NW 16th Ave	1,300 ft of 12-in pipe	From NW Hood St to NW Cascade St.	Provide Prune Hill fire flow
D-5	2035	Phase II of Transmission main upsize for new Forest Home PS	2,120 ft of 16-in pipe	Along NE 5th and NE 4th Ave	To convey flow and prevent over-pressurization of 343 Zone

Table 9.13 **Distribution System Improvements**
Water System Plan
City of Camas

Project No.	Year	Project Description	Capacity/ Length	Location	Purpose
D-6	2021	Dead-end Looping Program	N/A	N/A	Address dead0end pressure and fire flow deficiencies
D-7	2021	PRV Zone Study Program	N/A	N/A	Address PRV Zone fire flow deficiencies
D-8	2025	Transmission main upsize for Well 6 capacity upgrades	1,940 ft of 18-in pipe	Along SE 6th Ave	To meet 2025 Demands

Table 9.14 Pumping Improvements
Water System Plan
City of Camas

Project No.	Year	Project Description	Capacity/ Length	Location	Purpose
PS-1	2021	New Forest Home PS Transmission main upsize for new Forest Home PS	+1,000 gpm 1,220 ft of 16-in pipe	Along NW 74th Ave	**To meet Pumping Redundancy Criterion**
PS-2	2021	New 455 Zone PS Capacity.	+1,000 gpm		**To meet Pumping Redundancy Criterion**
PS-3	2021	New 852 Zone PS Capacity.	+1,000 gpm		**To meet Pumping Redundancy Criterion**
PS-4	2025	New 544 Zone PS Capacity Phase I	+2,000 gpm		**To meet 2025 Demands**
PS-5	2035	New 544 Zone PS Capacity Phase II Transmission main upsize for new 544 Zone PS Capacity Phase II	+4,000 gpm above existing 3,870 ft of 24-in pipe	NE Woodburn Dr	**To meet 2035 Demands**
PS-6	2021	NW Couch St 50 gpm PS and check features to allow 455 Zone to provide fire flow		NW Couch St and NW 21st Ave	**Provide service pressure**

Table 9.15 Storage Improvements
Water System Plan
City of Camas

Project No.	Year	Project Description	Capacity/ Length	Location	Purpose
ST-1	2021	New 544 Zone Tank	2 MG	Corner of NW 18th Ave and NW Tidland St.	Address 544 Zone storage deficit
		New 544 Zone Tank transmission main	3,060 ft of 16-in pipe		
ST-2	2035	New Gregg Tank	3 MG	At Gregg Tank Site	Address 544 Zone storage deficit
		New Gregg Tank transmission main	580 ft of 24-in pipe		
ST-3	2035	343 Zone Tank	1.4 MG	At the Cemetery	Replace Butler Reservoir
ST-5	2021	Upper Prune Hill Pressure Improvements Study	N/A	Near Upper Prune Hill Standpipe	Address 852 Zone pressure deficiencies

9.7 LIMITING CAPACITY ANALYSIS

As described in above sections, to meet 2021 demands the City requires additional supply (S-1 and S-2), transmission capacity (D-2), and additional storage (ST-1). Further supply, booster pump station, and piping projects will be needed to meet projected growth beyond 2021. With these improvements, the limiting capacity of the physical water system was determined for 2035. The limiting capacity analysis used the mythology described in DOH Water System Design Manual (2009) Worksheet 6-1 and Table 6-1.

The limiting capacity considers ERUs for both MDD and ADD, which are shown in Table 9.16. The ERUs were calculated based on the projected residential customer class 2035 MDD and ADD in Chapter 5 – Water Requirements.

The physical capacity of each of the systems components were calculated: storage, sources, and pumping. The "Capacity-Related Storage" was calculated based on Equation 6-8 for each storage operating area and is shown in Table 9.17. The 542/544 will have little remaining storage capacity by 2035. Source capacity was evaluated for system overall for both the ADD and MDD per Equation 6-3 and Equation 6-4, respectively. The system will have sufficient supply through 2035, as shown in Table 9.18; however, the City will likely need to develop supplies shortly after the end of the planning period. As previously stated, these supplies are anticipated to come from the Steigerwald Regional Supply. The majority of supplies will be pumped from the 343 PZ to higher PZ; therefore, limiting booster pump station capacity was analyzed. Shortly after 2035, the City will likely need to provide additional pumping capacity for all pressure zones, as shown in Table 9.19. Transmission capacity was assumed to be addressed as part of source and pumping capacity. Note, distribution was not considering capacity limited, as the City has planned projects to address all identified deficiencies and design standards ensure all new development meets City standards.

The limiting capacity for the system is summarized in Table 9.20. In 2035, the City will be limited by booster pump station capacity and storage in the 542/544. While not limiting, the City will likely need to be actively pursuing additional ADD source capacity by 2035 due to the potentially lengthy process of developing new supplies.

Table 9.16 Limiting Capacity Demand Parameters
Water System Plan
City of Camas

Demand Parameters	gpm/ERU	gpd/ERU
ADD/ERU	0.20	286
MDD/ERU	0.46	662

Table 9.17 Storage Limiting Capacity Analysis Water System Plan City of Camas				
Planning Year	2035	2035	2035	2035
Equalizing Storage duration (min)	150	150	150	150
MDD/ERU (gpm/ERU)	0.46	0.46	0.46	0.46
C (demand factor)	1.6	1.6	1.6	1.6
F (demand factor)	225	225	225	225
Standby Requirement (gal/ERU)	200	200	200	200
ERUs that can be Served (DOH Eq 6-8)	4,588	6,309	15,373	7,782
Storage Surplus/(Deficit) (ERUs)	1,263	3,779	3	2,792

Table 9.18 Source Capacity Limiting Capacity Analysis Water System Plan City of Camas	
ADD/ERU (gpm/ERU)	0.20
ERUs that can be Served (DOH Eq 6-3)	26,780
Total System ERUs	26,216
ADD Source Surplus/(Deficit) (ERUs)	564
MDD/ERU (gpm/ERU)	0.46
ERUs that can be Served (DOH Eq 6-4)	27,772
Total System ERUs	26,216
MDD Source Surplus/(Deficit) (ERUs)	1,555
* Assumes largest source (Steigerwald Intertie) out-of-service	

Table 9.19 Booster Pump Station Limiting Capacity Analysis Water System Plan City of Camas			
Service Area	455	542/544	852
Planning Year	2035	2035	2035
Firm BPS Capacity (gpm)	5,600	6,030	2,750
BPS Required (gpm)	5,505	6,030	2,660
Unutilized Pumping (gpm)	95	0	90
MDD/ERU (gpm/ERU)	0.46	0.46	0.46
Unutilized Pumping (ERUs)	207	0	196

Table 9.20 Limiting Capacity Analysis Summary Water System Plan City of Camas						
Service Area		343	455	544/542	852	542/544
Storage - Additional Capacity		1,263	3,779	0	2,792	3
Supply - Additional ADD Capacity		564				
Supply - Additional MDD Capacity		1,555				
Pumping - Additional Capacity		0	207	0	196	0

CAPITAL IMPROVEMENTS PLAN

10.1 INTRODUCTION

This chapter summarizes the City of Camas's (City's) comprehensive capital improvements program (CIP) for the water system that is based on the analyses presented in previous Chapters. The purpose of the CIP is to provide the City with a guideline for planning and budgeting of its water system. The CIP consists of schedule and cost estimates in present dollars (December 2016) for each project.

This Plan contains time fames that are the intended framework for future funding decisions. However, these timeframes are estimates and may change depending on factors involved in the growth, project implementation, and availability of funding. The framework does not represent actual commitments by the City. The City has prepared design standards for the replacement and installation of new water infrastructure, which are provided in Appendix K.

10.1.1 Capital Project Categories

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

- Supply (S)
- Distribution System Improvements (DS)
- Pump Station (PS)
- Storage (ST)
- General (G)
- Repair and Replacement (R)
- North Shore Expansion (NS)

The above abbreviations were used as the initial letter in the Project ID and aid in delineating the project category. Repair and Replacement (R&R) includes projects for the existing supply, storage, pumping, and distribution system. North Shore Expansion (NS) category includes the distribution piping for the North Shore Area. Supply, pumping, and storage to serve these customers are included in the respective category.

10.1.2 Capital Project Types

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

1. Capacity – Provides additional system capacity to meet future demand growth.

2. Upgrade – Increases level-of-service (i.e., redundant pumping, backup power, seismic retrofits, upgraded Supervisory Control and Data Acquisition [SCADA] controls, etc.) of existing infrastructure.
3. Non-Capacity – Repair and Replacement of system.

Project types were defined as a percent of the total costs. Projects may include elements of multiple types. The allocation between multiple types were made based on professional judgement.

10.1.3 Capital Planning Periods

CIP projects were allocated into one of three planning periods referenced in previous chapters:

1. Short-term (2017-2022).
2. Medium-term (2023-2026).
3. Long-term (2027-2036).

The short-term planning horizon is allocated to individual years to be consistent with the City's CIP planning. Projects in medium- and long-term planning horizons do not provide the same level of specificity, reflecting the uncertainty in future needs and City resources. The project timing in this Chapter is subject to change, as the City regularly reviews and updates its CIP based on changing conditions and priorities.

10.1.4 Standard Development Charges

SDC, also known as connection charges, are differentiated by South and North Shore areas. The City charges different SDCs rates for the areas. SDCs are calculated for each area based on the Capacity CIP costs that contribute to the respective area. Costs for common CIP projects, shared by both areas, are identified as "common".

10.1.5 Developer Share

Projects costs anticipated to be funded in whole or in part by developers are indicated for each CIP project.

10.2 COST ESTIMATING ASSUMPTIONS

10.2.1 Cost Estimate Level

The CIP cost estimates presented in this chapter are American Academy of Cost Engineers (AACE) Class 4 estimates. Class 4 estimates are budget level estimates. Actual costs may vary from these estimates by -30 percent to +50 percent. These costs were determined based on the City's and Consultant's perception of current conditions at the project locations.

All costs are in December 2016 dollars. The Engineering New Report (ENR) U.S. 20-City Construction Cost Index for December 2013 is 10,530. The estimates are subject to change as the project design matures. Cost of labor, materials, and equipment may vary in the future.

10.2.2 Cost Estimates Elements

The total CIP cost estimates were based on construction costs that are inflated using cost factors to account for non-construction project elements. The cost factors for the Plan are shown in Table 10.1. For a typical project, the cost factors would increase the construction costs by 85 percent to represent the total project cost.

Table 10.1 Cost Factors
Water System Plan Update
City of Camas

Adjustment Factors	Description	Factor
Contingency	Costs that may occur due to uncertainty in project scope and conditions.	30%
General Conditions & Overhead	Contractor costs indirectly related to construction.	25%
Engineering/Planning	Cost for planning and design of project.	20%
City Admin	Cost to administer the project.	10%

10.2.3 Pipeline Unit Costs

Pipeline unit cost assumptions are shown in Table 10.2. These costs were developed from recent construction costs from the City and typical cost adjustments for various diameter sizes. To be conservative, these unit costs assume open-trench construction in improved areas. If trenchless construction is possible for some projects, the cost estimates may need to be modified. Costs include pavement cutting, excavation, hauling, shoring, pipe materials and installation, backfill material and installation, and pavement replacement. The unit costs are for construction in stable soil at a depth ranging between 3 to 5 feet. Costs reflect increased effort to construct on shallow bedrock that overlays large areas of the City and its Urban Growth Area (UGA). Steep slopes, extensive permitting, or acquisition of right of way may result in additional costs. These costs are construction costs only and do not reflect the Contingency, General Conditions & Overhead, Engineering/Planning, and City Admin.

10.2.4 Pump Station Costs

Pump station project costs were developed based on typical pump station costs. Pump station costs were estimated based on pump station horsepower (hp), rather than flow, which allowed consistent costs to be calculated for both new pump stations and expansion of existing stations. Unit costs are per hp, as shown in Table 10.3, and should be applied to all new pumps in the station, including backup (redundant) pumps.

Table 10.2 Pipeline Unit Costs
Water System Plan Update
City of Camas

Pipe Size (Inches)	Pipeline Unit Cost ($/Linear Foot)(1)
8	$175
10	$186
12	$216
16	$236
18	$243
24	$265
48	$417

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

Table 10.3 Pump Station Unit Costs
Water System Plan Update
City of Camas

Pump Size	Cost per hp per Pump ($/hp)
0 to 199 hp	$4,000
200 to 349 hp	$3,200
350 to 649 hp	$2,400
> 650 hp	$1,600

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

10.2.5 Well Costs

New well project costs were developed based on the City's Well 17 project and general costs from past projects. Well costs were estimated based on capacity in gallons per minute (gpm), as presented in Table 10.4.

Table 10.4 Well Unit Costs Water System Plan Update City of Camas	
Well Capacity (gpm)	**Cost per gpm ($/gpm)**
0 to 500 gpm	$1,800
Greater than 500 gpm	$1,500

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

10.2.6 Reservoir Costs

New reservoir project costs were developed based typical costs from past projects. Conceptual costs for reservoirs vary by type: ground, standpipe, and elevated. Costs are estimates based on reservoir volume in gallons, as presented in Table 10.5. Reservoir costs are sensitive to site-specific geotechnical and seismic considerations; therefore, it is recommended that a reservoir siting study that addresses these issues be conducted at the initiation of a new reservoir project.

Table 10.5 Reservoir Unit Costs Water System Plan Update City of Camas	
Reservoir Type	**Cost per gallon ($/gal)**
Ground	$1
Standpipe	$2
Elevated	$4

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

10.2.7 Additional Costs

Other common costs for the CIP included: onsite generators, pressure reducing valve (PRV) stations, and land. Conceptual costs were estimates based past projects, as presented in Table 10.6.

Table 10.6 Additional Reservoir Costs Water System Plan Update City of Camas	
Reservoir Type	**Cost ($)**
Onsite Generator	$200,000 per generator installation
PRV Station	$150,000 per station
Land	$500,000 per 0.5 acres

Note:
(1) Other costs are for construction only.

10.3 CIP PROJECT SHEETS AND COST SUMMARY

CIP projects are based on analyses in previous chapters. The CIP Projects summarized in Table 10.7 are in December 2016 dollars and have not been escalated. The table presents the costs for the short-, medium-, and long-term planning horizons. Additionally, it allocates projects between areas (South, North Shore, Common) used in SDC evaluations and project type (i.e., Capacity, Upgrade, and R&R). Where developer contributions to the project are anticipated, the developer's share is noted as a percentage. The table provides a total cost and average annual cost for all CIP items.

An individual Project Sheet was generated for each CIP project and includes project identifiers, description, costs, project type, and comments to aid in future implementation. To aid in finding individual projects, Project Sheets have been separated by sections, by project category. A summary of costs by project category and type is presented at the end of the Chapter.

Table 10.7 CIP Project Summary
Water System Plan Update
City of Camas

Project No.	SDC Area	Project Name	Developer Share	Total CIP Cost Estimate	CIP Phasing 2017	2018	2019	2020	2021	2022	2023	Short-term (2017-2022)	Mid-term (2023-2026)	Long-term (2027-2036)	Project Type Capacity	Upgrade	R&R
Capital Improvement Program Summary																	
Supply				**$28,937,000**	**$2,852,000**	**$2,296,000**	**$759,000**	**$3,595,000**	**$440,000**	**$723,000**	**$2,813,250**	**$10,665,000**	**$7,684,000**	**$10,588,000**			
S-1	Common	Well 17	0%	$1,815,000	$150,000	$1,665,000	$ -	$ -	$ -	$ -	$ -	$1,815,000	$ -	$ -	100%	0%	0%
S-2	Common	Parkers Landing Well	0%	$4,560,000	$ -	$456,000	$684,000	$3,420,000	$ -	$ -	$ -	$4,560,000	$ -	$ -	100%	0%	0%
S-3	Common	Wastewater Treatment Plant (WWTP) Well	0%	$3,651,000	$ -	$ -	$ -	$ -	$365,100	$547,650	$2,738,250	$912,750	$2,738,250	$ -	100%	0%	0%
S-4	Common	Washougal Wellfield Improvements	0%	$4,446,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$4,446,000	$ -	100%	0%	0%
S-5	Common	Steigerwald Regional Source	0%	$10,823,000	$60,000	$75,000	$75,000	$75,000	$75,000	$75,000	$75,000	$435,000	$300,000	$10,088,000	100%	0%	0%
S-6	Common	Watershed Forest Management	0%	$1,070,000	$70,000	$100,000	$ -	$100,000	$ -	$100,000	$ -	$370,000	$200,000	$500,000	0%	0%	100%
S-7	Common	544 Zone Watershed Source Improvements	0%	$2,572,083	$2,572,083	$ -	$ -	$ -	$ -	$ -	$ -	$2,572,083	$ -	$ -	0%	0%	100%
Distribution System Improvements				**$7,874,000**	**$515,000**	**$55,000**	**$861,000**	**$2,064,000**	**$778,000**	**$55,000**	**$55,000**	**$4,328,000**	**$2,070,000**	**$1,476,000**			
D-1	South	Transmission main from NW 11 Cir to NW Brady Rd	0%	$269,000	$ -	$ -	$ -	$ -	$269,000	$ -	$ -	$269,000	$ -	$ -	0%	0%	100%
D-2	Common	343 Zone Supply Transmission Upsizing	0%	$2,505,000	$ -	$ -	$626,250	$1,878,750	$ -	$ -	$ -	$2,505,000	$ -	$ -	50%	50%	0%
D-3	South	NE Birch St upsized transmission main	0%	$65,000	$ -	$ -	$ -	$ -	$65,000	$ -	$ -	$65,000	$ -	$ -	0%	0%	100%
D-4	South	New transmission main along NW 16th Ave	0%	$519,000	$ -	$ -	$ -	$129,750	$389,250	$ -	$ -	$519,000	$ -	$ -	0%	0%	100%
D-5	South	New Distribution along NW 6th Ave/ NE Adams St	0%	$926,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$926,000	100%	0%	0%
D-6	South	Dead-end Looping Program	0%	$1,045,000	$ -	$55,000	$55,000	$55,000	$55,000	$55,000	$55,000	$275,000	$220,000	$550,000	0%	0%	100%
D-7	Common	PRV Adjustment Study	0%	$180,000	$ -	$ -	$180,000	$ -	$ -	$ -	$ -	$180,000	$ -	$ -	0%	0%	100%
D-8	Common	Well 6/14 Transmission Line	0%	$515,050	$515,050	$ -	$ -	$ -	$ -	$ -	$ -	$515,050	$ -	$ -	0%	0%	100%
D-9	Common	Parallel Boulder Creek Intake	0%	$1,850,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$1,850,000	$ -	100%	0%	0%

Table 10.7 CIP Project Summary
Water System Plan Update
City of Camas

Capital Improvement Program Summary																	
Project No.	SDC Area	Project Name	Developer Share	Total CIP Cost Estimate	CIP Phasing										Project Type		
Pump Station				**$11,526,000**	**$ -**	**$925,000**	**$463,000**	**$28,000**	**$ -**	**$ -**	**$544,500**	**$1,416,000**	**$4,141,000**	**$5,969,000**			
PS-1	South	New Forest Home PS	0%	$3,117,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$779,250	$2,337,750	0%	50%	50%
PS-2	Common	New 455 Zone PS Capacity	0%	$1,258,000	$ -	$ -	$ -	$ -	$ -	$ -	$314,500	$ -	$1,258,000	$ -	0%	50%	50%
PS-3	Common	Lower Prune Hill PS Expansion	0%	$1,388,000	$ -	$925,000	$463,000	$ -	$ -	$ -	$ -	$1,388,000	$ -	$ -	0%	50%	50%
PS-4	25% South/75% North Shore	North Shore PS Capacity Phase I	75%	$1,184,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$1,184,000	$ -	100%	0%	0%
PS-5	25% South/75% North Shore	North Shore PS Capacity Phase II	75%	$3,631,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$3,631,000	100%	0%	0%
PS-6	South	NW Couch St PS	0%	$920,000	$ -	$ -	$ -	$ -	$ -	$ -	$230,000	$ -	$920,000	$ -	0%	0%	100%
PS-7	South	NW 10th Ave Study	0%	$28,000	$ -	$ -	$ -	$28,000	$ -	$ -	$ -	$28,000	$ -	$ -	0%	0%	100%
Storage				**$21,087,000**	**$2,947,000**	**$4,289,000**	**$ -**	**$711,000**	**$1,205,000**	**$5,331,000**	**$ -**	**$14,483,000**	**$ -**	**$6,604,000**			
ST-1	Common	New 544 Zone Reservoir	0%	$7,236,000	$2,946,660	$4,289,340	$ -	$ -	$ -	$ -	$ -	$7,236,000	$ -	$ -	100%	0%	0%
ST-2	Common	New Gregg Tank	75%	$3,984,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$3,984,000	100%	0%	0%
ST-3	South	343 Zone Reservoir	0%	$7,108,000	$ -	$ -	$ -	$710,800	$1,066,200	$5,331,000	$ -	$7,108,000	$ -	$ -	25%	0%	75%
ST-4	Common	Lower Prune Hill Reservoir Rehabilitation	0%	$2,620,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$2,620,000	0%	25%	75%
ST-5	Common	Upper Prune Hill Pressure Improvements Study	0%	$139,000	$ -	$ -	$ -	$ -	$139,000	$ -	$ -	$139,000	$ -	$ -	0%	50%	50%
General				**$550,000**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$275,000**	**$275,000**			
G-1	Common	Water System Plan Update	0%	$550,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$275,000	$275,000	0%	0%	100%
Repair and Replacement				**$44,327,000**	**$320,000**	**$470,000**	**$470,000**	**$470,000**	**$1,164,000**	**$390,000**	**$1,951,750**	**$3,284,000**	**$7,807,000**	**$33,236,000**			
R-1	South	Supply R&R Projects	0%	$1,256,000	$120,000	$ -	$ -	$ -	$148,000	$ -	$93,500	$268,000	$374,000	$614,000	0%	0%	100%
R-2	South	Pump R&R Projects	0%	$1,505,000	$ -	$ -	$ -	$ -	$546,000	$ -	$145,750	$546,000	$583,000	$376,000	0%	0%	100%
R-3	South	Pipeline R&R Projects	0%	$40,266,000	$ -	$195,000	$195,000	$195,000	$195,000	$390,000	$1,712,500	$1,170,000	$6,850,000	$32,246,000	0%	0%	100%
R-4	South	Meter Replacement Program	0%	$1,300,000	$200,000	$275,000	$275,000	$275,000	$275,000			$1,300,000	$ -	$ -			
North Shore Expansion				**$25,353,000**	**$3,100,000**	**$ -**	**$2,225,000**	**$2,225,000**	**$2,225,000**	**$2,225,000**		**$12,000,000**	**$4,450,000**	**$8,903,000**			
NS-1	North Shore	Annual North Shore Distribution Program	75%	$22,253,000	$ -	$ -	$2,225,000	$2,225,000	$2,225,000	$2,225,000		$8,900,000	$4,450,000	$8,903,000	100%	0%	0%
NS-2	North Shore	Leadbetter Road Transmission Main	75%	$3,100,000	$3,100,000	$ -	$ -	$ -	$ -	$ -	$ -	$3,100,000	$ -	$ -			
CIP Total				**$139,654,067**	**$9,733,897**	**$8,035,170**	**$4,778,125**	**$9,092,650**	**$5,812,275**	**$8,723,825**	**$5,364,500**	**$46,175,942**	**$26,427,250**	**$67,050,875**	**$69,388,500**	**$4,858,500**	**$61,007,133**
Annual Cost				**$6,983,000**	$9,734,000	$8,035,200	$4,778,100	$9,092,700	$5,812,300	$8,723,800	$5,364,500	$7,696,000	$6,606,800	$6,705,100			

10.3.1 Supply Project Sheets

Supply projects were identified in Chapter 8 – Water Resources and Chapter 9 – System Analysis. To meet future demand, the City will need to rehabilitate existing wells, develop new City owned wells, and participate in the development of the Steigerwald Regional Well Field. The majority of supply projects will be in the 343 Pressure Zone:

- S-1 Well 17.
- S-2 Parkers Landing Well.
- S-3 Wastewater Treatment Plant (WWTP) Well.
- S-4 Washougal Wellfield Improvements.
- S-5 Steigerwald Regional Source.
- S-6 Watershed Forest Management.
- S-7 544 Zone Watershed Source Improvements.

General notes on the supply projects include:

- Supply projects do not include costs for property, right-of-way, or easements.
- S-1 Well 17 was based on the City's existing project budget that has been established from independent efforts.
- S-5 Steigerwald Regional Source costs reflect anticipated costs for the City's portion of the supply. A cost allowance for transmission main development/ improvements, was included and should be revisited when more information is available.
- S-6 Watershed Forest Management and S-7 544 Zone Watershed Source Improvements were estimated by the City based on prior studies.

City of Camas
Water System Plan Update
Capital Improvement Program

Project Identification:	S-1	**SDC Area**	Common
Project Name:	Well 17		
Facility Type:	Supply		

Cost Allocation	Percent	Cost	Total Cost
Capacity:	100%	$ 1,665,000	**$ 1,665,000**
Upgrade:	0%	$ -	
Non-capacity:	0%	$ -	

Project Description:
Design and construct Well 17 near NW Lake Rd and NW Leadbetter Dr. The well is anticipated to provide 500 gpm of new supply in the 544 Pressure Zone. The City has applied for a new water right for Well 17.

Project Element	Quantity	Unit	Unit Cost ($/Unit)	Contingency	GC & Overhead	Engineering/ Planning	City Admin	Total Project Cost	Developer Share
				30%	25%	20%	10%		
New Well 17	500	gpm	$ 1,800	$ 270,000	$ 225,000	$ 180,000	$ 90,000	$ 1,665,000	
				$ -	$ -	$ -	$ -	$ -	
				$ -	$ -	$ -	$ -	$ -	

City of Camas
Water System Plan Update
Capital Improvement Program

Project Identification:	S-1	**SDC Area**	Common
Project Name:	Well 17		
Facility Type:	Supply		

Cost Allocation	Percent	Cost	Total Cost
Capacity:	100%	$ 1,665,000	$ 1,665,000
Upgrade:	0%	$ -	
Non-capacity:	0%	$ -	

Notes on Cost Estimation:
Cost based on 2013 CFP

Project Location:

Trigger:

Level of Service Goal	Trigger	Value	Anticipated Need
Redundant Supply	MDD	10.2 MGD	2018

City of Camas
Water System Plan Update
Capital Improvement Program

Project Identification:	S-2	**SDC Area**	Common
Project Name:	Parkers Landing Well		
Facility Type:	Supply		

Cost Allocation	Percent	Cost	Total Cost
Capacity:	100%	$ 4,559,584	**$ 4,559,584**
Upgrade:	0%	$ -	
Non-capacity:	0%	$ -	

Project Description:
Design and construct Parkers Landing Well at Front St and SE 11th Ave, which is currently permitted (G2-30146) for 1,000 gpm peak production and an annual withdrawal of 880 acre-feet per year. As part of design, conduct a hydrogeological investigation to size the well and pump. Approximately 3,240 feet of 16-inch water main will be required to convey the new supply. From the well site, the main will travel north on Front St, turning west on Frontage Rd. Upsize the existing 8-inch main on SE Union St to 16-inch, between Frontage Rd and SE 8th Ave. Upsize the 16-inch main along SE 8th Ave to 16-inch, from Union St to SE Polk St.

Project Element		Quantity	Unit	Unit Cost ($/Unit)	Contingency	GC & Overhead	Engineering/ Planning	City Admin	Total Project Cost	Developer Share
					30%	25%	20%	10%		
Design and Construct Parkers Landing Well		1,000	gpm	$ 1,500	$ 450,000	$ 375,000	$ 300,000	$ 150,000	$ 2,775,000	
Backup Power Generator		1	LS	$ 200,000	$ 60,000	$ 50,000	$ 40,000	$ 20,000	$ 370,000	
Upsize Distribution Main:	16-inch	3,240	ft	$ 236	$ 229,392	$ 191,160	$ 152,928	$ 76,464	$ 1,414,584	

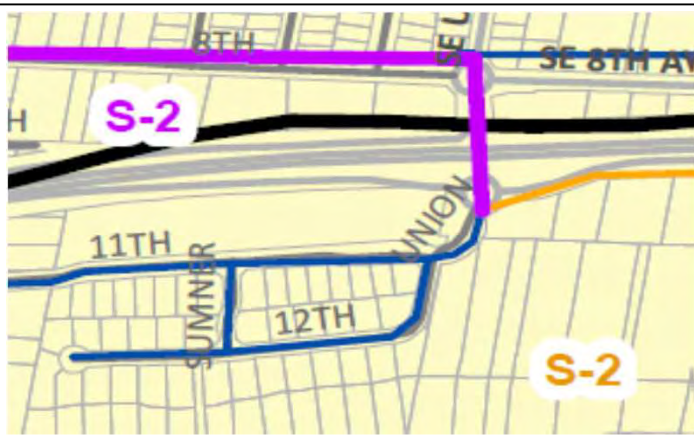
City of Camas
Water System Plan Update
Capital Improvement Program

Project Identification:	S-2	**SDC Area**	Common
Project Name:	Parkers Landing Well		
Facility Type:	Supply		

Cost Allocation	Percent	Cost	Total Cost
Capacity:	100%	$ 4,559,584	$ 4,559,584
Upgrade:	0%	$ -	
Non-capacity:	0%	$ -	

Notes on Cost Estimation:

Project Location:



Trigger:

Redundant Supply	System MDD	10.9 MGD	2020

City of Camas
Water System Plan Update
Capital Improvement Program

Project Identification: S-3 **SDC Area** Common
Project Name: WWTP Well
Facility Type: Supply

Cost Allocation	Percent	Cost	Total Cost
Capacity:	100%	$ 3,651,456	**$ 3,651,456**
Upgrade:	0%	$ -	
Non-capacity:	0%	$ -	

Project Description:
Design and construct a Treatment Plant Well at SE Polk St and SE 11th Ave, which is currently permitted (G2-30147) for 1,000 gpm peak production and an annual withdrawal of 880 acre-feet per year. As part of design, conduct a hydrogeological investigation to size the well and pump. Approximately 1,160 feet of 16-inch water main will be required to convey the new supply. Upsize the 6-inch and 8-inch mains along SE Polk St. to 16-inch, from SE 8th Ave to SE 6th Ave.

Project Element		Quantity	Unit	Unit Cost ($/Unit)	Contingency	GC & Overhead	Engineering/ Planning	City Admin	Total Project Cost	Developer Share
					30%	25%	20%	10%		
Design and Construct Treatment Plant Well		1,000	gpm	$ 1,500	$ 450,000	$ 375,000	$ 300,000	$ 150,000	$ 2,775,000	
Backup Power Generator		1	LS	$ 200,000	$ 60,000	$ 50,000	$ 40,000	$ 20,000	$ 370,000	
Upsize Distribution Main:	16-inch	1,160	ft	$ 236	$ 82,128	$ 68,440	$ 54,752	$ 27,376	$ 506,456	
					$ -	$ -	$ -	$ -	$ -	

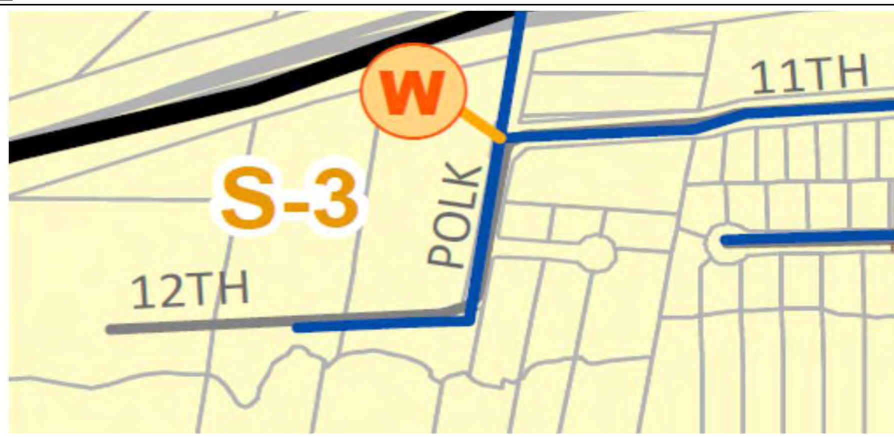
City of Camas
Water System Plan Update
Capital Improvement Program

Project Identification: S-3 **SDC Area** Common
Project Name: WWTP Well
Facility Type: Supply

Cost Allocation	Percent	Cost	Total Cost
Capacity:	100%	$ 3,651,456	$ 3,651,456
Upgrade:	0%	$ -	
Non-capacity:	0%	$ -	

Notes on Cost Estimation:

Project Location:



Trigger:

Level of Service Goal	Trigger	Value	Anticipated Need
Redundant Supply	System MDD	12.2 MGD	2022

City of Camas
Water System Plan Update
Capital Improvement Program

Project Identification:	S-4	**SDC Area**	Common
Project Name:	Washougal Wellfield Improvements		
Facility Type:	Supply		

Cost Allocation	Percent	Cost	Total Cost
Capacity:	100%	$ 4,446,105	**$ 4,446,105**
Upgrade:	0%	$ -	
Non-capacity:	0%	$ -	

Project Description:

Maximize use of existing water rights in the Washougal Wellfield. Increase yield of Well 6 from 1,000 gpm to 1,500 gpm and address issues with Well 5. As part of design, conduct a hydrogeological investigation to determine the preferred improvements. Approximately 1,940 feet of 18-inch water main will be required to convey the new supply from Well 6. Upsize approximately 1,160 ft of 12-inch main, along SE 6th Ave, to 18-inch, from SE 8th Ave to SE 6th Ave.

Project Element		Quantity	Unit	Unit Cost ($/Unit)	Contingency	GC & Overhead	Engineering/ Planning	City Admin	Total Project Cost	Developer Share
					30%	25%	20%	10%		
Washougal Wellfield Improvements		1,100	gpm	$ 1,500	$ 495,000	$ 412,500	$ 330,000	$ 165,000	$ 3,052,500	
Transmission Main:	18-inch	1,940	ft	$ 243	$ 141,426	$ 117,855	$ 94,284	$ 47,142	$ 872,127	
Upsize Distribution Main:	18-inch	1,160	ft	$ 243	$ 84,564	$ 70,470	$ 56,376	$ 28,188	$ 521,478	
					$ -	$ -	$ -	$ -	$ -	

City of Camas
Water System Plan Update
Capital Improvement Program

Project Identification:	S-4	**SDC Area**	Common
Project Name:	Washougal Wellfield Improvements		
Facility Type:	Supply		

Cost Allocation	Percent	Cost	Total Cost
Capacity:	100%	$ 4,446,105	**$ 4,446,105**
Upgrade:	0%	$ -	
Non-capacity:	0%	$ -	

Notes on Cost Estimation:

Project Location:

Trigger:

Level of Service Goal	Trigger	Value	Anticipated Need
Redundant Supply	System MDD	13.3 MGD	2025

City of Camas
Water System Plan Update
Capital Improvement Program

Project Identification:	S-5	**SDC Area**	Common
Project Name:	Steigerwald Regional Source		
Facility Type:	Supply		

Cost Allocation	Percent	Cost	Total Cost
Capacity:	100%	$ 10,822,554	**$ 10,822,554**
Upgrade:	0%	$ -	
Non-capacity:	0%	$ -	

Project Description:

In the long-term, the City anticipates obtaining supply from the future Steigerwald Regional Wellfield (Water Right Application G2-30528), which will be developed jointly with the City of Washougal. As an entirely new supply source, the Cities will need to permit, design, and construct the proposed wells and related facilities, such as disinfection, auxiliary power, and, potentially, treatment. The conveyance from the regional wellfield, near Steigerwald Wildlife Refuge, to the City has not been determined. A $2M transmission cost allowance is provided and should be revised when additional information is available. To convey the new supplies: upsize the 8-inch water main on SE James St to 16-inch, from the Intertie to NE 2nd Ave; upsize the 8-inch water main on NE 2nd Ave to 16-inch, from SE James St to NE 3rd Ave; and upsize the 8-inch water main on NE 3rd Ave to 16-inch, from NE 2nd Ave to SE Crown Rd.

Project Element		Quantity	Unit	Unit Cost ($/Unit)	Contingency	GC & Overhead	Engineering/ Planning	City Admin	Total Project Cost	Developer Share
					30%	25%	20%	10%		
Steigerwald Regional Water Source Phase I		1,000	gpm	$ 1,500	$ 450,000	$ 375,000	$ 300,000	$ 150,000	$ 2,775,000	
Steigerwald Regional Water Source Phase II		1,000	gpm	$ 1,500	$ 450,000	$ 375,000	$ 300,000	$ 150,000	$ 2,775,000	
Backup Power Generator		1	LS	$ 200,000	$ 60,000	$ 50,000	$ 40,000	$ 20,000	$ 370,000	
Steigerwald Transmission		1	LS	$ 2,000,000	$ -	$ -	$ -	$ 200,000	$ 2,200,000	
Upsize Distribution Main:	16-inch	6,190	ft	$ 236	$ 438,252	$ 365,210	$ 292,168	$ 146,084	$ 2,702,554	

City of Camas
Water System Plan Update
Capital Improvement Program

Project Identification:	S-5	**SDC Area**	Common
Project Name:	Steigerwald Regional Source		
Facility Type:	Supply		

Cost Allocation	Percent	Cost	Total Cost
Capacity:	100%	$ 10,822,554	$ 10,822,554
Upgrade:	0%	$ -	
Non-capacity:	0%	$ -	

Notes on Cost Estimation:

Project Location:

Trigger:

Level of Service Goal	Trigger	Value	Anticipated Need
Redundant Supply	System MDD	13.8 MGD	2030

City of Camas
Water System Plan Update
Capital Improvement Program

Project Identification: S-6 **SDC Area** Common
Project Name: Watershed Forest Management
Facility Type:

Cost Allocation	Percent	Cost	Total Cost
Capacity:		$ -	$ 1,070,000
Upgrade:	0%	$ -	
Non-capacity:	100%	$ -	

Project Description:

Project Element	Quantity	Unit	Unit Cost ($/Unit)	Contingency	GC & Overhead	Engineering/ Planning	City Admin	Total Project Cost	Developer Share
				30%	25%	20%	10%		
				$ -	$ -	$ -	$ -	$ -	
				$ -	$ -	$ -	$ -	$ -	
				$ -	$ -	$ -	$ -	$ -	

City of Camas
Water System Plan Update
Capital Improvement Program

Project Identification: S-6 **SDC Area** Common
Project Name: Watershed Forest Management
Facility Type:

Cost Allocation	Percent	Cost	Total Cost
Capacity:		$ -	$ 1,070,000
Upgrade:	0%	$ -	
Non-capacity:	100%	$ -	

Notes on Cost Estimation:

Project Location:

Trigger:

Level of Service Goal	Trigger	Value	Anticipated Need

City of Camas
Water System Plan Update
Capital Improvement Program

Project Identification: S-7 **SDC Area** Common
Project Name: 544 Zone Watershed Source Improvements
Facility Type:

Cost Allocation	Percent	Cost	Total Cost
Capacity:		$ -	$ 2,572,083
Upgrade:	0%	$ -	
Non-capacity:	100%	$ -	

Project Description:

Project Element	Quantity	Unit	Unit Cost ($/Unit)	Contingency 30%	GC & Overhead 25%	Engineering/ Planning 20%	City Admin 10%	Total Project Cost	Developer Share
				$ -	$ -	$ -	$ -	$ -	
				$ -	$ -	$ -	$ -	$ -	
				$ -	$ -	$ -	$ -	$ -	

City of Camas
Water System Plan Update
Capital Improvement Program

Project Identification: S-7 **SDC Area** Common
Project Name: 544 Zone Watershed Source Improvements
Facility Type:

Cost Allocation	Percent	Cost	Total Cost
Capacity:		$ -	$ 2,572,083
Upgrade:	0%	$ -	
Non-capacity:	100%	$ -	

Notes on Cost Estimation:

Project Location:

Trigger:

Level of Service Goal	Trigger	Value	Anticipated Need

10.3.2 Distribution System Improvements Project Sheets

Distribution system improvements to resolve system deficiencies were identified in Chapter 9 – System Analysis. Projects are spread throughout the system:

- D-1 Transmission main from NW 11 Cir to NW Brady Rd.
- D-2 343 Zone Supply Transmission Upsizing.
- D-3 NE Birch St upsized transmission main.
- D-4 New transmission main along NW 16th Ave.
- D-5 New Distribution along NW 6th Ave/ NE Adams St.
- D-6 Dead-end Looping Program.
- D-7 PRV Adjustment Study.
- D-8 Well 6/14 Transmission Line.
- D-9 Parallel Boulder Creek Intake.

General notes on the distribution system projects include:

- Distribution system improvement projects do not include costs for property, right-of-way, or easements.
- D-6 Dead-end Looping Program provides funding for an annual program, where the City will typically address one to two dead-end mains per year. Actual Individual dead-end main project costs vary widely based on site specific conditions.
- D-7 PRV Adjustment Study includes a cost allowance for PRV improvements that should be revisited when the initial PRV study is complete.
- D-8 Well 6/14 Transmission Line costs are based on the City's existing budget.
- D-9 Parallel Boulder Creek Intake costs were provided by the City.

City of Camas
Water System Plan Update
Capital Improvement Program

Project Identification:	D-1	**SDC Area**	South
Project Name:	Transmission main from NW 11 Cir to NW Brady Rd		
Facility Type:	Distribution		

Cost Allocation	Percent	Cost	Total Cost
Capacity:	0%	$ -	$ 268,713
Upgrade:	0%	$ -	
Non-capacity:	100%	$ 268,713	

Project Description:
To increase fire flow on NW 18th Ave, construct 830 feet of 8-inch pipe to connect NW 11th Cir to NW Brady Rd.

Project Element		Quantity	Unit	Unit Cost ($/Unit)	Contingency 30%	GC & Overhead 25%	Engineering/ Planning 20%	City Admin 10%	Total Project Cost	Developer Share
New Distribution Main:	8-inch	830	ft	$ 175	$ 43,575	$ 36,313	$ 29,050	$ 14,525	$ 268,713	
					$ -	$ -	$ -	$ -	$ -	

City of Camas
Water System Plan Update
Capital Improvement Program

Project Identification:	D-1	**SDC Area**	South
Project Name:	Transmission main from NW 11 Cir to NW Brady Rd		
Facility Type:	Distribution		

Cost Allocation	Percent	Cost	Total Cost
Capacity:	0%	$ -	**$ 268,713**
Upgrade:	0%	$ -	
Non-capacity:	100%	$ 268,713	

Notes on Cost Estimation:

Cost does not include obtaining easements for the new pipe.

Project Location:

Trigger:

Level of Service Goal	Trigger	Value	Anticipated Need
Fire Flow	City Resources	When	Short-term

City of Camas
Water System Plan Update
Capital Improvement Program

Project Identification: D-2 **SDC Area** Common
Project Name: 343 Zone Supply Transmission Upsizing
Facility Type: Distribution

Cost Allocation	Percent	Cost	Total Cost
Capacity:	50%	$ 1,252,589	$ 2,505,178
Upgrade:	50%	$ -	
Non-capacity:	0%	$ -	

Project Description:
Approximately 5,110 feet of 24-inch water main will be required to convey the new supply from new supplies in the 343 Pressure Zone. Upsize the existing 18-inch transmission main along NE Oak St, NE 19th Ave, NE Ione St, and NE 22nd St. Note, the pipe diameter is sized to convey future Steigerwald Regional Water Supply.

Project Element		Quantity	Unit	Unit Cost ($/Unit)	Contingency	GC & Overhead	Engineering/ Planning	City Admin	Total Project Cost	Developer Share
					30%	25%	20%	10%		
Upsize Distribution Main:	24-inch	5,110	ft	$ 265	$ 406,245	$ 338,538	$ 270,830	$ 135,415	$ 2,505,178	
					$ -	$ -	$ -	$ -	$ -	
					$ -	$ -	$ -	$ -	$ -	

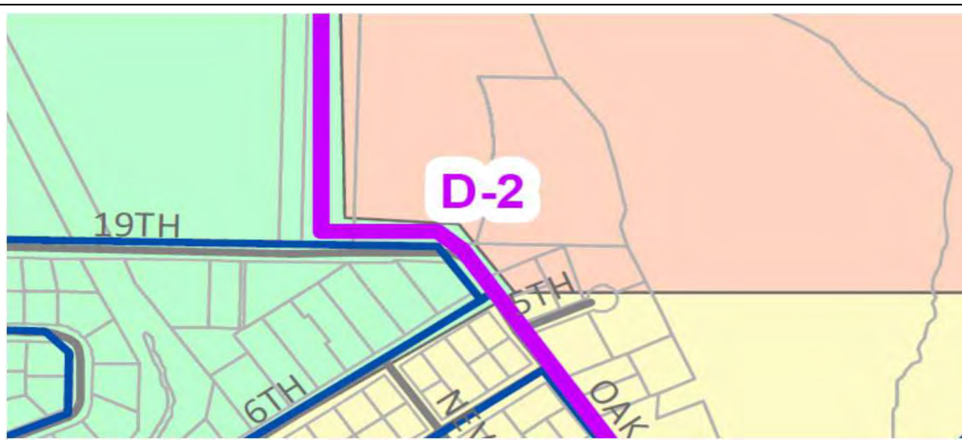
City of Camas
Water System Plan Update
Capital Improvement Program

Project Identification:	D-2	**SDC Area**	Common
Project Name:	343 Zone Supply Transmission Upsizing		
Facility Type:	Distribution		

Cost Allocation	Percent	Cost	Total Cost
Capacity:	50%	$ 1,252,589	$ 2,505,178
Upgrade:	50%	$ -	
Non-capacity:	0%	$ -	

Notes on Cost Estimation:

Project Location:



Trigger:

Level of Service Goal	Trigger	Value	Anticipated Need
Redundant Supply	New Supply	New Supply in 343 PZ	0

City of Camas
Water System Plan Update
Capital Improvement Program

Project Identification: D-3 **SDC Area** South
Project Name: NE Birch St upsized transmission main
Facility Type: Distribution

Cost Allocation	Percent	Cost	Total Cost
Capacity:	0%	$ -	$ 64,750
Upgrade:	0%	$ -	
Non-capacity:	100%	$ 64,750	

Project Description:
To increase fire flow, upsize the 2-inch water main on NE Birch St to 8-inch, from NE 3rd Ave to the Railroad tracks.

Project Element		Quantity	Unit	Unit Cost ($/Unit)	Contingency 30%	GC & Overhead 25%	Engineering/ Planning 20%	City Admin 10%	Total Project Cost	Developer Share
New Distribution Main:	8-inch	200	ft	$ 175	$ 10,500	$ 8,750	$ 7,000	$ 3,500	$ 64,750	
					$ -	$ -	$ -	$ -	$ -	
					$ -	$ -	$ -	$ -	$ -	

City of Camas
Water System Plan Update
Capital Improvement Program

Project Identification: D-3 **SDC Area** South
Project Name: NE Birch St upsized transmission main
Facility Type: Distribution

Cost Allocation	Percent	Cost	Total Cost
Capacity:	0%	$ -	$ 64,750
Upgrade:	0%	$ -	
Non-capacity:	100%	$ 64,750	

Notes on Cost Estimation:

Project Location:

Trigger:

Level of Service Goal	Trigger	Value	Anticipated Need
Fire Flow	City Resources	When	Short-term

City of Camas
Water System Plan Update
Capital Improvement Program

Project Identification:	D-4	**SDC Area**	South
Project Name:	New transmission main along NW 16th Ave		
Facility Type:	Distribution		

Cost Allocation	Percent	Cost	Total Cost
Capacity:	0%	$ -	$ 519,480
Upgrade:	0%	$ -	
Non-capacity:	100%	$ 519,480	

Project Description:
To increase distribution system capacity from the Upper Prune Hill Reservoir, construct a new 12-inch transmission main along NW 16th Ave, from NW Hood St to NW Cascade St.

Project Element		Quantity	Unit	Unit Cost ($/Unit)	Contingency	GC & Overhead	Engineering/ Planning	City Admin	Total Project Cost	Developer Share
					30%	25%	20%	10%		
New Distribution Main:	12-inch	1,300	ft	$ 216	$ 84,240	$ 70,200	$ 56,160	$ 28,080	$ 519,480	
					$ -	$ -	$ -	$ -	$ -	
					$ -	$ -	$ -	$ -	$ -	

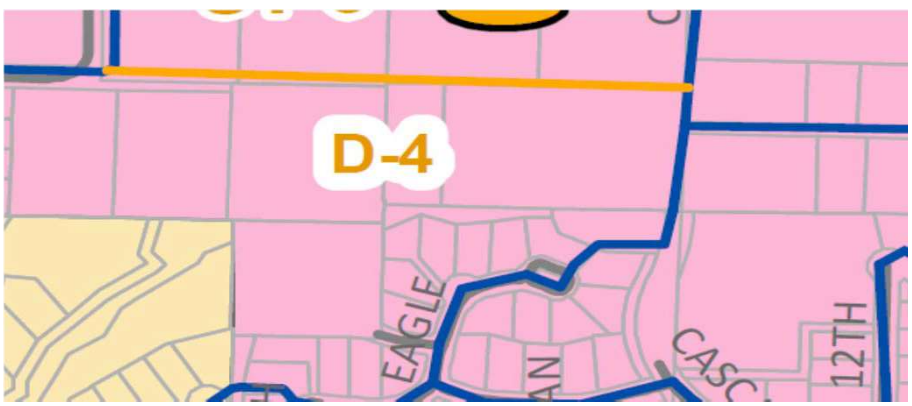
City of Camas
Water System Plan Update
Capital Improvement Program

Project Identification:	D-4	**SDC Area**	South
Project Name:	New transmission main along NW 16th Ave		
Facility Type:	Distribution		

Cost Allocation	Percent	Cost	Total Cost
Capacity:	0%	$ -	$ 519,480
Upgrade:	0%	$ -	
Non-capacity:	100%	$ 519,480	

Notes on Cost Estimation:
Costs do not include purchase of land or easements.

Project Location:



Trigger:

Level of Service Goal	Trigger	Value	Anticipated Need
Fire Flow	City Resources	When	Short-term

City of Camas
Water System Plan
Capital Improvement Program

Project Identification:	D-5	**SDC Area**	South
Project Name:	New Distribution along NW 6th Ave/ NE Adams St		
Facility Type:	Distribution		

Cost Allocation	Percent	Cost	Total Cost
Capacity:	100%	$ 925,592	**$ 925,592**
Upgrade:	0%	$ -	
Non-capacity:	0%	$ -	

Project Description:

Upsize distribution main to convey future supplies from the Steigerwald Intertie to the Forest Home BPS; preventing over-pressurization of 343 Zone. Upsize the 6-inch water main on NW 6th Ave to 16-inch, from NW 7th Ave to NE Adams St. Upsize the 8-inch water main on NE Adams St to 16-inch, from NW 6th Ave to NE 3rd Ave.

Project Element		Quantity	Unit	Unit Cost ($/Unit)	Contingency	GC & Overhead	Engineering/ Planning	City Admin	Total Project Cost	Developer Share
					30%	25%	20%	10%		
Upsize Distribution Main:	16-inch	2,120	ft	$ 236	$ 150,096	$ 125,080	$ 100,064	$ 50,032	$ 925,592	
					$ -	$ -	$ -	$ -	$ -	
					$ -	$ -	$ -	$ -	$ -	

City of Camas
Water System Plan
Capital Improvement Program

Project Identification: D-5 **SDC Area** South
Project Name: New Distribution along NW 6th Ave/ NE Adams St
Facility Type: Distribution

Cost Allocation	Percent	Cost	Total Cost
Capacity:	100%	$ 925,592	**$ 925,592**
Upgrade:	0%	$ -	
Non-capacity:	0%	$ -	

Notes on Cost Estimation:

Project Location:

Trigger:

Level of Service Goal	Trigger	Value	Anticipated Need
Redundant Supply	Related Infrastructure	Construction of Steigerwald Intertie (S-11)	0

City of Camas
Water System Plan Update
Capital Improvement Program

Project Identification:	D-6	**SDC Area**	South
Project Name:	Dead-end Looping Program		
Facility Type:	Distribution		

Cost Allocation	Percent	Cost	Total Cost
Capacity:	0%	$ -	$ 1,045,000
Upgrade:	0%	$ -	
Non-capacity:	100%	$ 1,045,000	

Project Description:
Address dead-end mains through an annual program to improve water quality and fire flow. Mains, which may be looped or upsized, as determined on a case by case basis, are typically constructed through small works contracts and/or developer improvements. An annual budget of $50,000 has been allocated for this work.

Project Element	Quantity	Unit	Unit Cost ($/Unit)	Contingency	GC & Overhead	Engineering/ Planning	City Admin	Total Project Cost	Developer Share
				0%	0%	0%	10%		
Dead-end Main Program	1	LS	$ 50,000	$ -	$ -	$ -	$ 5,000	$ 55,000	
Dead-end Main Program	1	LS	$ 50,000	$ -	$ -	$ -	$ 5,000	$ 55,000	
Dead-end Main Program	1	LS	$ 50,000	$ -	$ -	$ -	$ 5,000	$ 55,000	
Dead-end Main Program	1	LS	$ 50,000	$ -	$ -	$ -	$ 5,000	$ 55,000	
Dead-end Main Program	1	LS	$ 50,000	$ -	$ -	$ -	$ 5,000	$ 55,000	
Dead-end Main Program	4	LS	$ 50,000	$ -	$ -	$ -	$ 20,000	$ 220,000	
Dead-end Main Program	10	LS	$ 50,000	$ -	$ -	$ -	$ 50,000	$ 550,000	

City of Camas
Water System Plan Update
Capital Improvement Program

Project Identification:	D-6	**SDC Area**	South
Project Name:	Dead-end Looping Program		
Facility Type:	Distribution		

Cost Allocation	Percent	Cost	Total Cost
Capacity:	0%	$ -	$ 1,045,000
Upgrade:	0%	$ -	
Non-capacity:	100%	$ 1,045,000	

Notes on Cost Estimation:

Project Location:

Trigger:

Level of Service Goal	Trigger	Value	Anticipated Need
Fire Flow	City Resources	When	Short-term
Water Quality	City Resources	When	Short-term

City of Camas
Water System Plan Update
Capital Improvement Program

Project Identification: D-7 **SDC Area** Common
Project Name: PRV Adjustment Study
Facility Type: Distribution

Cost Allocation	Percent	Cost	Total Cost
Capacity:	0%	$ -	$ 180,000
Upgrade:	0%	$ -	
Non-capacity:	100%	$ 180,000	

Project Description:
Optimize service pressures and address fire flow deficiencies in PRV feed pressure zones. It is anticipated that the study will require a combination of field investigation and desktop hydraulic modeling. A general allowance of $100,000 has been provided to implement minor maintenance and improvements that may be recommended by the study.

Project Element	Quantity	Unit	Unit Cost ($/Unit)	Contingency	GC & Overhead	Engineering/ Planning	City Admin	Total Project Cost	Developer Share
				30%	25%	20%	10%		
PRV Study	1	LS	$ 50,000	$ 15,000	$ -	$ -	$ 5,000	$ 70,000	
PRV Improvement Allowance	1	LS	$ 100,000	$ -	$ -	$ -	$ 10,000	$ 110,000	
				$ -	$ -	$ -	$ -	$ -	

City of Camas
Water System Plan Update
Capital Improvement Program

Project Identification:	D-7
SDC Area	Common
Project Name:	PRV Adjustment Study
Facility Type:	Distribution

Cost Allocation	Percent	Cost	Total Cost
Capacity:	0%	$ -	$ 180,000
Upgrade:	0%	$ -	
Non-capacity:	100%	$ 180,000	

Notes on Cost Estimation:

Study does not include costs to repair or replace PRVs. Allowance for minor maintenance and improvements to existing PRV and vaults.

Project Location:

Trigger:

Level of Service Goal	Trigger	Value	Anticipated Need
Fire Flow	City Resources	When	Short-term

City of Camas
Water System Plan
Capital Improvement Program

Project Identification:	D-8	**SDC Area**	Common
Project Name:	Well 6/14 Transmission Line		
Facility Type:	Distribution		

Cost Allocation	Percent	Cost	Total Cost
Capacity:		$ -	$ 515,050
Upgrade:	0%	$ -	
Non-capacity:	100%	$ 515,050	

Project Description:
Upsize Well 6/14 trasmission main to provide increased capacity when both wells are pumping.

Project Element	Quantity	Unit	Unit Cost ($/Unit)	Contingency	GC & Overhead	Engineering/ Planning	City Admin	Total Project Cost	Developer Share
				0%	0%	0%	0%		
Well 6/14 Transmission Line	1	LS	$ 515,050	$ -	$ -	$ -	$ -	$ 515,050	0%
				$ -	$ -	$ -	$ -	$ -	
				$ -	$ -	$ -	$ -	$ -	

Notes on Cost Estimation:
Total cost of $515,050 was provided by the City.

Trigger:

Level of Service Goal	Trigger	Value	Anticipated Need
Not Applicable			

City of Camas
Water System Plan
Capital Improvement Program

Project Identification: D-9 **SDC Area** Common
Project Name: Parallel Boulder Creek Intake
Facility Type: Distribution

Cost Allocation	Percent	Cost	Total Cost
Capacity:	100%	$ 1,800,000	**$ 1,800,000**
Upgrade:	0%	$ -	
Non-capacity:	0%	$ -	

Project Description:
Install a parallel line to the Boulder Creek Intake to increase the available supply capacity from 1,150 gpm to the full water right of 1,570 gpm. This project will allow full use of the surface water rights and Slow Sand WTP. Additional investigation is needed to refine project costs.

Project Element	Quantity	Unit	Unit Cost ($/Unit)	Contingency	GC & Overhead	Engineering/ Planning	City Admin	Total Project Cost	Developer Share
				0%	0%	0%	0%		
Parallel Boulder Creek Intake	1	LS	$ 1,800,000	$ -	$ -	$ -	$ -	$ 1,800,000	0%
				$ -	$ -	$ -	$ -	$ -	
				$ -	$ -	$ -	$ -	$ -	

Notes on Cost Estimation:
Total cost of $1.8M provided by the City.

Trigger:

Level of Service Goal	Trigger	Value	Anticipated Need
Not Applicable			

10.3.3 Pump Station Project Sheets

Pump Station projects to resolve system deficiencies and meet future growth were identified in Chapter 9 – System Analysis. Projects are anticipated in conjunction with, or occur near, existing infrastructure:

- PS-1 New Forest Home PS.
- PS-2 New 455 Zone PS Capacity.
- PS-3 Lower Prune Hill PS Expansion.
- PS-4 North Shore PS Capacity Phase I.
- PS-5 North Shore PS Capacity Phase II.
- PS-6 NW Couch St PS.
- PS-7 NW 10th Ave Study.

General notes on the pump station projects include:

- Pump Station costs are estimated using the anticipated hp of the existing City pump stations performing to/from the same pressure zone. Relocation of pumps stations may require additional hp or transmission and distribution improvements.
- Where a new pump station is anticipated a land allowance has been provided.
- PS-7 NW 10th Ave Study is intended to provide an alternative analysis and does not include construction costs.

City of Camas
Water System Plan
Capital Improvement Program

Project Identification:	PS-1	**SDC Area**	South
Project Name:	New Forest Home PS		
Facility Type:	Pump Station		

Cost Allocation	Percent	Cost	Total Cost
Capacity:	0%	$ -	
Upgrade:	50%	$ 892,292	**$ 3,116,584**
Non-capacity:	50%	$ 1,558,292	

Project Description:
Replace the existing Forest Home BPS with a 2,000 gpm station to provide redundant supply from the 343 Pressure Zone to the 455 Pressure Zone. The new BPS is anticipated to include three (3) 75 hp variable speed pumps that will produce 1,000 gpm each, where one pump is redundant. On-site backup power is included for station reliability. Upsize the 6-inch water main on NW 7th Ave to 16-inch, from NW 6th Ave to the new BPS. BPS is required to transfer supply from the 455 Pressure Zone to higher Pressure Zones (544, 852, etc.).

Project Element		Quantity	Unit	Unit Cost ($/Unit)	Contingency	GC & Overhead	Engineering/ Planning	City Admin	Total Project Cost	Developer Share
					30%	25%	20%	10%		
New Forest Home BPS		225	hp	$ 3,200	$ 216,000	$ 180,000	$ 144,000	$ 72,000	$ 1,332,000	
Backup Power Generator		1	LS	$ 200,000	$ 60,000	$ 50,000	$ 40,000	$ 20,000	$ 370,000	
Upsize Distribution Main:	16-inch	3,240	ft	$ 236	$ 229,392	$ 191,160	$ 152,928	$ 76,464	$ 1,414,584	
					$ -	$ -	$ -	$ -	$ -	

City of Camas
Water System Plan
Capital Improvement Program

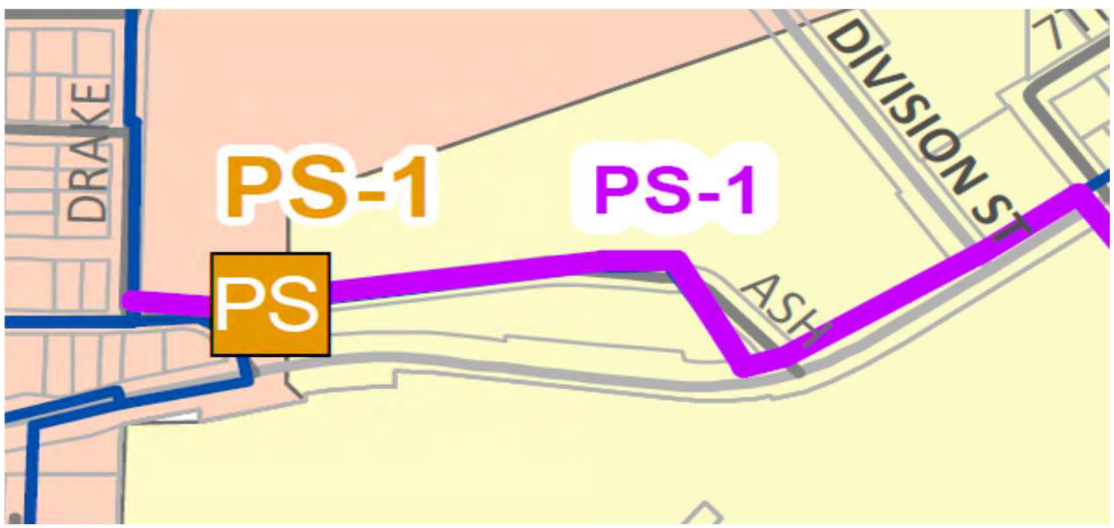
Project Identification:	PS-1	**SDC Area**	South
Project Name:	New Forest Home PS		
Facility Type:	Pump Station		

Cost Allocation	Percent	Cost	Total Cost
Capacity:	0%	$ -	$ 3,116,584
Upgrade:	50%	$ 892,292	
Non-capacity:	50%	$ 1,558,292	

Notes on Cost Estimation:

The portion of the project on NW 6th AVE was been upsized to 12" in 2017/2018. An additional analysis should be conducted during pre-deisgn to update the distribution upsizing that is required. Costs were not adjusted to provide budget for changes in scope.

Project Location:



Trigger:

Level of Service Goal	Trigger	Value	Anticipated Need
Redundant Supply	Peak Pumping	All BPS pumps required to maintain reservoir levels	Near-term

City of Camas
Water System Plan Update
Capital Improvement Program

Project Identification:	PS-2	**SDC Area**	Common
Project Name:	New 455 Zone PS Capacity		
Facility Type:	Pump Station		

Cost Allocation	Percent	Cost	Total Cost
Capacity:	0%	$ -	$ 1,258,000
Upgrade:	50%	$ 185,000	
Non-capacity:	50%	$ 629,000	

Project Description:
Add an additional 1,000 gpm of pumping, from the 343 Pressure Zone to the 455 Pressure Zone, as required to supply the future pumping to the 852 Pressure Zone (S-6). It is anticipated that the additional pumping will be added through a new 1,000 gpm station with a redundant pump or an addition to the Angelo BPS.

Project Element	Quantity	Unit	Unit Cost ($/Unit)	Contingency	GC & Overhead	Engineering/ Planning	City Admin	Total Project Cost	Developer Share
				30%	25%	20%	10%		
343 to 455 Pumping Capacity	150	hp	$ 3,200	$ 144,000	$ 120,000	$ 96,000	$ 48,000	$ 888,000	
Backup Power Generator	1	LS	$ 200,000	$ 60,000	$ 50,000	$ 40,000	$ 20,000	$ 370,000	
				$ -	$ -	$ -	$ -	$ -	

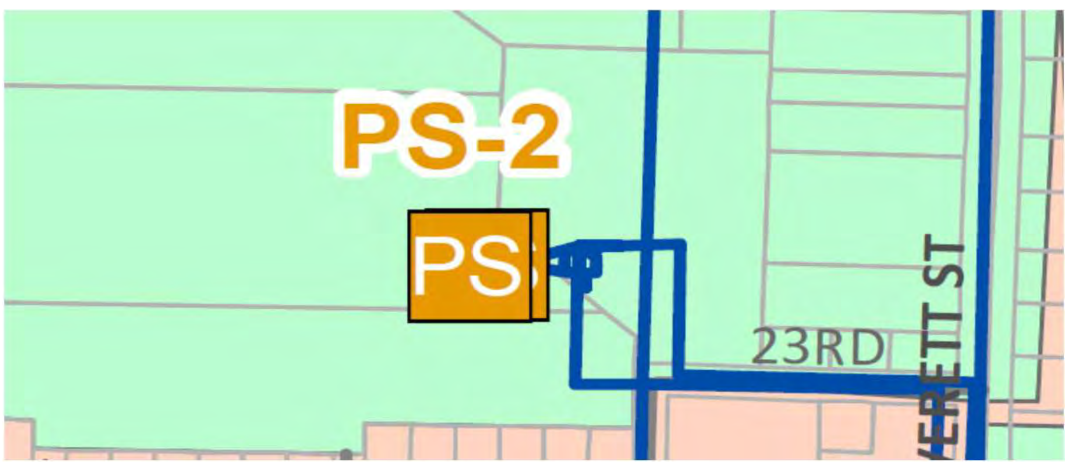
City of Camas
Water System Plan Update
Capital Improvement Program

Project Identification: PS-2 **SDC Area** Common
Project Name: New 455 Zone PS Capacity
Facility Type: Pump Station

Cost Allocation	Percent	Cost	Total Cost
Capacity:	0%	$ -	**$ 1,258,000**
Upgrade:	50%	$ 185,000	
Non-capacity:	50%	$ 629,000	

Notes on Cost Estimation:

Project Location:



Trigger:

Level of Service Goal	Trigger	Value	Anticipated Need
Redundant Supply	Related Infrastructure	Construction of 852 PZ BPS (S-6)	0

City of Camas
Water System Plan Update
Capital Improvement Program

Project Identification:	PS-3	**SDC Area**	Common
Project Name:	Lower Prune Hill PS Expansion		
Facility Type:	Pump Station		

Cost Allocation	Percent	Cost	Total Cost
Capacity:	0%	$ -	$ 1,387,500
Upgrade:	50%	$ 231,250	
Non-capacity:	50%	$ 693,750	

Project Description:
Expand Lower Prune Hill PS to add an additional 1,000 gpm of pumping from the 455 Pressure Zone to the 852 Pressure Zone to meet redundancy goals and to provide additional capacity to meet long-term growth in the pressure zone. It is anticipated that the additional pumping will be added on-site and will not require onsite auxiliary power.

Project Element	Quantity	Unit	Unit Cost ($/Unit)	Contingency	GC & Overhead	Engineering/ Planning	City Admin	Total Project Cost	Developer Share
				30%	25%	20%	10%		
455 to 852 Pumping Capacity P1	125	hp	$ 4,000	$ 150,000	$ 125,000	$ 100,000	$ 50,000	$ 925,000	
455 to 852 Pumping Capacity P2	63	hp	$ 4,000	$ 75,000	$ 62,500	$ 50,000	$ 25,000	$ 462,500	
				$ -	$ -	$ -	$ -	$ -	

City of Camas
Water System Plan Update
Capital Improvement Program

Project Identification:	PS-3	**SDC Area**	Common
Project Name:	Lower Prune Hill PS Expansion		
Facility Type:	Pump Station		

Cost Allocation	Percent	Cost	Total Cost
Capacity:	0%	$ -	$ 1,387,500
Upgrade:	50%	$ 231,250	
Non-capacity:	50%	$ 693,750	

Notes on Cost Estimation:

Project Location:

Trigger:

Level of Service Goal	Trigger	Value	Anticipated Need
Redundant Supply	Peak Pumping	All BPS pumps required to maintain reservoir levels	Near-term
Ability to Pump	852 PZ MDD	2,500 gpm	2030

City of Camas
Water System Plan Update
Capital Improvement Program

Project Identification: PS-4
Project Name: North Shore PS Capacity Phase I
Facility Type: Pump Station
SDC Area 25% South / 75% North Shore

Cost Allocation	Percent	Cost	Total Cost
Capacity:	100%	$ 1,184,000	$ 1,184,000
Upgrade:	0%	$ -	
Non-capacity:	0%	$ -	

Project Description:
Provide 2,000 gpm of additional supply to the North Shore area (Pressure Zone 544). Crown Road BPS has the ability to add two new 100 hp variable speed pumps that may provide up to 2,000 gpm.

Project Element	Quantity	Unit	Unit Cost ($/Unit)	Contingency	GC & Overhead	Engineering/ Planning	City Admin	Total Project Cost	Developer Share
				30%	25%	20%	10%		
Crown Road Expansion	200	hp	$ 3,200	$ 192,000	$ 160,000	$ 128,000	$ 64,000	$ 1,184,000	75%
				$ -	$ -	$ -	$ -	$ -	
				$ -	$ -	$ -	$ -	$ -	

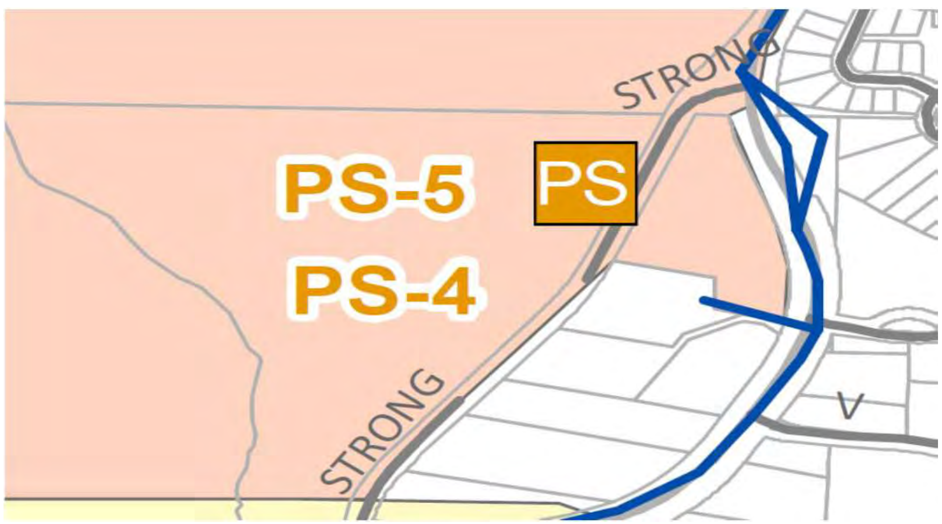
City of Camas
Water System Plan Update
Capital Improvement Program

Project Identification: PS-4 **SDC Area** 25% South / 75% North Shore
Project Name: North Shore PS Capacity Phase I
Facility Type: Pump Station

Cost Allocation	Percent	Cost	Total Cost
Capacity:	100%	$ 1,184,000	$ 1,184,000
Upgrade:	0%	$ -	
Non-capacity:	0%	$ -	

Notes on Cost Estimation:
It is assumed that the existing onsite gerenator can serve the new pumps for planning purposes.

Project Location:



Trigger:

Level of Service Goal	Trigger	Value	Anticipated Need
Redundant Supply	Peak Pumping	All BPS pumps required to maintain reservoir levels	2025
Ability to Pump	544 PZ MDD	5,250 gpm	2030

City of Camas
Water System Plan Update
Capital Improvement Program

Project Identification: PS-5
Project Name: North Shore PS Capacity Phase II
Facility Type: Pump Station
SDC Area 25% South / 75% North Shore

Cost Allocation	Percent	Cost	Total Cost
Capacity:	100%	$ 3,631,268	$ 3,631,268
Upgrade:	0%	$ -	
Non-capacity:	0%	$ -	

Project Description:
Provide 2,000 gpm of additional supply to the North Shore area (Pressure Zone 544). It is anticipated that a new BPS will be constructed in the vicinity of the Crown Road BPS. To convey the additional supplies, upsize the 12-inch water main on SE 283rd Ave to 24-inch, from SE 23rd St to NE 2rd Ave. Upsize the 12-inch water main on NE 2nd Ave to 16-inch, from SE James St to NE 3rd Ave. Upsize the 12 inch water main on NE 3nd Ave to 16-inch, from NE 2nd Ave to SE 15th St.

Project Element		Quantity	Unit	Unit Cost ($/Unit)	Contingency	GC & Overhead	Engineering/ Planning	City Admin	Total Project Cost	Developer Share
					30%	25%	20%	10%		
Phase II Northshore Pumping		200	hp	$ 3,200	$ 192,000	$ 160,000	$ 128,000	$ 64,000	$ 1,184,000	75%
Upsize Distribution Main:	24-inch	3,870	ft	$ 265	$ 307,665	$ 256,388	$ 205,110	$ 102,555	$ 1,897,268	75%
Land Allowance		1	LS	$ 500,000	$ -	$ -	$ -	$ 50,000	$ 550,000	75%

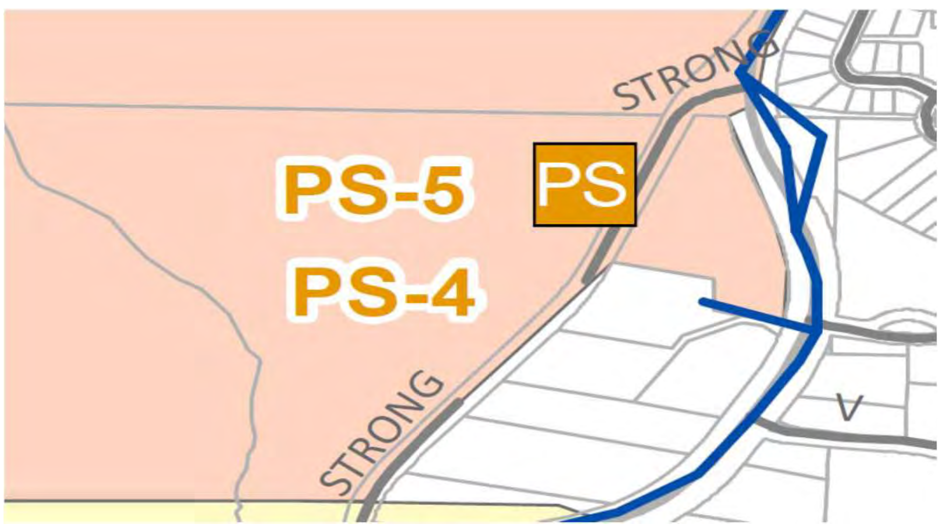
City of Camas
Water System Plan Update
Capital Improvement Program

Project Identification: PS-5 **SDC Area** 25% South / 75% North Shore
Project Name: North Shore PS Capacity Phase II
Facility Type: Pump Station

Cost Allocation	Percent	Cost	Total Cost
Capacity:	100%	$ 3,631,268	$ 3,631,268
Upgrade:	0%	$ -	
Non-capacity:	0%	$ -	

Notes on Cost Estimation:

Project Location:



Trigger:

Level of Service Goal	Trigger	Value	Anticipated Need
Redundant Supply	Peak Pumping	All BPS pumps required to maintain reservoir levels	2030
Ability to Pump	544 PZ MDD	6,850 gpm	2035

City of Camas
Water System Plan Update
Capital Improvement Program

Project Identification: PS-6 **SDC Area** South
Project Name: NW Couch St PS
Facility Type: Pump Station

Cost Allocation	Percent	Cost	Total Cost
Capacity:	0%	$ -	$ 920,000
Upgrade:	0%	$ -	
Non-capacity:	100%	$ 920,000	

Project Description:
Construct a 50 gpm pump station to improve service pressures near NW Couch St. PS to include check features to allow 455 Zone to continue to provide fire flow to the area.

Project Element	Quantity	Unit	Unit Cost ($/Unit)	Contingency	GC & Overhead	Engineering/ Planning	City Admin	Total Project Cost	Developer Share
				30%	25%	20%	10%		
NW Couch St. PS	50	hp	$ 4,000	$ 60,000	$ 50,000	$ 40,000	$ 20,000	$ 370,000	
Land Allowance	1	LS	$ 500,000	$ -	$ -	$ -	$ 50,000	$ 550,000	
				$ -	$ -	$ -	$ -	$ -	

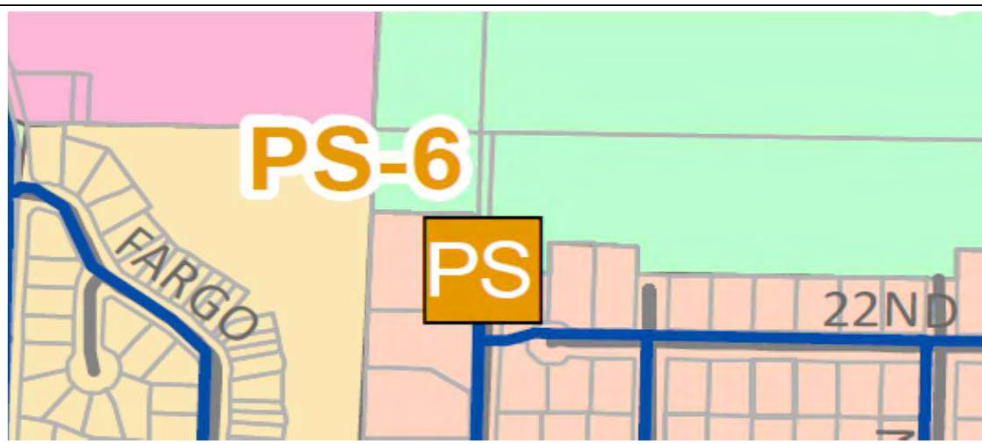
City of Camas
Water System Plan Update
Capital Improvement Program

Project Identification: PS-6
SDC Area: South
Project Name: NW Couch St PS
Facility Type: Pump Station

Cost Allocation	Percent	Cost	Total Cost
Capacity:	0%	$ -	$ 920,000
Upgrade:	0%	$ -	
Non-capacity:	100%	$ 920,000	

Notes on Cost Estimation:

Project Location:



Trigger:

Level of Service Goal	Trigger	Value	Anticipated Need
Service Pressure	City Resources	When available	Short-term

City of Camas
Water System Plan Update
Capital Improvement Program

Project Identification:	PS-7	**SDC Area**	South
Project Name:	NW 10th Ave Study		
Facility Type:	Distribution		

Cost Allocation	Percent	Cost	Total Cost
Capacity:	0%	$ -	$ 27,500
Upgrade:	0%	$ -	
Non-capacity:	100%	$ 27,500	

Project Description:
The NW 10th Ave near NW Forest Home Rd. and the immediately surrounding area has low service pressures. Conduct a study to evluate alternatives for increasing service to these customers. It is anticipated that customers will need to be rezoned into a small boosted zone.

Project Element		Quantity	Unit	Unit Cost ($/Unit)	Contingency	GC & Overhead	Engineering/ Planning	City Admin	Total Project Cost	Developer Share
					30%	25%	20%	10%		
NW 10th Ave Study		1	LS	$ 25,000		$ -	$ -	$ 2,500	$ 27,500	
					$ -	$ -	$ -	$ -	$ -	

City of Camas
Water System Plan Update
Capital Improvement Program

Project Identification:	PS-7	**SDC Area**	South
Project Name:	NW 10th Ave Study		
Facility Type:	Distribution		

Cost Allocation	Percent	Cost	Total Cost
Capacity:	0%	$ -	$ 27,500
Upgrade:	0%	$ -	
Non-capacity:	100%	$ 27,500	

Notes on Cost Estimation:
Study does not include costs to repair or replace PRVs. Allowance for minor maintenance and improvements to existing PRV and vaults.

Project Location:

Trigger:

Level of Service Goal	Trigger	Value	Anticipated Need
Fire Flow	City Resources	When	Short-term

10.3.4 Storage Project Sheets

Storage projects to maintain adequate equalizing and emergency storage were identified in Chapter 9 – System Analysis. Projects include the ongoing New 544 Zone Reservoir and new reservoirs near Greg Reservoir and for the 343 Pressure Zone in the long-term. Lower Prune Hill Rehabilitation costs were based on a prior study conducted by the City:

- ST-1 New 544 Zone Reservoir.
- ST-2 New Gregg Tank.
- ST-3 343 Zone Reservoir.
- ST-4 Lower Prune Hill Reservoir Rehabilitation.
- ST-5 Upper Prune Hill Pressure Improvements Study.

General notes on the storage projects include:

- ST-1 New 544 Zone Reservoir land acquisition costs were provided by the City based on prior work efforts.
- ST-2 Gregg Reservoir is assumed to be constructed on the existing site.
- ST-4 Lower Prune Hill Improvements costs were developed by the City based on prior work efforts.
- ST-6 Upper Prune Hill Improvements includes a construction cost allowance that should be updated based on the findings of the project's study.

City of Camas
Water System Plan Update
Capital Improvement Program

Project Identification: ST-1 **SDC Area** Common
Project Name: New 544 Zone Reservoir
Facility Type: Storage

Cost Allocation	Percent	Cost	Total Cost
Capacity:	100%	$ 7,235,996	**$ 7,235,996**
Upgrade:	0%	$ -	
Non-capacity:	0%	$ -	

Project Description:
Construct a 2 MG ground reservoir to serve the 544 Pressure Zone to address storage needs and fire flow deficiencies. An ideal location for this tank is near the corner of NW 18th Ave and NW Tidland St. Construct a new 16-inch transmission main in the utility easement between NW Pacific Rim Blvd and NW 18th Ave.

Project Element		Quantity	Unit	Unit Cost ($/Unit)	Contingency 30%	GC & Overhead 25%	Engineering/ Planning 20%	City Admin 10%	Total Project Cost	Developer Share
New 544 Zone Tank		2,000,000	gal	$ 1.0	$ 600,000	$ 500,000	$ 400,000	$ 200,000	$ 3,700,000	
New Transmission Main:	16-inch	3,060	ft	$ 236	$ 216,648	$ 180,540	$ 144,432	$ 72,216	$ 1,335,996	
Land Allowance		4	LS	$ 500,000	$ -	$ -	$ -	$ 200,000	$ 2,200,000	

City of Camas
Water System Plan Update
Capital Improvement Program

Project Identification: ST-1 **SDC Area** Common
Project Name: New 544 Zone Reservoir
Facility Type: Storage

Cost Allocation	Percent	Cost	Total Cost
Capacity:	100%	$ 7,235,996	**$ 7,235,996**
Upgrade:	0%	$ -	
Non-capacity:	0%	$ -	

Notes on Cost Estimation:
Costs do not include purchase of land or easements.

Project Location:

Trigger:

Level of Service Goal	Trigger	Value	Anticipated Need
Storage	City Resources	When	Short-term
Fire Flow	City Resources	When	Short-term

City of Camas
Water System Plan Update
Capital Improvement Program

Project Identification:	ST-2	**SDC Area**	Common
Project Name:	Gregg Reservoir		
Facility Type:	Storage		

Cost Allocation	Percent	Cost	Total Cost
Capacity:	100%	$ 3,984,345	**$ 3,984,345**
Upgrade:	0%	$ -	
Non-capacity:	0%	$ -	

Project Description:
Construct 1 MG of storage to support growth in the North Shore area. The storage may be placed at the site of the existing Gregg Standpipe, which is hydraulically beneficial due to its proximity to the Crown Road BPS and the Slow Sand Filtration Plant PRV. Upsize the transmission piping, from the tank to SE 15th St, to 24-inches.

Project Element		Quantity	Unit	Unit Cost ($/Unit)	Contingency	GC & Overhead	Engineering/ Planning	City Admin	Total Project Cost	Developer Share
					30%	25%	20%	10%		
Gregg Tank		1,000,000	gal	$ 2.0	$ 600,000	$ 500,000	$ 400,000	$ 200,000	$ 3,700,000	75%
New Transmission Main:	24-inch	580	ft	$ 265	$ 46,110	$ 38,425	$ 30,740	$ 15,370	$ 284,345	75%
					$ -	$ -	$ -	$ -	$ -	

City of Camas
Water System Plan Update
Capital Improvement Program

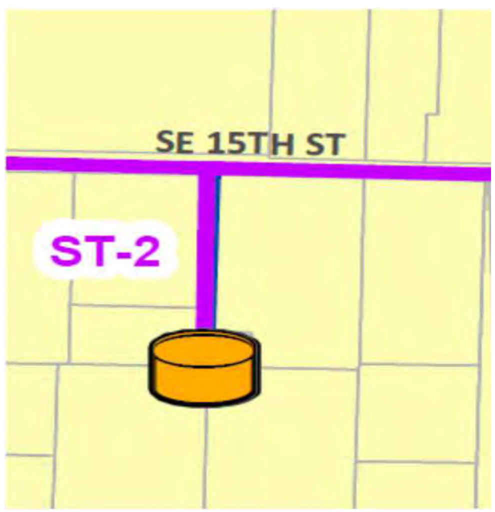
Project Identification:	ST-2	**SDC Area**	Common
Project Name:	Gregg Reservoir		
Facility Type:	Storage		

Cost Allocation	Percent	Cost	Total Cost
Capacity:	100%	$ 3,984,345	**$ 3,984,345**
Upgrade:	0%	$ -	
Non-capacity:	0%	$ -	

Notes on Cost Estimation:

Gregg Tank limited to 1M gallons based on current property size. Reservoir could be up to 2M gallons if the site allows.

Project Location:



Trigger:

Level of Service Goal	Trigger	Value	Anticipated Need
Storage	Growth	After development of ~5,000 ERUs in 542/544 Pressure Zone	Long-term

City of Camas
Water System Plan Update
Capital Improvement Program

Project Identification:	ST-3	**SDC Area**	South
Project Name:	343 Zone Reservoir		
Facility Type:	Storage		

Cost Allocation	Percent	Cost	Total Cost
Capacity:	25%	$ 1,776,925	$ 7,107,700
Upgrade:	0%	$ -	
Non-capacity:	75%	$ 5,330,775	

Project Description:
Replace the Butler Reservoir with a new 1.5 MG reservoir on Cemetery Hill, which is a more hydraulically advantageous location due to its proximity to the pressure zone and major transmission mains. Decommission the Butler Reservoir upon construction of the new reservoir. It is anticipated that a new 16-inch transmission main will be required to connect the new Cemetery Hill reservoir to the distribution system.

Project Element		Quantity	Unit	Unit Cost ($/Unit)	Contingency	GC & Overhead	Engineering/ Planning	City Admin	Total Project Cost	Developer Share
					30%	25%	20%	10%		
New 343 Zone Tank		500,000	gal	$ 4.0	$ 600,000	$ 500,000	$ 400,000	$ 200,000	$ 3,700,000	
New 343 Zone Tank		1,000,000	gal	$ 1.0	$ 300,000	$ 250,000	$ 200,000	$ 100,000	$ 1,850,000	
Transfer BPS		100	hp	$ 3,200	$ 96,000	$ 80,000	$ 64,000	$ 32,000	$ 592,000	
New Transmission Main:	16-inch	2,000	ft	$ 236	$ 141,600	$ 118,000	$ 94,400	$ 47,200	$ 873,200	
Decommision Butler Reservoir		1	LS	$ 50,000	$ 15,000	$ 12,500	$ 10,000	$ 5,000	$ 92,500	

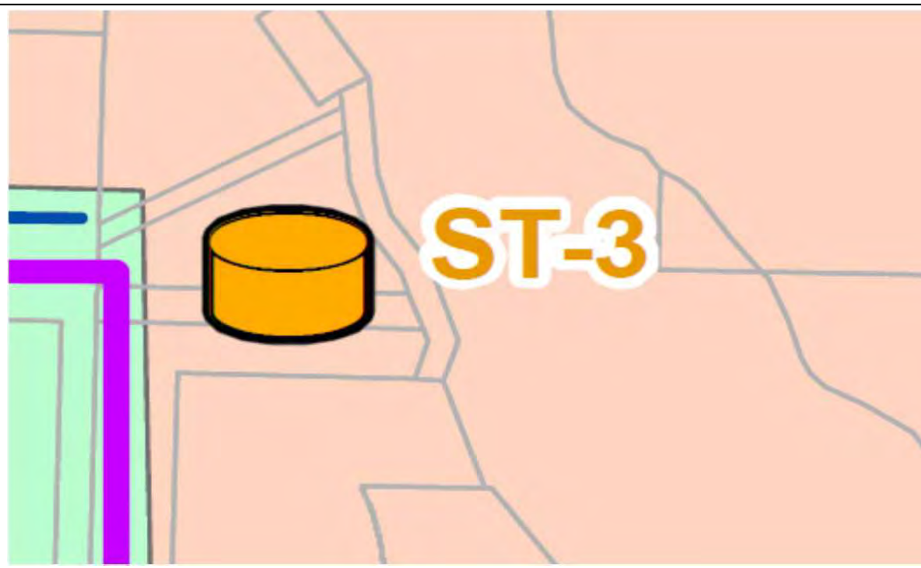
City of Camas
Water System Plan Update
Capital Improvement Program

Project Identification: ST-3 **SDC Area** South
Project Name: 343 Zone Reservoir
Facility Type: Storage

Cost Allocation	Percent	Cost	Total Cost
Capacity:	25%	$ 1,776,925	**$ 7,107,700**
Upgrade:	0%	$ -	
Non-capacity:	75%	$ 5,330,775	

Notes on Cost Estimation:

Project Location:



Trigger:

Level of Service Goal	Trigger	Value	Anticipated Need
Storage	Condition	Replace when Butler Reservoir reaches the end of its useful life	Long-term

City of Camas
Water System Plan Update
Capital Improvement Program

Project Identification:	ST-4	**SDC Area**	Common
Project Name:	Lower Prune Hill Reservoir Rehabilitation		
Facility Type:	Storage		

Cost Allocation	Percent	Cost	Total Cost
Capacity:	0%	$ -	**$ 2,619,830**
Upgrade:	25%	$ -	
Non-capacity:	75%	$ 1,964,873	

Project Description:
Rehabilitate the Lower Prune Hill Reservoir. Replace the 0.5 MG reservoir on-site, which has reached the end of its usable life, and seismically retrofit the remaining tank.

Project Element	Quantity	Unit	Unit Cost ($/Unit)	Contingency 30%	GC & Overhead 25%	Engineering/ Planning 20%	City Admin 10%	Total Project Cost	Developer Share
Lower Prune Hill Rehabilitation	1	LS	$ 1,871,307	$ 561,392	$ -	$ -	$ 187,131	$ 2,619,830	

City of Camas
Water System Plan Update
Capital Improvement Program

Project Identification: ST-4 **SDC Area** Common
Project Name: Lower Prune Hill Reservoir Rehabilitation
Facility Type: Storage

Cost Allocation	Percent	Cost	Total Cost
Capacity:	0%	$ -	$ 2,619,830
Upgrade:	25%	$ -	
Non-capacity:	75%	$ 1,964,873	

Notes on Cost Estimation:
Costs from previous Water System Plan that were escalated to 2016 dollars from an ENR of 8660. GC & Overhead and Engineering/Planning assumed to be part of cost.

Project Location:

Trigger:

Level of Service Goal	Trigger	Value	Anticipated Need
Storage	Condition	Replace when Butler Reservoir reaches the end of its useful life	Long-term

City of Camas
Water System Plan Update
Capital Improvement Program

Project Identification: ST-5 **SDC Area** Common
Project Name: Upper Prune Hill Pressure Improvements Study
Facility Type: Storage

Cost Allocation	Percent	Cost	Total Cost
Capacity:	0%	$ -	**$ 1,238,750**
Upgrade:	50%	$ 550,000	
Non-capacity:	50%	$ 619,375	

Project Description:
Study solutions to resolve low service pressures in the area surrounding the Upper Prune Hill Standpipe. Low pressures are due to high service elevations; therefore, solutions will likely require rezoning the area. A general allowance of one million dollars has been assumed for the mid-term to implement the recommendations of the study.

Project Element	Quantity	Unit	Unit Cost ($/Unit)	Contingency 30%	GC & Overhead 25%	Engineering/ Planning 20%	City Admin 10%	Total Project Cost	Developer Share
Upper Prune Hill Pressure Improvements Stud	1	LS	$ 75,000	$ 22,500	$ 18,750	$ 15,000	$ 7,500	$ 138,750	
Upper Prune Hill Improvements Allowance	1	LS	$ 1,000,000	$ -	$ -	$ -	$ 100,000	$ 1,100,000	
				$ -	$ -	$ -	$ -	$ -	

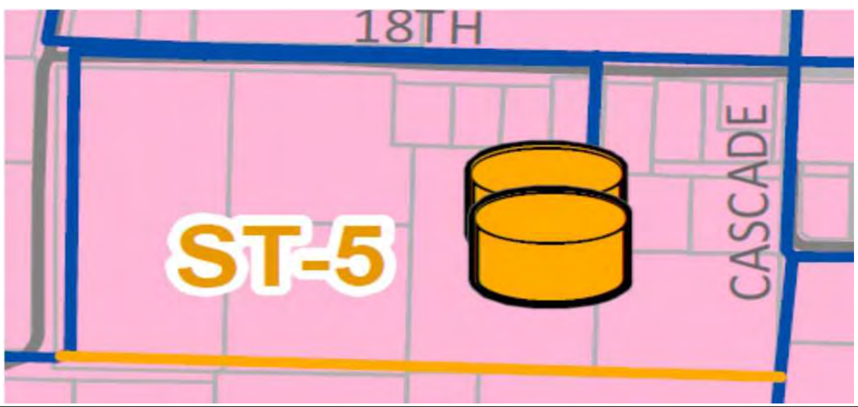
City of Camas
Water System Plan Update
Capital Improvement Program

Project Identification: ST-5 **SDC Area** Common
Project Name: Upper Prune Hill Pressure Improvements Study
Facility Type: Storage

Cost Allocation	Percent	Cost	Total Cost
Capacity:	0%	$ -	$ 1,238,750
Upgrade:	50%	$ 550,000	
Non-capacity:	50%	$ 619,375	

Notes on Cost Estimation:

Project Location:



Trigger:

Level of Service Goal	Trigger	Value	Anticipated Need
Pressure	City Resources	When	Short-term

10.3.5 General Project Sheets

A Water System Plan Update will be required every 10 years per Washington state law, which is planned for in the General Project category:

- G-1 Water System Plan Update.

City of Camas
Water System Plan Update
Capital Improvement Program

Project Identification:	G-1	**SDC Area**	Common
Project Name:	Water System Plan Update		
Facility Type:	General		

Cost Allocation	Percent	Cost	Total Cost
Capacity:	0%	$ -	$ 550,000
Upgrade:	0%	$ -	
Non-capacity:	100%	$ 550,000	

Project Description:
Update Water System Plan every 10-years, per regulatory requirements.

Project Element	Quantity	Unit	Unit Cost ($/Unit)	Contingency 30%	GC & Overhead 25%	Engineering/ Planning 20%	City Admin 10%	Total Project Cost	Developer Share
Water System Plan Update	1	LS	$ 250,000				$ 25,000	$ 275,000	
Water System Plan Update	1	LS	$ 250,000				$ 25,000	$ 275,000	
				$ -	$ -	$ -	$ -	$ -	

City of Camas
Water System Plan Update
Capital Improvement Program

Project Identification:	G-1	**SDC Area**	Common
Project Name:	Water System Plan Update		
Facility Type:	General		

Cost Allocation	Percent	Cost	Total Cost
Capacity:	0%	$ -	$ 550,000
Upgrade:	0%	$ -	
Non-capacity:	100%	$ 550,000	

Notes on Cost Estimation:

Project Location:

Notes:

10.3.6 Repair and Replacement Project Sheets

R&R projects were identified for supply, pumping, and piping in Chapter 4 – Operations and Maintenance. Supply and pumping projects are based on the 2016 Condition Assessment:

- R-1 Supply R&R Projects.
- R-2 Pump R&R Projects.
- R-3 Pipeline R&R Projects.
- R-4 Meter Replacement Program.

General notes on the R&R projects include:

- R-1, R-2, and R-3 R&R projects are based on the 2016 Condition Assessment summarized previously.
- R-4 Meter Replacement Program costs were provided by the City based on prior efforts.

City of Camas
Water System Plan Update
Capital Improvement Program

Project Identification: R-1 **SDC Area** South
Project Name: Supply R&R Projects
Facility Type: R&R

Cost Allocation	Percent	Cost	Total Cost
Capacity:	0%	$ -	$ 1,135,900
Upgrade:	0%	$ -	
Non-capacity:	100%	$ 1,135,900	

Project Description:
Repair and replace existing equipment, as identified in the 2016 Condition Assessment. This CIP line item includes projects that are supply related projects.

Project Element	Quantity	Unit	Unit Cost ($/Unit)	Contingency	GC & Overhead	Engineering/ Planning	City Admin	Total Project Cost	Developer Share
				30%	25%	20%	10%		
RS - 01 Well 8 Pump Rehabilitation	$ 1	LS	$ 29,000	$ 8,700	$ 7,250	$ 5,800	$ 2,900	$ 53,650	
RS - 02 Well No. 9 Rehabilitation	$ 1	LS	$ 29,000	$ 8,700	$ 7,250	$ 5,800	$ 2,900	$ 53,650	
RS - 03 Well 9 Analyzers	$ 1	LS	$ 13,000	$ 3,900	$ 3,250	$ 2,600	$ 1,300	$ 24,050	
RS - 05 Well 6 Electrical Improvements	$ 1	LS	$ 4,000	$ 1,200	$ 1,000	$ 800	$ 400	$ 7,400	
RS - 06 Well 7 General Improvements	$ 1	LS	$ 5,000	$ 1,500	$ 1,250	$ 1,000	$ 500	$ 9,250	
RS - 07 Well No. 10 Rehabilitation	$ 1	LS	$ 29,000	$ 8,700	$ 7,250	$ 5,800	$ 2,900	$ 53,650	
RS - 08 Well No. 11 Rehabilitation	$ 1	LS	$ 29,000	$ 8,700	$ 7,250	$ 5,800	$ 2,900	$ 53,650	
RS - 09 Well No. 12 Rehabilitation	$ 1	LS	$ 29,000	$ 8,700	$ 7,250	$ 5,800	$ 2,900	$ 53,650	
RS - 10 Well 6 Telemetry Improvements	$ 1	LS	$ 40,000	$ 12,000	$ 10,000	$ 8,000	$ 4,000	$ 74,000	
RS - 11 Washougal Wellfield Salt Storage Buil	$ 1	LS	$ 75,000	$ 22,500	$ 18,750	$ 15,000	$ 7,500	$ 138,750	
RS - 12 Well No. 13 Rehabilitation	$ 1	LS	$ 29,000	$ 8,700	$ 7,250	$ 5,800	$ 2,900	$ 53,650	
RS - 13 Well No. 14 Rehabilitation	$ 1	LS	$ 29,000	$ 8,700	$ 7,250	$ 5,800	$ 2,900	$ 53,650	
RS - 14 Well 7 Electrical Improvements	$ 1	LS	$ 11,000	$ 3,300	$ 2,750	$ 2,200	$ 1,100	$ 20,350	
RS - 15 Well 8 Electrical improvements	$ 1	LS	$ 4,000	$ 1,200	$ 1,000	$ 800	$ 400	$ 7,400	
RS - 16 Washougal Wellfield Disinfection Imp	$ 1	LS	$ 150,000	$ 45,000	$ 37,500	$ 30,000	$ 15,000	$ 277,500	
RS - 17 Well 11 and 12 Mechanical Improvem	$ 1	LS	$ 3,000	$ 900	$ 750	$ 600	$ 300	$ 5,550	
RS - 18 Well 11 and 12 Electrical Maintenanc	$ 1	LS	$ 3,000	$ 900	$ 750	$ 600	$ 300	$ 5,550	
RS - 19 Well No. 6 Rehabilitation	$ 1	LS	$ 29,000	$ 8,700	$ 7,250	$ 5,800	$ 2,900	$ 53,650	
RS - 20 Well No. 7 Rehabilitation	$ 1	LS	$ 29,000	$ 8,700	$ 7,250	$ 5,800	$ 2,900	$ 53,650	
RS - 21 Well 9 Electrical Improvements	$ 1	LS	$ 45,000	$ 13,500	$ 11,250	$ 9,000	$ 4,500	$ 83,250	
				$ -	$ -	$ -	$ -	$ -	

City of Camas
Water System Plan Update
Capital Improvement Program

Project Identification:	R-1	**SDC Area**	South
Project Name:	Supply R&R Projects		
Facility Type:	R&R		

Cost Allocation	Percent	Cost	Total Cost
Capacity:	0%	$ -	**$ 1,135,900**
Upgrade:	0%	$ -	
Non-capacity:	100%	$ 1,135,900	

Notes on Cost Estimation:

Project Location:

Trigger:

Level of Service Goal	**Trigger**	**Value**	**Anticipated Need**
Pressure	City Resources	When	Short-term

City of Camas
Water System Plan Update
Capital Improvement Program

Project Identification:	R-2	**SDC Area**	South
Project Name:	Pump R&R Projects		
Facility Type:	R&R		

Cost Allocation	Percent	Cost	Total Cost
Capacity:	0%	$ -	$ 1,504,050
Upgrade:	0%	$ -	
Non-capacity:	100%	$ 1,504,050	

Project Description:
Repair and replace existing equipment, as identified in the 2016 Condition Assessment. This CIP line item includes projects that are booster pump related projects.

Project Element	Quantity	Unit	Unit Cost ($/Unit)	Contingency 30%	GC & Overhead 25%	Engineering/ Planning 20%	City Admin 10%	Total Project Cost	Developer Share
RP - 1 Replace or Refurbish Lacamas BPS Pumps and M	1	LS	$ 80,000	$ 24,000	$ 20,000	$ 16,000	$ 8,000	$ 148,000	
RP - 2 Replace or Refurbish Butler BPS Pumps and Mot	1	LS	$ 60,000	$ 18,000	$ 15,000	$ 12,000	$ 6,000	$ 111,000	
RP - 4 Replace or Refurbish Angelo BPS Pumps and Mo	1	LS	$ 140,000	$ 42,000	$ 35,000	$ 28,000	$ 14,000	$ 259,000	
RP - 5 Lower Prune Hill BPS Discharge Header Improve	1	LS	$ 5,000	$ 1,500	$ 1,250	$ 1,000	$ 500	$ 9,250	
RP - 6 Crown Road BPS Standby Generator Modificatio	1	LS	$ 5,000	$ 1,500	$ 1,250	$ 1,000	$ 500	$ 9,250	
RP - 7 Upper Prune Hill BPS Discharge Header Improve	1	LS	$ 5,000	$ 1,500	$ 1,250	$ 1,000	$ 500	$ 9,250	
RP - 8 Replace or Refurbish Upper Prune Hill BPS Pump	1	LS	$ 110,000	$ 33,000	$ 27,500	$ 22,000	$ 11,000	$ 203,500	
RP - 9 Replace or Refurbish Gregg BPS Pumps and Mot	1	LS	$ 80,000	$ 24,000	$ 20,000	$ 16,000	$ 8,000	$ 148,000	
RP - 10 Replace or Refurbish Lower Prune Hill BPS Pum	1	LS	$ 125,000	$ 37,500	$ 31,250	$ 25,000	$ 12,500	$ 231,250	
RP - 11 Replace or Refurbish Crown Road BPS Pumps a	1	LS	$ 75,000	$ 22,500	$ 18,750	$ 15,000	$ 7,500	$ 138,750	
RP - 12 Replace or Refurbish Gregg BPS Pump 3 and M	1	LS	$ 30,000	$ 9,000	$ 7,500	$ 6,000	$ 3,000	$ 55,500	
RP - 13 Lower Prune Hill BPS Electrical Equipment Repl	1	LS	$ 42,000	$ 12,600	$ 10,500	$ 8,400	$ 4,200	$ 77,700	
RP - 14 Lacamas BPS Generator Maintenance	1	LS	$ 3,000	$ 900	$ 750	$ 600	$ 300	$ 5,550	
RP - 15 Lacamas BPS Electrical Maintenance & Testing	1	LS	$ 5,000	$ 1,500	$ 1,250	$ 1,000	$ 500	$ 9,250	
RP - 16 Upper Prune Hill BPS Electrical Equipment Repl	1	LS	$ 43,000	$ 12,900	$ 10,750	$ 8,600	$ 4,300	$ 79,550	
RP - 17 Butler BPS Motor Starter Replacement	1	LS	$ 3,000	$ 900	$ 750	$ 600	$ 300	$ 5,550	
RP - 19 Butler BPS Check Valve Replacement	1	LS	$ 2,000	$ 600	$ 500	$ 400	$ 200	$ 3,700	
				$ -	$ -	$ -	$ -	$ -	

City of Camas
Water System Plan Update
Capital Improvement Program

Project Identification:	R-2	**SDC Area**	South
Project Name:	Pump R&R Projects		
Facility Type:	R&R		

Cost Allocation	Percent	Cost	Total Cost
Capacity:	0%	$ -	$ 1,504,050
Upgrade:	0%	$ -	
Non-capacity:	100%	$ 1,504,050	

Notes on Cost Estimation:

Project Location:

Trigger:

Level of Service Goal	Trigger	Value	Anticipated Need
Pressure	City Resources	When	Short-term

City of Camas
Water System Plan Update
Capital Improvement Program

Project Identification:	R-3	**SDC Area**	South
Project Name:	Pipeline R&R Projects		
Facility Type:	R&R		

Cost Allocation	Percent	Cost	Total Cost
Capacity:	0%	$ -	$ 40,265,813
Upgrade:	0%	$ -	
Non-capacity:	100%	$ 40,265,813	

Project Description:
During the short and medium-term, maintain a small annual R&R program to address localized issues or to participate in joint projects that cost-effectively replace aging piping. Expand the program, in long-term planning, to address aging infrastructure near downtown that is anticipated to reach the end of its usable life in the 2030s. Small diameter mains (2-inch to 6-inch) should be upsized to 8-inch to meet current City standards. A CIP project will be conducted to repair and replace the surface water raw water line from the sources to the treatment plant.

Project Element		Quantity	Unit	Unit Cost ($/Unit)	Contingency	GC & Overhead	Engineering/ Planning	City Admin	Total Project Cost	Developer Share
					30%	25%	20%	10%		
Raw Water Main R&R	8-inch	18,750	ft	$ 175	$ 984,375	$ 820,313	$ 656,250	$ 328,125	$ 6,070,313	
Raw Water Main R&R	8-inch	18,750	ft	$ 175	$ 984,375	$ 820,313	$ 656,250	$ 328,125	$ 6,070,313	
Pipeline R&R Program		1	LS	$ 150,000	$ -	$ -	$ 30,000	$ 15,000	$ 195,000	
Pipeline R&R Program		1	LS	$ 150,000	$ -	$ -	$ 30,000	$ 15,000	$ 195,000	
Pipeline R&R Program		1	LS	$ 150,000	$ -	$ -	$ 30,000	$ 15,000	$ 195,000	
Pipeline R&R Program		1	LS	$ 150,000	$ -	$ -	$ 30,000	$ 15,000	$ 195,000	
Pipeline R&R Program		1	LS	$ 150,000	$ -	$ -	$ 30,000	$ 15,000	$ 195,000	
Pipeline R&R Program		1	LS	$ 150,000	$ -	$ -	$ 30,000	$ 15,000	$ 195,000	
Pipeline R&R Program		4	LS	$ 150,000	$ -	$ -	$ 120,000	$ 60,000	$ 780,000	
Pipeline R&R Program	12-inch	17,500	ft	$ 216	$ 1,134,000	$ 945,000	$ 756,000	$ 378,000	$ 6,993,000	
Pipeline R&R Program	8-inch	59,250	ft	$ 175	$ 3,110,625	$ 2,592,188	$ 2,073,750	$ 1,036,875	$ 19,182,188	

City of Camas
Water System Plan Update
Capital Improvement Program

Project Identification:	R-3	**SDC Area**	South
Project Name:	Pipeline R&R Projects		
Facility Type:	R&R		

Cost Allocation	Percent	Cost	Total Cost
Capacity:	0%	$ -	$ 40,265,813
Upgrade:	0%	$ -	
Non-capacity:	100%	$ 40,265,813	

Notes on Cost Estimation:

Project Location:

Trigger:

Level of Service Goal	Trigger	Value	Anticipated Need
Fire Flow	City Resources	When	Short-term

City of Camas
Water System Plan Update
Capital Improvement Program

Project Identification: R-4 **SDC Area** South
Project Name: Meter Replacement Program
Facility Type:

Cost Allocation	Percent	Cost	Total Cost
Capacity:		$ -	$ 1,300,000
Upgrade:	0%	$ -	
Non-capacity:	100%	$ -	

Project Description:

Project Element	Quantity	Unit	Unit Cost ($/Unit)	Contingency 30%	GC & Overhead 25%	Engineering/ Planning 20%	City Admin 10%	Total Project Cost	Developer Share
				$ -	$ -	$ -	$ -	$ -	
				$ -	$ -	$ -	$ -	$ -	
				$ -	$ -	$ -	$ -	$ -	

City of Camas
Water System Plan Update
Capital Improvement Program

Project Identification: R-4 **SDC Area** South
Project Name: Meter Replacement Program
Facility Type:

Cost Allocation	Percent	Cost	Total Cost
Capacity:		$ -	$ 1,300,000
Upgrade:	0%	$ -	
Non-capacity:	100%	$ -	

Notes on Cost Estimation:

Trigger:

Level of Service Goal	Trigger	Value	Anticipated Need

10.3.7 North Shore Expansion Project Sheets

North Shore Expansion project develops the distribution piping for the North Shore Area:

- NS-1 Annual North Shore Distribution Program.
- NS-2 Leadbetter Road Transmission Main.

A pump station and reservoir will be also developed within the North Shore area that is presented in prior sections:

- PS-4 North Shore PS Capacity Phase I.
- PS-5 North Shore PS Capacity Phase II.
- ST-2 New Gregg Tank.

General notes on the North Shore Expansion projects include:

- The North Shore Area is heavily reliant on the existing system. In particular, it will use storage and pumping in the existing 544 and 542 Pressure Zones. Supply to the North Shore will largely occur from the 343 Pressure Zone.
- NS-1 Annual North Shore Distribution Program letter designations correspond to map on the second page. Where no road currently exists, no road name was provided.
- NS-2 Leadbetter Road Transmission Main is complete. No CIP sheet has been included.

City of Camas
Water System Plan Update
Capital Improvement Program

Project Identification:	NS-1	**SDC Area**	North Shore
Project Name:	Annual North Shore Distribution Program		
Facility Type:	North Shore		

Cost Allocation	Percent	Cost	Total Cost
Capacity:	100%	$ 22,254,000	$ 22,254,000
Upgrade:	0%	$ -	
Non-capacity:	0%	$ -	

Project Description:
Construct North Shore area distribution system through a 10-year annual program. Sizing based on a looped 544 Pressure Zone distribution system, where indivdiual developments may be served through sub pressure zones.

Project Element		Quantity	Unit	Unit Cost ($/Unit)	Contingency	GC & Overhead	Engineering/ Planning	City Admin	Total Project Cost	Developer Share
					30%	25%	20%	10%		
Annual North Shore Distribution Main Program									$ 2,225,400	75%
Annual North Shore Distribution Main Program									$ 2,225,400	75%
Annual North Shore Distribution Main Program									$ 2,225,400	75%
Annual North Shore Distribution Main Program									$ 2,225,400	75%
Annual North Shore Distribution Main Program									$ 8,901,600	75%
Annual North Shore Distribution Main Program									$ 4,450,800	75%
Individual North Shore Distribution System Piping Projects (Do Not Enter Project Timing)										
A. SE 15th St. transmission main upsize.	24-inch	1,730	ft	$ 265	$ 137,535	$ 114,613	$ 91,690	$ 45,845	$ 848,000	
B. NE 43rd Ave transmission main upsize	18-inch	1,560	ft	$ 243	$ 113,724	$ 94,770	$ 75,816	$ 37,908	$ 701,000	
C. SE 283rd Ave transmission main upsize	18-inch	2,640	ft	$ 243	$ 192,456	$ 160,380	$ 128,304	$ 64,152	$ 1,187,000	
D. SE Robinson/SE 7th St transmission mai	18-inch	3,620	ft	$ 243	$ 263,898	$ 219,915	$ 175,932	$ 87,966	$ 1,627,000	
E. NE Goodwin Road	18-inch	3,620	ft	$ 243	$ 263,898	$ 219,915	$ 175,932	$ 87,966	$ 1,627,000	
F	8-inch	7,709	ft	$ 175	$ 404,723	$ 337,269	$ 269,815	$ 134,908	$ 2,496,000	
G	18-inch	7,436	ft	$ 243	$ 542,084	$ 451,737	$ 361,390	$ 180,695	$ 3,343,000	
H	18-inch	8,596	ft	$ 243	$ 626,648	$ 522,207	$ 417,766	$ 208,883	$ 3,864,000	
I	18-inch	2,615	ft	$ 243	$ 190,634	$ 158,861	$ 127,089	$ 63,545	$ 1,176,000	
J	12-inch	3,619	ft	$ 216	$ 234,511	$ 195,426	$ 156,341	$ 78,170	$ 1,446,000	
K	12-inch	5,471	ft	$ 216	$ 354,521	$ 295,434	$ 236,347	$ 118,174	$ 2,186,000	
L	12-inch	2,259	ft	$ 216	$ 146,383	$ 121,986	$ 97,589	$ 48,794	$ 903,000	
M	12-inch	2,127	ft	$ 216	$ 137,830	$ 114,858	$ 91,886	$ 45,943	$ 850,000	

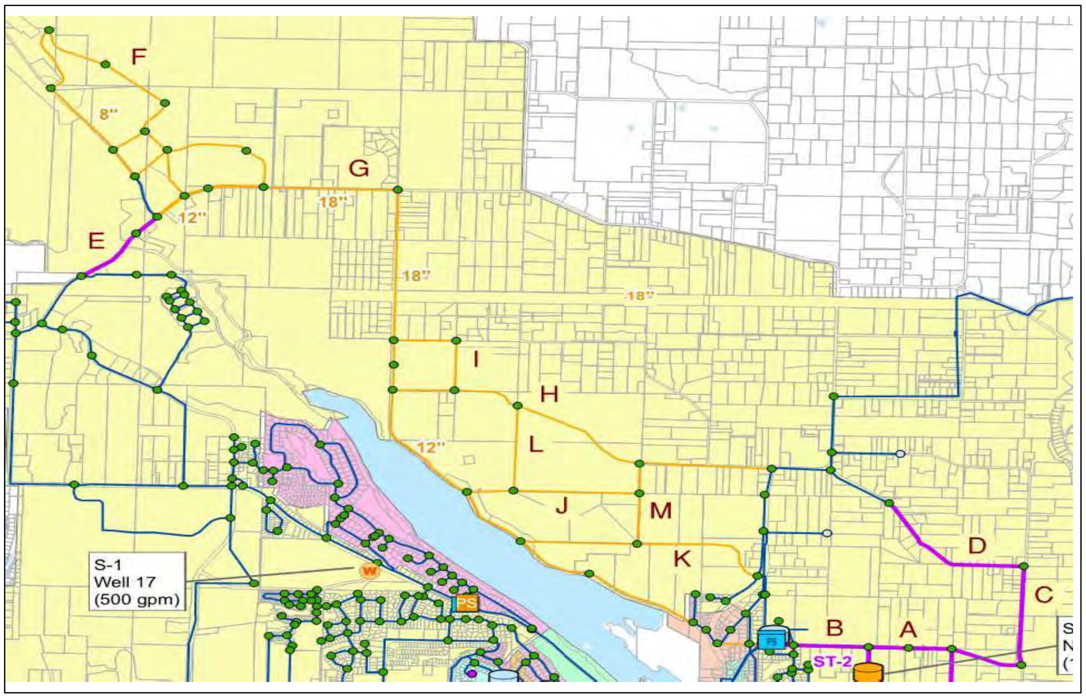
City of Camas
Water System Plan Update
Capital Improvement Program

Project Identification:	NS-1	**SDC Area**	North Shore
Project Name:	Annual North Shore Distribution Program		
Facility Type:	North Shore		

Cost Allocation	Percent	Cost	Total Cost
Capacity:	100%	$ 22,254,000	**$ 22,254,000**
Upgrade:	0%	$ -	
Non-capacity:	0%	$ -	

Notes on Cost Estimation:

Project Location:



Trigger:

Level of Service Goal	Trigger	Value	Anticipated Need
Pressure and Fire Flow	North Shore Development	Implement in conjunction with development.	Mid-term, Long-term

City of Camas
Water System Plan Update
Capital Improvement Program

Project Identification: NS-2 **SDC Area** North Shore
Project Name: Leadbetter Road Transmission Main
Facility Type:

Cost Allocation	Percent	Cost	Total Cost
Capacity:		$ -	$ 3,100,000
Upgrade:	0%	$ -	
Non-capacity:	100%	$ -	

Project Description:

Project Element	Quantity	Unit	Unit Cost ($/Unit)	Contingency	GC & Overhead	Engineering/ Planning	City Admin	Total Project Cost	Developer Share
				30%	25%	20%	10%		
				$ -	$ -	$ -	$ -	$ -	75%
				$ -	$ -	$ -	$ -	$ -	
				$ -	$ -	$ -	$ -	$ -	

City of Camas
Water System Plan Update
Capital Improvement Program

Project Identification: NS-2 **SDC Area** North Shore
Project Name: Leadbetter Road Transmission Main
Facility Type:

Cost Allocation	Percent	Cost	Total Cost
Capacity:		$ -	$ 3,100,000
Upgrade:	0%	$ -	
Non-capacity:	100%	$ -	

Notes on Cost Estimation:

Trigger:

Level of Service Goal	Trigger	Value	Anticipated Need

10.3.8 Cost Summary

CIP projects were summarized by project category and type in Table 10.8 and Table 10.9 respectively. When considering CIP costs by project category, as shown in Table 10.8, the majority of CIP costs occur from supply, storage, and the North Shore Expansion. Major supply CIP projects and the construction of the North Shore Expansion are anticipated to occur throughout the planning period. Storage CIP projects are anticipated to occur in the short-term and long-term planning periods. A majority of pumping CIP projects are anticipated in the medium-term planning period. Consistent with the non-capacity costs, repair and replacement project are largely anticipated in the long-term planning horizon.

CIP costs by project type are largely split between capacity and non-capacity. Capacity costs, as shown in Table 10.9, are anticipated to be relatively constant throughout the planning horizon, while non-capacity costs are largely anticipated to occur in the long-term planning horizon.

Table 10.8 CIP Cost by Project Category Summary
Water System Plan Update
City of Camas

Project Category	Total CIP Cost ($)	CIP Phasing		
		Short-term (2017-2022)	Medium-term (2023-2026)	Long-term (2027-2036)
Supply	$28,937,000	$10,665,000	$7,684,000	$10,588,000
Distribution System Improvements	$6,024,000	$4,328,000	$220,000	$1,476,000
Pump Station	$11,526,000	$1,416,000	$4,141,000	$5,969,000
Storage	$21,087,000	$14,483,000	$-	$6,604,000
General	$550,000	$-	$275,000	$275,000
Repair and Replacement	$44,327,000	$3,284,000	$7,807,000	$33,236,000
North Shore Expansion	$25,353,000	$12,000,000	$4,450,000	$8,903,000
Total Cost	**$137,804,067**	**$46,175,942**	**$24,577,250**	**$67,050,875**

Table 10.9 CIP Cost by Project Type Summary Water System Plan Update City of Camas				
Project Type	**Total CIP Cost ($)**	**CIP Phasing**		
		Short-term (2017-2022)	**Medium-term (2023-2026)**	**Long-term (2027-2036)**
Capacity	$67,538,500	$26,888,250	$13,118,250	$27,532,000
Upgrade	$4,858,500	$2,016,000	$1,018,625	$1,823,875
Non-Capacity	$61,007,133	$12,871,633	$10,440,625	$37,694,875
Total Cost	**$137,804,067**	**$46,175,942**	**$24,577,250**	**$67,050,875**
Average Annual Cost	**$6,890,000**	**$7,696,000**	**$6,144,300**	**$6,705,100**

FINANCIAL PLAN

11.1 INTRODUCTION

This chapter was prepared by FCS GROUP to provide a financial program that allows the City of Camas (City) water utility to remain financially viable during the planning period. This financial viability analysis considers the historical financial condition, current and identified future financial and policy obligations, operation and maintenance (O&M) needs, and the ability to support the financial impacts related to the completion of the capital projects identified in this Water System Plan Update (Plan). Furthermore, this chapter provides a review of the water utility's current rate structure with respect to rate adequacy and customer affordability.

11.1.1 Past Financial Performance

This section includes a historical summary of financial performance as reported by the City on fund resources and uses arising from cash transactions, as well as a historical summary of comparative statements of net position, which are useful indicators of the City's financial position.

11.1.2 Comparative Financial Statements

The City legally owns and operates both a water and sewer utility. Operations and financial reporting occur on a combined utility fund basis. The City combined utility fund reflects historical integrations that are difficult to separate from an accounting perspective (bond issues, combined asset projects, etc.). The City's long-term goal is to separate the accounting of its Utilities. Currently, all new assets are tracked separately and the Utilities are operated separately.

Table 11.1 shows a summary of the utility fund resources and uses arising from cash transactions for the previous six years (2011 through 2016) for the water and sewer utilities combined. Table 11.2 shows a summary of assets and liabilities, with the difference between the two reported as "net position." Increases or decreases in net position are useful indicators of the financial position of the City's utility fund. Noteworthy findings and trends are discussed following each table to demonstrate the historical performance and condition of the City's combined utility fund.

Table 11.1 Summary of Historical Fund Resources and Uses Arising from Cash Transactions

	2011	2012	2013	2014	2015	2016
OPERATING REVENUES						
Charges for Service	$ 8,830,034	$ 9,509,660	$ 9,780,132	$ 10,336,358	$ 11,202,674	$ 11,411,593
Total Operating Revenues	$ 8,830,034	$ 9,509,660	$ 9,780,132	$ 10,336,358	$ 11,202,674	$ 11,411,593
OPERATING EXPENSES						
Water Operations and Maintenance	$ 1,702,490	$ 1,647,170	$ 1,608,470	$ 1,817,542	$ 1,885,556	$ 2,453,392
Sewer Operations and Maintenance	2,079,045	2,094,288	2,115,178	2,482,466	2,300,528	2,730,173
Customer Accounts	42,210	45,607	23,209	44,451	39,123	77,005
Administration	952,884	833,476	1,066,780	965,205	1,277,740	1,181,535
Taxes	328,948	355,759	341,492	350,141	389,507	435,240
Depreciation and Amortization	2,072,212	2,207,980	2,898,739	3,057,858	3,071,893	3,183,705
Total Operating Expenses	$ 7,177,789	$ 7,184,280	$ 8,053,868	$ 8,717,663	$ 8,964,347	$ 10,061,050
OPERATING INCOME (Loss)	$ 1,652,245	$ 2,325,380	$ 1,726,264	$ 1,618,695	$ 2,238,327	$ 1,350,543
NONOPERATING REVENUES (Expenses)						
Interest Earnings	$ 19,267	$ 5,290	$ 13,372	$ 27,982	$ 26,983	$ 204,446
State and Federal Grants	-	-	-	-	-	-
Interest and Fiscal Charges	(587,031)	(767,618)	(718,093)	(612,588)	(842,275)	(1,136,153)
Gain (Loss) on Disposal of Assets	-	(539,843)	-	10,000	(30,508)	3,821
Miscellaneous Revenue (Expense)	121,680	376,566	376,784	139,535	161,635	641,503
Total Non-Operating Revenues (Expenses)	$ (446,084)	$ (925,605)	$ (327,937)	$ (435,071)	$ (684,165)	$ (286,383)
Income (Loss) before Contributions and Transfers	$ 1,206,161	$ 1,399,775	$ 1,398,327	$ 1,183,624	$ 1,554,162	$ 1,064,160
Capital Contributions	3,125,970	798,547	2,488,803	2,223,065	2,601,733	5,881,163
Transfers In	-	-	-	-	-	-
Transfers Out	-	-	-	-	-	-
Increase(Decrease) in Net Position	$ 4,332,131	$ 2,198,322	$ 3,887,130	$ 3,406,689	$ 4,155,895	$ 6,945,323
TOTAL NET POSITION, BEGINNING OF YEAR	$ 54,269,607	$ 59,186,863	$ 61,385,185	$ 65,269,090	$ 68,680,879	$ 71,814,867
Change in Accounting Principles	-	-	(52,222)		(1,021,907)	
Prior Period Adjustment	(212,354)			5,100		(145,459)
TOTAL NET POSITION, END OF YEAR	$ 58,389,384	$ 61,385,185	$ 65,220,093	$ 68,680,879	$ 71,814,867	$ 78,614,731
O&M Coverage Ratio	123.0%	132.4%	121.4%	118.6%	125.0%	113.4%
Net Operating Income as a % of Operating Revenue	18.7%	24.5%	17.7%	15.7%	20.0%	11.8%
Debt Service Coverage Ratio	2.91	2.10	2.04	1.95	1.93	1.51

Table 11.2 Summary of Historical Comparative Statements of Net Position

	2011	2012	2013	2014	2015	2016
CURRENT ASSETS						
Cash, Cash Equivalents and Pooled Investments	$ 339,942	$ 2,410,155	$ 3,239,531	$ 4,366,864	$ 4,619,622	$ 6,652,747
Receivables						
Accounts	239,973	1,274,107	1,404,626	1,446,320	1,603,637	1,705,130
Due from Other Governmental Units		-	-	-	-	-
Prepaid Expenses		4,800	2,421	-	-	-
Restricted Assets						
Cash and Cash Equivalents	3,086,249	4,484,586	2,369,523	3,081,955	6,743,812	6,433,517
Investments	384,226	370,572	203,034	203,949	15,024,018	15,119,563
Interest Receivable	9,198	4,434	-	-	8,858	600
Total Current Assets	$ 4,059,588	$ 8,548,654	$ 7,219,135	$ 9,099,088	$ 27,999,947	$ 29,911,557
LONG TERM ASSETS						
Nondepreciable Assets						
Land and Improvements to Land	$ 953,931	$ 953,931	$ 983,172	$ 1,014,021	$ 1,108,023	$ 1,015,178
Land Rights	-	-	-	-	-	92,845
Construction In Progress	14,471,939	307,979	4,509,217	2,110,912	10,074,376	4,155,957
Deferred Charges	60,164	52,222	-	-	-	-
Property, Plant and Equipment (Net)						
Building	14,920,205	21,873,877	21,350,093	20,031,819	20,913,401	21,438,584
Intangible Assets	-	12,414	9,601	10,164	388,526	385,721
Improvements Other than Buildings	5,896,484	5,644,074	5,593,518	6,428,115	5,177,609	9,918,134
Machinery and Equipment	11,551,665	18,502,927	17,714,897	20,441,699	18,567,853	18,986,219
Infrastructure	34,475,598	34,137,165	36,547,623	39,123,609	39,776,490	45,498,995
Total Noncurrent Assets	$ 82,329,986	$ 81,484,589	$ 86,708,121	$ 89,160,339	$ 96,006,278	$ 101,491,633
TOTAL ASSETS	$ 86,389,574	$ 90,033,243	$ 93,927,256	$ 98,259,427	$ 124,006,225	$ 131,403,190
Total deferred outflows of resources						
Deferred amount on refunding	-	-	-	-	246,166	$ 223,615
Amounts related to pensions	-	-	-	-	150,855	280,188
Total deferred outflows of resources	-	-	-	-	397,021	$ 503,803
LIABILITIES						
Current Liabilities						
Accounts Payable	$ 159,288	$ 367,288	$ 367,967	$ 315,462	$ 1,161,415	$ 633,737
Custodial Accounts	300	-	155,023	-	-	-
Accrued Interest Payable	147,605	229,033	161,589	161,343	227,132	293,713
Accrued Employee Benefits	21,557	18,070	15,564	16,809	12,916	15,476
Line of Credit		-	-	-	-	2,647,259
Unearned Revenues		-	1,674,456	1,418,946	35,000	-
Bonds, Notes and Loans Payable	1,281,775	2,161,472	2,264,393	2,392,744	2,752,641	3,012,332
Payable from Restricted Assets	605,104	-	-	-	78,375	407
Total Current Liabilities	$ 2,215,629	$ 2,775,863	$ 4,638,992	$ 4,305,304	$ 4,267,479	$ 6,602,924
NONCURRENT LIABILITIES						
Bonds, Notes and Loans Payable	$ 25,528,816	$ 25,655,339	$ 23,856,877	$ 25,045,080	$ 45,838,121	$ 44,347,386
Unearned Revenue - Developer Credit	-	-	-	-	1,083,944	604,647
Net Pension Liability	-	-	-	-	1,031,588	1,500,278
Accrued Employee Benefits	255,745	216,856	211,294	228,164	208,142	200,800
Total Non Current Liabilities	$ 25,784,561	$ 25,872,195	$ 24,068,171	$ 25,273,244	$ 48,161,795	$ 46,653,111
TOTAL LIABILITIES	$ 28,000,190	$ 28,648,058	$ 28,707,163	$ 29,578,548	$ 52,429,274	$ 53,256,035
DEFERRED INFLOWS OF RESOURCES						
Amounts Related to Pensions	$ -	$ -	$ -	$ -	$ 159,105	$ 36,227
Total deferred inflows of resources	$ -	$ -	$ -	$ -	$ 159,105	$ 36,227
NET POSITION						
Net Investment in Capital Assets	$ 56,800,805	$ 56,429,163	$ 60,586,851	$ 58,597,582	$ 64,569,715	$ 67,960,072
Restricted for Debt Service	699,967	825,047	901,440	902,307	1,548,179	1,567,095
Restricted for Capital Purposes	826,970	1,053,198	1,671,117	3,510,847	2,208,041	5,776,990
Unrestricted	61,642	3,077,777	2,060,685	5,670,143	3,488,932	3,310,574
TOTAL NET POSITION	58,389,384	61,385,185	65,220,093	68,680,879	71,814,867	78,614,731
Current Ratio	1.8	3.1	1.6	2.1	6.6	4.5
Debt to Net Position Ratio	0.5	0.5	0.4	0.4	0.7	0.7
Debt to Noncurrent Capital Assets Ratio	0.3	0.4	0.3	0.3	0.5	0.5

11.2 FINDINGS AND TRENDS

The City's combined water and sewer charges for services increased from $8.8 million (M) in 2011 to $11.4M in 2016. The average annual increase is 4.9 percent per year, with a total increase of 29.2 percent from 2011 to 2016. Expenses range from $7.2M in 2011 to $10.1M in 2016, showing increases every year. With an average increase of 6.7 percent, expenses have grown faster than revenues over the past six years and have increased 40.2 percent overall. While maintenance and operations expenses have increased 37.1 percent, the largest contributor to increases in expenses is depreciation and amortization, growing by 53.6 percent since 2011.

The O&M Coverage Ratio (total operating revenues divided by total operating expenses) was 123.0 percent in 2011. After a high of 132.4 percent in 2012, this ratio has trended downward ending at 113.4 percent in 2016. A ratio of 100 percent or greater shows that revenue will successfully cover expenses, and the City has remained above this ratio for the past six years.

Net Operating Income as a percent of Operating Revenue was 18.7 percent in 2011. This metric has varied over the past 6 years with a high of 24.5 percent in 2012 and ending 2016 at its low point of 11.8 percent. Similar to the O&M Coverage Ratio, these trends help to show how successfully operating revenue actually covered operating expenses, with higher positive numbers being the best and negative numbers showing need for improvement.

The Debt Service Coverage Ratio measures the amount of cash flow available to meet interest and principal payments. Typically, bond debt service coverage requires a minimum factor of 1.25 during the life of the loans. This ratio is calculated by dividing cash operating income (revenues less expenses before depreciation) by annual revenue bond expenses. The Debt Service Coverage Ratio for all outstanding debt ends 2011 at its high of 2.91 and trends downward to end 2016 at a low of 1.51. The ability of this ratio to remain at levels significantly higher than the bond covenant minimum of 1.25 indicates a stable capacity for new debt and will likely result in favorable terms when entering the bond market.

The Current Ratio is calculated by dividing the unrestricted current assets by current liabilities and measures a city's ability to pay short-term obligations. This ratio begins in 2011 at 1.8, drops to a low of 1.6 in 2013, and then rebounds to 4.5 by 2016. Anything above a 2.0 for this liquidity ratio is good.

The Debt to Net Position Ratio compares total debt to total net position, which is the difference between current assets and liabilities. This ratio ends 2011 at 0.48, dips to a low of 0.43 in 2014 before bouncing back to 0.68 by 2016. For city utilities, a ratio of 50 to 60 percent is within an industry target range. The variance of the Debt to Net Position Ratio over the past 6 years puts the City's ratio close but slightly above this target range.

The Debt to Noncurrent Capital Asset Ratio compares total debt to noncurrent assets, which are also known as property, plant, and equipment. This ratio begins at 0.3, or

30 percent debt to 70 -percent noncurrent assets, in 2011. Noncurrent capital assets increase $19.2M throughout the 6-year history, while total liabilities increase by $25.3M; therefore, the ratio increases to 0.5 by 2016. A ratio of 60-percent debt to 40-percent equity is a general industry target. The City's Debt to Noncurrent Capital Asset Ratio is on the low end of the industry target, signifying capacity for new debt in the future.

11.3 CURRENT FINANCIAL STRUCTURE

This section summarizes the current financial structure used as the baseline for the capital financing strategy and financial forecast developed for this Plan.

11.3.1 Financial Plan

The water utility is responsible for generating sufficient revenue to meet all of its costs. The primary source of funding is derived from ongoing monthly charges for service, with additional revenue coming from hook-up fees, penalties, timber sales and other miscellaneous revenue. Late fees or penalties are assessed on customers that are delinquent on water bill payments. The City controls the level of user charges and, subject to the City Council, can adjust user charges as needed to meet financial objectives.

The financial plan can only confirm financial feasibility if it considers the total system costs of providing water services, both operating and capital. To meet these objectives, the following elements have been completed.

Capital Funding Plan. Identifies the total capital improvement program (CIP) obligations of the planning period. The plan defines a strategy for funding the CIP, including an analysis of available resources from rate revenues, existing reserves, 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 plan through the use of debt financing (resulting in annual debt service) and the assumed rate revenue available for capital funding.

Financial Forecast. Identifies future annual non-capital costs associated with the operation, maintenance, and administration of the water system. Included in the financial plan is a reserve analysis that forecasts cash flow and fund balance activity, along with testing for satisfaction of actual or recommended minimum fund balance policies. The financial plan ultimately evaluates the sufficiency of utility revenues in meeting all obligations, including cash uses such as operating expenses, debt service, capital outlays, and reserve contributions, as well as any coverage requirements associated with long-term debt. The plan also identifies the future adjustments required to fully fund all utility obligations in the planning period.

11.3.1.1 Capital Funding Plan

To properly evaluate future annual capital funding needs, capital costs were escalated by 3.50 percent annually to the year of planned spending. The CIP developed for this Plan identifies $84.7M in project costs over the 10-year planning horizon. The 20-year period totals $195M in total project costs.

A summary of the 10-year and 20-year CIP is shown in Table 11.3. As shown, each year has varied capital cost obligations depending on construction schedules and infrastructure planning needs. Approximately 43 percent of the capital costs are included in the 10-year planning period. Table 11.4 provides more detail for the 10-year CIP.

Table 11.3 10- and 20-year CIP

Year	Escalated $
2017	$ 9,733,793
2018	8,316,577
2019	5,118,581
2020	10,080,796
2021	6,670,035
2022	10,360,960
2023	6,594,340
2024	10,038,601
2025	6,058,309
2026	11,682,756
10-Year Total	**$ 84,654,748**
2027 - 2036	110,091,081
20-Year Total	**$ 194,745,829**

Table 11.4 10 Year CIP (escalated $)

Project	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Supply										
Well 17	150,000	1,723,275								
Parkers Landing Well		471,960	732,718	3,791,815						
WWTP Well					418,961	650,436	3,366,008			
Washougal Wellfield Improvements									2,927,266	3,029,721
Steigerwald Regional Source	60,000	77,625	80,342	83,154	86,064	89,076	92,194	95,421	98,761	102,217
Watershed Forest Management	70,000	103,500		110,872		118,769		127,228		136,290
544 Zone Watershed Source Improvements	2,572,083									
Distribution System Improvements										
Transmission main from NW 11 Cir to NW Brady Rd					308,684					
343 Zone Supply Transmission Upsizing			670,855	2,083,004						
NE Birch St upsized transmission main					74,589					
New transmission main along NW 16th Ave				143,856	446,673					
New Distribution along NW 6th Ave/ NE Adams St										
Dead-end Looping Program		56,925	58,917	60,979	63,114	65,323	67,609	69,975	72,424	74,959
PRV Adjustment Study			192,821							
Well 6/14 Transmission Line	515,050									
Parallel Boulder Creek Intake								2,353,717		
Pump Station										
New Forest Home PS										1,062,038
New 455 Zone PS Capacity							386,601	1,200,395		
Lower Prune Hill PS Expansion		957,375	495,977							
North Shore PS Capacity Phase I									389,775	1,210,253
North Shore PS Capacity Phase II										
NW Couch St PS							282,729	877,873		
NW 10th Ave Study				31,044						
Storage										
New 544 Zone Reservoir	2,946,660	4,439,467								
New Gregg Tank										
343 Zone Reservoir				788,077	1,223,489	6,331,556				
Lower Prune Hill Reservoir Rehabilitation										
Upper Prune Hill Pressure Improvements Study					159,506					
General										
Water System Plan Update										374,797
Repair and Replacement										
Supply R&R Projects	120,000				169,833		114,935	118,958	123,122	127,431
Pump R&R Projects					626,548		179,164	185,435	191,925	198,642
Pipeline R&R Projects		201,825	208,889	216,200	223,767	463,198	2,105,100	2,178,778	2,255,035	2,333,962
Meter Replacement Program	200,000	284,625	294,587	304,897	315,569					
North Shore Expansion										
Annual North Shore Distribution Program			2,383,476	2,466,897	2,553,239	2,642,602		2,830,821		3,032,447
Leadbetter Road Transmission Main	3,100,000									
Total	**$ 9,733,793**	**$ 8,316,577**	**$ 5,118,581**	**$ 10,080,796**	**$ 6,670,035**	**$ 10,360,960**	**$ 6,594,340**	**$ 10,038,601**	**$ 6,058,309**	**$ 11,682,756**

11.4 CAPITAL FINANCIAL STRATEGY

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 the needs for which the City's available cash resources are insufficient. Revenue bonds have been used as the debt funding instrument in this analysis. The capital financing strategy developed to fund the CIP identified in this Plan assumes the following funding resources:

- Accumulated cash reserves.
- Transfers of excess cash (over minimum balance targets) from the Operating Fund.
- Connection fee revenues.
- Developer contributions.
- Interest earned on Construction Fund balances and other miscellaneous capital resources.
- Revenue bond financing.

Based on information provided by the City, the water utility began 2017 with $309,000 in the Operating Fund and $7.46M in the Capital Fund. Additional funds beyond the Operating Fund target of 90 days of O&M expenses are transferred to the Capital Fund.

The cash resources described above are anticipated to fund 84 percent of the 10-year CIP and 67 percent of the 20-year CIP. The remaining funding is assumed to be from new debt obligations. Table 11.5 presents the corresponding 20-year capital financing strategy.

Table 11.5 20-year Capital Funding Strategy

Year	Capital Expenditures Escalated	Revenue Bond Financing	Cash Funding	Total Financial Resources
2017	**$ 9,733,793**	$ -	$ 9,733,793	**$ 9,733,793**
2018	**8,316,577**	-	8,316,577	**8,316,577**
2019	**5,118,581**	-	5,118,581	**5,118,581**
2020	**10,080,796**	5,100,000	4,980,796	**10,080,796**
2021	**6,670,035**	-	6,670,035	**6,670,035**
2022	**10,360,960**	-	10,360,960	**10,360,960**
2023	**6,594,340**	3,700,000	2,894,340	**6,594,340**
2024	**10,038,601**	-	10,038,601	**10,038,601**
2025	**6,058,309**	5,200,000	858,309	**6,058,309**
2026	**11,682,756**	-	11,682,756	**11,682,756**
Subtotal	**$ 84,654,748**	**$ 14,000,000**	**$ 70,654,748**	**$ 84,654,748**
2027 - 2036	**110,091,081**	50,800,000	59,291,081	**110,091,081**
Total	**$ 194,745,829**	**$ 64,800,000**	**$ 129,945,829**	**$ 194,745,829**

11.5 AVAILABLE FUNDING ASSISTANCE AND FINANCING RESOURCES

Feasible long-term capital funding strategies must be defined to ensure that adequate resources are available to fund the CIP identified in this Plan. In addition to the City's 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 the City's internal and external resources.

11.6 CITY RESOURCES

Resources appropriate for funding capital needs include accumulated cash in the capital fund, rate revenues designated for capital spending purposes, developer contributions and capital-related charges such as connection fee revenue. The first two resources will be discussed in the Fiscal Policies section of the Financial Forecast. Capital-related charges are discussed below.

11.6.1 Capital Connection Charges

A connection charge such as the connection fee refers to a one-time charge imposed on new customers as a condition of connecting to the water system. The purpose of the connection charge is two-fold: 1) to promote equity between new and existing customers; and 2) to provide a source of revenue to fund capital projects. Revenue can only be used to fund utility capital projects or to pay debt service incurred to finance those projects. In 2017, the City charged all new customers a connection fee dependent upon the location of the property. A charge of $4,778 per meter capacity equivalent (MCE) was charged to for the South Area while a charge of $7,310 per MCE was charged for the North Shore Area.

11.6.2 Local Facilities Charges

While a connection charge is the manner in which new customers pay their share of plant investment costs, local facilities funding 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 upfront by either connecting customers and developers, or through an assessment to properties, but never from rates.

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 facilities assessment fee); (b) a developer funds an 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. 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 when no developer-installed facilities are needed through developer extension due to the prior existence of available mains already serving the developing property.

The developer extension is a requirement that a developer install on-site and sometimes off-site 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 planning to extend service might include a latecomer agreement, resulting in a latecomer charge to new connections for the developer extension.

Latecomer charges are 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. The City passes this charge on to the developer who installed the facilities. As part of the developer extension process, this defines the allocation of costs and records latecomer obligations on the title of affected properties. No interest is allowed, and the reimbursement agreement cannot exceed 20 years in duration.

ULID/LID is another mechanism for funding infrastructure that assesses benefited properties based on the special benefit received by the construction of specific facilities. 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.

11.7 OUTSIDE RESOURCES

This section outlines various grant, loan, and bond opportunities available to the City through federal and state agencies to fund the CIP identified in the Plan.

11.7.1 Grants and Low Cost Loans

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 generally 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 the Department of Commerce, including two assistance programs for which the City may be eligible.

Public Works Trust Fund (PWTF) – Cities, counties, special purpose districts, public utility districts, and quasi-municipal governments are eligible to receive loans from the PWTF.

Eligible projects include repair, replacement, and construction of infrastructure for domestic water, sanitary wastewater, stormwater, solid waste, road, and bridge projects that improve public health and safety, respond to environmental issues, promote economic development, or upgrade system performance.

PWTF loans are typically available at interest rates ranging from 1.28 percent to 2.55 percent depending on the repayment term, with reduced interest rates available for all projects located in communities that have been declared a natural disaster. The standard loan offer is 1.66 percent interest repaid over a 20-year term. All loan terms are subject to negotiation and Board approval.

Currently there is no funding available for construction loans. Funding may become available during the 2019-2021 biennium if the capital budget is approved. Funding cycles typically begin during the summer months.

Information regarding the application process, as well as rates and terms, are posted on the PWTF website in early spring. Further detail is available at http://www.pwb.wa.gov.

Drinking Water State Revolving Fund (DWSRF) Loan Program – DWSRF funding historically targets protection of public health, compliance with drinking water regulations and assistance for small and disadvantaged communities. Terms are up to 20 years to pay back, and in some cases, provide partial loan forgiveness. Interest rates are 1.0 to 1.5 percent and no local match is required.

Applicants need an approved water system plan, or plan amendment, containing the DWSRF project prior to submitting an application. All public water systems that receive a DWSRF loan must undergo an environmental review, a cultural review, and an Investment Grade Efficiency Audit (IGEA). The IGEA is an effort to apply energy efficiency to water systems and may be financed as part of the DWSRF loan.

The fall 2018 application cycle will begin October 1st, 2018 and conclude November 30th, 2018. DWSRF takes applications annually in the fall. Further detail is available at http://www.doh.wa.gov/DWSRF.

11.7.2 Bond Financing

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 the Washington constitution and statute. Specifically, the amount of debt that can be issued is linked to assessed valuation.

Revised Code of Washington (RCW) 39.36.020 states:

(2)(a)(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 the 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 perhaps the practical limit of the utility's ability to generate sufficient revenue to repay the debt and provide coverage. In some cases, poor credit might make issuing bonds problematic.

11.8 FINANCIAL FORECAST

The financial forecast, or revenue requirement analysis, forecasts the amount of annual revenue that needs to be generated by user rates. The analysis incorporates operating revenues, O&M expenses, debt service payments, rate-funded capital needs, and any other identified revenues or expenses related to operations. The objective of the financial forecast is to evaluate the sufficiency of the current level of rates. In addition to annual operating costs, the revenue needs also include debt covenant requirements and specific fiscal policies and financial goals of the City.

The analysis determines the amount of revenue needed in a given year to meet that year's expected financial obligations. 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 City 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 City 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 the 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, and 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 any purpose, including funding capital projects. Targeting a higher coverage factor can help the City achieve a better credit rating and provide lower interest rates for future debt issues.

In determining the annual revenue requirement, both the cash and coverage sufficiency test must be met, and the test with the greatest deficiency drives the level of needed rate increase in any given year.

11.9 CURRENT FINANCIAL STRUCTURE

The City maintains a fund structure and implements financial policies that target management of a financially viable and fiscally responsible water system.

11.9.1 Fiscal Policies

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.

Operating Fund – Operating reserves are designed to provide a liquidity cushion to ensure that adequate cash working capital will be maintained to deal with significant cash balance fluctuations, such as seasonal fluctuations in billings and receipts, unanticipated cash expenses, or lower than expected revenue collections. 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 O&M expenses, with the minimum requirement varying with the expected revenue volatility. Industry practice for utility operating reserves ranges from 30 days

(8 percent) to 120 days (33 percent) of O&M expenses, with the lower end more appropriate for utilities with stable revenue streams and the higher end more appropriate for utilities with significant seasonal or consumption-based fluctuations. The City's current goal is to maintain a minimum balance in the Operating Fund equal to 90 days of O&M expenses for working capital.

Capital Fund – A capital contingency reserve is an amount of cash set aside in case of an emergency should a piece of equipment or a portion of the utility's infrastructure fail unexpectedly. The reserve also could be used for other unanticipated capital needs, including capital project cost overruns. Industry practices range from maintaining a balance equal to 1 to 2 percent of fixed assets, an amount equal to a 5-year rolling average of CIP costs, or an amount determined sufficient to fund equipment failure (other than catastrophic failure). The final target level should balance industry standards with the risk level of the City. The City currently aims to maintain a capital fund balance target of $250,000. The capital fund target balance is meant to represent the need for an emergency repair of the system infrastructure.

System Reinvestment – System reinvestment funding promotes system integrity through ongoing repair and replacement of system infrastructure. Ideally, a detailed asset management plan would guide the level of rate funded system reinvestment, however, in absence of this level of effort, a good benchmark is annual depreciation expense used 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 full depreciation expense could significantly impact rates. An 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 currently have a policy in place for system reinvestment funding. No dedicated funding is assumed in the financial model, however, on average, the City is able to fund approximately $870,000 annually through rates. System reinvestment is recommended for consideration during future policy review and rate planning.

Debt Management – It is prudent to consider policies related to debt management as part of a 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 City has one outstanding water revenue bond, which will be fully repaid in 2017. Coverage on this bond is tested at 1.25.

11.9.2 Financial Forecast

The financial forecast is established from 2018 budget documents along with other key factors and assumptions to develop a complete portrayal of the City's annual financial obligations for the water utility. The following is a list of the key revenue and expense factors and assumptions used to develop the financial forecast.

Growth – Rate revenue escalation varies from 2.05 to 2.90 percent for all years of the forecast period with the exception of 2021 where the growth rate jumps to 13.1 percent for one year. The City is expecting the addition of a large industrial customer during this timeframe. Growth rates are provided in Chapter X of this Plan.

Revenue – The City has two general revenue sources: 1) water service charges (rate revenue); and 2) miscellaneous (non-rate) revenue. In the event of a forecasted annual shortfall, rate revenue can be increased to meet the annual revenue requirement. For the purpose of this financial forecast, rate revenues are forecast to increase with customer growth. Non-rate revenues are forecast to increase with customer growth or general cost inflation depending on the nature of the revenue.

System Development Charge Revenue – The current standard development charge (SDC) is forecast to generate revenue between $1.4M in 2017 and $3.3M in 2035 collected from an average of 470 new connections per year. 2021 is forecast to be a large growth year for the City with 1,840 new connections forecast, resulting in $9.8M in SDC revenue. This jump in growth is related to the connection of a large industrial customer. The resources received are used to fund growth related capital projects.

Expenses – O&M expense projections are based on the 2018 budget and forecasted to increase with general cost inflation of 1.77 percent, labor cost inflation of 3.00 percent and benefit cost inflation of 3.00 percent. Budget 2018 figures were used for 2018 taxes; future taxes are calculated based on forecasted revenues and prevailing tax rates.

Existing Debt – The City currently has ten outstanding debt issues, including one revenue bond, two PWTF loans, five DWSRF loans, one Department of Ecology loan and one contractual water rights loan. The final 2007 revenue bond payment was for $223k in 2017; PWTF payments range from $4,437 to $108,000; DWSRF loan payments range from $256,000 to $726,000 and the contractual water rights loan is $53,898 annually over the 20-year study period. The total annual existing debt service obligations begin 2017 at $970,000 and are reduced to $360,000 by 2037.

Future Debt – The capital financial strategy developed for this Plan forecasts the need for $64.8M in new debt proceeds in eight separate instances throughout the twenty year forecast. The analysis performed assumes all revenue bond financing. Annual new debt service obligations begin in 2020 at $450,000, increasing to $5.6M by 2035.

Transfer to Capital –Operating Fund balance above the minimum requirement is assumed to be available to fund capital projects and projected to be transferred to the Capital Fund each year. On average, the utility funds approximately $870,000 of capital improvements with cash.

Although the financial plan is completed for the 20-year time horizon of this Plan, the rate strategy focuses on the shorter term planning period of 2017 through 2026. It is recommended that the City revisit the proposed rates every 2 to 3 years 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 11.6 summarizes the annual revenue requirements based on the forecast of revenues, expenditures, fund balances, and fiscal policies.

Table 11.6 10-year Financial Forecast

Revenue Requirement	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Revenues										
Rate Revenues Under Existing Rates	$ 4,250,897	$ 4,409,345	$ 4,524,720	$ 4,640,950	$ 5,249,906	$ 5,377,758	$ 5,509,467	$ 5,641,678	$ 5,785,010	$ 5,924,993
Non-Rate Revenues	402,580	630,984	394,180	419,349	469,076	738,027	508,763	769,778	546,468	808,101
Total Revenues	**$ 4,653,477**	**$ 5,040,329**	**$ 4,918,900**	**$ 5,060,299**	**$ 5,718,982**	**$ 6,115,785**	**$ 6,018,230**	**$ 6,411,456**	**$ 6,331,478**	**$ 6,733,094**
Expenses										
Cash Operating Expenses	$ 3,274,547	$ 3,679,892	$ 3,939,036	$ 4,098,424	$ 4,318,041	$ 4,313,115	$ 4,411,122	$ 4,510,502	$ 4,615,123	$ 4,716,680
Existing Debt Service	969,585	590,320	887,798	883,277	878,758	874,237	869,718	865,198	860,678	803,260
New Debt Service	-	-	-	449,831	449,831	449,831	776,179	776,179	1,234,831	1,234,831
Rate Funded System Reinvestment	-	-	-	-	-	-	-	-	-	-
Total Expenses	**$ 4,244,132**	**$ 4,270,212**	**$ 4,826,833**	**$ 5,431,532**	**$ 5,646,629**	**$ 5,637,184**	**$ 6,057,019**	**$ 6,151,879**	**$ 6,710,632**	**$ 6,754,771**
Total Surplus (Deficiency)	**$ 409,345**	**$ 770,117**	**$ 92,066**	**$ (371,234)**	**$ 72,353**	**$ 478,601**	**$ (38,789)**	**$ 259,577**	**$ (379,154)**	**$ (21,677)**
Annual Rate Adjustment	**0.00%**	**5.00%**	**2.50%**	**2.50%**	**2.50%**	**2.50%**	**2.50%**	**2.50%**	**2.50%**	**2.50%**
Cumulative Annual Rate Adjustment	**0.00%**	**5.00%**	**7.62%**	**10.32%**	**13.07%**	**15.90%**	**18.80%**	**21.77%**	**24.81%**	**27.93%**
Rate Revenues After Rate Increase	$ 4,250,897	$ 4,629,812	$ 4,869,730	$ 5,119,693	$ 5,936,253	$ 6,232,840	$ 6,545,129	$ 6,869,748	$ 7,220,387	$ 7,579,980
Additional Taxes from Rate Increase	-	11,087	17,351	24,076	34,516	43,002	52,083	61,760	72,185	83,229
Net Cash Flow After Rate Increase	**$ 409,345**	**$ 979,497**	**$ 419,726**	**$ 83,433**	**$ 724,184**	**$ 1,290,682**	**$ 944,790**	**$ 1,425,887**	**$ 984,038**	**$ 1,550,081**
Coverage After Rate Increases	12.9	n/a	n/a	9.8	26.3	13.2	7.5	8.2	5.2	5.6

The financial forecast indicates that the utility becomes deficient in 2020 as new debt is added to fund the capital program. This financial analysis recognizes the 2018 adopted rate increase of 5.0 percent. In addition to the 2018 rate increase, annual inflationary level rate increases of 2.50 percent are implemented to cover the forecast deficiency.

11.10 CITY FUNDS AND RESERVES

Table 11.7 shows a summary of the projected Operating Fund and Capital Fund ending balances through 2026 based on the rate forecasts presented above. The operating fund is maintained at a minimum of 90 days of O&M expenses from 2018 forward, and the capital fund balance fluctuates annually depending on the addition of debt proceeds and the capital projects scheduled.

Table 11.7 Ending Cash Balance Summary

Ending Fund Balances	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Operating Fund	$ 718,750	$ 907,371	$ 971,269	$ 1,010,570	$ 1,064,722	$ 1,063,508	$ 1,087,674	$ 1,112,179	$ 1,137,976	$ 1,163,017
Capital Fund	1,559,669	394,138	382,316	272,677	5,975,900	2,211,942	3,492,386	280,998	4,025,353	345,581
Total	**$ 2,278,419**	**$ 1,301,509**	**$ 1,353,585**	**$ 1,283,247**	**$ 7,040,622**	**$ 3,275,449**	**$ 4,580,060**	**$ 1,393,176**	**$ 5,163,328**	**$ 1,508,598**

11.11 CURRENT AND PROJECTED RATES

11.11.1 Current Rates

The City's current rate structure consists of a fixed monthly charge based on meter size and a variable monthly charge per hundred cubic feet (ccf) for all use. The fixed monthly charge is the same for all classes while the variable charge differs depending on rate class. Table 11.8 shows the existing rate schedule.

Table 11.8 Existing Schedule of Rates

2017 Monthly Rates		
Base Rate		**per account**
5/8"	$	9.24
3/4"		10.01
1"		12.35
1.25"		13.90
1.5"		15.48
2"		24.05
3"		87.11
4"		110.50
6"		165.02
8"		227.34
10"		297.44
Volume Charge		**per ccf**
Residential	$	1.77
Commercial		2.16
Industrial		1.79
Cemetery		0.80
Irrigation		2.01

11.12 PROJECTED RATES

The financial forecast discussed above indicates that while the water utility is covering all financial obligations in the near term, with the addition of new debt in 2020, rate increases are needed to satisfy all future financial responsibilities. In addition to the adopted 5.0 percent rate increase in 2018, a rate strategy of 2.50 percent annually for the remainder of the study period is recommended to satisfy this forecast deficiency. Table 11.9 shows the projected rates with increases applied uniformly to all rate components in all classes.

Table 11.9 Proposed Schedule of Rates

Monthly Rates	Existing	Adopted	Proposed							
	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Base Rate	per account	per account	per account	per account	per account	per account	per account	per account	per account	per account
5/8"	$ 9.24	$ 9.70	$ 9.94	$ 10.19	$ 10.45	$ 10.71	$ 10.98	$ 11.25	$ 11.53	$ 11.82
3/4"	10.01	10.51	10.77	11.04	11.32	11.60	11.89	12.19	12.49	12.81
1"	12.35	12.97	13.29	13.62	13.96	14.31	14.67	15.04	15.41	15.80
1.25"	13.90	14.60	14.96	15.33	15.72	16.11	16.51	16.93	17.35	17.78
1.5"	15.48	16.25	16.66	17.08	17.50	17.94	18.39	18.85	19.32	19.80
2"	24.05	25.25	25.88	26.53	27.19	27.87	28.57	29.29	30.02	30.77
3"	87.11	91.47	93.75	96.10	98.50	100.96	103.48	106.07	108.72	111.44
4"	110.50	116.03	118.93	121.90	124.95	128.07	131.27	134.55	137.92	141.37
6"	165.02	173.27	177.60	182.04	186.59	191.26	196.04	200.94	205.96	211.11
8"	227.34	238.71	244.67	250.79	257.06	263.49	270.08	276.83	283.75	290.84
10"	297.44	312.31	320.12	328.12	336.33	344.73	353.35	362.19	371.24	380.52
Volume Charge	per ccf	per ccf	per ccf	per ccf	per ccf	per ccf	per ccf	per ccf	per ccf	per ccf
Residential	1.77	1.86	1.90	1.95	2.00	2.05	2.10	2.16	2.21	2.26
Commercial	2.16	2.27	2.32	2.38	2.44	2.50	2.57	2.63	2.70	2.76
Industrial	1.79	1.88	1.93	1.97	2.02	2.07	2.13	2.18	2.23	2.29
Cemetery	0.80	0.84	0.86	0.88	0.90	0.93	0.95	0.97	1.00	1.02
Irrigation	2.01	2.11	2.16	2.22	2.27	2.33	2.39	2.45	2.51	2.57

11.12.1 Conservation Based Rates

In 2003 the Washington State Legislature passed the Municipal Water Supply Efficiency Requirements Act. The Water Use Efficiency rules went into effect on January 22, 2007 and typically apply to Water System Plans that each jurisdiction is required to develop every six to ten years. The RCW outlines the rules of this act, under RCW 70.119.180. In section 4(B), the RCW states that jurisdictions must perform an "evaluation of the feasibility of adopting and implementing water delivery rate structures that encourage water conservation." A city does not need to actually adopt such a rate structure, but is required to consider it, which is what the following analysis represents.

Block rate structures (also known as inclining, inverted and tiered block rates) charge a higher rate for increasing consumption. Block rates are designed to send a more conservation oriented price signal to customers – the more you use the more you pay. Water system infrastructure must be built to handle peak demand. Those who peak more, cost the system more since system facilities must be oversized to accommodate system peak requirements. The higher volume charge is intended to helps recover the higher cost of providing peaking capacity. Increasing block rates are not a one size fits all solution. The ideal customer class is one that has relatively homogenous usage patterns and peaking characteristics. As such, a block rate structure is most effective for the residential class. A block rate structure for other classes that may have highly varied usage patterns and demand characteristics is not as effective and runs the risk of presenting inequities since larger customers may pay more simply for being a large user and not necessarily for being an inefficient water user. The focus of the conservation based rate structure evaluation for the City of Camas is for the residential class as it represents 93 percent of the total City accounts.

It is important to remember that any rate structure that may decrease water consumption may also decrease water sales revenue, creating a level of revenue volatility that may require higher reserve levels or establishment of a rate stabilization reserve to shelter against unexpected revenue shortfalls. A block rate structure can also be more costly to administer (initial billing system set-up) and more difficult to communicate to customers that are accustomed to a uniform consumption rate. The following explanation discusses the development of an increasing block rate structure for the residential class.

11.13 METHODOLOGY

There are many ways to design a block rate structure. The most basic structure needs the following items:

How many blocks?

A three-block structure is very common. This structure allows for a meaningful price signal without being too aggressive in the upper block rates.

What are the thresholds for each block?

Block 1: Set at the average monthly winter consumption. This allows a unit rate that reflects average indoor water usage.

Block 2: Set at twice the summer monthly average.

Block 3: Set to encourage usage reduction at the higher end of the demand curve.

In order to design a block rate structure, a bill frequency analysis was performed to show the distribution of residential customer bills throughout the year. This analysis helps to ensure that the appropriate amount of revenue is recovered based on the block sizes and rates set for each block size.

11.14 RESULTS

The current residential rate for the City is composed of a fixed meter charge differentiated by meter size and a uniform rate for all usage. Table 11.10 demonstrates that in order to satisfy the 2019 revenue requirement as proposed in the existing financial model, an increasing block rate structure would result in a Block 1 rate of $1.55 per ccf for usage up to 14 ccf, a Block 2 rate of $2.05 per ccf for usage between 14.01 and 26 ccf and a Block 3 rate of $2.58 per ccf for all usage over 26 ccf bi-monthly.

Table 11.10 Residential Conservation Rates

Block Rate Calculation	Block 1	Block 2	Block 3	Total
Block Ranges				
Bi-Monthly Block Thresholds (ccf)	14	26	26+	
Bi-Monthly Block Ranges (ccf)	(0-14)	(14.01-26)	(>26)	
Total Residential Usage (ccf)				988,896
Distribution of Bills (%)	51.90%	27.23%	20.87%	
Distribution of Usage (%)	55.43%	19.52%	25.04%	
Distribution of Usage (ccf)	548,186	193,079	247,631	
Calculating Block Rates				
Total 2019 Variable Revenue Target ($)				**$ 1,883,811**
$ Rate per 100 Cubic Foot	**$ 1.55**	**$ 2.05**	**$ 2.58**	

Under the proposed rate structure a residential customer with a use of 14 ccf bi-monthly would have a bill reduction of $3.81, water use of 26 ccf bi-monthly would see a $1.53 reduction and a user with 50 ccf bi-monthly would see an increase of $15.69. The initial block rate structure is intended to get the conservation rate concept in place. As the rate structure matures the block thresholds can be adjusted to increase the conservation price signal. The rate design discussed above was evaluated as part of the water system planning effort that is currently underway and provides a conservation based rate structure alternative for the City. As previously discussed, the City is not required to adopt such a rate structure, but is required to consider a conservation rate structure as part of this Plan. The City Council discussed implementing a conservation rate structure and decided to maintain the existing rate structure at this time.

11.15 AFFORDABILITY

The Washington State Department of Health and the Department of Commerce Public Works Board use an affordability index to prioritize low-cost loan awards depending on whether rates exceed 2.0 percent of the median household income for the service area. The average median household income for the City was $94,350 between 2012 and 2016 according to the U.S. Census Bureau. The 2016 value is escalated based on the assumed 1.77 percent general cost inflation to show the median household income in future years. Table 11.11 presents the City's rates projected to 2026, tested against the 2.0 percent monthly affordability threshold.

Table 11.11 Affordability Test

Year	Inflation	Median HH Income	2% Monthly Threshold	Projected Monthly Bill	% of Median HH Income
2016		$ 94,350	$ 157.25	$ 25.70	0.33%
2017	1.77%	96,020	160.03	26.94	0.34%
2018	1.77%	97,720	162.87	28.29	0.35%
2019	1.77%	99,449	165.75	28.99	0.35%
2020	1.77%	101,209	168.68	29.72	0.35%
2021	1.77%	103,001	171.67	30.46	0.35%
2022	1.77%	104,824	174.71	31.22	0.36%
2023	1.77%	106,679	177.80	32.00	0.36%
2024	1.77%	108,568	180.95	32.80	0.36%
2025	1.77%	110,489	184.15	33.62	0.37%
2026	1.77%	112,445	187.41	34.46	0.37%

Applying the 2.0 percent test, the City's rates are forecasted to remain within the indicated affordability range through 2026.

11.16 CONCLUSION

The results of this analysis indicate that rates must increase to provide revenue sufficient to cover all utility financial obligations, including the addition of new debt and partial cash funding of the capital program through 2026. A rate increase of 5.0 percent in 2018, followed by annual rate increases of 2.5 percent through 2026 should provide for continued financial viability while maintaining generally affordable rates.

It is important to remember that the analysis performed in this chapter assumes growth rates from Chapter 4 of this Plan. If the future growth rates change, the existing rate strategy may need to be updated and revised.

It is recommended that the City regularly review and update the key underlying assumptions that compose the multi-year financial plan to ensure that adequate revenues are collected to meet the City's total financial obligations.