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FINAL REPORT | JUNE 2024

Water Master Plan

PREPARED FOR

City of Albany

PREPARED BY

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Water Master Plan

Prepared for

City of Albany

Project No. 519-50-22-21

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LIST OF APPENDICES

LIST OF ACRONYMS AND ABBREVIATIONS

°F	Fahrenheit
µg/L	Micrograms Per Liter
2004 WFP	2004 Water Facilities Plan
AACE	Association of the Advancement of Cost Engineering
AC	Asbestos Cement
ACH	Aluminum Chlorohydrate
ADD	Average Day Demand
ADU	Accessory Dwelling Unit
ALA	American Lifeline Alliance
AM	Albany Millersburg
AM WTP	Albany Millersburg Water Treatment Plant
AMP	Adaptive Management Plan
ASCE	American Society Civil Engineers
AWOP	Oregon Area Wide Optimization Program
AWWA	American Water Works Association
BLM	Bureau of Land Management
Canal	Santiam-Albany Canal
CCL	Contaminant Candidate List
CCT	Corrosion Control Treatment
CEB	Chemical Enhanced Backwash
CFE	Combined Filter Effluent

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cfs	Cubic Feet Per Second
CI	Cast Iron
CIP	Capital Improvement Program
City	City of Albany, Oregon
COF	Consequence of Failure
CSZ	Cascadia Subduction Zone
CWS	Community Water System
DBP	Disinfection By-Product
DBPR	Disinfection By-products Rule
DEQ	Department of Environmental Quality
DI	Ductile Iron
DOGAMI	Department of Geology and Mineral Industries
DWS	Drinking Water Services
EC	E. Coli
ENR CCI	Engineering News Record Construction Cost Index
EOC	Emergency Operations Center
EPA	Environmental Protection Agency
EPAct	Energy Policy Act
EPS	Extended Period Simulation
EWSP	Emergency Water Supply Plan
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
fps	Feet Per Second
ft	Feet
GHPS	Gibson Hill Pump Station
GI	Galvanized Iron
GIS	Geographic Information System
gpcd	Gallons Per Capita Per Day
gpd	Gallons Per Day
gpm/ft^2	Gallon Per Minute Per Square Foot
GWUDI	Groundwater Under the Direct Influence of Surface Water
HAA5	Haloacetic Acids
HALs	Health Advisory Level
HB	House Bill
HDPE	High Density Polyethylene
HGL	Hydraulic Grade Line
HPU	Hydraulic Power Unit
IDSE	Initial Distribution System Evaluation
IESWTR	Interim Enhanced Surface Water Treatment Rules
IOCs	Inorganic Contaminants
IRIS	Integrated Risk Information System
ISO	Insurance Services Office

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kWh	Kilowatt Hours
LCR	Lead and Copper Rule
LCRI	Lead and Copper Rule Improvements
LCRR	Lead and Copper Rule Revision
LF	Linear Feet
LFCS	Lebanon Flow Control Structure
LOS	Level of Service
LRAA	Locational Running Annual Average
LSL	Lead Service Line
LSLR	Lead Service Line Replacement
M	Magnitude
MCL	Maximum Contaminant Level
MCLG	MCL Goal
MDD	Maximum Day Demand
MG	Million Gallons
mg/L	Million Gallons Per Liter
mgd	Million Gallons Per Day
MMD	Minimum Monthly Demand
MRDLs	Maximum Residual Disinfectant Levels
MRL	Method Reporting Limits
NACSD	North Albany County Service District
NAPS	North Albany Pump Station
ng/L	Nanograms Per Liter
NTNCWS	Non-Transient Non-Community Water System
NTU	Nephelometric Turbidity Unit
O&M	Operations And Maintenance
OAR	Oregon Administrative Rule
ODDW	Outside Diameter Dipped and Wrapped Steel
ODOT	Oregon Department of Transportation
OFC	Oregon Fire Code
OHA	Oregon Health Authority
ORP	Oregon Resilience Plan
ORS	Oregon Revised Statute
OWRD	Oregon Water Resources Department
PET	Potential evapotranspiration
PFAS	Per- and polyfluoroalkyl substances
PFBS	Perfluorobutanesulfonic Acid
PFHpA	Perfluoroheptanoic Acid
PFHxS	Perfluorohexanesulfonic Acid
PFNA	Perfluorononanoic Acid
PFOA	Perfluorooctanoic Acid
PFOS	Perfluorooctane Sulfonic Acid

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PGD	Permanent Ground Deformations
PGV	Peak Ground Velocity
POD	Point of Distribution
POF	Probability of Failure
PPC	Public Protection Classification
ppm	Parts Per Million
PRC	Population Research Center
PRV	Pressure Reducing Valve
PS	Pump Station
PSU	Portland State University
PVC	Polyvinyl Chloride
PWS	Public Water Systems
RAA	Running Annual Average
RR	Repair Rates
RS	River Station
RUL	Remaining Useful Life
RWPS	Raw Water Pump Station
SAL	State Action Level
SCADA	Supervisory Control and Data Acquisition
SDC	Systems Development Charges
SDWA	Safe Drinking Water Act
SOCs	Synthetic Organic Contaminants
STL	Steel
SWTR	Surface Water Treatment Rules
TC	Total Coliform
TCR	Total Coliform Rule
TM	Technical Memorandum
TOC	Total Organic Carbon
TTHM	Total Trihalomethanes
UBC	Uniform Building Code
UCMR	Unregulated Contaminant Monitoring Rule
UGB	Urban Growth Boundary
USGS	U.S. Geological Survey
VFD	Variable Frequency Drive
VOCs	Volatile Organic Contaminants
WERF	Water Environment Research Foundation
WFP	Water Facilities Plan
WI	Wrought Iron
WMP	Water Master Plan
WQP	Water Quality Parameters
WRD	Water Resource Department
WTP	Water Treatment Plant

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INTRODUCTION

The City of Albany, Oregon (City) provides municipal water service to the City of Albany, the City of Millersburg, and additional customers inside and outside the Urban Growth Boundary (UGB). An overview of the City's Water System is shown in Figure ES-1.

This Water Master Plan (WMP) is an updated evaluation of the City's existing water system including the water treatment plants, reservoirs, pump stations, distribution system, and other assets within the water system. Also, the WMP includes evaluations of the Santiam-Albany Canal (Canal), and the City's hydroelectric plant at Vine Street. The purpose is to identify deficiencies under existing or future demand conditions and provide recommended water system improvements.

The following sections summarize the different chapters within the WMP and the key takeaways.

EXISTING WATER SYSTEM (CHAPTER 2)

The cities of Albany and Millersburg receive drinking water from one of two water treatment plants (WTPs):

- The Vine Street WTP, constructed in 1912, receives raw water from the Santiam-Albany Canal, supplied by the South Santiam River via a diversion dam located near Lebanon. Vine Street WTP has an observed 16 MGD capacity.
- The Albany-Millersburg (AM) WTP, constructed in 2005, receives raw water directly downstream of the confluence of the North and South Santiam Rivers. The AM WTP currently has a 13.9 MGD capacity.

The City of Albany distribution system facilities include 272 miles of both distribution and transmission piping, 4 pressure zones, 6 pumping stations, 9 storage reservoirs, and other appurtenances such as system valves and flushing stations.

POPULATION AND WATER DEMANDS (CHAPTER 3)

Reliable water demand projections are foundational to developing an effective water master plan. The City's historical water demands were used to project future water demands from 2023 to build out of the UGB (approximately 2070), although the WMP primarily focuses on the next 20-year horizon to 2045. Projections were based on population growth, land use, water loss, water conservation, and climate change. Using data from 2008 to 2022, the historic average day demand (ADD) and the maximum day demand (MDD) are presented in Chapter 3. Chapter 3 also presents three projected future demand scenarios: Low Demand, Medium Demand, and High Demand based on different assumptions. The City chose to use the Medium Demand Scenario which includes projected values for the 2045 ADD and 2045 MDD.

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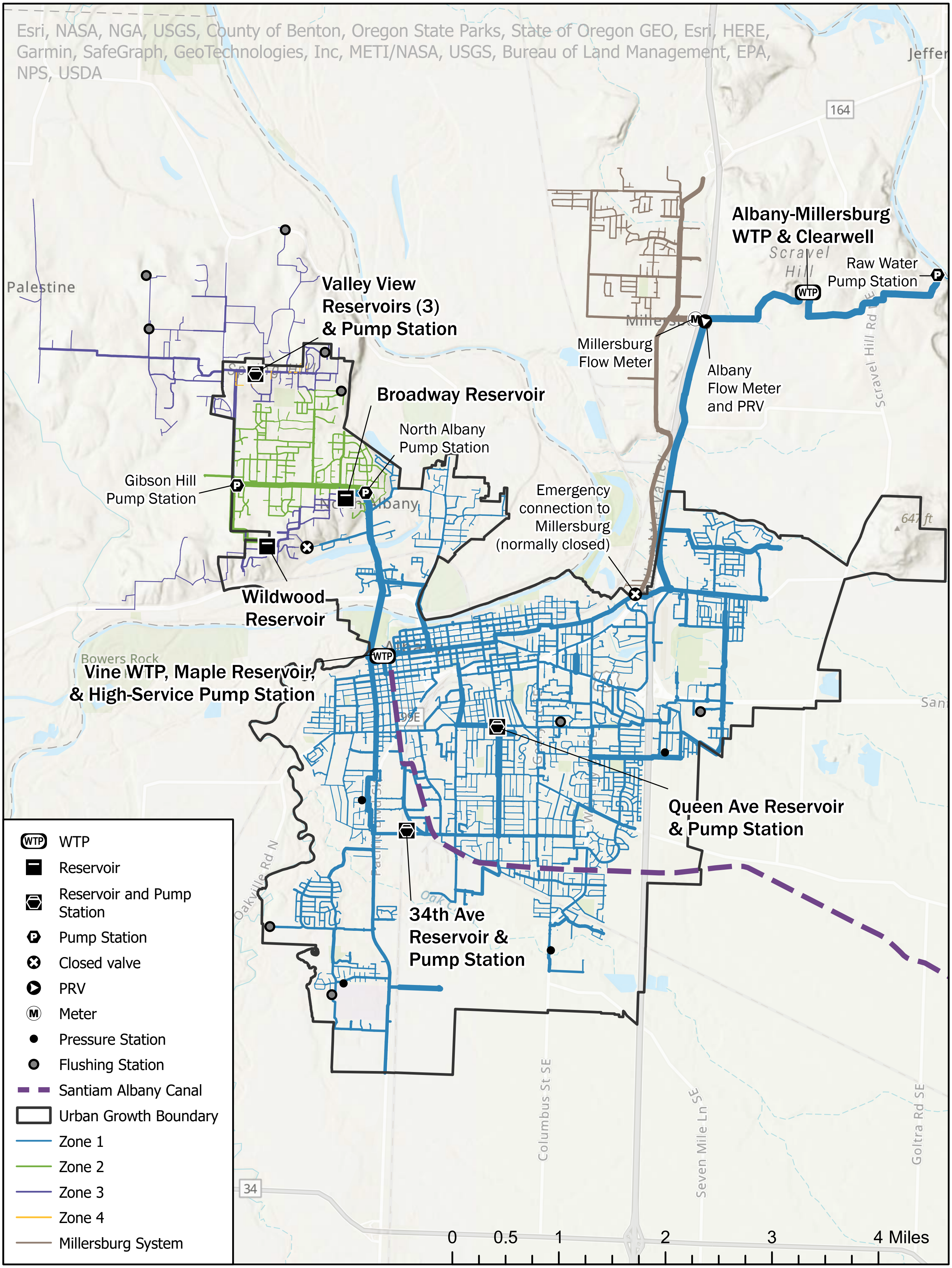

Figure ES-1. Water System Map

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PLANNING CRITERIA (CHAPTER 4)

Chapter 4 presents the water system design and performance criteria used for development of the WMP. Another term for performance criteria is the expected level of service (LOS) that regulators, customers, stakeholders, and the City expect under normal, emergency, and disaster conditions. The LOS goals are key to assessing the performance of the existing water system, measuring the expected future performance, and identifying potential capital improvements to assure the adequacy of the water system to meet the City's mission. LOS criteria were established for water supply, pipes, pump stations, and reservoir storage. In addition, the Oregon Resilience Plan (ORP) sets goals for a water system recovery after a major earthquake using a magnitude 9.0 Cascadia Subduction Zone earthquake planning scenario. A summary of the planning criteria identified is provided in Table ES-1.

Table ES-1. Summary of Planning Criteria

Criterion		Value
Pipe Criteria		
Minimum Diameter		8-inch (6-Inch may be allowable if fire flow demands are met and it is approved by the City Engineer)
Pressure	Minimum Operating	40 psi
	Maximum Operating	80 psi
	Minimum During a Fire	20 psi
Maximum Velocity	Distribution pipes (≥8 inch and <16 inch)	Existing: 10 fps New: 5 fps
	Transmission pipes (≥ 16 inch)	5 fps
Maximum Headloss	Distribution pipes (≥8 inch and <16 inch)	10 feet or 4 psi / 1000 feet
	Transmission pipes (≥ 16 inch)	3 feet or 1 psi / 1000 feet
Reliability	Transmission pipes	Redundant supply lines to hydraulically isolated areas wherever feasible
	Distribution pipes	Looping wherever feasible
Pump Station Criteria		
Pump Station Firm Capacity		Enough capacity to supply the peak demand with the largest pump out of service
Firm Capacity Required Serving Zone with Reservoir Storage		Firm capacity ≥ MDD
Firm Capacity Required Serving Zone without Reservoir Storage		Firm capacity is the greater of MDD + largest fire flow demand, or peak hour demand
Storage Capacity Criteria[a]		
Equalization Storage		Calculated using a system-wide seasonal diurnal demand pattern. Approximately 16 percent of the daily demand in the winter, 12 percent of the daily demand in the summer. Figure 4-2 shows how the equalization storage is calculated from the diurnal pattern. Volume seasonally adjusted for water quality purposes.
Fire Storage		Largest fire flow/duration in the zone supplied from the storage reservoir. See Table 4-4 for requirements by land use type. (OAR 333-061-0050)
Emergency Storage		Volume equal to 1 day of demand, seasonally adjusted for water quality purposes. One day of average summer demands for summer months, one day of average winter demands for winter months.

Fire Flow and Storage Criteria

Land Use Type	Fire Flow Demand, gpm	Duration, hours	Fire Storage Volume, gal
Residential – Low Density	1,500	2	180,000
Residential – Medium Density	2,500		300,000
Residential – High Density	3,500	3	630,000
Commercial			
Mixed Use			
Institutional			
Industrial			
Schools			

(a) Storage volume can be shared between zones if emergency power is available.

WATER SYSTEM REGULATORY REVIEW (CHAPTER 5)

The United States Environmental Protection Agency (EPA) develops and implements drinking water regulations under the Safe Drinking Water Act (SDWA) of 1974 and subsequent 1986 and 1996 amendments which regulate public drinking water systems. In some cases, states develop more stringent requirements. Oregon rules specific to drinking water are codified as Oregon Administrative Rules (OAR) 333-061. The following regulations were evaluated for the City:

- Surface Water Treatment Rules (SWTR)
- Chemical Contaminant Rule
- Stage 1 and 2 Disinfection By-Product (DBP) Rules
- Lead and Copper Rule (LCR) and Lead and Copper Rule Revision (LCRR)
- Total Coliform Rule (TCR)
- Filter Backwash Recycling Rule
- Proposed PFAS Rule
- Additional State-Specific Regulations

The City has taken proper steps to reduce water quality concerns and remain within the water quality constituent limits. There are no recommendations of changes to operation to improve water quality.

EXISTING SYSTEM EVALUATION (CHAPTER 6)

Chapter 6 evaluates the capacity of each facility in the City's water system including WTPs, pump stations, storage reservoirs, and the distribution system. Each category of facility is discussed further below:

- **Water Treatment Plants:** The Vine Street WTP has an existing capacity of 16 mgd and the Albany-Millersburg WTP has an existing capacity of 13.9 mgd with the ability to expand to 16.5 mgd. The current MDD of 12 mgd can be met by either WTP individually, but the 2045 MDD of 20 mgd requires both WTPs to be operating. If one WTP were compromised in an emergency, the other WTP could not meet the demand for 2045 MDD. To prepare for the future, it is recommended to increase the AM WTP to its maximum capacity by adding a fifth filter cell and increasing the number of membranes in each cell. At Vine Street WTP, due to many factors, it is recommended to conduct a viability study to determine the preferred alternative for the future of the Vine Street WTP and associated facilities.
- **Storage Reservoirs:** The City currently has 16.9 MG of storage volume available for use by the distribution system. Comparing the storage available to the projected demand indicates that there is sufficient existing storage volume to meet the demands within the 20-year horizon to 2045. By buildout, it is expected that there will be a 0.8 MG deficit in the summer and a surplus in the winter. New storage is mostly needed in the upper zone. There is no room at the Valley View site, but there is room at the Wildwood and Broadway sites, with the Wildwood site being preferred because it serves Zone 2. Additional storage capacity should be in place 2 to 3 years before required, approximately 2063. In the next WMP update, it is recommended to review the timing of new storage in the upper zone. Also, as the City considers alternatives for the Vine Street WTP, there could be an opportunity to consolidate some of the Zone 1 storage into a single location by decommissioning the Maple, Queen, and 34th reservoirs and constructing an equivalent volume at a new WTP

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site. The option to consolidate Zone 1 storage is recommended for further hydraulic evaluation and viability analysis as part of the Vine Street viability study.

- **Pump Stations:** The pump station capacity evaluations show that North Albany and Gibson Hill pump stations are near capacity and will need to be replaced. North Albany Pump Station (PS) is recommended for replacement near term (1-5 years) and Gibson Hill PS is recommended for replacement in the medium term (5-10 years). If a new WTP is built with equivalent storage and pumping, Maple, Queen, and 34th Pump Stations could be decommissioned and replaced by a new pump station. In addition to simplifying maintenance, this would result in more efficient pumping and lower energy consumption as the Queen and 34th pump stations do not supply the system but are used instead to move water around Zone 1. The option to consolidate Zone 1 pumping is recommended for further hydraulic evaluation and viability analysis as part of the Vine Street viability study.
- **Distribution System:** The City's transmission and distribution pipes were evaluated under existing and buildout conditions, for both MDD (including PHD) and MDD plus fire flow. Model results were compared to evaluation criteria to identify pressure and velocity issues, as well as the ability to supply the required fire flow from a single hydrant. In some cases, the required fire flow can be provided by using multiple nearby hydrants. For improvements to the distribution system, 21 fire flow and 10 development driven projects were identified for pipeline improvements.

CONDITION ASSESSMENT (CHAPTER 7)

A condition assessment of the City's water system assets was conducted as part of the master plan. The condition assessment was split into three categories: the canal, hydropower, and treated water facilities. A fourth assessment of the distribution system condition was done through a review of pipeline data and the City's pipeline replacement program.

Canal

The City owns the 18.2-mile-long Santiam-Albany Canal, which has a history of channel bed degradation and exhibits a significant number of bank failures along its entire length. As a part of this master plan, an assessment of the entire canal condition was performed, identifying 177 sites recommended for repair. The high priority sites were recommended for repair over the next 20 years and the medium and low priority sites were recommended for repair in the buildout-term. Other project recommendations include repair of the retaining walls and dredging for the canal within the main City blocks between Queen Avenue and 4th Street. In addition, it is recommended to perform further geotechnical evaluation at Cheadle Lake Berm, and to provide some fencing and safety features at a handful of canal sites.

As the City evaluates the future of the Vine Street site through the viability study, the decisions made for the Vine Street WTP and Hydroelectric facility may significantly impact flow through the entire canal. For example, if the viability study concludes that the preferred alternative is construction of a new WTP located south of the Vine Street WTP and if the Hydroelectric facility is decommissioned, then the required flow through the entire canal could be reduced significantly and different solutions to bank stabilization may be possible. The viability study should consider the impacts to the canal flow and associated canal costs for each alternative considered.

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Hydropower

The City's hydroelectric turbine, in operation for 13 years, was inspected to evaluate its performance and provide recommendations. The evaluation revealed that the turbine is not performing to its expected level, with the main issue being the corrosion of the wicket gate system. To perform repairs or replacement of the wicket gates and bearings, the turbine must be disassembled and reassembled which allows opportunity to perform other recommended repairs including installing a spiral case cleanout, and inspecting, blasting and recoating of the interior of the turbine. In addition, possible improvements to other areas of the turbine system include the trash rack, flow meter, and hydraulic power unit (HPU). With the already identified turbine improvements, it is estimated that the energy generation may be able to increase anywhere from 4.3 to 26.5 percent. However, as discussed in Chapter 9, the estimated revenue projections for the hydropower are significantly less than the estimated cost of repairs suggesting that the investment is not economical for the City. The generator was not evaluated as part of the turbine recommendation, which could require more improvements. Thus, it is recommended to first perform, an evaluation of the generator to determine the cost and magnitude of any other not yet identified improvements. Ultimately, it is recommended that the City explore future options for the Hydroelectric facility including decommissioning as part of the Vine Street viability study. The viability study should evaluate the costs of different alternatives, a return-on-investment analysis, and the impact of the city's non-consumptive water rights for the hydroelectric facility.

Treated Water Facilities

The treated water facility condition assessment covered the City's water treatment plants, pump stations, reservoirs, and their individual components. 588 individual assets were identified and assessed and scored for condition on a scale from 1 to 5 with 1 being Excellent and 5 needing Immediate Attention. Table ES-2 summarizes the distribution of scores showing that, overall, most of the City's assets are in fair to good condition.

Table ES-2. Condition Score Summary

Grading Definition	Score	Condition Count	Condition Percentage
Excellent	1	11	2
Good	2	328	55
Fair	3	125	21
Poor	4	115	20
Immediate Attention	5	9	1

Other factors considered during the condition assessment were typical useful life of assets, redundancy, and a risk assessment including review of the probability of failure and consequence of failure/criticality. The condition assessment included review from multiple disciplines including civil, structural, mechanical, and electrical as well as a performance assessment. The evaluation resulted in specific capital improvement program (CIP) project recommendations which are detailed in Chapter 7. The structural recommendations for the replacement of multiple Vine Street WTP buildings are among other recommendations that are described further in Chapter 8 and result in the main recommendations to begin studying alternatives at Vine Street. The civil and electrical recommendations identified for the water system were classified by the City as operations and maintenance projects. The mechanical recommendations mainly include measuring pipe thickness at Vine Street WTP site and using the results

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to determine if replacement or recoating is needed. Also, it was recommended to recoat other corroded items in the water system. Finally, the performance recommendations include expansion of the 5th cell at the AM WTP, and adding a clean-in-place pump at AM WTP, among other improvements.

In light of the condition assessment and analysis done at the Vine Street WTP, it is recommended that the City perform a viability study of all of the Vine Street water infrastructure including the Vine Street WTP, the Hydroelectric Facility, and the canal. The viability study should evaluate options for the Vine Street WTP including alternatives for decommissioning the existing Vine St WTP and hydroelectric facility and constructing a new water treatment plant at a different sites.

Pipeline Replacement Program

The purpose of the pipeline replacement program was to identify water main prioritization for replacement (i.e., high risk, expiring useful life, etc.) and combine assets into a 20-year replacement forecast. The replacement program looks at the replacement cycle by quantifying the cost to replace all water mains divided by the existing CIP budget to determine the replacement cycle in years. At $615,000,000 to replace all of the City's mains, divided by the existing City's annual pipeline replacement budget of $1,200,000, the replacement cycle is 513 years. Compared to the typical useful life of 90 to 95 years for a pipe, it is clear that the existing investment is not enough to replace pipes in a timely manner. Additionally, the water loss is a good indicator of the health of the water system. The water loss rate is 9.0 to 10.4 percent between 2018 and 2022, while the American Water Works Association recommends that agencies aim for a maximum water loss of 10 percent. High water loss corresponds to reactive maintenance practices and underinvestment in the water system, whereas low water loss is associated with preventative maintenance practices and adequate investment. Next, 8 different pipeline replacement categories were developed and used to forecast a recommended 20-year pipeline replacement budget. The forecast indicated that an annual average of $3,250,000 is recommended over the next 20-years.

SEISMIC RISK AND MITIGATION PLAN (CHAPTER 8)

Seismic hazards associated with a magnitude 9.0 Cascadia Subduction Zone (CSZ) earthquake event within the City's water service area were evaluated to identify potential water system impacts. The City is following recommendations for water systems outlined in the 2013 ORP. The results of the analyses indicate that pipe damage due to ground shaking is low. However, pipelines located in areas of moderate liquefaction and medium lateral spreading displacement will suffer more damage. This includes areas near the Willamette River and in some small creek areas. Damage to specific sites depends on the location of the site and the condition of the structures. Sites with a seismic performance expectation classified as Immediate Attention are multiple Vine Street WTP buildings including the raw water pump station, hydroelectric building, soda ash building, filters 1-6 and filters 7-10, and the North Albany Pump Station. The classification of Immediate Attention means that the structure will likely collapse during the CSZ event. To address seismic concerns for the City's water system facilities, recommendations include replacement of the Vine Street WTP and North Albany Pump Station. Multiple reservoir and pump station sites are recommended for seismic improvements including Maple Street, 34th Street, Queen Avenue, Gibson Hill, and Valley View. If a new WTP is built with equivalent storage and pumping, Maple, Queen, and 34th reservoirs and pump stations could potentially be decommissioned and replaced by a new reservoir and pump station. It is also recommended to add seismic straps to chemical tanks at both WTPs and add seismic valves at the critical reservoirs.

RECOMMENDED CAPITAL IMPROVEMENTS PROGRAM (CHAPTER 9)

Chapter 9 includes all of the Capital Improvement Project recommendations and cost estimates for the WMP. The projects are split into four planning horizons including the "near-term" horizon which extends from 0 to 5 years, the "medium-term" horizon which extends from 5 to 10 years, the "long-term" horizon which extends from 10 to 20 years, and the ''buildout-term" which is from 20 years to the current UGB buildout (approximately 2070). Projects recommended to be completed beyond the 20 year horizon should be reevaluated during the next water master plan update.

All of the recommended CIP project costs for the canal, hydropower, and water system are summarized in Table ES-3. Overall, the total 20-Year Capital Cost is estimated to be $164,000,000 which correlates to an annual budget of $8,200,000.

Table ES-3. Summary of Recommended CIP Projects[a], dollars

Project Type	Near-Term Capital Costs	Medium-Term Capital Costs	Long-Term Capital Costs	Total 20-Year Capital Cost	Buildout-Term Capital Costs[b]
WTP	8,860,000	3,730,000	2,100,000	15,000,000	0
Pipeline	23,800,000	37,500,000	48,300,000	110,000,000	0
Pump Station	4,440,000	3,650,000	0	8,100,000	0
Storage	560,000	3,550,000	0	4,110,000	7,200,000
Supplemental Studies	750,000	75,000	1,000,000	1,830,000	0
Hydropower	2,520,000	0	0	2,520,000	0
Canal	11,000,000	4,310,000	6,720,000	22,000,000	20,000,000
TOTAL	**$51,900,000**	**$52,800,000**	**$58,000,000**	**$164,000,000**	**$27,200,000**
Annual Costs	**$10,400,000**	**$10,600,000**	**$5,800,000**	**$8,200,000**	**$1,360,000**

(a) Costs are based on March 2023 ENR CCI of 15,107 (Seattle).
(b) Buildout-Term Costs include some but not all projects that will be included at Buildout. The next Water Master Plan will update the projects and costs associated with the Buildout-Term Costs.

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CHAPTER 1
Introduction

1.1 WATER SYSTEM MASTER PLAN PURPOSE

The City of Albany, Oregon (City) provides municipal water service to the cities of Albany and Millersburg and additional customers inside and outside the Urban Growth Boundary (UGB). In total the City provides water for more than 18,300 customer accounts.

In 2004, the City completed a Water Facility Plan. This Water Master Plan (WMP) is an updated evaluation of the City's existing water system infrastructure and needs. The purpose is to identify deficiencies under existing or future demand conditions and provide recommended water system improvements. As part of the WMP, a comprehensive Capital Improvement Program (CIP) was formulated to help with planning of the City's existing and future needs.

Evaluations and recommendations presented in this WMP are based on review of historical data and records, record drawings, past evaluations and reports, current Geographic Information System (GIS) data, updated demand estimates, and results from field inspections and data collected for this WMP, starting in late 2022.

This WMP was prepared to comply with Oregon Administrative Rule (OAR) 333-061-0060(5). As required by OAR 333-061-0060, any community water system with at least 300 connections or serving more than 1,000 individuals is required to complete a master plan and maintain the plan for the duration of the period to which the plan applies. This master plan is to evaluate the needs of the water system for at least a 20-year period, be prepared by a professional engineering registered in the state of Oregon and including the following information:

- The water quality, service goals, present and future water deficiencies, and recommendations to correct deficiencies along with schedule and financing.
- A description of the system including service area, source(s), status of water rights, status of water quality and compliance with regulations, operation and maintenance requirements, and maps of the system showing size and water use estimates.
- Water quality and level of service goals for the system considering future regulatory requirements, nonregulatory water quality needs of users, flow and pressure requirements, and capacity needs for use and fire flows, as appropriate.
- Growth projections for the water system during the master plan period and the impact on service area boundaries, water sources, and availability.
- Engineering evaluation of the existing water system and its ability to meet water quality and level of service goals, identifying existing deficiencies or ones likely to develop during the period of the plan.
- Identification of alternative solutions, environmental impacts, and associated capital and operational costs to correct any determined deficiencies and achieve expansion to meet expected growth.
- Alternatives to finance water system improvements such as including financing and financing assistant programs.
- Recommended improvement program with recommended alternatives, costs, maps or schematics and recommended schedule.

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- Seismic risk assessment and mitigation plan identifying critical facilities, evaluating risk and likelihood of consequences of seismic failures, and looking at a 50-year planning horizon with recommendations to minimize water loss in the case of an event.

This WMP also fulfills the City's 2020 Comprehensive Plan goal to:

> "Regularly update the Water Facility Plan as part of the Public Facilities Plan. The Water Facility Plan shall be used as the primary guide for setting priorities for the expansion, improvement, or modification of the water system."

1.2 WATER SYSTEM MASTER PLAN OBJECTIVES

The objectives of this WMP are to:

- Describe the existing City water system and facilities (Chapter 2)
- Evaluate historical, existing, and projected water demands to characterize water use patterns and trends. Establish the Level of Service performance criteria. The City will use normal, emergency, and disaster conditions (Chapter 3)
- Review the City's existing water supplies and the availability and reliability of each supply source (Chapter 4)
- Review federal, state, city, and industry water system regulations and standards for conformance. Review the City's performance and operational criteria under which the City water system will be evaluated (Chapter 5)
- Evaluate the City's existing water system and identify whether new water system facilities (including pipelines, supply facilities, storage facilities, pumping facilities, and treatment facilities) are needed to support existing and future water demands within the City (Chapter 6)
- Evaluate the condition and performance of the City's existing water facilities. Identify deficiencies and system maintenance or upgrades needed to meet operational and performance criteria (Chapter 7)
- Evaluate seismic risk to the water system and mitigation strategies (Chapter 8)
- Develop a CIP for implementation of recommended water system improvements (Chapter 9)

1.3 AUTHORIZATION

West Yost was authorized to prepare this WMP by the City on July 21, 2022.

1.4 ACKNOWLEDGEMENTS

The development of this WMP Update would not have been possible without key involvement and assistance of City staff. In particular the following staff provided comprehensive information, input, and insights throughout the development of the WMP:

Engineering

- Chris Bailey, Public Works Director
- Staci Belcastro, City Engineer
- Rob Emmons, Assistant City Engineer

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- Ryan Beathe, Engineer, Project Manager
- Chris Cerklewski, Engineer
- Nolan Nelson, Engineer
- Trisha Ruby, Public Works Accountant
- Kindra Coggins, Administrative Supervisor

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- Scott LaRoque, Superintendent
- Jeff Kinney, Water Distribution Supervisor
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- Dave Twenge, Technical Services Supervisor
- Jason Whittle, Facilities Automation Analyst
- Chris Burr, Facilities Automation Analyst
- Lisa Kirk, Computerized Maintenance Mgmt. System Analyst

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Emergency Management, Fire, Community Development

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- Lora Ratcliff, Fire Marshal
- Johnathan Balkema, Building Official Manager
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CHAPTER 2
Existing System Description

2.1 EXISTING WATER SERVICE AREA

The City is located in the Willamette Valley, approximately 24 miles south of Salem, Oregon, along Interstate I-5. The City is adjacent to the Willamette River, just east of its confluence with the Calapooia River. The City was incorporated in 1864 and is currently the 11th largest city in the state of Oregon with a population of 56,472 (2020 Census).

The City supplies water to the cities of Albany and Millersburg, customers within the City's urban growth boundary (UGB), and to some residents outside the UGB in the North Albany County Service District (NACSD). Figure 2-1 shows a map of the City's water service area and water distribution system facilities.

2.2 WATER SYSTEM HISTORY

The City's water system was at one time owned and operated by Pacific Power and Light (a privately owned utility corporation). Construction of the Santiam-Albany Canal began in 1872 with the purpose of transporting goods. The hydroelectric facility was brought online in 1892 and the Vine Street Water Treatment Plant (WTP) was built in 1912. The City purchased the system from Pacific Power and Light in 1984 and subsequently acquired ownership of the NACSD in 1991. The purchase from Pacific Power and Light included the 18-mile canal, the hydroelectric facility, and the Vine Steet WTP, along with the entire water distribution system including reservoirs that were in place at the time. The water system supplies water to more than 18,300 customer accounts, both within the City limits as well as to customers outside the City UGB in the NACSD.

The NACSD was created to provide water service to customers outside the City's UGB, in rural Benton County. These services have been provided pursuant to a 1990 agreement between the City and the NACSD. Oregon's Statewide Planning Goals intend that cities limit the level of urban services provided outside their UGB. Consequently, the City's policy is to maintain, but not expand or improve, the level of service to former NACSD customers located outside the UGB. It is also the City's policy not to extend City water service to properties located outside the city limits, but inside the UGB without meeting certain conditions.

In 2005, the cities of Albany and Millersburg completed construction of the Albany-Millersburg Water Treatment Plant (AM WTP), providing a jointly owned additional water supply source for the cities of Albany and Millersburg. Through intergovernmental agreements between the two cities, the City operates and maintains the AM WTP. The City provides maintenance support for Millersburg's distribution system, but the City of Millersburg is responsible for capital investments in its distribution system and evaluation of the Millersburg distribution system is not included in the WMP. Further history of the WTPs and distribution system facilities are provided later in this chapter.

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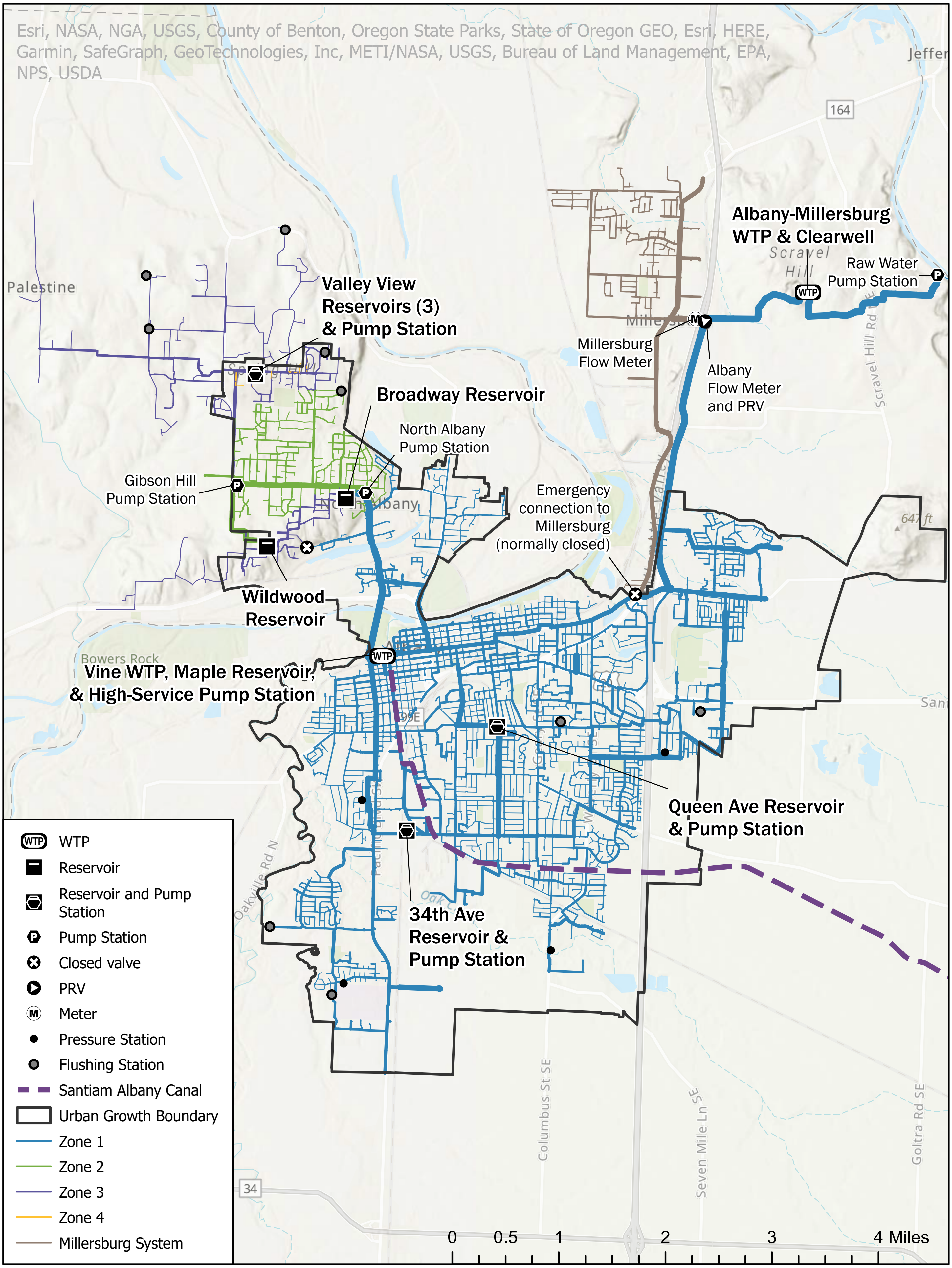

Figure 2-1. Water System Map

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2.3 EXISTING WATER SUPPLIES

The cities of Albany and Millersburg receive drinking water from one of two WTPs:

- The Vine WTP which receives raw water from the Santiam-Albany Canal (Canal), supplied by the South Santiam River via a diversion dam located near Lebanon.
- The AM WTP which receives raw water directly downstream of the confluence of the North and South Santiam Rivers.

A Source Water Assessment Report was updated by the Oregon Department of Environmental Quality (DEQ) in 2019 for the Santiam-Albany Canal serving the Vine Street Water Treatment Plant and the Santiam River serving the Albany-Millersburg Water Treatment Plant. The report describes the watershed stating, “the lower part of the watershed is primarily rural residential and limited agricultural land use along the rivers/streams with Bureau of Land Management (BLM) and private industrial forestry land throughout the uplands. The upper portion of the watershed is primarily US Forest Service lands.”

The South Santiam subbasin drains approximately 1,040 square miles. In the east is steep, mountainous terrain and to the west is a low floodplain. The watershed is characterized by much variation in elevation ranging from 200 feet to 5,721 feet. There is also variation in ecoregions, and land use practices. The mainstem river is 65 miles long; however, including all tributaries, the watershed has 1,013 stream miles through it. Foster Reservoir and Green Peter Reservoir impound water on the South Santiam with the primary use of recreation in the summer and flood control in the winter and spring.

The North Santiam subbasin drains approximately 766 square miles pouring off the slopes of Mt. Jefferson (elevation 10,497 feet). The mainstem river runs 92 river miles to the Willamette. The watershed is characterized by steep forested uplands and flat alluvial lowlands. Two dams, Detroit Dam and Big Cliff Dam, provide flood control and hydropower. Detroit Dam (463 feet tall) impounds Detroit Lake, a major recreational area.

2.3.1 Water Rights

The Oregon Water Resource Department (WRD) regulates water rights throughout the State of Oregon. Under Oregon law, all water belongs to the public. A water right is an authorization from the state to make use of surface water or ground water.

The first step in the water rights process is to obtain a water use permit, which requires the community to establish a need and demonstrate beneficial use for the water requested. A water right can be certified or “perfected” once the community demonstrates that the permitted water has been put to beneficial use.

A guiding principle in Oregon water law is that a water right must be used for a beneficial use without waste. Beneficial use is demonstrated differently depending on the type of use. Generally, if the certificate holder continues to use water in accordance with the certificate, the right continues in perpetuity. Certificated water rights may be forfeited after five consecutive years of non-use. However, municipal water use is the exception to this rule.

Albany and Millersburg have an intergovernmental agreement, which allows each City to use the other's water rights. The City has a variety of water rights for a variety of uses, including:

- **Municipal**. Examples of municipal water use include, but are not limited to: domestic water use, irrigation of lawns and gardens, commercial water use, industrial water use, fire protection, street washing, and irrigation and other uses in parks and recreation facilities. Municipal water use does not include generation of hydroelectric power. The City's municipal water rights total 57 cubic feet per second (cfs), or 36.83 million gallons per day (mgd). The City of Millersburg also holds 22 cfs (14.22 mgd) of municipal rights that can be used in the Albany service area.
- **Recreation**. This water is used for supply, beautification, and recreation purposes for "the benefit of the general public." The City's recreation water rights total 1 cfs (0.65 mgd).
- **Hydroelectric**. Water projects that generate electricity over specified amounts must be licensed by the Federal Energy Regulatory Commission (FERC). Hydroelectric water permits, as is the case with the City, can also be subject to other requirements related to a FERC permit. OAR 690-051-0000 includes rules related to hydroelectric development. The City's hydroelectric water rights total 190 cfs (122.78 mgd).
- **Flow augmentation**. This water is used to augment flows in canals or streams. The City's flow augmentation water rights total 85 cfs (54.93 mgd).

The cities of Albany and Millersburg's water rights are summarized in Table 2-1.

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Table 2-1. Albany and Millersburg Water Rights

Certificate or Permit Number	Rate, cfs	Volume, acre-ft	Priority Year	Use	Notes
C-93318	28.57	-	1979	Municipal	Perfected. Water supply to Vine and AM WTPs. Maximum diversion rate cannot exceed 30.59 cfs at point of diversion (POD) 1 (Santiam Albany Canal) or 25.98 cfs at POD 2 (the Albany-Millersburg Water Treatment Plant), based on a combination of rights from certificates C-93318, C-83323, C-83325, and C-83976.
P-44388	0.43	-	1979	Municipal	Not perfected. Water supply to Vine and AM WTPs.
C-83976	21	-	1878	Municipal	Perfected. Water supply to Vine and AM WTPs. Maximum diversion rate cannot exceed 30.59 cfs at POD 1 (Santiam Albany Canal) or 25.98 cfs at POD 2 (the Albany-Millersburg Water Treatment Plant), based on a combination of rights from certificates C-93318, C-83323, C-83325, and C-83976.
C-83323	2	-	1968	Municipal	Recreation, fish culture, and beautification for Timber-Linn Lake and Waverly Lake. Maximum diversion rate cannot exceed 30.59 cfs at POD 1 (Santiam Albany Canal) or 25.98 cfs at POD 2 (the Albany-Millersburg Water Treatment Plant), based on a combination of rights from certificates C-93318, C-83323, C-83325, and C-83976.
C-83324	-	24.04	1877	Municipal	Allows for storage of Cox Creek water for “recreation, fish culture, and beautification” at Timber-Linn Lake.
C-83325	5	-	1970	Municipal	Provides for “recreation and fish life” for Upper and Lower Swan Lakes, Timber-Linn Lake, and Waverly Lake. Maximum diversion rate cannot exceed 30.59 cfs at POD 1 (Santiam Albany Canal) or 25.98 cfs at POD 2 (the Albany-Millersburg Water Treatment Plant), based on a combination of rights from certificates C-93318, C-83323, C-83325, and C-83976.
C-14547	1			Recreation	For Waverly Lake. Supply, beautification, and recreation for the benefit of the general public.
C-81570	190		1874	Hydroelectric	The certificate originally allowed use of 275 cfs, but during FERC relicensing in the 2000’s, FERC determined that the hydroelectric project could only make beneficial use of 190 cfs. The City then transferred 85 cfs to flow augmentation.
C-95725	85		1874	Flow Augmentation	Supply to 8 waterways along the Santiam-Albany canal. Table 2-2 provides the names of each waterway and the allowable diversion flow rate.
S-52885 and S-52886	22		1989	Municipal (Millersburg)	Total can be diverted from the South Santiam River, the Willamette River, or a combination of the two sources. Water can also be used in the City of Albany service area.
Total	**355.0**	**24.04**	**-**	**-**	**-**

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Table 2-2. Flow Augmentation Diversions

Waterway Name	Allowable Diversion Flow Rate, cfs
Marks Slough	4
Hospital Slough	6
Burkhart Creek	20
Cox Creek	20
Periwinkle Creek	20
Cathey Creek	13
8th Street Canal	2
Total	**85**

The water right priority date is the approval date of the original permit. When comparing two water rights, the right with the earlier priority date is labeled “senior" and the right with the later priority date is labeled “junior". During a water shortage, water right holders with senior rights have priority and are allowed to access their full allocations prior to a junior water right holder. In some cases, this may result in a junior water right allocation not being fulfilled.

2.3.2 Source Water Quality

The 2019 DEQ Source Water Assessment Report evaluating the City’s source water concluded that the source water may be susceptible to contamination from sediments (turbidity), microbiological sources, and nutrients.

Chapter 5 presents regulatory standards and historical finished water quality. The two existing WTPs (Vine Street and AM, discussed in more detail below) have met federal and state regulations given historical water quality.

If source water quality were to degrade due to nutrients and increasing organic concentrations, this could be more challenging to the existing treatment processes. Algal toxins and taste and odor compounds are directly linked to the amount of nutrients in a source water. Since Oregon first required biweekly cyanotoxin sampling in 2019, the City has had no toxin detections. The existing WTPs would be challenged to remove taste and odor compounds, as well as algal toxins with the existing treatment processes described in more detail below and in Chapter 6.

Raw water organic concentrations have remained relatively consistent across the past 20 years with concentrations typically ranging between 1 and 2 million gallons per liter (mg/L). Raw water organic concentrations are presented in Chapter 5 along with disinfection byproduct (DBP) data in the finished water distribution system. If organic concentrations were to double over time, then the existing WTPs would be more challenged to meet DBP requirements and may require additional process improvements that target organics removal.

The existing WTPs are well equipped to deal with increasing turbidity and microbiological sources.

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The US Army Core of Engineers is in the process of modifying seasonal storage and discharge rule curves from both the Green Peter Reservoir and Foster Reservoir. Starting in June 2023, the US Army Corps of Engineers started drawing down the Green Peter Reservoir near Sweet Home, OR, with the goal of increasing Chinook and Steelhead fish survival and passage. The Green Peter Reservoir feed the South Santiam River and impacts all downstream users including the City. The 2023 reservoir draw down caused increased turbidity levels and debris in the River putting strain on water treatment technologies including the City's filters and membranes. High turbidity events can cause lowered WTP capacities, more frequent backwashing, more chemical usage, and other impacts. There may be an impact to membrane lifetime and warranty if high turbidity events cause the membranes to exceed the typical range. At this time, it is unknown how long the Green Peter Reservoir drawdown program will continue and what the future impact will be on the South Santiam River water and the City. The City will continue to monitor the impacts of reservoir drawdown.

2.4 WATER TREATMENT PLANTS

The City has two WTPs; the Vine Street WTP and the AM WTP. Vine Street WTP was built in 1912 and was the City's sole source of drinking water for many years until the Albany Millersburg (AM) Plant was built in 2005. Now the two treatment plants operate together to provide water for the City.

2.4.1 Vine Street Water Treatment Plant

The Vine Street WTP, shown in Figure 2-2, uses mixed-media filter technology to treat water from the Santiam-Albany Canal and has a maximum finished water capacity of 16 mgd. Finished water is stored on site in the Maple Street Reservoir before being pumped to the distribution system by high-service pumps. The Vine Street WTP was constructed in 1912 and has gone through several upgrades, outlined below:

- **1912**: The original construction included two settling basins and six filter beds. This project included hydropower generation, refer to Chapter 7 for more information.
- **1948**: A new raw water pump station, flocculator, and clarifier were added to the existing treatment processes.
- **1960's**: One of the existing sedimentation basins was converted into two filters (Filters 7 and 8).
- **1970's**: A solids contact basin and multiple backwash ponds were added to the existing treatment processes.
- **1991**: The plant was expanded to increase peak capacity from 15 mgd to 20 mgd. Additional features were implemented to ensure continued compliance with drinking water regulations. Improvements included the addition of two raw water pumps, addition of tube settlers to Accelator® #1, a second clarifier with tube settlers (Accelator® #2), the conversion of one existing settling tank into filters 9 and 10, and the installation of a Hypalon baffle in the Maple Street Reservoir to improve the contact time for disinfection.
- **1995**: Solids handling was improved through outlet modifications to the backwash/sludge holding lagoons and the addition of a second drying bed.

Vine Street WTP Capacity

Table 2-3 shows the design capacity of the unit processes at Vine Street WTP.

Table 2-3. Vine Street Design Criteria

Unit Process	Quantity	Design Data	Total Design Capacity
Entire Plant		-	• 20 mgd (Currently limited to 16 mgd for disinfection)
Intake Screen	1	• Effective Area 20 sqft	• 1.55 fps at 20 mgd
Raw Water Pumps	9	• (1) 20 HP • (1) 40 HP • (5) 50 HP • (2) 75 HP	• 31.4 mgd Total Capacity • 25.6 mgd Firm Capacity
Solids Contact Clarifiers (Accelators®)	2	• Overflow Rate 2.54 gpm/sqft • Rated Capacity 8 & 8.5 mgd • Hydraulic Capacity 10 mgd Each	• 20 mgd
Filters 1-6	6	• 213.5 sqft each	• Capacity at 5.0 gpm/sf is 23.40 mgd
Filters 7-10	4	• 490.6 sqft each	
Clearwell	1	• 0.21 MG	-
Backwash Pumps	2	• 75 HP each	• 10,500 gpm Total Capacity
Transfer Pumps	4	• (1) 100 HP • (1) 125 HP • (2) 200 HP	• 32.1 mgd Total Capacity • 22.8 mgd Firm Capacity
Maple Street Reservoir	1	-	• 2.0 MG
Finished Water Pumps	5	• (1) 100 HP • (1) 150 HP • (1) 200 HP • (2) 300 HP	• 28.8 mgd Total Capacity • 20.2 mgd Firm Capacity

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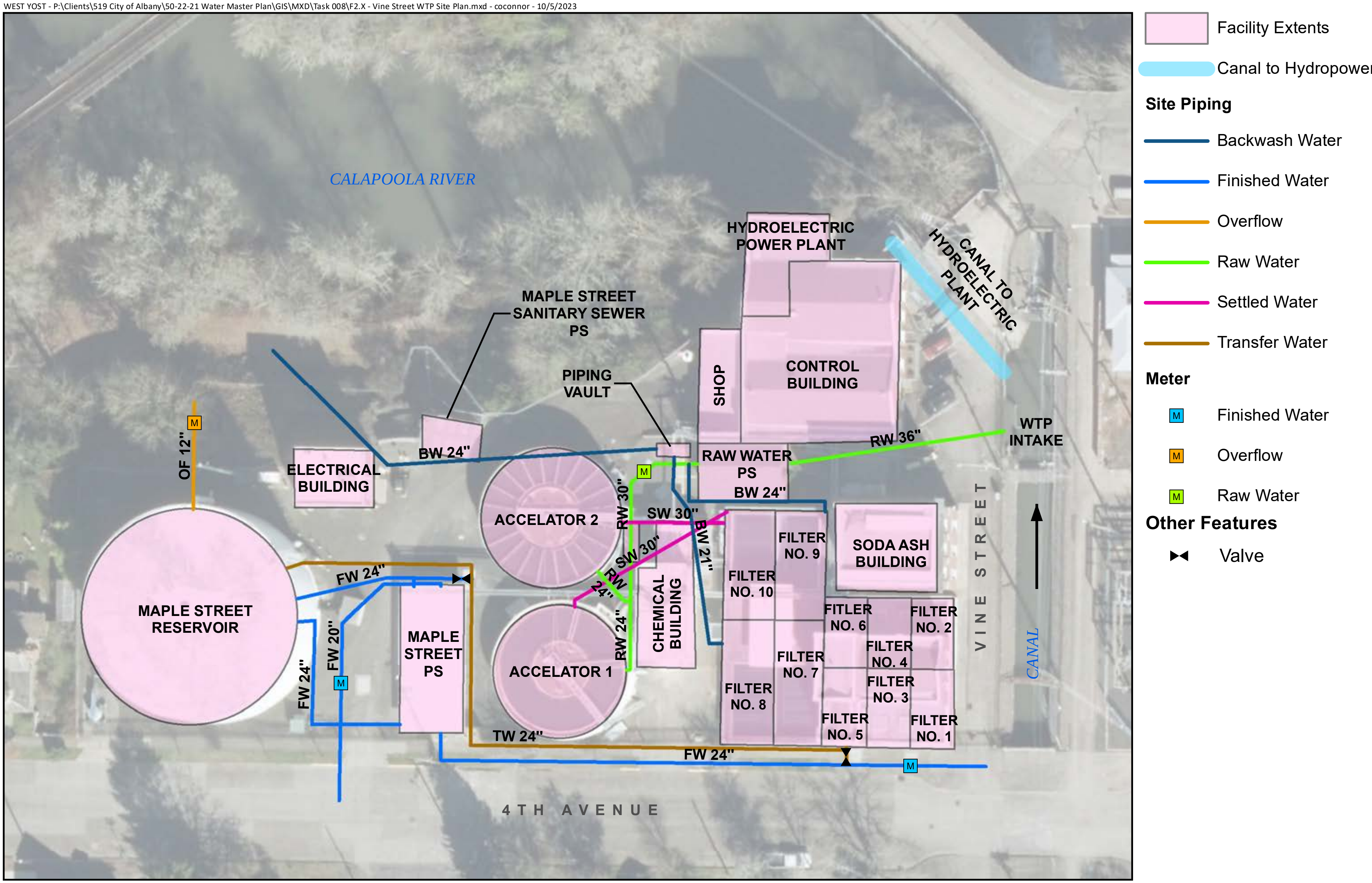

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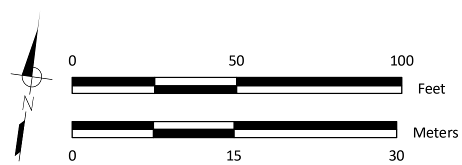

Prepared for:
City of Albany
Water Master Plan

Vine Street WTP
Site Plan

Figure 2-2

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Vine Street WTP Process

The Vine Street WTP receives water from the South Santiam River through the Santiam-Albany Canal. When the water reaches the WTP, it is passed through a rotating screen, then is pumped by the raw water pump station to two circular flocculating clarifiers (Accelators®) which are operated in parallel. From the clarifiers, water then flows by gravity to and through 10 granular media filters. Each filter discharges directly to the clearwell. Water is then pumped to the Maple St Reservoir, which provides additional chlorine contact time. After chlorine contact time is achieved, water is pumped from the reservoir to the City's distribution system by the Maple Street Pump Station. Figure 2-3 is the Process Flow Diagram for the Vine Street WTP.

Intake Screen

The intake screen is a 12-foot diameter rotating circular screen which serves to remove debris in the raw water as it enters from the canal and is diverted to the Raw Water Pump Station wet well. At the plant capacity of 20 mgd, the approach velocity through the screen is estimated at 1.6 feet per second (fps). Although this velocity is relatively high for debris screens compared to modern design standards, the raw water has low screenings load, and the Vine Street WTP is typically operated well below maximum capacity.

Photo 1
Vine Street Intake Screen

Raw Water Pump Station

The Raw Water Pump Station (RWPS) was constructed in the early 1950's and houses 9 pumps ranging from 20 to 75 HP. Pumps 8 and 9 have variable frequency drives (VFDs) which are used along with the other constant speed pumps to achieve the desired flow rate. The number and size of pumps is listed in Table 2-3. In 2010 some structural seismic retrofits were constructed which added metal framing and upgrading connections on the interior of the RWPS.

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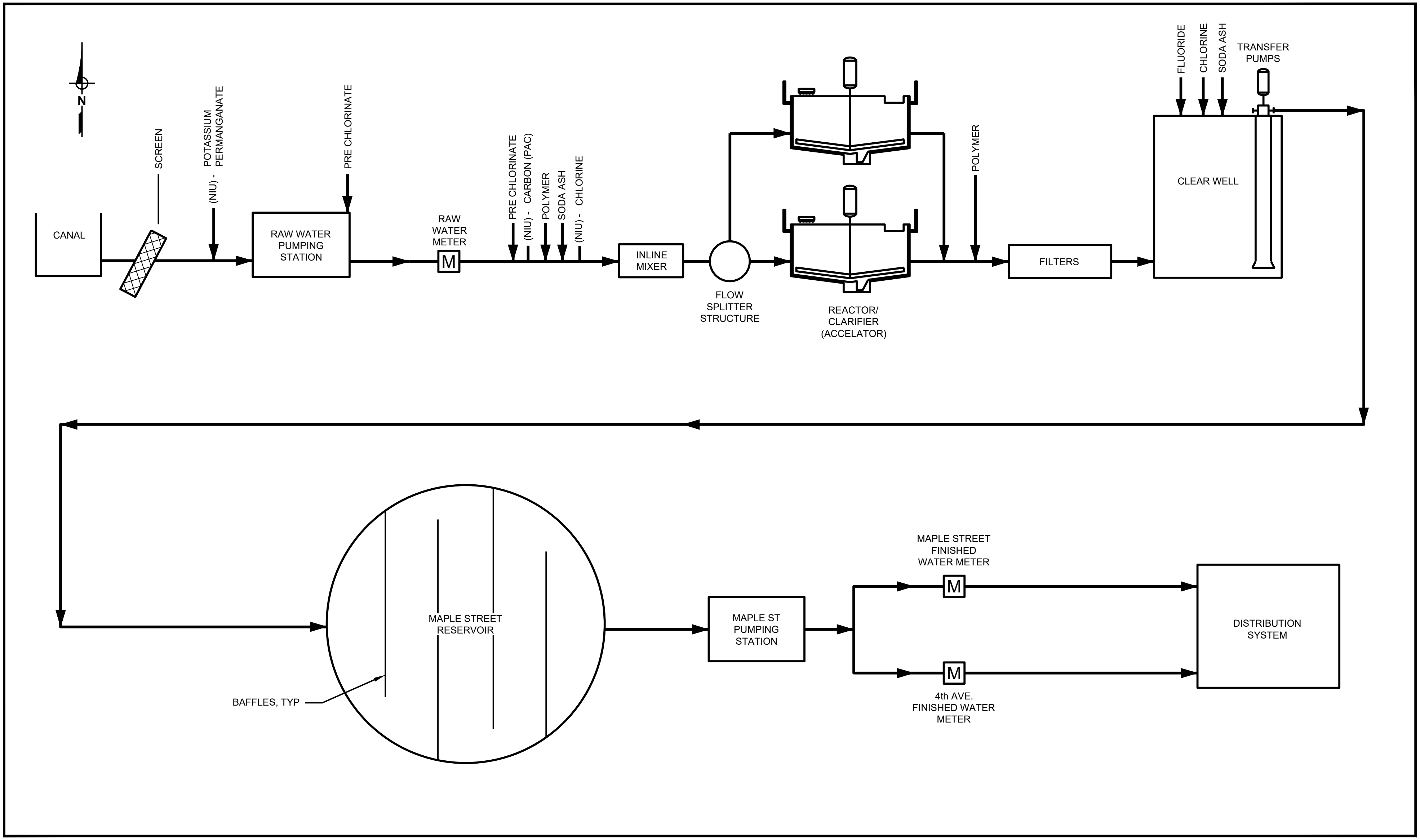

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Figure 2-3

Vine Street WTP Process Flow Schematic

City of Albany

Water Master Plan

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Photo 2
Vine Street – Raw Water Pump Station Exterior

Photo 3
Vine Street – Raw Water Pump Station Interior

Chemical Systems

Several chemicals are used for water treatment at the Vine Street plant. Storage for chemicals is in both the chemical storage building and soda ash building.

The chemical building stores the following chemicals:

- **Sodium Hypochlorite:** The original plant used a gaseous chlorine system which was replaced in 2007 with a liquid sodium hypochlorite storage and feed system. Sodium hypochlorite is purchased, delivered, and stored in the lower level of the chemical building in two 1,015-gallon double walled tanks. The sodium hypochlorite is metered with peristaltic metering pumps. Sodium Hypochlorite is added at multiple locations at the Vine Street Plant: the raw water pump station, the chemical injection vault, after the Accelators®, the clearwell, and after the Maple Street Reservoir.
- **Aluminum Chlorohydrate (ACH):** Alum was used as a chemical for flocculation in the clarifiers until 2021, when the plant switched to ACH. ACH is stored in a 1,015-gallon double walled tank. ACH is added to raw water in the chemical injection vault prior to the Accelators®.
- **Non-ionic Polymer:** Polymer is added to improve flocculation. Polymer is added to the raw water in the chemical injection vault and after the Accelators®. Polymer is stored on the second floor of the chemical building.

The soda ash building stores the following chemicals:

- **Soda Ash:** Soda Ash is added to provide alkalinity and improve treatability. Soda Ash is added in the chemical injection vault, the clearwell, and after the Maple St Reservoir.
- **Sodium Fluorosilicate:** Sodium Fluorosilicate is added to the clearwell. It is added by the City to improve dental health.

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The Chemical Injection Vault was installed in 1990 and is located between the Raw Water Pump Station and the Splitter Box to the Accelators®. The chemical injection vault includes a static mixer.

Photo 4
Vine Street – Soda Ash Building

Photo 5
Vine Street – Dry Chemical Room

Photo 6
Vine Street – Liquid Chemical Room

Photo 7
Vine Street – Chemical Injection Vault

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Clarifiers

Accelator® 1 is a circular concrete solids contact clarifier constructed in the early 1950s. It is 58 feet in diameter with a rated capacity of 8 mgd meaning that the performance is guaranteed up to 8 mgd. The hydraulic capacity is 10 mgd and is the maximum flow capacity that can go through the structure. Settling tubes were installed in 1972. The concrete was rehabbed in 2019.

Accelator® 2 is a circular steel epoxy coated clarifier, 60 feet in diameter, with an 8.5 mgd rated capacity and a 10 mgd hydraulic capacity. It was built in 1990. The steel was sandblasted and recoated and the settling tubes were replaced in 2019.

Flow is split to the Accelators® using a splitter box, also installed in 1990. Both Accelators® were recoated in 2019 In the Accelators®, ACH is added to the raw water to improve flocculation in the central mixing zone. The flocculation mixture flows under a skirt and upward through media which promotes settling of the precipitates. Clarified water flows into the launder and is conveyed to the filters.

Photo 8
Vine Street - Concrete Accelator 1

Photo 9
Vine Street – Steel Accelator 2

Filters

Water from the clarifiers flows through 10 gravity filters. The filter media are comprised of anthracite coal, silica sand, and red garnet sand. The media rest on top of support gravel and underdrains.

Each filter is backwashed individually based on the volume of water treated or based on turbidity levels. During the backwash cycle, the media are cleaned by surface agitation and backwashed with filtered water from the clearwell. Two pumps provide backwash water to the filters, and then the backwash water is discharged to the backwash ponds. The backwash ponds are located remotely from the plant near the Calapooia River. The backwash ponds were constructed in 1974. Multiple backwash pond upgrade and cleaning projects were performed from 1989 through 1996. In 2018, both ponds had debris removed, concrete and grading work, and new liner systems installed. Wash water is settled in the ponds and the decant is discharged to the Calapooia River under a NPDES permit.

Photo 10
Filter Media

Filters 1 through 6 are smaller in size than Filters 7 through 10 and are located inside the filter building and above the clearwell. These filters were installed with the original plant and updated in 1972. These filters are operated at a 3 gallon per minute per square foot (gpm/ft^2) maximum filtration rate for a capacity of 670 gpm through each filter.

Filters 7 through 10 are located outside. Filters 7 and 8 were installed in 1972 and Filters 9 and 10 were installed in 1990. They are operated at a maximum filtration rate of 5 gpm/ft^2 for a capacity of 2,500 gpm per filter.

Photo 11
Vine Street - Filters 1-6

Photo 12
Vine Street - Filters 7-10

Clearwell

The filter clearwell is located under Filters 1-6 and was built with the original plant. The clearwell had concrete repairs performed in 2016 and again in 2020.

Transfer Pump Station and Disinfection

Four transfer pumps located in the same building as Filters 1-6 are used to pump filtered water from the filter clear well to the Maple Street Reservoir. Transfer Pumps 3 and 4 have VFDs installed to adjust speed. Chlorine is added at the filter clearwell and the Maple Street Reservoir is used to obtain additional chlorine contact time before finished water is pumped into the water distribution system.

Photo 13
Transfer Pump Station

Maple Street Reservoir

The Maple Street Reservoir is located at Vine Street WTP and used to achieve chlorine contact time before water enters the distribution system.

The reservoir was built in 1960 and seismically upgraded in 2011. In 2011 the baffling system inside the reservoir was repaired and the energy dissipater at the inlet to the reservoir was modified.

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Photo 14
Maple Street Reservoir

2.4.2 Albany Millersburg Water Treatment Plant

The Cities of Millersburg and Albany jointly developed and share ownership of the AM WTP, located northeast of the City of Albany at Berry Drive NE as shown in Figure 2-4. The plant was constructed in 2005 and uses membrane technology to filter water from the Santiam River, with a maximum published finished water capacity of 12 mgd during the winter and 16.5 mgd during the summer. Chapter 6 provides further evaluation of the existing AM WTP capacity which is limited based on time required for the backwash cycles. Finished water is stored on site in a 5.7 million gallons (MG) reservoir before it is conveyed by gravity to the separate Albany and Millersburg distribution systems. The AM WTP has undergone several upgrades as outlined below:

- **2012:** Raw Water Pump Station Sand Removal Improvements
- **2015:** Chemical Tank Replacement
- **2021:** Valve installation between filtrate and A-M Reservoir, A-M Reservoir Cleaning and Inspection
- **2021-**2023: Raw Water Pumps 1-4 Rebuild and VFD Replacement
- **2023:** Raw Water Pump Station Generator (under construction), WTP Seismic Valve Replacement (planned), WTP Generator Design

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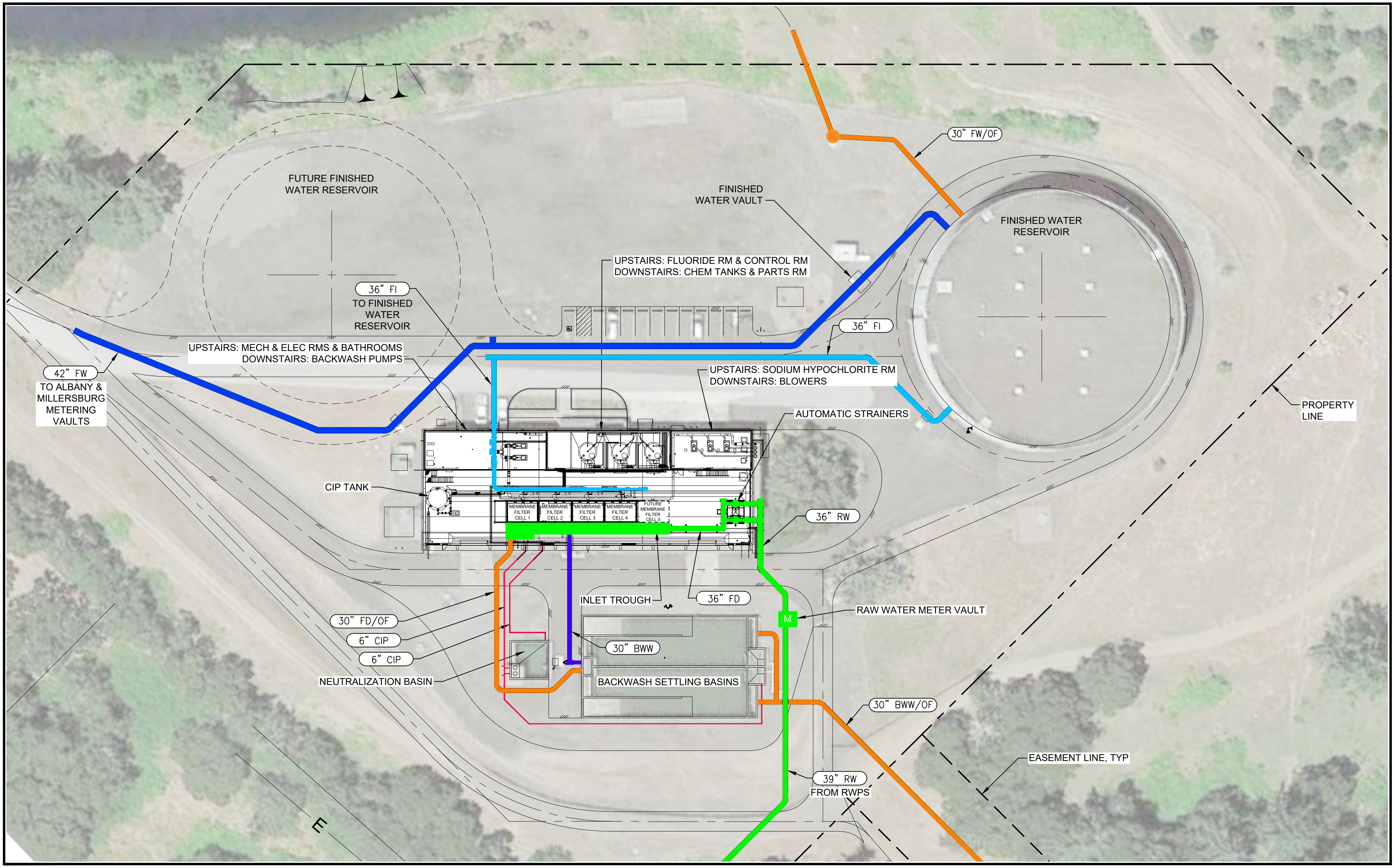

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- Overflow (OF)
- Finished Water (FW)
- Raw Water (RW)
- Filtrate Water (FI)
- Backwash Water (BWW)
- Clean-in-Place (CIP)

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SCALE IN FEET

WEST YOST

Figure 2-4

Albany-Millersburg WTP Overall Civil Site Plan

City of Albany

Water Master Plan

AM WTP Capacity

Table 2-4 shows the design capacity of the unit processes at AM WTP.

Table 2-4. AM Design Criteria

Unit Process	Quantity	Design Data	Total Design Capacity
Entire Plant		-	• 12.0 mgd Winter • 16.5 mgd Summer
Intake Screens	8	-	• 2300 gpm each • 18,400 gpm Total (26.5 mgd)
Raw Water Pumps	4	• 350 HP Each with VFDs • 220 feet TDH	• 4,500 gpm Each Pump • 14,200 gpm Firm Capacity (20.4 mgd)
Raw Water Sand Removal	2	• 15 HP Sand Pumps • 0.5 HP Sand Classifier	• 220 gpm each
Pre-Filter Strainers	2	-	• 18,000 gpm each
Membranes	4	• Dupont Mempore	• 648 Membranes Each Cell • 2592 Total Membranes
Filtrate Pumps	4	• 125 HP with VFDs	• 4315 gpm Design Capacity each
Air Compressors	2	• 15 HP	• 37 scfm min capacity • 1,600 gallons test air receiver tank • 400 gallons control air receiver tank
Air Blowers	3	• 60 HP	• 2,033 scfm capacity each • 3,390 scfm backwash air flow
Backwash Supply Pump	2	• 100 HP with VFDs	• 4,756 gpm required backwash flow • 6,420 gpm Design Capacity
Clean-In-Place System	1	• 15 HP Pump	• 1,000 gpm pump • 7,000-gallon tank
Waste Neutralization	2	• 7.5 HP	• 250 gpm each pump • 18,000 gallons in basin
Backwash Water Handling	2	• 4,560 gallons Waste Volume/BW • 1,005,888 gallons Waste Volume/day	• 699 gpm equalized flow
Backwash Settling Basins	2	• 332 minutes Design Detention Time	• 116,000 gallons each
Supernatant Pumps	2	• 20 HP • 50 feet TDH	• 1,000 gpm each

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AM WTP Process

The AM WTP receives water from its intake on the South Santiam River in the immediate vicinity of the confluence of the North and South Santiam Rivers. Raw water is screened at the intake structure and is pumped approximately 1.7 miles to the AM WTP by the RWPS. At the AM WTP site, raw water is passed through two strainers operated in parallel, then is filtered through 4 parallel membrane cells. Filtered water is then disinfected and pumped to the AM Reservoir. After sufficient chlorine contact time is achieved in the reservoir, finished water is conveyed west down Berry Road and then metered separately to both Albany and Millersburg. Figure 2-5 is the Process Flow Diagram from the original 2004 design of the AM WTP.

Intake and Raw Water Pump Station

Water from the Santiam River flows through four fully-submerged fish screens located on the riverbed. Water flows by gravity through the screens to the settling chambers at the RWPS. Sand is removed in the settling chambers prior to water overflowing into the wet well. Water from the wet well is pumped to the WTP by 4 vertical turbine pumps, each with a VFD. Sand collected in the settling chamber is removed by two pumps to the sand classifier.

Photo 15
AM – RWPS

Photo 16
AM – RWPS Sand Classifier

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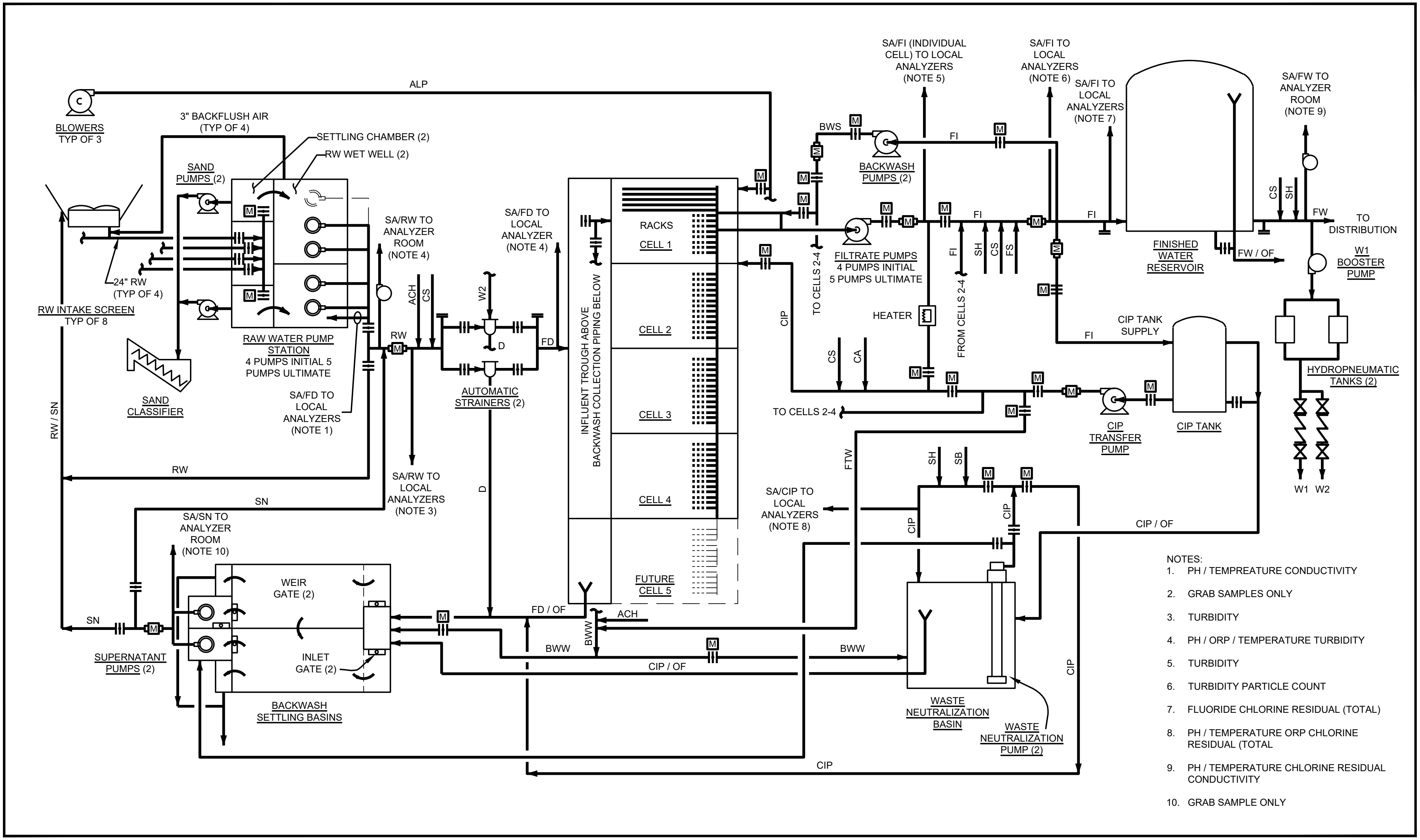

NOTES:

1. PH / TEMPREATURE CONDUCTIVITY
2. GRAB SAMPLES ONLY
3. TURBIDITY
4. PH / ORP / TEMPERATURE TURBIDITY
5. TURBIDITY
6. TURBIDITY PARTICLE COUNT
7. FLUORIDE CHLORINE RESIDUAL (TOTAL)
8. PH / TEMPERATURE ORP CHLORINE RESIDUAL (TOTAL
9. PH / TEMPERATURE CHLORINE RESIDUAL CONDUCTIVITY
10. GRAB SAMPLE ONLY

Figure 2-5

Albany-Millersburg WTP Process Flow Diagram

City of Albany

Water Master Plan

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Strainers

When water arrives at the AM WTP, it goes through the two parallel pre-filter strainers and then onto the membrane cells.

Photo 17
AM - Strainers

Photo 18
AM – Strainers Side View

Membrane Cells

Four membrane cells are used in parallel to treat the water. When originally installed, the plant used Dupont MEMCOR® membranes at 648 per cell. In an attempt to increase capacity, the plant staff tried another membrane brand which did not perform as desired, and ultimately the plant staff switched back to Dupont MEMCOR® membranes. Currently there are 552 membranes in each of the 4 cells (full cell capacity is 648 membranes per cell). There is room for a fifth cell to be installed.

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Photo 19
AM – Membrane Cells

Photo 20
AM - Membranes

Backwash & Settling Ponds

Two backwash pumps are available to backwash membranes. Only one cell is backwashed at a time, and the duration of the backwash is typically set at about 7 to 8 minutes. Used backwash water is sent to two outdoor settling basins. The frequency of a backwash is dependent on numerous factors such as plant flow and raw water quality. At raw water flows over 15.7 mgd, backwash timing begins to limit the production capacity of the plant.

Photo 20
AM – Backwash Pumps

Photo 21
AM – Backwash Settling Basins

Chemicals

Chemicals used at the AM WTP include:

- **Sodium Hypochlorite:** 12.5 percent concentration is used for disinfection and clean-in-place washes. The average disinfection dose is 3.5 mg/L and the maximum dose is 5 mg/L. The sodium hypochlorite is kept in two 10,000-gallon tanks in the upstairs hypochlorite/hydroxide room.
- **Sodium Bisulfite:** 38 percent concentration is used for the clean-in-place process. It is stored in a tank in the downstairs chemical area.
- **Sodium Silicofluoride:** 98 percent concentration is used for providing fluoride in the drinking water. The dosage is 1 mg/L. It is stored in the fluoride room upstairs.
- **Aluminum Chlorohydrate:** 50 percent concentration is used for coagulation of the raw water, with an average small dose at 1.0 mg/l. It is stored in a tank in the downstairs chemical area.
- **Sodium Hydroxide:** 25 percent concentration is used for pH adjustment with a 2.0 mg/L average dosage. It is stored in a tank in the upstairs hypochlorite/hydroxide room.
- **Citric Acid:** 50 percent concentration is used for the clean-in-place process. It is stored in a tank in the downstairs chemical area.

Clean-in-Place System

The clean-in-place system is used to clean membrane filter cells and includes one tank, one tank-mounted water heating element, and one transfer pump. The clean-in-place chemical system uses the following chemicals:

- **12.5 percent Sodium Hypochlorite Chemical Enhanced Backwash (CEB):** 3.4 gallons at 100 parts per million (ppm) are used once per day on each cell to reduce membrane fouling.
- **12 percent Sodium Hypochlorite clean-in-place:** 16 gallons at 500 ppm are used 8 times per year per cell.
- **50 percent Citric Acid:** 155 gallons at 20,000 ppm are used 8 times per year per cell.

Photo 22
AM – Clean-in-Place Tank and Pump

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Waste Neutralization Basin

The waste neutralization basin takes clean-in-place chemicals and neutralizes them using the following chemicals:

- **25 percent Sodium Hydroxide:** 116 gallons per clean-in-place cycle are used 8 times per year per cell.
- **38 percent Sodium Bisulfite clean-in-place:** 29 gallons per clean-in-place cycle are used 8 times per year per cell.
- **38 percent Sodium Bisulfite Maintenance Wash:** 1.5 gallons per maintenance wash performed on two cells per day.

Photo 23
AM – Neutralization Basin

AM Reservoir

Finished water is stored on site in the 5.7 MG reservoir.

Photo 24
AM – Reservoir

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2.5 WATER DISTRIBUTION SYSTEM FACILITIES

The City distribution system facilities include 272 miles of both distribution and transmission piping, 4 pressure zones, 6 pumping stations, 9 storage reservoirs, and other appurtenances such as system valves and flushing stations. Figure 2-6 illustrates how the distribution system facilities are connected and how they interact with one another.

2.5.1 Pressure Zones

In areas with significant elevation changes, water systems are typically separated into pressure zones. Pressure zones enable a water system to serve customers over a wide range of elevations while maintaining relatively consistent service pressures throughout the entire distribution system. Pumps, closed valves, pressure reducing valves (PRVs), or physical separation of pipes, serve as pressure zone boundaries. As shown in Figure 2-6, the City's distribution system is comprised of four pressure zones:

- **Zone 1** is comprised of industrial, commercial, and residential customers. It is served by the Maple Street Pump Station at the Vine Street WTP, and the Queen Avenue, 34th Avenue, and Broadway reservoirs. The connection points with Millersburg are also located in Zone 1.
- **Zone 2** is comprised primarily of residential customers and is served by the Wildwood Reservoir and the North Albany Pump Station.
- **Zone 3** is comprised of residential customers and is served by the Valley View Reservoirs and the Gibson Hill Pump Station. Zone 3 includes customers located outside the UGB that were previously served by the NACSD. Some of the infrastructure serving these customers is located at pressure Zone 2 elevations. In these locations, system pressures can approach 120 psi. Given the high pressures, individual customer PRVs are used to reduce pressures to an acceptable level.
- **Zone 4** is the smallest pressure zone and is comprised completely of residential customers. These customers are located within the boundaries of Zone 3, centered around the Valley View Reservoirs on Valley View Drive. The topography and operating levels of the reservoirs would result in low water pressures for these customers if supplied at the Zone 3 hydraulic grade line (HGL), so the Valley View pump station was constructed to serve this zone. The pump station operates to fill a small hydropneumatic tank that maintains pressures of approximately 50-70 psi at the discharge point. Fireflows in Zone 4 are met with hydrants fed from Zone 3 lines.

Table 2-5 summarizes the information about each pressure zone.

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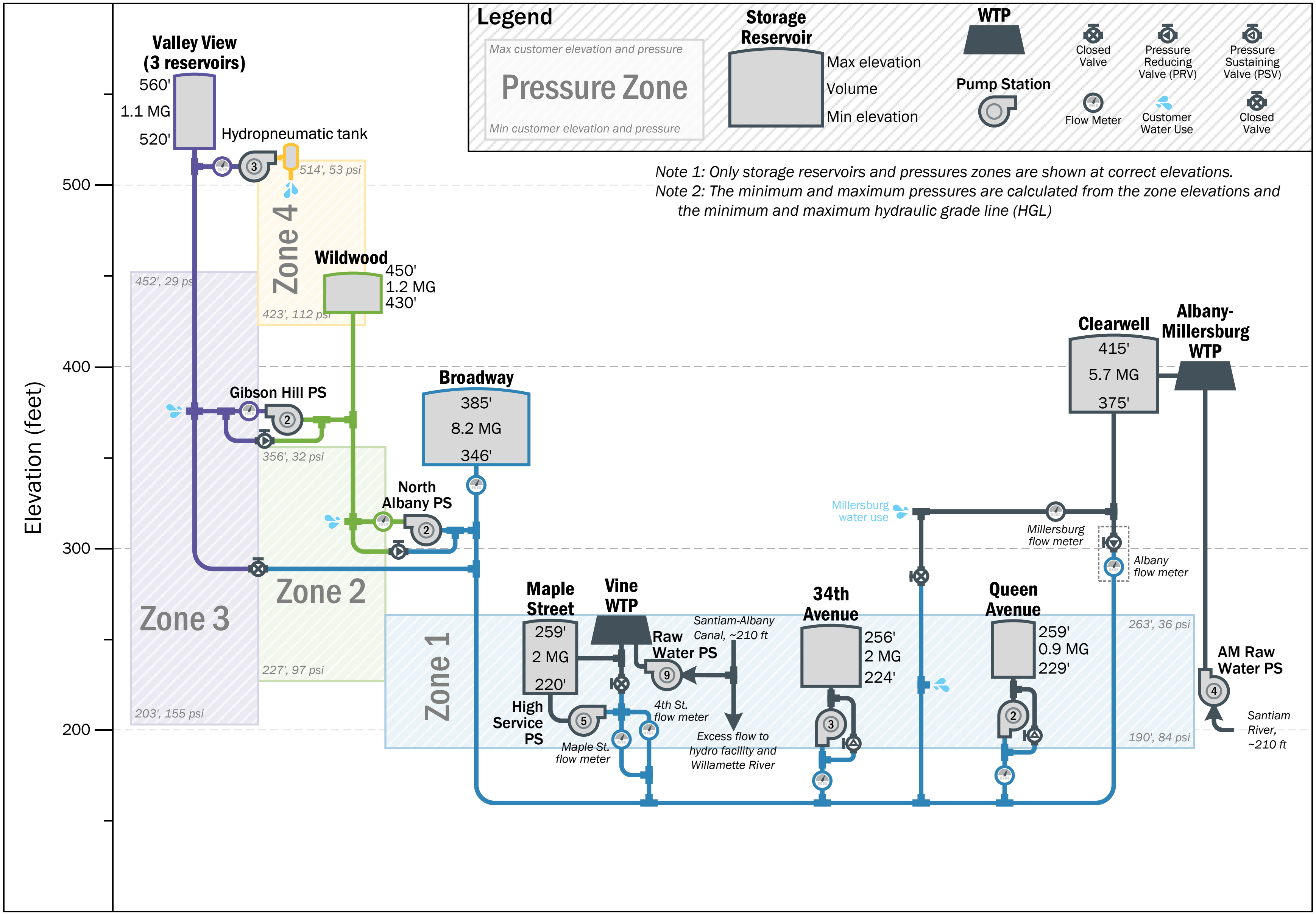

Figure 2-6. Water System Hydraulic Schematic

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Table 2-5. Pressure Zone Summary					
Zone	Minimum Customer Elevation, feet	Maximum Customer Elevation, feet	Minimum HGL, feet	Maximum HGL, feet	Approximate Number of Customers
Zone 1	190	263	346	385	15,300
Zone 2	227	356	430	450	1,700
Zone 3	203	452	520	560	1,000
Zone 4	423	514	636	682	84

2.5.2 Distribution Mains

The City's pipeline network is comprised of more than 270 miles of pipe with diameters ranging from 2 to 42 inches. Water lines with a diameter of 16 inches or larger are classified as transmission lines. Transmission lines are typically designed to convey large volumes of water from one point to another without numerous service connections. Approximately 38 miles, or 14 percent of the City's pipes are transmission lines.

Water lines less than 16 inches in diameter are classified as distribution lines. Distribution lines are typically used to convey water from the transmission lines to the end user. Approximately 231 miles, or 86 percent, of the City's water lines are considered distribution lines.

Material types for both transmission and distribution lines vary. Pipe materials include asbestos cement (AC), cast iron (CI), ductile iron (DI), galvanized iron (GI), polyvinyl chloride (PVC), outside diameter dipped and wrapped steel (ODDW), and steel (STL).

The standard construction materials for water lines have changed over time. Figure 2-7 shows pipeline lengths and materials by installation decade. The oldest pipes in the City's distribution system were installed in approximately 1890. The maximum useful life of water pipes is typically 100 years, requiring replacement considerations for some of the City's oldest. Table 2-6 lists the pipe lengths by diameter and material.

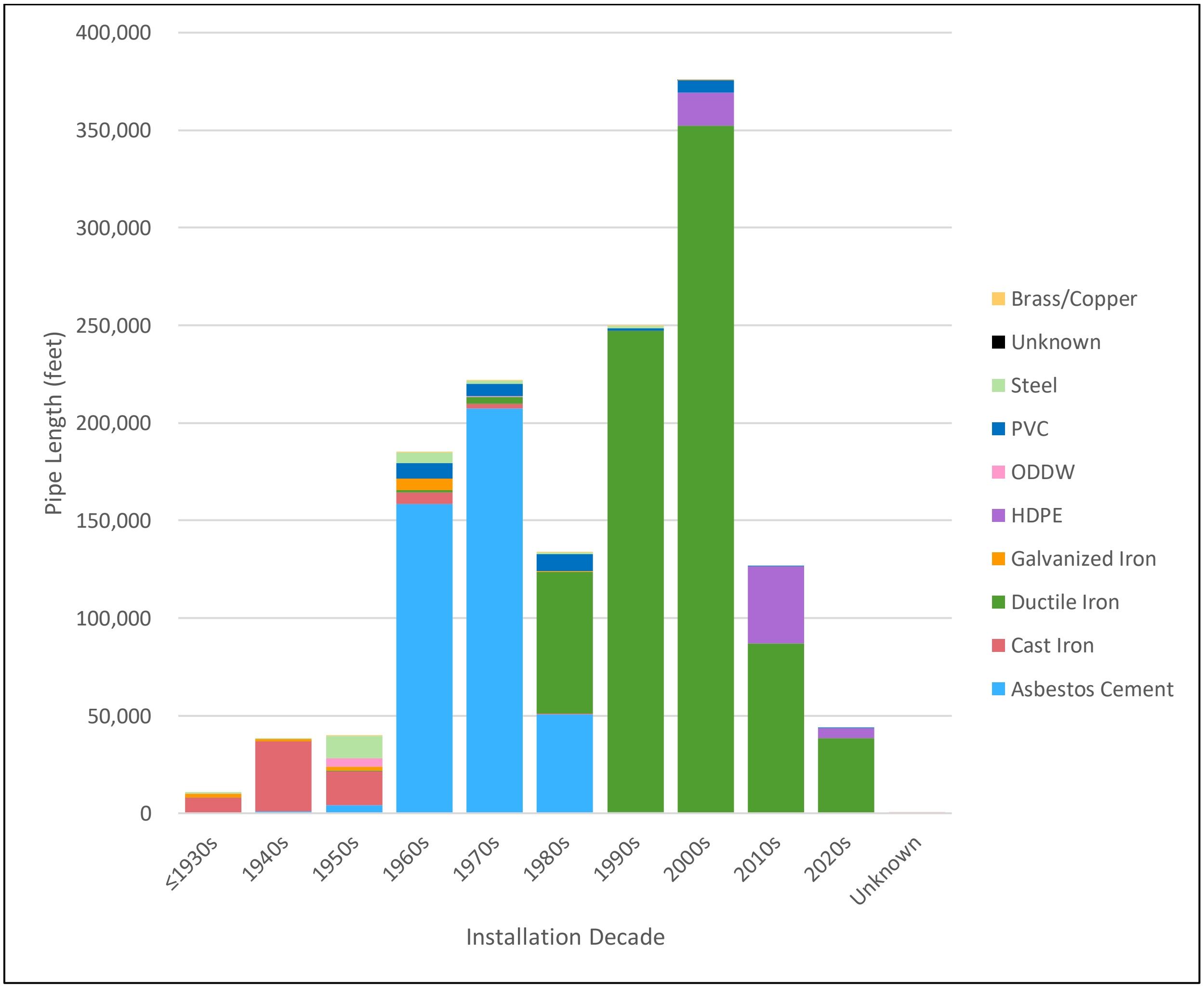

Figure 2-7. Pipe Length by Installation Year

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Table 2-6. Length of Water Mains and Material by Diameter

Material	Length of Piping (feet) by diameter (inches)								Total	Percent of Total
	<=2	3-4	6	8	10-12	16	18-24	40-42		
Asbestos Cement	359	25,134	171,983	82,462	97,774	35,665	8,390	-	421,767	30
Brass/Copper	1,117	7	31	-	-	-	-	-	1,155	0
Cast Iron	1,763	18,863	23,115	6,326	20,129	876	-	-	71,072	5
Ductile Iron	70	30,982	44,669	409,937	177,818	41,175	74,627	22,317	801,595	56
Galvanized Iron	8,930	788	-	817	435	-	-	-	10,970	1
HDPE	8,058	9,778	2,140	20,804	1,501	-	-	18,856	61,137	4
ODDW	378	1,164	1,738	4	1,514	-	-	-	4,798	0
PVC	10,237	7,679	8,422	5,246	-	-	-	-	31,584	2
Steel	5	5,250	10,503	3,671	760	80	1,497	-	21,766	2
Unknown	-	-	-	12	-	-	-	-	12	0
Total	**30,917**	**99,645**	**262,601**	**529,279**	**299,931**	**77,796**	**84,514**	**41,173**	**1,425,856**	**100%**
Percent of Total	**2%**	**7%**	**18%**	**37%**	**21%**	**6%**	**6%**	**3%**	**100%**	

Source: GIS layer – CoA_mainlines, June 21, 2023

ODDW = Outside diameter dipped and wrapped steel pipe
HDPE = High density polyethylene
PVC = Polyvinyl chloride

DRAFT

2.5.3 Pump Stations

The City maintains six treated water pumping stations, as well as treatment process pumps, transfer pumps, and raw water pumps at the Vine Street WTP and AM WTP. Information about the six treated water pump station facilities is summarized in Table 2-7 and pump station locations are shown in Figure 2-1. Manufacturer's pump curves for each pump are included in Appendix A.

Table 2-7. Potable Water Pump Stations

Name	Pump Name	Year Constructed	Pump Size, hp	Pump Design Flow, gpm	Pump Design TDH, feet	Station Total Capacity, gpm[(a)]	Station Firm Capacity, gpm[(b)]
Maple Street Pump Station	11	Original: 1959 Improvements: 2001	150	3,250	145	22,650	15,950
	12		300	6,700	145		
	13		100	2,000	145		
	14		200	4,000	145		
	15		300	6,700	145		
34th Ave Reservoir Pump Station	41	Original: 1971 Improvements: 1990	50	800	150	5,800	2,800
	42		100	2,000	150		
	43		125	3,000	150		
Queen Ave Reservoir Pump Station	21	Original: 1955 Improvements: 1990	30	500	150	1,900	500
	22		75	1,400	150		
North Albany Pump Station	51	Original: 1980 Improvements: 2000 & 2018	75	1,800	82	3,600	1,800
	52		75	1,800	82		
Gibson Hill Pump Station	61	Original: 1999	75	900	138	1,800	900
	62		75	900	138		
Valley View Pump Station	1	Original: 2006	3	53	146	527	290
	2		7.5	237	92		
	3		7.5	237	92		

(a) These capacities will vary with system pressures and, therefore, will not be realized under all demand scenarios.
(b) Firm capacity represents the combined pump station capacity with the largest pump out of service.

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2.5.4 Reservoirs

The City's water system has nine finished water storage reservoirs, which provide a total storage capacity of 21.3 MG. Reservoir locations are shown on Figure 2-1 and storage volumes/dimensions are summarized in Table 2-8.

Table 2-8. Reservoirs

Name	Type	Year Constructed	Total Volume, MG	Diameter, feet	Bottom Elevation, feet	Overflow Elevation, feet	Notes
AM WTP Clearwell	At-grade steel	2005	5.70	156	375.0	415.0	1 MG needed for chlorine contact time. Remaining volume is shared equally with Millersburg (2.35 MG available to each city).
Maple	At-grade steel	1960	2.00	93	220.0	259.8	Vine WTP clearwell, 0.5 MG needed for chlorine contact time. Remaining 1.5 MG available for use by the distribution system.
Queen Avenue	At-grade steel	1955	0.90	73.2	229.0	260.5	-
34th Avenue	At-grade steel	1971	2.00	104	224.0	255.5	-
Broadway	At-grade concrete	1992	8.20	188.7	346.0	385.0	-
Wildwood	At-grade concrete	1999	1.15	99.3	430.0	450.0	-
Valley View North	At-grade steel	1963 and 1967	0.25	25	520.0	567.5	These three reservoirs are located at the same site
Valley View Middle	At-grade steel		0.25	25	520.0	567.5	
Valley View South	At-grade steel	1982	0.85	55	520.0	567.5	

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2.5.5 Other Facilities

The water system also includes system control valves, flushing stations, and pressure monitoring stations.

Key System Valves

The City's PRV and metering station is located on the transmission pipeline from the AM WTP near Berry Drive NE. Because the AM WTP is at a higher elevation than the Broadway reservoir, this PRV controls flow into the system from AM WTP to maintain adequate water levels in the Broadway reservoir. The pressure setting at the PRV is controlled via SCADA and is changed in response to water levels in the Broadway reservoir. An emergency interconnect valve with the Millersburg water system is located in Zone 1 on Salem Avenue SE. This valve is normally closed but can be opened to supply water to Millersburg from the Vine WTP in the event of an outage at the AM WTP.

Flushing Stations

Nine automatic flushing stations are located at points in the system where water quality is a concern. These flushing stations operate on timers to release water from the distribution system, improving the water age and quality. Four stations are located in Zone 1, one station is in Zone 2, and the remaining four stations are in Zone 3, as shown in Figure 2-1.

Pressure Monitoring Stations

In addition to the City's ability to monitor pressures at the PRV and the pump stations, four pressure monitoring stations are located in Zone 1 at City-owned sewer lift station buildings, as shown in Figure 2-1.

Water Meters

The City currently has over 18,900 water meters in its distribution system. Since the late 1990's the City had been using Sensus water meters for all new installations and replacements. In 2009, the City began installing the iPerl and Omni model water meters, which have a port where a transmitter can be plugged in for advanced metering infrastructure (AMI) application. Approximately 41 percent of water meters in service have the AMI capability. Until AMI capability is installed and commissioned in the entire system, the City will continue contracting a meter reading service. The current rate for meter reading is $140,000 annually. The City's current operational goal is to replace water meters every 20 years.

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CHAPTER 3
Population and Water Demands

3.1 INTRODUCTION AND PURPOSE

Reliable demand projections are a foundational element to developing an effective water master plan. This chapter summarizes the City's historical water demands and the methods used to estimate future demands. A range of demands were projected to illustrate the potential impacts of uncertainties with conservation effectiveness, climate change, and development trends. The demand projections include only the City of Albany's water service area, and do not include projections for the City of Millersburg.

3.2 HISTORIC WATER DEMAND

This section summarizes the historical water demands, water loss calculations, indoor and outdoor use, and unit use rates by land use type.

3.2.1 Demand

Hourly records from the City Supervisory Control and Data Acquisition (SCADA) system for January 2008 through December 2022 were used to calculate daily demand for this period. The SCADA records included water treatment plant production, tank level records, and flow to Millersburg.

For years prior to 2008, monthly water use data was obtained from the Oregon Water Resources Department (OWRD) records. OWRD records report raw water use. The 2004 Water Facility Plan (2004 WFP) estimated treated water produced at Vine WTP (the only WTP in operation at the time) as 95 percent of the reported raw water numbers.

In the OWRD reporting, the Millersburg demands were combined with the Albany demands from 1994 to 2007, so the City of Albany demand for those years is estimated based on an assumption of 0.98 mgd for Millersburg, which is the Millersburg average daily demand recorded from SCADA in 2008. Due to flow metering and recording improvements, demands from 2008 and onward are the most reliable. City demands before 2008 are estimates.

Table 3-1 shows the average daily demand (ADD), minimum monthly demand (MMD), and maximum day demand (MDD) for 2008 through 2022. The MMD represents the winter demand, which is assumed to be the indoor demand. Average monthly demands and MDD are shown in Figure 3-1. ADD for 1994 through 2022 is shown in Figure 3-2. 2006 was the first full year of operation for the AM WTP, so the numbers for that year may not be reflective of actual water use in the City. Starting in 2008, likely linked to the housing crisis and recession in the United States, many utilities in the pacific northwest experienced a slight reduction in water use as seen in Figure 3-2.

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Table 3-1. Albany Historical Demand[(a)], 2008 to 2022

Year	Demand, mgd			MDD Date	MDD Multiplier
	ADD	MMD[(b)]	MDD		
2008	6.56	5.47	9.35	7/7	1.42
2009	6.82	5.25	13.07	7/27	1.92
2010	6.10	4.86	11.36	7/25	1.86
2011	5.93	4.74	10.24	8/24	1.73
2012	5.95	4.57	10.67	8/15	1.79
2013	6.07	4.60	10.83	7/24	1.79
2014	6.07	4.52	10.77	7/16	1.77
2015	6.32	4.53	11.67	7/29	1.85
2016	6.15	4.40	11.07	8/18	1.80
2017	6.20	4.61	12.21	7/31	1.97
2018	6.42	4.54	11.50	7/25	1.79
2019	6.22	4.75	10.39	8/4	1.67
2020	6.23	4.67	11.28	7/27	1.81
2021	6.49	4.53	11.33	6/26	1.75
2022	5.90	4.41	10.64	7/29	1.80
Average	6.23	4.70	11.09	7/28	1.78
Minimum	5.90	4.40	9.35	6/26	1.42
Maximum	6.82	5.47	13.07	8/24	1.97

(a) Albany demand only. Does not include deliveries to Millersburg.
(b) Minimum month demand calculated as average of January and February.

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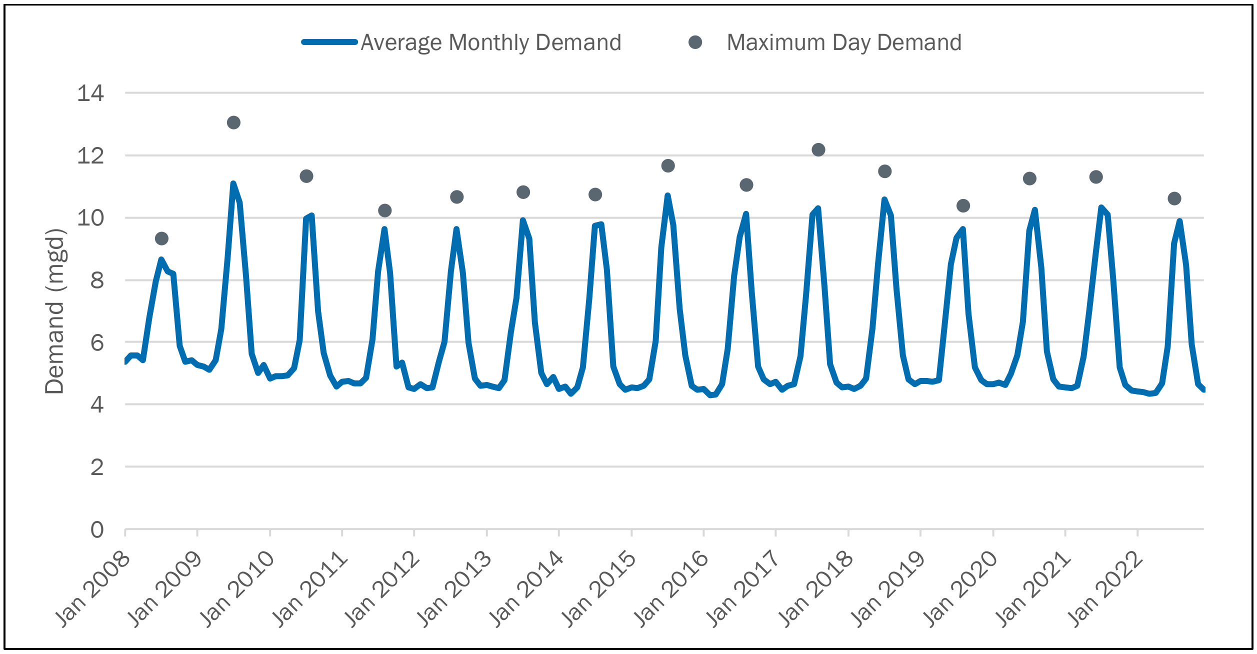

Figure 3-1. Albany Monthly Demand and MDD, 2008 — 2022

Note: Albany demand only. Does not include deliveries to Millersburg.

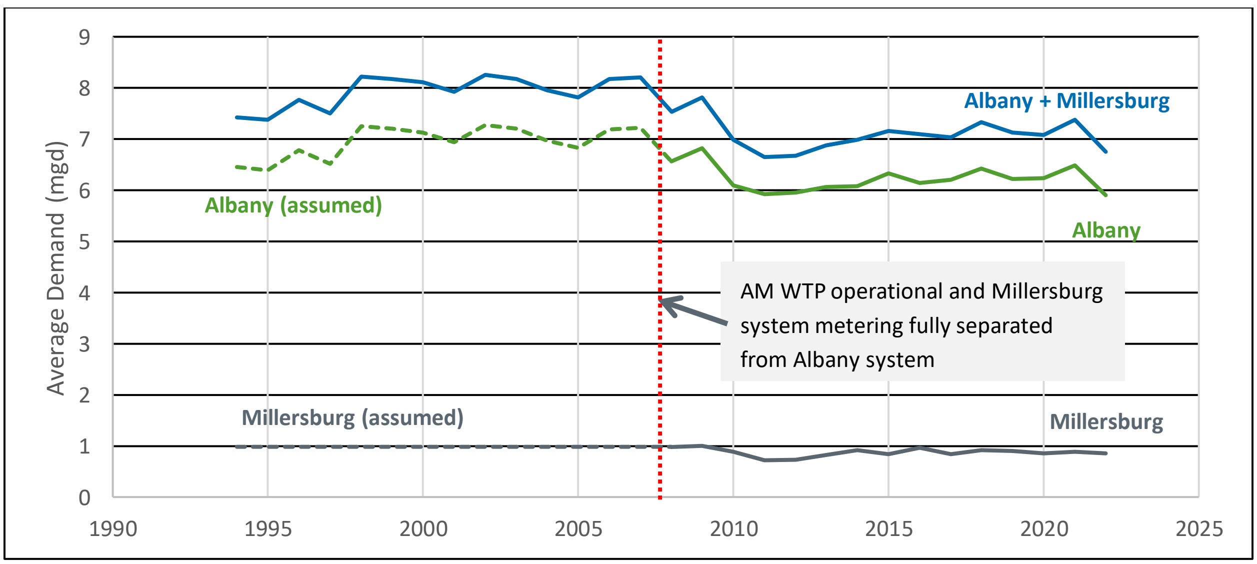

Figure 3-2. Average Day Demand, 1994 through 2022

3.2.2 Water Loss

SCADA records and monthly metered customer water use for January 2018 through December 2022 were used to calculate water loss for the system. Water loss is the difference between water produced and water consumed, and is usually the result of leakage, metering inaccuracies, and unauthorized consumption.

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The average monthly production, consumption, and water loss for 2018 through 2022 are summarized in and shown in Figure 3-3. Note that the real loss percents shown in are slightly different than the values calculated by the City. The differences are due to the data sources used and methods of correcting incorrect SCADA values. (uses hourly SCADA and includes changes in storage, the City calculation use daily average production)

Table 3-2. Total Production and Consumption Comparison, mgd

	Supply			Authorized Consumption			Losses		
Year	Total Production	To Millersburg	To Albany	Billed Albany Customers	Un-Billed Metered(a)	Estimated Un-metered(b)	Estimated Apparent(c)	Real	Real %
2018	7.33	0.91	6.42	5.46	0.149	0.068	0.055	0.671	10.4
2019	7.12	0.90	6.22	5.38	0.145	0.067	0.054	0.563	9.1
2020	7.08	0.85	6.23	5.34	0.165	0.067	0.053	0.584	9.4
2021	7.37	0.88	6.49	5.64	0.126	0.070	0.056	0.587	9.0
2022	6.76	0.85	5.90	5.12	0.090	0.064	0.051	0.561	9.5

(a) Automatic flushing stations, hydropower cooling water, Dumbeck Lane water billing (ended 2020, customers incorporated into City billing system),
(b) Total estimated as 1.25% of billed metered consumption
(c) Total estimated as 1.00% of billed metered consumption

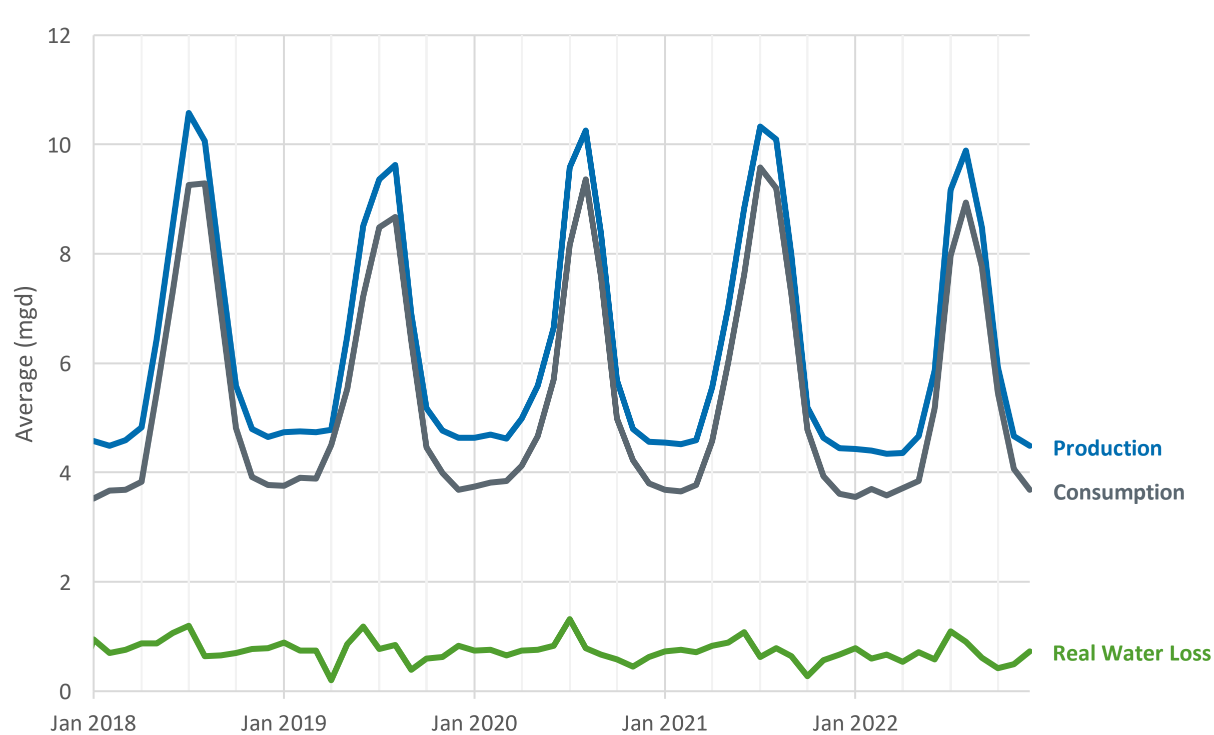

Figure 3-3. Monthly Average Water Production, Consumption, and Loss

Note: Albany demand only. Does not include deliveries to Millersburg.

3.2.3 Indoor and Outdoor Demand

Indoor water use is generally constant all year. Total water use typically increases in the spring and summer months as irrigation increases. Water use in the winter months can be assumed to represent only indoor use, because there typically will be no irrigation occurring. Outdoor water use is assumed to be the difference between total use and the assumed indoor use. Figure 3-4 shows the cycle of water use throughout the year. Table 3-3 shows the average annual indoor and outdoor water use for each zone for 2018 through 2022, calculated from SCADA production records.

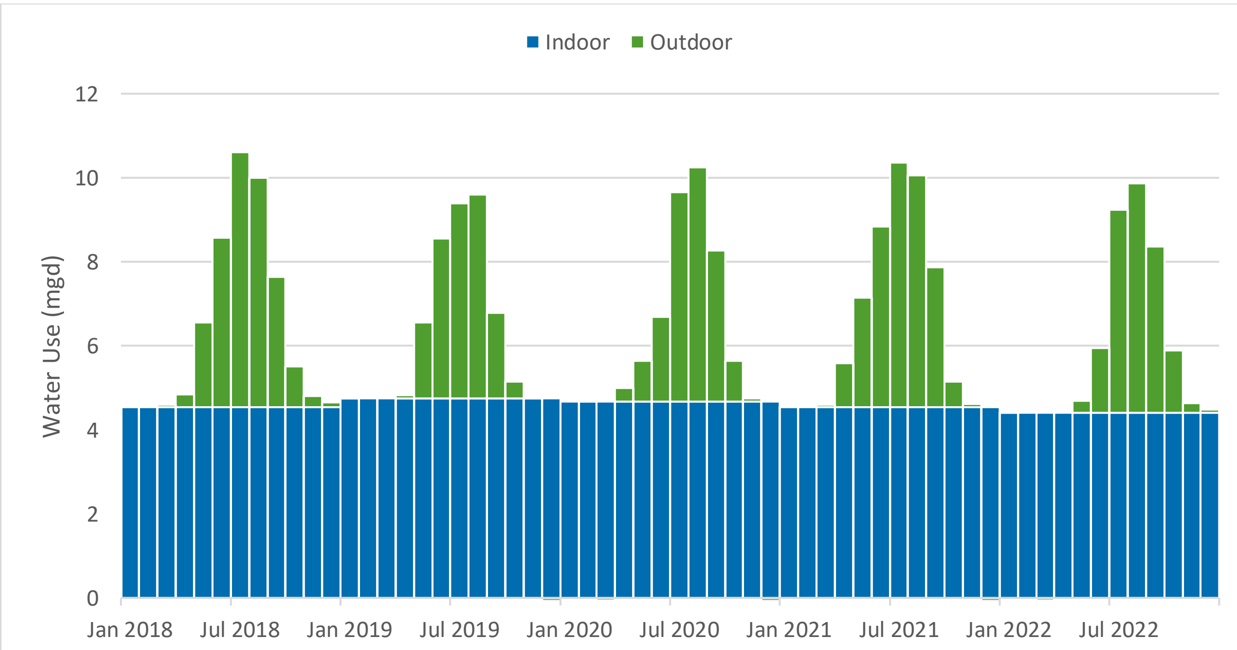

Figure 3-4. Indoor and Outdoor Use

Table 3-3. Total Albany Indoor and Outdoor Use, mgd

Year	Total Indoor Water Use				Total Outdoor Water Use				Total Water Use
	Zone 1	Zone 2	Zone 3 / 4	Total	Zone 1	Zone 2	Zone 3 / 4	Total	
2018	4.01	0.25	0.27	4.53	1.52	0.22	0.15	1.89	6.42
2019	4.24	0.27	0.23	4.75	1.13	0.18	0.16	1.47	6.22
2020	4.16	0.25	0.29	4.69	1.26	0.20	0.15	1.54	6.23
2021	3.99	0.27	0.28	4.54	1.53	0.22	0.20	1.95	6.49
2022	3.85	0.26	0.30	4.41	1.17	0.18	0.14	1.49	5.90

3.2.4 Unit Use Rates

Water unit use rates were developed from the consumption records and land use from the City of Albany Comprehensive Plan. The average total consumption for 2021 and 2022 was divided by the land area to get a unit use rate for each land use and pressure zone, both indoor and outdoor, as shown in Table 3-4.

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For non-residential areas, the "outdoor" rate may not actually represent outdoor use and may be a seasonal increase unrelated to irrigation use. For instance, food processors who do a lot more work during the growing season might consume more water as part of their process, not necessarily for outdoor irrigation use.

Note that in Table 3-4, the outdoor use rate for Residential – Medium Density in Zone 2 is higher than the use rate for Low Density, which is unexpected. This appears to be due to the small sample size skewing the results – a single small neighborhood with a park in Zone 2 is zoned as Medium Density. There is no expected growth of Residential — Medium Density land in Zone 2, so this value does not affect the demand projections.

The indoor and outdoor water rates for Residential-Low Density areas in Zone 3/4 are also significantly less than those in Zones 1 and 2. The reasons for this discrepancy are not immediately apparent from the available data. It's possible that Zone 3/4 has fewer residents per lot compared to Zones 1 and 2, which could explain the reduced indoor water consumption rates. Additionally, an inspection of parcels in Zone 3/4 reveals that they tend to be large and wooded, with minimal to no turf grass, unlike the more compact parcels in Zones 1 and 2 that have a larger proportion of turf grass. This difference in parcel size and landscaping likely contributes to the lower water usage rates per acre in Zone 3/4.

Table 3-4. Existing Albany Water Consumption Unit Use Rates, gallons per day (gpd)/acre

Pressure Zone	Land Use	Indoor Unit Use Rate			Outdoor Unit Use Rate		
		2021	2022	Indoor Average	2021	2022	Outdoor Average
Zone 1	Commercial — General	418	436	427	231	183	207
	Commercial — Light	365	373	369	274	253	263
	Industrial	689	615	652	365	270	317
	Industrial — Light	164	173	168	107	84	95
	Mixed Use/Neighborhood Village	440	483	462	215	190	202
	Open Space	6	6	6	16	7	11
	Public and Semi—Public	40	41	41	17	12	14
	Residential — Low Density	474	456	465	269	198	234
	Residential — Medium Density	898	893	895	256	206	231
Zone 2	Public and Semi-Public	12	11	12	205	182	193
	Residential — Low Density	332	328	330	340	271	305
	Residential — Medium Density	584	553	569	807	610	708
Zone 3 / 4	Residential — Low Density	65	70	68	84	66	75

3.3 PROJECTED WATER DEMAND

Water demand forecasting is difficult and frequently inaccurate. For example, the projected demands from the 2004 WFP compared to the actual demands for the City are shown in Figure 3-5. While the population projections were fairly accurate, the City's average water use and per capita use rate diverged significantly from the projections in the period from 2004 through 2022. Further discussion on

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factors contributing to water use not increasing as previously forecasted can be found in Section 3.3.2 Conservation and Efficiency.

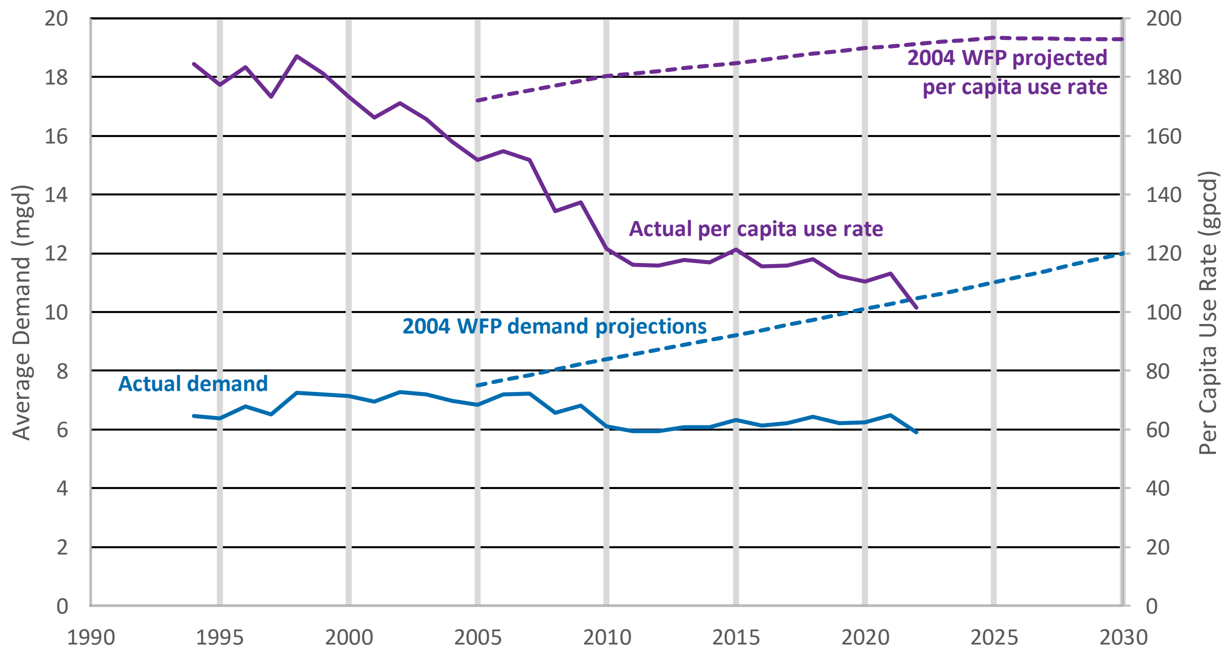

Figure 3-5. Comparison of Projected and Actual Demands and Per Capita Use Rates

Note: Albany demand only. Does not include deliveries to Millersburg or Millersburg population.

For this study, a land-use-based approach was used to project current demands to buildout. Compared to other methods like the population-based approach, a land-use based approach utilizes well-considered land-use plans, which are often enacted by City ordinances and zoning laws. In contrast, population-based methods assume water usage is directly proportional with population size.

Adjustments to the indoor and outdoor unit use rates were made for uncertainty in growth rates, conservation, and climate change to try and account for a range of possible future conditions. The total water use was then divided by the expected population to verify that the demand forecasts were reasonable.

3.3.1 Land Use

The City has developed a land use Comprehensive Plan for areas inside the UGB. The UGB is the area in which a city expects to ultimately grow. Areas outside of a UGB are restricted from urban developments to protect farm and forest resource land. While a UGB can be expanded, the Comprehensive Plan represents the best estimate of buildout conditions. The buildout date of the existing City UGB is uncertain, but for the purpose of this plan buildout is assumed to occur in 2070.

The land use data from the Comprehensive Plan, as well as a land use plan for the east Albany area, were spatially joined with parcel data. Each parcel was flagged as either “developed” or “undeveloped.” Table 3-5 shows the developed and undeveloped areas within each pressure zone by land use type as of 2022. Figure 3-6 shows a map of these areas.

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Table 3-5. Albany Land Use Area, acres

Land Use	Currently Developed Area				Undeveloped Area within UGB			
	Zone 1	Zone 2	Zone 3 / 4	Total	Zone 1	Zone 2	Zone 3 / 4	Total
Commercial — General	536	—	—	536	43	—	—	43
Commercial — Light	62	—	—	62	—	—	—	—
Industrial	400	—	—	400	—	—	—	—
Industrial — Light	874	—	—	874	552	—	—	552
Mixed Use/Neighborhood Village	426	—	—	426	86	—	—	86
Open Space	1,262	—	—	1,262	95	—	—	95
Public and Semi—Public	4,435	32	—	4,468	26	—	—	26
Residential — Low Density	3,186	646	2,139	5,974	403	283	552	1,237
Residential — Medium Density	765	16	—	781	328	—	—	328
Residential — High Density	—	—	—	—	130	—	—	130
Urban Residential Reserve	—	—	—	—	1,017	—	—	1,017
Total	**11,947**	**695**	**2,137**	**14,781**	**2,681**	**283**	**552**	**1,017**

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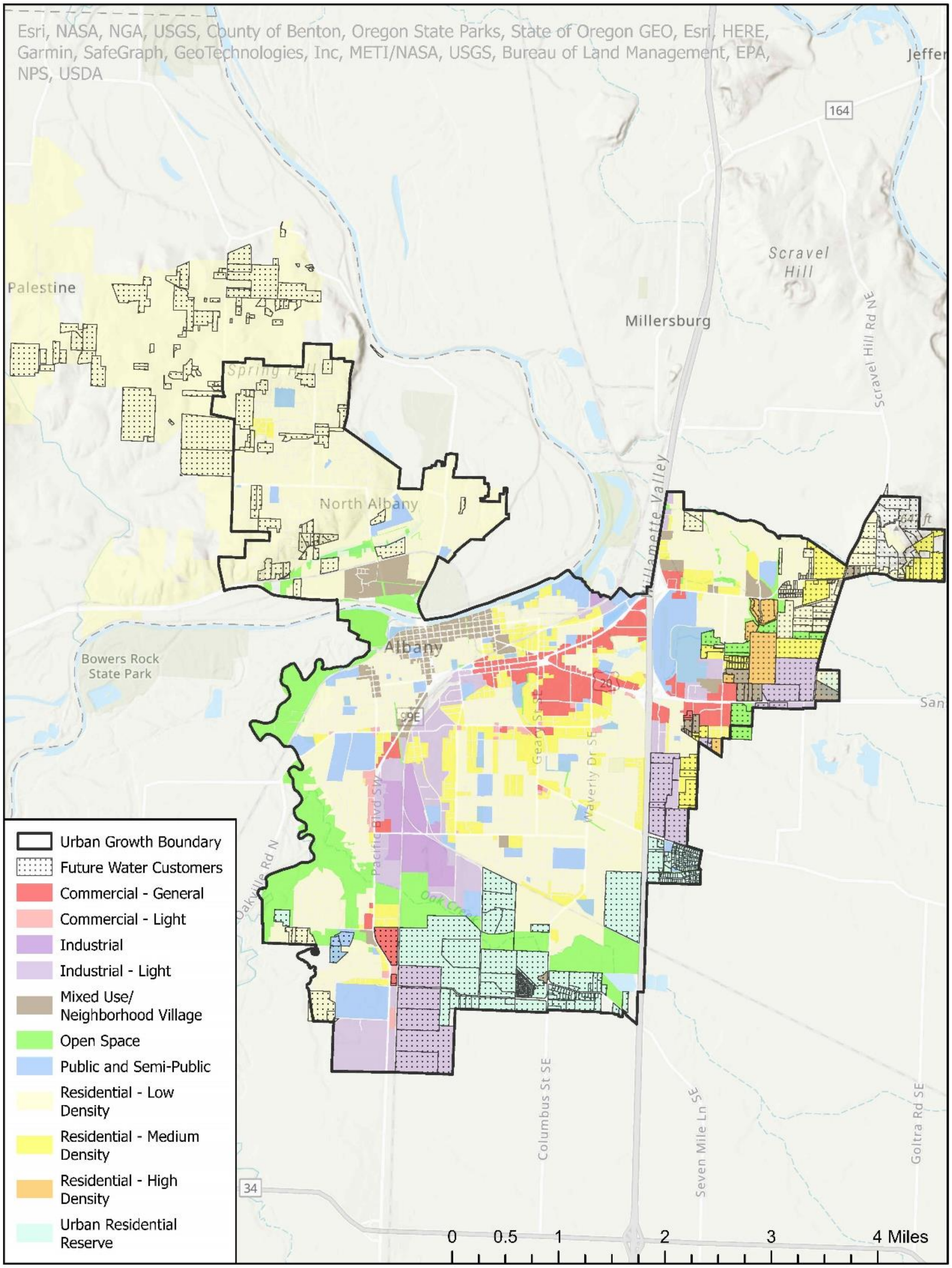

Figure 3-6. Existing and Future Land Use

Sources: Comprehensive Plan, East Albany land use plan, South Albany land use plan, discussion with City staff

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In 2019, Oregon passed HB 2001, which attempts to address housing shortage and affordability issues across the state. The law requires medium and large cities to allow construction of various types of "middle housing" (ADU's, duplexes, triplexes, fourplexes, cottage clusters, and townhouses) in residential areas.

The consequence for the City is that areas currently zoned or planned for low density residential may be redeveloped to be medium density, which has different water use characteristics. No one knows how this process will play out or how many properties this may affect. Section 3.3.4 below addresses how this, and a selection of other uncertainties, are accounted for in forecasting future demand.

3.3.2 Conservation and Efficiency

Oregon requires municipalities of the City's size to implement the following 11 basic conservation measures:

- Annual Water Audit
- Metered Accounts, Meter Testing, and Meter Maintenance
- Rate Structure Based on Consumption
- Leak Detection and Line Replacement
- Public Education and Outreach
- Water Re-use, Recycling, and Non-Potable Water Opportunities
- Technical and Financial Assistance

The City has implemented and plans to continue to promote water conservation through these conservation measures. The City does not have a re-use/recycling/non-potable water program but encourages customers to utilize re-use/recycling/non-potable water where it is safe and feasible. No additional conservation measures are planned (WMCP, 2017).

A likely reason for the reduction in water use and per capita use rates in the past 20 years has been the replacement of steel pipes, which were the primary source of leaks in the water system. As of January 2023, approximately 74 percent of the steel pipes (listed as steel, galvanized iron, wrought iron, ODDW, or unknown material) present in 2003 have been replaced.

Another likely influence on reducing water use was the Energy Policy Act (EPAct) of 1992, which contained the first national standards requiring water efficiency in new consumer products. Standards for plumbing fixtures and appliances have resulted in a dramatic nationwide decrease in household water use since 1992 (NRDC 2017). The EPAct standards focused on newly made products, which gradually make their way into homes and businesses as owners upgrade or replace old equipment.

Starting in 2008, likely linked to the housing crisis and recession in the United States, many utilities in the pacific northwest experienced reductions in water use.

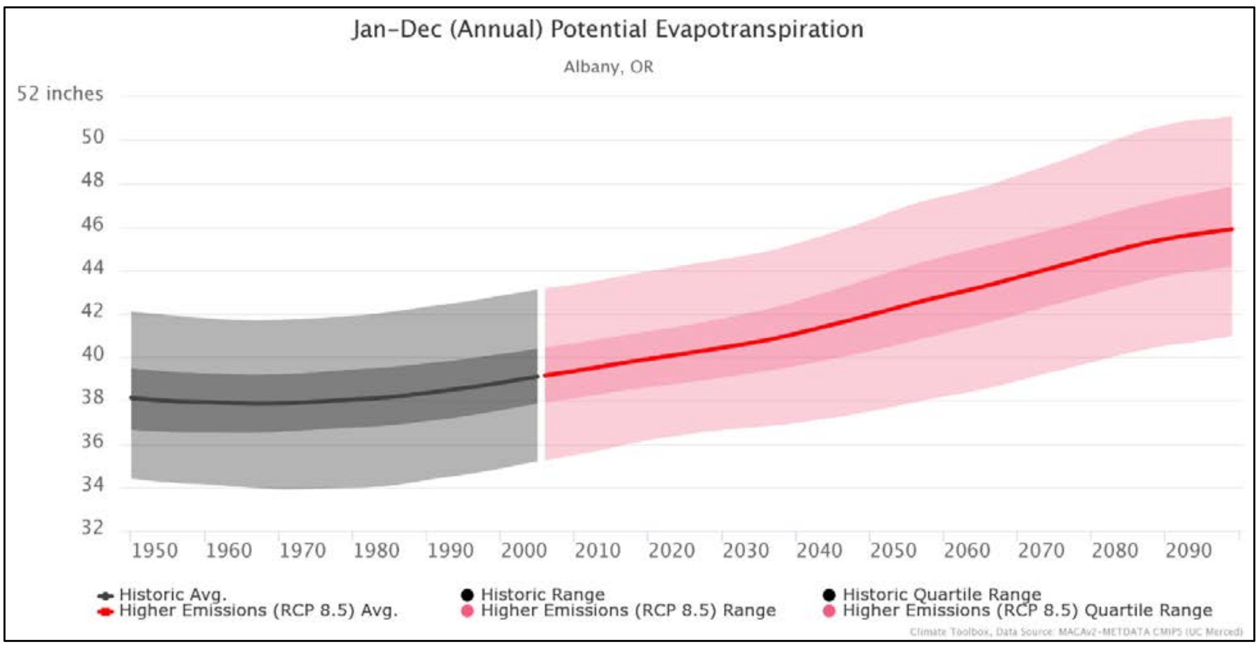
The impact of leak reduction efforts and water efficiency standards can be seen in the City's water use data shown in Figure 3-5. Most of the significant water efficiency gains resulting from the pipe leak repairs and EPAct standards have likely already been realized. Only 7.5 miles of steel pipe remain in the distribution system (see Chapter 2, Section 2.52), and these steel pipes will likely be replaced by buildout. Most of the plumbing fixtures installed before 1992 have likely been replaced with new efficient fixtures, and new buildings constructed since 1992 have used plumbing fixtures meeting the new standards.

For these reasons, additional reductions in per capita water use due to plumbing code improvements or conservation efforts, or reductions in water loss are likely to be minimal.

3.3.3 Climate Change

Oregon's average annual temperature has increased approximately 2.2 Fahrenheit (°F) since 1895 and is projected to increase by an additional 5°F by the 2080's if greenhouse gas emissions continue at current levels. Warming is expected to impact both water supplies and demand in the Willamette Valley (Sixth Oregon State University, 2023).

While the impact of future climate change on water demand is difficult to quantify, it will primarily affect outdoor water use. Potential evapotranspiration (PET) is a measure of the atmosphere's "thirst" for water through evaporation of water from soils and transpiration of water from plants. Changes in outdoor water use are coupled with changes in PET, which are affected by temperature increases and rainfall. By 2070, average PET for the City area is projected to increase by 9 percent above 2020 levels in a high-emissions scenario, shown in Figure 3-7 (Climate Toolbox 2023).



Source: https://climatetoolbox.org/tool/Future-Time-Series

Figure 3-7 Future Potential Evapotranspiration Due to Climate Change

3.3.4 Demand Scenarios

Demand projections use the land areas and unit water use rates from Table 3-4 and Table 3-5 to project the buildout demands. Three land use-based scenarios (low, medium, high) were developed to account for uncertainty in land use, conservation, and climate change variables. The differences between these scenarios are shown in Table 3-6.

The projections assume all urban residential reserve land will be developed as medium-density residential. Future high-density residential land (of which there is not currently any) will have approximately double the number of dwelling units per acre as medium-density residential, therefore the indoor use rate for future high-density residential land was also assumed to be double that of medium-density residential.

Table 3-6. Demand Projection Scenario Descriptions at Buildout

Scenario	Middle Housing Development[b]	Conservation	Water Loss	Climate Change[a]
Low	10 percent of existing and future low density residential gets redeveloped to medium density at buildout.	Unit use rates decrease by 10 percent	Water loss reduced by 25 percent	Outdoor water use increases by 5 percent
Medium	50 percent of existing and future low density residential gets redeveloped to medium density at buildout.	Unit use rates decrease by 5 percent	Water loss reduced by 10 percent	Outdoor water use increases by 7 percent
High	100 percent of existing and future low density residential gets redeveloped to medium density at buildout.	No additional conservation	Existing water loss rates	Outdoor water use increases by 9 percent

(a) Climate change impacts on PET for the buildout year.
(b) See Section 3.3.1 for description of Middle Housing Development

3.3.5 Average Day Demand Projections

Average indoor and outdoor demands for each scenario and pressure zone are listed in Table 3-7. Demand was interpolated linearly between 2023 and buildout as shown in Table 3-8 and Figure 3-8. Buildout is estimated to occur in 2070 as indicated in the tables below.

Table 3-7. Albany Average Day Demand Projections, mgd

Zone	Average Water Demand at Buildout (Est. 2070)								
	Low Scenario			Medium Scenario			High Scenario		
	Indoor	Outdoor	Total	Indoor	Outdoor	Total	Indoor	Outdoor	Total
Zone 1	5.03	2.05	7.07	6.05	2.23	8.28	7.31	2.41	9.71
Zone 2	0.31	0.29	0.60	0.42	0.28	0.70	0.56	0.26	0.82
Zone 3/4	0.36	0.35	0.71	1.07	0.62	1.69	2.07	0.99	3.06
Total	**5.70**	**2.69**	**8.38**	**7.54**	**3.13**	**10.67**	**9.94**	**3.66**	**13.60**

Table 3-8. Albany Average Day Demand Projections, mgd

Year	Total ADD		
	Low Scenario	Medium Scenario	High Scenario
2023	5.98	6.34	6.73
2025	6.08	6.53	7.03
2030	6.34	6.99	7.76
2035	6.59	7.45	8.49
2040	6.85	7.91	9.22
2045	7.10	8.37	9.95
2050	7.36	8.83	10.68
2055	7.61	9.29	11.41
2060	7.87	9.75	12.14
2065	8.12	10.21	12.87
2070 – Build out	8.38	10.67	13.60

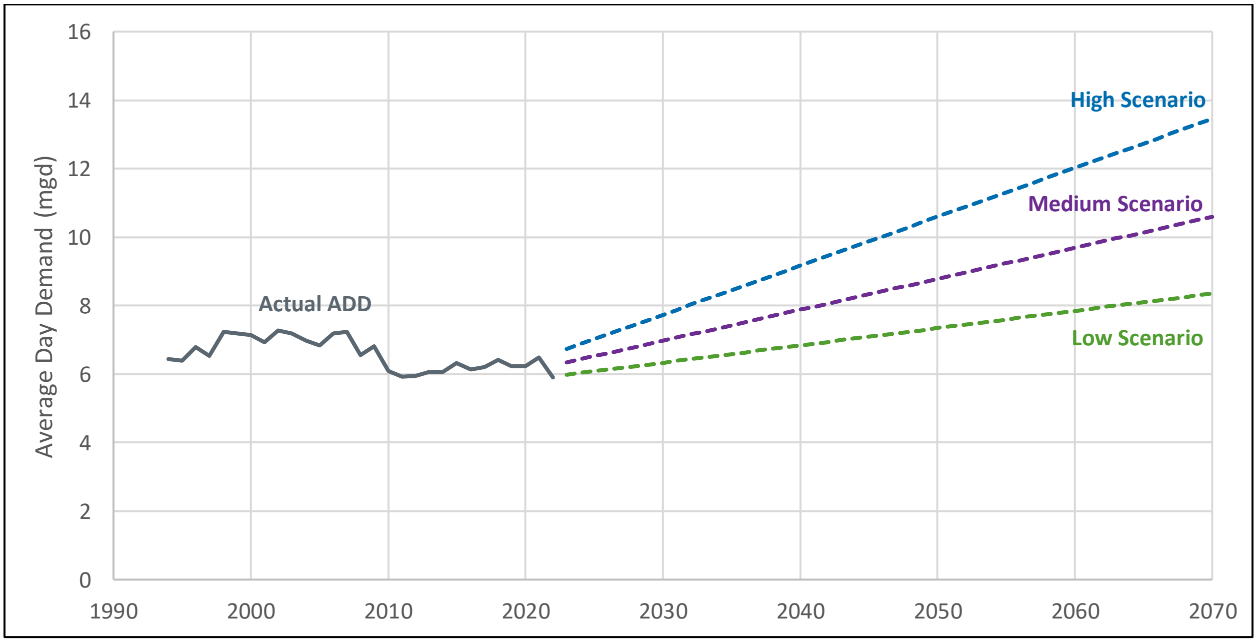


Figure 3-8. Historical and Projected Average Day Demands
Note: Albany demand only. Does not include deliveries to Millersburg.

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3.3.6 Per Capita Demand Comparison

To verify that demand projections are reasonable, the historical population was used to calculate per capita demands that were compared with projections.

Population projections from the Portland State University (PSU) Population Research Center (PRC) were used to calculate projected per capita demands. This is the official population forecast used by communities in Oregon. Table 3-9 and Figure 3-9 show the historical population and the population projections, as well as the annual growth rate. The large spike in growth rate in 1991 (Figure 3-9) is due to the annexation of North Albany into the City.

Table 3-9. Albany Population Projections

Year	City Actual	Projected (PSU PRC)
1990	29,731	—
1995	36,049	—
2000	41,151	—
2005	45,021	—
2010	50,172	—
2015	52,186	—
2020	56,474	55,954
2025	—	59,427
2030	—	63,270
2035	—	66,668
2040	—	69,840
2045	—	72,990
2050	—	76,171
2055	—	79,483
2060	—	82,930
2065	—	86,519
2070 Build out	—	90,255

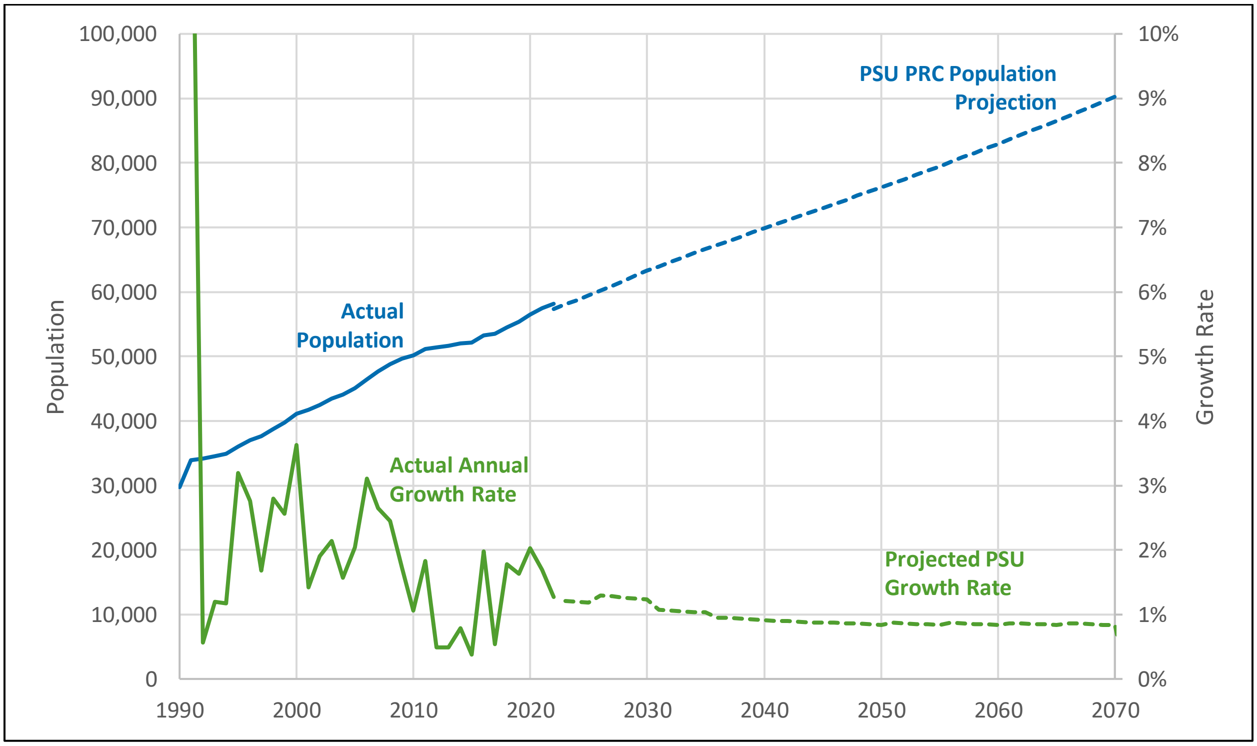

Figure 3-9. Historical and Projected Population with Growth Rate

Dividing demand projections from the three scenarios by the PSU population projections for each future year yields the projected per capita use rates as shown in Figure 3-10.The last 30 years has seen a steady decrease in the per capita use rate, from a high of 187 gallons per capita per day (gpcd) in 1998, to a low of 101 gpcd in 2022. However, reductions in the per capita use rate likely cannot continue indefinitely. The low scenario shows a slightly slower reduction in the per capita use rate than in the past 10 years, while the medium scenario shows an essentially constant per capita use rate. The high scenario shows an increase in the per capita use rate.

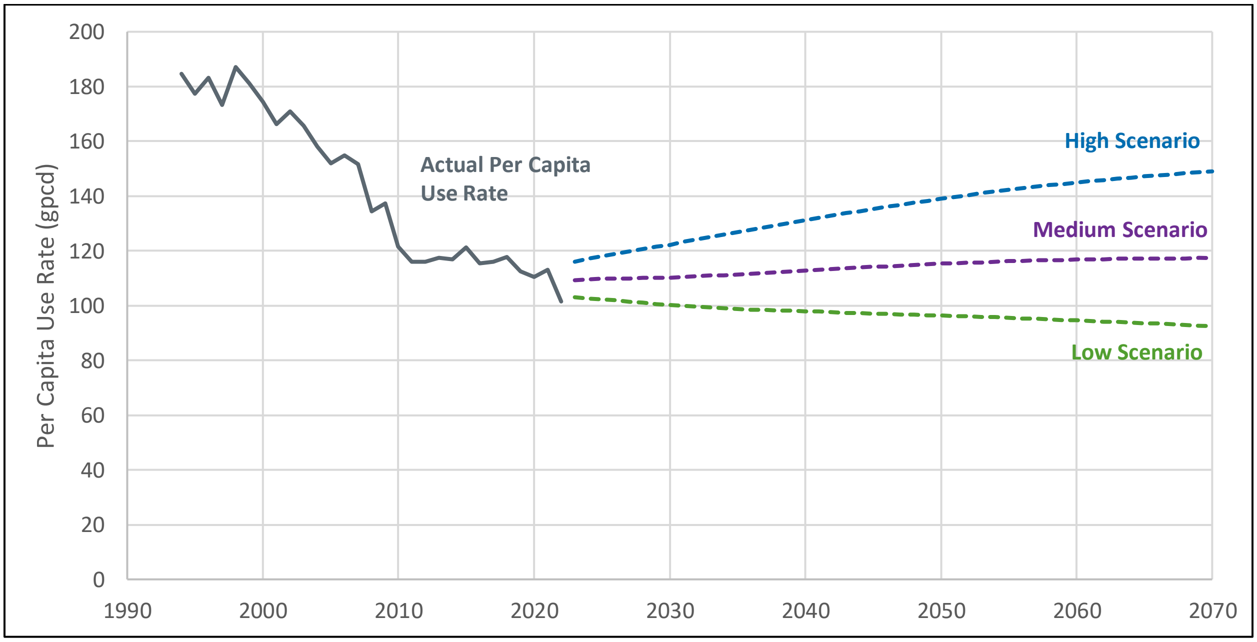

Figure 3-10. Albany Per Capita Use Rate Projections

Note: Albany demand and population only. Does not include deliveries to Millersburg.

3.3.7 Maximum Day Demand Projections

Future maximum day demands were calculated by using the ADD projections and an MDD/ADD multiplier. The average MDD multiplier for 2018 through 2022 (a value of 1.76) was used to calculate future MDD. Table 3-10 and Figure 3-11 show the future MDD projections.

Table 3-10. Albany Maximum Day Demand Projections, mgd

Year	MDD			
	Actual	Low Scenario	Medium Scenario	High Scenario
2018	11.50	—	—	—
2019	10.39	—	—	—
2020	11.28	—	—	—
2021	11.33	—	—	—
2022	10.64	—	—	—
2025	—	10.7	11.5	12.4
2030	—	11.1	12.3	13.7
2035	—	11.6	13.1	14.9
2040	—	12.1	13.9	16.2
2045	—	12.5	14.7	17.5
2050	—	13.0	15.5	18.8
2055	—	13.4	16.3	20.1
2060	—	13.9	17.2	21.4
2065	—	14.3	18.0	22.7
2070 Build out	—	14.7	18.8	23.9

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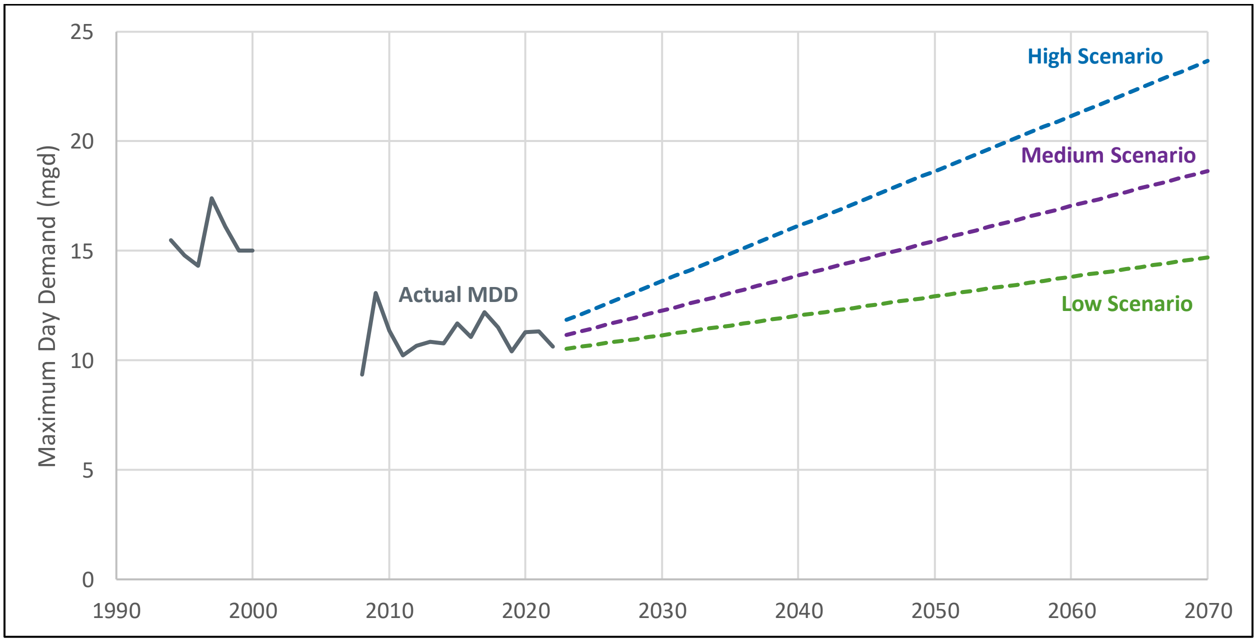

Figure 3-11. Albany Maximum Day Demand Projections

Note: Albany demand only. Does not include deliveries to Millersburg.

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3.4 REFERENCES

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CHAPTER 4
Planning Criteria

4.1 WATER SYSTEM DESIGN AND PERFORMANCE CRITERIA (LOS GOALS)

Chapter 4 represents the water system design and performance criteria used for development of the City WMP. Another term for performance criteria is the expected level of service (LOS) that regulators, customers, stakeholders, and the City expect under normal, emergency and disaster conditions. The criteria outlined in this chapter are derived from the LOS goals determined during the Master Planning process. These goals are key to assessing the performance of the existing water system, measuring the expected future performance, and identifying potential capital improvements to assure the adequacy of the water system to meet the City's mission.

4.2 WATER DISTRIBUTION

This section describes the criteria to be used for evaluating the City's existing drinking water distribution system and developing the design of future improvements. The criteria were developed to provide safe, reliable water service to each customer and to maximize the efficiency of the system. The criteria include the capacity, operational, and reliability requirements for supply, piping, pumping, and storage facilities in the water system. The three documents listed below provided guidance in the determination of the various criteria.

- *Oregon Administrative Rule (OAR) 333-061 [OAR 2022]* – Contains Oregon state regulations for drinking water.
- *Recommended Standards for Water Works [GLUMRB 2018]* - These recommended standards are frequently referred to as the Ten State Standards and are produced by the Water Supply Committee of the Great Lakes-Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers. It is widely accepted in the drinking water industry as a standard for the evaluation and design of water systems.
- *Manual of Water Supply Practices, M32, Computer Modeling of Water Distribution Systems (Fourth Edition) [American Water Works Association (AWWA) 2017]* – This manual was referenced where criteria were not provided in the documents listed above.

4.2.1 Planning Horizons

Four planning horizons were identified to determine improvements to pipelines, pump stations, and reservoirs and to determine the capacity requirements for treatment facilities. The first "near-term" horizon extends 5 years and was used to define immediate or near-term improvements needed. The second "medium-term" horizon extends from 5 to 10 years. The third "long-term" horizon extends from 10 to 20 years, and the fourth ''buildout-term" is from 20 years to the current UGB buildout.

- Near-term: 2024 to 2028
- Medium-term: 2029 to 2033
- Long-term: 2034 to 2043
- Buildout-term: 2044 to UGB buildout (Approximately 2070)

This WMP focuses on the 20-year horizon and the buildout horizon should be re-evaluated during the next WMP update. Projects recommended for the four planning horizons are based on planning criteria identified in this chapter as well as projected water demands presented in Chapter 3 - Population and Water Demands. It is difficult to predict when development driven projects will be needed and timing for those projects is entirely dependent on development. Given the variability in timing of projects, it is important that capital improvement plans have flexibility to respond to development as it occurs. The timing for construction of each project should be based on actual water demands rather than a pre-specified year.

4.2.2 Supply Criteria

The firm capacity of treatment facilities should meet or exceed the water system MDD. Firm capacity in this context means the ability of the facility to deliver water continuously. For example, if a WTP can produce 16 mgd for up to 8 hours, but can only produce 12 mgd continuously, then 12 mgd is the firm capacity.

The development of future water supply sources and any treatment capacity upgrades should occur once the existing firm supply capacity reaches between 90 to 95 percent of MDD. Detailed analysis of the firm capacity of each WTP is provided in Chapter 6.

4.2.3 Pipe Criteria

Piping criteria are used for the following:

- Identify existing pipes that are inadequately sized.
- Determine the appropriate size for future piping.
- Identify pipes that should be relocated or extended for reliability purposes.

Note that these criteria are specific to pipes in the distribution system and not within pump stations or water treatment plants. Table 4-1 lists the capacity, operational, and reliability criteria for evaluating and designing the water system piping.

Table 4-1. Pipe Criteria

Criterion		Value	Source/Notes
Minimum Diameter		8-inch (6-Inch may be allowable if fire flow demands are met and it is approved by the City Engineer)	• City
Pressure	Minimum Operating	40 psi	• City, OAR 2022 • Pressure measured at service connection
	Maximum Operating	80 psi	
	Minimum During a Fire	20 psi	
Maximum Velocity	Distribution pipes (≥8 inch and <16 inch)	Existing: 10 fps New: 5 fps	• AWWA 2017 • Existing pipes (distribution or transmission) are considered undersized if velocity >10 fps but may be considered for replacement if velocities regularly exceed 5-7 fps
	Transmission pipes (≥ 16 inch)	5 fps	
Maximum Headloss	Distribution pipes (≥8 inch and <16 inch)	10 feet or 4 psi / 1000 feet	• AWWA 2017 • AWWA recommends this criterion to avoid high operating costs, particularly for pumped systems. The cost of adding piping to meet it may exceed the benefit; therefore, it is provided by way of recommendation rather than requirement.
	Transmission pipes (≥ 16 inch)	3 feet or 1 psi / 1000 feet	
Reliability	Transmission pipes	Redundant supply lines to hydraulically isolated areas wherever feasible	• GLUMRB 2018
	Distribution pipes	Looping wherever feasible	

4.2.4 Pump Station Criteria

Booster pump stations are intended to increase pressure on the discharge side of the station during specified demand conditions or to convey water to higher elevation pressure zones. Table 4-2 summarizes pump station criteria.

Table 4-2. Pump Station Criteria		
Criterion	Value	Source
Pump Station Firm Capacity	Enough capacity to supply the peak demand with the largest pump out of service	GLUMRB 2018
Firm Capacity Required Serving Zones with Reservoir Storage	Firm capacity ≥ MDD	GLUMRB 2018
Firm Capacity Required Serving Zones without Reservoir Storage	Firm capacity is the greater of MDD + largest fire flow demand, or peak hour demand	GLUMRB 2018

4.2.5 Storage Criteria

Storage in a distribution system serves three primary purposes as outlined below:

1. **Equalization** – Equalization storage provides peak flow to customers so supply sources only need to be sized to produce the average demand rather than the peak demand. This is defined as the volume needed to meet demands that are greater than the average daily demand, and is described in more detail below.
2. **Fire** – Fire storage provides water to fight fires. Fire demands are often higher than normal demands and the capacity of the source. Volume is defined as the largest fire demand for the duration of a fire event.
3. **Emergency** – Emergency storage provides water during an emergency when the supply source is offline during events such as power outages, maintenance, natural disasters, facility failures, etc.

It is helpful to think of the three types of storage schematically, as shown in Figure 4-1. The top portion contains the equalization storage, which increases and decreases throughout the day as water usage changes. Below equalization is fire storage, which must be at an appropriate elevation to supply fire demands when the equalization storage is depleted. At the bottom is the emergency storage.

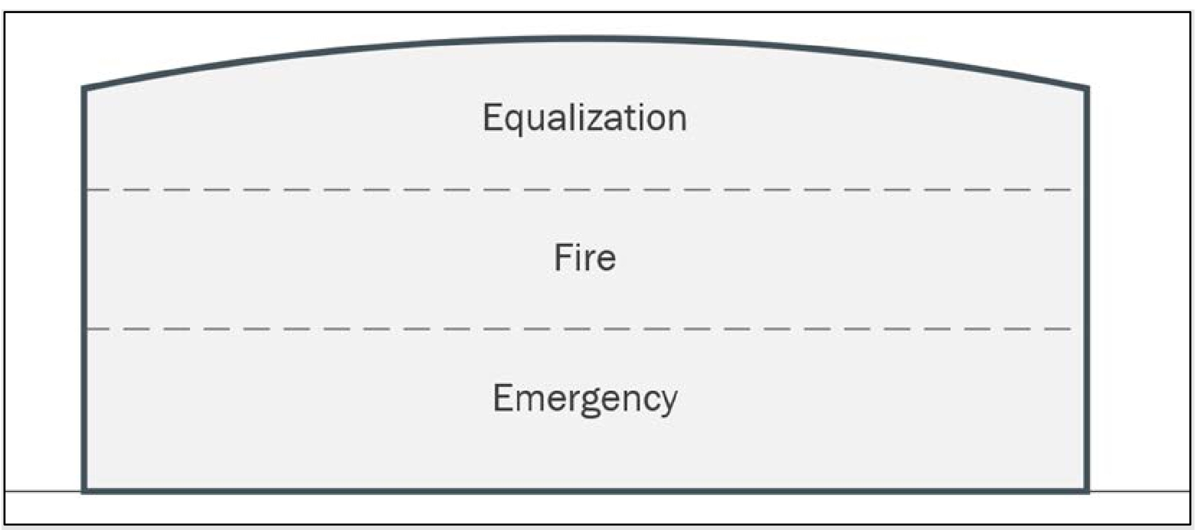

Figure 4-1. Storage Allocation Illustration

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Historically, a more-is-better approach was often taken when determining storage requirements, however recent water quality initiatives are driving a more detailed evaluation of storage requirements based on specific community needs. Balance between reserving enough water in reservoirs for possible emergencies and maintaining water quality must be sustained.

A summary of the storage criteria is shown in Table 4-3. Each storage component is discussed in more detail in the following sections.

Table 4-3. Storage Capacity Criteria[a]

Criterion	Value/Description
Equalization Storage	Calculated using a system-wide seasonal diurnal demand pattern. Approximately 16 percent of the daily demand in the winter, 12 percent of the daily demand in the summer. Figure 4-2 shows how the equalization storage is calculated from the diurnal pattern. Volume seasonally adjusted for water quality purposes.
Fire Storage	Largest fire flow/duration in the zone supplied from the storage reservoir. See Table 4-4 for requirements by land use type. (OAR 333-061-0050)
Emergency Storage	Volume equal to 1 day of demand, seasonally adjusted for water quality purposes. One day of average summer demands for summer months, one day of average winter demands for winter months.

(a) Storage volume can be shared between zones if emergency power is available.

Equalization Storage

Equalization storage is used to supply daily peak demand so that Water Treatment Plants (WTPs) only need to produce the average daily demand. Equalization storage can be calculated by comparing the average daily supply to the diurnal pattern (which shows the changing demands over a 24-hour period) as shown on Figure 4-2 (AWWA 2017). AWWA states that for large systems, equalization storage is typically 15 to 20 percent of the daily demand but may exceed 30 percent for small areas (AWWA 2017).

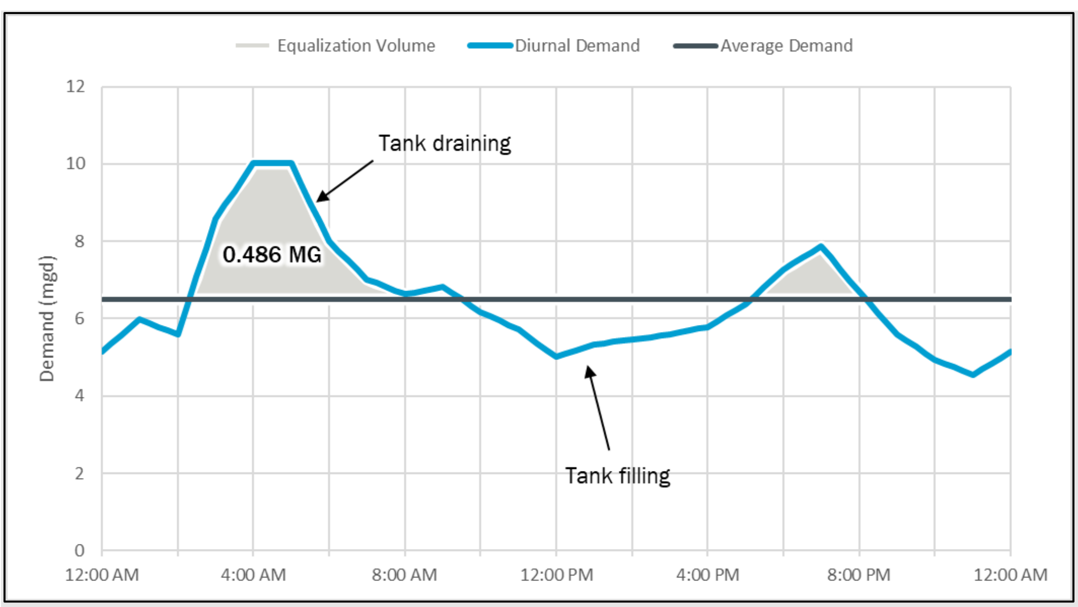

Figure 4-2. Storage from Diurnal Example

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Fire Storage

Oregon Administrative Rule 333-061-0050 states that the finished water storage capacity shall be increased to accommodate fire flows when fire hydrants are provided. The City's water system includes fire hydrants, therefore fire storage must be provided, where feasible. Fire storage volume is determined by multiplying the maximum fire flow demand in the zone by the duration of the fire. This volume remains constant through the year.

Overly conservative fire storage requirements can result in too much water storage capacity, leading to older water in the distribution system and the subsequent degradation of water quality. The maximum fire flow for the City was previously set at 5,000 gpm for 4 hours (2004 WFP). However, the maximum fire flow used by the Insurance Services Office (ISO) to calculate a community's Public Protection Classification (PPC) is 3,500 gpm for 3 hours (ISO 2022). The value provided by the ISO is commonly used for calculating the maximum flow that a municipal water system should be able to provide for fighting fires.

The Oregon Fire Code (OFC) is primarily concerned with building size and construction materials but lists a maximum fire flow of 3,000 gpm and states the following:

> *"Limiting the maximum fire flow to 3,000 gallons per minute provides local water purveyors with a predictable and cost-effective method to forecast infrastructure expenditures and can serve to lessen local fire services' apparatus capital expenditures. ... No building shall be constructed, altered, enlarged, moved or repaired in a manner that…creates a need for a fire flow in excess of 3,000 gallons per minute at 20 pounds per square inch residual pressure, as specified in Table B105.2, or exceeds the available fire flow at the site of the structure." (OFC 2022).*

Based on this information from OFC and discussions with the City's Fire and Building Departments that took place in 2022, the maximum fire flow demand that the water system should provide for distribution system planning was set at 3,500 gpm for 3 hours. The fire flow demand requirements for each land use type are shown in Table 4-4.

Table 4-4. Fire Flow and Storage Criteria

Land Use Type	Fire Flow Demand, gpm	Duration, hours	Fire Storage Volume, gal
Residential - Low Density	1,500	2	180,000
Residential - Medium Density	2,500		300,000
Residential - High Density	3,500	3	630,000
Commercial			
Mixed Use			
Institutional			
Industrial			
Schools			

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Emergency Storage

While the equalization and fire flow storage volume are well defined, there are few firm guidelines for determining how much emergency storage is required. Emergency storage is dependent on many factors some of which include, pump capacity, distribution system configuration, number and size of storage tanks within the pressure zone, variation in pressure zone demands, and the level of risk the utility is willing to tolerate. Utilities can also decide to vary the amount of storage volume by season as demands can be significantly different between seasons.

Emergency storage is usually specified as a number of days of demand and is the storage component most dependent on the risk tolerance of the water provider. Overly conservative emergency storage can result in too much water stored in the system, leading to degradation of water quality. Listed below are typical strategies to improve water quality:

- Reduce the emergency storage requirement if multiple redundant sources of supply are available (common).
- Allow a storage deficiency in a pressure zone to be made up by excess storage in another zone if pumping and conveyance capacity is available (very common).
- Assume that an emergency and a fire occurring simultaneously is not likely and therefore fire and emergency storage requirements should not be added together.
- Adjust emergency storage requirements seasonally to correlate with seasonal demands.

Historically, the City has required an emergency storage volume equal to 1 day of ADD. During a winter emergency, when demand is lower than ADD, the emergency storage volume would last for more than 1 day. In the summer, when demand is higher than ADD, the emergency storage volume would last for less than one day.

Using hourly SCADA data from 2018 through 2022, Figure 4-3 shows how long available storage would have been able to supply the system if the WTPs went offline when storage volumes were the lowest. This scenario closely reflects the emergency storage volume that was available. Assuming water can be transferred between zones using the North Albany and Gibson Hill pump stations, and no fires occur, the remaining storage would last for more than 2 days during the winter months, and approximately 1 day in the peak summer months.

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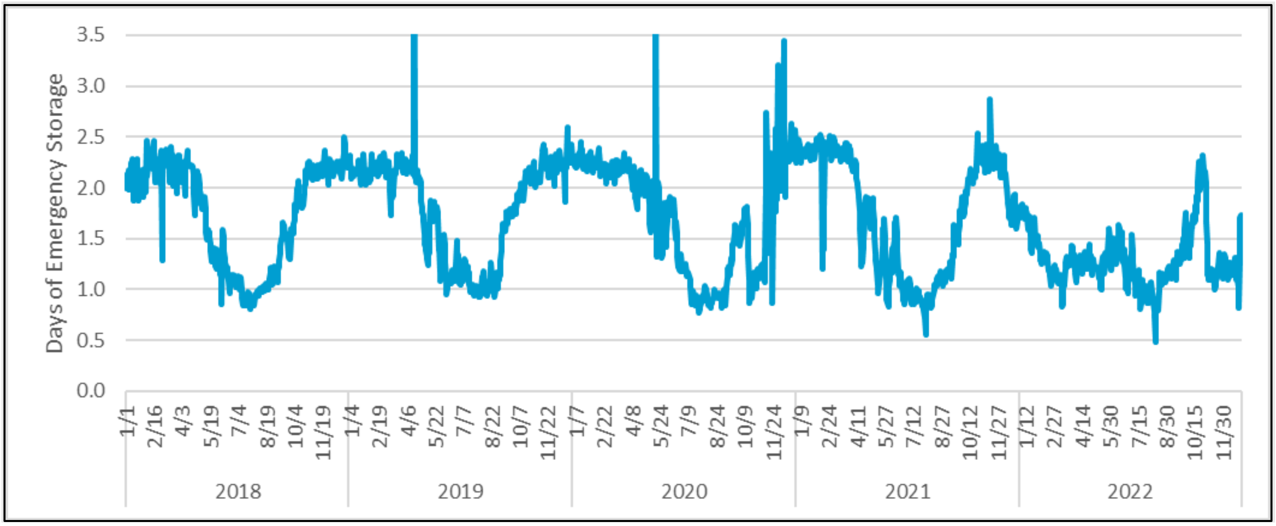

Figure 4-3. Maximum Emergency Duration based on Minimum Daily Storage Volume

The City revised its emergency storage requirement from being based on a fixed, annually-based 1 ADD volume, to a seasonally-based average demand volume that better balances resiliency with water quality. The operational effect of this results in keeping more water in the reservoirs during the summer and less water in the winter. The City successfully tested this method of storage operation in early 2022 as shown in Figure 4-3. The emergency storage volume required is:

- 1 day of average winter demand during winter months
- 1 day of average summer demand during summer months

4.3 RESILIENCY

Resiliency is the ability to withstand and reduce the magnitude and/or the duration of disruptive events, which includes the capability to anticipate, absorb, adapt to, and/or rapidly recover from such an event. For the City, resilience of the water system involves primary disruptive events such as earthquake, power outages, and flooding. The City is subject to OAR 333-61-0060 (5) (J), which specifically requires:

> *"seismic risk and mitigation plan for water systems fully located in areas identified as VII to X, inclusive, for moderate to very heavy damage potential using the Map of Earthquake and Tsunami Damage Potential for a Simulated Magnitude 9 Cascadia Earthquake Open File Report 0-13-06, Plate 7 published by the State of Oregon, Department of Geology and Mineral Industries."*

Figure 4-4 below shows the damage potential to the City from the above-mentioned event. The City is located, in whole, in Zone VII of a Magnitude 9 Cascadia Earthquake.

4.3.1 Disaster Level of Service

The Disaster Level of Service criteria for the water system are intended to ensure reasonable levels of emergency water supply in accordance with the 2013 Oregon Resilience Plan (ORP) from the Oregon Seismic Safety Policy Advisory Commission. The seismic resiliency of the water system is evaluated and projects to improve the seismic resiliency of the system are provided in Chapters 7 and 8.

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Oregon Resilience Plan Goals

The ORP sets target states of recovery for water systems after a major earthquake. These represent recommended long-term goals (50-year planning horizon) for water system readiness in case of a magnitude 9.0 Cascadia Subduction Zone (CSZ) earthquake. For the purposes of applying the ORP concepts to the City's water system, relevant information is contained in ORP Section 8, Water and Wastewater Systems. Figure 4-5 provides a graphical representation as presented in the ORP, which summarizes desired recovery states for water systems in the Willamette Valley area. Further interpretation and discussion of this information is included In Figure 4-5.

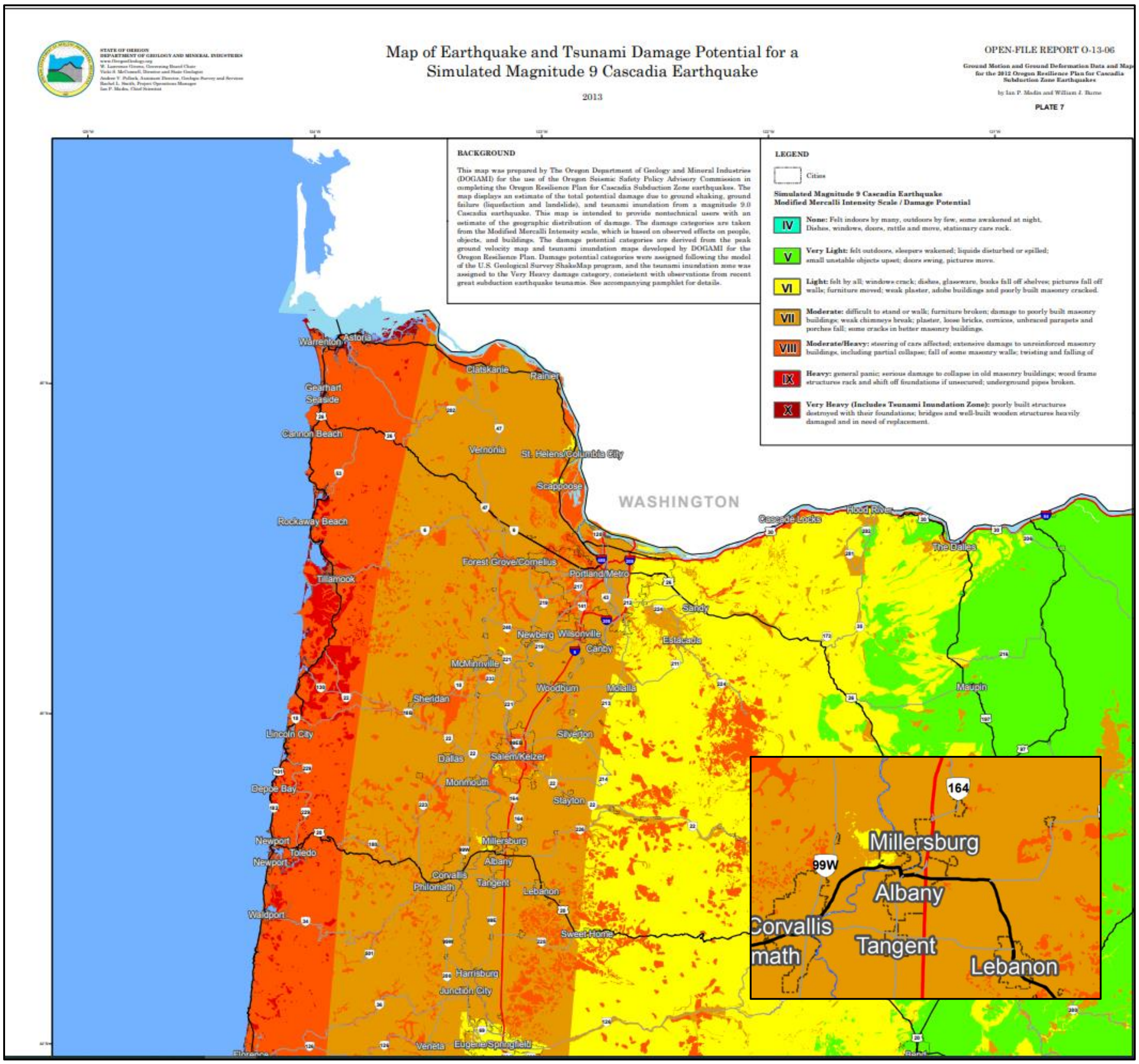

Figure 4-4. Earthquake and Tsunami Damage Potential for a Simulated Magnitude 9 Cascadia Earthquake

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KEY TO THE TABLE

TARGET TIMEFRAME FOR RECOVERY:

Desired time to restore component to 80–90% operational	G
Desired time to restore component to 50–60% operational	Y
Desired time to restore component to 20–30% operational	R
Current state (90% operational)	X

TARGET STATES OF RECOVERY: WATER & WASTEWATER SECTOR (VALLEY)

	Event occurs	0–24 hours	1–3 days	3–7 days	1–2 weeks	2 weeks–1 month	1–3 months	3–6 months	6 months–1 year	1–3 years	3 + years
Domestic Water Supply											
Potable water available at supply source (WTP, wells, impoundment)		R	Y		G			X			
Main transmission facilities, pipes, pump stations, and reservoirs (backbone) operational		G					X				
Water supply to critical facilities available		Y	G				X				
Water for fire suppression—at key supply points		G		X							
Water for fire suppression—at fire hydrants				R	Y	G			X		
Water available at community distribution centers/points			Y	G	X						
Distribution system operational			R	Y	G				X		

Source: 2013 Oregon Resiliency Plan

Figure 4-5. Summary of Target States of Delivery for Water Systems in the Willamette Valley

Figures 4-6 through 4-12 are simplified versions of ORP tables from 2013 which were developed based on multiple utilities in the Willamette Valley and are not specific to the City. They are meant to serve as emergency guidelines and goals.

Figure 4-6 is a simplified form of the ORP table that shows the desired performance and recovery of each water system component after an earthquake. These components are discussed individually below.

Category	Goals - Operational Performance Water Systems in Willamette Valley			Current Operational Performance 90% Water Systems in Willamette Valley
	20-30%	50-60%	80-90%	
Supply Source (WTP)	< 1 day	1-3 days	7-14 days	3-6 months
Main Transmission (Backbone pipeline, PS, storage)			< 1 day	1-3 months
Fire Suppression at Key Points			< 1 day	3-7 days
Fire Suppression at fire hydrants	3-7 days	7-14 days	14-30 days	6-12 months
Critical Facilities (Hospitals, EOC)		< 1 day	1-3 days	1-3 months
Distribution Points (Community distribution centers)		1-3 days	3-7 days	7-14 days
Distribution System (Pipeline and service connections)	1-3 days	3-7 days	7-14 days	6-12 months
General Overall Operational and Economic Recovery	**14-30 days**			**> 1 year?**

Figure 4-6. Simplified ORP Table Showing Desired Performance and Recovery of Each Water System Component after an Earthquake

Water Available at Supply Source. Potable water supply availability at and from supply sources is critical for recovery. Available distribution system storage near point of use is often limited to 1 to 3 days. Having some access to additional supply is needed immediately for life safety. This includes the WTPs and directly related raw water supply facilities, as well as interties to other utilities, groundwater wells and surface water sources. The ORP recommends operational performance targets as shown in Figure 4-7.

Category	Goals - Operational Performance Water Systems in Willamette Valley			Current Operational Performance 90% Water Systems in Willamette Valley
	20-30%	50-60%	80-90%	
Supply Source (WTP)	< 1 day	1-3 days	7-14 days	3-6 months

Figure 4-7. Simplified ORP Table Showing Operational Performance Targets for Supply Source

The ORP recommends 20 to 30 percent recovery within the first 24 hours (hr). This could provide immediate supply relief for critical needs such as firefighting and critical facilities. Approximately 50 to 60 percent recovery of supply within 1 to 3 days could satisfy additional minimum demand requirements for sanitary and drinking needs, and at emergency shelters. And 80 to 90 percent supply recovery at 7 to 14 days could supply potable water needs throughout the distribution system to near normal levels and allow business recovery.

The ORP estimates that generally in the Willamette Valley, the overall 90 percent recovery time frame for this category is currently in the 3-to-6-month time frame.

Transmission, Pumping, and Storage Backbone. Recovery of the backbone transmission system is critical within the first 24 hours to satisfy immediate life-safety needs. Having an operational backbone allows transmission of supply to key points in the system. The City's backbone system generally includes major pump stations, storage tanks, and large-diameter pipelines. The ORP recommends operational performance targets as shown in Figure 4-8.

Category	Goals - Operational Performance Water Systems in Willamette Valley			Current Operational Performance 90% Water Systems in Willamette Valley
	20-30%	50-60%	80-90%	
Main Transmission (Backbone pipeline, PS, storage)			< 1 day	1-3 months

Figure 4-8. Simplified ORP Table Showing Operational Performance Targets for Transmission Backbone

The ORP recommends 80 to 90 percent supply recovery within the first 24 hours to immediately serve critical points for the purposes of firefighting and emergency response. The ORP estimates that generally in the Willamette Valley, the overall 90 percent recovery time frame for this category is currently in the 1- to 3-month time frame.

Water Supply to Critical Facilities. Restoring water service to critical facilities will be essential for life safety. These facilities may include hospitals and emergency response-related locations, such as emergency operations centers (EOCs), which are needed for post-disaster essential services. The ORP recommends operational performance targets as shown in Figure 4-9.

Category	Goals - Operational Performance Water Systems in Willamette Valley			Current Operational Performance 90% Water Systems in Willamette Valley
	20-30%	50-60%	80-90%	
Critical Facilities (Hospitals, EOC)		< 1 day	1-3 days	1-3 months

Figure 4-9. Simplified ORP Table Showing Operational Performance Targets for Critical Facilities

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The ORP recommends 50 to 60 percent recovery within the first 24 hours. It is helpful to note the importance of the interrelationships in the ORP targets. Having lifelines to critical facilities operational at 50 to 60 percent within the first 24 hours makes use of the supply source targets (20 to 30 percent within 24 hours) and backbone transmission system (80 to 90 percent within 24 hours). This allows essential life services to continue, with hospitals treating related injuries and emergencies, and EOCs coordinating emergency response activities.

The ORP estimates that generally in the Willamette Valley, the overall 90 percent recovery time frame for this category is currently in the 1- to 3-month time frame.

Water for Fire Suppression at Key Supply Points. The ORP recommends operational performance targets as shown in Figure 4-10.

Category	Goals - Operational Performance Water Systems in Willamette Valley			Current Operational Performance 90% Water Systems in Willamette Valley
	20-30%	50-60%	80-90%	
Fire Suppression at Key Points			< 1 day	3-7 days
Fire Suppression at fire hydrants	3-7 days	7-14 days	14-30 days	6-12 months

Figure 4-10. Simplified ORP Table Showing Operational Performance Targets for Fire Suppression at Key Supply Points

Water Available at Community Distribution Centers. The ORP recommends operational performance targets as shown in Figure 4-11.

Category	Goals - Operational Performance			Current Operational Performance 90%
	20-30%	50-60%	80-90%	
Distribution Points (Community distribution centers)		1-3 days	3-7 days	7-14 days

Figure 4-11. Simplified ORP Table Showing Operational Performance Targets for Water Available at Community Distribution Centers

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Distribution System Operational Performance. The distribution system includes the remaining pipeline network and all service connections. The full recovery of the distribution system represents restoration of residential and business services. The ORP recommends operational performance targets as shown in Figure 4-12.

Category	Goals - Operational Performance			Current Operational Performance 90%
	20-30%	50-60%	80-90%	
Distribution System (Pipeline and service connections)	1-3 days	3-7 days	7-14 days	6-12 months

Figure 4-12. Simplified ORP Table Showing Operational Performance Targets for Distribution System

The ORP recommends 20 to 30 percent recovery within the first 1 to 3 days. This time frame allows time to isolate broken parts of the system and continue service to intact areas. Providing a minimal level of residential service could also start to lessen the load and resources for community centers and shelters. At 3 to 7 days, restoration would be increased to 50 to 60 percent of the distribution service area before reaching 80 to 90 percent targets at 7 to 14 days. Recovery of the distribution system to near normal levels facilitates full residential and business recovery.

The ORP estimates that generally in the Willamette Valley, the overall 90 percent recovery time frame for this category is currently in the 6-to 12-month range.

4.4 SUMMARY TABLE

A summary of the planning criteria presented in this chapter is compiled and provided in Table 4-5 below. Table 4-5 includes information from Tables 4-1, 4-2, 4-3, and 4-4.

Table 4-5. Summary of Planning Criteria		
Criterion		**Value**
Pipe Criteria		
Minimum Diameter		8-inch (6-Inch may be allowable if fire flow demands are met and it is approved by the City Engineer)
Pressure	Minimum Operating	40 psi
	Maximum Operating	80 psi
	Minimum During a Fire	20 psi
Maximum Velocity	Distribution pipes (≥8 inch and <16 inch)	Existing: 10 fps New: 5 fps
	Transmission pipes (≥ 16 inch)	5 fps
Maximum Headloss	Distribution pipes (≥8 inch and <16 inch)	10 feet or 4 psi / 1000 feet
	Transmission pipes (≥ 16 inch)	3 feet or 1 psi / 1000 feet
Reliability	Transmission pipes	Redundant supply lines to hydraulically isolated areas wherever feasible
	Distribution pipes	Looping wherever feasible
Pump Station Criteria		
Pump Station Firm Capacity		Enough capacity to supply the peak demand with the largest pump out of service
Firm Capacity Required Serving Zone with Reservoir Storage		Firm capacity ≥ MDD
Firm Capacity Required Serving Zone without Reservoir Storage		Firm capacity is the greater of MDD + largest fire flow demand, or peak hour demand
Storage Capacity Criteria[a]		
Equalization Storage		Calculated using a system-wide seasonal diurnal demand pattern. Approximately 16 percent of the daily demand in the winter, 12 percent of the daily demand in the summer. Figure 4 2 shows how the equalization storage is calculated from the diurnal pattern. Volume seasonally adjusted for water quality purposes.
Fire Storage		Largest fire flow/duration in the zone supplied from the storage reservoir. See Table 4-4 for requirements by land use type. (OAR 333-061-0050)
Emergency Storage		Volume equal to 1 day of demand, seasonally adjusted for water quality purposes. One day of average summer demands for summer months, one day of average winter demands for winter months.

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Table 4-5. Summary of Planning Criteria

Land Use Type	Fire Flow Demand, gpm	Duration, hours	Fire Storage Volume, gal
Fire Flow and Storage Criteria			
Residential - Low Density	1,500	2	180,000
Residential - Medium Density	2,500		300,000
Residential - High Density	3,500	3	630,000
Commercial			
Mixed Use			
Institutional			
Industrial			
Schools			

(a) Storage volume can be shared between zones if emergency power is available.

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CHAPTER 5
Water System Regulatory Review

5.1 WATER SYSTEM REGULATORY REVIEW

A summary of regulation requirements and future regulatory actions that were considered during the Master Plan update are included in this chapter. The United States Environmental Protection Agency (EPA) develops and implements drinking water regulations under the Safe Drinking Water Act (SDWA) of 1974 and subsequent 1986 and 1996 amendments. The SDWA regulates public drinking water systems as well as source waters such as rivers, lakes, reservoirs, and groundwater wells. States are able to develop their own regulations but must adhere to the EPA's minimum requirements.

In some cases, states develop more stringent requirements. Oregon's more stringent regulations are highlighted below. Per the SDWA requirements and the Code of Federal Regulations 40 CFR 142, Oregon has primary responsibility (primacy) to enforce EPA mandated rules 40 CFR 141 to 143 for drinking water, including protection of source water quality and design and operation of water system facilities. Oregon Health Authority (OHA) is the state agency responsible for compliance with these regulations, and the OHA Public Health Division program of Drinking Water Services (DWS) is charged with rule enforcement. Rules specific to drinking water are codified as OAR to assist the OHA in implementing and interpreting their statutory authority. The relevant OAR for this project is OAR 333-061, which provides the regulations pertinent to water quality and to the design and performance of the filtration facilities. This OAR will be described in more detail in this chapter.

5.2 CURRENT DRINKING WATER QUALITY REGULATION

This section provides an overview of federal regulations focusing on source water, treatment, disinfection, and disinfection byproducts (DBPs), lead and copper, and microbial protection.

The following topics are discussed further:

- Surface Water Treatment Rules (SWTR)
- Chemical Contaminant Rule
- Stage 1 and 2 Disinfection By-Product Rules
- Lead and Copper Rule (LCR) and Lead and Copper Rule Revision (LCRR)
- Total Coliform Rule (TCR)
- Filter Backwash Recycling Rule
- Proposed PFAS Rule
- Additional State-Specific Regulations

5.2.1 Surface Water Treatment Rules

An overview of the SWTR progression is summarized in Table 5-1. below, from the original implementation in 1989, to the subsequent Interim Enhanced SWTR (IESWTR) in 1998, the Long-Term 1 Enhanced SWTR (LT1 Rule) in 2002, and the current version, the Long-Term 2 Enhanced SWTR (LT2 Rule) established in 2006.

Table 5-1. Surface Water Treatment Rules

	SWTR, 1989[a]	IESWTR, 1998[b]	LT1 Rule, 2002[c]	LT2 Rule, 2006[d]
Who these rules apply to	All systems using surface water or groundwater under the direct influence of surface water (GWUDI).	All systems using surface water or GWUDI that serve <10,000 people.	All systems using surface water or GWUDI that serve <10,000 people.	All public water systems using surface water or GWUDI.
Established Removals	Establishes 3-log removal/inactivation of *Giardia* and bacteria and 4-log removal/inactivation for viruses.	Establishes 2.0-log removal in filtered system for *Cryptosporidium* and potential *Cryptosporidium* source control for unfiltered systems.	Sets maximum contaminant level goals (MCLG) of 0 for *Cryptosporidium*. Added *Cryptosporidium* as indicator of GWUDI. Required systems using alternative techniques demonstrate 2-log removal of *Cryptosporidium*.	Requires monitoring and treatment for *Cryptosporidium;* log removal dependent on bin classification.[e]
Disinfection Credits	Requires residual disinfection to be ≥0.2 mg/L at distribution system entrance and detectable throughout.	—	Requires disinfection profile with daily inactivation measurements compiled over 1 year; establishes lowest monthly inactivation as the benchmark.	—
Monitoring Requirements	Requires continuously monitored turbidity (<0.5 NTU in 95 percent of monthly samples, 5 NTU max). Establishes operational guidelines.	Establishes monitoring frequency requirements for combined (every 4 hours) and individual filters (every 15 minutes); established turbidity <0.3 NTU in 95 percent of monthly samples, 1 NTU max.	Establishes different effluent requirements dependent on treatment technology.	Assigns filtered systems to four possible bins based on *Cryptosporidium* concentrations with associated requirements.
Additional Rules	—	Requires periodic sanitary surveys and cover for all new, finished water storage facilities. Evaluates impact on microbial risk by determining if system needs to profile, develop a disinfection profile that reflects daily *Giardia lamblia* inactivation for a year, and calculate disinfection benchmark based on the profile	—	Requires that water is stored in a covered reservoir or that reservoir discharge is treated to established log-removals.

(a) Summarized from EPA resource: SWTR Guidance Manual.
(b) Summarized from EPA Resource: IESWTR Reference Guide.
(c) Summarized from EPA Resource: LT1 Quick Reference Guide.
(d) Rules, including bin classification and corresponding concentrations and treatment required for filtered systems from EPA resource: LT2ESWTR Factsheet.
(e) Filtered systems are given a bin classification based on source water monitoring results.

5.2.2 Chemical Contaminant Rules

The chemical contaminants rules were created in phases called the Phase II/V Rules or the Chemical Contaminant Rules. Over 65 contaminants are regulated by these rules, categorized in the following contaminant groups:

- Inorganic Contaminants (IOCs), including nitrate and arsenic
- Volatile Organic Contaminants (VOCs)
- Synthetic Organic Contaminants (SOCs)

The size, type, and water source of all public water systems (PWS) determines which contaminants required monitoring for that particular system.

Through the Phase II/V Rules, MCLGs, MCLs, monitoring requirements, and best available technology for removal were established for all 65 contaminants. While the MCLG is not a legal limit and not enforceable, it is the maximum level of a contaminant at which no known or anticipated adverse effect on a person's health would occur.

The City has not had any exceedances for IOCs, VOCs, or SOCs. The sampling frequency for chemical contaminants are summarized in Table 5-2.

Table 5-2. Sampling Frequency for Chemical Contaminants

Test Group	No. of Samples Required	Sampling Frequency
IOCs	1 at each WTP, 2 Total	Nine Years
VOCs	1 at each WTP, 2 Total	Yearly
SOCs	2 at each WTP, 4 Total[a]	Three Years

(a) Each WTP must be sampled for two consecutive samples.

5.2.3 Stage 1 and 2 Disinfection By-Product Rules

Along with the SWTR, disinfectants and DBPs are regulated through the Stage 1 and Stage 2 DBPRs summarized in Table 5-3., below. Stage 1 Rule was established in 1998 and expanded with Stage 2 in 2006.

The initial Stage 1 Rule set primary maximum contaminant levels (MCLs) based on two groups of disinfection byproducts, total trihalomethanes (TTHM) at 80 micrograms per liter (µg /L) and haloacetic acids (HAA5) at 60 µg /L based on averaging distribution system sampling locations into one running annual average (RAA). Stage 1 also set rules for maximum residual disinfectant levels (MRDLs).

Stage 2 maintained the same MCLs for TTHM and HAA5 as Stage 1. However, the levels are based on averaging each location's quarterly sample results to calculate the TTHM locational running annual averages (LRAA). Stage 2 also included an initial distribution system evaluation requirement for water systems to characterize their distribution systems and identify monitoring sites where customers are likely to be exposed to high concentrations of DBPs based on water age and provide more equitable water quality across the system.

Table 5-3. Stage 1 and 2 DBPR Requirements[a]

Stage 1 DBPR (1998)	Stage 2 DBPR (2006)
• TTHM and HAA5 MCL calculated using RAA of all samples and system locations.	• MCL calculated using LRAA for each monitoring location based on initial distribution system evaluation. • Monitoring requirement no longer dependent on number of facilities or wells.
• Reduced monitoring for TTHM and HAA5 available if RAA ≤0.040 mg/L and HAA5 ≤0.030 mg/L. • Total organic carbon (TOC) removal dependent on source water TOC (2–4, 4–8, or >8 mg/L) and alkalinity (0–60, 60–120, or >120 mg/L) for conventional treatment facilities.	• Eligibility unchanged, but source water TOC samples required every 30 days for most systems and every 90 days for reduced monitoring systems.
• Regulated contaminants include TTHMs, HAA5, bromate, chlorite, chlorine/chloramines, and chlorine dioxide.	• If operational evaluation level is exceeded, DBP mitigation actions must be identified by the system operator. • New analytical method approved for bromate evaluation.
• MCLs defined: TTHMs (0.080 mg/L)[b], HAA5s[b] (0.060 mg/L), bromate (0.010 mg/L), chlorite (1.0 mg/L).	• No changes in MCLs. • MCLG expanded to include chloroform (0.07 mg/L) and monochloroacetic acid (0.07 mg/L) and lowered for trichloroacetic acid (0.2 mg/L).
• MRDL defined for the following disinfectants: chlorine and chloramines (4.0 mg/L as Cl_2) and chlorine dioxide (0.8 mg/L).	• No changes in MRDLs.

(a) Summarized from EPA Resource: Stage 1 DBPR Quick Reference Guide .
(b) Although there is no collective MCLG for this contaminant group, there are individual MCLGs for some contaminants:
Trihalomethanes: bromodichloromethane (0); bromoform (0); dibromochloromethane (0.06 mg/L): chloroform (0.07 mg/L).
HAAs: dichloroacetic acid (0); trichloroacetic acid (0.02 mg/L); monochloroacetic acid (0.07mg/L). Bromoacetic acid and dibromoacetic acid are regulated with this group but have no MCLGs.

Maximum Residual Disinfectant Levels (MRDL) and DBP compliance requirements are presented in the Stage 1 and Stage 2 Disinfectants and Disinfection By-products Rules (DBPRs) at the federal level, and OAR 333-061-0030(2)(b) and 0031 in Oregon. Regulatory requirements for disinfectant residuals and DBP concentrations are summarized in Table 5-4. and Table 5-5., respectively.

Table 5-4. Regulatory Requirements for Disinfectants[a]

Regulated Disinfectant	Oregon	Federal	
	MRDL	MRDL	Maximum Level Disinfection Level Goal
Chlorine	4.0 (mg Cl2/L)	4.0 (mg Cl2/L)	4 (mg Cl2/L)
Chloramines	4.0 (mg Cl2/L)	4.0 (mg Cl2/L)	4 (mg Cl2/L)
Chlorine Dioxide	0.8 (mg ClO2/L)	0.8 (mg ClO2/L)	0.8 (mg ClO2/L)

(a) Summarized from Oregon material accessed: OAE 333-061-0031.

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For disinfectant residuals, the Stage 1 and Stage 2 DBPRs set MRDLs applicable to samples collected throughout the distribution system. Water systems must measure chlorine residual at the same site in the distribution system and at the same time when coliform samples are collected. Compliance is based on the RAA, computed quarterly, of monthly averages of all distribution system sites, as described in OAR 333-061-0036(4)(i).

In the Stage 1 DBPR, TTHMs and HAA5 compliance was calculated based on RAA of quarterly samples collected across the distribution system. The Stage 2 DBPR requires DBP compliance based on location with a LRAA of quarterly samples collected at individual distribution system sites. The Stage 2 DBPR also included an initial distribution system evaluation (IDSE) to characterize each distribution system and identify monitoring sites with the highest DBP concentrations. The Stage 1 and Stage 2 DBPRs also include TOC removal requirements to limit DBP formation.

Water systems must also develop a monitoring plan that includes monitoring locations, dates, and compliance calculation procedures. The plan must be submitted to OHA and revised as needed.

Table 5-5. Regulatory Requirements for DBPs[(a)]

	Oregon	Federal	
Regulated DBP	MCL, mg/L	MCL, mg/L	MCLG, mg/L
Total Trihalomethanes (TTHMs)	0.080	0.080	--
Bromodichloromethane	--	--	Zero
Bromoform	--	--	Zero
Chloroform	--	--	0.07
Dibromochloromethane	--	--	0.06
Haloacetic Acids (five) (HAA5)	0.060	0.060	--
Monochloroacetic Acid	--	--	0.07
Dichloroacetic Acid	--	--	Zero
Trichloroacetic Acid	--	--	0.02
Monobromoacetic Acid	--	--	--
Dibromoacetic Acid	--	--	--
Bromate	0.010	0.01	Zero
Chlorite	1.0	1	0.8

(a) Summarized from Oregon material accessed: OAE 333-061-0031.

Historical TTHM and HAA5 concentrations for the past five years have remained below their respective MCLs of 0.08 mg/L and 0.06 mg/L. The City has a water quality goal of half of the MCL for both TTHM and HAA5 concentrations.

Figure 5-1 presents historical TTHM concentrations. There are TTHM concentrations at various locations that are higher than the water quality goal of half the MCL. The TTHM LRAA was above the goal at six sites in the past five years. Historically, Springhill Drive and Shortridge Street sites have never exceeded the LRAA.

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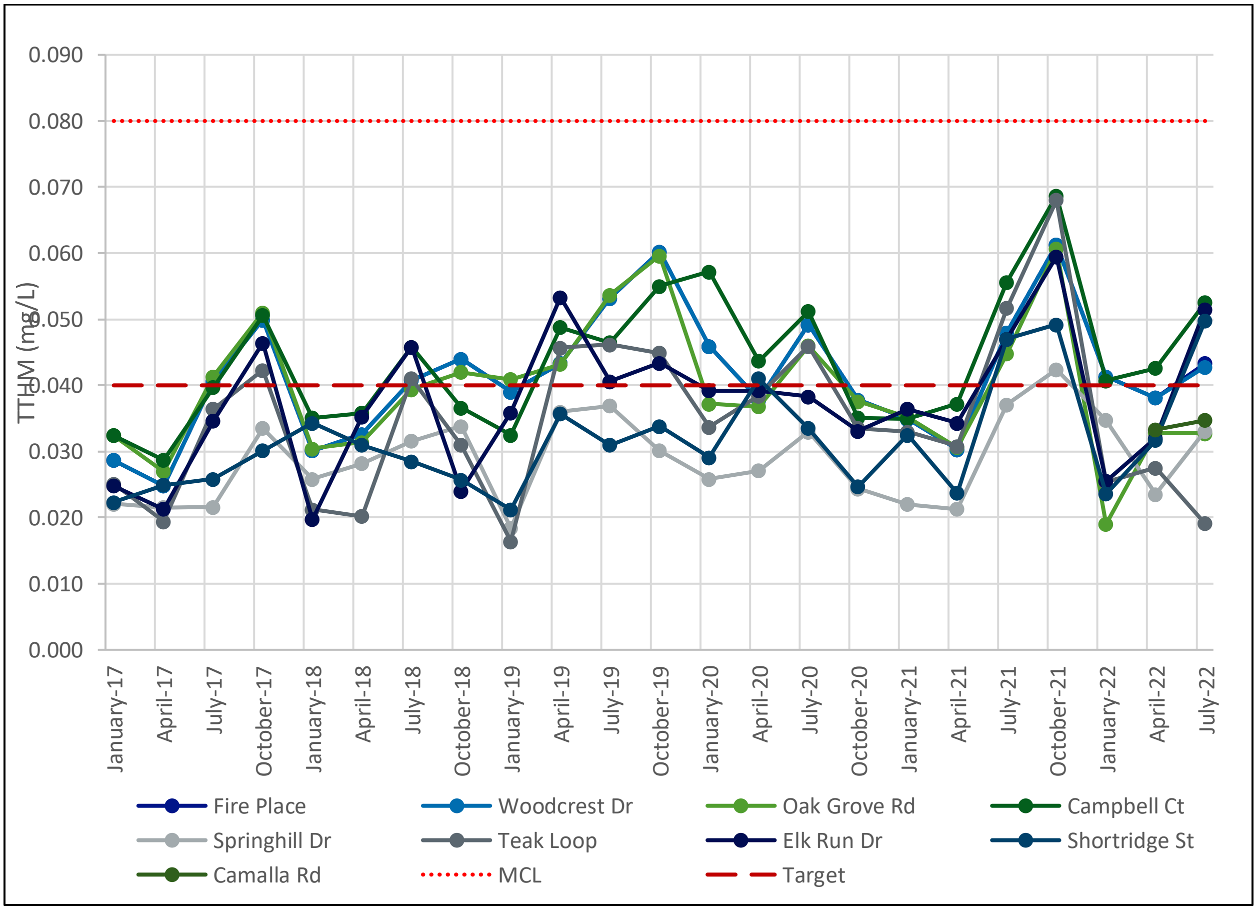

Figure 5-1. TTHM Concentrations January 2017 – July 2022

Figure 5-2 presents historical HAA5 concentrations. HAA5 concentrations were above the water quality goal of 0.03 mg/L seasonally, but the LRAA for each sampling location was never above the City's goal.

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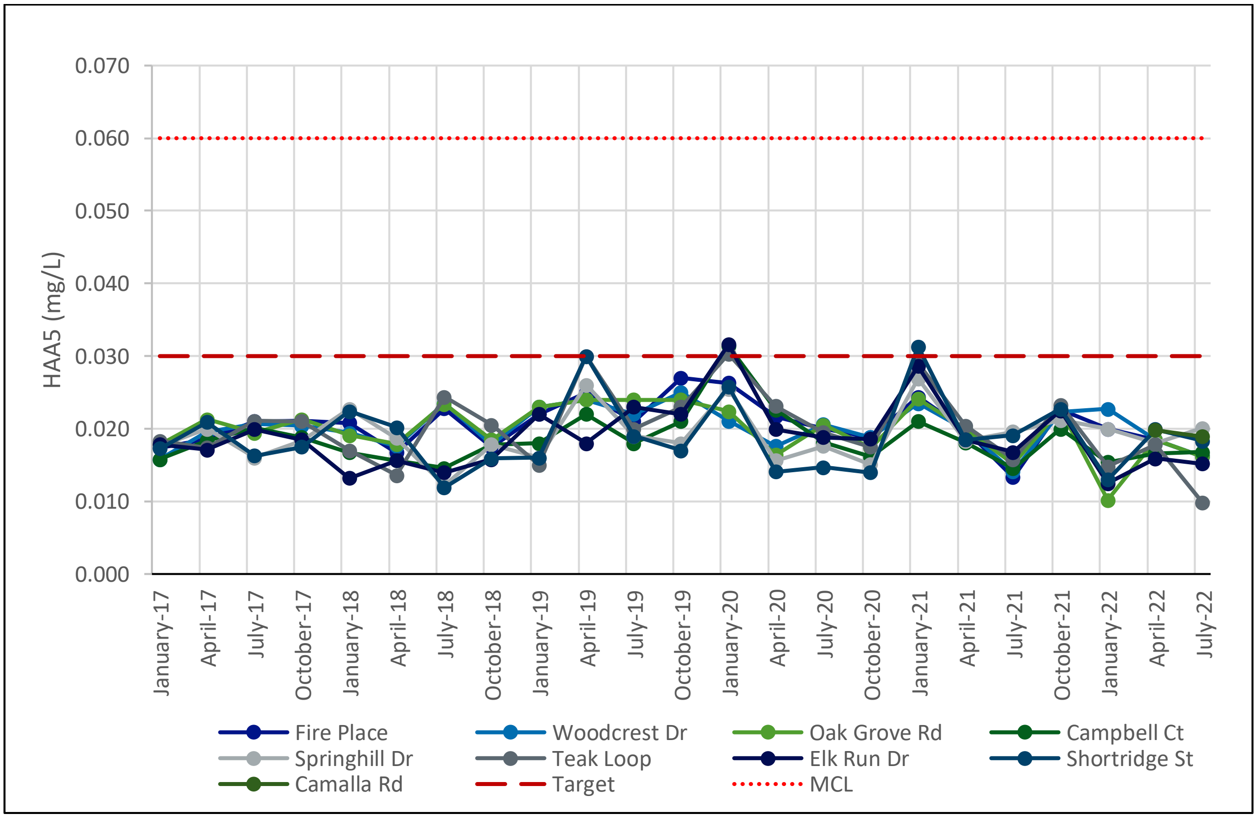

Figure 5-2. HAA5 Concentrations January 2017 – July 2022

Table 5-6. summarizes the MCL, target, and LRAA at each site for 2021, the most recent year with a full dataset.

Table 5-6. DBP 2021 LRAA

DBP	Water Quality Goal, mg/L	MCL, mg/L	Fire Place	Woodcrest Dr	Oak Grove Rd	Campbell Ct	Springhill Dr	Teak Loop	Elk Run Dr	Shortridge St
TTHM	0.04	0.08	0.044	0.044	0.043	0.049	0.031	0.046	0.044	0.038
HAA5	0.03	0.06	0.020	0.020	0.020	0.018	0.022	0.022	0.022	0.023

In order to reduce DBPs and water age, the City installed flushing stations to reduce DBPs at system dead ends and in 2022, the City began lowering reservoir levels significantly in the winter to reduce water age.

Beyond sampling for DBPs, TOC is an indicator for potential DBP formation. Raw water and finished water TOC levels are shown in Figure 5-3 and Figure 5-4 for the Vine Street and Albany-Millersburg (AM) water treatment plants, respectively. Raw water TOC concentrations are generally between 1 and 2 mg/L and finished water TOC concentrations are less than 1 mg/L for the majority of the sampling results. Note, AM WTP did not have finished water TOC data available from 2013 through 2023.

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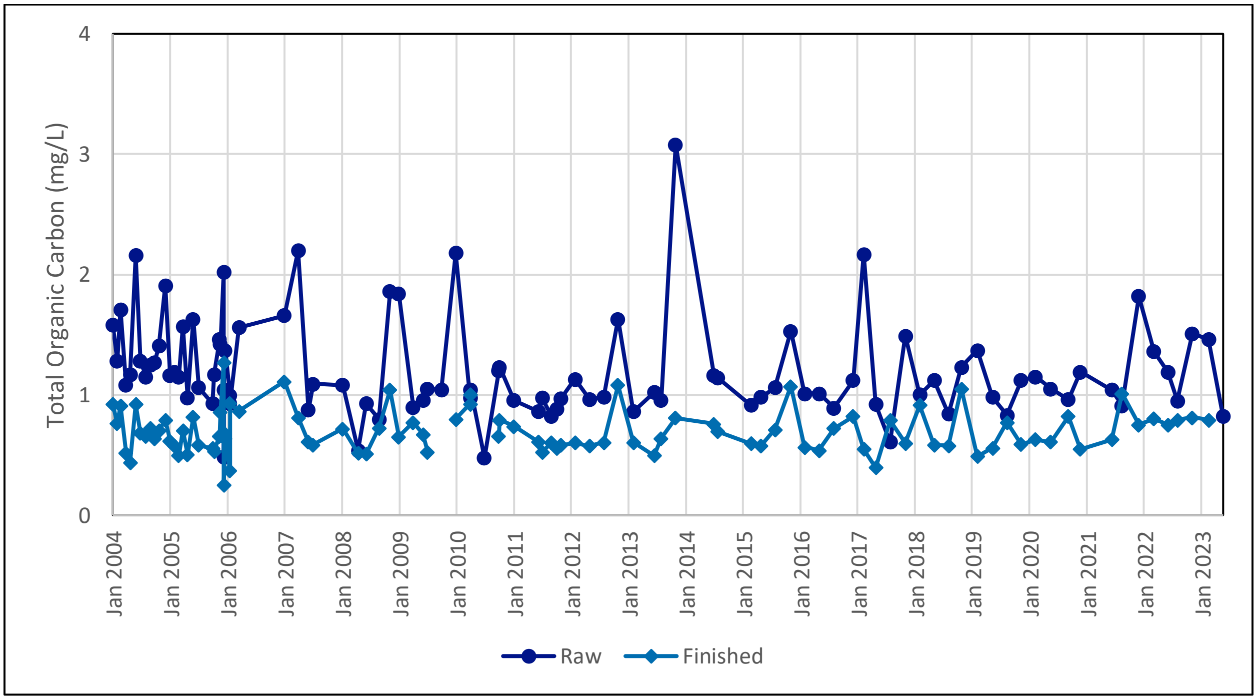

Figure 5-3. Raw Water and Finished Water TOC at Vine Street WTP, 2004 – 2023

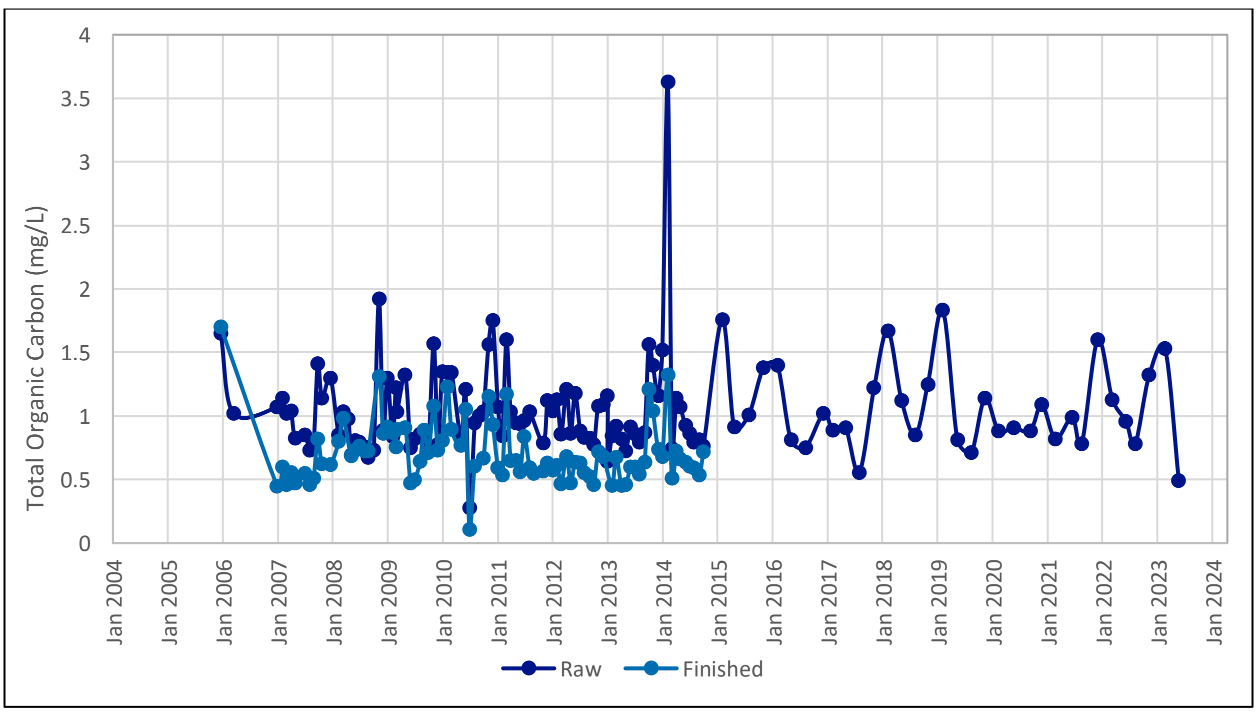

Figure 5-4. Raw Water and Finished Water TOC at Albany-Millersburg WTP, 2004 - 2023

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5.2.4 Lead and Copper Rule and Lead and Copper Rule Revision

In 1991, the EPA published the LCR to minimize lead and copper in drinking water. Previously, the standard of 50 ppb measured at the entry point in the distribution system was used. The lead and copper regulations and subsequent modifications are summarized in Tables 5-7, 5-8, and 5-9, based on EPA's LCR Quick Reference Guide.

LCR (1991 — 1992)

Table 5-7. LCR (1991 – 1992)

MCLs	MCLGs established for lead (0.0 mg/L) and copper (1.3 mg/L).
Action Levels	Established for lead (0.015 mg/L) and copper (1.3 mg/L) based on 90th percentile level of water samples.
Compliance	If action levels are exceeded, other requirements could be triggered, including water quality monitoring, corrosion control treatment, source water monitoring or treatment, public education, or lead service line replacements.
Lead and Copper Monitoring	Required first draw samples for areas with high-risk occurrence; number of samples depends on system size; monitoring required every 6 months.
Water Quality Monitoring	Required for systems serving ≥50,000 or if action level is exceeded.
Reduced Monitoring	Allowed systems to qualify for reduced monitoring dependent on the system population as well as monitoring results.
Reporting and Education	Provide individual lead tap results to people who receive water from sampled sites; all systems required to provide education statement and report violations in Consumer Confidence Reports.

Modified LCR (2000)

Table 5-8. Modified LCR (2000)

MCLs	Maintained
Action Levels	Maintained
Compliance	Clarified that demonstration of optimized corrosion control treatment and replacement of lead service lines is required.
Lead and Copper Monitoring	N/A
Water Quality Monitoring	N/A
Reduced Monitoring	N/A
Reporting and Education	Required public education but allowed more flexibility in mode of delivery for public education, especially for smaller systems

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Modified LCR (2007)

Table 5-9. Modified LCR (2007)

MCLs	MCLGs established for lead (0.0 mg/L) and copper (1.3 mg/L).
Action Levels	Established for lead (0.015 mg/L) and copper (1.3 mg/L) based on 90th percentile level of water samples.
Compliance	Water systems required to reevaluate service lines replaced through testing. Compliance period defined as 3-year calendar period.
Lead and Copper Monitoring	Required 5+ samples per monitoring period for systems serving ≤100 people. If <5 taps for human consumption, required 1 sample per tap. Defined monitoring period as specific period in which water systems conduct required monitoring.
Water Quality Monitoring	Required for systems serving ≥50,000 or if action level is exceeded.
Reduced Monitoring	N/A
Reporting and Education	N/A

Lead and Copper Rule Revisions (LCRR)

On January 15, 2021, the United States EPA published the National Primary Drinking Water Regulations: LCRR in the Federal Register, with the effective date December 16, 2021, and the compliance date of October 15, 2024.

The LCRR adds several major requirements to those included in the current LCR. The LCRR kept the same action levels of 1.3 mg/L and 0.015 mg/L (15 µg/L) for copper and lead, respectively, based on 90th percentile concentrations of samples collected during each monitoring round. The new regulation adds a trigger level of 0.010 mg/L (10 µg/L) for lead, based on the 90th percentile, to compel water systems to take proactive actions. If the 90th percentile lead level exceeds this trigger level, systems are required to take various actions based on whether they practice corrosion control treatment (CCT), and whether they have lead service lines (LSLs) or lead status unknown service lines. Water systems on reduced monitoring that exceed the lead trigger level are also required to sample annually at the standard number of distribution system sites instead of triennially at the reduced number of sites.

The following Table 5-10 below summarizes the most critical changes, in addition to the new trigger level described above.

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Table 5-10. LCRR Critical Changes

Critical Changes	Description	Frequency or Deadline
Development of a service line material inventory	All community water systems (CWSs) and non-transient non-community water systems (NTNCWSs) must develop a service line material inventory. Service line inventories must be made publicly available, and systems that serve more than 50,000 people must make it available online.	Update their inventory when they collect tap samples: every three years if they are on reduced monitoring, annually of they are on standard monitoring (systems sampling every 6 months do not need to revise their inventory that often).
Development of a lead service line replacement plan	Water systems with lead service lines, galvanized requiring replacement service lines, or lead status unknown service lines to prepare a Lead Service Line Replacement (LSLR) Plan. Following any monitoring periods, water systems that exceed the lead trigger level of 10 µg/L but not the action level of 15 µg/L must implement their goal-based LSLR Plan, whereas systems that exceed the action level must implement their LSLR Plan with a mandatory 3 percent replacement rate.	LSLR Plan must be completed by the Compliance Date (October 16, 2024). Replacement of lead service lines, galvanized requiring replacement service lines, and lead status unknown service lines must begin on the first days following the end of the monitoring period when the exceedance occurs.
Revision of sampling sites for lead and copper at customer taps and associated sampling protocols	Using the LSLR Plan, the tap sampling sites will be revised to better target locations with high lead levels. Sampling plan must include: List of customer tap sampling sites, list of sampling sites for water quality parameters (WQP), and tap sampling protocol.	Sampling plans must be submitted to the primacy agency at least 60 days prior to collecting the first samples.
Sample for lead at schools and licensed childcare facilities	Added requirement to sample for lead at schools and licensed childcare facilities, sampling at least 20 percent of licensed facilities and 20 percent of elementary schools. In advance of sampling, systems must provide the following information to schools and facilities: health risks of lead, how to request sampling, instructions on how to identify outlets, and how to collect samples.	By the compliance date, water systems must develop an inventory of schools and licensed childcare facilities and revise it every 5 years. Facilities built or that have replaced all plumbing after January 1, 2014 are excluded from sampling.
Implementation of a find-and-fix approach for individual customer taps with elevated lead levels	Water systems required to conduct additional samplings if a customer tap exceeds 15 µg/L for lead. Systems must also recommend solutions to the primacy agency.	Within 5 days of this finding, systems must collect a WQP sample at or near the site where the lead concentration exceeded 15 µg/L and collect a follow-up sample for lead within 30 days at each site where lead concentrations exceeded 15 µg/L. Solution recommendations must be submitted within 6-months.

Table 5-10. LCRR Critical Changes		
Critical Changes	Description	Frequency or Deadline
Strengthening of CCT requirements	The LCRR strengthens the CCT requirements by allowing primacy agencies to require optimization of CCT for large systems with 90th percentiles above the 0.005 mg/L practical quantification level, and mandating systems that exceed trigger or action levels to re-optimize their CCT.	Systems must be ready to re-optimize within 6-months after the end of the monitoring period when the exceedance occurred.
Improvement to the public education and customer notification components of the LCR to strengthen risk communication.	Requires systems send public education materials regularly, as well as notifications to specific customers in certain cases.	

In August 2020, 30 homes were tested within the City and an additional 10 homes were tested within Millersburg. The 90th percentile for routine sampling of both lead and copper, at both locations, were below Action Levels and the target level for lead, with the 90th percentile value of the 2020 sampling summarized in Table 5-11. The City is only required to sample for lead and copper every three years at total of 30 sample sites throughout their distribution system.

Table 5-11. 2020 Lead and Copper Sampling Results				
Location	Lead 90th Percentile, mg/L	Lead MCL, mg/L	Copper 90th Percentile, mg/L	Copper MCL, mg/L
Vine Street WTP	1.4	15	0.017	1.3
AM WTP	1.1	15	0.025	1.3

Beyond 2020 sampling results, the City has a team evaluating the system, with 6,200 connections identified that were installed before 1986 when the Oregon state code outlawed lead. Of the 6,200 connections with potential lead, over 4,800 connections have been inventoried to date, with no lead lines found. Along with the current inventory work, the City previously removed lead pigtails in schools and daycares.

In August 2023, the City sampled and had one home where the lead levels exceeded the action level. The City is investigating the cause for this elevated lead level and plans to also resample.

Lead and Copper Rule Improvements (LCRI)

In November 2023, the EPA proposed the LCRI. The proposed regulation has the following key provisions:

- Requires water providers to replace lead service lines within 10 years.
- Requires water systems to regularly update their inventories, create a publicly available service line replacement plan, and identify the materials of all service lines of unknown material.

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Requires water systems to collect first liter and fifth liter samples at sites with lead service lines and use the higher of the two values when determining compliance with the rule. The first liter sample is to identify potential lead in the fixture or premise plumbing while the first liter sample is to identify lead in the distribution system.

- Proposes to lower the lead action level from 15 µg/L to 10 µg/L.
- Requires additional outreach to consumers and make filters certified to reduce lead available to all consumers.

EPA anticipates finalizing the LCRI in October 2024.

The lower proposed lead levels could present challenges. The City should continue its lead service line inventory in advance of the October 2024 submittal deadline for the lead service line inventory, and if needed, consider further optimization of corrosion control treatment.

5.2.5 Total Coliform Rule

In 1989, the TCR was established to improve public health by reducing fecal pathogens to minimum levels through control of total coliform (TC) bacteria, including fecal coliforms and E. coli (EC). In 2014, a revised TCR was released. OHA implemented provisions to this rule in 2016. This revision required a program submission to the EPA region along with the adoption of Level 1 and 2 assessment categories to reflect severity and frequency of a problem. The Revised TCR also includes a treatment technique violation if a system fails to conduct an assessment, fails to correct sanitary defects from an assessment within 30 days, or a seasonal system fails to complete approved procedures prior to serving water to the public.

The sampling and monitoring requirements and violation and reporting requirements are defined in Table 5-12, below.

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Table 5-12. TCR and Revised TCR Requirements

Parameter	TCR (1989)[a]	Revised TCR (2014)[b, c]
Sampling Requirement	• TC sample must be collected at sites representative of distribution system and performed at regular intervals throughout the month. • Sampling frequency based on population served. • If positive routine sampling, three repeat samples collected and analyzed for TC: one sample from original tap, one sample within five service connections upstream, one sample within five service connections downstream. • Each TC+ sample must be tested for fecal coliforms or EC.	• Sample site plan is required, including quarterly monitoring and annual identification of additional routine monitoring. • Sampling frequency according to sample site plan; assessment and corrective action if system is considered vulnerable to contamination. • Each TC+ must be tested for EC.
Violations	• Monthly MCL Violations: — Systems collecting <40 samples: Violation if >1 routine or repeat sample per month is TC+. — Systems collecting ≥40 samples: Violation if >5percent of routine or repeat samples per month are TC+. — Acute MCL Violations (all systems): — Violations if fecal coliform or EC+ in repeat sample, or if fecal coliform or EC+ routine sample. and TC+ repeat sample.	• Assessment Trigger: — Non-acute MCL removed; violations >5 percent TC+ in monthly samples trigger Level 1 assessment instead. — Major MCL Violations (all systems): — EC MCL violations replaced TCR's acute MCL. — Combinations resulting in violation: Routine / Repeat EC+ / TC+ EC+ / Any missed sample EC+ / EC+ TC+ / EC+ • TC+ / TC+ (but no EC analysis)
Reporting	• Monthly Reporting: — Public: Within 30 days. — State: End of next business day. — Acute Reporting: — Public: Within 24 hours. — State: End of next business day.	• For all systems, if any repeat sample is TC+ and EC+ must report to the state by the end of day.

(a) Summarized from EPA material accessed: EPA Total Coliform Rule
(b) Summarized from EP material accessed: EPA Revised Total Coliform Rule
(c) Oregon-specific details adapted from OH's Revised Coliform Monitoring Requirements

The City has had no exceedances for total coliform in their weekly testing. From 2020 through 2023, routine weekly sampling resulted in all non-detects at each of the 14 locations sampled.

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5.2.6 Filter Backwash Recycling Rule

Along with the regulations detailed above, the Filter Backwash Recycling Rule in 2001 required streams of water returned to the facility be returned prior to primary coagulant addition. The EPA's *Filter Backwash Recycling Rule Technical Guidance Manual* recommends the recycle flow be at or below 10 percent of facility flow (EPA, 2002). The following information related to filter backwash must be submitted to OHA per the requirements specified in OAR 333-061-0032 10:

- Copy of recycle notification
- List of recycled flows and return frequency
- Average and maximum backwash rate and duration
- Typical filter run length and how that is determined
- Type of treatment for recycled flow
- Data on treatment unit sizing with loading rates, chemicals used, and frequency of solids removal

The City does not recycle backwash water at either the AM WTP or Vine St. WTP, thus the City is not bound to the Filter Backwash Recycling Rule. For more details about filter backwash see Section 5.2.8 and Chapter 6.

5.2.7 PFAS Regulations

Following establishment of EPA's first provisional health advisory levels (HALs) for PFAS in 2009, monitoring for six of the most prevalent PFAS compounds was included in the third round of the Unregulated Contaminant Monitoring Rule (UCMR3) with sampling from 2013 to 2015 including PFOA, PFOS, PFBS, PFHxS, PFHpA, and PFNA. At that time, the analytical methods were limited to method reporting limits (MRL) from 10 to 90 nanograms per liter (ng/L); therefore, sources of PFAS present at levels below the MRL went undetected. Since then, testing methods have improved and the MRL for many PFAS has decreased by an order of magnitude to as low as 3-5 ng/L , allowing detection of 29 PFAS at much lower levels.

In 2016, EPA released an updated HAL, which superseded the provisional HALs, which set a combined HAL of 70 ng/L for the sum of PFOA and PFOS (see Table 5-13, below). Since then, states have been setting their own HALs, MCLs, and state action levels (SALs). In 2022, Oregon developed HALs for four PFAS as shown in Table 5-10. Water systems are required to monitor six PFAS compounds through the UCMR5, published in December 2021.

EPA released a PFAS Strategic Roadmap in October 2021, which aimed to establish a national primary drinking water regulation for PFAS in Fall 2022, before the Agency's statutory deadline of March 2023, with a final rule expected in Fall 2023. In June 2022, the EPA updated it's 2016 HALs for PFAS. The new HALs established by the EPA are orders of magnitude lower than those in 2016, as can be seen in the Table 5-13 below.

In March 2023, EPA proposed a draft National Primary Drinking Water Regulation to establish legally enforceable levels for six PFAS compounds in drinking water. In addition to setting new MCLs, the EPA also proposed health-based, non-enforceable MCL Goals (MCLG) for these six PFAS. Under the proposed regulation, PFOA and PFOS will be regulated as individual contaminants. PFHxS, PFNA, PFBS, and GenX will be regulated as a mixture, referred to as the Hazard Index. Based on the EPA's new proposed regulation, it is anticipated that the MCLs will be finalized in early 2024 and the MCLs will be enforceable three years from the final regulation.

Table 5-13. Pertinent PFAS MCLs and Advisories (ng/L)

PFAS	2009 Provisional HAL	2016 EPA HAL	2022 EPA HAL	2022 Oregon HAL[(a)]	2023 EPA MCL	2023 EPA MCLG
PFOS	200	70	0.02[(b)]	30	4	0
PFOA	400	(total of PFOS + PFOA)	0.004[(b)]	30	4	0
PFNA	Not Included	Not Included	Not Included	30	Hazard Index < 1.0[(c)]	Hazard Index < 1.0[(c)]
PFHxS	Not Included	Not Included	Not Included	30		
PFBS	Not Included	Not Included	2,000	Not included		
Gen X	Not Included	Not Included	10	Not Included		

(a) The HAL is exceeded if any individual chemical exceeds 30 ng/L or if the sum of the four PFAS exceeds 30 ng/L.

(b) Interim health advisory levels.

(c) The Hazard Index calculation for the sum of these four compounds shall not exceed a ratio of 1 based on individual health-based water concentrations. The Hazard Index is calculated as follows:

$$Hazard\ Index = \frac{GenX_{Water}}{10} + \frac{PFBS_{Water}}{2{,}000} + \frac{PFNA_{Water}}{10} + \frac{PFHxS_{Water}}{9}$$

Under UCMR3 sampling, the City had no detections for the following PFAS compounds:

- Perfluorooctanesulfonic acid (PFOS)
- Perfluorooctanoic acid (PFOA)
- Perfluorononanoic acid (PFNA)
- Perfluorohexanesulfonic acid (PFHxS)
- Perfluoroheptanoic acid (PFHpA)
- Perfluorobutanesulfonic acid (PFBS)

For UCMR3, the City tested the distribution entry points at the Albany-Millersburg and Vine Street treatment plant between 2013 and 2014. Under UCMR5 sampling, the City also sampled the distribution entry points at the Albany-Millersburg and Vine Street WTPs and had no detections for the 29 PFAS compounds sampled in the first three quarters.

5.2.8 Additional State-Specific Regulations

Beyond the federal regulations discussed in the previous section, this section aims to review state specific regulations that apply to the City. These include cyanotoxin regulations and discharge pollutants through the National Pollutant Discharge Elimination System (NPDES) permit program.

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Cyanotoxins

Oregon has moved to regulate two common cyanotoxins: Microcystins (total) and Cylindrospermopsin. While there are no federal regulations pertaining to cyanotoxins at this time, a cyanotoxin event in Salem in 2018 led to emergency rules, and now a permanent rule in Oregon. This rule requires cyanotoxin monitoring in public drinking water systems and establishes a set of Oregon action levels. The Oregon action levels are based on the following EPA health advisory limits:

- Total Microcystins: 0.3 µg/L for vulnerable populations; 1.6 µg/L for anyone
- Cylindrospermopsin: 0.7 µg/L for vulnerable populations; 3.0 µg/L for anyone

EPA determined that there was insufficient data to develop health advisory levels for anatoxin- and saxitoxin, so there are no regulations for these cyanotoxins at this time. If voluntarily sampling results in detections of these unregulated cyanotoxins, OHA would consult with experts and advise the water system on specific steps that will be needed to protect public health. The details of Oregon's rule are summarized in Table 5-14, below.

Since Oregon first required biweekly cyanotoxin sampling in 2019, the City has had no microcystin or cylindrospermopsin detections. Although the North Santiam River has had harmful algal blooms (HABs) historically, the majority of the City's source water comes from the South Santiam River and none of the City's raw water samples have detected cyanotoxins.

Table 5-14. Cyanotoxin Regulation Details[a]

Regulation Category	Detail of Regulation
Applicable Systems	• Surface water source that has harmful algal blooms or cyanotoxins detected in the past. • Use a surface water source downstream from a water body with past harmful algal blooms or cyanotoxin detections. • Use a surface water source determined to be susceptible to cyanotoxins. • Base on water body-limiting factors of algal and aquatic weeds as determined by Oregon DEQ. • A water supplier that purchases and supplies water from any of the above water systems.
Monitoring	• Raw water (susceptible sources) sample very 2-weeks, May through October 31. • If cyanotoxins are detected in raw water at, or above, 0.3 µg/L for Microcystin or Cylindrospermopsin, sample raw water and finished water weekly. • If detected in finished water, sample finished water daily. • Monitoring of finished water can return to weekly following two consecutive non-detects at the entry point and can cease if not detected in two consecutive weekly samples and levels are below 0.3 µg/L in raw water. • If finished water results are over any advisory level, collect confirmation sample as soon as practical, within 24-hours. Sample daily at entry point. If confirmed over any health advisory level in finished water, a “do-not-drink” advisory must be issued for that system and any purchasing water systems.
Health Advisory	• “Do-not-drink” advisory if routine and confirmation samples are over any health advisory level: — Health advisory levels established by EPA for the two cyanotoxins regulated by these rules are set at a concentration that anticipates no adverse health effects expected if the water is consumed for up to 10-days. — Issuing an advisory only when results are confirmed is consistent with other SEWA contaminants. Given errors in sample collection or analysis, confirming the results prior to action is a standard and reasonable approach. — An advisory may be lifted upon approval by OHA if two consecutive samples from finished water and the distribution system are at or below the health advisory level in both the system treating the water, and any downstream purchasing water systems.
Public Notification	• Though not required, public notification should be considered if any treated water sample is over the health advisory level, or if routine and confirmation samples detect either Microcystin or Cylindrospermopsin in finished drinking water below health advisory levels. • Public notification is considered with a detection or concentration below health advisory levels for cyanotoxins but not for other contaminants due to the current high level of public interest in cyanotoxins. Each water supplier should assess the best course of action for themselves.

(a) Summarized from OHA material accessed at: OHA Cyanotoxins

Discharge Permit

In order to comply with the Federal Clean Water Act (CWA), Oregon Department of Environmental Quality (DEQ) administers National Pollutant Discharge Elimination System (NPDES) permits to regulate point source discharges. For the City, the discharge of filter backwash requires a NPDES general permit 200-J

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Filter Backwash. To comply with the NPDES 200-J permits for Vine Street and AM WTP, permit numbers 986986 and 971455 respectively, discharge limitations, monitoring and reporting requirements, and special conditions are described in this section.

Waste discharge limitations under NPDES 200-J Schedule A include the following:

- Settleable solids: Shall not exceed 0.1 mL/L
- pH: Shall be within the range 6.0 – 9.0 standard units

Prior to discharging to water of the State, water must be dechlorinated to under total residual chlorine concentrations of 0.1 mg/L, with monitoring requirements outlined in NPDES 200-J Schedule B.

Monitoring requirements for the City under NPDES 200-J Schedule B, discharging to surface waters, are summarized in Table 5-15.

Table 5-15. Minimum Monitoring Requirements for NPDES Permit

Item or Parameter	Minimum Frequency	Sample Type [(a)]
Effluent flow (mgd)	Once a month	Record [(b)]
Settleable solids	Twice a month	Grab
Total residual chlorine (mg/L)	Twice a month	Grab
pH	Twice a month	Grab

(a) Samples to be collected at overflow of settling pond or other treatment device during filter backwash cycle. If filters are backwashed less than twice a month, data to be collected during the time backwash occurs. If the settling pond does not overflow, the data shall be collected during the draining or pumping.
(b) Flow recorded on a per event basis; only monthly averages reported.

DEQ requires that monitoring data be recorded each month, with an annual tabulation submitted to DEQ by January 15 of each year, along with any permit violation to be reported within five days of discovery, as well as an explanation and correction plan.

Special conditions are summarized in NPDES 200-J Schedule D, including the requirement that any solids removed from the filters, settling basins, and reservoirs must be disposed of in a manner that will prevent public water discharge and nuisance conditions.

Since the City's permit in 2002 and permit renewal in 2005, there have been no violations.

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5.3 FUTURE DRINKING WATER REGULATIONS

Along with the regulations previously described, there are different stages that potential regulations can be categorized in. To provide more detail on these stages, this section is divided into the following:

- Six-Year Review
- Contaminant Candidate List (CCL)
- Unregulated Contaminant Monitoring Program

5.3.1 Six-Year Review

The SDWA requires EPA to review, and revise, if necessary, each drinking water regulation in a 6-year review cycle. This review considers health effects, changes in technology, and factors that will improve public health protection. The following decisions have been made as part of this process:

- The Six-Year Review 2 was announced in March 2010. The EPA stated that it had initiated a reassessment of the health risks associated with exposure to total chromium and did not believe it was appropriate to revise this particular standard of an MCL of 0.1 mg/L. Oregon's MCL requirement for total chromium is presented in OAR 33-061-0030(1), and sampling and analytical requirements are presented in OAR 33-061-0036. Since Six-Year Review 2, the EPA has been assessing health effects and other relevant information to determine whether hexavalent chromium (or chromium-6) should be regulated.
- For Six-Year Review 3, the EPA is reviewing the following regulations as candidates for potential revisions: chlorite, *Cryptosporidium parvum*, *Giardia lamblia*, HAA5, heterotrophic bacteria, *Legionella*, TTHM, and viruses.
- Completion of Six-Year Review 4 is anticipated for 2024. Microbial and disinfection byproduct data from this review are available as part of a preliminary release ahead of any published decisions.

Table 5-16 summarizes regulations the EPA is currently developing or reviewing.

Table 5-16. Potential Future Regulations

Regulation	Overview	Status
LCR Improvements (LCRI)[(a)]	Intended to address key issues and opportunities identified in the review of the LCRR; EPA intends to promulgate the LCRI prior to October 16, 2024. Focus areas for rulemaking: • Replacing all lead service lines • Action and trigger levels • Compliance tap sampling • Prioritizing underserved communities	Under Development
Microbial and Disinfection By-Products Rule Revision[(b)]	The following candidates for revision include: • Chlorite • Heterotrophic bacteria • Total trihalomethanes • Cryptosporidium • Giardia lamblia • Haloacetic acids • Legionella • Viruses Along with EPA conducting analysis to further evaluate the eight candidates listed above, chlorate and nitrosamines are contaminants also being evaluated.	Under Development
Per- and Polyfluoroalkyl Substances (PFAS)[(c)]	The final regulation for perfluorooctanoic acid (PFOA) and perfluorooctane sulfonic acid (PFOS) is expected in 2024. The proposal will include both a non-enforceable MCLG and an enforceable standard or MCL or Treatment Technique.	Under Development
Chromium (Total/Hexavalent Chromium)[(d)]	MCL of 100 µg/L previously established with plans to monitor selected systems' levels under UCMR3. Development of integrated risk information system (IRIS) assessment determined potential health effects with inhalation and ingestion of hexavalent chromium.	Being Reviewed

(a) Summarized from EPA material accessed at: EPA LCRI
(b) Summarized from EPA material accessed at: EPA DBPs
(c) Summarized from EPA material accessed at: EPA PFAS
(d) Summarized from EPA material accessed at: EPA Chromium

5.3.2 Contaminant Candidate List

Independent from the Six-Year Review, EPA periodically publishes a CCL and establishes regulatory determination on at least five contaminants from the list of known or anticipated to occur contaminants in water systems. While these contaminants are not currently regulated, they are listed on the EPA's current CCL4 and may be subject to future regulation under the SDWA. These chemical and microbiological contaminants include pesticides, carcinogens such as DBPs (including halogenated and nitrogenous DBPs), chemicals used in commerce and pharmaceuticals, and waterborne pathogens such as *legionella*, *mycobacterium*, and *salmonella*. With the exception of perchlorate, all contaminants listed on CCL3 were carried forward. The EPA publishes the CCL every 5 years with nominations for the next list accepted approximately midway through the 5-year duration. For example, CCL5 was announced in 2021 and after minor revisions, the final CCL5 list was published on November 14, 2022. According to OHA,

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cyanotoxins, manganese, and PFAS are contaminants of concern in Oregon (OHA, 2019). Working with DEQ, OHA is currently mapping potential PFAS contaminated sites, and their proximity to water systems, to determine risk.

Within the list, contaminants are separated as either ready for regulatory determination, or in need of further research to determine specifics such as health effects, treatability, analytical methods, and occurrence. Between versions of CCLs, listed contaminants can be removed if sufficient information determines no regulation is needed. Alternately, candidate contaminants can become regulated contaminants.

If categorized as needing further research, contaminants can fall under UCMR, a SDWA amendment that includes up to 30 unregulated contaminants that are monitored by public water systems. UCMR is based largely on the review of the CCL and development in coordination. Currently, UCMR5 monitoring includes a total of 66 chemicals, with common chemical and biological contaminants listed:

- PFAS including chemicals that contain at least one of the following three structures: R-(CF2)-CF(R')R'', R-CF2OCF2-R', and CF3C(CF3)RR'
- Cyanotoxins including Microcystins, cylindrospermopsin, anatoxin-a, and saxitoxin
- DBPs
- 12 microbes including 8 bacteria, 3 viruses, and 1 protozoan

5.3.3 Unregulated Contaminant Monitoring Program

The 1996 Amendments to the SDWA require the EPA to establish criteria for a monitoring program for unregulated contaminants, and to publish, once every 5 years, a list of no more than 30 contaminants to be monitored by water systems. Water systems are directly notified by the EPA for this special monitoring and report results to the EPA. Four rounds of UCMR monitoring have been completed thus far.

According to the UCMR, all PWSs serving more than 10,000 people will monitor, all PWSs serving 3,300 – 10,000 people and 900 representatives serving fewer than 3,300 people will monitor, subject to availability of lab capacity.

UCMR5 spans from 2022 to 2026, with 29 per- and polyfluoroalkyl substances and one metal, lithium, being monitored during a 12-month period between January 2023 and December 2025. The rule was published at the end of 2021 and the cycle spans from 2022 to 2026, with sample collection taking place between 2023 and 2025. As a surface water system, the City must monitor four times during a consecutive 12-month period and sampling events must be at least 3 months apart. Samples are to be collected at the entry point to the distribution system for all contaminants.

At this point in time, the City has collected 3 quarterly samples. No detections of lithium or PFAS have been detected at the entry point at Vine Street or AM WTP.

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5.4 CITY WATER SYSTEM POLICIES

The published City water policies were reviewed to evaluate any impacts to growth and operations that are outlined within the WMP. Customer Service, Financial, Water System Rules and Regulations as well as Water Distribution System Engineering Standards were also reviewed.

This section outlines recommendations of updates or additions to the City's Policies and Procedures that impact the water utility in light of the WMP. This is not intended to be a deep dive into all of the City's policies, but rather to highlight areas that may impact the renewal and replacement, growth, and general operations of the water utilities infrastructure.

5.4.1 Analysis Methodology

The following City Policies regarding the water utility were reviewed:

- **City of Albany Municipal Code** (June 27, 2022) – Title 11 Water
- **City of Albany Development Code** (December 28, 2022) – Article 12 Public Improvements; General Provisions, Utilities- General, Water, and Improvement Assurances
- **City of Albany Comprehensive Plan** (September 25, 2020) Chapter 6 - Public Facilities and Services (Goal 11) Water Policies and Implementation Methods
- **City of Albany Engineering Standards**
  - Division A – General (October 2019)
  - Division B – Water Distribution (October 2019)
  - Division F – Water Pump Stations
  - Division G – Water Reservoir
- **City of Albany Standard Construction Specifications**
  - Division 1 – General (July 2019)
  - Division 2 – General Technical Requirements (July 2019)
  - Division 5 - Water (July 2019)
  - Drawings were not reviewed
- **City of Albany Water Rates and Resolutions - June 8 , 2022**
- **City of Albany Systems Development Charges (SDCs) - October 12, 2022**
- **United States of America Federal Energy Regulatory Commission – October 23, 1998**
  - City of Albany, Oregon, Project No. 11509-000
  - Order Issuing Original License

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5.4.2 Analysis Results

Each published code, policy and standard was reviewed. A summary of the code along with recommendations is listed below:

- **City of Albany Municipal Code**

  Title 11 WATER – This section of the City's municipal code outlines the water system rules and regulations, ranging from service area, customer policies, main extension and service policies, mandated programs that the City must adhere to, (e.g., Fire Protection, Cross-Connection and Backflow prevention requirements) and appeal procedures.

  Overall, the municipal code for water covers the necessary and required policies that are needed to operate a water utility. The City does regularly update the municipal code to meet current needs and to meet best management practices.

  Additional language should be added to 11.01.300 – Authority of Utility, to have the authority to withhold sensitive and confidential information that adheres to the exemption of the Freedom of Information Act on certain water facilities. Oregon Revised Statute (ORS) §192.311 outlines this exemption.

- **City of Albany Development Code**

  The Development Code provides public improvement standards to address the City's concern for public health, safety, and welfare as it relates to its public transportation and utilities. Included in the development code are General Provisions, Utilities – General, and Water as main headings in Article 12 of the Development Code.

  The Development Code as it pertains to the water utility outlines the high-level development requirements. The Code is updated on a regular basis and meets the needs for the City and reflect best management practices for a water utility.

  There are no recommendations to modify or add any Development Code requirements.

- **City of Albany Comprehensive Plan**

  As part of the City's overall planning framework, the Comprehensive Plan is intended to help local officials, developers and neighborhood community groups and other stakeholder entities and individuals make better decisions about the uses of land in the City. The Comprehensive Plan is to be used in a holistic manner, meaning no one section or chapter should be looked at without recognizing the needs of other chapters. However, for the sake of the WMP policy review, only chapters, goals, and policies pertaining to the Water Utility were reviewed.

  Goal 11 – Public Facilities and Services, Water Policies, and Implementation Methods were reviewed. Goal 11 outlines 14 water policies, including the need for adequate supply, maintaining high water quality and service level standards, development requirements, and the need for adequate supply and facility planning, to name a few. The plan is updated regularly and meets the need for the City, and the policies reflect common and best management practices conducted by other municipalities in Oregon.

  Goal 11 also outlines five Implementation Methods and one recommendation to develop an intergovernmental agreement with the City of Lebanon to help protect water quality by reducing stormwater runoff into the Santiam-Albany Canal, the source of water for the Vine Street WTP.

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There are no recommendations to modify or add any Policies, or Implementation Methods, to Goal 11 of the Comprehensive Plan.

- **City of Albany Engineering Standards**

  The Engineering Standards for the Water Utility are contained in Division A and B for the City. Primarily "Design Standards," these standards set the General, System Design and Sizing Criteria, and Physical Design Requirement for the Water Distribution System.

  The Engineering Standards revolve primarily around Level of Service Standards that have been developed and modified over time to meet the City's Level of Service (LOS) goals. For the WMP, these LOS goals have been reviewed and verified for routine, emergency, and disaster recovery LOS goals. Engineering Standards will be, for the most part, dictated by the LOS goals for routine day to day service expectations, and some standards will be impacted by emergency LOS goals.

  The City should review and update the Engineering Standards, in light of the LOS goals provided by the WMP. Areas of focus should include:

  - B2.02 – Water System Capacity – Ensure pressures, C values, pipe velocity, consumption data and fire flows are consistent with Water Master Plan LOS goals.
  - B2.03 – Main Classification – Include American Lifeline Alliance (ALA) pipe classification guidelines in this section.
  - B3.04 – Minimum Depth – As pipe diameter increases, the minimum depth of pipe should also increase. Use a range of pipe sizes with minimum depths in this section. Allow for variances for special circumstances.

  Seismic Pipeline Standards – It is a current standard that lock tight or push-on joint restraining systems be the minimum standard for all pipe installed in the City's system. It is also recommended that the City develop earthquake resistant joint standards for pipelines that are identified as critical pipelines per ALA pipe classification in liquifiable soils as defined in the Chapter 8 of the WMP.

- **City of Albany Standard Construction Specifications**

  The Standard Construction Specifications were reviewed including:

  - Division 1 – General (July 2019)
  - Division 2 – General Technical Requirements (July 2019)
  - Division 5 - Water (July 2019)
  - Standard drawings were not reviewed

  The Construction Specifications are updated regularly and meet the City's needs and represent best management practices.

  There are no recommendations to adjust or update the construction standards. Additional material standards and installation standards may be needed if seismic design standards are included in the Engineering Design Standards.

- **City of Albany Water Rates and Resolutions**

  The City regularly reviews and updates the water rates and charges. There are no recommendations, except that of the potential financial impacts due to the WMP Capital Improvement Program, to adjust water rates and financial strategies.

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- **City of Albany Systems Development Charges (SDCs)**

  The City regularly reviews and updates its System Development Charges. There are no recommendations, except that of the potential financial impacts due to the WMP Capital Improvement Plan, to adjust SDCs and financial strategies.

- **United States of America Federal Energy Regulatory Commission (FERC)– October 23, 1998**

  City of Albany, Oregon, Project No. 11509-000

  Order Issuing Original License

  The City's Hydroelectric facility, located adjacent to the Vine St. WTP, is under FERC regulatory license as listed above. This license outlines the regulations, conditions, and operational requirements of the hydroelectric facility. These regulations cover a variety of requirements, including water quality, fish passage and protections, endangered species, and other licensing requirements. Currently, there are no policies that the City maintains apart from the FERC licensing requirements. The license has a 50-year term, expiring on October 1, 2048.

  One condition of the license is for the City to establish a funding mechanism for decommissioning and retirement (Section VIII). It was noted in the section that since the canal was also utilized for more than just hydro facilities, that "the most likely form of decommissioning would be to simply remove or disable the powerhouse turbine, which would cost about $45,000 in today's dollars (1998)." The City should consider this option if decommissioning of the hydroelectric facility is within the span of the license period.

  All other conditions for fish passage, water quality and other protections are listed in detail in the license. There are no recommendations for policy changes regarding the FERC License and Hydroelectric Plant.

5.5 SUMMARY OF REGULATORY CONSIDERATIONS

This section reviewed current water quality regulations and potential future regulations that may be applicable to the design of the filtration facilities. Key considerations for project definition include:

- The relevant OAR for this project is OAR 333-061-0660, which provides the regulations pertinent to the completion of this WMP.
- The City adheres to all current regulations, including all Federal regulations as well as Oregon's cyanotoxin monitoring and sampling regulation.
- Along with the current regulations, future regulations under development include LCRI, updates to Microbial and Disinfection By-Products Rule, and draft proposed PFAS Rule at the Federal level.
- Future regulations may regulate manganese levels in the distribution system.

The City has met current regulations. As the City looks to the future, it should continue its lead service line inventory and corrosion control treatment optimization to continue to meet the LCRI proposed requirements. Future WTP improvements should also consider a means to reduce organics and algae/algal toxins to prepare for future changing water quality and provide water resiliency to future climate change scenarios.

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CHAPTER 6
Existing System Evaluation

6.1 INTRODUCTION

The purpose of this chapter is to provide evaluation of the City's existing water system. The primary focus is on the projected demands and identifying improvements that are recommended to meet the future demands. The projected demands were compared to the water rights, the capacity and performance of the water treatment plants, and the distribution system, including pipes, pump stations, and reservoirs. Recommended projects are provided to meet existing demands, future demands, or address performance concerns.

6.2 SOURCE OF SUPPLY EVALUATION

To evaluate the source of supply adequacy, demand projections were compared with existing Albany and Millersburg water right allocations to estimate when new additional water rights will be needed in the future. Millersburg demands and water rights are included in this analysis because Millersburg water rights can also be used in the City of Albany service area. City demand projections are from the MDD projections described in Chapter 3. Millersburg MDD projections were obtained from the 2022 Millersburg Water Conservation and Management Plan. Millersburg MDD projections are available through 2041.

For the purpose of accommodating potential future non-residential water demand, a reserve of 3 mgd of non-residential water demand was added to the water demand forecast. This was requested by the City to provide flexibility and capacity to accommodate more water-intensive commercial and industrial customers. Customers that require this amount of water will likely need to pay to offset the effect of their demand on the City system, therefore the additional 3 mgd demand is factored in for supply and treatment planning but is not used for evaluation of the distribution system as no specific projects or locations requiring this amount of water have been identified.

Figure 6-1 shows a comparison of the Albany and Millersburg water rights with the demand projections. Existing water rights are sufficient to supply foreseeable Albany and Millersburg demands through 2070.

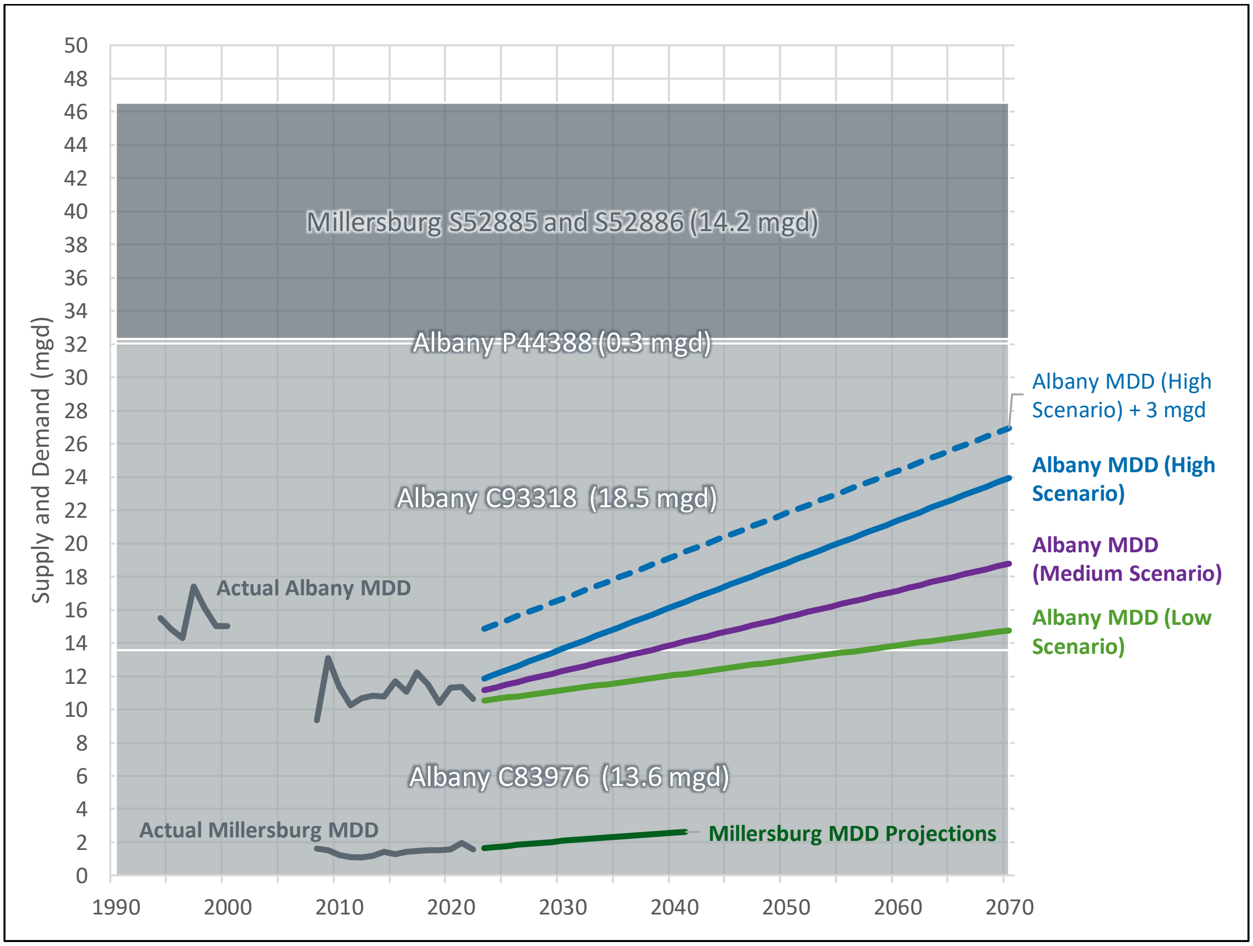

Figure 6-1. Water Rights and Demand Projections Comparison

The Medium Growth Scenario has been adopted by the City for the evaluation and recommendations made in this report. However, even with the High Growth Scenario, the 3 mgd provision for additional non-residential water demand, and Millersburg demand, existing water rights are more than adequate through 2070.

6.3 EXISTING WTP EVALUATION

The City's two existing WTPs, Vine Street WTP and AM WTP, were evaluated for capacity and performance. The capacity of the City's WTPs was assessed for each individual WTP and the combined capacity of both plants was considered to meet both existing and future water demands.

6.3.1 WTP Capacity

This section considers the existing WTP's capacities and the ability to meet the needs of existing and future flow demands.

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Vine Street WTP Capacity

Vine Street WTP has a published design capacity of 20 mgd but the current reliable capacity is 16 mgd based on operational experience, including the need to provide backwash for the filters. Full details for the capacity of each unit process at the Vine Street WTP are provided in Chapter 2.

The Vine Steet WTP typically produces finished water in a specific window of time during regular working hours, 6:30 am to 4:30 pm with seasonal fluctuations in total daily production. Table 6-1 shows the average plant run time and average daily and peak day filter flow rates from August 2021 to July 2022.

Table 6-1. Vine Street WTP Filter Flows and Efficiency

Month-Year	Average Plant Run Time, hours	Average Daily Filter Flow, MGD	Peak Day Filter Flow, MGD
August 2021	9.6	3.6	7.2
September 2021	7.8	2.4	3.4
October 2021	5.0	1.2	1.7
November 2021	4.7	1.1	1.4
December 2021	3.0	0.7	1.2
January 2022	3.7	0.8	1.5
February 2022	3.0	0.7	1.5
March 2022	1.8	0.4	0.8
June 2022	2.1	0.4	1.0
May 2022	2.5	0.6	1.2
June 2022	3.5	0.9	3.2
July 2022	7.2	2.4	4.6

AM WTP Capacity

The AM WTP typically produces finished water 24 hours per day year-round with the flow rate varying seasonally. Outside of the seasonal high demands periods, the flow rate is relatively constant over a typical day. Table 6-2 shows the average daily and peak day filter flow rates from August 2021 to July 2022.

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Table 6-2. AM WTP Plant Flows and Efficiency

Month-Year	Average Daily Filter Flow, MGD	Peak Day Filter Flow, MGD
August 2021	8.1	9.3
September 2021	6.7	7.9
October 2021	4.8	5.8
November 2021	4.3	5.3
December 2021	4.4	5.4
January 2022	4.3	5.2
February 2022	4.4	5.1
March 2022	4.6	5.1
June 2022	4.6	5.1
May 2022	4.9	6.1
June 2022	5.9	8.0
July 2022	8.3	9.8

Table 6-3 lists the AM WTP water production capacities evaluated at different conditions including:

- Initial phase (4 cells, 480 membrane modules per cell)
- Existing conditions (4 cells, 552 membrane modules per cell)
- Initial phase buildout (4 cells, 648 membrane modules per cell)
- Ultimate buildout (5 cells, 648 membrane modules per cell)

The published values come from the Design Data Summary drawing for the AM WTP Design Drawings. Full details for the capacity of each structure at the AM WTP are provided in Chapter 2. The published capacities do not consider runtime and water volumes used for backwash of the filters and thus they are higher than actual WTP production capacity. The constraining factor for AM WTP capacity is that only one filter can be backwashed at a time. Considering time required for backwash and the existing constraint of running one backwash cycle at a time, the existing maximum water production was calculated to be 13.9 mgd and at ultimate buildout it would be 16.5 mgd.

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Table 6-3. AM WTP Capacity Evaluation

Criteria	Initial Phase	Existing[a]	Initial Phase, Buildout	Ultimate Buildout
Published Values[a]				
Number of Cells	4	4	4	5
Modules per Cell	480	552	648	648
Total modules	1920	2088	2592	3240
Membrane filter area per module, ft2	275.6	275.6	275.6	275.6
Total filter area, ft2	529,152	575,453	714,355	892,944
Summer flux, gpd/ ft2	31.2	31.2	31.1	29.1
Winter flux, gpd/ ft2	22.7	22.7	22.7	22.7
Summer Capacity, mgd	16.5	18.0	22.2	26.0
Winter Capacity, mgd	12.0	13.1	16.2	20.3
Existing Backwash Constraints, One Filter at a Time				
Gallons between backwash cycles, gallons	-	110,000	125,000	125,000
Maximum No. of Backwash Cycles per cell	-	45	45	36
Backwash Cycles per Cell	-	45	44	35
Maximum Raw Water Capacity, mgd	-	20	22	22
Maximum Production Capacity, mgd	-	13.9	15.5	16.5

(a) Values for Initial Phase, Initial Phase, Buildout, and Ultimate are from the AM WTP Design Data Summary on the Construction Drawings. The Existing Conditions are not published in the Construction Drawings, but the same calculations are followed.

WTP Capacity Summary

Chapter 4 recommends that the timing of development of future water supply sources and any treatment capacity upgrades should occur once the existing plant capacity reaches between 90 to 95 percent of the MDD. Table 6-4 shows the MDD for existing conditions and 2045 water demands based on data in Chapter 3. The existing 2022 MDD is 12.2 mgd. Both Vine Steet WTP, with 16 mgd capacity, and AM WTP, with 13.9 mgd capacity, can meet the existing MDD individually if the other plant was off.

The 2045 MDD from Table 6-4 is 20.3 mgd. Together the two water treatment plants can meet the demand, but neither can produce the 2045 MDD individually. To achieve the full WMP WTP capacity of 16.5 mgd, it is recommended to add a fifth filter cell. Until the cell is filled with membranes, it provides a location to store membranes from other cells during cleaning and maintenance. It is also recommended to increase the number of membranes to the maximum 648 per cell, which the City already plans to do during the next replacement cycle from 2026 to 2028.This additional AM WTP capacity is still not enough to meet 2045 MDD on its own.

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Table 6-4. Water Demands

Hazard	ADD, mgd	MDD, mgd
Existing Demand Conditions		
Albany Existing Demand (2022)	5.9	10.6
Millersburg Existing Demand (2022)	0.9	1.6
Total Existing Demand	**6.8**	**12.2**
2045 Demand Conditions (Medium Demand Scenario)		
Albany 2045 Demand	8.4	14.7
Millersburg 2041(a) Demand	1.3	2.6
Future Large water user, 2045 Demand	1.7	3.0
Total 2045 MDD	**11.4**	**20.3**

ADD = Average Day Demand, MDD = Maximum Day Demand
(a) Millersburg 2022 WCMP only lists demand projections through 2041.

Because the backwash restrictions are the limiting factor for AM WTP capacity, additional calculations were performed to assess the impact of increasing the backwash capability so that two filters could be backwashed simultaneously. If two filters could be backwashed at the same time, the existing capacity would increase to 16.2 mgd and the buildout capacity would increase to 18.6 mgd as shown in Table 6-5.

Table 6-5. AM WTP Backwash Capacity Evaluation

Criteria	Initial Phase	Existing[(a)]	Initial Phase, Buildout	Ultimate Buildout
Published Values[(a)]				
Number of Cells	4	4	4	5
Modules per Cell	480	552	648	648
Total modules	1920	2088	2592	3240
Membrane filter area per module, ft2	275.6	275.6	275.6	275.6
Total filter area, ft2	529,152	575,453	714,355	892,944
Summer flux, gpd/ ft2	31.2	31.2	31.1	29.1
Winter flux, gpd/ ft2	22.7	22.7	22.7	22.7
Summer Capacity, mgd	16.5	18.0	22.2	26.0
Winter Capacity, mgd	12.0	13.1	16.2	20.3
Potential Backwash Upgrade, Two Filters at a Time				
Gallons between backwash cycles, gallons	-	110,000	125,000	125,000
Maximum No. of Backwash Cycles per cell	-	90	90	72
Backwash Cycles per Cell	-	59	52	42
Maximum Raw Water Capacity, mgd	-	26	26	26
Maximum Production Capacity, mgd	-	16.2	17.3	18.6

(a) Values for Initial Phase, Initial Phase, Buildout, and Ultimate are from the AM WTP Design Data Summary on the Construction Drawings. The Existing Conditions are not published in the Construction Drawings, but the same calculations are followed.

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To achieve the increase in the number of backwash cycles, numerous improvements would be needed, and at a minimum would include the following:

- For the backwash water, the existing pumps may have enough capacity, but flow control valves and flow meters would be installed at each filter.
- Backwash basins may need to be increased or expanded.
- Air used for the backwash cycle comes from three blowers. With two cells being backwashed, two blowers would need to be on, which could cause surge conditions. Individual air flow and backflow meters would also need to be installed on each cell.
- Numerous SCADA system improvements would be required.

Overall, an improvement to the backwash system would increase the capacity by roughly 2 mgd, but the improvements required would be significant and expensive and are not recommended. Even if backwash improvements were made to allow backwashing two filters simultaneously, capacity would be increased to 18.6 mgd, which is still insufficient to meet the 2045 MDD demand.

The Vine Street WTP with its advanced age and lack of seismic resiliency (discussed in Chapters 7 and 8) presents concerns of continuing to meet demands in the next 20 years and beyond. Through attentive and consistent operation, maintenance, and improvements, the City has used the Vine Street WTP to provide the public safe drinking water for over 110 years. To continue to extend the lifetime of the Vine Street WTP for the future 20+ years, major improvements including replacement of buildings, structures, and systems would be required as described in Chapters 7 and 8. If the Vine Street WTP becomes unavailable, the AM WTP would become the only source for long term drinking water operations and the AM WTP is unable to meet the projected 2045 MDD alone. Thus, it is recommended that the City begin planning for the future of the Vine St site through a viability study which should analyze different alternatives including the replacement of the Vine Street WTPas a long--term enhancement for resilient water operation. In an emergency, the recommended emergency water supply, as presented in Chapter 4 should be capable of meeting the annual ADD. The existing ADD of 6.8 mgd and the 2045 ADD of 11.4 mgd (see Table 6-4) can be met by either treatment plant.

WTP Performance

The condition assessment results in Chapter 7 summarize the overall performance concerns and recommendations at each WTP. This section focuses on the filter or membrane performance and efficiency at each WTP.

Vine Street WTP Performance

Since the last master plan update, the federal rules titled Long Term 2 Enhanced Surface Water Treatment Rule (LT2) were adopted by Oregon in 2009. West Yost was hired to review the compliance and provided a technical memorandum (TM) in 2011 titled Compliance with Long Term 2 Enhanced Water Treatment Rule at the Vine Street Water Treatment Plant. When the Vine Street WTP performance was compared to the LT2 rules, it was found that the WTP did not meet the threshold triggering requirements for an additional 1-log of Cryptosporidium removal credit to meet LT2 requirements. The City reached compliance by obtaining additional treatment credits:

- 0.5-log removal credit for individual filter effluent that meets less than 0.15 NTU in 95 percent of measurements per month

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- 0.5-log removal credit for combined filter effluent that meets less than 0.15 NTU in 95 percent of measurements per month

Thus, the City met the extra credits by monitoring and reporting turbidity at individual Vine Street WTP filters and demonstrating that the measurements met the turbidity requirements.

In 2019, a Filter Media Assessment was performed at the Vine Street WTP. The evaluation covered filter surface mapping, filter probes and cores, backwash analysis, and flocculation retention analysis for all 10 filters. The study found that the "condition of the media overall appears to be good, and the plant is operated in a manner to protect the integrity of the media." The assessment included recommendations for more regular monitoring including performing a spot check at each filter once every five years with the coring tool to examine the full column of media closely. At the time of the 2019 assessment, the Filter 7 rotating surface wash arms did not rotate resulting in some scouring and mounding of the media. It was also found that Filters #7 and #8 did not include a silica sand layer which resulted in flocculated material being retained more uniformly in Filters #7 and #8, while other filters retained the majority of flocculated material in the first 6 inches of media. It was recommended to consider adding silica sand to Filters #7 and #8 the next time the anthracite media is replaced.

Prior to 2019, some work may have been performed to repair cracks in between Filters #7 and #8. There are small leaks in numerous other locations around the filters and the City is currently looking into possible temporary repair options, such as grout injections. However, these small leaks are indicative of larger structural issues (quality of original construction, aging/cracking concrete) that will eventually require more permanent fixes or replacement. Chapters 7 and 8 expand on the structural condition and seismic concerns of City facilities.

Figure 6-2 presents Vine Street WTP turbidity filter data from September 2021 to August 2022. and shows that the turbidity has never exceeded 0.15 NTU, which is the limit that 95 percent of readings must remain below. Considering the current performance of the filters is adequate, it is not recommended to replace the Vine Street WTP filter media, surface agitation system, troughs, and underdrains as was previously recommended in the 2004 Water Master Plan. Instead, continued monitoring and periodic coring at each filter is recommended to monitor filter media performance. The Oregon Area Wide Optimization Program (AWOP) has a filtered water turbidity goal for combined filter effluent and individual filter effluent of less than 0.1 NTU 95 percent of the time and a maximum filter turbidity of 0.3 NTU. The Vine Street WTP filtrate turbidity meets the Oregon AWOP requirements for turbidity.

The overall Vine Street WTP filter efficiency was calculated based on monthly filter and backwash flow totals from August 2021 to July 2022 and presented in Table 6-6. The filter efficiency ranges from 96 to 99 percent. Losses in filter production are due to backwash volume. A filter efficiency goal of greater than 95 percent is ideal.

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Table 6-6. Vine Street WTP Filter Flows and Efficiency			
Month-Year	Monthly Filter Flow Total, MG	Monthly Backwash Flow Total, MG	Filter Efficiency, percent
August 2021	112.8	4.2	96
September 2021	71.6	1.5	98
October 2021	36.7	0.8	98
November 2021	32.0	0.6	98
December 2021	21.2	0.5	98
January 2022	24.4	0.5	98
February 2022	18.6	0.3	98
March 2022	12.8	0.2	98
June 2022	13.4	0.3	98
May 2022	17.2	0.5	97
June 2022	28.3	0.4	99
July 2022	73.0	1.1	98

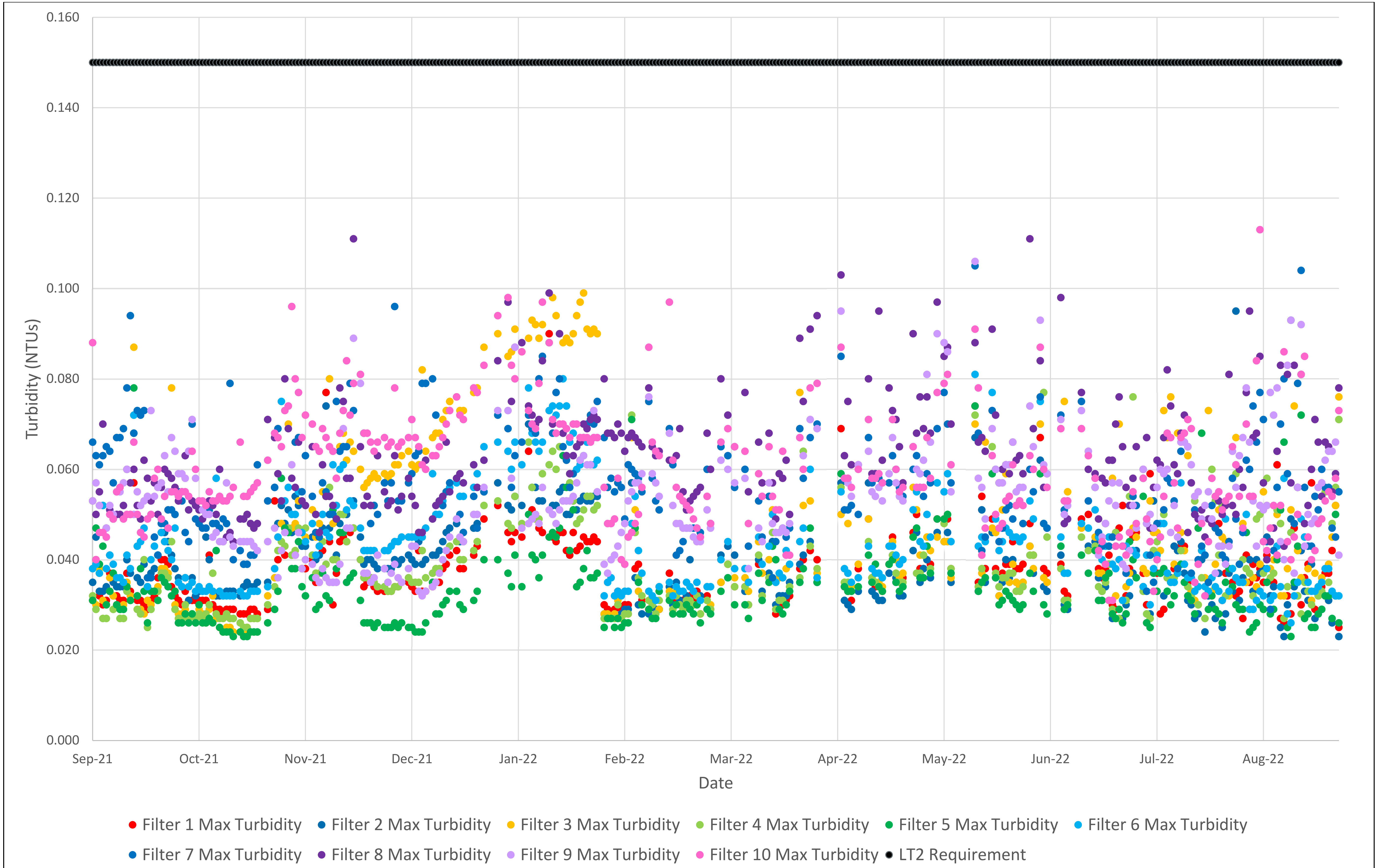

Figure 6-2. Vine St WTP Turbidity

AM WTP Performance

AM WTP combined filter effluent (CFE) turbidity data from May 2021 to September 2022 is shown in Figure 6-3. The limit of turbidity is set by OAR 333-061-0030 (3), which requires all readings to be below 5 NTU and also 95 percent of readings to remain below 1 NTU. The City meets the state requirements. The turbidity of the AM WTP also meets Oregon's AWOP requirements. The elevated NTU levels starting in January 2022 were caused by a malfunctioning meter that was replaced.

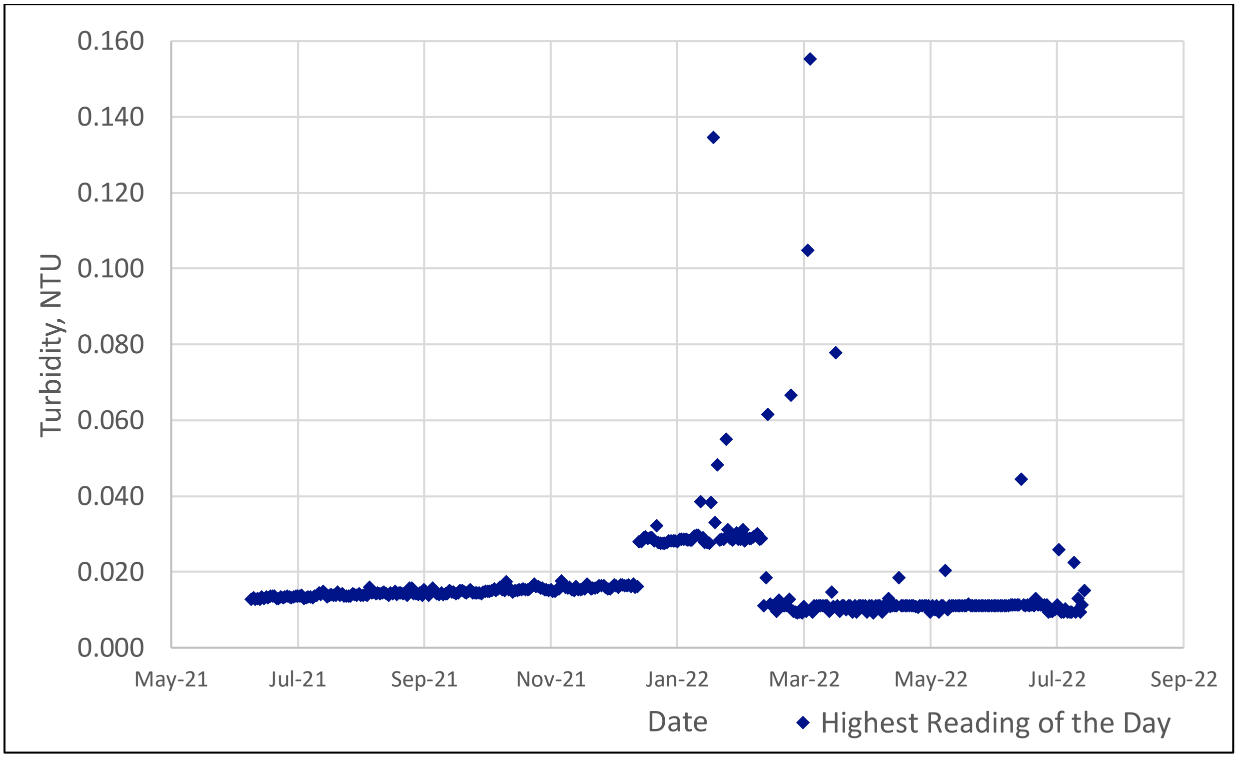

Figure 6-3. AM WTP Turbidity

Table 6-7 shows the AM WTP monthly raw and finished flow rates over one year of data from August 2021 to July 2022. The AM WTP plant efficiency was calculated based on monthly raw water and finished water flows. The filter efficiency ranges from 88 to 92 percent. Losses in production volume are attributed to the strainer drain, analyzers, and backwash water.

Table 6-7. AM WTP Plant Flows and Efficiency			
Month-Year	Raw Flow Total, MG	Finished Flow, MG	Plant Efficiency, Percent
August 2021	281	252	90
September 2021	224	202	90
October 2021	164	149	90
November 2021	145	128	88
December 2021	151	135	90
January 2022	148	133	90
February 2022	134	123	92
March 2022	158	142	90
June 2022	152	138	91
May 2022	171	151	88
June 2022	194	177	91
July 2022	280	257	92

There are currently no recommendations to improve the treatment performance at the AM WTP.

6.4 DISTRIBUTION SYSTEM EVALUATION

A distribution system hydraulic computer model (model) was used to evaluate the capacity of existing facilities, test scenarios, and help identify and evaluate needed distribution system improvements.

6.4.1 Hydraulic Model Update

This section describes the update of the City's model.

The City uses Bentley System Inc.'s WaterGEMS software for distribution system hydraulic modeling. The City's model was updated by incorporating the most current (January 2023) asset data (e.g., mainlines, valves, meters) GIS data and other various operational system data provided by City staff.

The model includes extended period simulation (EPS) scenarios, which simulate system performance over a period of time, such as 24 hours or more. EPS scenarios take more time to develop than steady state scenarios (a single snapshot in time), but provide greater simulation and analysis flexibility, allow for water age modeling, simulate changing demands and the operation of pumps and tanks, and provide more insight to identify operational issues and deficiencies. EPS scenarios use diurnal demand patterns to vary demands throughout the day. Figure 6-4 shows the water demand patterns used for the MDD simulations that were created by evaluating the flows in and out of each zone on the maximum day demand in 2022.

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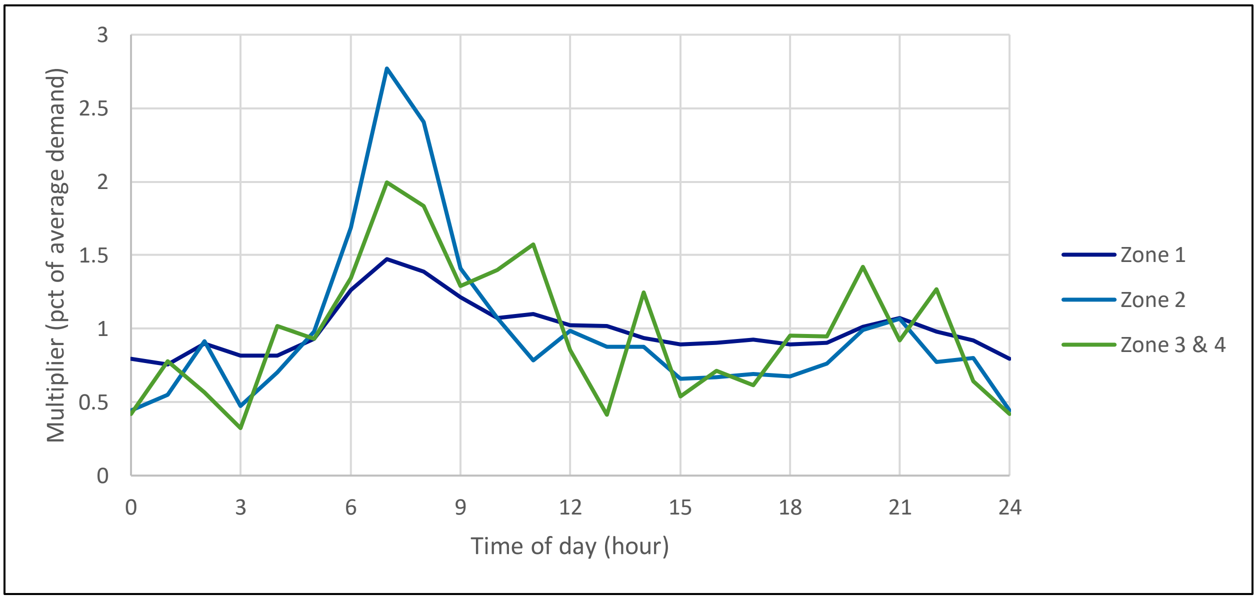

Figure 6-4. 2022 MDD Diurnal Patterns

To accurately evaluate the water system performance, water demands must be appropriately represented in the model. Demands are first calculated and then allocated to model nodes representing physical locations. The total demand for each zone was allocated to the model junctions by utilizing the City's billing records and GIS customer meter data. The steps used to allocate customer demands to the model are listed below.

1. Obtain monthly customer billing records including meter numbers and calculate the usage for each customer.
2. Match customers to GIS meter layer or parcel.
3. Assign each customer demand to the closest model pipe and closest junction on that pipe network, ignoring non-demand junctions at WTPs, pump stations, or reservoir sites.
4. After allocating customer water usage to the appropriate model junctions, account for water loss by scaling the allocated usage to match the total system demand estimates. Scaled water loss was then distributed to model junctions by pipe length (junctions connected to longer pipes have more loss associated with them).
5. Assign diurnal patterns to demand junctions.

Next, information from SCADA records was used to update the model controls to reflect the current facilities and operations. After the model was updated for physical, demand, and operational conditions, it was validated by comparing model results with field test data and SCADA records. A good match was achieved between the model results and the actual system performance for the purposes of this project. During the calibration period, the Wildwood and Valley View reservoir levels were not consistent from day to day. Typically, the Gibson Hill PS and North Albany PS are operated on level control but may have been manually operated during the calibration period. Results of the system validation are shown in Appendix B.

After the model was calibrated, scenarios were developed to evaluate the model in its existing state under winter day demand, ADD, and MDD conditions. Scenarios were also developed for each of the following demand conditions: near-term (5-year horizon), medium-term (10-year horizon), long-term (20-year horizon) and buildout-term (Approx. 50-year horizon, 2070).

Future demands for new customers within the UGB were calculated based on the expected land use as described in Chapter 3 and using the "Medium" Demand Scenario. These demands were assigned to the appropriate model junctions as described above.

The model was also used to perform fire flow analyses. Under this scenario, system hydrants were assigned a fire flow based on the land use of nearby parcels. Chapter 4 lists the fire demand by land use type which ranges from 1,500 gpm for low-density residential to 3,500 gpm for non-residential.

6.4.2 Water System Facility Capacity Evaluation

Reservoir and pump station capacity for existing and future conditions was evaluated and compared to the planning criteria. The planning criteria for system facilities are described in more detail in Chapter 4. The hydraulic model was also used to evaluate the capacity of the distribution system piping for existing and future conditions. A summary of these evaluations is provided in the following sections.

Storage Reservoirs

The City currently has 21.3 MG of total storage, of which 17.5 MG is available for use by the distribution system. Some of the volume at the WTP reservoirs is needed for chlorine contact time, and so it was not considered available for use by the distribution system. At the AM WTP, 1.0 MG is needed for contact time and the remaining 4.7 MG is split equally between the City of Millersburg and the City of Albany. The City of Millersburg has 2.35 MG designated for use in addition to the 0.5 MG needed for contact time.

The total and available storage volumes for each reservoir, by pressure zone, is shown in Table 6-8.

Table 6-8. Existing Available Storage

Zone	Name	Volume, MG		
		Total	Unavailable Volume[a]	Net Available for Albany
Zone 1	AM WTP	5.70	3.35	2.35
	Maple	2.00	0.50	1.50
	Broadway	8.20	-	8.20
	Queen	0.90	-	0.90
	34th	2.00	-	2.00
Zone 2	Wildwood	1.15	-	1.15
Zone 3 & 4	Valley View North	0.25	-	0.25
	Valley View Middle	0.25	-	0.25
	Valley View South	0.85	-	0.85
	Whole System Total	**21.30**	**3.85**	**17.45**

(a) Reserved for Millersburg and/or chlorine contact time at AM WTP and Maple.

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Table 6-9 and Table 6-10 give a comparison of the existing storage capacity with the existing and buildout storage requirements, based on the "Medium" Demand Scenario from Chapter 3. Summer demand (average of July, August, and September) is 1.47 x ADD, which is lower than MDD (1.76 x ADD). Note that while each zone is listed individually, the whole system should be considered together because of the capability to transfer water throughout the system using pumps and valves. This analysis assumes that all existing reservoirs either remain in place or are replaced with reservoirs of equivalent capacity.

Table 6-9 and Table 6-10 indicate that overall, the City currently has adequate storage capacity for existing winter and summer conditions. Prior to this master planning effort, the City completed previous analysis that showed that operating the Zone 1 reservoirs (Broadway, Queen, 34th) at lower levels in the winter would reduce water age and improve chlorine residual throughout the system (Water System Optimization TM, 2022), while still meeting the minimum pressure requirements. The City has since implemented modified reservoir operations to account for the seasonal demand changes.

Zone 2 does not have enough summer storage when considered on its own but can access surplus storage from Zone 1 and Zone 3, assuming the North Albany pump station is operating and has enough capacity, or the Gibson Hill pump station bypass pressure reducing valve (PRV) can open.

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Table 6-9. Storage Analysis, Existing Demands

Zone	Winter Demand, mgd	Summer Demand, mgd	Existing Net Available Storage, MG	Required Storage, MG							Surplus Storage, MG	
				Equalization (Winter)	Equalization (Summer)	Fire	Emergency (Winter)	Emergency (Summer)	Total (Winter)	Total (Summer)	Winter	Summer
Zone 1	3.99	8.12	14.95	0.64	0.98	0.63	3.99	8.12	5.26	9.73	9.69	5.22
Zone 2	0.26	0.71	1.15	0.04	0.09	0.63	0.26	0.71	0.93	1.43	0.22	-0.28
Zone 3 & 4	0.28	0.71	1.35	0.05	0.09	0.18	0.28	0.71	0.51	0.978	0.84	0.37
Whole System	**4.53**	**9.54**	**17.45**	**0.73**	**1.16**	**0.63** [(a)]	**4.53**	**9.54**	**5.89**[(b)]	**11.33**[(b)]	**11.56**	**6.12**

(a) Maximum fire flow for the whole system
(b) Totals for the whole system were calculated using the same approach as individual zones.

Table 6-10. Storage Analysis, Buildout (2070) Demands

Zone	Winter Demand, mgd	Summer Demand, mgd	Existing Net Available, Storage, MG	Required Storage, MG							Surplus Storage, MG	
				Equalization (Winter)	Equalization (Summer)	Fire	Emergency (Winter)	Emergency (Summer)	Total (Winter)	Total (Summer)	Winter	Summer
Zone 1	6.05	12.17	14.95	0.97	1.47	0.63	6.05	12.17	7.65	14.27	7.30	0.68
Zone 2	0.42	1.03	1.15	0.07	0.12	0.63	0.42	1.03	1.12	1.78	0.03	-0.63
Zone 3 & 4	1.07	2.48	1.35	0.17	0.30	0.18	1.07	2.48	1.42	2.96	-0.07	-1.61
Whole System	**7.54**	**15.68**	**17.45**	**1.21**	**1.89**	**0.63**[(a)]	**7.54**	**15.68**	**9.38**[(b)]	**18.20**[(b)]	**8.07**	**-0.75**

(a) Maximum fire flow for the whole system
(b) Totals for the whole system were calculated using the same approach as individual zones.

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Table 6-9 and Table 6-10 indicate that overall, the City currently has adequate storage capacity for existing winter and summer conditions. Prior to this master planning effort, the City completed previous analysis that showed that operating the Zone 1 reservoirs (Broadway, Queen, 34th) at lower levels in the winter would reduce water age and improve chlorine residual throughout the system (Water System Optimization TM, 2022), while still meeting the minimum pressure requirements. The City has since implemented modified reservoir operations to account for the seasonal demand changes.

Zone 2 does not have enough summer storage when considered on its own but can access surplus storage from Zone 1 and Zone 3, assuming the North Albany pump station is operating and has enough capacity, or the Gibson Hill pump station bypass pressure reducing valve (PRV) can open.

There is also adequate storage to meet the 20-year horizon demands through 2045, as evaluated in this WMP. By buildout, there will be a 0.75 MG system deficit in the summer while there will still be a surplus in the winter. Therefore, additional storage will need to be constructed to satisfy summertime demand conditions. Assuming additional storage should be in place 2 to 3 years before the required storage exceeds the existing available storage capacity, Figure 6-5 show that new storage will be needed by approximately 2063 for the Medium Demand Scenario, or when total system ADD exceeds about 10.0 mgd. It is recommended to review the timing of new storage in the upper zone in the next WMP update.

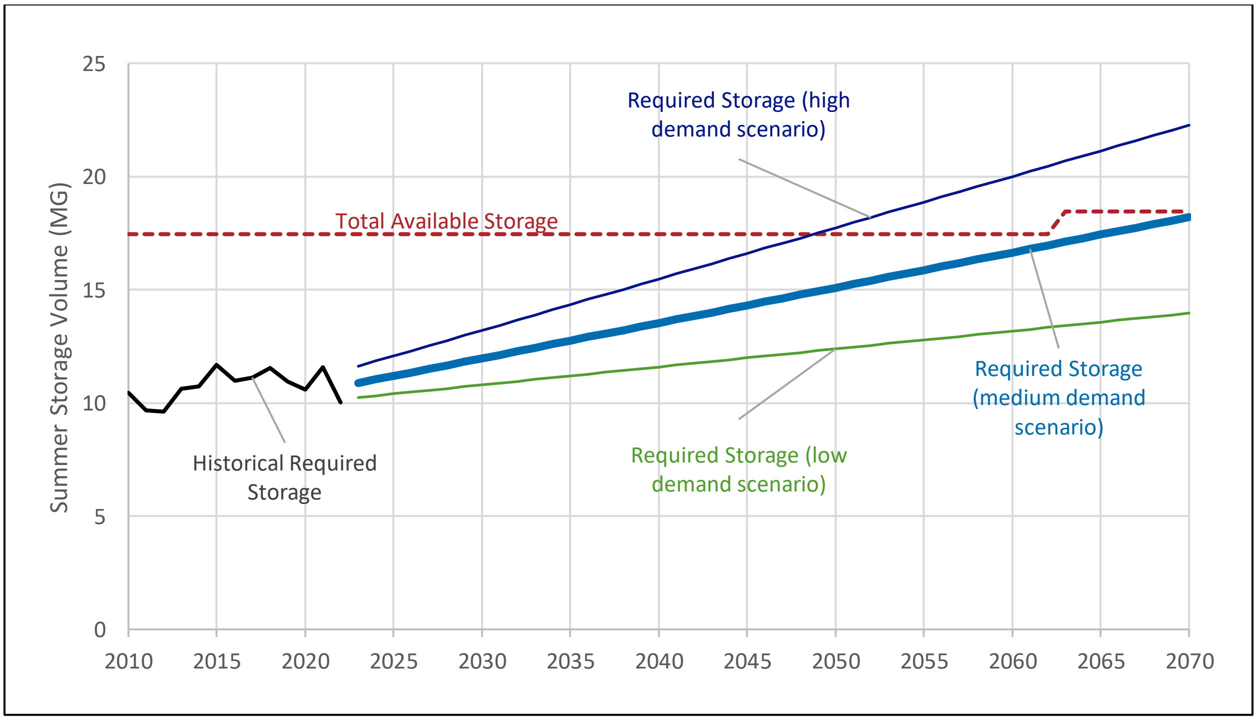

Figure 6-5. Reservoir Timing

Conservation measures targeting summer water usage could result in the required storage following the Low Demand Scenario line, eliminating the need to construct additional storage. If instead, actual demand follows the High Scenario, more storage will need to be constructed, starting about 2047.

Based on Table 6-10, the new storage is mostly needed in the upper zones. There is no room at the Valley View site for additional storage, but there is room at the Wildwood site and the Broadway site for an at-grade steel or concrete reservoir. The Wildwood site is a more efficient location for operations because

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it serves Zone 2 and is therefore the preferred location. If the Broadway site were selected, it would need to be paired with additional pumping capacity at the North Albany Pump Station.

As the City is considering alternatives for the Vine Street WTP, it could be an opportunity to consolidate some of the Zone 1 storage into a single location by decomissioing the Maple, Queen, and 34th reservoirs and constructing an equivalent volume at a new WTP site. In addition to simplifying maintenance, this would result in more efficient pumping and lower energy consumption. The option to consolidate Zone 1 storage is recommended for further hydraulic evaluation and viability analysis as part of the Vine Street viability study.

Currently, water produced by the Vine WTP must be pumped from ground elevation (~250 ft) up to the Zone 1 hydraulic grade (375 ft). The energy used to pump this water is lost when the Queen and 34th reservoirs are filled. To use the water in these reservoirs, it must again be pumped up to 375 ft. If the storage at the Maple, Queen, and 34th reservoirs was consolidated at a new WTP, this repumping could be eliminated, and the water would only need to be pumped once, saving energy.

Figure 6-6 shows a profile schematic of the water system with the potential storage changes and construction of a new WTP. Also shown are pump station improvements described in subsequent subsections.

Valley View Hydropneumatic Tank

In addition to the storage tanks discussed above, the Valley View site includes a small pump station with a 450-gallon hydropneumatic surge tank to serve Zone 4 customers. The three pumps (1 jockey and 2 main pumps) operate to fill the tank to 75 psi. As customers use water, the tank drains and the pressure decreases to 50 psi, at which point the pumps turn on to refill the tank.

Calculations with the tank and pump specifications confirm that the existing tank is undersized and empties too quickly, causing the pumps to turn on and off frequently. This causes excess wear on the pump components, particularly the motors, leading to a reduced life. Table 6-11 shows calculations for the existing pumps and tank. The “starts per hour” value (lines 14 and 15) should be less than the “maximum allowable starts per hour” (line 6).

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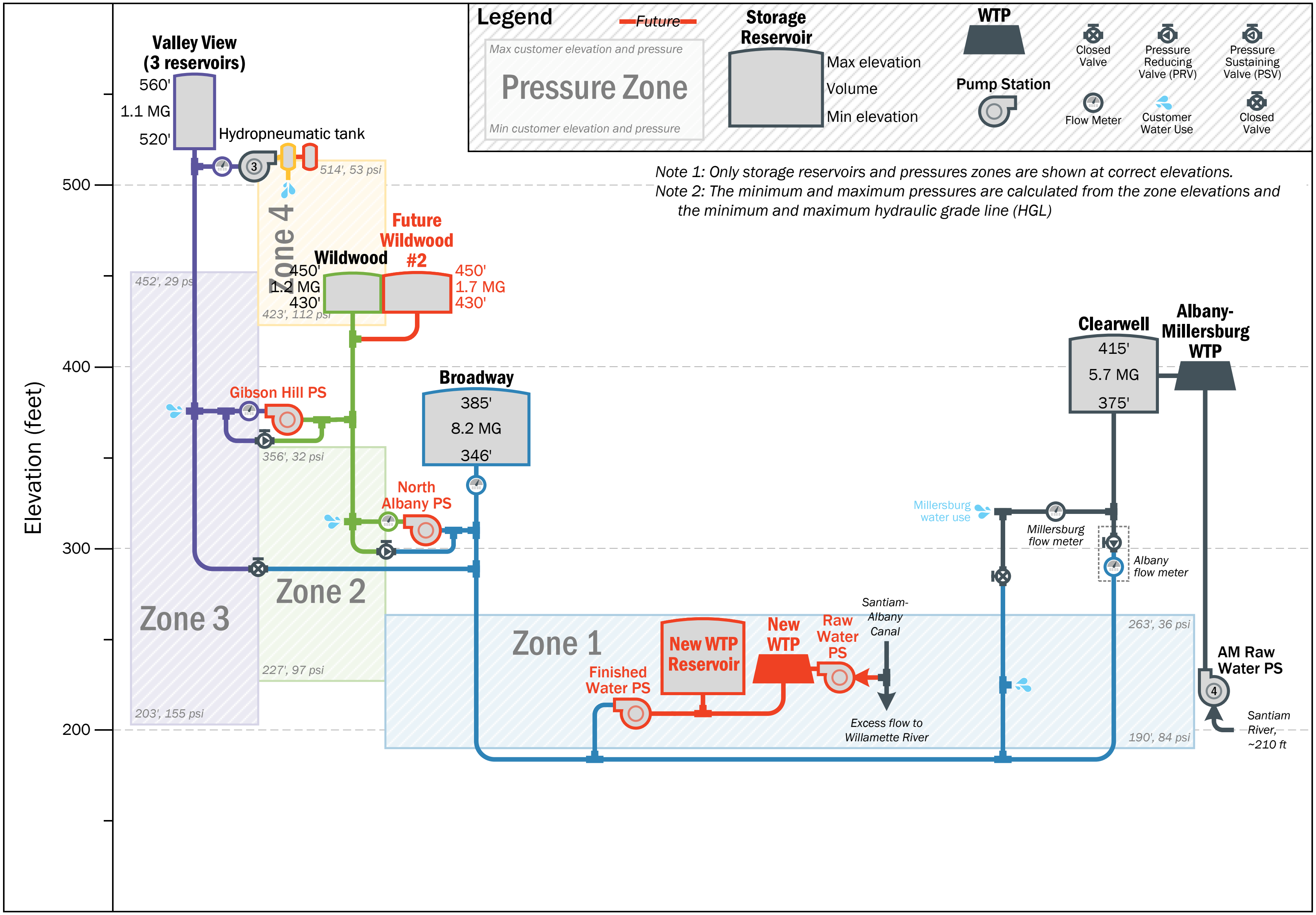

Figure 6-6. **Possible Future Water System Hydraulic Schematic**

Table 6-11. Valley View Hydropneumatic Tank Analysis

	Item	Value	Notes/Source
1	Zone 4 PHD demand (gpm)	59	-
2	Pump 2 & 3 design flow (gpm)	238	Each pump
3	Pump horsepower (HP)	7.5	-
4	Pump rpm	3,467	-
5	Pump number of poles	2	-
6	Maximum allowable motor starts per hour	7.0	NEMA MG 10-2017 Table 8
7	Minimum rest time between starts (sec)	88.0	NEMA MG 10-2017 Table 8
8	Existing hydro tank total volume (gal)	450	-
9	Hydro tank useable percent	28	Bell & Gosset (xylem) Domestic Water Pressure Booster Design Manual for 50-75 psi
10	Hydro tank useable water volume (gal)	126	-
11	Peak flow drain time (min)	2.1	Time for useable volume to drain during PHD
12	Peak flow fill time (min)	0.7	Time to refill the tank during PHD
13	Pump cycle time during peak demand (min)	2.8	-
14	Starts per hour	21.2	This value should be smaller than row 6
15	Starts per hour (alternating pumps)	10.6	If pumps alternate which one turns on each time. This value should be smaller than row 6

Adding a second 450-gallon tank would allow the pumps to meet the maximum start/hour criterion with alternating pumps. Replacing the existing tank with a single 1,500-gallon tank would allow the pumps to meet the criterion without alternating pumps. However, replacing the pump motors more frequently may be an acceptable solution, given the small size of the motors. The City recently had to replace a motor and has since modified the pump control logic to reduce the number of starts and hopefully extend the life of the pump motors.

Pump Stations

The pump station firm capacities were compared with the required capacity to identify deficiencies for existing and future conditions.

The Queen and 34th pump stations do not supply the system but are used instead to supply Zone 1 from ground-level storage, and therefore the capacity of these pumps was not evaluated. The Maple high service pump station is able to provide the whole system MDD without the Queen and 34th pumps in case the AM WTP or transmission pipeline from the AM plant is offline for maintenance or repair. Also, as the City considers alternatives for the Vine Street WTP, there could be an opportunity to consolidate the Zone 1 pumping into a single location by decommissioning the Maple, Queen, and 34th pumping stations and constructing an equivalent capacity pump station at a new WTP site. The option to consolidate Zone 1 pumping and storage is recommended for further hydraulic evaluation and viability analysis as part of the Vine Street viability study.

Table 6-12 summarizes the pump station capacity for existing and buildout conditions. The evaluation indicates that the North Albany was at or near capacity when the impellers were replaced in 2018. Based

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on 2010-2022, demands in the pump station service area are currently trending higher than the medium demand scenario. If this trend continues, MDD will exceed the pump station firm capacity of 2.6 mgd by approximately 2028. To ensure adequate water supply, a new pump station will need to be constructed, or the existing pumps upgraded to a higher capacity. If demands follow the medium scenario, a new pump station may be needed by 2034.

Demands for the Gibson Hill pump stations are also increasing, but the trend from the past 12 years is lower than the medium demand scenario. The capacity of the pump station will need to be increased when Zone 3/4 MDD exceeds about 1.2 mgd, expected in 2030 for the medium demand scenario.

Figure **6**-**7** and Figure 6-8 show possible timing of phased capacity upgrades for the Medium Demand Scenario, assuming upgrades must be complete 2 to 3 years before the required capacity exceeds the available capacity. Note that the years projected for capacity upgrades are an estimate. Conservation measures targeting summer water usage could delay the need for new pump stations. Conversely, higher growth, climate impacts, or other trends could accelerate the schedule. MDD for both pump station service areas should be closely monitored to determine when capacity improvements are needed and construction planning can be initiated.

Table 6-12. Pump Station Capacity Analysis

Zone	Pump Station	Firm Capacity, mgd	Required Capacity	Existing Capacity, mgd		Buildout Capacity, mgd	
				Required	Surplus	Required	Surplus
1	Maple High Service Pump Station	23.0	Whole system MDD	11.1	11.9	18.8	4.2
2	North Albany Pump Station	2.6	Zone 2 MDD + Zone 3 MDD + Zone 4 MDD	2.0	0.6	4.2	-1.6[(a)]
3	Gibson Hill Pump Station	1.3	Zone 3 MDD + Zone 4 MDD	0.9	0.4	3.0	-1.7[(a)]
4	Valley View Pump Station	0.4	Zone 4 PHD	0.1	0.3	0.2	0.2

(a) Negative values (red) indicate there is insufficient firm capacity to meet the required demands

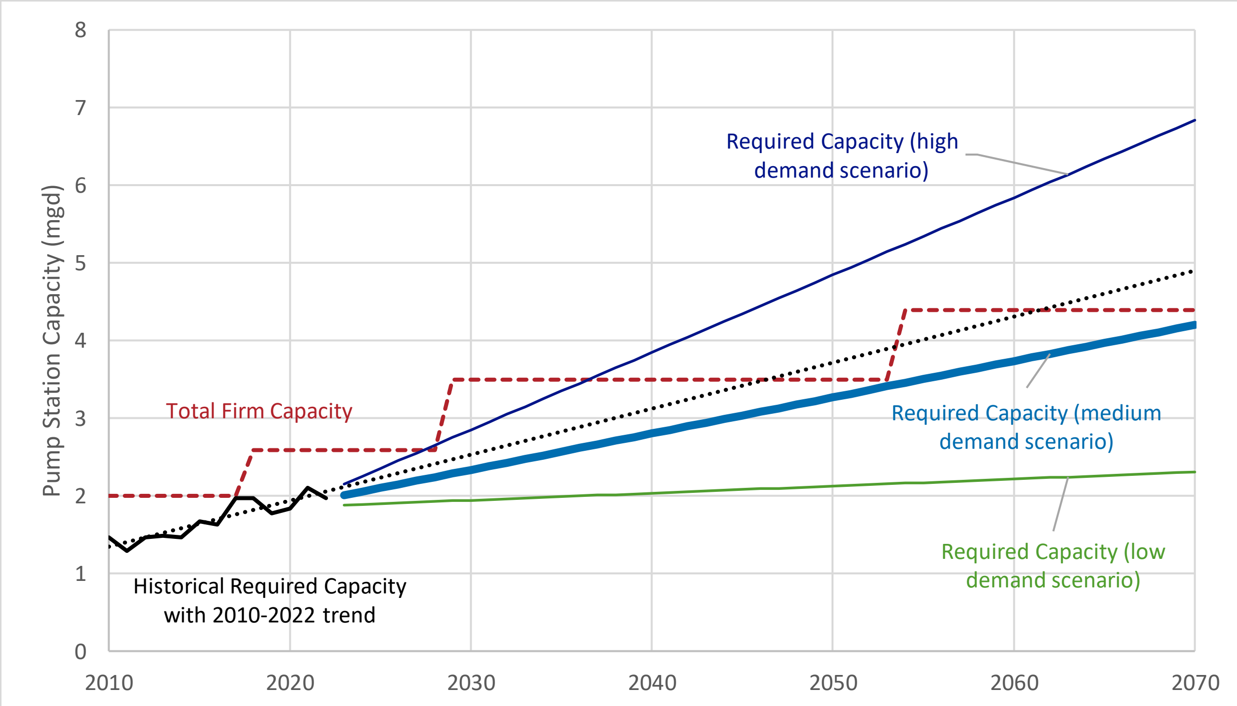

Figure 6-7. North Albany Pump Station Upgrade Timing

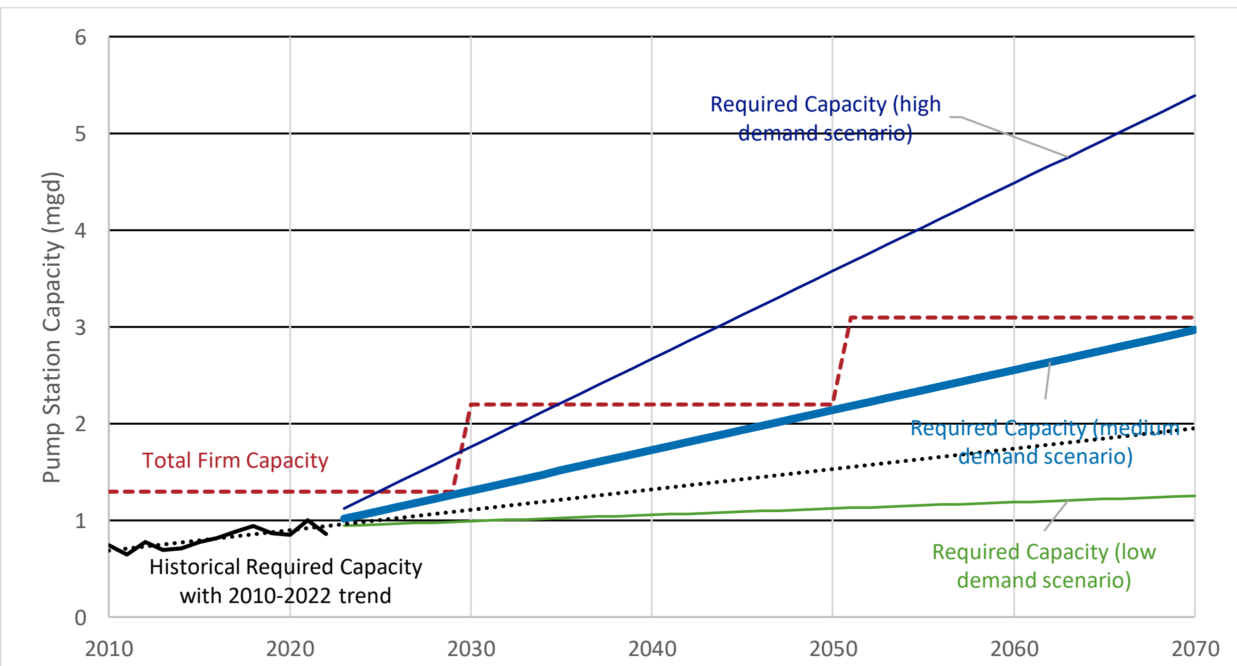

Figure 6-8. Gibson Hill Pump Station Upgrade Timing

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Piping

The City's transmission and distribution pipes were evaluated under existing and buildout conditions, for both MDD (including PHD) and MDD + fire flow. Model results were compared to evaluation criteria to identify pressure and velocity issues, as well as ability to supply the required fire flow from a single hydrant. Figure 6-9 shows locations where the minimum and maximum pressure criteria are not met for existing conditions. Figure 6-10 shows the hydrants that cannot provide the required fire flow from a single hydrant. In some cases, the required fire flow can be provided by using multiple nearby hydrants. Most areas outside the UGB in the NACSD are unable to supply the required fire flow (1,500 gpm for low-density residential). However, in the NACSD, the City is only required to provide fire flow in this area to the level it existed at the time of the Agreement (July 1991) , so no projects were identified at this time to alleviate these existing deficiencies.

Pressure in North Albany (Zone 2 and Zone 3) exceeds the 80-psi maximum pressure criterion, with some pressures as high as 150 psi. Customers in these areas have individual PRVs installed to protect piping in their homes. The distribution pipes in this area are assumed to be designed to handle these high pressures.

Pipes were added to the model for the buildout scenario in areas expected to grow within the UGB. The latest update (Jan 2023) of the East Albany Land Use Plan was evaluated, and transmission pipes were added to follow future roads. The need for buildout project pipes from the previous master plan that have not yet been constructed was also evaluated. Some of these pipes are no longer necessary given the lower demand projections described in Chapter 3 (assuming the Medium Demand Scenario is followed). Other development-driven pipes identified in the previous master plan can be reduced in diameter.

No pipe capacity issues were identified for the existing or buildout MDD scenarios.

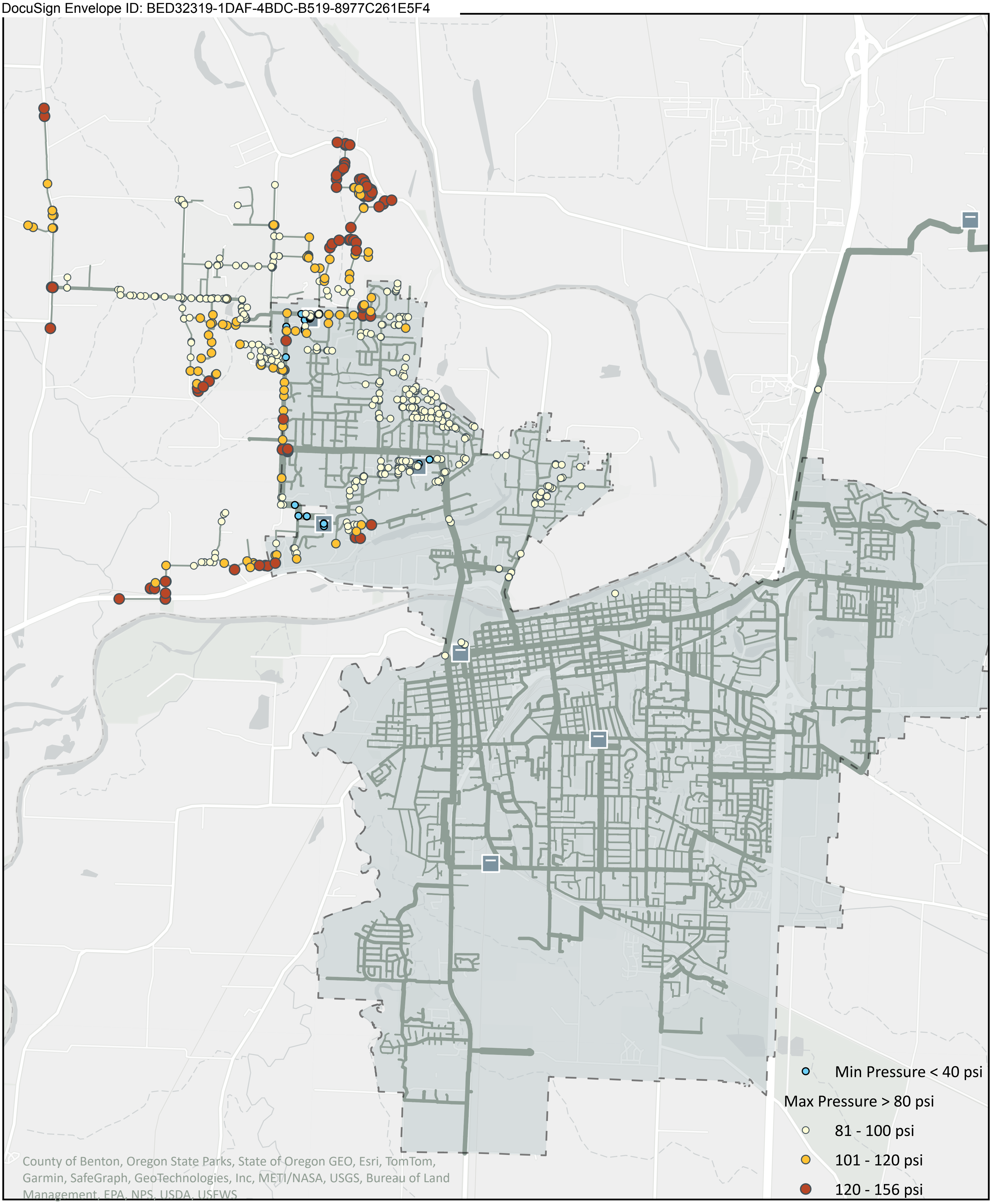

Figure 6-9. Model pressure and velocity results for existing MDD conditions

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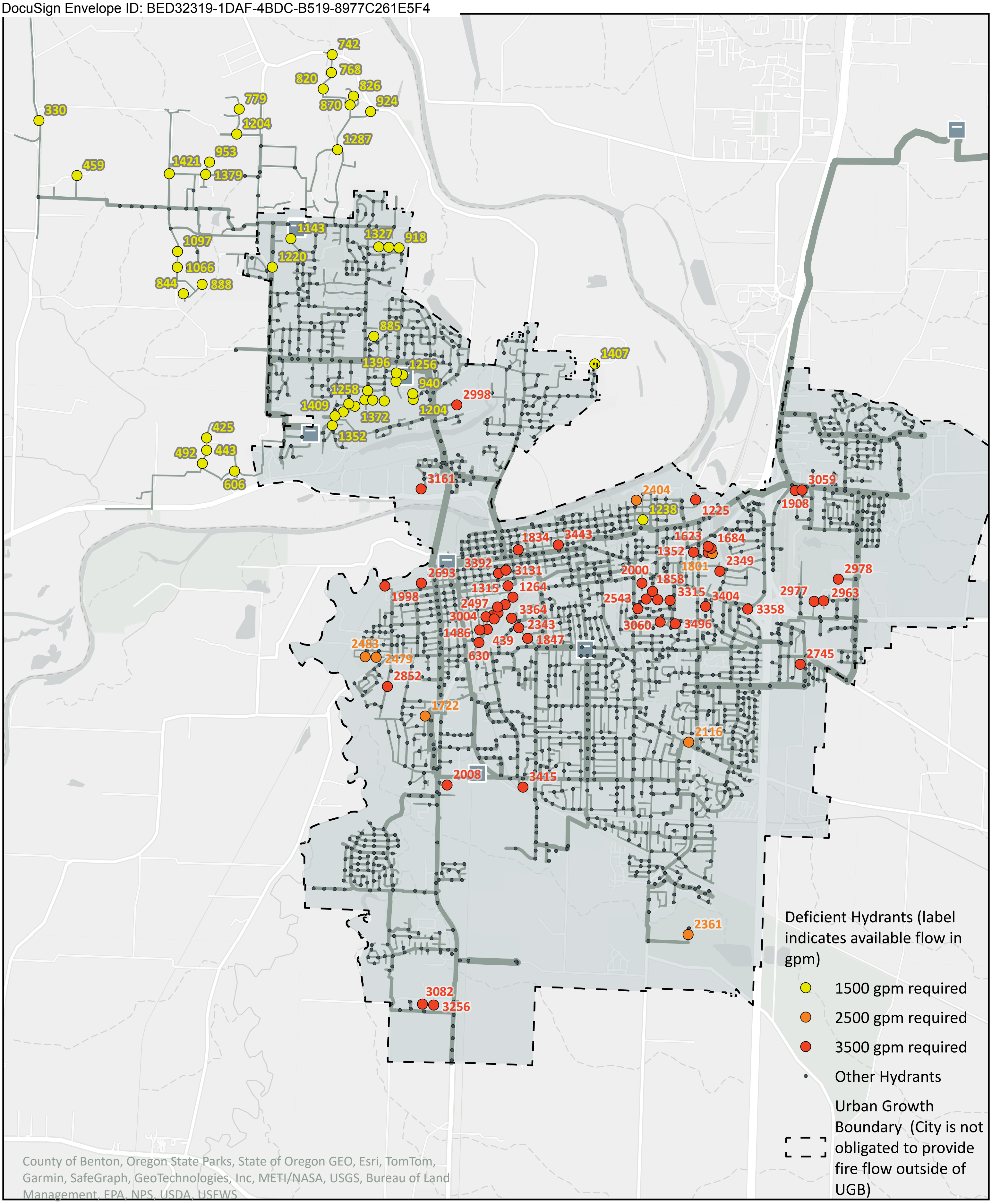

Figure 6-10. Model hydrant results for existing MDD conditions

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Water Meters

As described in Chapter 2, the City has over 18,900 water meters and is in the process of converting to advanced metering infrastructure (AMI) which allows meter reading through transmitters instead of through contracting a meter reading service. Currently 41 percent of the water meters in service have the AMI capability and the City goal is to complete the AMI installation in the entire system in the next 5 years.

Having an AMI system in place is beneficial for several reasons. First, the city will no longer need to contract meter reading which will reduce the annual operating costs. System modeling and water loss calculations will become more accurate by being able to instantaneously account for water use, rather than relying on meter reads from a previous month that are collected over a few days. More information will be available to customers and to the utility since AMI systems are typically setup to report water use throughout the day. An interface will allow customers to see their daily water use, similar to power billing. The system can also alert the utility of potential leaks indicated by the water meter. All of this information can help change customer behavior with water usage and therefore will contribute to water conservation efforts. Additionally, AMI system use is expanding beyond just being use for water meters. The systems can piggyback other sensors onto the and water quality parameters on the network (such as temperature, pressure, pH, and chlorine). This can aid in monitoring the distribution system for leaks or water quality issues.

The City's operational goal is to replace water meters every 20 years which may need to be accelerated depending upon battery life expectancy of the new meters and transmitters. When meters are changed out, this includes replacing the box and lid with one compatible with the future transmitter, but not the transmitter itself. The City budgets for 1,000 meters annually and plans to increase this number in the next biennium cycle (2025-2027) to help achieve the goal of incorporating AMI meters throughout the entire system. In the current biennium and going forward, the City is planning to save $500,000 a year for this AMI project and plans to apply for grant funding with the goal of completing the AMI installation in the entire system in the next 5 years.

6.5 SUMMARY OF RECOMMENDED IMPROVEMENTS

Table 6-13 summarizes the recommended improvements from the chapter and Figure 6-11 shows the location of the distribution system projects. Planning-level costs were estimated using the Basis of Cost TM (see Appendix C) and as summarized in Chapter 9. Additional CIP Project Sheets showing each project are provided in Appendix D.

Projects were grouped into four main categories:

- **Capacity improvements**. These projects are needed to meet existing or future demands.
- **Fire flow improvements**. These projects are needed to supply the required fire flow under existing or future conditions.
- **Development-driven**. Pipes needed to supply expected developments. These pipes will be constructed as areas develop and will be mostly driven by the timing of development. For the purposes of this plan, these projects were assumed to be needed in the medium-term (2031-2040). The exact layout of the pipes is uncertain but were drawn to follow expected road alignments. These pipes were grouped into projects that will likely be constructed together. The City will share the cost with developers for large-diameter pipes.

- **Performance improvements**. These projects are recommended to improve specific aspects of performance of facilities.

Projects were grouped into near-term, medium-term, and long-term horizons and buildout-term given suitable identifiers. East Albany development driven projects were assumed to take place in the medium-term horizon and the South Albany development driven projects were assumed to take place in the long-term horizon. Unless otherwise noted, fire flow improvement projects were assumed to take place in the medium-term horizon.

- Near-term: 2024 to 2028 (“N-” prefix)
- Medium-term: 2029 to 2033 (“M-” prefix)
- Long-term : 2034 to 2043 (“L-” prefix)
- Buildout-term: 2044 to UGB Buildout (Approx. 2070)(“B-” prefix)

Table 6-13. Summary of Recommended Projects

Project Number	Project Name	Trigger	Project Type	Project Purpose and Description
N-SS-1	Vine Street Facilities Viability Study	Existing Need	Planning	In light of the condition and seismic concerns at the Vine Street WTP, and the extent of improvements at the Hydroelectric Facility and Canal, it is recommended for the City to perform a viability study to evaluate different alternatives for the future of the Vine St site. First, the viability study should include the alternative of Vine St WTP replacement with a new WTP. Project numbers N-SS-1A, N-SS-1B, etc. convey the many capital projects recommended at the existing Vine St WTP, if it is not decommissioned. The viability study should include an analysis of the cost of reactive maintenance at the existing Vine St WTP and the amount of extended lifetime from performing those projects compared to the cost and lifetime of a new WTP investment. The viability study should also consider the challenges and feasibility of replacing structures at Vine St WTP, due to their historical nature, and the phasing challenges if the Vine St WTP is able to remain in service while performing the major recommended upgrades. The viability study should look at multiple different locations for a new WTP and perform a cost-benefits analysis for each location. The viability study should refine assumptions with a new WTP and update the cost estimate. Next, the hydroelectric facility should be evaluated. A generator inspection should be performed and identify estimated generator upgrade costs. The study should update the expected cost of improvement at the Hydroelectric facility and refine the return-on-investment analysis. The viability study should also include the alternative to decommission the hydroelectric facility and what to do with non-consumptive water rights. Then, impacts to the canal should be considered in the viability study. Different locations of a WTP may impact the flow and required repairs of the Canal, which should be evaluated. Also, the decision to potentially decommission the Hydroelectric Facility may also have an impact on canal flows and repairs which should be encompassed. The study should determine if recommendations for repairs and remediation to the Canal will change with different alternatives and the cost impacts associated. Last, as the City considers replacement alternatives for of the Vine St WTP, there may be an opportunity to consolidate some of the Zone 1 storage and pumping into a single location by decommissioning the Maple, Queen, and 34th reservoirs and pump stations and constructing an equivalent storage volume and pumping capabilities at a new WTP site. The option of Zone 1 consolidation is recommended for further hydraulic and cost evaluation as part of the Vine St. viability study.
L-WTP-1	Vine Street WTP Filters #7 & #8 Silica Sand Layer	Future Need	Performance (Optional)	In 2019, it was determined that Vine Street WTP Filters #7 and #8 do not include silica media. The next time the anthracite media is replaced, it is recommended to consider adding silica sand to Filters #7 and #8.
M-WTP-1	Vine Street WTP Filter Media Coring	Future Need	Performance	It is recommended to perform periodic coring at each filter to examine the full column of media closely.
M-WTP-2	AM WTP 5th Filter Cell	Existing need	Capacity	It is recommended that a 5th membrane cell be installed. It can be used to improve cleaning and maintenance of the membranes for existing needs and in the future, membranes can be added to reach the ultimate plant capacity.
N-WTP-1	AM WTP Membrane Replacement	Replacement Schedule	Capacity	Membrane lifespan is 10 years and the next replacement cycle is 2026-2028. The City plans to increase the number of membranes to the maximum 648 membranes per cell at that point which is recommended to achieve full capacity.
N-PS-1	Valley View Hydropneumatic Tank	Existing need	Capacity (optional)	Optional Project. The Valley View pump station currently includes a 450-gallon hydropneumatic surge tank. The existing tank is undersized and empties too quickly, causing the pumps to turn on and off frequently. This causes excess wear on the pump components, particularly the motors, leading to a reduced life. Adding a second 450-gallon tank would allow the pumps to meet the maximum starts/hour criteria with alternating pumps. This project is optional because replacing the pump motors more frequently may be an acceptable solution, given the small size of the motors. In addition, the City has recently changed operations of the pumps and tanks to reduce the number of pump starts and extend the life of the pump motors.
N-PS-2	North Albany PS Replacement	When Total MDD for Zones 2, 3, and 4 exceeds 2p.6 mgd	Capacity/ Seismic/ Condition	This project is needed to meet the future pumping capacity requirements for supplying Zones 2, 3, and 4. Demands in these zones are approaching the firm capacity of the North Albany Pump Station (NAPS). This project assumes a new pump station will be constructed near the existing NAPS site around 2028 (based on recent demand trends) and the existing pump station will be retired. The pump station should be constructed in two phases. The first phase should have enough firm capacity to meet medium-term and long-term requirements, with room for expansion to meet buildout requirements in a second phase which will likely needed by about 2053 (Medium Demand Scenario). If demands follow the medium scenario, the first phase of this project could be constructed around 2034.
M-PS-1	Gibson Hill PS Replacement	When Total MDD for Zones 3 and 4 exceeds 1.3 mgd	Capacity	This project is needed to meet the future pumping capacity requirements for supplying Zones 3 and 4. Demands in these zones are approaching the total capacity of the Gibson Hill Pump Station (GHPS). This does not leave any backup capacity in case of maintenance needs or for redundancy. Further evaluation is needed to determine the feasibility of upgrading the existing pump station capacity. This project assumes a new pump station will be constructed near the existing GHPS site by 2030 (medium demand scenario) and the existing pump station will be retired. The pump station should be constructed in two phases. The first phase should have enough firm capacity to meet medium-term and long-term requirements, with room for expansion to meet buildout requirements in a second phase which will likely needed by about 2051.
N-D-1	Advanced Metering Infrastructure	Existing Need	Performance	The City has over 18,900 water meters and is in the process of concerting to advanced metering infrastructure (AMI) which allows meter reading through transmitters instead of through contracting a meter reading service. Currently 41 percent of the water meters in service have the AMI capability. In the current biennium and going forward, the City is planning to save $500,000 a year for this AMI project and plans to apply for grant funding with the goal of completing the AMI installation in the entire system in the next 5 years.
N-D-2	Zone 2 South Fire Flow Improvement 1	Existing need	Fire flow	This project reduces the severity of an existing fire flow deficiencies in Zone 2 near the Wildwood Reservoir. Pressures in this area are currently about 50-90 psi during normal conditions, but due to poor looping and the long distance from the Valley View Reservoirs, hydrants in this area cannot meet the required fire flow of 1,500 gpm. Project

Table 6-13. Summary of Recommended Projects

Project Number	Project Name	Trigger	Project Type	Project Purpose and Description
				M-D-1 eliminates all the fire flow deficiencies but requires replacement of a large quantity of pipe. This project provides a short-term solution that reduces (but does not eliminate) the number of hydrants unable to supply 1,500 gpm. This project involves replacing a short segment of 8-inch pipe with 12-inch and constructing three new double check valves from Zone 1 to Zone 2. The 12-inch pipe alleviates a constriction near the Wildwood Reservoir, and the check valves will open to allow water from Zone 2 to supply fire demands near the boundary of Zone 1 and Zone 2.
M-D-1	Zone 2 South Fire Flow Improvement 2	Existing need	Fire flow/ Condition	This project eliminates an existing fire flow deficiency in Zone 2 near the Wildwood Reservoir. Pressures in this area are currently 50-90 psi, but due to poor looping and the long distance from the Valley View Reservoirs, hydrants in this area cannot meet the required fire flow of 1,500 gpm. Project N-D-2 eliminates some of the fire flow deficiencies in the short term. This project provides a long-term solution that allows all the hydrants in this area to provide 1,500 gpm. This project involves replacing a large quantity of 10-inch pipe with 12-inch between Gibson Hill Rd and Wildwood Dr and is therefore recommended to be completed as part of the pipe renewal and replacement program.
M-D-2	Heritage Mall Fire Flow Improvement	Existing need	Fire flow	New pipe needed to alleviate fire flow capacity deficiencies near the Heritage Mall. This type of land use requires a fire flow of 3,500 gpm (see Chapter 4). Only a few of the hydrants in this area can supply 3,500 gpm. This project allows most of the hydrants surrounding the mall to supply 3,500 gpm during a fire.
M-D-3	Rail Yard Fire Flow Improvement	Existing need	Fire flow	This project is needed to supply the required fire flow to nearby customers. Medium-density residential, commercial, and industrial customers in this area require a fire flow of 2,500 to 3,500 gpm. These flows cannot be provided by the existing system due to insufficient looping and small pipes.
N-D-3	Washington Street Area Projects	Existing need	Fire flow	This is an existing project the City is currently planning for 2024, and is listed here for reference. This project will replace aging 4-inch and 6-inch pipes near Washington Street. This project will also eliminate existing fire flow deficiencies along Highway 99.
M-D-4	Commercial Way Fire Flow Improvement	Existing need	Fire flow	This project is needed to supply the required 3,500 gpm fire flow to commercial customers in the area shown. This flow cannot be provided by the existing 6-inch pipes, which should be replaced with 8-inch pipes.
M-D-5	South Shore Elementary Fire Flow Improvement	Existing need	Fire flow	This project is needed to supply the required 3,500 gpm fire flow to South Shore Elementary School. This flow cannot be provided by the existing 6-inch pipes, which should be replaced with 8-inch pipes.
M-D-6	Umatilla St Fire Flow Improvement	Existing need	Fire flow	This project is needed to supply the required 2,500 gpm fire flow to medium-density residential customers on SW Umatilla St. This flow cannot be provided by the existing 6-inch pipe. Adding looping from the north end of this pipe will allow the required flow to be provided.
M-D-7	1st Ave Fire Flow Improvement	Existing need	Fire flow	This project is needed to supply the required 2,500 gpm fire flow to medium-density residential customers on 1st Avenue. This flow cannot be provided by the existing 4-inch pipe. Replacing the 4-inch pipe with 6-inch will allow the required flow to be provided.
M-D-8	Thurston St Fire Flow Improvement	Existing need	Fire flow	This project is needed to supply the required 1,500 gpm fire flow to low-density residential customers near 27th Ave and Thurston St. This flow cannot be provided by the existing 6-inch pipe due to insufficient looping. Constructing this 6-inch will improve looping and allow the required flow to be provided.
M-D-9	Prairie Pl Fire Flow Improvement	Existing need	Fire flow	This project is needed to supply the required 2,500 gpm fire flow to medium-density residential customers on Prairie Pl SE. This flow cannot be provided by the existing 6-inch pipe. Adding looping from the south end of this pipe across Grand Prairie Rd will allow the required flow to be provided. Alternatively, the existing 6-inch pipe on Prairie Pl could be replaced with 8-inch.
M-D-10	Lyon St Fire Flow Improvement	Existing need	Fire flow	This project is needed to supply the required 3,500 gpm fire flow to nearby commercial customers. This flow cannot be provided by the existing pipes due to insufficient looping. Adding 8-inch looping along Lyon St will allow the required flow to be provided.
M-D-11	3rd Ave Fire Flow Improvement 1	Existing need	Fire flow	This project is needed to supply the required 3,500 gpm fire flow to commercial customers in the area shown. This flow cannot be provided by the existing 4-inch pipes which are too small. Replacing the 4-inch pipe on 3rd Ave with 8-inch will allow the required flow to be provided.
M-D-12	3rd Ave Fire Flow Improvement 2	Existing need	Fire flow	This project is needed to supply the required 3,500 gpm fire flow to commercial customers in the area shown. This flow cannot be provided by the existing 6-inch pipes. Replacing the 6-inch pipe on 3rd Ave with 8-inch will allow the required flow to be provided.
M-D-13	Geary St Fire Flow Improvement	Existing need	Fire flow	This project is needed to supply the required 2,500 gpm fire flow to medium-density residential customers on Geary St. This flow cannot be provided by the existing 6-inch pipe due to insufficient looping. Adding looping from Willamette Ave will allow the required flow to be provided.
M-D-14	Waverly Dr Fire Flow Improvement	Existing need	Fire flow	This project is needed to supply the required 3,500 gpm fire flow to customers on Waverly Dr. This flow cannot be provided by the existing 6-inch pipes. Replacing the 6-inch pipe on 3rd Ave with 12-inch will allow the required flow to be provided.
M-D-15	Front St Fire Flow Improvement	Existing need	Fire flow	This project is needed to supply the required 3,500 gpm fire flow to the commercial customer on Front St. This flow cannot be provided by the existing 6-inch pipe due to insufficient looping. Adding an 8-inch pipe from Waverly Dr will improve looping and allow the required flow to be provided.
M-D-16	Broadway St Fire Flow Improvement	Existing need	Fire flow	This project is needed to supply the required 3,500 gpm fire flow to the commercial customers on Broadway St. This flow cannot be provided by the existing pipes due to insufficient looping. Adding an 8-inch pipe from Liberty St will improve looping and allow the required flow to be provided.

Table 6-13. Summary of Recommended Projects

Project Number	Project Name	Trigger	Project Type	Project Purpose and Description
M-D-17	17th Ave Fire Flow Improvement	Existing need	Fire flow	This project is needed to supply the required 2,500 gpm fire flow to medium-density residential customers on 17th Ave. This flow cannot be provided by the existing 6-inch pipe. Adding looping from Queen Ave will allow the required flow to be provided.
M-D-18	20th Loop Fire Flow Improvement	Existing need	Fire flow	This project is needed to supply the required 1,500 gpm fire flow to low-density residential customers on NW 20th Loop. This flow cannot be provided by the existing 4-inch pipe. Replacing the 4-inch pipe with 6-inch will allow the required flow to be provided.
M-D-19	Bloom Ln Fire Flow Improvement	Existing need	Fire flow	This project is needed to supply the required 1,500 gpm fire flow to low-density residential customers on Bloom Ln. This flow cannot be provided by the existing 6-inch pipe. Adding looping from Arroyo Ridge Dr will allow the required flow to be provided.
M-D-20	East Albany Development 1	As needed for development	Development-driven	This project is needed to supply expected future development in East Albany.
M-D-21	East Albany Development 2	As needed for development	Development-driven	This project is needed to supply expected future development in East Albany.
M-D-22	East Albany Development 3	As needed for development	Development-driven	This project is needed to supply expected future development in East Albany.
M-D-23	East Albany Development 4	As needed for development	Development-driven	This project is needed to supply expected future development in East Albany.
M-D-24	East Albany Development 5	As needed for development	Development-driven	This project is needed to supply expected future development in East Albany.
M-D-25	East Albany Development 6	As needed for development	Development-driven	This project is needed to supply expected future development in East Albany.
M-D-26	East Albany Development 7	As needed for development	Development-driven	This project is needed to supply expected future development in East Albany.
L-D-1	South Albany Development 1	As needed for development	Development-driven	This project is needed to supply expected future development in South Albany.
L-D-2	South Albany Development 2	As needed for development	Development-driven	This project is needed to supply expected future development in South Albany.
B-S-1	North Albany Storage	When average demand for summer months is 13.9 mgd, approximately 2063 (medium demand scenario)	Capacity	This project is needed to meet summer buildout storage requirements in North Albany. As demands in the system increase, the existing storage capacity will not be sufficient to supply equalization, fire, and emergency needs. By approximately 2063 (medium demand scenario), total system storage needs in the summer will exceed available capacity, assuming all existing reservoirs remain in service. The Wildwood and Valley View reservoirs specifically will not have enough storage to meet the requirements. There is no room at the Valley View site for additional storage, but there is room at the Wildwood site and the Broadway site for a 2.0 MG at-grade steel or concrete reservoir. The Wildwood site is a more efficient location for operations.

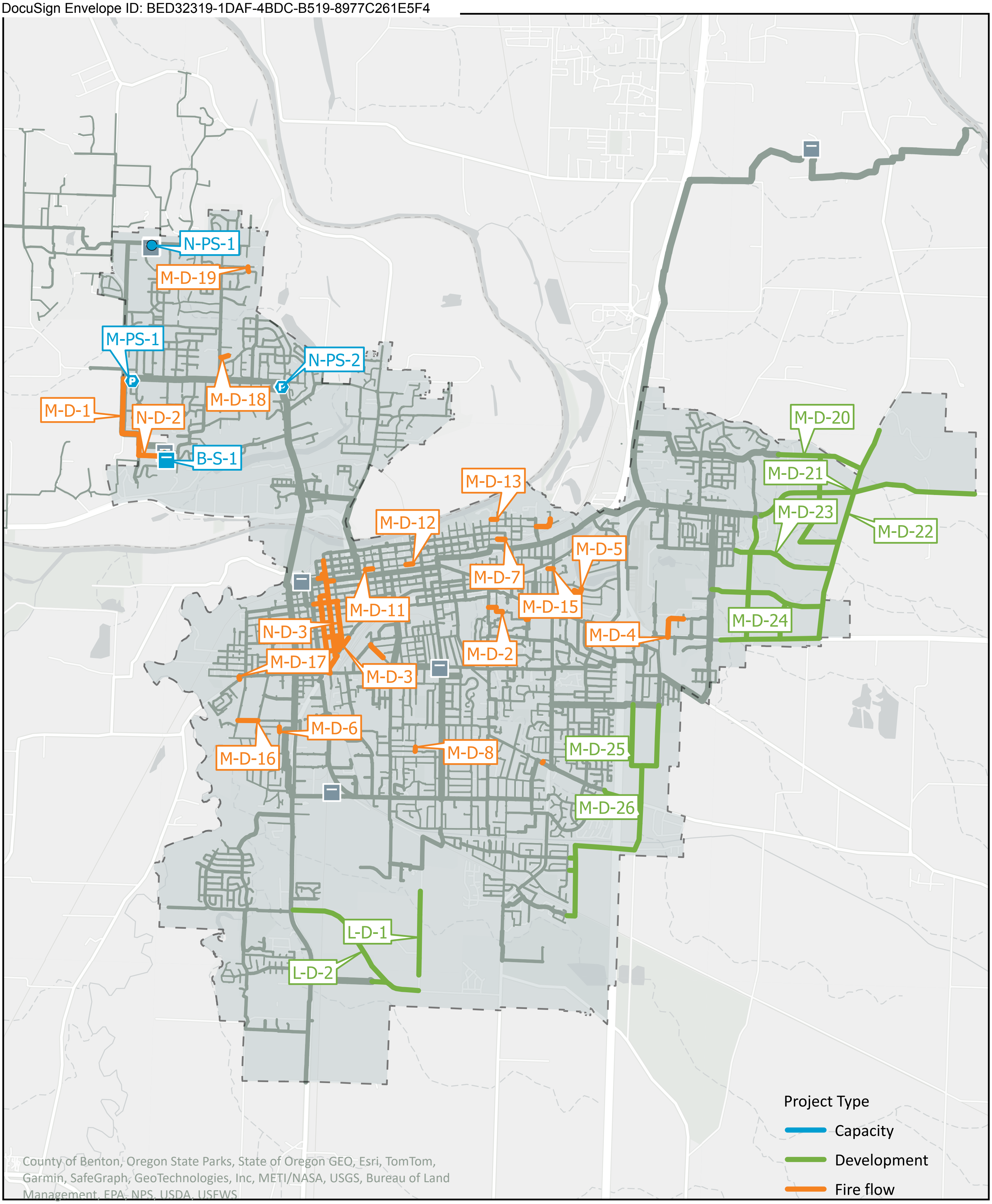

Figure 6-11. Distribution System Projects

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6.6 REFERENCES

Brown and Caldwell (BC). June 2022. *Technical Memorandum: Water Distribution System Optimization*

West Yost Associates (WY). February 2011. *Technical Memorandum: Compliance with Long Term 2 Enhances Water Treatment Rule at the Vine Street Water Treatment Plant*

Aquamize. October 2019. *Filter Media Assessment & Evaluation Vine Street Water Treatment Plant.*

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CHAPTER 7
Facilities Condition Assessments

7.1 INTRODUCTION

Chapter 7 summarizes condition assessments covering the City's raw water facilities, treated water facilities, and the distribution system pipelines. The raw water and treated water facilities assessment included visual inspections and testing to assess condition and performance. The pipeline distribution system assessment focused on the City's pipeline replacement program. These condition assessments identified existing and projected system deficiencies and recommended future investments which are presented throughout this chapter. Costs and projects are included in the summary of the recommended Capital Improvements Program projects compiled in Chapter 9. Major features of the water system assessment in this chapter include the following:

- Raw Water Facilities
  - Canal from Lebanon to Albany
  - Hydroelectric power plant facility (mechanical systems)
- Treated Water Facilities
  - Water treatment plants
  - Pump stations
  - Reservoirs
- Pipeline Replacement Program

7.2 RAW WATER FACILITIES

The raw water facilities evaluated for the condition assessment include: the entire length of the canal and the powerplant facility component of the City's hydroelectric project. Both the canal and the hydroelectric facility are associated with the Vine Street WTP as the WTP has its intake at the end of the canal and the hydroelectric facility draws from the canal and is located within the same building complex as the WTP.

7.2.1 Canal

The City owns the 18.2-mile-long canal. The canal has a long history of channel bed degradation and exhibits a significant number of bank failures along its entire length. A bank stability study was completed for the City in 2008 (Otak, 2008), which included a field-based assessment of the canal and a list of identified failure locations. Since the bank failure inventory was completed 15 years ago, only a small number of the previously identified sites have been rehabilitated, and new failures continue to be observed. Due to the sheer magnitude and cost of canal projects, the City addresses critical bank failures on a case-by-case basis and makes repairs as required and as possible with available funding. As further described in this Chapter, new bank failures on the canal have continued to appear and may continue to occur into the future, entailing continuous effort by the City. In addition, to studies like the 2008 study and the condition assessment performed as part of this WMP, the City also inspects a portion of the canal banks every year, with the entire length covered at least once every 3 years to update their prioritization of projects. The City uses information from the inspections and studies to maintain a list of potential failure sites prioritized from high to low criticality for repair planning. As a part of this WMP, a new 'rapid assessment' of the entire canal condition was performed. The purpose of the rapid assessment bank inventory was to:

- Determine if previously identified sites have degraded further
- Evaluate the current condition of rehabilitated sites

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- Identify new failure sites that have occurred since the 2008 study
- Provide recommendations and a prioritized list of CIP projects for all identified bank failures

In addition to the canal bank inventory, the canal evaluation included varied levels of assessment and evaluation on the following subtopics:

- Grade control
- Lebanon Intake Structure
- Flushing analysis
- Cheadle Lake Berm
- Canal Improvements Adjacent to Vine Steet
- Ancillary Facilities

The summary of each of the subtopics is provided in subsections below. Figure 7-1 shows a map of the canal, with the 17 reaches as organized in the full assessment. Supporting TMs are included in Appendices E Canal Condition Assessment, Appendix F Cheadle Lake Berm, and Appendix G Canal Ancillary Facilities.

Figure 7-1. Canal Reach Designations

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Bank Inventory and Site Prioritization

The Canal Condition Assessment (Appendix E) highlights a continued decline of the canal conditions since the 2008 study. Eight of the 87 original sites were repaired as CIP projects following recommendations from the 2008 study. All of the repaired sites were observed to be in good condition. Of the remaining 79 non-repaired original sites, the majority were found to be in a more deteriorated condition, primarily due to an increase in failure length along the bank, with the average length of the non-repaired original sites increasing from 30 ft to 67 ft. During the 2023 rapid assessment, 98 new sites were identified and documented. All 177 sites (remaining 2008 and new 2023) were assigned a repair priority of High, Medium, or Low based on their location and associated risk factors, such as proximity to nearby infrastructure. Table 7-1 summarizes the priority listing showing 41 sites were assigned high priority, 27 were assigned medium priority, and 109 were assigned low priority.

Table 7-1. Final Site Repair Prioritization

Priority	# Original Sites, 2008	# New Sites, 2023	Total Sites	Percent of Total
High	17	24	**41**	23
Medium	7	20	**27**	15
Low	55	54	**109**	62
Total	**79[a]**	**98**	**177**	**100%**

(a) Less than 87 sites since eight sites have been repaired since 2008.

Each site was assigned one of four conceptual repair designs:

- Stacked Boulder Toe
- Riprap Blanket
- Wrapped Soil Lifts
- Structural Concrete Wall

Once a repair design was identified, the repair cost was estimated. It is recommended that canal CIP projects be grouped together such that total project length is at least 100 ft to avoid “small project” premiums.

In addition to sites identified in the 2008 studies, new spontaneous failures have occurred that the City has repaired which are not accounted for in the data. There may be additional spontaneous failure sites not identified here that also require repair in the future. Due to the undetermined nature of spontaneous future failure sites, this WMP does not account for these additional sites and costs associated with repair.

Grade Control Review

A comparison of the 2023 channel profile survey data with available historic data indicates that significant degradation of the canal has occurred since the late 1800’s, particularly in reaches 3 through 8, with the most significant degradation appearing in reach 6. Degradation has continued to occur in reach 3 through 6 between 2007 and 2023. However, the data appear to indicate that reach 7 through 10 have not experienced reach-wide degradation over the past 15 years. Upstream of reach 9, both aggradation and degradation are occurring. Since the canal has been in operation for nearly 130 years, it is possible that

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the majority of the expected incision and widening has already taken place, in particular in the lower and middle reaches of the canal. However, it is possible that the degradational trend may continue upstream, though likely at a reduced rate.

Based on review of the available data, there does not appear to be a need for grade control structures at this time. It is recommended that the grade control recommendations included in the 2008 Study for reaches 7 and 8 be placed on hold. Further, it is recommended that the City consider developing an Adaptive Management Plan (AMP) for the canal. A key component of the AMP would be development and implementation of a long-term plan to monitor key locations in the canal and collect regular, high-quality survey data to identify and quantify degradational or aggregational trends, which will better inform the need for grade control structures to be included in future CIPs.

Lebanon Intake Structure

With the recent relocation of the City of Lebanon's water treatment plant off the canal, the backwater from the Lebanon Flow Control Structure (LFCS) creates an unnecessary high water surface profile within the City of Lebanon that is, in part, retained by earthen embankment sections. Since the intake diversion structure is no longer needed to create backwater to divert to Lebanon's treatment plant, it could potentially be modified in such a way to lower upstream water surface elevations and reduce flood risk from potential embankment failures.

An analysis was conducted to determine the effect of LFCS modification on the upstream water surface elevations. The analysis consisted of modeling different structure alternatives using the City's HEC-RAS hydraulic model of the canal. None of the alternatives included removal of the entire intake structure since the structure also provides beneficial grade control to protect against channel incision. The two alternatives that provided significant reductions in flood risk included:

1. Lowering of the intake weir to the elevation of the bottom of the radial gate (346.41 ft) and dredging upstream of the intake from River Station (RS) 77,611 to RS 83,384 by an average depth of 3.2 ft.
2. Modification or replacement of the intake facility structure with a 25-ft-wide rectangular weir with a crest elevation of 346.41 ft plus dredging upstream of the intake from RS 77,611 to RS 83,384 by an average depth of 3.2 ft.

Either of the two alternatives listed above would significantly reduce the number of potential embankment breaches. Further reductions in water surface elevations would require more significant dredging which may exacerbate bank instabilities. Accordingly, the flood risk for the earthen embankment sections could potentially be addressed by placing a minor amount of fill on the landward side of the embankment.

The concept level dredge geometry for the alternatives requires that approximately 14,500 cubic yards of material be removed from the canal. Detailed analysis and design is recommended if the City desires to move forward with a dredging project.

Flushing Analysis

An evaluation was conducted to determine if the radial gate at the downstream end of the canal could be operated in a manner that might reduce the amount of sedimentation that occurs upstream to Queen Avenue. The City's HEC-RAS hydraulic model was converted from steady to unsteady flow and was used to assess gate operations with respect to altering channel velocities to reduce or possibly eliminate

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the need for periodic dredging. The simulated drawdown procedure indicated that there was no operational alternative related to gate control that would result in a significant reduction of sedimentation occurring in the lower reach of the canal.

Due to the results of the analysis, the City will need to continue dredging the canal to remove sediment buildup. The City of Albany currently dredges as needed.

Cheadle Lake Berm

Located within the City of Lebanon, the Cheadle Lake Berm separates Cheadle Lake from the Santiam-Albany Canal. The +/-4,400-foot-long berm has an 8 to 10-foot-wide asphaltic concrete paved walking trail on top and is an active section of a trail complex within the City of Lebanon. A site visit to assess the condition of the berm was conducted in January 2023. At the time of the visit, the water level in Cheadle Lake was about 4 ft above the water level in the canal. There were wet soil conditions on the lower canal bank approximately 1 to 1.5 ft above the canal water level which appears to be associated with seepage through the berm. In addition, the berm was constructed from soil composed of silt, sand, and gravel and likely taken from the excavations for the canal and lake which are relatively permeable, making seepage through the berm likely.

A summary of the inspection and full analysis of the berm can be found in Appendix F (FEI, January 2023 Site Visit). Conditions summarized in Appendix F are generally consistent with previous inspection in May 2015. No indications of active instability on the berm slopes were observed during the January 2023 site visit. However, there is likely a risk of berm slope instability and breaching during a 9.0 M CSZ earthquake which could lead to flooding downstream. Therefore it is recommended that the city conduct additional geotechnical work including exploratory drilling and analysis to evaluate the stability of the berm for both static and seismic loading conditions.

Canal Improvements Adjacent to Vine Street

Separate recommendations for specific canal improvements adjacent to Vine Street between Queen Avenue and 4th Avenue were provided by the City. Within this area, there are multiple blocks of existing retaining walls within the canal. The City completed improvements to retaining walls between 3rd and 4th Avenue in 2017. Future repairs are identified in the current CIP for the section of wall between 4th and 7th Avenue, and future repairs/improvements are identified for canal retaining wall sections of lesser magnitude between 7th and 8th Avenue and 14th to Queen Avenue. The City has provided anticipated construction repair costs for each project in Table 7-2.

Table 7-2. Canal Project Recommendations

Project Number	Project Name	Project Type	Project Purpose and Description
N-C-1	High Priority Canal Projects	Condition	A total of 41 canal sites were identified as a high priority. The proposed budget for the canal repairs the high priority sites over the next 20-years. Each canal site was assigned a repair strategy for cost estimating. The capital cost of the high priority project repairs is $9,816,000.
B-C-1	Medium & Low Priority Canal Projects	Condition	A total of 27 canal sites were identified as medium priority and 109 canal sites were identified as a low priority and assigned a repair strategy. The total capital cost of the medium priority projects is $3,048,000 and the low priority repairs is $16,921,000, for a total capital cost of $19,969,000.
N-C-2	Canal Bank Repair (Retaining Wall Improvements) from 4th to 6th Avenue	Condition	This is an existing project the City is currently planning for 2024, and is listed here for reference. The retaining wall in the canal between 4th and 6th avenue needs repairing. This project cost is not included in the WMP CIP budget because it is already included in the City budget for 2024-2028 CIP projects.
M-C-1	Canal Retaining Wall Improvements from 6th to 7th Avenue	Condition	The retaining wall in the canal between 6th and 7th Avenue needs repairing. The City provided the repair cost of $2,500 per foot. The distance between the blocks was measured as 225 feet on each side which totals 450 feet of repair.
M-C-2	Canal Retaining Wall Improvements from 7th to 8th Avenue	Condition	The retaining wall in the canal between 7th and 8th Avenue needs repairing. The City provided the repair cost of $2,000 per foot. The distance between the blocks was measured as 250 feet on each side which totals 500 feet of repair.
L-C-1	Canal Retaining Wall Improvements from 14th to Queen Avenue	Condition	The retaining wall in the canal between 14th and Queen Avenue needs repairing. The City provided the repair cost of $2,000 per foot. The distance between the blocks was measured as 910 feet on each side which totals 1820 feet of repair.
N-C-3	Added Security Fencing/ Fall Protection	Condition	A few sites were identified for installation of security fencing and/or fall protection including 1 Crown Zellerbach gates, 2 Albany Gates, 3 Periwinkle Creek Diversion, 4 34th Ave Debris Screen, 5 Vine St Intake Bar Screen.
N-C-4	Canal Adaptive Management Plan	Condition	A key component of the AMP would be development and implementation of a long-term plan to monitor key locations in the canal and collect regular, high-quality survey data to identify and quantify degradational or aggradational trends, which will better inform the need for grade control structures to be included in future CIPs.
N-C-5	Cheadle Lake Berm Geotechnical Analysis	Condition	It is recommended to conduct additional geotechnical work including exploratory drilling and analysis to evaluate the stability of the berm for both static and seismic loading conditions.
N-C-6	Near-Term Canal Dredging	Condition	This is an existing project the City is currently planning for 2025, and is listed here for reference. The City dredges the downtown area (starting at Vine St WTP south approximately 4,300 feet) of the canal. This project will include removal of sedimentation, plants and other debris required to maintain the capacity and mitigate flooding of adjacent properties.
M-C-3	Medium-Term Canal Dredging	Condition	The City dredges the downtown area (starting at Vine St WTP south approximately 4,300 feet) of the canal. This project will include removal of sedimentation, plants and other debris required to maintain the capacity and mitigate flooding of adjacent properties.
L-C-2	Long-Term Canal Dredging	Condition	The City dredges the downtown area (starting at Vine St WTP south approximately 4,300 feet) of the canal. This project will include removal of sedimentation, plants and other debris required to maintain the capacity and mitigate flooding of adjacent properties.
N-C-7	Lebanon Intake Structure	Condition	With the recent relocation of the City of Lebanon's water treatment plant off the canal, the intake diversion structure is no longer needed to create backwater to divert to Lebanon's treatment plant and it could potentially be modified in such a way to lower upstream water surface elevations and reduce flood risk from potential embankment failures. Two potential alternatives were identified for modification. Further evaluation of the preliminary alternatives is recommended.

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Canal Ancillary Facilities

The Canal Ancillary Facilities Technical Memorandum (Appendix G) reviewed the condition of other key features along the canal including the fish screens and head gate structure, inline flow control structures, several minor canal flow diversions, and the intake for the hydropower at the Vine Street WTP. The structures and facilities were generally found to be in excellent to good condition. All facilities are functioning well, except for a few minor subsystems including SCADA communication and control implementation which are not complete for all facilities. Additionally, some minor safety improvements such as adding *security fencing and/or fall protection could be made at the following locations:*

1. Crown Zellerbach Gates
2. Albany Gates
3. Periwinkle Creek Diversion
4. 34th Avenue Debris Screen
5. Vine Street *intake* bar screen

A summary of all the Canal Capital Improvements Projects are included in Table 7-2.

7.2.2 Hydroelectric Facility

This section summarizes the Vine Street Hydroelectric Turbine Condition Assessment (Appendix H). The turbine has been in operation for 13 years, and only limited maintenance has been carried out on the facility since installation. A photo of the hydroelectric scroll case and wicket gates is included in Figure 7-2.

Figure 7-2. Hydroelectric Scroll Case and Wicket Gates Photo

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An initial evaluation was conducted to perform a general inspection of the system, and a second evaluation was completed to address specific wicket gate issues. These evaluations revealed that the turbine is not performing to its expected level, with the main issue being corrosion of the wicket gate system. The analysis indicated that the wicket gates, made of carbon steel, have experienced significant corrosion, causing binding, decreased operational range, and ultimately, a reduction in power generation. This problem likely extends to the wicket gate bearing journals and the bushings. Several solutions have been proposed, including manufacturing new wicket gates from corrosion-resistant alloy and new greaseless wicket gate bushings.

To perform repairs or replace the wicket gates and bearings, the turbine must be disassembled and reassembled which also allows opportunity to perform other recommended repairs, including installing a spiral case cleanout, and inspecting, blasting and recoating the interior of the turbine. Installing a spiral case cleanout flange allows for better access for inspection, cleaning, and removal of debris from the smallest portions of the turbine case where debris is problematic. Blasting and coating of the interior of the turbine is another measure to protect against corrosion.

In addition, recommended improvements to other areas of the turbine system include the trash rack, flow meter, and hydraulic power unit (HPU). One recommendation that has already been completed is the relocation of the cooling water pipe for the turbine. The water pipe originally discharged directly onto the turbine headcover but has since been rerouted by City staff.

The city decided not to include a generator inspection as part of this WMP. A complete inspection of the generator is now recommended as part of the Vine Street facilities viability study, based on the age of the facility and issues affecting facility performance. Personnel training for the controls system is also advised as the existing system is un-intuitive. These recommendations may improve the condition and function of the hydroelectric system and therefore would decrease the downtime and loss of generation.

An analysis of operational data spanning from February 2016 to September 2022 revealed crucial insights. At rated net head and flow, an expected turbine efficiency of approximately 86.5 percent was calculated. Assuming a generator efficiency of 95 percent, a combined system efficiency of 82.2 percent was expected. Examining the relationship between recorded system output, net head and flow, an average combined system efficiency of approximately 60 percent was observed.

In addition to this analysis, a preliminary design of a new turbine runner and wicket gates was prepared to estimate the performance increase that could be expected with these re-designed components. The preliminary analysis shows a peak estimated turbine efficiency of 91 percent. Again, assuming a generator efficiency of 95 percent, the combined peak efficiency with a newly designed runner and wicket gates was estimated at approximately 86.5 percent. In broad terms, this indicates that energy generation may be able to increase anywhere from 4.3 percent to 26.5 percent with a newly designed runner and wicket gates.

It is recommended that the City perform an evaluation of the existing generator to identify any possible upgrades. It is also recommended to perform an operational data and turbine utilization analysis to determine if hydropower generation time can be increased and to perform a return-on-investment analysis. This analysis may be grouped with the Vine Street Facility Viability Study described in more detail throughout this Chapter. For the hydropower generation, the viability study should include an alternative for the cost to decommission the hydroelectric facility and what to do with non-consumptive water rights.

Table 7-3 includes a summary of the hydropower Capital Improvements Projects. Costs associated with the recommended projects are included in Chapter 9.

Table 7-3. Hydropower CIP Recommendations

Project Number	Project Name	Project Type	Project Purpose and Description
N-H-1	Vine Street Hydropower Generator Inspection & Contingency	Condition	The generator requires inspection which should come before the utilization analysis to assess any further upgrades required for operation. This project includes the inspection and a contingency for possible recommended upgrades.
N-H-2	Vine Street Hydropower Operational Data and Turbine Utilization Analysis	Condition	Preliminary evaluation indicates that the combined turbine system efficiency can be improved anywhere from 4.3 percent to 26.5 percent with a newly designed runner and wicket gates. Additional analysis is recommended to determine the root causes of turbine down time when canal flow would otherwise allow for generation.
N-H-3	Vine Street Hydropower Combined Upgrades	Condition	The upgrades are grouped together because they all require the disassembly and reassembly of the turbine. Upgrades include wicket gate replacement, bearing replacement, and spiral case flange for cleaning. It also includes the inspection, blasting, and coating of the interior of the turbine and contingencies for welding repairs and shop repairs.
N-H-4	Vine Street Hydropower Hydraulic Power Unit.	Condition	The HPU has some design/build characteristics which make it unintuitive to use and maintain. It is apparent that the hydraulic pump(s) run continuously during operation of the turbine while other HPU designs run only when needed, thus saving a considerable amount of energy over the lifespan of the unit. It is recommended that the current HPU be replaced with one of newer design.
N-H-5	Vine Street Hydropower Turbine Personnel Training	Condition	The controls system has several project specific peculiarities that make the human machine interface (HMI) un-intuitive to operate and appear to be sources of confusion. It is recommended that the controls system be reviewed by a professional and that a training session be held to familiarize the users with the architecture and operation of the system.
N-H-6	Vine Street Hydropower Intake and Trash Rack Evaluation	Condition	It is recommended to perform further investigation of the hydropower intake and trash rack for the potential to improve generation time and decrease maintenance costs.

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7.3 TREATED WATER FACILITIES

The condition assessment of treated water facilities assessed the water treatment plants, pump stations, and reservoirs in the City's water system. Prior to the condition assessment, Albany provided access to their Cartegraph™ asset registries which include asset information (e.g., manufacturer, model, age) on Automation Hardware, Chemical Systems, Compressors, Cranes, Electrical Generators, Instruments, Motor Starters, Pressure Vessels, Water Facilities, Water Pumps, Water Storage Tanks, WTP Valves, and WTP Tanks. This list identified 588 assets in the system that needed assessment and scoring. After the list was identified, the follow analysis was performed:

- Condition and performance scoring
- Remaining useful life calculations
- Reliability and redundancy evaluation
- Risk assignment

The condition assessment included civil, mechanical, structural, and electrical evaluations of assets, with the results intended to inform the City of assets that need repair or replacement. The Treated Water Facilities Condition Assessment is presented in Appendix I.

7.3.1 Condition and Performance

A summary of the physical condition and performance assessment of the water system assets is described herein. The condition assessment team assigned scores to each asset based on the following:

- Review of existing drawings and Cartegraph™ asset databases
- Visual inspection of assets including photographs and videos
- Operational interviews with O&M and engineering staff

A seismic risk assessment (ASTM E2026) and Tier 1 screening (ASCE/SEI 41) was also conducted utilizing information collected during review of as-builts and the on-site inspection.

Based on the standardized condition assessment scoring systems defined in Table 7-4, condition scores were selected from a scale of 1 to 5 for each asset, with a 1 being Excellent and 5 requiring Immediate Attention.

Table 7-4. Physical Condition Scoring Criteria

Score	Grading Definition	Site/Civil	Structural	Mechanical	Electrical and I&C
1	Excellent	New condition	New condition	New condition	New condition
2	Good	Minor defects or deterioration	Minor structural impacts, cracking (e.g., < 1mm) deformation	Minor cosmetic surface abrasion or coating deterioration	Cosmetic surface defects with no impact on performance
3	Fair	Average wear and tear, minor cracking, and ponding of water	Average structural impacts, cracking (e.g., 1-2mm) deformation	Average surface or structural wear and tear	Average physical wear and tear
4	Poor	Above average wear and tear, some cracking of pavement	Moderate structural impacts, one to two locations of major cracking (e.g., > 2mm), exposed reinforcement, deformation	Moving parts show excessive wear and tear and require rehabilitation within two years or less	Above average wear and tear on the asset requiring replacement within two years or less
5	Immediate Attention	Condition is not at acceptable level, major cracking, severe ponding	Structural Condition is not at acceptable level and needs immediate replacement	Structural and physical condition is not at acceptable level and needs immediate replacement	Physical condition is not at acceptable level and needs immediate replacement

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The performance assessment was based on the Operations and Maintenance staff's knowledge and experience with issues unique to the asset. Table 7-5 indicates how performance condition criteria were measured, with a 1 being Excellent and 5 requiring Immediate Attention.

Table 7-5. Performance Condition Scoring Criteria

Score	Grading Definition	Reliability	Operability	Capacity	Obsolescence
1	Excellent	Very reliable. No reported failures. Equipment is generally available >99 percent of the time.	Normal operator involvement during average and peak flow conditions.	Adequate capacity for average and peak flow conditions, margin for increased capacity	Technology Best Available/ State of the Art
2	Good	Good reliability. Infrequent breakdown. Equipment generally available 95-99 percent of the time.	Normal operator involvement during average flow conditions. Greater than normal operator involvement during peak flow conditions.	Adequate capacity for average and peak flow conditions. No margin for increased capacity for peak flow conditions.	Technology Industry Standard/ "Tried and True"
3	Fair	Average reliability. Occasional breakdowns. Equipment generally available >85 percent of the time.	Greater than normal operator involvement during average and peak flow conditions.	Maximum capacity for average and peak flow conditions, no margin for increase.	Technology Considered Appropriate
4	Poor	Poor reliability. Periodic (monthly) breakdowns with repeated repairs. Equipment generally available >70 percent of the time.	Greater than normal operator involvement during normal flow conditions. Excessive operator involvement during peak conditions.	Maximum capacity for average flow conditions, no margin for increase. Overloaded for peak flow conditions, may impact other processes.	Technology Nearing Obsolescence
5	Immediate Attention	Very poor reliability. Continuous recurrent (weekly) breakdown . Equipment out of service for more than 70 percent of time.	Excessive operator involvement during normal and peak conditions.	Overloaded for average and peak flow conditions, may impact other processes	Technology Obsolete/ Out of Date

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A summary of the condition scores and performance scores assigned to assets are included in Table 7-6. Overall, the majority of the assets were rated as good (2) or excellent (1). For both condition and performance, 21 percent of assets were scored fair (3) and 20 percent of assets were scored poor (4). Only 1 to 2 percent of assets were scored as a 5 needing immediate attention.

Table 7-6 Condition & Performance Score Summary

Grading Definition	Score	Condition Count	Condition Percentage	Performance Count	Performance Percentage
Excellent	1	11	2	10	2
Good	2	328	55	325	55
Fair	3	125	21	124	21
Poor	4	115	20	119	20
Immediate Attention	5	9	1	10	2

All of the scoring and analysis helped identify specific comments and recommendations for improvement. Comments and recommendations are organized by asset discipline (civil, structural, mechanical, electrical, and performance). Some of the noted issues and improvements were identified as maintenance projects based on discussions with the City. There were no CIP recommendations for Civil or Electrical. Table 7-7, 7-8, and 7-9 summarize the condition and performance related comments and CIP recommendations.

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Table 7-7. Structural Condition Assessment Recommendations

Project Number	Project Name	Facility Condition Score	Trigger	Comments & Recommended Action
N-SS-1	Vine Street Facilities Viability Study	NA	Existing Need	In light of the condition and seismic concerns at the Vine Street WTP, and the extent of improvements at the Hydroelectric Facility and Canal, it is recommended for the City to perform a viability study to evaluate different alternatives for the future of the Vine St site. First, the viability study should include the alternative of Vine St WTP replacement with a new WTP. Project numbers N-SS-1A, N-SS-1B, etc. convey the many capital projects recommended at the existing Vine St WTP, if it is not decommissioned. The viability study should include an analysis of the cost of reactive maintenance at the existing Vine St WTP and the amount of extended lifetime from performing those projects compared to the cost and lifetime of a new WTP investment. The viability study should also consider the challenges and feasibility of replacing structures at Vine St WTP, due to their historical nature, and the phasing challenges if the Vine St WTP is able to remain in service while performing the major recommended upgrades. The viability study should look at multiple different locations for a new WTP and perform a cost-benefits analysis for each location. The viability study should refine assumptions with a new WTP and update the cost estimate. Next, the hydroelectric facility should be evaluated. A generator inspection should be performed and identify estimated generator upgrade costs. The study should update the expected cost of improvement at the Hydroelectric facility and refine the return-on-investment analysis. The viability study should also include the alternative to decommission the hydroelectric facility and what to do with non-consumptive water rights. Then, impacts to the canal should be considered in the viability study. Different locations of a WTP may impact the flow and required repairs of the Canal, which should be evaluated. Also, the decision to potentially decommission the Hydroelectric Facility may also have an impact on canal flows and repairs which should be encompassed. The study should determine if recommendations for repairs and remediation to the Canal will change with different alternatives and the cost impacts associated. Last, as the City considers replacement alternatives for of the Vine St WTP, there may be an opportunity to consolidate some of the Zone 1 storage and pumping into a single location by decommissioning the Maple, Queen, and 34th reservoirs and pump stations and constructing an equivalent storage volume and pumping capabilities at a new WTP site. The option of Zone 1 consolidation is recommended for further hydraulic and cost evaluation as part of the Vine St. viability study.
N-SS-1A	Vine Street WTP: Raw Water Pump Station Replacement (Supports the need for Project N-SS -1)	4	Existing need	The Vine Street WTP Raw Water Pump Station is noncompliant for nearly all of the items on the ASCE/SEI 41-17 Checklist for this building type. Prepare for replacement of this structure. A seismic retrofit for a structure of this age and type is not appropriate for this essential facility.
N-SS-1B	Vine Street WTP: Hydroelectric Building Replacement (Supports the need for Project N-SS -1)	4	Existing need	The Vine Street WTP Hydroelectric Building is also connected to the Raw Water Pump Station and Controls Building. It is noncompliant for nearly all of the items on the ASCE/SEI 41-17 Checklist for this building type. Prepare for replacement of this structure. A seismic retrofit for a structure of this age and type is not appropriate for this essential facility.
N-SS -1C	Vine Street WTP: Control Building/ Chemical Storage Building Replacement (Supports the need for Project N-SS -1)	4	Existing need	The Vine Street WTP Control Building/Chemical Storage Building reinforcing bar details do not comply with recommended standards. A seismic retrofit to address the shortcomings identified by the ASCE/SEI 41-17 checklist would be very difficult to perform.
N-SS -1D	Vine Street WTP: Soda Ash Building Replacement (Supports the need for Project N-SS -1)	5	Existing need	The Vine Street WTP Soda Ash Building is noncompliant for nearly all of the items on the ASCE/SEI 41-17 Checklist for this building type. Prepare for replacement of this structure. A seismic retrofit for a structure of this age and type is not appropriate for this essential facility.
N-SS -1E	Vine Street WTP: Filters 1-6 Building Replacement (Supports the need for Project N-SS -1)	5	Existing need	The Vine Street WTP Filters 1-6 Building is noncompliant for nearly all of the items on the ASCE/SEI 41-17 Checklist for this building type. Prepare for replacement of this structure. A seismic retrofit for a structure of this age and type is not appropriate for this essential facility.
N-SS -1F	Vine Street WTP: Filters 7-10 Building Replacement (Supports the need for Project N-SS -1)	4	Existing need	The Vine Street WTP, reinforcing bar details for the Filters 7-10 Building are unknown for the ASCE/SEI 41-17 Checklist for this building type. It is unlikely that any reinforcing bars are appropriately sized, spaced and placed. Prepare for replacement of this structure. A seismic retrofit for a structure of this age and type is extremely difficult for this essential facility.
N-SS -1G	Vine Street WTP: Accelator 1 Foundation (Supports the need for Project N-SS -1)	4	Existing need	At Vine Street WTP, the perimeter columns below the exterior walls of Accelator 1 create a vertical irregularity and weak lateral force resisting system at the base. Infill between the existing columns with a concrete wall footing to eliminate the vertical irregularity. Tie the foundations together. If this structure is planned for future decommissioning due to the new WTP, the City may choose not to implement this project.
N-SS -1H	Vine Street WTP: Accelator 2 Foundation (Supports the need for Project N-SS -1)	3	Existing need	The Vine Street WTP Accelator 2 is not bolted to the foundation and relies on friction between the steel and concrete. Maintenance of steel wall is recommended. Consider adding anchor bolts capable of resisting uplift and sliding seismic forces. Clean and remove moss, mold, and rust then maintain tank coating. If this structure is planned for future decommissioning due to the new WTP, the City may choose not to implement this project.
N-WTP-2	AM WTP Neutralization Basin Concrete Repair	3	Existing need	The AM WTP Neutralization Basin concrete wall has exposed aggregate near the inlet and below the waterline. Clean and provide a coating repair for the concrete with significant surface loss and exposed aggregate to prevent further loss of wall thickness.

Table 7-7. Structural Condition Assessment Recommendations

Project Number	Project Name	Facility Condition Score	Trigger	Comments & Recommended Action
M-S-1	Maple St Reservoir Anchor Bolts	4	Existing need	The Maple St Reservoir is not bolted to the foundation and relies on friction between the steel & concrete. Maintenance of steel wall is recommended. Consider adding anchor bolts capable of resisting uplift and sliding seismic forces. Clean and remove moss, mold, and rust then maintain tank coating. If this structure is planned for future decommissioning, the City may choose not to implement this project.
B-PS-1	Maple St Pump Station Roof Connection	4	Existing need	The Maple St PS roof to wall connection may not be adequate to resist all seismic forces. During a maintenance re-roofing project for this building, upgrade the roof to wall connection. If this structure is planned for future decommissioning, the City may choose not to implement this project.
L-S-1	34th St Reservoir Anchor Bolts	3	Existing need	The 34th St Reservoir is not bolted to the foundation and relies on friction between the steel & concrete. Maintenance of steel wall is recommended. Consider adding anchor bolts capable of resisting uplift and sliding seismic forces. Clean and remove moss, mold, and rust then maintain tank coating. If this structure is planned for future decommissioning, the City may choose not to implement this project.
M-PS-2	34th St Pump Station Roof Connection	3	Existing need	The 34th St Pump Station roof to wall connection of the Pump Station is non-compliant. During a maintenance re-roofing project for this building, upgrade the roof to wall connection. If this structure is planned for future decommissioning, the City may choose not to implement this project.
L-S-2	Queen Ave Reservoir Anchor Bolts	3	Existing need	The Queen Ave Reservoir is not bolted to the foundation and relies on friction between the steel and concrete. Maintenance of steel wall is recommended. Consider adding anchor bolts capable of resisting uplift and sliding seismic forces. Clean and remove moss, mold, and rust then maintain tank coating. If this structure is planned for future decommissioning, the City may choose not to implement this project.
M-PS-3	Queen Ave Pump Station Roof Connection	3	Existing need	The roof to wall connection of the Pump Station is non-compliant. During a maintenance re-roofing project for this building, upgrade the roof to wall connection. If this structure is planned for future decommissioning, the City may choose not to implement this project.
N-PS-2A	North Albany Pump Station Building Replacement (Supports the need for Project N-PS-2, CH 6)	4	Existing need	Project N-PS-2A supports the need for Project N-PS-2, North Albany Pump Station Replacement, which is included in Chapter 6. The Pump Station is noncompliant for nearly all of the items on the ASCE/SEI 41-17 Checklist for this building type. There is cracking at several locations at exterior of building walls. The corner of the structure appears to be rebuilt but not finished at interior pump station. Prepare for replacement of this structure.
M-S-2	Valley View Reservoir Anchor Bolts	3-4	Existing need	The Reservoirs are not bolted to the foundation and relies on friction between the steel & concrete. Maintenance of steel wall is recommended. Consider adding anchor bolts capable of resisting uplift & sliding seismic forces. Clean and remove moss, mold, and rust then maintain tank coating.

Table 7-8. Mechanical Condition Assessment Recommendations

Project Number	Project Name	Facility Condition Score	Trigger	Comments & Recommended Action
N-S-1	Maple St Reservoir Coating	4	Existing need	This is an existing project the City is currently planning for 2024, and is listed here for reference. The City can't pressure wash the existing Maple St Reservoir coating because it can chip the coating and expose the orange coating underneath which may contain lead. Recoat Reservoir.
N-S-2	Queen Avenue Reservoir Coating	3	Existing need	This is an existing project the City is currently planning for 2024, and is listed here for reference. The Queen Ave Reservoir paint is chipping. Recoat reservoir.
M-WTP-3	Vine Street WTP Raw Water Pump Station Pipes	3	Existing need	The Vine Street WTP RWPS pipe coatings are chipping. Recoat pipes.
N-WTP-3	Vine Street WTP Backwash System Check Valves	4	Existing need	The Vine Street WTP backwash system appears to have no check valves. Add check valves if possible.
N-WTP-4	Vine Street WTP Backwash Pump Base	4	Existing need	The Vine Street WTP large backwash pump has a cracked base. Confirm pump anchorage is secure.
M-WTP-4	Vine Street WTP Raw Water Splitter Coating	4	Existing need	The Vine Street WTP Raw Water Splitter (Diverter) is rusted. Recoat.
N-WTP-5	Vine Street WTP Filter Gallery Pipes	4	Existing need	The Vine Street WTP filter pipe gallery has rust and corrosion on piping. May need more pipe supports. Replace pipe or measure pipe thickness and recoat pipes, as necessary. Add pipe supports within 2 feet of changes of direction, where practical.
N-WTP-6	Vine Street WTP Transfer Water Pump Station Pipes	4	Existing need	The Vine Street WTP Transfer Water PS piping has rust. Appears to have no check valves. May need more pipe supports including lateral supports, may need more dismantling joints. Replace pipe or measure pipe thickness and recoat, as necessary. Add pipe supports within 2 feet of changes of direction, where practical. Add check valves and dismantling joints where practical.
N-WTP-7	Vine Street WTP RWPS Flow Meter Vault Pipes	5	Existing need	The Vine Street RWPS Flow Meter Vault piping has rust. Measure pipe thickness. Replace or recoat.
N-WTP-8	Vine Street WTP RWPS Check Valves	5	Existing need	The Vine Street WTP RWPS pumps have some missing check valves . Add check valves where practical.
N-WTP-9	Vine Street WTP RWPS Valve Vault	4	Existing need	The Vine Street WTP RWPS Valve Vault piping and valve are rusted. Measure pipe thickness. Replace or recoat. Replace valve.
M-WTP-5	Vine Street WTP Raw Water Intake Screen Replacement	4	Existing need	Vine Street WTP RW Screen has rust. Replace RW intake screen.
M-WTP-6	Vine Street WTP Chemical Injection Vault Pipes	3	Existing need	Vine Street WTP Chemical Injection Vault piping, bolts, and pipe supports have rust. Measure pipe thickness. Replace or recoat. Replace bolts. Replace pipe supports, as necessary.
N-WTP-10	AM WTP Chemical Tanks Seismic Straps	2	Existing need	A&M WTP Chemical Tanks appear to have no seismic straps. Consider adding seismic straps.

Table 7-9. Performance Assessment Recommendations

Project Number	Project Name	Performance Score	Trigger	Condition Comments & Recommended Action
N-S-3	Maple St Reservoir Baffle Investigations	4	Existing need	Maple St Reservoir has concerns about a baffle tear inside reservoir. Perform further investigation of condition of baffle tear inside reservoir.
N-WTP-11	Vine Street WTP Chemical Tank Anchorage	4	Existing need	Liquid chemical room tanks may need more anchorage. Check for MSDS on tanks. Provide added tank anchorage as needed. Add MSDS on tanks as needed.
M-WTP-2	AM WTP 5th Filter Cell	3	Existing need	It is recommended that a 5th membrane cell be installed. It can be used to improve cleaning and maintenance of the membranes for existing needs and in the future, membranes can be added to reach the Ultimate plant capacity.
M-WTP-7	AM WTP Replace Filter Cell Header Pipes	3	Existing need	The general filtrate piping at AM WTP was scored for performance as a 3, fair. However, operators have indicated that the specific header pipes for the filter cells have cracked and failed multiple times. It is thought that the pipe thickness may need to be thicker. It is recommended to replace the cell header pipes and consider a thicker pipe and stronger connection.
M-WTP-8	AM WTP Clean-In-Place Pump	NA	Existing need	There is only one existing clean-in-place pump used to clean AM WTP filter membranes. It is recommended to install a second pump for redundancy.
N-WTP-12	AM WTP RWPS Valve Replacement	3	Existing need	AM WTP RWPS has one of the valves that is not sealing fully so the City can't isolate the wet well. Low level valves are also especially hard to isolate. Consider replacing all lowest level valves.
L-WTP-2	AM WTP Chemical Improvements	2	Future Condition Concerns	The AM WTP chemical systems were generally scored as having good performance. This is an optional project. When the condition of the sodium hypochlorite and caustic tanks and piping requires improvement, the City can consider installing a sodium hypochlorite on site generation for improved availability of sodium hypochlorite.

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7.3.2 Remaining Useful Life

Asset useful life is generally considered to be the duration of time that an asset provides valued service, after which it does not meet its intended service level. End of life is not necessarily indicative of catastrophic failure, and in most cases an asset can still hold functionality beyond the end of its useful life, however, its operation may result in increased maintenance costs. Asset remaining useful life (RUL) can be estimated by using a time-based age calculation and condition data gathered in the condition assessment. Table 7-10 presents typical useful life expectancies used for the time-based calculation. Typical useful life values for different equipment categories are based on the AWWA, Water Environment Research Foundation (WERF), EPA, and experience working with other agencies.

Table 7-10. Assets and Typical Useful Life

Equipment	Useful Years
Pump & Motors	25
Piping	40
Valves	20
Sump Pumps	15
Cranes/Hoists	20
Chemical Systems	15
Water Storage Tanks: Concrete & Steel[(a)]	50-75
WTP Tanks (includes chemical tanks)	15
Site Pavement	20
Switchgear[(b)]	15-75
Motor Control Centers	30
PLCs	15
Motor Starters	15
Electrical Generators	20
Instruments	15
Automation Hardware	15
Compressors	15
Pressure Vessels	15
Water Facilities	50

(a) Storage Tanks and Reservoirs typical life ranges from 50 to 75 years. An average useful life of 63 years was used for analysis purposes.
(b) Switchgears have been known to last for up to 75 years; however, technology and components can become outdated and obsolete and can result in useful life as low as 15 years when it becomes difficult to purchase replacement parts. An average useful life of 45 years was used for analysis purposes.

Table 7-11 shows that the majority of City assets are in the late middle period of their remaining useful life. For example, an asset that has an expected useful life of 50 years with an RUL of 20-40 percent, is expected to have 10-20 years remaining of reliable service. The RUL for each individual asset can be found in Appendix I.

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Table 7-11 Remaining Useful Life Percentage Summary

RUL Range, percentage	Count	Asset Percentage
0-20	93	16
20-40	169	29
40-60	163	28
60-80	120	20
80-100	43	7

7.3.3 Reliability and Redundancy

The City evaluated reliability and redundancy requirements at each site. The typical guidelines for reliability and redundancy levels are evaluated for each site in Table 7-12 below. The scores help influence the probability of failure (POF) and consequence of failure (COF) scores used to calculate risk.

Table 7-12 Reliability and Redundancy at Each Site

Redundancy & Resilience Recommendations	WTP1 (Vine Street)	WTP2 (AM)	34th Street	Gibson Hill	Valley View	Queen Avenue	Broadway Street	Wildwood	Maple Street	North Albany
	Yes (Y) or No (N)									
Mechanical										
Pumps have n+1 redundancy	Y(a)	Y(b)	Y	Y	Y	Y	NA	NA	Y	Y
Spare parts are readily available and located at or near the site	N	N	N	N(c)	N	N	N	N	N	N(c)
Means to bypass the facility is available	N	N	Y	Y	Y	Y	NA	NA	Y	N
Electrical										
Two sources of power are available	N	N	N	N	Y	N	N	N	N	N
MCCs on alternate power sources	N	Y	N	N	N	N	N	N	N	N
Standby power with 24 hours of diesel fuel storage is available	N	N	N	N	Y	N	N	N	N	N
Quick plug-in connection for portable generator is available	N	N	Y	Y	N	Y	N	N	N	Y
Instrumentation										
Two different types of wet well level control are available	N	N	N	N	N	N	N	N	N	N
UPS or battery backup for PLC/communication system is available	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Backup float controls for pump operation	N	N	N	N	N	N	N	N	N	N

(a) Yes, for Vine Street WTP raw water pumps and high service pumps. No for Vine Street WTP transfer pumps.
(b) Yes, for AM WTP raw water pumps. No for AM WTP filtrate pumps which only have one pump per cell.
(c) Spare pump parts available, no spare motor.

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7.3.4 Risk Assessment

Asset risk assessment considers both the probability of failure (POF) and consequence of failure (COF) of an asset (component). The POF assesses the probability that a failure will occur, and the COF considers the impact a component's failure may have on the required level of service.

Asset risk is then calculated using equation 7-1:

$$Risk = POF \ x \ COF \qquad \text{Eqn. 7-1}$$

The asset risk score is typically plotted on a risk matrix using thresholds as shown in Table 7-13. The goal of this matrix is to determine when an asset needs replacement based on its POF and COF scores. The thresholds and risk levels (Low, Medium, High, Severe) are typically based on the risk tolerance.

Table 7-13. Risk Matrix

	Probability of Failure				
Consequence of Failure	Very Low 1	Low 2	Moderate 3	High 4	Very High 5
Severe 5	Medium	Medium	High	Severe	Severe
Major 4	Medium	Medium	High	Severe	Severe
Moderate 3	Low	Medium	Medium	High	High
Low 2	Low	Low	Medium	Medium	Medium
Negligible 1	Low	Low	Low	Low	Low

The POF is scored from 1 to 5 (Very Low to Very High) for each asset. The POF is based on the condition and performance scores of an asset as an asset in poor condition is more likely to fail.

Asset criticality addresses the COF. The level of criticality is a relative measure of the asset COF based on objectives and criteria deemed important by an organization. Table 7-14 presents the COF criteria and scoring used in the criticality assessment.

Table 7-14. Criticality/COF Scoring Criteria

Score	Economic	Environmental	Social	Health & Safety	O&M
1	Negligible to no impacts	Minimal to no impact	Minimal to no impacts	No adverse health effect on the public or employees	Minimal to no impacts
2	Low Impact/ Minor Consequence	Low impact, minor permit violations	Occasionally cannot meet customer requirements	Minor injury to public or employees; no illness among citizens	Disruption less than 3 hours duration
3	Moderate Impact/ Moderate Consequence	Moderate impact, significant permit violations	Frequently cannot meet requirements for localized area of customer base	Moderate injury to public or employees; no illness among citizens	Disruption between 3- and 12-hours duration
4	Major Impact/Significant Consequence	Significant impact, major permit violations	Significant impact for not meeting requirements for several areas of customer base	Severe injury or illness affecting a few citizens or employees	Disruption between 12- and 24-hours duration
5	Severe Impact/ Catastrophic Consequence	Major impact, permit violations may involve federal and state actions	Continuously cannot meet customer requirements	Any loss of life; severe injury or illness affecting numerous citizens or employees	Disruption over 24-hours duration

Prior to presenting the risk scores, each treated water facility was assigned a COF based on conversations with the City and the criticality of each site as shown in Table 7-15 and Figure 7-3. In Appendix I, the COF scores for each asset are found.

Table 7-15. Criticality/COF by Site

Site	COF Score
WTP1 (Vine Street)	4
WTP2 (AM)	5
34th Street	2
Gibson Hill	3
Valley View	3
Queen Avenue	2
Broadway Street	5
Wildwood	3
Maple Street	4
North Albany	4

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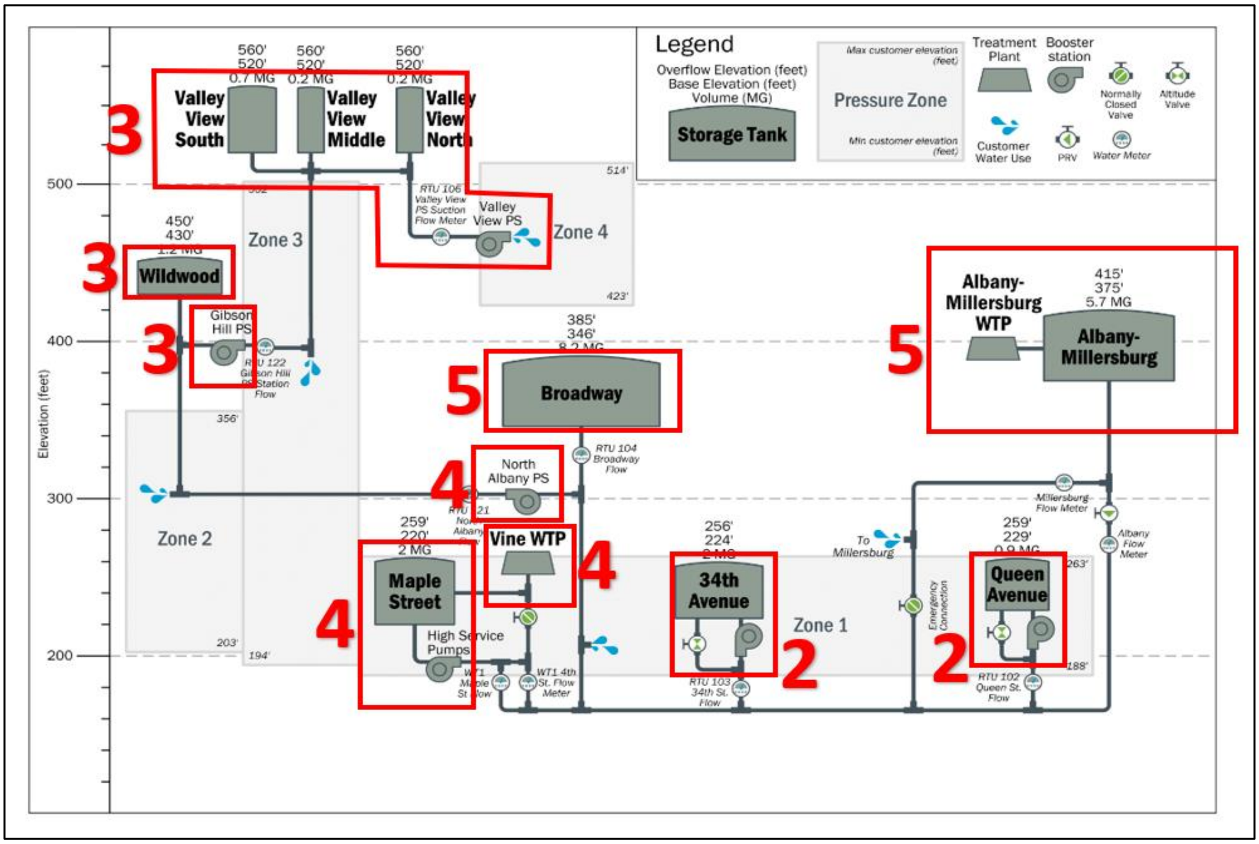

Figure 7-3. Criticality/COF by Site

In general, the different site COFs were selected based on the typical use and zone service as described below:

- The City has two WTPs, meaning that if one WTP failed, there is the other WTP to provide water to the City. AM WTP was scored with a COF of 5, Severe, because it is a shared WTP with Millersburg and due to it's higher elevation, operationally, drinking water can gravity flow to Zone 1 and also partially fill the Broadway Reservoir. The AM WTP is also the more seismically resilient plant, in better condition, and with a longer design lifetime. If the AM WTP were to fail, the long-term and financial consequence to the City would be worse than if the Vine Street WTP failed. The AM Reservoir also uses the AM COF site score of 5. The Vine Street WTP COF was scored as 4, high.
- Maple Street Reservoir was also scored as a 4, high, because it is connected to the Vine Street WTP which also scored a 4 and water from Vine Street WTP is dependent on the reservoir for Chlorine Contact Time.
- Queen Avenue and 34th Street sites are in Zone 1 and were scored as a 2, low, because the disruption of not having them is less than from other City assets. As noted in Chapter 6, the energy used to pump water into Zone 1 is lost when the Queen and 34th reservoirs are filled. To use water in these reservoirs, it must be pumped again back to the Zone 1 pressure.

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- Broadway was scored as a 5, severe, because it is the largest reservoir and it is at a mid-level elevation which assists the water getting pumped up to the higher zones and it is also able to serve Zone 1.
- North Albany Pump Station was scored a 4, major, as it pumps water up to Zone 3 which ultimately helps water also be delivered to the Zone 4.
- Gibson Hill, Valley View, and Wildwood were all scored as a 3, moderate, because they serve the upper zones with fewer customers.

The risk scores were assigned for each asset. Table 7-16 shows the range of risk categories showing that the majority of assets are in the low to medium risk categories.

Table 7-16 Risk Summary

Risk Category	Count	Percentage of Assets
Low	219	37
Medium	225	38
High	94	16
Severe	50	9

The assets receiving a severe risk score in the water system are found mostly at Maple Street Pump Station & Reservoir, North Albany Pump Station, and Vine Street WTP. A few assets at Broadway Reservoir and AM WTP were also scored severe in risk score likely because those facilities have the highest consequence of failure. The COF, POF, and risk scores for each individual asset can be found in Appendix I.

7.3.5 Summary of Results

As seen in tables 7-7, 7-8, and 7-9 there are several specific recommendations to improve the City's water system's operational capabilities, resiliency to assessed threats, and extend the useful life of the water system. The AM WTP, installed in 2008, now 15 years old, is overall in good condition without many large concerns. Key concerns are for the Vine Street WTP which is now over 110 years old and the North Albany Pump Station.

At the Vine Street WTP, multiple structures are noncompliant for nearly all of the items on the ASCE/SEI 41-17 checklist for the building classification as detailed in Table 7-7 and Appendix L. The structural engineer condition assessment resulted in recommendations for replacement of multiple structures at Vine Street WTP. The structural engineer's professional opinion is that a seismic retrofit for multiple structures would be very difficult to perform and not appropriate due to the age and type of the essential facilities. More detail on the seismic evaluation of the structures is in Chapter 8. The Vine Street WTP also has mechanical condition concerns for different pipes and pieces of equipment as shown in Table 7-8.

Given the significant concerns from the condition assessment at the Vine Street WTP, it is recommended for the City to start planning for the future of the Vine Street site including the Vine Street WTP, the Hydroelectric Facility, and the Canal through a viability study. The viability study should include different alternatives for the Vine Street WTP including replacement of the existing Vine Street WTP with a new

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WTP. The viability study should look at the cost needed to address condition concerns at the existing Vine Street WTP and the amount of extended lifetime compared to the cost and lifetime of a new WTP investment. The study should also consider the challenges and feasibility of replacing structures at Vine Street WTP due to their historical nature, and the structural code and seismic concerns associated with retrofit of existing structures, and the phasing challenges if the Vine Street WTP is to remain in service while performing the major recommended upgrades. The viability study should evaluate the cost of decommissioning the Vine Street WTP and explore multiple location options for a potential new WTP including new sites along the Canal and an option of replacement of the WTP at the Vine Street site.

The North Albany Pump Station is not seismically stable and has capacity concerns identified in Chapter 6, thus the North Albany PS structure is also recommended for replacement. The rest of the City's reservoirs and pump stations are in fair condition and overall, the City has performed timely and consistent maintenance of assets which has prolonged asset lifetime.

7.4 PIPELINE REPLACEMENT PROGRAM

The purpose of this study is to improve the City's pipeline replacement program by:

- identifying water mains that should be prioritized for replacement (i.e., high risk, expiring useful life, etc.)
- extracting institutional knowledge about different pipe materials/sizes that have chronic issues, and
- combining assets into a 20-year replacement forecast

The forecast supports the development of capital improvement projects that the City can strategically, and feasibly, implement over the next 20 years. The full analysis is found in Appendix J, *Water System Mains Replacement Program Projections TM*.

7.4.1 Existing Pipeline Replacement Program

The City currently uses a risk-based methodology to prioritize pipe replacement. The City spends approximately $1.2 million per year on water main replacements. Where appropriate, the City aligns water pipeline replacement projects with other utility projects to maximize use of City funds. The City provided a GIS database that is a master inventory of existing pipe segments within the City's potable water system (asset register) including information on pipeline by material, age, size, and number of leaks. This database allows prioritization of pipe replacement based on risk scoring.

7.4.2 Evaluating the Health of the Water System

This section summarizes two metrics that are useful to track the existing and future health of the water system: replacement cycle and water loss.

Replacement Cycle

Replacement costs represent the amount of money that the City would have to spend to replace all water mains with new, equivalent assets at current market prices. Unit costs developed in the Basis for Cost Estimating TM, Appendix J, were used to estimate the replacement cost for each pipe segment. As summarized in Table 7-17, the total cost for replacement of all the pipes within the distribution system totals $615,952,000.

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Table 7-17. Replacement Cost by Diameter

Diameter, inches	Length, miles	No. of Segments	Replacement Cost, 2023 dollars
<u><</u>2	5.9	175	10,759,000
3-4	19.0	764	34,894,000
6	50.2	2,016	96,235,000
8	100.8	5,010	202,692,000
10-12	56.9	2,619	119,903,000
16	14.7	482	41,469,000
18-24	16.0	600	63,638,000
30-42	7.8	129	46,362,000
Total	**271.3**	**11,795**	**$615,952,000**

The replacement cycle of a water system is calculated by dividing the total replacement costs by the existing capital improvements budget (Equation 7-2).

$$Replacement\ Cycle\ (Years) = \frac{Total\ Replacement\ Costs}{Existing\ Capital\ Improvement\ Budget} \qquad \textit{Eqn. 7-2}$$

Based on the existing annual budget of $1.2M for pipeline replacement, the current replacement cycle is 513 years. The replacement cycle metric can be evaluated against the expected useful life of water mains (discussed in following sections) to identify if the existing capital improvement budget is sufficient to replace assets at the rate in which they degrade.

Water Loss

Water loss is defined as the amount of water that has been "lost" between the production site and the customer. Water loss can be expressed as a volume, or as a percent of total water production and is caused by:

- Main leaks and storage tank overflows
- Unauthorized use (theft and tampering)
- Unbilled consumption and meter inaccuracy
- Unmetered consumption

Water loss can be used to track the health of the water system over time; it provides insight on the efficacy of the existing operations and maintenance (O&M) methods, and if there has been enough capital investment into the water system in the past. High water loss corresponds to reactive maintenance practices and underinvestment in the water system, whereas low water loss is associated with preventative maintenance practices and adequate investment. The American Water Works Association recommends agencies aim for a maximum water loss of 10 percent. Based on data in Chapter 3, the water loss for the City ranges from 9.0 percent to 10.6 percent between 2018 and 2022.

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7.4.3 Prioritization of Pipeline Replacement

There are two main methodologies which are used to develop the pipeline replacement prioritization described in this section: time-based and risk-based prioritization.

Time-Based Prioritization

The time-based remaining useful life (RUL_T) is calculated based on a linear decay of the asset's useful life expectancy. For example, an asset with a 100-year useful life that has been in service 75 years would have a RUL_T of 25 years.

The expected useful life was developed based industry standards including published values from the American Water Works Association, Water Environment Research Foundation, and other resources. Each pipe material and diameter within the City 's potable water system was assigned a standard useful life. The vast majority of pipelines have an expected useful life of 90 to 95 years. Table 7-18 presents the standard useful life of buried pipe by material along with City data for length and count of pipelines by material.

Table 7-18. Standard Useful Life of Buried Pipes & Pipe Summary by Material

Material	Useful Life, years	Length, Miles	Percentage of Total
Asbestos Cement < 6-inches[(a)]	30	80.1	29.5
Asbestos Cement ≥ 6-inches	90		
Polyvinyl Chloride (PVC)	90	5.6	2.1
Brass	90	< 0.0	0.0
Cast Iron	95	13.5	5.0
Ductile Iron Pipe	95	152.4	56.2
High Density Polyethylene	90	11.6	4.3
Copper	95	0.2	0.1
Galvanized Pipe	95	2.1	0.8
Yelomine (PVC)	90	0.3	0.1
Steel	95	5.0	1.8
Unknown	95	0.5	0.2
	Total	**271.3**	**100%**

(a) Asbestos cement less than 6-inches in diameter has a lower useful life of pipes of the same material that are 6-inches or greater due to the brittle nature of the material. When exposed to clay soils with high shrink-swell potential, small diameter asbestos cement pipes are prone to breaks.

Pipe RUL_T results were grouped into four classes ranging from: Class I, excellent, which includes newer assets in the first 25 percent of their useful life expectancy or assets that are expected to be in new or like new condition; to Class IV, poor, which includes assets in the last 25 percent of their useful life expectancy. Table 7-19 presents the percent RUL_T ranges, associated classification, and expected condition along with the RUL_T class by length (miles of pipeline) and percent of total system length. For example, Class I (green) represents pipe segments between 75 and 100 percent RUL_T and is the most common class within the potable water system. This information provides a snapshot view of the condition of the City's potable water pipe segments and in general the City's potable water system is in **excellent to good** condition based on the RUL_T estimation and classification.

Table 7-19. RUL$_T$ Class Ranges

Percent RUL$_T$	Class	Expected Condition	Length, miles	Relative Total, percent
75 - 100	I	**Excellent**	102.2	38
50 - 75	II	**Good**	81.8	30
25 - 50	III	**Fair**	70.0	26
0 - 25	IV	**Poor**	17.2	6

Risk-Based Prioritization

The existing risk framework, scoring mechanisms, and risk results were provided by the City to identify distinct levels across the risk metrics (POF, COF, risk index). For the detailed risk calculation worksheet that the City uses, see Appendix J. The risk metrics levels are defined as Low, Medium, and High. The risk metrics level interpretations and scoring ranges are summarized in Table 7-20.

Table 7-20. Risk Metric Interpretation

Metric Level	Probability of Failure (1-10)	Consequence of Failure (1-10)	Risk Index (1-10)
Low	**Range: < 2.5** • Typically installed after 1990 • Material of DI, or HDPE • 8-inches < Diameter < 42 inches • No leakage history	**Range: < 4.0** • Material of DI, or HDPE • Diameter < 8-inches • No location criticality • Located on a local or collector road	**Range: < 3.25** • Younger pipes of flexible material, no leakage history, and minimal interaction with high criticality infrastructure.
Medium	**Range: 2.5 – 3.5** • Installed before 1990 • Material = CIP, AC, or STL • 8-inches < Diameter < 16-inches • No leakage history	**Range: 4.0 – 6.0** • Material of CIP, DI, HDPE, or STL • 8-inches < Diameter < 16-inches • Highly critical location (e.g., backbone, critical customer, railroad crossing) • 21 percent chance of being located on an arterial street or highway	**Range: 3.25 – 4.75** • Pipes of varying material and age with no leakage history, and more likely to be closer to high criticality infrastructure.
High	**Range: > 3.5** • Installed before 1980 • Material of CIP, AC, or STL • Diameter < 6-inches • 25 percent chance of having > 1 leak • 7 percent chance of having > 3 leaks / 500 feet	**Range: > 6.0** • Material of AC • 12-inches < Diameter < 24-inches • Highly critical location (e.g., backbone, critical customer, railroad crossing) • 56 percent chance of being located on an arterial street or highway	**Range: > 4.75** • Older pipes that either have leakage history or characteristics that are prone to elevated degradation rates and are likely near high criticality infrastructure.

To better illustrate the complexity of the process for developing scoring ranges for each risk metric level, an example of a main (ID = 40361) on the border of medium and high-risk metric levels is provided below:

- Probability of Failure Factors
  - Construction Year = 1964 → Unweighted POF factor score = 8.
  - Pipe Size = 6-inches → Unweighted POF factor score = 5.
  - Pipe Material = AC → Unweighted POF factor score = 10.
  - Number of Leaks = 0 leaks / 500 feet → Unweighted POF factor score = 0.
  - Type of Recorded Leak = Not Applicable → Unweighted POF factor score = 0.
- Consequence of Failure Factors
  - Road Type = Highway → Unweighted COF factor score = 10.
  - Critical Location = None → Unweighted COF factor score = 0.
  - Pipe Types Prone to Catastrophic Breaks = AC → Unweighted COF factor score = 10.
  - Pipe Size = 6-inches → Unweighted COF factor score = 3.
- Total Factor Scores & Levels
  - Probability of Failure = 3.8 → Level = High
  - Consequence of Failure = 6.1 → Level = High
  - Risk = 5.0 → Level = High

Despite the minimal leakage history for this main, other attributes are characteristic of degraded condition. Not only was the main installed nearly 60 years ago, but the material (asbestos-cement) is brittle and prone to shear in dry conditions and softening in saturated conditions. From a criticality standpoint, the main is located near or running through a highway and is prone to catastrophic breaks. If this main were to break it would cause significant social and economic impacts to the community. That said, the main is not a critical pipeline (e.g., backbone pipeline). Based on the review of the attributes associated with the condition and criticality of the main, this pipeline was used to help delineate the borders between medium and high scoring ranges for each risk metric levels, all of which scored in the high level.

The distribution of scores for COF, POF, and risk are shown on Table 7-21.

Table 7-21. Risk Metric Interpretation

Metric Level	Probability of Failure		Consequence of Failure		Risk Index	
	Length, miles	Relative Total, percent	Length, miles	Relative Total, percent	Length, miles	Relative Total, percent
Low	158.5	58	171.1	63	156.2	58
Medium	45.2	17	59.8	22	77.9	29
High	57.4	21	30.1	11	26.9	10
Other[(a)]	10.2	4	10.2	4	10.2	4

(a) Water mains within the system classified as Other were not evaluated for POF, COF, and risk as insufficient data were available.

Combined Pipeline Replacement Prioritization

The risk and age-based replacement methodologies described above were used together to develop the pipeline replacement program. Table 7-22 summarizes the prioritized replacement groups, replacement costs for each group (2023 dollars), and associated length of pipeline. The program consists of eight pipeline replacement groups and associated catalysts which are defined as metrics that indicate a replacement action is justified. The eight replacement catalysts were developed based on the relative importance and source data efficacy and shown in the table from highest to lowest priority.

Table 7-22. Replacement Group Descriptions and Lengths[a]

Replacement Group	Replacement Catalyst Description	Replacement Category	Replacement Cost, dollars 2023[b,c]	Length, miles
1	Extensive Leak History (> 5 leaks / 500 ft)	Risk-based	4,148,000	2.13
2	Expired Useful Life (i.e., RULT = 0)	Age-based	10,808,000	5.88
3	High Risk (Risk Score > 6.0) and High POF (POF Score > 3.5)	Risk-based	1,484,000	0.68
4	Medium-High Risk (6.0 > Risk Score > 5.0) and High POF (POF Score > 3.5)	Risk-based	5,280,000	2.41
5	Near-Term Expiring Useful Life (i.e., RULT = 1 – 10 years)	Age-based	1,245,000	0.67
6	Medium Risk (5.0 > Risk Score > 4.0) and High POF (POF Score > 3.5)	Risk-based	15,523,000	7.92
7	Medium-Term Expiring Useful Life (i.e., RULT = 10 – 20 years)	Age-based	13,259,000	6.65
8	Long-Term Expiring Useful Life (i.e., RULT > 20 years)	Age-based	564,207,000	244.85

(a) Water mains with insufficient data to perform the risk-based prioritization were prioritized only within the age-based replacement groups.
(b) If a water main is categorized into a replacement group, then it is ineligible for lower priority replacement groups. For example, if a water main has > 5 leaks / 500 feet, then the replacement costs are allocated to Replacement Group 1, and are ineligible to be allocated to Replacement Groups 2 – 6.
(c) Replacement costs based on unit costs developed in Basis for Cost Estimating TM (i.e., not adjusted for inflation due to undetermined replacement year[s]).

7.4.4 20-Year Pipeline Replacement Program Forecast

The pipeline Replacement Program forecast anticipates planned effort and expenditures for the pipeline replacement. This forecast may be used for fiscal planning and as a tool to prioritize further investigation of water mains via desktop assessments (e.g., review of field and maintenance records) or field assessments (e.g., condition assessment studies).

The risk-based and age-based replacement groups presented above were assigned a year of action based on the following prioritization criteria or assumptions:

1. Risk-based replacements will occur based on the priority shown in Table 7-22 (i.e., Group 1 first).

2. Age-based replacements that are already beyond their useful life will occur in year 1 of the replacement program, or as soon as possible given budget constraints.
3. Age-based replacements that are expected to reach the end of their useful life after year 1 will occur on the year they reach $RUL_T = 0$.

Using this logic, the 20-Year Replacement Program projections were developed, the results of which are presented in tabular format in Table 7-23. Costs associated with higher risk-based replacements were distributed over the first 5 years.

Table 7-23. 20-Year Pipeline Replacement Program Projections

Year	Replacement Cost, dollars 2023		
	Risk-Based Replacements	Aged-Based Replacements	Total
2024	830,000	1,205,000	2,035,000
2025	830,000	1,205,000	2,035,000
2026	830,000	1,205,000	2,035,000
2027	830,000	1,205,000	2,035,000
2028	830,000	1,205,000	2,035,000
2029	1,353,000	1,205,000	2,558,000
2030	1,353,000	1,205,000	2,558,000
2031	1,353,000	1,205,000	2,558,000
2032	1,353,000	1,205,000	2,558,000
2033	1,353,000	1,205,000	2,558,000
2034	2,878,000	1,326,000	4,204,000
2035	2,878,000	1,326,000	4,204,000
2036	2,878,000	1,326,000	4,204,000
2037	2,878,000	1,326,000	4,204,000
2038	2,878,000	1,326,000	4,204,000
2039	2,878,000	1,326,000	4,204,000
2040	2,878,000	1,326,000	4,204,000
2041	2,878,000	1,326,000	4,204,000
2042	2,878,000	1,326,000	4,204,000
2043	2,878,000	1,326,000	4,204,000
		20-Year Average Annual Replacement Cost	**$3,250,000**

According to City staff, each percent that the City increases water user rates, yields an additional $150,000 that can be allocated for water main capital improvements on an annual basis. The average annual total replacement cost over the next 20 years is $3,250,000 which requires an approximate a 14 percent rate increase applied in 2024. The pipeline replacement program was broken into three CIP projects covering the near-term (Project N-D-4), medium-term (Project M-D-27), and long-term (Project L-D-3) with an annual budget of $3,250,000. One other option that the City could use is to start by increasing the annual budget to $2,035,000 for the first five years, then increasing the budget to $2,558,000 for the next five to

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ten years, and then finally increasing the budget to $4,204,000 for the final ten to twenty years. This option would allow a more gradual rate increase initially.

7.4.5 Pipeline Lifetime Replacement Cycle

As mentioned above, the City staff indicated that each percent increase in rates yields an additional $150,000 on an annual basis. In Figure 7-4, the green line represents the linear rate increase. Despite the linear increase in available funds with each percent increase, the replacement cycle follows a logarithmic trend, as shown in red in Figure 7-4. In essence, the replacement cycle follows the Law of Diminishing Returns, which states that benefits gained from something will represent a proportionally smaller gain as more money is invested in it. The first 1 to 5 percent of rate increases would have a bigger impact on lowering the replacement cycle than the next 5 percent, and so on. Figure 7-4 can also be used to identify the required rate increase and capital improvement budget based on a target replacement cycle by following the black dotted lines. Based on the City's risk prioritization for the next 20-years, the overall replacement cycle is between 150 and 200 years. The 14 percent increase mentioned above is shown to result in a $3,250,000 annual budget.

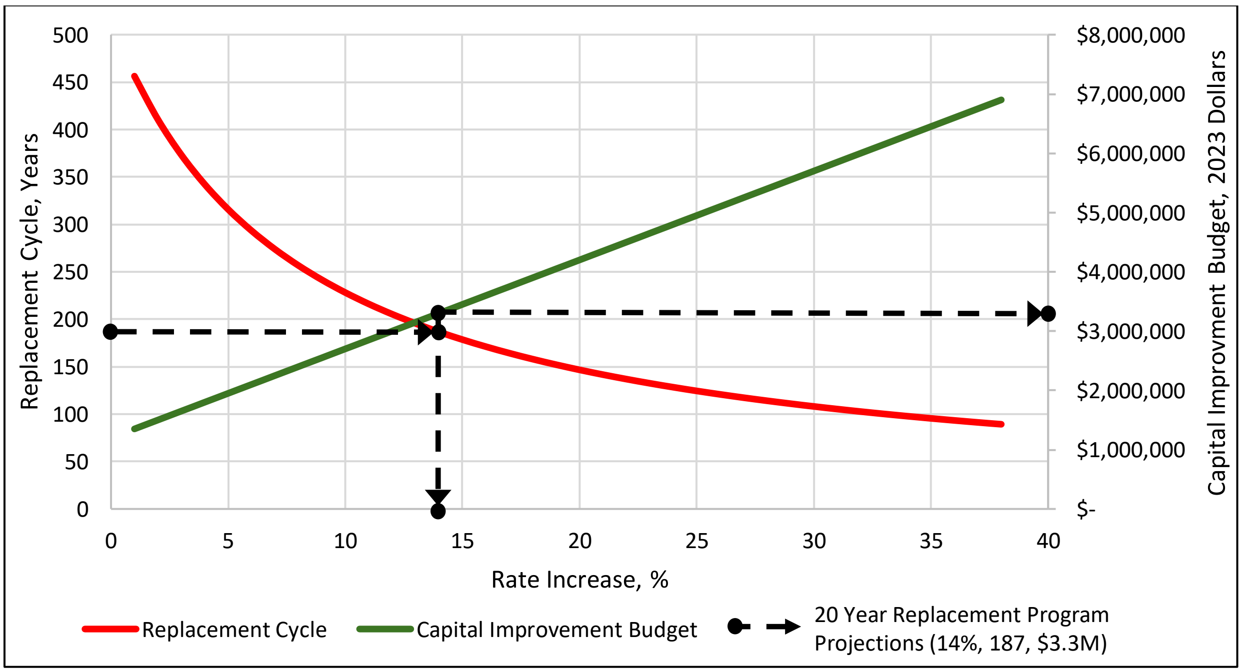

Figure 7-4. Rate Increase vs. Replacement Cycle Relationship

Ultimately, the City should aim to lower the water system mains replacement cycle to as close to the standard useful life of water system mains as possible, pending financial constraints. This approach transitions the City from a reactive maintenance to a preventative maintenance policy and flattens the year over year curve of anticipated costs for replacement. Figure 7-4 shows that to achieve a replacement cycle of 95 years, which equates to the standard useful life of buried pipelines, an increase of 35 to 37.5 percent is needed.

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7.5 SUMMARY OF FINDINGS AND RECOMMENDATIONS

The condition assessment of the City's water system assets provides many recommendations and future CIP projects which are presented with costs in Chapter 9. The canal and hydroelectric facility have separate CIP lists to delineate them as they are their own unique categories. The treated water facility recommendations and pipeline replacement recommendations are included in the main combined water system CIP. The replacement costs are presented as a lump sum budget for each period of time based on the analysis provided in this chapter.

7.6 REFERENCES

OTAK, Santiam-Albany Canal Rehabilitation Bank Stability Analysis, June 12, 2008

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CHAPTER 8
Seismic Risk Assessment and Mitigation Plan

8.1 SEISMIC RISK ASSESSMENT AND MITIGATION PLAN PURPOSE

This chapter presents a seismic risk assessment and mitigation plan to help the City prepare and appropriately invest in resilience planning for its drinking water system. A resilient water system is one that can provide a continuous water supply for critical needs in a post-disaster scenario. According to Department of Geology and Mineral Industries (DOGAMI) seismic hazard maps, the City is located in an area with potential for moderate to moderate/heavy damage potential as a result of a Magnitude (M) 9.0 CSZ earthquake. This plan further investigates and discusses the City's seismic hazards and provides recommended improvements for seismic resiliency of the water system.

This plan was developed in accordance with OHA requirements, specifically OAR 333-061-0060 (J), and the ORP goals. Recommendations are guided by the City's level of service goals as presented in detail in Chapter 4 - Planning Criteria. Recommendations in this plan are founded on the findings from the Geotechnical Seismic Hazards Evaluation TM (Appendix K), the Structural/Seismic Condition Assessment and American Society Civil Engineers (ASCE/SEI) 41-17 Evaluation TM (Appendix L), and the Pipeline Fragility Evaluation as presented below in Section 8.3.3 and Appendix M.

8.2 GEOTECHNICAL SEISMIC HAZARD STUDY

A geotechnical seismic hazards study was completed to identify seismic hazards associated with the M 9.0 CSZ earthquake and to determine seismic parameters for further evaluation of the resilience of the critical facilities and backbone pipelines. The study included identifying the geologic setting based on a review of geologic maps and reports, local water well logs, and boring logs from local geotechnical explorations.

Seismic hazards were evaluated based on a review of the DOGAMI seismic hazard maps and interpretation of the geologic conditions. Evaluated seismic hazards included strong ground shaking and associated peak ground velocities (PGVs) and peak ground accelerations (PGAs), liquefaction and liquefaction-induced settlement, lateral spread and associated permanent ground displacement, and earthquake-induced landslides. Estimated PGVs, spectral accelerations, and permanent ground deformations (PGDs) associated with a M 9.0 CSZ earthquake were provided for the evaluation of the critical structures and pipelines.

The critical structures evaluated included the AM Plant raw water intake structure, the treatment plants, pump stations, and reservoirs. The evaluation of the backbone pipeline focused on existing Functional Class III and IV pipelines and the future Functional Class IV pipelines, as defined below. The seismic design parameters were utilized in the Facility Structural Seismic Resiliency Evaluation and the Pipeline Fragility Evaluation discussed below.

The Geotechnical Seismic Hazards Evaluation TM (Foundation Engineering, Inc.) is included in Appendix K.

8.3 WATER SYSTEM BACKBONE AND CRITICAL FACILITIES

A water system "backbone" is a compilation of required critical pipelines and facilities that supply critical customers and locations for fire suppression access and a lifeline supply of water dispensing locations to aide in post disaster response and recovery efforts. The backbone includes a selection of watermains (pipes) within the water distribution system that provide connectivity to critical facilities and customers. Critical facilities are facilities such as water treatment plants, reservoirs, pump stations, and other points in the system that supply water to critical customers that provide essential health care, emergency response, and social and economic needs. Based on methods developed by the American Lifelines Alliance (ALA), backbone pipelines are categorized into functional classes that associate them with the critical facilities and critical customers they serve. This helps prioritize improvements that may be required to bring the system backbone up to the desired post-earthquake scenario level of service. Pipeline functional classes are defined below in Table 8-1. A map of the City's backbone system and critical facilities and critical customers are shown in Figure 8-1. Figure 8-1 shows pipeline functional classes 2, 3, and 4. Class 1 pipe is mostly small diameter and service laterals and was not shown for clarity.

Table 8-1. Pipeline Function Class, Adapted from the American Lifelines Alliance (2005)

Pipe Function Class	Description
I	Class I pipelines represent a low hazard to human life and have a low economic impact in the event of failure. These pipelines primarily serve agricultural or irrigation usage, certain temporary facilities, or minor (non-water) storage facilities, which do not have a significant role in local or regional economy. Pipelines and appurtenances with diameters of 6 inches or less are also defined as Pipe Function Class I and may include some residential areas.
	Level of Service: Class I pipelines are not required to be functional immediately following an earthquake and can endure longer restoration times. Residential areas in this class are to be restored to 80-90 percent operational in 2 weeks.[a] All other pipelines in this class are to be fully operational in 6 to 12 months.
II	Class II pipelines provide water for typical use within the utility where only a limited impact would be realized in the event of failure. These pipelines require shorter restoration time than Class I pipelines to limit the impact to the surrounding community. This category provides water for typical domestic use within the system and includes all pipelines not identified in Class I, III, and IV. These pipelines in residential areas should be identified for fire flow capability and or service level considerations to and through the residential areas.
	Level of Service: Class II pipelines are to be 80-90 percent operational in 2 weeks and fully operational in 6 to 12 months.[a]
III	Class III pipelines represent a higher criticality than the typical pipelines within a utility. These pipelines deliver water to many, or critical customers[b] and may also result in significant social or economic impacts in the event of failure or outage. These pipelines provide water for post-earthquake firefighting and emergency support.
	Level of Service: Class III pipelines require minimal restoration times following a major event. Service is to be reestablished to 80-90 percent of critical customers in less than 3 days. Remaining Class III pipelines are to be fully operational in 1 to 3 months.[a]
IV	Class IV pipelines provide water to essential facilities for post-earthquake response, public health, and safety[a]. These pipelines provide water for post-earthquake firefighting and emergency support.
	Level of Service: Class IV pipelines are intended to remain functional during and after a designed earthquake. The Class IV backbone pipelines are expected to remain functional after connecting pipelines that are damaged are valved off. Class IV pipelines serving critical customers are to be 80-90 percent operational in less than 24 hours and fully functional in 1 to 3 months.[a]

(a) Oregon Resilience Plan (2013) – Recovery Plan Goals (Valley).
(b) Critical customers by Pipe Function Class are listed in Table 8-6.

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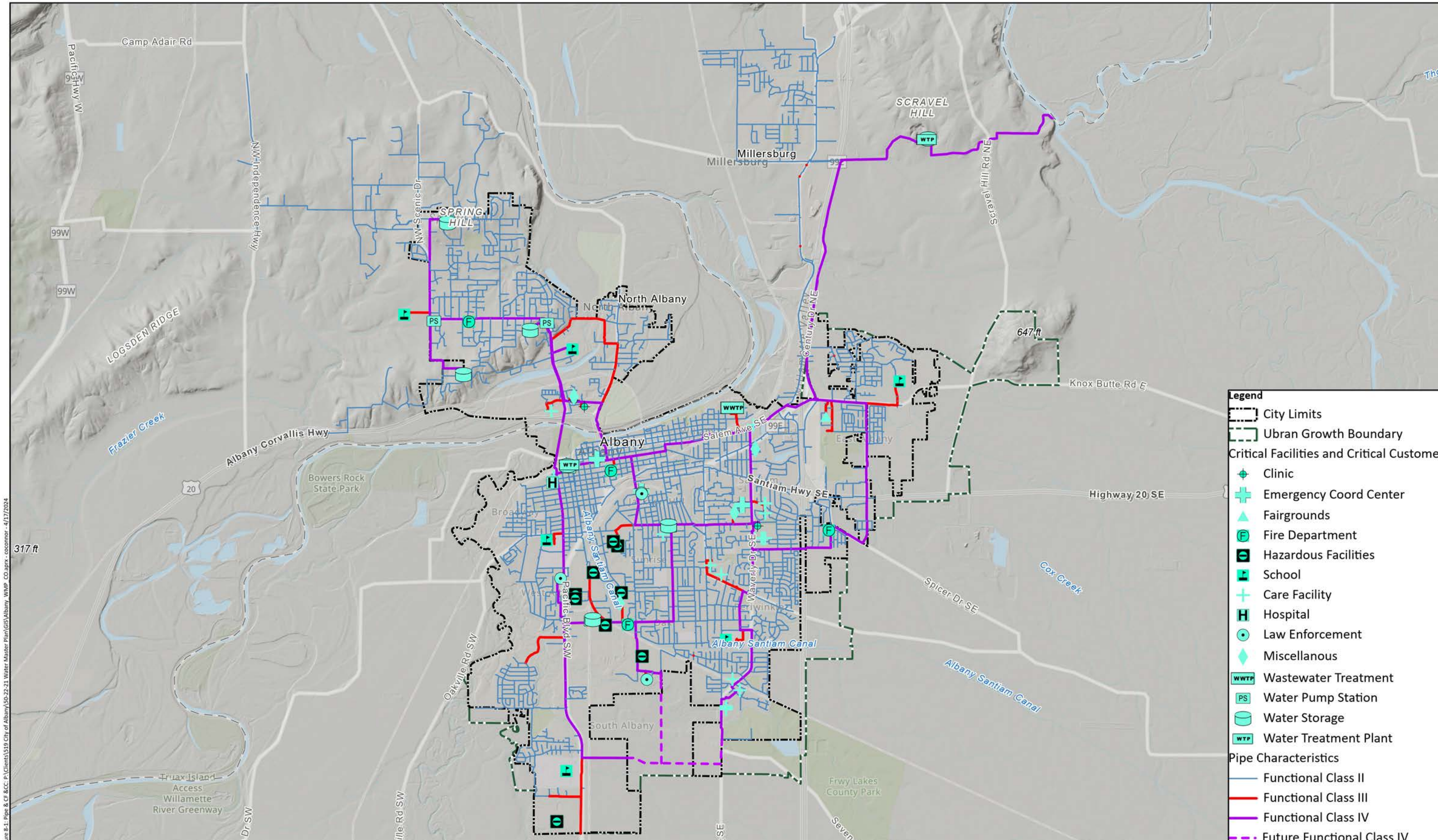

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Prepared for:

City of Albany
Water Master Plan

Potable Water System Pipe Characteristics, Critical Facilities, and Critical Customers

Figure 8-1

8.3.1 Pipeline Fragility Evaluation

The ALA method published in the report *Seismic Fragility Formulations for Water Systems* (ALA 2001) was used to estimate the likelihood of damage to buried pipe from a seismic event. This method estimates seismic fragility of water pipes, based on the frequency of pipe breaks or leaks resulting from past earthquakes, and correlates that data with the measured ground movements at the site during the earthquake. A detailed description of this method is included below, and the workbook used for this evaluation is included in Appendix M.

The ALA method recommends using two functions, shown in Table 8-2, to evaluate the repair rates (RR) for a large inventory of pipelines such as the City's water distribution system. The first function estimates a RR per 1,000 linear feet (LF) of pipe as a function of PGV, or seismic wave propagation. The second function estimates a RR per 1,000 LF of pipe as a function of PGD. K1 and K2 are empirical factors that scale the repair rates for different pipe diameters, pipe materials, and joint types. K1 represents the strength and flexibility of the pipe material to withstand ground shaking. Ground "shaking" for the evaluation of pipelines is quantified using the PGV. K2 represents strength, ductility, and flexibility to resist barrel and joint damage and separation during ground deformation due to liquefaction. The distribution for the various damage states can be described with a lognormal distribution, β. A summary of these parameters is included below in Table 8-3.

Table 8-2. Buried Pipe Vulnerability Functions

Hazard	Vulnerability Function	Lognormal Standard Deviation, β
Wave Propagation	RR=K1 x 0.00187 x PGV	1.15
Permanent Ground Deformation	RR=K2 x 1.06 x PGD 0.319	0.74
RR = repairs per 1,000 LF of pipe PGV = peak ground velocity (in/sec) PGD = permanent ground deformation (in)		

Table 8-3. Pipe Vulnerability Design Parameters

Hazard	Seismic Design Parameter
Probability of Levels of Liquefaction, percent:	
Very Low	1
Low	5
Moderate	15
High	25
Permanent Ground Deformation	
Max	12 in
Zone 1 Area (Majority of Backbone Pipes)	1 in
Peak Ground Velocity	
Max	10.63 in/s
Min	7.87 in/s

The City's critical facilities and backbone water system extend across a wide range of seismic hazards. Based on the geotechnical study, it was concluded that ground shaking is estimated to cause low to

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moderate potential damage depending on the location. Liquefaction, settlement, and lateral spreading are also estimated to be low in the City except along the Willamette River and smaller creek areas, where liquefaction probability and lateral spreading are medium (up to 11 percent) and high (up to 14 inches), respectively. Seismic-induced landslides are not a concern for the critical facilities and backbone pipeline system as shown in Appendix K Figure 7A.

The City's backbone pipeline system is composed of several different materials. Over 60 percent of the pipes are ductile iron (DI), with 28 percent of the remaining pipe consisting of asbestos cement (AC), high density polyethylene (HDPE), steel, polyvinyl chloride (PVC), and cast iron. A very small fraction (0.04 percent) of pipes are of unknown material. These pipes were evaluated using the ALA fragility evaluation discussed above. Table 8-4 summarizes the estimated breaks in the backbone system.

Table 8-4. Estimated Breaks by Pipeline Material in Classes III & IV[a]

Pipe Material Description	Pipe Material Abbreviation	Length of Pipe within system, ft	Estimated Repairs, Number of breaks & leaks
Ductile Iron (DI)	DI	139,260	4.08
Asbestos Concrete (AC)	AC	62,836	6.16
HAA (HDPE)	HDPE	18,164	0.43
Welded Steel	STL	2,608	0.08
Polyvinyl Chloride (PVC)	PVC	1,013	0.04
Cast Iron	CI	871	0.05
Unknown	UNK	52	0.00
	Total	**224,804**	**10.83**

(a) Estimated breaks are back calculated from RR per pipeline segment length.

The results of the analysis indicate that the risk of backbone pipeline damage due to ground shaking is generally low. However, the backbone pipelines located in areas with a medium probability of liquefaction and a medium lateral spread PGD hazard may suffer more damage. Figure 8-2 shows the potentially susceptible areas, which include the vicinity of Thornton Lake, along the bank of the Calapooia River adjacent to the Vine Street WTP settling ponds, along the north bank of the Willamette River, and at other creek areas. It should be assumed pipeline repairs will be needed in some areas due to ground shaking, and liquefaction induced settlement, and lateral spread PGD's associated with a M 9.0 CSZ seismic event.

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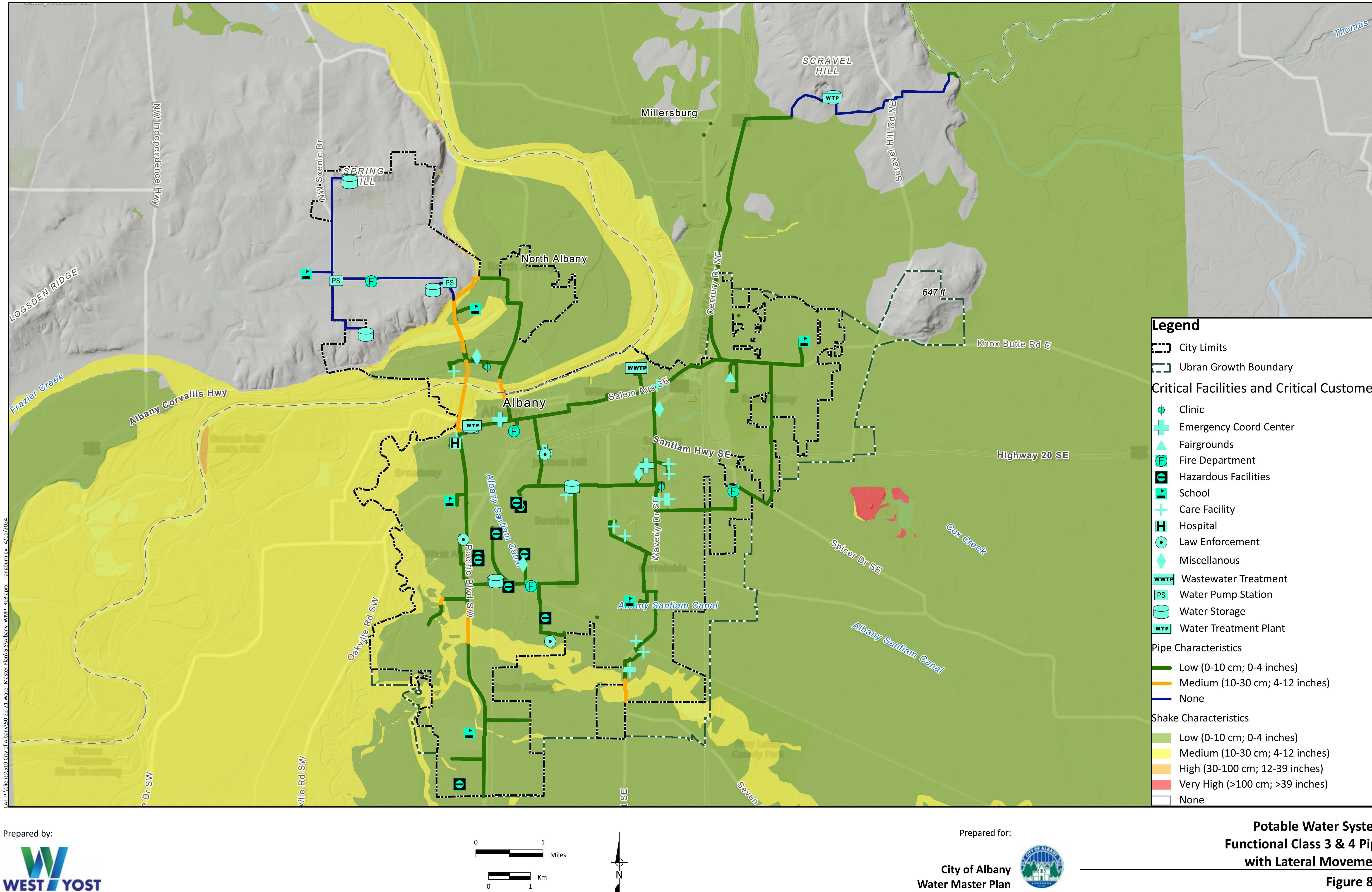

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Water Master Plan

Potable Water System
Functional Class 3 & 4 Pipe
with Lateral Movement

Figure 8-2

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In assessing the need for pipeline replacement, it is essential to recognize that the seismic risk alone may not warrant immediate action, particularly if it is determined to be low seismic risk as many of the pipes within Albany are. While seismic considerations are undeniably important, a comprehensive evaluation of the pipeline's overall condition, age, and capacity is imperative. The decision to replace a pipeline should be informed by a holistic assessment that considers various factors that should be carefully weighed alongside seismic considerations. To make an informed decision, it is recommended that the City undertake a thorough site-specific analysis in the areas mentioned above with medium probability of liquefaction and lateral spread as part of the main replacement program. Also as part of the main replacement program, it is recommended to consider replacing existing AC and cast iron pipe with more seismic resilient pipeline systems (i.e., materials with lower break rates) such as welded steel pipe, DI pipe with restrained joints, earthquake resistant ductile iron pipe (ERDIP), HDPE pipe (AWWA-C906), or Molecularly Oriented PVC pipe (AWWA-C909). The City maintains seismic pipeline standards for the design of future pipelines and it is recommended to continue to update these standards as industry knowledge and products advance.

An additional analysis was performed on the city's entire water distribution piping as shown in Table 8-5 below.

Table 8-5. Estimated Breaks by Pipeline Material in All Classes[(a)]

Pipe Material Description	Pipe Material Abbreviation	Length of Pipe within system, ft	Estimated Repairs, Number of breaks & leaks
Ductile Iron (DI)	DI	933,112	32.04
Asbestos Concrete (AC)	AC	434,173	28.37
High Density Polyethylene (HDPE)	HDPE	61,293	0.49
Welded Steel	STL	26,543	0.59
Polyvinyl Chloride (PVC)	PVC	30,454	0.73
Cast Iron	CI	71,195	4.15
Galvanized Iron (GI)	GI	10,999	0.46
Copper	CU	1,149	0.02
Brass	BRS	10	0.00
Unknown	UNK	4,717	0.34
	Total	**1,573,647**	**67.19**

(a) Estimated breaks are back calculated from RR per pipeline segment length.

The results of the analysis indicates that the risk of the City's water pipelines being damaged due to ground shaking and deformation is generally low. Similar to the backbone pipelines, areas that are near streams or rivers is where the higher likelihood of repairs will be needed.

8.3.2 Willamette River Crossings

The City has two Willamette River crossings that feed North Albany. One is a 24-inch welded steel pipe that was installed on the Lyon Street Bridge (Hwy 20) in 1979. The second crossing is a 30-inch HDPE pipe (Broadway Reservoir Transmission Line), constructed in 2012, that was directionally bored under the Willamette and Calapooia Rivers. Information pertaining to the geology of the river from other adjacent projects was also reviewed in addition to the information in the Geotechnical Seismic Hazards Evaluation TM (Foundation Engineering, Inc.) included in Appendix K. Further study must be conducted if geotechnical impacts are to be evaluated more closely due to these additional resources. The review of the pipeline river crossings focused on the vulnerability due to the CSZE. In correspondence with the Oregon Department of Transportation (ODOT), the discussions indicated that the Highway 20 bridge (Lyons Street Bridge) will suffer catastrophic damage and likely severely or completely damage the 24-inch steel main that is hung on the bridge. Isolation valves are existing at each end of the bridge. It is recommended to add earthquake style valves or integrate an earthquake warning system with the existing valves to provide timely isolation to the potentially damaged line and conserve water in the distribution system. When ODOT replaces the bridge, or seismically upgrades the bridge, the 24-inch main should be reinforced or replaced.

The 30-inch HDPE pipeline was designed and constructed in order to minimize the impacts of an earthquake and should survive the forces projected for the CSZE. No recommendations of improvements to this crossing are necessary.

Hydraulic modelling indicated that the 30-inch HDPE crossing can supply water to North Albany for both the existing and builout maximum day demand, so the loss of the 24-inch steel pipeline on the bridge will not interupt service to North Albany.

In general, it is recommended that the City perform local conditions assessments where pipes cross creeks or rivers as part of the main replacement program. Although replacing the pipelines crossings creeks or rivers will eventually be needed, the driver of those replacements should be based on condition assessments and multiple risk factors, including earthquake and flooding. There is no recommendation for replacement of these pipeline crossings solely based on earthquake risk.

8.3.3 Critical Facilities and Customers

Critical water facilities are facilities such as water treatment plants, reservoirs, pump stations, and other points in the system that supply water to critical customers that provide essential health care, emergency response, and social and economic needs. One reason to identify critical facilities and customers is to aid in post disaster response and recovery efforts. The critical facilities and customers identified by the City are shown in Figure 8-1 and also listed in Table 8-6.

Table 8-6. Critical Facilities and Customers List

Type of Facility	Name	Address
Clinic	Albany Family & Specialty Medicine	1705 Waverly Drive SE
Clinic	Corvallis Clinic at North Albany Village	601 Hickory Avenue NW
Clinic	Samaritan North Albany Urgent Care/Medical Clinics	400 Hickory Avenue NW
Clinic	Albany Internal Medicine Group	400 NW Hickory Street
Clinic	Fresenius Kidney Care	605 Hickory Street NW
Clinic	Waverly Lake Surgery Center	633 Waverly Drive SE
Community College	Linn Benton Community College	6500 Pacific Boulevard SW
Elementary School	Oak Grove Elementary School	1500 Oak Grove Drive NW
Emergency Coord Center	City Hall	333 Broadalbin Street SW
Emergency Coord Center	Albany Public Library	2450 14th Avenue SE
Emergency Coord Center	Linn County Emergency Management	1115 Jackson Street SE
Fairgrounds	Linn County Fair & Expo	3700 Knox Butte Road E
Fire Department	Albany Fire Station 14	2850 Gibson Hill Road NW
Fire Department	Albany Fire Station 12	120 34th Avenue SE
Fire Department	Albany Fire Station 11	611 Lyon Street SE
Fire Department	Albany Fire Station 13	1980 Three Lakes Road SE
Hazardous Facilities	Absorbent Technologies Inc.	140 Queen Avenue SW
Hazardous Facilities	ATI Alivac	530 34th Avenue SW
Hazardous Facilities	Absorbent Technologies Inc.	2930 Ferry Street SW
Hazardous Facilities	Target Distribution Center	875 Beta Drive SW
Hazardous Facilities	Oregon Freeze Dry Inc.	770 29th Avenue SW
Hazardous Facilities	Oregon Freeze Dry Inc.	525 25th Avenue SW
Hazardous Facilities	Pacific Cast Technologies Inc.	150 Queen Avenue SW
Hazardous Facilities	National Frozen Foods Corp	745 30th Avenue SW
Hazardous Facilities	Sno Temp Cold Storage	3815 Marion Street SW
High School	South Albany High School	3705 Columbus Street SE
High School	West Albany High School	2100 SW Elm Street
Hospice	Samaritan Evergreen Hospice	4600 Evergreen Place SE
Hospital	Samaritan Albany General Hospital	1046 6th Avenue SW
Law Enforcement	Linn County Sheriff & Linn County Emergency Management	1115 Jackson Street SE
Law Enforcement	Albany Police Station	2600 Pacific Boulevard SW
Law Enforcement	Linn County Jail/Sheriff's Office	1115 Jackson Street SE
Law Enforcement	Linn Benton County Juvenile Detention Center	4400 Lochner Road
Middle School	North Albany Middle School	1205 North Albany Road
Middle School	Timber Ridge Middle School	385 Timber Ridge Street NE
Nursing Home	Mennonite Village Nursing Home	5353 Columbus Street SE
Nursing Home	Regency of Albany Nursing Home	805 19th Avenue SE
Nursing Home	Timberview Care Center	1023 6th Street SW
Public Works	Linn County Road Department	3010 Ferry Street SW
Residential Care Facility	Mitchell Place Residential Care Facility	1927 Waverly Drive SE
Residential Care Facility	Mitchell Place Residential Care Facility	1931 Waverly Drive SE
Residential Care Facility	Bonaventure of Albany	420 Geri Street
Residential Care Facility	Mitchell Place Residential Care Facility	1925 Waverly Drive SE
Residential Care Facility	Scheler House Residential Care Facility	1921 Waverly Drive SE
Residential Care Facility	Lydia's House Alzheimer's Care Residential Care Facility	5353 Columbus Street SE
Residential Care Facility	Timberwood Court Memory Care Community	2875 14th Avenue SE
Retirement Life Care Facility	Brookdale Senior Living Retirement & Life Care Facility	1560 Davison Street SE
Retirement Life Care Facility	Brookdale Senior Living Retirement & Life Care Facility	2445 Geary Street SE
Retirement Life Care Facility	Mennonite Village Retirement & Life Care Facility	5353 Columbus Street SE
Retirement Life Care Facility	Brookdale Senior Living Retirement & Life Care Facility	1929 Grand Prairie Road SE
Retirement Life Care Facility	Avamere at Albany	2800 14th Avenue SE
Retirement Life Care Facility	Quail Run Assisted Living	2525 47th Avenue SE
Retirement Life Care Facility	Waverly Place Assisted Living	2853 Salem Avenue SE
Retirement Life Care Facility	Timberwood Court Memory Care Community	2875 14th Avenue SE
Wastewater Treatment	City of Albany Wastewater Treatment Plant	310 Waverly Drive NE
Wastewater Treatment	Albany Public Works Operations	310 Waverly Drive NE
Water Pump Station	Pump Station Facility - 34th Street	475 34th Avenue SW
Water Pump Station	Pump Station Facility - Maple Street	732 4th Avenue SW
Water Pump Station	Pump Station Facility - Queen Avenue	950 Queen Avenue SE
Water Pump Station	Pump Station Facility - Gibson HIll	3400 Gibson Hill Road NW
Water Pump Station	Pump Station Facility - North Albany	1008 Gibson Hill Road NW
Water Pump Station	Pump Station Facility - Valley View	3240 Valley View Drive NW
Water Source	Albany Millersburg Water Treatment Plant	33883 Berry Drive NE
Water Source	City of Albany Water Treatment Plant	300 Vine Street SW
Water Storage	Reservoir Facility - 34th Street	475 34th Avenue SW
Water Storage	Reservoir Facility - AM Plant	33883 Berry Drive NE
Water Storage	Reservoir Facility - Broadway Street	1501 Broadway Street NW
Water Storage	Reservoir Facility - Maple Street	817 4th Avenue SW
Water Storage	Reservoir Facility - Queen St	1709 Hill Street SE
Water Storage	Reservoir Facility - WIldwood	890 Edgewood Drive NW
Water Storage	Reservoir Facility - Valley View	2930 Valley View Drive NW

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8.3.4 Facility Structural Seismic Resiliency Evaluation

A structural seismic evaluation of the critical facilities in the treatment and distribution system was completed to identify potential structural and seismic deficiencies. This evaluation is based on review of available record drawings, seismic hazards evaluation data provided in the geotechnical study, and site observations at each facility. The Tier 1 level of ASCE 41-17 "Seismic Evaluation and Upgrade of Existing Buildings" provided the guidance for the evaluation, with the "Immediate Occupancy" criteria used to evaluate the required performance level of these critical structures. Both structural and non-structural items were evaluated and compared to current prescribed criteria and detailing requirements for lateral (wind/seismic) loading. Non-structural items include utilities, fixtures, equipment, finishes, and furnishings and are discussed later in this Chapter. The Structural/Seismic Condition Assessment and ASCE/SEI 41-17 Evaluation TM (ACE Engineering, LLC) is included Appendix L.

A seismic assessment performance expectation rating was assigned to each facility as part of the analysis. The rating criteria are presented in Table 8-7 and the associated rating at each site is shown in Table 8-8.

There are several recommendations that would improve the resiliency of the City's critical water supply facilities. Key concerns are for the Vine Street WTP which is now over 110 years old and the North Albany Pump Station (PS). The largest concerns at Vine Street are structural with multiple structures being noncompliant for nearly all of the items on the ASCE/SEI 41-17 checklist for the building classification. The structural engineer's professional opinion is that a seismic retrofit for multiple Vine Street structures would be very difficult to perform and not appropriate due to the age and type of these critical facilities. Instead, replacement of existing structures with new structures built to current seismic standards is recommended.

In 2008, a seismic assessment and retrofit strategy evaluation was performed for the Vine Street WTP (Creegan and D'Angelo, 2008) with the recommendation *"that the buildings be retrofit to levels 'generally conforming to the current code', …defined as 1997 Uniform Building Code (UBC) Zone 3."* The goal was to provide enough improvements to have the basic ability to pump water to the City system, even if not treated in the aftermath of a disaster. The evaluation included retrofits at several buildings and the Maple Reservoir. Retrofits typically consisted of replacing roofing systems, adding metal framing, and upgrading connections on the interior of the Raw Water Pump Station, Chemical Building, Control Building, and High Service Pump Station. Three inlet/outlet pipes were upgraded at the Maple Reservoir and selected nonstructural equipment was anchored. Though the retrofits provide some benefit, they do not bring the structures up to the current code requirements. The close proximity of buildings that haven't been seismically retrofitted also poses a risk to the buildings that have been retrofitted; it is possible that an adjacent building could collapse onto one of the buildings that has been retrofitted causing both buildings to lose functionality. Seismic codes have continued to develop in the past 15 years as more is learned about the dangers of a CSZ earthquake. Water treatment and distribution facilities were formerly classified as commercial structures by the building code but are now classified as essential facilities to provide water for fire suppression and life after a disaster. This change classifies water treatment facilities the same as schools, hospitals, and fire stations which the code describes as having the *"potential to cause a substantial economic impact and/or mass disruption of day-to-day civilian life in the event of failure."*

The North Albany PS structure is also recommended for replacement as it is not seismically stable, and has capacity concerns as identified in Chapter 6. In addition, multiple reservoir and pump station sites including Maple, Queen, and 34th Street sites are recommended for tank anchorage projects and pump station roof connection projects. The Valley View Reservoirs are recommended for tank anchorage projects and a retrofit of the pump station. A summary of the recommended projects for structural seismic mitigation of critical water supply facilities are provided at the end of this chapter.

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Table 8-7. Seismic Performance Expectation Rating Criteria

Condition Rating	Seismic Performance Expectation	Expected Performance	Re-Occupancy	Maintained Serviceability	Repairs or Replacement	Recommendations
1	Excellent	Structure likely to experience minimal damage and remain operational	Immediate occupancy expected	Expected	No significant repairs needed	Perform regular maintenance, repairs, and evaluations
2	Good	Structure likely to experience limited damage but remain safe to occupy and operate	Likely	Likely	Limited structural repairs needed	Perform regular maintenance, repairs, evaluations, and upgrades.
3	Fair	Structure likely to experience damage but retain a margin of safety against partial or total collapse allowing occupants to safely exit	Possible	Possible	Extensive structural repairs needed, or replacement of structure expected	Perform ASCE 41 Tier 2 & Tier 3 Evaluations & Retrofits. Perform regular maintenance Plan for replacement of structure in the future
4	Poor	Structure likely to experience damage and support gravity loads, but retains no margin of safety against collapse	Unlikely	Unlikely	Significant structural repairs needed or replacement of structure necessary	Perform ASCE 41 Tier 2 & Tier 3 Evaluations & Retrofits. Perform regular maintenance Consider replacement of structure
5	Immediate Attention	Structure likely to collapse or partially collapse	Unlikely	Unlikely	Complete replacement of structure necessary	Prepare for replacement of structure in the near future

Table 8-8. Seismic Performance Expectation of Critical Water System Facilities

Project Name	Facility Condition Rating	Seismic Performance Expectation
Vine Street WTP	5	Immediate Attention
Vine Street WTP: Raw Water Pump Station	5	Immediate Attention
Vine Street WTP: Hydroelectric Building	5	Immediate Attention
Vine Street WTP: Control Building/ Chemical Storage Building	4	Poor
Vine Street WTP: Soda Ash Building	5	Immediate Attention
Vine Street WTP: Filters 1-6	5	Immediate Attention
Vine Street WTP: Filters 7-10	5	Immediate Attention
Vine Street WTP: Accelator 1	4	Poor
Vine Street WTP: Accelator 2	3	Fair
Maple Street Reservoir	4	Poor
Maple Street High Service Pump Station	4	Poor
AM WTP Raw Water Pump Station	2	Good
AM WTP Filter Facility	2	Good
AM WTP Reservoir	2	Good
34th Street Reservoir	4	Poor
34th Street Pump Station	4	Poor
Wildwood Reservoir	2	Good
Gibson Hill Pump Station	2	Good
Queen Avenue Reservoir	4	Poor
Queen Avenue Pump Station	3	Fair
Valley View Reservoirs	4	Poor
Valley View Pump Station	3	Fair
Broadway Reservoir	3	Fair
North Albany Pump Station	5	Immediate Attention

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8.4 GENERAL NON-STRUCTURAL ITEM CONSIDERATIONS

Non-structural items were also evaluated and compared to current prescribed criteria and detailing requirements for lateral (wind/seismic) loading (see Appendix L). Non-structural items include utilities, fixtures, equipment, finishes, and furnishings. It is recommended that City staff review the general seismic resilience checklist and consider the items at each facility for compliance with the best practices for storing items and equipment. Table 8-9 includes conditions to consider.

It is important to note that buildings may also contain some form of hazardous materials. These materials will need to be dealt with on a case-by-case basis depending on the damage they may present if spilled during a seismic event.

8.5 FLOOD RESILIENCE

A review of the FEMA (Federal Emergency Management Agency) flood maps was performed to assess the impacts of the 500-year flood to the City's water facilities. None of the City's pump stations, reservoirs, treatment plants, or critical facilities are in the 500-year flood zone as shown in Figure 8-3. As expected, pipelines near rivers and creeks are within the flood zone. Pipe damage is typically due to washout, undercutting, and/or landslide caused by undercutting at the banks of the river. Overall, there are no recommendations for improvements to the water system to improve flood resilience of pipelines or structures. Figure 8-3 shows pipeline functional classes 2, 3, and 4. Class 1 pipe is mostly small diameter and service laterals and was not shown for clarity.

8.6 EMERGENCY WATER SUPPLY PLANNING

It is recommended that the City prepare an Emergency Water Supply Plan (EWSP) specifically for the North Albany service area, which is dependent on two river crossings for water supply. The pipe crossing hung on the Lyons Street Bridge is anticipated to not survive the CSZE earthquake and if the bridge pipe failed, it would leave the bored HDPE river crossing pipe as the sole source for the North Albany area. Investigating ground water opportunities as an emergency source in North Albany, as well as other potential tactics to help supply provisional water after a disaster should be investigated.

The City's Water System Emergency Response Plan also has recommendations for the public on how to obtain water and boil and disinfect it. For emergency distribution, the City owns water storage trailers and a treatment trailer.

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Table 8-9. General Non-Structural Item Recommendations for Seismic Resilience

Category	Notes
Specialties	• Industrial Storage Racks: Industrial storage racks or similar items that are more than 12 feet high should be anchored to the floor. • Tall Narrow Cabinets: Cabinets, lockers, bookshelves, etc. more than 6 feet high and with height-to-depth ratios exceeding 3:1 should be anchored to the floor or wall. • Fall-Prone Contents: Equipment, stored items weighing more than 20 pounds and more than 4 feet above the floor should be braced or restrained.
Equipment	• Fall-Prone Equipment: Equipment weighing more than 20 pounds and more than 4 feet above the floor should be braced or restrained. • In-Line Equipment: Equipment installed in line with a duct or piping system, with an operating weight more than 75 pounds should be laterally braced independent of the duct or piping system. • Tall Narrow Equipment: Equipment, tanks, etc. more than 6 feet high and with height-to-depth ratios exceeding 3:1 should be anchored to the floor or wall. • Suspended Equipment: Equipment suspended without lateral bracing should be free to swing or move with the structure without damaging itself or adjoining components. • Heavy Equipment: Floor supported, or platform supported equipment weighing more than 400 pounds should be anchored to the structure.
Special Construction	• Hazardous Material Storage: Some chemicals used in the treatment process or used during regular cleaning and maintenance processes may be considered hazardous when spilled. Chemical storage should be restrained to prevent displacement, tipping, or falling. • Hazardous Material Distribution: Piping containing hazardous materials, such as natural gas, should be anchored or braced adequately to prevent damage that might allow the hazardous material to release.
Plumbing	• Piping or Ducts Crossing Seismic Joints: There are several elevated pipes and cable trays spanning between different structures. This primarily occurs at the Vine Street Water Treatment Plant. These items should be fitted with flexible couplings or flexible connections to prevent damage to themselves and the structures they span between. • Fluid And Gas Piping: Fluid and gas piping should be anchored and braced to the structure to limit spills or leaks. • C-Clamps: Restrain one-sided C-clamps that support piping or similar items larger than 2.5 inches in diameter to prevent the clamps from displacement during a seismic event.
Electrical	• Emergency Lighting: Provide emergency and egress lighting. Anchor or brace emergency and egress lighting. • Light Fixtures Lens Covers: Make sure lens covers on light fixtures are attached with safety devices and add safety devices if necessary. • Electrical Equipment and Cabinets: Electrical equipment should be laterally braced to the structure and cabinets anchored. • Conduit Couplings: Conduits greater than 2.5 inches should have flexible couplings.
Process Inter-connections	• Shutoff Valves: Piping containing hazardous material, including natural gas, should have shutoff valves or other devices to prevent spills or leaks. • Flexible Couplings: Hazardous material, ductwork, and piping, including natural gas piping, should have flexible couplings.

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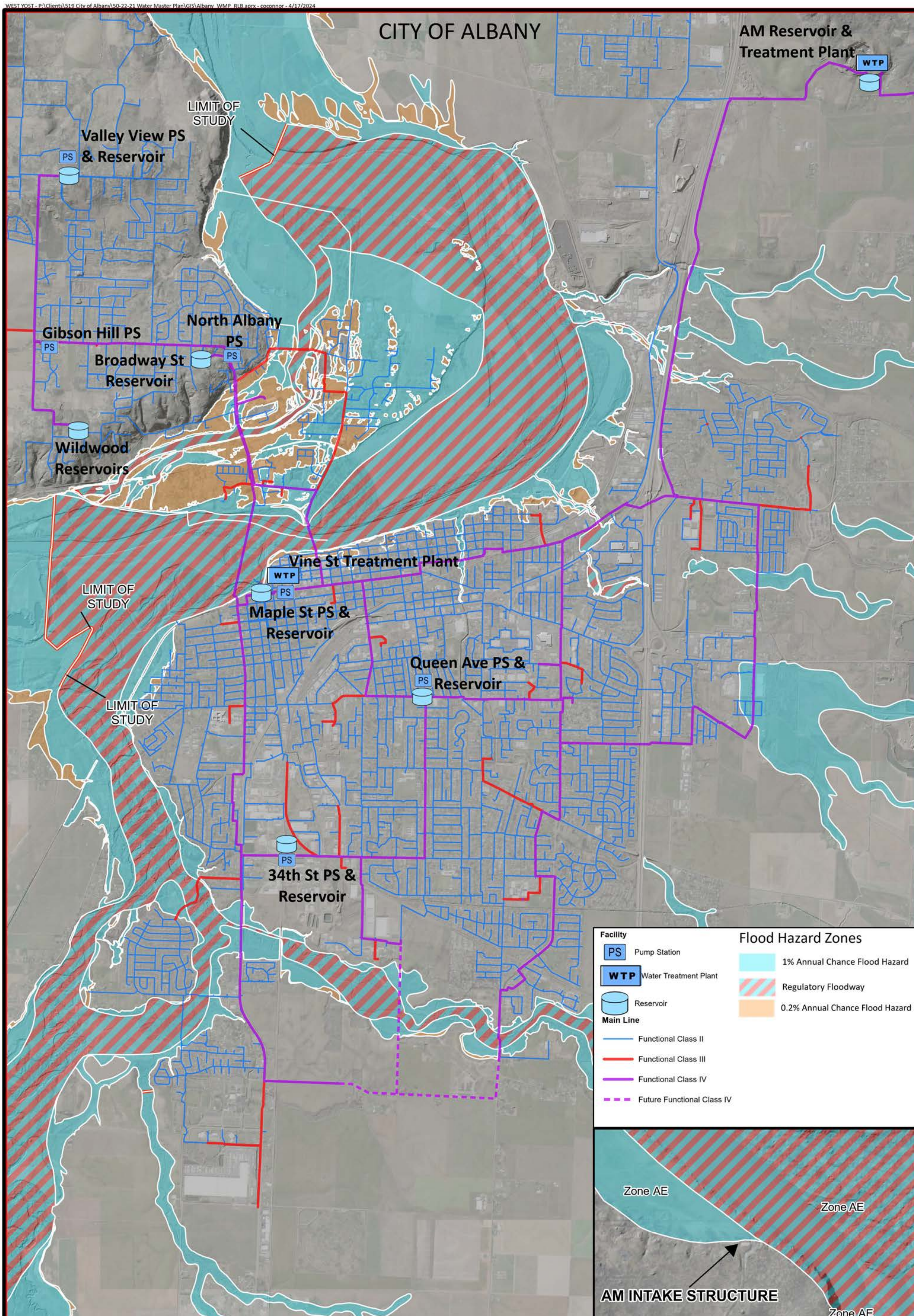

N

0 1 2 Miles

0 2 4 Km

Prepared for:
City of Albany
Water Master Plan

Potable Water System
Flood Hazard Zones
Figure 8-3

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8.7 OREGON RESILIENCE PLAN RECOMMENDATIONS

The City is following the 2013 ORP recommendations for recovery of water systems in the Willamette Valley as shown in Figure 8-4. The ORP presents target states of recovery following a major earthquake and suggests planning for long-term goals for water system resiliency to a M 9.0 CSZ earthquake.

Category	Goals - Operational Performance Water Systems in Willamette Valley			Current Operational Performance 90% Water Systems in Willamette Valley
	20-30%	50-60%	80-90%	
Supply Source (WTP)	< 1 day	1-3 days	7-14 days	3-6 months
Main Transmission (Backbone pipeline, PS, storage)			< 1 day	1-3 months
Fire Suppression at Key Points			< 1 day	3-7 days
Fire Suppression at fire hydrants	3-7 days	7-14 days	14-30 days	6-12 months
Critical Facilities (Hospitals, EOC)		< 1 day	1-3 days	1-3 months
Distribution Points (Community distribution centers)		1-3 days	3-7 days	7-14 days
Distribution System (Pipeline and service connections)	1-3 days	3-7 days	7-14 days	6-12 months
General Overall Operational and Economic Recovery	**14-30 days**			**> 1 year?**

Figure 8-4. Simplified ORP Table Showing Desired Performance and Recovery of Each Water System Component after an Earthquake

Table 8-10 outlines projected seismic performance and juxtaposes the 2013 Oregon Resilience Plan Goals for recovery.

Table 8-10. Water Facilities and the ORP Goals

Water Facility	Category	Operational Performance Immediately after Event, percent	Expected Time to 90 percent Performance	ORP Goal of 90 percent Performance	Currently Meets ORP Goals
Vine Street WTP	Supply Source	0	1 Year	7-14 Days	No
Vine Street WTP: Raw Water Pump Station	Supply Source	0	1 Year	7-14 Days	No
Vine Street WTP: Hydroelectric Bldg	Supply Source	0	1 Year	7-14 Days	No
Vine Street WTP: Control Bldg/ Chemical Storage Bldg	Supply Source	0	1 Year	7-14 Days	No

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Table 8-10. Water Facilities and the ORP Goals

Water Facility	Category	Operational Performance Immediately after Event, percent	Expected Time to 90 percent Performance	ORP Goal of 90 percent Performance	Currently Meets ORP Goals
Vine Street WTP: Soda Ash Bldg.	Supply Source	0	1 Year	7-14 Days	No
Vine Street WTP: Filters 1-6	Supply Source	0	1 Year	7-14 Days	No
Vine Street WTP: Filters 7-10	Supply Source	0	1 Year	7-14 Days	No
Vine Street WTP: Accelerator 1	Supply Source	0	1 Year	7-14 Days	No
Vine Street WTP: accelerator 2	Supply Source	0	1 Year	7-14 Days	No
Maple Street Reservoir	Main Transmission	0	6 Months	<1 Day	No
Maple Street High Service Pump Station	Main Transmission	50	1 Month	<1 Day	No
AM WTP Raw Water Pump Station	Main Transmission	75	< 1 Day	<1 Day	Yes
AM WTP	Supply Source	75	<1 Day	<1 Day	Yes
AM WTP Reservoir	Main Transmission	100	< 1 Day	<1 Day	Yes
34th Street Reservoir	Main Transmission	0	6 Months	<1 Day	No
34th Street Pump Station	Main Transmission	0	1 Month	<1 Day	No
Wildwood Reservoir	Main Transmission	100	< 1 Day	<1 Day	Yes
Gibson Hill Pump Station	Main Transmission	50-60	3 Days	<1 Day	No
Queen Avenue Reservoir	Main Transmission	0-10	6 Months	<1 Day	No
Queen Avenue Pump Station	Main Transmission	20-30	1 Month	<1 Day	No
Valley View Reservoirs	Main Transmission	0-10	6 Months	<1 Day	No
Valley View Pump Station	Main Transmission	20-30	1 Month	<1 Day	No
Broadway Reservoir	Main Transmission	100	< 1 Day	<1 Day	Yes
North Albany Pump Station	Main Transmission	0-10	6 Months	<1 Day	No
Backbone Pipe	Main Transmission	50-60	7 Days	< 1 Day	No
Fire Suppression at Key Points	Main Transmission	100	<1 Day	<1 Day	Yes[a]
Critical Facilities	Main Transmission	75	3 Days	1-3 Days	Yes[b]
Fire Suppression at Fire Hydrants	Distribution System	75	14 Days	14-30 Days	Yes
Distribution Points	Main Transmission	75	3 Days	3-7 Days	Yes [c]
Distribution System	Distribution System	75	14 Days	7-14 Days	Yes[d]

(a) Fire Suppression at key points along Class IV mains should be marked and planned for use
(b) Prioritization of Critical Facilities along Class IV mains will need to occur post EQ
(c) Prioritization of Critical Facilities along Class III & IV mains will need to occur post EQ
(d) Prioritization of repairs will need to occur post EQ

Given the predicted restoration periods for critical facilities, if the CSZE M9.0 were to happen in the near future, there also appears to be a need to seismically upgrade storage reservoirs. Some of the City's storage tanks are welded steel tanks and not anchored to the foundation. Recommendations for tank anchorage are included in Table 8-11 and are prioritized in order of replacement in Chapter 9.

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Per conversations with the City, Broadway Reservoir and AM Reservoir have had seismic valves added. Also, the Maple PS has a control that shuts the pumps off if a seismic event occurs and Maple Reservoir has flexible joints. It is recommended to install seismic valves at the remaining high priority reservoirs including Maple, Wildwood, and Valley View. The City has subscribed and integrated an earthquake early warning system and control logic to its existing seismic valves at reservoir sites.

There are also pump station seismic upgrades recommended in Table 8-11 and priorities in order of replacement in Chapter 9. Though the North Albany PS would be the highest concern, other pump stations that pump to the prioritized storage tanks should also be addressed.

8.8 SUMMARY OF FINDINGS AND RECOMMENDATIONS

A summary of the seismic evaluation capital improvements projects recommended in this Chapter are listed in Table 8-11. A cost evaluation of each CIP project is provided in Chapter 9.

Table 8-11. Seismic Evaluation Capital Improvements Projects

Project Number	Project Name	Comments & Recommended Actions
N-SS-1	Vine Street Facilities Viability Study	In light of the condition and seismic concerns at the Vine Street WTP, and the extent of improvements at the Hydroelectric Facility and Canal, it is recommended for the City to perform a viability study to evaluate different alternatives for the future of the Vine St site. First, the viability study should include the alternative of Vine St WTP replacement with a new WTP. Project numbers N-SS-1A, N-SS-1B, etc. convey the many capital projects recommended at the existing Vine St WTP, if it is not decommissioned. The viability study should include an analysis of the cost of reactive maintenance at the existing Vine St WTP and the amount of extended lifetime from performing those projects compared to the cost and lifetime of a new WTP investment. The viability study should also consider the challenges and feasibility of replacing structures at Vine St WTP, due to their historical nature, and the phasing challenges if the Vine St WTP is able to remain in service while performing the major recommended upgrades. The viability study should look at multiple different locations for a new WTP and perform a cost-benefits analysis for each location. The viability study should refine assumptions with a new WTP and update the cost estimate. Next, the hydroelectric facility should be evaluated. A generator inspection should be performed and identify estimated generator upgrade costs. The study should update the expected cost of improvement at the Hydroelectric facility and refine the return-on-investment analysis. The viability study should also include the alternative to decommission the hydroelectric facility and what to do with non-consumptive water rights. Then, impacts to the canal should be considered in the viability study. Different locations of a WTP may impact the flow and required repairs of the Canal, which should be evaluated. Also, the decision to potentially decommission the Hydroelectric Facility may also have an impact on canal flows and repairs which should be encompassed. The study should determine if recommendations for repairs and remediation to the Canal will change with different alternatives and the cost impacts associated. Last, as the City considers replacement alternatives for of the Vine St WTP, there may be an opportunity to consolidate some of the Zone 1 storage and pumping into a single location by decommissioning the Maple, Queen, and 34th reservoirs and pump stations and constructing an equivalent storage volume and pumping capabilities at a new WTP site. The option of Zone 1 consolidation is recommended for further hydraulic and cost evaluation as part of the Vine St. viability study.
N-SS-1A	Vine Street WTP: Raw Water Pump Station Replacement (Supports the need for Project N-SS -1)	Nearly every aspect of the Raw Water Pump Station's primary structural system does not comply with current structural standards. Prepare for replacement of this structure. A seismic retrofit for a structure of this age and type is not appropriate for this essential facility.
N-SS-1B	Vine Street WTP: Hydroelectric Building Replacement (Supports the need for Project N-SS -1)	Nearly every aspect of the Hydroelectric Building's primary structural system does not comply with current structural standards. Prepare for replacement of this structure. A seismic retrofit for a structure of this age and type is not appropriate for this essential facility.
N-SS -1C	Vine Street WTP: Control Building/ Chemical Storage Building Replacement (Supports the need for Project N-SS -1)	The concrete lintel over the south door opening does not have adequate reinforcing bars to resist the loads that it may need to resist during a seismic event. Also, the existing reinforcing bars in the concrete walls from 1963 are not appropriately detailed at the narrow wall piers along the south wall. Prepare for replacement of this structure. A seismic retrofit for this structure would be very difficult and might not be appropriate for this essential facility.
N-SS -1D	Vine Street WTP: Soda Ash Building Replacement (Supports the need for Project N-SS -1)	Nearly every aspect of the Soda Ash Building's primary structural system does not comply with current structural standards. Prepare for replacement of this structure. A seismic retrofit for a structure of this age and type is not appropriate for this essential facility.
N-SS -1E	Vine Street WTP: Filters 1-6 Building Replacement (Supports the need for Project N-SS -1)	Nearly every aspect of the Filter 1-6 Building's primary structural system does not comply with current structural standards. Prepare for replacement of this structure. A seismic retrofit for a structure of this age and type is not appropriate for this essential facility.
N-SS -1F	Vine Street WTP: Filters 7-10 Building Replacement (Supports the need for Project N-SS -1)	The original documents for the Filters 7-10 building do not note or detail any steel reinforcing bars. The unknown condition is a concern for this structure to resist seismic forces. It is a concern if the roof/floor to wall connections' has the ability to transfer seismic forces. It is likely that any existing reinforcing bars in the concrete walls are not appropriately detailed at the narrow wall piers. It is likely that any existing reinforcing bars in the concrete walls are not appropriately detailed at openings. It is a concern if the walls have adequate reinforcing bars doweled into the foundation elements. The concrete lintels over the lower levels likely do not have adequate reinforcing bars to resist the loads that it may need to resist during a seismic event. Prepare for replacement of this structure. A seismic retrofit for a structure of this age and type is extremely difficult and not appropriate for this essential facility.
N-SS -1G	Vine Street WTP: Accelator 1 Foundation (Supports the need for Project N-SS -1)	The perimeter concrete walls of the structure are supported by a perimeter ring of concrete columns creating a discontinuity for seismic forces. The center of the accelator slopes to the center creating an irregular load path for seismic forces. Infill the accelator concrete walls between the perimeter columns to provide a continuous load path for seismic forces. It is unclear if the foundations of the perimeter concrete columns are tied together and to the center of the accelator. The untied elements may separate during a seismic event. Add concrete footings and walls between the perimeter columns and center foundation.
N-SS -1H	Vine Street WTP: Accelator 2 Foundation (Supports the need for Project N-SS -1)	The Vine Street WTP Accelator 2 is not bolted to the foundation and relies on friction between the steel and concrete. Maintenance of steel wall is recommended. Consider adding anchor bolts capable of resisting uplift and sliding seismic forces. Clean and remove moss, mold and rust then maintain tank coating.
N-SS -1I	Vine Street WTP: Elevated Pipes and Cables (Supports the need for Project N-SS -1)	There are several elevated pipes and cable trays spanning between different structures. These elements present a falling hazard during a seismic event, particularly when located near egress areas. They also tie structures together, preventing them from moving independently. Elevated pipes and cable trays should be relocated to ground level or retrofitted to allow differential movement of the structure they are spanning between.

Table 8-11. Seismic Evaluation Capital Improvements Projects		
Project Number	Project Name	Comments & Recommended Actions
N-SS -1J	Vine Street WTP: Unreinforced Brick Parapet (Supports the need for Project N-SS -1)	There are multiple structures at Vine Street WTP that have an unreinforced brick parapet wall elements, which project above the roof, present a falling hazard during a seismic event particularly when located over areas of egress. The structures include the Raw Water Pump Station, Hydroelectric Building, Soda Ash Building, and Filters 1-6. It is recommended that the unreinforced brick parapets be removed so that the walls do not project above the roof, or they should be laterally braced to the roof framing for seismic & wind forces.
N-SS -1K	Vine Street Geotechnical Study	Preliminary evaluation has shown that the liquefaction and lateral spread hazards are low at the Vine Street WTP site, but exploratory drilling on site and analysis would be needed to confirm. The mapped landslide hazard corresponds to the ±45-foot-tall steep slope (slope ≥ 1.5H:1V) between the facility and the Calapooia River. If Vine Street WTP not replaced as recommended, or if Maple St Reservoir and Pump station remain in service long-term, exploratory drilling and analysis is recommended to confirm the subsurface conditions and evaluate the seismic-induced landslide hazard.
N-WTP-11	Vine Street WTP Chemical Tank Anchorage	Chemical storage tanks should have clips bolted to the concrete slab to prevent lateral movement and overturning during a seismic event.
N-S-1	Maple Street Reservoir Anchor Bolts	The steel tank reservoir is not bolted to the concrete foundation and may slide or overturn during a seismic event. Bolt the steel tank to the concrete foundation.
N-S-4	Maple, Wildwood, and Valley View Reservoirs Seismic Valves	It is recommended to install seismic valves at the remaining high priority reservoirs including Maple, Wildwood, and Valley View.
B-PS-1	Maple Street High Service Pump Station	It is unknown if during the seismic retrofit if the roof diaphragm was properly connected to the perimeter walls to transfer in-plane seismic forces. During a maintenance re-roofing project for this building, upgrade the roof to wall connection.
NA, Classified as Maintenance	AM WTP Reservoir Wall Thickness	The thickness of the concrete walls were found to be less than that recommended by the checklists, however due to the recent design & construction of the reservoir wall, the thickness was likely determined adequate by the engineer responsible for the design. Perform regular evaluation and maintenance.
L-S-1	34th Street Reservoir Anchor Bolts	The steel tank reservoir is not bolted to the concrete foundation and may slide or overturn during a seismic event. Bolt the steel tank to the concrete foundation
M-PS-2	34th Street Pump Station Roof Connection	The exterior masonry walls are not adequately connected to the roof diaphragm to transfer out-of-plane seismic forces. The connection between the walls and roof diaphragm puts the wood ledgers into cross-grain bending during a seismic event. Continuous cross ties between exterior walls or diaphragm chords are not present perpendicular to the roof joists. The span of the wood decking roof diaphragm exceeds allowable limits. The anchors connecting wood elements to the masonry walls are not stiff enough to remain within allowable limits. Perform a detailed seismic analysis of this structure and prepare to upgrade the roof diaphragm, roof to wall connections.
M-PS-1A	Gibson Hill Pump Station Anchor Bolts (Supports the need for Project M-PS-1, CH 6)	Project M-PS-1A supports the need for project M-PS-1, Gibson Hill PS Replacement, referenced in Chapter 6 and 9. No hold down hardware and anchor bolts are visible or shown on the existing drawings. Remove finishes and provide appropriate hold down anchors. If these connections are not present, provide the appropriate hold downs and sill bolts.
L-S-2	Queen Avenue Reservoir Anchor Bolts	The steel tank reservoir is not bolted to the concrete foundation and may slide or overturn during a seismic event. Bolt the steel tank to the concrete foundation.
M-PS-3	Queen Avenue Pump Station Roof Connection	It is unclear if the exterior masonry walls are adequately connected to the roof diaphragm to transfer out-of-plane seismic forces. It is unclear if the roof diaphragm is properly connected to the perimeter walls to transfer in-plane seismic forces. During a maintenance re-roofing project for this building, upgrade the roof to wall connection.
M-S-2	Valley View Reservoirs Anchor Bolts	The steel tank reservoirs are not bolted to their concrete foundations and may slide or overturn during a seismic event. It is recommended that all steel tanks be bolted to their concrete foundations or prepare to replace the reservoirs.
N-PS-2A	North Albany Pump Station (Supports the need for Project N-PS-2, CH 6)	Project N-PS-2A supports the need for Project N-PS-2, North Albany Pump Statin Replacement. The Pump Station is noncompliant for nearly all of the items on the ASCE/SEI 41-17 Checklist for this building type. There is cracking at several locations at exterior of building walls. The corner of the structure appears to be rebuilt but not finished at interior pump station. Prepare for replacement of this structure.
N-D-5	Lyons Street Bridge Crossing Seismic Isolation Valves	Install isolation valves at each end of the Lyons bridge 24-pipeline as a mitigation measure or potential seismic damage. When ODOT replaces the bridge, or seismically upgrades the bridge, an effort to reinforce or replace the 24-inch main should occur at that time.
M-SS-1	Emergency Water Supply Plan	It is recommended that the City conduct an emergency water supply plan specifically for North Albany service area, which is dependent on two river crossings for water supply. This plan should investigate ground water opportunities as an emergency source in North Albany, as well as other potential tactics to help supply provisional water after a disaster.

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8.9 REFERENCES

American Lifelines Alliance, 2001. *Seismic Fragility Formulations for Water Systems*. June 2001.

Creegan and D'Angelo Infrastructure Engineers. *Vine Street Water Treatment Plant Seismic Assessment and Retrofit Strategy Report*. June 2008.

Oregon Seismic Safety Policy Advisory Commission, 2013. *The Oregon Resilience Plan*. February 2013.

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CHAPTER 9
Recommended Capital Improvement Program

This chapter presents the recommended CIP for the City's water treatment plants, pump stations, reservoirs, and distribution system based on this Water Master Plan for the period of 2024 to 2043 and for some projects beyond 2043. Along with a summary of the recommended capital improvements projects, this chapter provides estimates of probable construction costs.

The following sections of this chapter summarize the cost estimating methodology and present the CIP to address existing system deficiencies and future growth.

9.1 COST ASSUMPTIONS

Probable construction and capital estimates are developed individually for each proposed improvement project. It should be noted that the recommended CIP only identifies improvements at a master plan level and does not necessarily include all required on-site infrastructure or provide design of improvements.

In accordance with Association for the Advancement of Cost Engineering International (AACE) criteria, the estimates developed for the proposed capital improvements are Class 5 estimates. A Class 5 estimate is defined as a conceptual-level or project viability estimate. Typically, design engineering is from 0 to 2 percent complete. Class 5 estimates are used to prepare planning-level cost scopes or evaluation of alternatives and long-range capital outlay planning. Expected accuracy for class 5 estimates typically ranges from –50 to +100 percent. Subsequent detailed design is required to determine the exact sizes and locations of these recommended improvements.

Construction costs are presented in dollars based on an Engineering News Record (ENR) Construction Cost Index (CCI) of 15,107 for Seattle March 2023. The Seattle ENR CCI was selected instead of the 20-Cities ENR because it reflects the change in the cost of construction for the northwest. The City uses the Seattle ENR CCI to apply inflationary impacts to construction costs. Construction costs were developed based on bids on other water facilities for the design projects and from standard cost estimating guides. For the capital cost, a 60 percent markup is applied: 30 percent for contingency and 30 percent for engineering, legal, and administration costs. Table 9-1 presents the markups to an example project to attain the capital costs.

Table 9-1. Project Related Capital Cost Markups

Cost Component	Percent	Cost, dollars
Subtotal Construction Costs[(a)]		**$1,000,000**
Capital Cost Markups		
Contingency	30	300,000
Engineering, Legal, Administration Costs	30	300,000
Total Project Cost Allowances		**$600,000**
Estimated Total Project Cost		**$1,600,000**

(a) Assumed cost of an example project.

For this Water Master Plan, it is assumed that recommended distribution system facilities will be developed in public right-of-way or on public property, therefore; land acquisition costs have not been included. The construction and capital cost estimates also do not include costs for annual operation and maintenance. A full description of the assumptions used in the development of the cost estimates is provided in Appendix C, Basis for Cost Estimating Technical Memo. System Development Charges and funding of CIP projects will be determined in the City financial plan.

9.2 ENVIRONMENTAL IMPACTS

In general, potential environmental impacts and necessary mitigation related to projects are recommended to be investigated during more detailed project design and planning. The majority of project recommendations at existing sites are expected to have little to no impacts to the surrounding environment. For potential projects at new undeveloped sites, an environmental impact report is recommended. Some notable projects recommended for further investigation of environmental impacts include canal dredging, added security fencing, and the Vine St viability study.

9.3 RECOMMENDED CAPITAL IMPROVEMENT PROGRAM

This section presents a summary of the recommended capital improvement program to address existing deficiencies and future growth as described throughout the Water Master Plan. Projects were assigned one of the four following planning terms:

- Near-term: 2024 to 2028 (“N-” prefix)
- Medium-term: 2029 to 2033 (“M-” prefix)
- Long-term : 2034 to 2043 (“L-” prefix)
- Buildout-term: 2044 to UGB Buildout (Approx. 2070)(“B-” prefix)

This WMP focuses on the next 20-year horizon but includes project identified for the buildout phase. Projects identified in the buildout phase should be reevaluated during the next water master plan update. The project trigger, estimated start year, estimated completion year, and project driver are also listed for each project. Project planning and budgeting should be initiated early enough to finish engineering and construction by the completion year or trigger listed. An alignment/siting study should be performed for each project to determine the most cost-effective approach to achieve the stated purpose of the project.

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9.3.1 Canal CIP

Chapter 7 of this WMP summarizes the different CIP project recommendations along the 18.2-mile-long Santiam-Albany Canal. CIP projects were identified and have a cost estimate provided in this Chapter. Project No. N-C-1, High Priority Canal Projects, is a group of 41 canal sites that are recommended for high priority repair spread out over the next 20-year period.

Similarly, Project No. B-C-1, Medium and Low Priority Canal Projects, is another group of 136 canal sites proposed for repair in the buildout-term. These two canal projects costs assume that projects will be grouped together so that the total project length is at least 100 ft to avoid a “small project” premium. Other projects include retaining wall repair and dredging within the downtown blocks of the canal, further analysis of the Cheadle Lake Berm, a Canal Adaptive Management Plan, and added security fencing and fall protection at a few sites. A summary of the Canal CIP projects and costs are presented in Table 9-2.

The Vine Street viability study introduced in previous chapters should explore different future alternatives for the Vine Street site and should consider impacts to the canal. The decommissioning or replacement of the Vine Street WTP and hydroelectric facility may affect the canal flow, project recommendations, repair methods, and associated costs.

9.3.2 Hydroelectric Power CIP

The hydroelectric turbine was evaluated in Chapter 7 for repairs with the main issue being the corrosion of the wicket gate system. Other recommended repairs include installing a spiral case cleanout, blasting, and recoating of the interior of the turbine, generator inspection, changes to the trash rack, flow meter, and hydraulic power unit. CIP projects were identified and are shown in Table 9-3 along with cost estimates.

The Vine Street viability study should include evaluation of the future of the hydroelectric facility. A generator inspection should be performed and identify estimated generator upgrade costs. Then, the study should update the expected CIP cost at the Hydroelectric Facility and refine the initial return-on-investment analysis presented in this WMP. The viability study should also include the alternative to decommission the hydroelectric facility and what to do with non-consumptive water rights.

An initial return-on-investment analysis was performed as part of this WMP by comparing the total Hydropower CIP cost against the expected power generation revenue provided by the City to determine if the investment is economical for the City. Table 9-4 presents anticipated costs for power purchased by Pacific Power as contained in their Oregon Standard Avoided Cost Rates schedule. The table shows the price in cents/kWh for both peak and off-peak demands is reduced from 2025 to 2026 and then gradually increases each year to 2040.

Table 9-2. Recommended Canal CIP Projects [(a)]

Project Number	Project Name	Trigger	Estimated Start Date	Estimated Completion Date	Project Driver	Project Purpose and Description	Estimated Cost			
							Construction Cost	Capital Cost	Capital Cost, Range Low (-50%)	Capital Cost, Range High (+100%)
N-C-1	High Priority Canal Projects	Existing need	2024	2043	Condition	A total of 41 canal sites were identified as a high priority. The proposed budget for the canal repairs the high priority sites over the next 20-years. Each canal site was assigned a repair strategy for cost estimating. The capital cost of the high priority project repairs is $9,816,000.	$6,140,000	$9,820,000	$4,910,000	$19,700,000
B-C-1	Medium & Low Priority Canal Projects	Existing need	2044	2070	Condition	A total of 27 canal sites were identified as medium priority and 109 canal sites were identified as a low priority and assigned a repair strategy for cost estimating. The total capital cost of the medium priority projects is $3,048,000 and the low priority repairs is $16,921,000, for a total capital cost of $19,969,000. It is recommended that this project be re-evaluated during the next WMP update.	$12,500,000	$20,000,000	$10,000,000	$40,000,000
N-C-2	Canal Bank Repair (Retaining Wall Improvements) from 4th to 6th Avenue	Existing need	2024	2025	Condition	This is an existing project the City is currently planning for 2024, and is listed here for reference. The retaining wall in the canal between 4th and 6th avenue needs repairing and is estimated by the City in to have a capital cost of $1,300,000. This project cost is not included in the WMP CIP budget because it is already included in the City budget for 2024-2028 CIP projects.	NA	NA	NA	NA
M-C-1	Canal Retaining Wall Improvements from 6th to 7th Avenue	Existing need	2029	2030	Condition	The retaining wall in the canal between 6th and 7th Avenue needs repairing. The City provided the repair cost of $2,500 per foot. The distance between the blocks was measured as 225 feet on each side which totals 450 feet of repair.	$1,130,000	$1,810,000	$910,000	$3,620,000
M-C-2	Canal Retaining Wall Improvements from 7th to 8th Avenue	Existing need	2031	2032	Condition	The retaining wall in the canal between 7th and 8th Avenue needs repairing. The City provided the repair cost of $2,000 per foot. The distance between the blocks was measured as 250 feet on each side which totals 500 feet of repair.	$1,000,000	$1,600,000	$800,000	$3,200,000
L-C-1	Canal Retaining Wall Improvements from 14th to Queen Avenue	Existing need	2034	2036	Condition	The retaining wall in the canal between 14th and Queen Avenue needs repairing. The City provided the repair cost of $2,000 per foot. The distance between the blocks was measured as 910 feet on each side which totals 1820 feet of repair.	$3,640,000	$5,820,000	$2,910,000	$11,700,000
N-C-3	Added Security Fencing/ Fall Protection	Existing need	2025	2027	Condition	A few sites were identified for installation of security fencing and/or fall protection including 1 Crown Zellerbach gates, 2 Albany Gates, 3 Periwinkle Creek Diversion, 4 34th Ave Debris Screen, 5 Vine St Intake Bar Screen.	$40,000	$64,000	$32,000	$130,000
N-C-4	Canal Adaptive Management Plan	Existing need	2024	2043	Condition	A key component of the AMP would be development and implementation of a long-term plan to monitor key locations in the canal and collect regular, high-quality survey data to identify and quantify degradational or aggradational trends, which will better inform the need for grade control structures to be included in future CIPs. The costs presented assume that the AMP will require monitoring every 5 years for the next 20 years.	NA	$100,000	$50,000	$200,000

Table 9-2. Recommended Canal CIP Projects [(a)]

Project Number	Project Name	Trigger	Estimated Start Date	Estimated Completion Date	Project Driver	Project Purpose and Description	Estimated Cost: Construction Cost	Estimated Cost: Capital Cost	Estimated Cost: Capital Cost, Range Low (-50%)	Estimated Cost: Capital Cost, Range High (+100%)
N-C-5	Cheadle Lake Berm Geotechnical Analysis	Existing need	2024	2025	Condition	It is recommended to conduct additional geotechnical work including exploratory drilling and analysis to evaluate the stability of the berm for both static and seismic loading conditions.	NA	$45,000	$23,000	$90,000
N-C-6	Near-Term Canal Dredging	Existing need	2025	2026	Condition	This is an existing project the City is currently planning for 2025, and is listed here for reference. The City dredges the downtown area (starting at Vine St WTP south approximately 4,300 feet) of the canal. This project will include removal of sedimentation, plants and other debris required to maintain the capacity and mitigate flooding of adjacent properties. The 2024-2028 Capital Improvement Program included a capital cost of $900,000.	NA	$900,000	$450,000	$1,800,000
M-C-3	Medium-Term Canal Dredging	Future Need	2030	2031	Condition	The City dredges the downtown area (starting at Vine St WTP south approximately 4,300 feet) of the canal. This project will include removal of sedimentation, plants and other debris required to maintain the capacity and mitigate flooding of adjacent properties. The 2024-2028 Capital Improvement Program included a cost of $900,000.	NA	$900,000	$450,000	$1,800,000
L-C-2	Long-Term Canal Dredging	Future Need	2035	2036	Condition	The City dredges the downtown area (starting at Vine St WTP south approximately 4,300 feet) of the canal. This project will include removal of sedimentation, plants and other debris required to maintain the capacity and mitigate flooding of adjacent properties. The 2024-2028 Capital Improvement Program included a cost of $900,000.	NA	$900,000	$450,000	$1,800,000
N-C-7	Lebanon Intake Structure Modification Evaluation	Existing need	2025	2026	Condition	With the recent relocation of the City of Lebanon’s water treatment plant off the canal, the intake diversion structure is no longer needed to create backwater to divert to Lebanon’s treatment plant and it could potentially be modified in such a way to lower upstream water surface elevations and reduce flood risk from potential embankment failures. Two potential alternatives were identified for modification. Further evaluation of the preliminary alternatives is recommended.	NA	$50,000	$25,000	$100,000
						Capital Improvement Program Total:	**$24,500,000**	**$42,000,000**	**$21,000,000**	**$84,100,000**

(a) Costs are based on March 2023 ENR CCI of 15,107 (Seattle).

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Table 9-3. Recommended Hydropower CIP Projects[(a)]

Project Number	Project Name	Trigger	Estimated Start Date	Estimated Completion Date	Project Driver	Project Purpose and Description	Estimated Cost: Construction Cost	Estimated Cost: Capital Cost	Estimated Cost: Capital Cost, Range Low (-50%)	Estimated Cost: Capital Cost, Range High (+100%)
N-H-1	Vine St Hydropower Generator Inspection and Contingency	Existing need	2024	2025	Condition	The generator requires inspection which should come before the utilization analysis to assess any further upgrades required for operation. This project includes the inspection, approximately $40,000, and contingency , approximately $400,000, for possible recommended upgrades.	NA	$440,000	$220,000	$880,000
N-H-2	Vine St Hydropower Operational Data & Turbine Utilization Analysis	Existing need	2024	2025	Condition	Preliminary evaluation indicates that the combined turbine system efficiency can be improved anywhere from 4.3 percent to 26.5 percent with a newly designed runner and wicket gates. Additional analysis is recommended to determine the root causes of turbine down time when canal flow would otherwise allow for generation.	NA	$8,500	$4,000	$17,000
N-H-3	Vine St Hydropower Combined Upgrades (Wicket Gates, Bearings, Spiral Case Cleaning, Blast and Coat Turbine, & Contingency)	Existing need	2026	2027	Condition	The upgrades are grouped together because they all require the disassembly and reassembly of the turbine. Upgrades include wicket gate replacement, bearing replacement, and spiral case flange for cleaning. It also includes the inspection, blasting, and coating of the interior of the turbine and contingencies for welding repairs, approximately $100,000, and shop repairs, approximately $75,000.	$1,120,000	$1,790,000	$900,000	$3,580,000
N-H-4	Vine St Hydropower Turbine Hydraulic Power Unit	Existing need	2026	2027	Condition	The HPU has some design/build characteristics which make it unintuitive to use and maintain. It is apparent that the hydraulic pump(s) run continuously during operation of the turbine while other HPU designs run only when needed, thus saving a considerable amount of energy over the lifespan of the unit. It is recommended that the current HPU be replaced with one of newer design.	$163,000	$261,000	$131,000	$522,000
N-H-5	Vine St Hydropower Turbine Personnel Training	Existing need	2027	2027	Condition	The controls system has several project specific peculiarities that make the human machine interface (HMI) un-intuitive to operate and appear to be sources of confusion. It is recommended that the controls system be reviewed by a professional and that a training session be held to familiarize the users with the architecture and operation of the system.	NA	$8,500	$4,000	$17,000
N-H-6	Vine St Hydropower Intake and Trash Rack Evaluation	Existing need	2027	2027	Condition	It is recommended to perform further investigation of the hydropower intake and trash rack for the potential to improve generation time and decrease maintenance costs.	NA	$15,000	$8,000	$30,000
						Capital Improvement Program Total:	**$1,280,000**	**$2,520,000**	**$1,270,000**	**$5,050,000**

(a) Costs are based on March 2023 ENR CCI of 15,107 (Seattle).

Table 9-4. Pacific Power Avoided Cost Prices		
	Peak	Off-Peak
Year	Cents/kWh	Cents/kWh
2024	11.54	7.46
2025	11.41	7.68
2026	5.72	3.37
2027	6.04	4.01
2028	6.22	4.145
2029	6.39	4.28
2030	6.47	7.31
2031	6.69	4.49
2032	9.96	4.71
2033	7.17	4.87
2034	7.4	5.04
2035	7.49	5.09
2036	7.65	5.19
2037	7.95	5.44
2038	8.25	5.69
2039	8.54	5.93
2040	8.88	6.2

Using the Pacific Power costs in Table 9-4, the approximate revenue from the Hydropower facility was calculated by the City based on past data. Using average data of 2020-2023, while the hydropower energy generation was lower, the projected cumulative revenue for 17 years (to 2040) is $600,000. Using the average data from 2012 to 2023, with higher overall hydropower energy generation, the projected cumulative revenue over the next 17 years is $1,094,000, see Figure 9-1.

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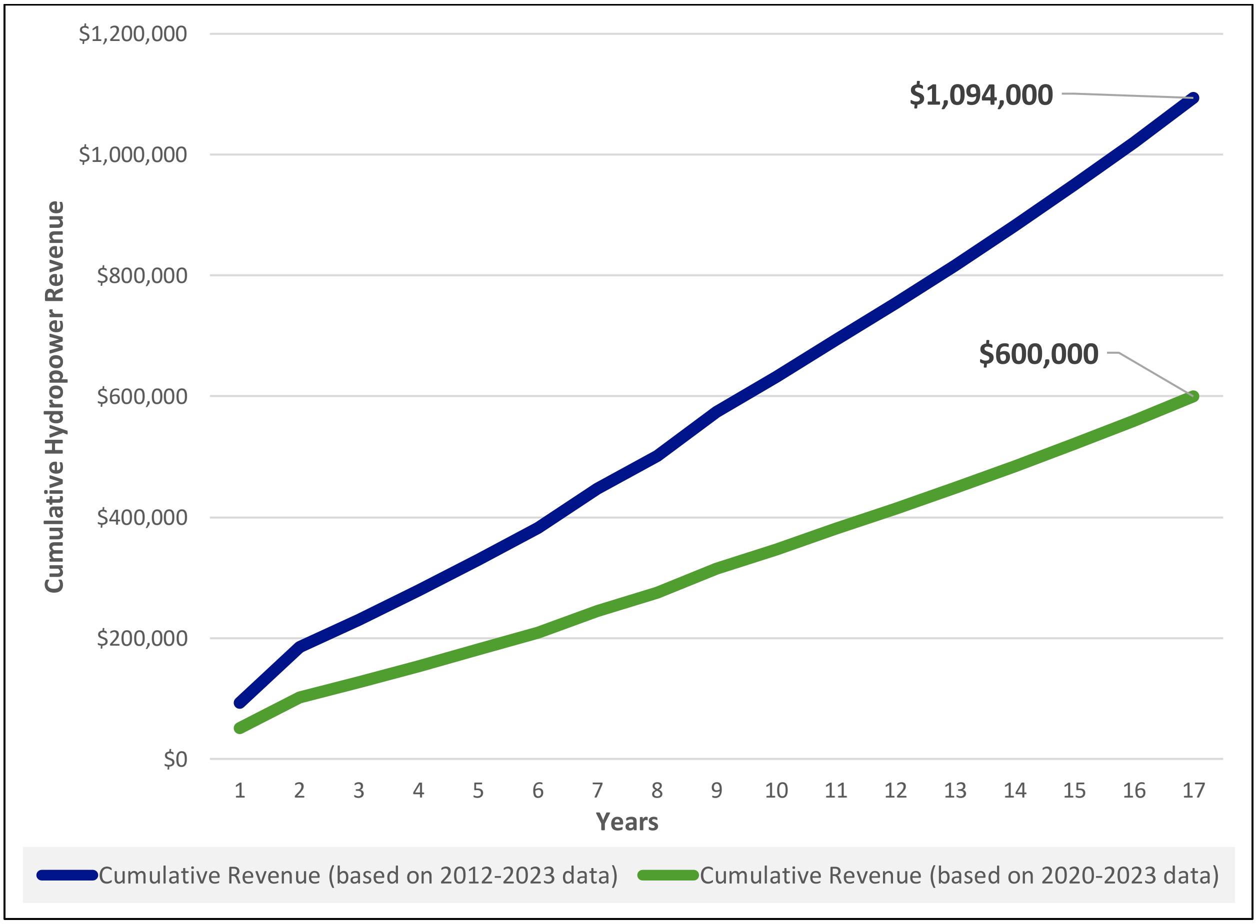

Figure 9-1. Hydropower Revenue Projections

Based on preliminary analysis in the hydroelectric turbine analysis, the energy generation could be improved anywhere from 4.3 to 26.5 percent if the recommended improvements are performed. Assuming the maximum 26.5 percent increase applied to the more recent revenue projection of $600,000, the revenue would increase to $759,000. Ultimately, the maximum revenue projections do not appear that to cover the estimated expenses in the Hydropower CIP. The utilization evaluation suggests that the City may invest more in repairs than it will earn back in revenue. As mentioned above, it is recommended that the viability study, re-evaluate the return-on-investment of the Hydroelectric facility after performing a generator inspection and refining the cost of generator improvements.

9.3.3 Water System CIP

Chapters 6, 7, and 8 include the recommended projects for the water system. The list below summarizes different categories of recommended projects for the City:

- **Vine Street Facilities Viability Study**: The existing Vine Street WTP is over 110 years old. Chapter 6 describes that if the Vine Street WTP becomes unavailable, the AM WTP would become the only source for long term drinking water operations and the AM WTP at maximum capacity is unable to meet the projected 2045 MDD water demands. Chapter 7 evaluates the condition of the Vine Street WTP for structural, mechanical, civil, and electrical condition which identifies many areas of concern for condition. Chapter 8 provides a seismic evaluation of the Vine Street WTP noting that multiple structures do not comply with current structural standards and the structural engineer's professional opinion is that a seismic retrofit for multiple structures would be very difficult to perform and not appropriate due to the age and type of the essential facilities. Though Vine Street WTP has been well maintained over an extended lifetime, it is recommended that the City conduct a Vine Street Facility Viability Study which would evaluate different alternatives for the future of the canal along Vine Street, the hydroelectric facility, and Vine Street WTP. Different alternatives should be considered for environmental impacts.

- **Vine Street WTP Improvements:** Recommendations to the existing Vine Street WTP only address immediate needs, without improving performance or addressing future condition related concerns. It is recommended to only make improvements necessary to keep the Vine Street WTP operating efficiently at its existing capacity until the Vine Street Facilities Viability Study (Project #N-SS-1) is complete and a final course of action is determined for the plant. If the Vine St WTP is determined to remain in service, project numbers N-SS-1A, N-SS-1B, etc. convey the capital projects recommended at the existing Vine St WTP. The costs associated with Vine Street WTP improvements are not included in the CIP due to the viability study recommendation.

  AM WTP: The main improvements recommended at the AM WTP are to increase capacity by adding a 5th cell for filtration and increasing the number of membranes in each cell at the next replacement cycle. The added capacity at the AM WTP helps the City prepare for the future water demands which are projected to increase over time. Other project recommendations include adding seismic straps to chemical tanks, repairing neutralization basin concrete, replacing the filter cell header pipes, adding a redundant clean-in-place pump, and replacing the raw water pump station valves that have had issues isolating. A future optional project could be to install a sodium hypochlorite generation system.

- **Storage Reservoirs:** Storage reservoirs including Maple Street, 34th Street, Valley View, and Queen Avenue reservoirs have recommendations to secure reservoir foundations to the tank structure to add seismic resilience. Maple Street and Queen Avenue reservoirs are recommended for recoating to protect against corrosion. It is recommended to perform further investigations of the Maple Street reservoir baffle and in the build-out term, it is anticipated that a new North Albany storage tank will be required. Chapter 6 mentions the possibility of consolidating Zone 1 storage by decommissioning Maple, St, 34th Street, and Queen Avenue sites if a new WTP with adequate storage is built which is recommended for further hydraulic evaluation as part of the Vine St facilities viability study.

- **Pump Stations:** The highest priority pump station recommendation is the replacement of the North Albany PS. The North Albany PS has capacity, seismic, and condition concerns that make it recommended for replacement near-term. Around 2030, the Gibson Hill PS is also recommended for replacement due to future capacity and existing seismic concerns. Other pump station recommendations include upgrading the roof to wall connection at the Maple Street, 34th Street, and Queen Avenue PSs. Finally, at Valley View PS there is an optional project to address the undersized hydropneumatic tank and a PS retrofit to add hold downs and sill anchors. Chapter 6 mentions the possibility of consolidating Zone 1 storage/pumping by decommissioning Maple Street, 34th Street, and Queen Avenue sites if a new WTP with adequate storage and pump station is built. The option to consolidate Zone 1 pumping is recommended for further hydraulic evaluation and viability analysis as part of the Vine Street facilities viability study.

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- **Distribution System Projects:** Chapter 6 covers the majority of the recommended projects to the distribution pipelines. Distribution projects are recommended for reasons including improvements to capacity, fire flow, condition, and development-driven projects. East Albany development driven projects were assumed to take place in the medium-term horizon, South Albany development driven projects were assumed to take place in the long-term horizon, and fire flow improvement projects were assumed to take place in the medium-term horizon.
- **Pipeline Replacement Program:** The pipeline replacement program in Chapter 7 presents the recommended annual cost for the next 20-years to replace the highest priority pipes in the distribution system. The annual costs are used in the CIP to create a near-term, medium-term, and long-term CIP project that covers the pipeline replacement budget.
- **Supplemental Studies:** The Vine Street Facility Viability Study is recommended to explore options of the Canal, Hydroelectric facility, and Vine Street WTP. It is also recommended to perform another water system master plan evaluation in the next 20-year period per OAR 333-061-0060 (Project L-SS-1). Additionally, an emergency water supply plan is recommended to explore developing an emergency raw water source for North Albany.

Table 9-5 provides details for each individual water system CIP project proposed and Appendix D provides project summary sheets of water system CIP project recommendations.

Table 9-5. Recommended Water System CIP Projects[a]

Project Number	Project Name	Trigger	Estimated Start Date	Estimated Completion Date	Project Driver	Project Purpose and Description	Estimated Cost Construction Cost	Capital Cost	Capital Cost, Range Low (-50%)	Capital Cost, Range High (+100%)
VINE ST Site										
N-SS-1	Vine St Facilities Viability Study	Existing Need	2025	2026	Planning	In light of the condition and seismic concerns at the Vine Street WTP, and the extent of improvements at the Hydroelectric Facility and Canal, it is recommended for the City to perform a viability study to evaluate different alternatives for the future of the Vine St site. First, the viability study should include the alternative of Vine St WTP replacement with a new WTP. Project numbers N-SS-1A, N-SS-1B, etc. convey the many capital projects recommended at the existing Vine St WTP, if it is not decommissioned. The viability study should include an analysis of the cost of reactive maintenance at the existing Vine St WTP and the amount of extended lifetime from performing those projects compared to the cost and lifetime of a new WTP investment. The viability study should also consider the challenges and feasibility of replacing structures at Vine St WTP, due to their historical nature, and the phasing challenges if the Vine St WTP is able to remain in service while performing the major recommended upgrades. The viability study should look at multiple different locations for a new WTP and perform a cost-benefits analysis for each location. The initial evaluation done as part of this WMP suggests that a new is approximately $87,500,000 capital cost as detailed further on the project cut sheet in Appendix D. The viability study should refine assumptions with a new WTP and update the cost estimate. Next, the hydroelectric facility should be evaluated. A generator inspection should be performed and identify estimated generator upgrade costs. The study should update the expected cost of improvement at the Hydroelectric facility and refine the return-on-investment analysis. The viability study should also include the alternative to decommission the hydroelectric facility and what to do with non-consumptive water rights. Then, impacts to the canal should be considered in the viability study. Different locations of a WTP may impact the flow and required repairs of the Canal, which should be evaluated. Also, the decision to potentially decommission the Hydroelectric Facility may also have an impact on canal flows and repairs which should be encompassed. The study should determine if recommendations for repairs and remediation to the Canal will change with different alternatives and the cost impacts associated. Last, as the City considers replacement alternatives for of the Vine St WTP, there may be an opportunity to consolidate some of the Zone 1 storage and pumping into a single location by decommissioning the Maple, Queen, and 34th reservoirs and pump stations and constructing an equivalent storage volume and pumping capabilities at a new WTP site. The option of Zone 1 consolidation is recommended for further hydraulic and cost evaluation as part of the Vine St. viability study.	NA	$750,000	$375,000	$1,500,000
Projects Supporting Project N-SS-1										
N-SS-1A	Vine St WTP Raw Water Pump Station Replacement (Supports the need for Project N-SS-1)	Existing need	2025	2026	Seismic/ Condition	The Vine St WTP Raw Water Pump Station is noncompliant for nearly all of the items on the ASCE/SEI 41-17 Checklist for this building type. Prepare for replacement of this structure. A seismic retrofit for a structure of this age and type is not appropriate for this essential facility.	NA	NA	NA	NA
N-SS-1B	Vine St WTP Hydroelectric Building Replacement (Supports the need for Project N-SS-1)	Existing need	2025	2026	Seismic/ Condition	The Vine St WTP Hydroelectric Building is noncompliant for nearly all of the items on the ASCE/SEI 41-17 Checklist for this building type. Prepare for replacement of this structure. A seismic retrofit for a structure of this age and type is not appropriate for this essential facility.	NA	NA	NA	NA
N-SS-1C	Vine St WTP Control Building/ Chemical Storage Building Replacement (Supports the need for Project N-SS-1)	Existing need	2025	2026	Seismic/ Condition	The Vine St WTP Control Building/Chemical Storage Building reinforcing bar details do not comply with recommended standards. A seismic retrofit to address the shortcomings identified by the ASCE/SEI 41-17 checklist would be very difficult to perform.	NA	NA	NA	NA
N-SS-1D	Vine St WTP Soda Ash Building Replacement (Supports the need for Project N-SS-1)	Existing need	2025	2026	Seismic/ Condition	The Vine St WTP Soda Ash Building is noncompliant for nearly all of the items on the ASCE/SEI 41-17 Checklist for this building type. Prepare for replacement of this structure. A seismic retrofit for a structure of this age and type is not appropriate for this essential facility.	NA	NA	NA	NA
N-SS-1E	Vine St WTP Filters 1-6 Building Replacement (Supports the need for Project N-SS-1)	Existing need	2025	2026	Seismic/ Condition	The Vine St WTP Filters 1-6 Building is noncompliant for nearly all of the items on the ASCE/SEI 41-17 Checklist for this building type. Prepare for replacement of this structure. A seismic retrofit for a structure of this age and type is not appropriate for this essential facility.	NA	NA	NA	NA
N-SS-1F	Vine St WTP Filters 7-10 Building Replacement (Supports the need for Project N-SS-1)	Existing need	2025	2026	Seismic/ Condition	The Vine St WTP, reinforcing bar details for the Filters 7-10 Building are unknown for the ASCE/SEI 41-17 Checklist for this building type. It is unlikely that any reinforcing bars are appropriately sized, spaced and placed. Prepare for replacement of this structure. A seismic retrofit for a structure of this age and type is extremely difficult for this essential facility.	NA	NA	NA	NA

Table 9-5. Recommended Water System CIP Projects[(a)]

Project Number	Project Name	Trigger	Estimated Start Date	Estimated Completion Date	Project Driver	Project Purpose and Description	Estimated Cost			
							Construction Cost	Capital Cost	Capital Cost, Range Low (-50%)	Capital Cost, Range High (+100%)
N-SS-1G	Vine St WTP Accelator 1 Foundation (Supports the need for Project N-SS-1)	Existing need	2025	2026	Seismic/ Condition	At Vine St WTP, the perimeter columns below the exterior walls of Accelator 1 create a vertical irregularity and weak lateral force resisting system at the base. Infill between the existing columns with a concrete wall footing to eliminate the vertical irregularity. Tie the foundations together. If executed, the construction cost of this project is estimated at $286,000. If this structure is planned for future decommissioning due to the new WTP, the City may choose not to implement this project.	NA	NA	NA	NA
N-SS-1H	Vine St WTP Accelator 2 Foundation (Supports the need for Project N-SS-1)	Existing need	2025	2026	Seismic/ Condition	The Vine St WTP Accelator 2 is not bolted to the foundation and relies on friction between the steel and concrete. Maintenance of steel wall is recommended. Consider adding anchor bolts capable of resisting uplift and sliding seismic forces. Clean and remove moss, mold and rust then maintain tank coating. If executed, the construction cost of this project is estimated at $603,000. If this structure is planned for future decommissioning due to the new WTP, the City may choose not to implement this project.	NA	NA	NA	NA
N-SS-1I	Vine St WTP: Elevated Pipes and Cables (Supports the need for Project N-SS-1)	Existing need	2025	2026	Seismic	There are several elevated pipes and cable trays spanning between different structures. These elements present a falling hazard during a seismic event, particularly when located near egress areas. They also tie structures together, preventing them from moving independently. Elevated pipes and cable trays should be relocated to ground level or retrofitted to allow differential movement of the structure they are spanning between.	NA	NA	NA	NA
N-SS-1J	Vine St WTP: Unreinforced Brick Parapet (Supports the need for Project N-SS-1)	Existing need	2025	2026	Seismic	There are multiple structures at Vine St WTP that have an unreinforced brick parapet wall elements, which project above the roof, present a falling hazard during a seismic event particularly when located over areas of egress. The structures include the Raw Water Pump Station, Hydroelectric Building, Soda Ash Building, and Filters 1-6. It is recommended that the unreinforced brick parapets be removed so that the walls do not project above the roof, or they should be laterally braced to the roof framing for seismic & wind forces.	NA	NA	NA	NA
N-SS-1K	Vine St WTP Geotechnical Study (Supports the need for Project N-SS-1)	Future Need	2025	2026	Seismic	Preliminary evaluation has shown that the liquefaction and lateral spread hazards are low at the Vine Street WTP site, but exploratory drilling on site and analysis would be needed to confirm. The mapped landslide hazard corresponds to the ±45-foot-tall steep slope (slope ≥ 1.5H:1V) between the facility and the Calapooia River. If Vine St WTP not replaced as recommended, or if Maple St Reservoir and Pump station remain in service long-term, exploratory drilling and analysis is recommended to confirm the subsurface conditions and evaluate the seismic-induced landslide hazard. If executed, the capital cost of this project is estimated at $75,000.	NA	NA	NA	NA
Other Vine St WTP Projects										
L-WTP-1	Vine St WTP Filters #7 & #8 Silica Sand Layer	Future Need	2041	2043	Performance (Optional)	In 2019, it was determined that Vine St WTP Filters #7 and #8 do not include silica media. The next time the anthracite media is replaced, it is recommended to consider adding silica sand to Filters #7 and #8.	$300,000	$480,000	$240,000	$960,000
M-WTP-1	Vine St WTP Filter Media Coring	Future Need	2029	2029	Performance	It is recommended to perform periodic coring at each filter to examine the full column of media closely.	$0	$50,000	$25,000	$100,000
M-WTP-3	Vine St WTP Raw Water Pump Station Pipes	Existing need	2033	2033	Condition	The Vine St WTP RWPS pipe coatings are chipping. Recoat pipes	$20,000	$32,000	$16,000	$64,000
N-WTP-3	Vine St WTP Backwash System Check Valves	Existing need	2027	2028	Condition	The Vine St WTP backwash system appears to have no check valves. Add check valves if possible.	$185,000	$300,000	$150,000	$600,000
N-WTP-4	Vine St WTP Backwash Pump Base	Existing need	2027	2028	Condition	The Vine St WTP large backwash pump has a cracked base. Confirm pump anchorage is secure.	$5,000	$8,000	$4,000	$16,000
M-WTP-4	Vine St WTP Raw Water Splitter Coating	Existing need	2033	2033	Condition	The Vine St WTP Raw Water Splitter (Diverter) is rusted. Recoat.	$30,000	$48,000	$24,000	$96,000
N-WTP-5	Vine St WTP Filter Gallery Pipes	Existing need	2026	2026	Condition	The Vine St WTP filter pipe gallery has rust and corrosion on piping. May need more pipe supports. Replace pipe or measure pipe thickness and recoat pipes as necessary. Add pipe supports within 2 feet of changes of direction, where practical.	$860,000	$1,380,000	$690,000	$2,760,000

Table 9-5. Recommended Water System CIP Projects[(a)]

Project Number	Project Name	Trigger	Estimated Start Date	Estimated Completion Date	Project Driver	Project Purpose and Description	Estimated Cost: Construction Cost	Capital Cost	Capital Cost, Range Low (-50%)	Capital Cost, Range High (+100%)
N-WTP-6	Vine St WTP Transfer Water Pump Station Pipes	Existing need	2026	2026	Condition	The Vine St WTP Transfer Water PS piping has rust. Appears to have no check valves. May need more pipe supports including lateral supports, may need more dismantling joints. Replace pipe or Measure pipe thickness and recoat as necessary. Add pipe supports within 2 feet of changes of direction, where practical. Add check valves and dismantling joints where practical.	$50,000	$80,000	$40,000	$160,000
N-WTP-7	Vine St WTP RWPS Flow Meter Vault Pipes	Existing need	2026	2026	Condition	The Vine St RWPS Flow Meter Vault piping has rust. Measure Pipe Thickness. Replace or recoat.	$5,000	$8,000	$4,000	$16,000
N-WTP-8	Vine St WTP RWPS Check Valves	Existing need	2028	2028	Condition	The Vine St WTP RWPS pumps have some missing check valves . Add check valves where practical.	$105,000	$168,000	$84,000	$336,000
N-WTP-9	Vine St WTP RWPS Valve Vault	Existing need	2025	2026	Condition	The Vine St WTP RWPS Valve Vault piping and valve are rusted. Measure pipe thickness. Replace or recoat. Replace valve.	$125,000	$200,000	$100,000	$400,000

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Table 9-5. Recommended Water System CIP Projects[a]

Project Number	Project Name	Trigger	Estimated Start Date	Estimated Completion Date	Project Driver	Project Purpose and Description	Estimated Cost			
							Construction Cost	Capital Cost	Capital Cost, Range Low (-50%)	Capital Cost, Range High (+100%)
M-WTP-5	Vine St WTP Raw Water Intake Screen Replacement	Existing need	2033	2033	Condition	Vine St WTP RW Screen has rust. Replace RW intake screen.	$125,000	$200,000	$100,000	$400,000
M-WTP-6	Vine St WTP Chemical Injection Vault Pipes	Existing need	2033	2033	Condition	Vine St WTP Chemical Injection Vault piping, bolts, and pipe supports have rust. Measure Pipe Thickness. Replace or Recoat. Replace bolts. Replace pipe supports as necessary.	$30,000	$48,000	$24,000	$96,000
N-WTP-11	Vine St WTP Chemical Tank Anchorage	Existing need	2024	2024	Condition	Chemical tanks at Vine St WTP may need more anchorage. Provide clips bolted to the concrete slab to prevent lateral movement and overturning during a seismic event. Add MSDS on tanks as needed.	$5,000	$8,000	$4,000	$16,000
AM WTP										
M-WTP-2	AM WTP 5th Filter Cell	Existing Need	2031	2033	Capacity/ Performance	It is recommended that a 5th membrane cell be installed. It can be used to improve cleaning and maintenance of the membranes for existing needs and in the future, membranes can be added to reach the ultimate plant capacity.	$1,820,000	$2,910,000	$1,460,000	$5,820,000
N-WTP-1	AM WTP Membrane Replacement	Replacement Schedule	2026	2028	Capacity	Membrane lifespan is 10 years and the next replacement cycle is 2026-2028. The City plans to increase the number of membranes to the maximum 648 membranes per cell at that point which is recommended to achieve full capacity.	$3,500,000	$5,600,000	$2,800,000	$11,200,000
N-WTP-2	AM WTP Neutralization Basin Concrete Repair	Existing need	2028	2028	Condition	The AM WTP Neutralization Basin concrete wall has exposed aggregate near the inlet and below the waterline. Clean and provide a coating repair for the concrete with significant surface loss and exposed aggregate to prevent further loss of wall thickness.	$170,000	$272,000	$136,000	$544,000
N-WTP-10	AM WTP Chemical Tanks Seismic Straps	Existing need	2024	2024	Seismic	A&M WTP Chemical Tanks appear to have no seismic straps. Consider adding seismic straps.	$25,000	$40,000	$20,000	$80,000
M-WTP-7	AM WTP Replace Filter Cell Header Pipes	Existing need	2032	2033	Performance	The existing header pipes for the filter cells have cracked and failed multiple times. It is thought that the pipe thickness may need to be thicker. It is recommended to replace the cell header pipes and consider a thicker pipe and stronger connection.	$150,000	$240,000	$120,000	$480,000
M-WTP-8	AM WTP Clean-In-Place Pump	Existing need	2032	2033	Redundancy	There is only one existing clean-in-place pump used to clean AM WTP filter membranes. It is recommended to install a second pump for redundancy.	$125,000	$200,000	$100,000	$400,000
N-WTP-12	AM WTP RWPS Valve Replacement	Existing need	2027	2028	Condition	AM WTP RWPS has one of the valves that is not sealing fully so the City can't isolate the wet well. Low level valves are also especially hard to isolate. Consider replacing all lowest level valves	$500,000	$800,000	$400,000	$1,600,000
L-WTP-2	AM WTP Chemical Improvements	Future Condition Concerns	2041	2043	Performance (Optional)	Optional Project: When the condition of the sodium hypochlorite and caustic tanks and piping requires improvement, the City should evaluate installing an on-site sodium hypochlorite generation for improved availability of sodium hypochlorite.	$1,000,000	$1,600,000	$800,000	$3,200,000

Table 9-5. Recommended Water System CIP Projects[a]

Project Number	Project Name	Trigger	Estimated Start Date	Estimated Completion Date	Project Driver	Project Purpose and Description	Estimated Cost: Construction Cost	Capital Cost	Capital Cost, Range Low (-50%)	Capital Cost, Range High (+100%)
Storage Reservoirs and Pump Stations										
N-PS-2	North Albany PS Replacement	When Total MDD for Zones 2, 3, and 4 exceeds 2.6 mgd	2028	2029	Capacity/ Seismic/ Condition	This project is needed to meet the future pumping capacity requirements for supplying Zones 2, 3, and 4. Demands in these zones are approaching the firm capacity of the North Albany Pump Station (NAPS). This project assumes a new pump station will be constructed near the existing NAPS site around 2028 (based on recent demand trends) and the existing pump station will be retired. The pump station should be constructed in two phases. The first phase should have enough firm capacity to meet medium-term and long-term requirements, with room for expansion to meet buildout requirements in a second phase which will likely needed by about 2053 (medium demand scenario). If demands follow the medium scenario, the first phase of this project could be constructed around 2034.	$2,770,000	$4,430,000	$2,220,000	$8,900,000
N-PS-2A	North Albany Pump Station Building Replacement (Supports the need for Project N-PS-2)	Existing need	2028	2029	Seismic/ Condition	Project N-PS-2A supports the need for Project N-PS-2, North Albany Pump Statin Replacement. The Pump Station is noncompliant for nearly all of the items on the ASCE/SEI 41 17 Checklist for this building type. There is cracking at several locations at exterior of building walls. The corner of the structure appears to be rebuilt but not finished at interior pump station. Prepare for replacement of this structure.	NA	NA	NA	NA
M-PS-1	Gibson Hill PS Replacement	When Total MDD for Zones 3 and 4 exceeds 1.3 mgd	2030	2032	Capacity	This project is needed to meet the future pumping capacity requirements for supplying Zones 3 and 4. Demands in these zones are approaching the total capacity of the Gibson Hill Pump Station (GHPS). This does not leave any backup capacity in case of maintenance needs or for redundancy. Further evaluation is needed to determine the feasibility of upgrading the existing pump station capacity. This project assumes a new pump station will be constructed near the existing GHPS site by 2030 (medium demand scenario) and the existing pump station will be retired. The pump station should be constructed in two phases. The first phase should have enough firm capacity to meet medium-term and long-term requirements, with room for expansion to meet buildout requirements in a second phase which will likely needed by about 2051.	$2,280,000	$3,650,000	$1,830,000	$7,300,000
M-PS-1A	Gibson Hill PS Anchor Bolts (Supports the need for Project M-PS-1)	Existing need	2030	2032	Seismic	Project M-PS-1A supports the need for project M-PS-1, Gibson Hill PS Replacement, referenced in Chapter 6 and 9. No hold down hardware and anchor bolts are visible or shown on the existing drawings. Remove finishes and provide appropriate hold down anchors. If these connections are not present, provide the appropriate hold downs and sill bolts.	NA	NA	NA	NA
N-PS-1	Valley View Hydropneumatic Tank	Existing need	2025	2026	Capacity (optional)	Optional Project. The Valley View pump station currently includes a 450-gallon hydropneumatic surge tank. The existing tank is undersized and empties too quickly, causing the pumps to turn on and off frequently. This causes excess wear on the pump components, particularly the motors, leading to a reduced life. Adding a second 450-gallon tank would allow the pumps to meet the maximum starts/hour criteria with alternating pumps. This project is optional because replacing the pump motors more frequently may be an acceptable solution, given the small size of the motors. In addition, the City has recently changed operations of the pumps and tanks to reduce the number of pump starts and extend the life of the pump motors.	$8,500	$14,000	$7,000	$28,000
M-S-2	Valley View Reservoirs Anchor Bolts	Existing need	2032	2033	Seismic/ Condition	The three Valley View Reservoirs are not bolted to the foundation and relies on friction between the steel & concrete. Maintenance of steel wall is recommended. Consider adding anchor bolts capable of resisting uplift & sliding seismic forces. Clean and remove moss, mold and rust then maintain tank coating.	$2,220,000	$3,550,000	$1,780,000	$7,100,000
N-S-4	Maple, Wildwood, and Valley View Reservoirs Seismic Valves	Existing need	2026	2028	Seismic	It is recommended to install seismic valves at the remaining high priority reservoirs including Maple, Wildwood, and Valley View.	$300,000	$480,000	$240,000	$960,000
M-S-1	Maple St Reservoir Anchor Bolts	Existing need	2032	2033	Seismic/ Condition	The Maple St Reservoir is not bolted to the foundation and relies on friction between the steel & concrete. Maintenance of steel wall is recommended. Consider adding anchor bolts capable of resisting uplift and sliding seismic forces. Clean and remove moss, mold and rust then maintain tank coating. If executed, the construction cost of this project is estimated at $1,884,000. If this structure is planned for future decommissioning, the City may choose not to implement this project.	NA	NA	NA	NA

Table 9-5. Recommended Water System CIP Projects[a]

Project Number	Project Name	Trigger	Estimated Start Date	Estimated Completion Date	Project Driver	Project Purpose and Description	Estimated Cost			
							Construction Cost	Capital Cost	Capital Cost, Range Low (-50%)	Capital Cost, Range High (+100%)
B-PS-1	Maple St Pump Station Roof Connection	Existing need	2044	2045	Seismic/ Condition	The Maple St PS roof to wall connection may not be adequate to resist all seismic forces. During a maintenance re-roofing project for this building, upgrade the roof to wall connection. If executed, the construction cost of this project is estimated at $288,000. If this structure is planned for future decommissioning, the City may choose not to implement this project. It is recommended that this project be re-evaluated during the next WMP update.	NA	NA	NA	NA
N-S-1	Maple St Reservoir Coating	Existing need	2024	2025	Condition	This is an existing project the City is currently planning for 2024, and is listed here for reference. The City can't pressure wash the existing Maple St Reservoir coating because it can chip the coating and expose the orange coating underneath which may contain lead. Recoat Reservoir. The City estimates a capital cost of $500,000 when combined with Vine St Hydropower Penstock Coating. The price for the reservoir coating is assumed to be half, $250,000. This project cost is not included in the WMP CIP budget because it is already included in the City budget for 2024-2028 CIP projects.	NA	NA	NA	NA
N-S-3	Maple St Reservoir Baffle Investigations	Existing need	2026	2027	Condition	Maple St Reservoir has concerns about a baffle tear inside reservoir. Perform further investigation of condition of baffle tear inside reservoir.	$50,000	$80,000	$40,000	$160,000
L-S-1	34th St Reservoir Anchor Bolts	Existing need	2035	2037	Seismic/ Condition	The 34th St Reservoir is not bolted to the foundation and relies on friction between the steel & concrete. Maintenance of steel wall is recommended. Consider adding anchor bolts capable of resisting uplift and sliding seismic forces. Clean and remove moss, mold and rust then maintain tank coating. If executed, the construction cost of this project is estimated at $1,936,000. If this structure is planned for future decommissioning, the City may choose not to implement this project.	NA	NA	NA	NA
M-PS-2	34th St Pump Station Roof Connection	Existing need	2032	2033	Seismic/ Condition	The 34th St Pump Station roof to wall connection of the Pump Station is non-compliant. During a maintenance re-roofing project for this building, upgrade the roof to wall connection. If executed, the construction cost of this project is estimated at $142,000. If this structure is planned for future decommissioning, the City may choose not to implement this project.	NA	NA	NA	NA
L-S-2	Queen Ave Reservoir Anchor Bolts	Existing need	2035	2037	Seismic/ Condition	The Queen Ave Reservoir is not bolted to the foundation and relies on friction between the steel and concrete. Maintenance of steel wall is recommended. Consider adding anchor bolts capable of resisting uplift and sliding seismic forces. Clean and remove moss, mold and rust then maintain tank coating. If executed, the construction cost of this project is estimated at $1,197,000. If this structure is planned for future decommissioning, the City may choose not to implement this project.	NA	NA	NA	NA
M-PS-3	Queen Ave Pump Station Roof Connection	Existing need	2032	2033	Seismic/ Condition	The Queen Ave Pump Station roof to wall connection of the Pump Station is non-compliant. During a maintenance re-roofing project for this building, upgrade the roof to wall connection. If executed, the construction cost of this project is estimated at $95,000. If this structure is planned for future decommissioning, the City may choose not to implement this project.	NA	NA	NA	NA
N-S-2	Queen Avenue Reservoir Coating	Existing need	2024	2025	Condition	This is an existing project the City is currently planning for 2024, and is listed here for reference. The Queen Ave Reservoir paint is chipping. Recoat reservoir. The City estimates a capital cost of $200,000. This project cost is not included in the WMP CIP budget because it is already included in the City budget for 2024-2028 CIP projects.	NA	NA	NA	NA
B-S-1	North Albany Storage	When average demand for summer months is 13.9 mgd	2063	2065	Capacity	By approximately 2063 (medium demand scenario), total system storage needs in the summer will exceed available capacity, assuming all existing reservoirs remain in service. The Wildwood and Valley View reservoirs specifically will not have enough storage to meet the requirements. There is no room at the Valley View site for additional storage, but there is room at the Wildwood site and the Broadway site for an at-grade steel or concrete reservoir. The Wildwood site is a more efficient location for operations because it serves Zone 2. (If the Broadway site was selected, it would need to be paired with additional pumping capacity at the North Albany Pump Station.) This project assumes a 2.0 MG reservoir is needed to meet summer buildout storage requirements in North Albany. It is recommended that this project be re-evaluated during the next WMP update.	$4,480,000	$7,200,000	$3,600,000	$14,400,000

Table 9-5. Recommended Water System CIP Projects[a]

Project Number	Project Name	Trigger	Estimated Start Date	Estimated Completion Date	Project Driver	Project Purpose and Description	Estimated Cost			
							Construction Cost	Capital Cost	Capital Cost, Range Low (-50%)	Capital Cost, Range High (+100%)
Distribution Projects										
N-D-1	Advanced Metering Infrastructure	Existing need	2024	2028	Performance	The City has over 18,900 water meters and is in the process of concerting to advanced metering infrastructure (AMI) which allows meter reading through transmitters instead of through contracting a meter reading service. Currently 41% of the water meters in service have the AMI capability. In the current biennium and going forward, the City is planning to save $500,000 a year for this AMI project and plans to apply for grant funding with the goal of completing the AMI installation in the entire system in the next 5 years.	NA	$2,000,000	$1,000,000	$4,000,000
N-D-2	Zone 2 South Fire Flow Improvement 1	Existing need	2027	2028	Fire flow	This project reduces the severity of an existing fire flow deficiencies in Zone 2 near the Wildwood Reservoir. Pressures in this area are currently about 50-90 psi during normal conditions, but due to poor looping and the long distance from the Valley View Reservoirs, hydrants in this area cannot meet the required fire flow of 1,500 gpm. Project M-D-1 eliminates all the fire flow deficiencies but requires replacement of a large quantity of pipe. This project provides a short-term solution that reduces (but does not eliminate) the number of hydrants unable to supply 1,500 gpm. This project involves replacing a short segment of 8-inch pipe with 12-inch and constructing three new double check valves from Zone 1 to Zone 2. The 12-inch pipe alleviates a constriction near the Wildwood Reservoir, and the check valves will open to allow water from Zone 2 to supply fire demands near the boundary of Zone 1 and Zone 2.	$540,000	$860,000	$430,000	$1,720,000
N-D-3	Washington Street Area Projects	Existing need	2024	2025	Fire flow	This is an existing project the City is currently planning for 2024, and is listed here for reference. This project will replace aging 4-inch and 6-inch pipes near Washington Street. This project will also eliminate existing fire flow deficiencies along Highway 99. The estimated capital cost is $6,580,000. This project cost is not included in the WMP CIP budget because it is already included in the City budget.	NA	NA	NA	NA
M-D-1	Zone 2 South Fire Flow Improvement 2	Existing need	2029	2030	Fire flow	This project eliminates an existing fire flow deficiency in Zone 2 near the Wildwood Reservoir. Pressures in this area are currently 50-90 psi, but due to poor looping and the long distance from the Valley View Reservoirs, hydrants in this area cannot meet the required fire flow of 1,500 gpm. Project N-D-2 eliminates some of the fire flow deficiencies in the short term. This project provides a long-term solution that allows all the hydrants in this area to provide 1,500 gpm. This project involves replacing a large quantity of 10-inch pipe with 12-inch between Gibson Hill Rd and Wildwood Dr and is therefore recommended to be completed as part of the pipe renewal and replacement program.	$1,540,000	$2,460,000	$1,230,000	$4,920,000
M-D-2	Heritage Mall Fire Flow Improvement	Existing need	2029	2030	Fire flow	New pipe needed to alleviate fire flow capacity deficiencies near the Heritage Mall. This type of land use requires a fire flow of 3,500 gpm (see Chapter 4). Only a few of the hydrants in this area can supply 3,500 gpm. This project allows most of the hydrants surrounding the mall to supply 3,500 gpm during a fire.	$300,000	$480,000	$240,000	$960,000
M-D-3	Rail Yard Fire Flow Improvement	Existing need	2029	2030	Fire flow	This project is needed to supply the required fire flow to nearby customers. Medium-density residential, commercial, and industrial customers in this area require a fire flow of 2,500 to 3,500 gpm. These flows cannot be provided by the existing system due to insufficient looping and small pipes.	$1,390,000	$2,220,000	$1,110,000	$4,440,000
M-D-4	Commercial Way Fire Flow Improvement	Existing need	2029	2030	Fire flow	This project is needed to supply the required 3,500 gpm fire flow to commercial customers in the area shown. This flow cannot be provided by the existing 6-inch pipes, which should be replaced with 8-inch pipes.	$520,000	$830,000	$420,000	$1,660,000
M-D-5	South Shore Elementary Fire Flow Improvement	Existing need	2030	2031	Fire flow	This project is needed to supply the required 3,500 gpm fire flow to South Shore Elementary School. This flow cannot be provided by the existing 6-inch pipes, which should be replaced with 8-inch pipes.	$180,000	$290,000	$150,000	$580,000
M-D-6	Umatilla St Fire Flow Improvement	Existing need	2030	2031	Fire flow	This project is needed to supply the required 2,500 gpm fire flow to medium-density residential customers on SW Umatilla St. This flow cannot be provided by the existing 6-inch pipe. Adding looping from the north end of this pipe will allow the required flow to be provided.	$76,000	$120,000	$60,000	$240,000
M-D-7	1st Ave Fire Flow Improvement	Existing need	2030	2031	Fire flow	This project is needed to supply the required 2,500 gpm fire flow to medium-density residential customers on 1st Avenue. This flow cannot be provided by the existing 4-inch pipe. Replacing the 4-inch pipe with 6-inch will allow the required flow to be provided.	$120,000	$190,000	$100,000	$380,000

Table 9-5. Recommended Water System CIP Projects[a]

Project Number	Project Name	Trigger	Estimated Start Date	Estimated Completion Date	Project Driver	Project Purpose and Description	Estimated Cost			
							Construction Cost	Capital Cost	Capital Cost, Range Low (-50%)	Capital Cost, Range High (+100%)
M-D-8	Thurston St Fire Flow Improvement	Existing need	2030	2031	Fire flow	This project is needed to supply the required 1,500 gpm fire flow to low-density residential customers near 27th Ave and Thurston St. This flow cannot be provided by the existing 6-inch pipe due to insufficient looping. Constructing this 6-inch will improve looping and allow the required flow to be provided.	$70,000	$110,000	$55,000	$220,000
M-D-9	Prairie Pl Fire Flow Improvement	Existing need	2030	2031	Fire flow	This project is needed to supply the required 2,500 gpm fire flow to medium-density residential customers on Prairie Pl SE. This flow cannot be provided by the existing 6-inch pipe. Adding looping from the south end of this pipe across Grand Prairie Rd will allow the required flow to be provided. Alternatively, the existing 6-inch pipe on Prairie Pl could be replaced with 8-inch.	$25,000	$40,000	$20,000	$80,000
M-D-10	Lyon St Fire Flow Improvement	Existing need	2031	2032	Fire flow	This project is needed to supply the required 3,500 gpm fire flow to nearby commercial customers. This flow cannot be provided by the existing pipes due to insufficient looping. Adding 8-inch looping along Lyon St will allow the required flow to be provided.	$65,000	$100,000	$50,000	$200,000
M-D-11	3rd Ave Fire Flow Improvement 1	Existing need	2031	2032	Fire flow	This project is needed to supply the required 3,500 gpm fire flow to commercial customers in the area shown. This flow cannot be provided by the existing 4-inch pipes which are too small. Replacing the 4-inch pipe on 3rd Ave with 8-inch will allow the required flow to be provided.	$120,000	$190,000	$100,000	$380,000
M-D-12	3rd Ave Fire Flow Improvement 2	Existing need	2031	2032	Fire flow	This project is needed to supply the required 3,500 gpm fire flow to commercial customers in the area shown. This flow cannot be provided by the existing 6-inch pipes. Replacing the 6-inch pipe on 3rd Ave with 8-inch will allow the required flow to be provided.	$110,000	$180,000	$90,000	$360,000
M-D-13	Geary St Fire Flow Improvement	Existing need	2031	2032	Fire flow	This project is needed to supply the required 2,500 gpm fire flow to medium-density residential customers on Geary St. This flow cannot be provided by the existing 6-inch pipe due to insufficient looping. Adding looping from Willamette Ave will allow the required flow to be provided.	$90,000	$140,000	$70,000	$280,000
M-D-14	Waverly Dr Fire Flow Improvement	Existing need	2031	2032	Fire flow	This project is needed to supply the required 3,500 gpm fire flow to customers on Waverly Dr. This flow cannot be provided by the existing 6-inch pipes. Replacing the 6-inch pipe on 3rd Ave with 12-inch will allow the required flow to be provided.	$340,000	$540,000	$270,000	$1,080,000
M-D-15	Front St Fire Flow Improvement	Existing need	2032	2033	Fire flow	This project is needed to supply the required 3,500 gpm fire flow to the commercial customer on Front St. This flow cannot be provided by the existing 6-inch pipe due to insufficient looping. Adding an 8-inch pipe from Waverly Dr will improve looping and allow the required flow to be provided.	$90,000	$140,000	$70,000	$280,000
M-D-16	Broadway St Fire Flow Improvement	Existing need	2032	2033	Fire flow	This project is needed to supply the required 3,500 gpm fire flow to the commercial customers on Broadway St. This flow cannot be provided by the existing pipes due to insufficient looping. Adding an 8-inch pipe from Liberty St will improve looping and allow the required flow to be provided.	$320,000	$510,000	$260,000	$1,020,000
M-D-17	17th Ave Fire Flow Improvement	Existing need	2032	2033	Fire flow	This project is needed to supply the required 2,500 gpm fire flow to medium-density residential customers on 17th Ave. This flow cannot be provided by the existing 6-inch pipe. Adding looping from Queen Ave will allow the required flow to be provided.	$46,000	$74,000	$37,000	$150,000
M-D-18	20th Loop Fire Flow Improvement	Existing need	2032	2033	Fire flow	This project is needed to supply the required 1,500 gpm fire flow to low-density residential customers on NW 20th Loop. This flow cannot be provided by the existing 4-inch pipe. Replacing the 4-inch pipe with 6-inch will allow the required flow to be provided.	$120,000	$190,000	$100,000	$380,000
M-D-19	Bloom Ln Fire Flow Improvement	Existing need	2032	2033	Fire flow	This project is needed to supply the required 1,500 gpm fire flow to low-density residential customers on Bloom Ln. This flow cannot be provided by the existing 6-inch pipe. Adding looping from Arroyo Ridge Dr will allow the required flow to be provided.	$74,000	$120,000	$60,000	$240,000

Table 9-5. Recommended Water System CIP Projects[a]

Project Number	Project Name	Trigger	Estimated Start Date	Estimated Completion Date	Project Driver	Project Purpose and Description	Estimated Cost			
							Construction Cost	Capital Cost	Capital Cost, Range Low (-50%)	Capital Cost, Range High (+100%)
M-D-20	East Albany Development 1	As needed for development	2029	2031	Development-driven	This project is needed to supply expected future development in East Albany. It is assumed that the Developer will pay for the main costs but the City will pay for costs associated with additional capacity. The total construction cost is $1,524,000 and it is assumed that the City will pay 25%.	$380,000	$610,000	$310,000	$1,220,000
M-D-21	East Albany Development 2	As needed for development	2029	2031	Development-driven	This project is needed to supply expected future development in East Albany. It is assumed that the Developer will pay for the main costs but the City will pay for costs associated with additional capacity. The total construction cost is $2,370,000 and it is assumed that the City will pay 25%.	$590,000	$940,000	$470,000	$1,880,000
M-D-22	East Albany Development 3	As needed for development	2029	2031	Development-driven	This project is needed to supply expected future development in East Albany. It is assumed that the Developer will pay for the main costs but the City will pay for costs associated with additional capacity. The total construction cost is $3,069,000 and it is assumed that the City will pay 25%.	$770,000	$1,230,000	$620,000	$2,460,000
M-D-23	East Albany Development 4	As needed for development	2031	2033	Development-driven	This project is needed to supply expected future development in East Albany. It is assumed that the Developer will pay for the main costs but the City will pay for costs associated with additional capacity. The total construction cost is $3,477,000 and it is assumed that the City will pay 25%.	$870,000	$1,390,000	$700,000	$2,780,000
M-D-24	East Albany Development 5	As needed for development	2031	2033	Development-driven	This project is needed to supply expected future development in East Albany. It is assumed that the Developer will pay for the main costs but the City will pay for costs associated with additional capacity. The total construction cost is $3,630,000 and it is assumed that the City will pay 25%.	$910,000	$1,460,000	$730,000	$2,920,000
M-D-25	East Albany Development 6	As needed for development	2031	2033	Development-driven	This project is needed to supply expected future development in East Albany. It is assumed that the Developer will pay for the main costs but the City will pay for costs associated with additional capacity. The total construction cost is $1,824,000 and it is assumed that the City will pay 25%.	$460,000	$740,000	$370,000	$1,480,000
M-D-26	East Albany Development 7	As needed for development	2031	2033	Development-driven	This project is needed to supply expected future development in East Albany. It is assumed that the Developer will pay for the main costs but the City will pay for costs associated with additional capacity. The total construction cost is $3,408,000 and it is assumed that the City will pay 25%.	$850,000	$1,360,000	$680,000	$2,720,000
L-D-1	South Albany Development 1	As needed for development	2041	2043	Development-driven	This project is needed to supply expected future development in South Albany. It is assumed that the Developer will pay for the main costs but the City will pay for costs associated with additional capacity. The total construction cost is $1,477,000 and it is assumed that the City will pay 25%.	$370,000	$590,000	$300,000	$1,180,000
L-D-2	South Albany Development 2	As needed for development	2041	2043	Development-driven	This project is needed to supply expected future development in South Albany. It is assumed that the Developer will pay for the main costs but the City will pay for costs associated with additional capacity. The total construction cost is $2,318,000 and it is assumed that the City will pay 25%.	$580,000	$930,000	$470,000	$1,860,000
N-D-4	Near-Term Distribution System Pipeline Replacement Program	Existing Need	2024	2028	Condition	The City of Albany has an annual budget dedicated for water main replacement. This budget is used for pipeline replacement to improve the overall health of the water system by reducing the potential for water main breaks and leaks. This budget assumes $3,250,000 annual budget for pipeline replacement	$13,000,000	$20,800,000	$10,400,000	$41,600,000
M-D-27	Medium-Term Distribution System Pipeline Replacement Program	Future Need	2029	2033	Condition	The City of Albany has an annual budget dedicated for water main replacement. This budget is used for pipeline replacement to improve the overall health of the water system by reducing the potential for water main breaks and leaks. This budget assumes $3,250,000 annual budget for pipeline replacement	$13,000,000	$20,800,000	$10,400,000	$41,600,000

Table 9-5. Recommended Water System CIP Projects[a]

Project Number	Project Name	Trigger	Estimated Start Date	Estimated Completion Date	Project Driver	Project Purpose and Description	Estimated Cost			
							Construction Cost	Capital Cost	Capital Cost, Range Low (-50%)	Capital Cost, Range High (+100%)
L-D-3	Long-Term Distribution System Pipeline Replacement Program	Future Need	2034	2043	Condition	The City of Albany has an annual budget dedicated for water main replacement. This budget is used for pipeline replacement to improve the overall health of the water system by reducing the potential for water main breaks and leaks. This budget assumes $3,250,000 annual budget for pipeline replacement	$29,250,000	$46,800,000	$23,400,000	$93,600,000
N-D-5	Lyons St Bridge Crossing Seismic Isolation Valves	Existing need	2026	2026	Seismic	In correspondence with the Oregon Department of Transportation (ODOT), the informal discussions indicated that the Highway 20 bridge (Lyons St. Bridge) will suffer catastrophic damage and likely severely or completely damage the 24-inch steel main that is hung on the bridge. Isolation valves are existing at each end of the bridge. It is recommended to add earthquake style valves or integrate an earthquake warning system with the existing valves to provide timely isolation to the potentially damaged line and conserve water in the distribution system. When ODOT replaces the bridge, or seismically upgrades the bridge, an effort to reinforce or replace the 24-inch main should occur at that time.	$100,000	$160,000	$80,000	$320,000
Supplemental Studies										
L-SS-1	Water System Master Plan	Future Need	2042	2043	Planning	Per OAR 333-061-0060, a master plan is required to evaluate the needs of the water system for at least a 20-year period.	NA	$1,000,000	$500,000	$2,000,000
M-SS-1	Emergency Water Supply Plan	Future Need	2029	2030	Planning	It is recommended that the City conduct an emergency water supply plan specifically for North Albany service area, which is dependent on two river crossings for water supply. This plan should investigate ground water opportunities as an emergency source in North Albany, as well as other potential tactics to help supply provisional water after a disaster.	NA	$75,000	$38,000	$150,000
						Capital Improvement Program Total:	**$89,000,000**	**$145,000,000**	**$73,000,000**	**$291,000,000**

(a) Costs are based on March 2023 ENR CCI of 15,107 (Seattle).

9.3.4 Summary of Capital Improvement Program

The recommended CIP project costs for the canal, hydropower, and water system are summarized in Table 9-6. Overall, the total 20-Year Capital Cost is estimated to be $164,000,000 which correlates to an annual budget of $8,200,000.

Table 9-6. Summary of Recommended CIP Projects[a], dollars

Project Type	Near-Term Capital Costs	Medium-Term Capital Costs	Long-Term Capital Costs	Total 20-Year Capital Cost	Buildout-Term Capital Costs[b]
WTP	8,860,000	3,730,000	2,100,000	15,000,000	0
Pipeline	23,800,000	37,500,000	48,300,000	110,000,000	0
Pump Station	4,440,000	3,650,000	0	8,100,000	0
Storage	560,000	3,550,000	0	4,110,000	7,200,000
Supplemental Studies	750,000	75,000	1,000,000	1,830,000	0
Hydropower	2,520,000	0	0	2,520,000	0
Canal	11,000,000	4,310,000	6,720,000	22,000,000	20,000,000
Total	**$51,900,000**	**$52,800,000**	**$58,000,000**	**$164,000,000**	**$27,200,000**
Annual Costs	**$10,400,000**	**$10,600,000**	**$5,800,000**	**$8,200,000**	**$1,360,000**

(a) Costs are based on March 2023 ENR CCI of 15,107 (Seattle).

(b) Buildout-Term Costs include some but not all projects that will be included at Buildout. The next Water Master Plan will update the projects and costs associated with the Buildout-Term Costs.

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925-949-5800

Davis

2020 Research Park Drive, Suite 100
Davis CA 95618
530-756-5905

Lake Forest

23692 Birtcher Drive
Lake Forest CA 92630
949-420-3030

Lake Oswego

5 Centerpointe Drive, Suite 130
Lake Oswego OR 97035
503-451-4500

Oceanside

804 Pier View Way, Suite 100
Oceanside CA 92054
760-795-0365

Phoenix

4505 E Chandler Boulevard, Suite 265
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602-337-6110

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6800 Koll Center Parkway, Suite 150
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