RESOLUTION NO. 1649

A RESOLUTION APPROVING THE 2020 WATER MASTER PLAN

RECITALS:

A. WHEREAS, the City contracted with Brown and Caldwell to analyze the long terms needs of the City's water system; and

B. WHEREAS, Oregon Administrative Rule 333-061-0060 requires community water systems with 300 or more service connections maintain current master plans that have been reviewed and approved by the State Department of Human Services; and

C. WHEREAS, the 2020 Water Master Plan serves an update to the 2009 Master Plan and represents a twenty year planning horizon.

The City of Central Point resolves as follows:

Section 1. The City of Central Point approves the 2020 Water Master Plan.

Section 2. The City Manager is hereby authorized to send the Water Master Plan to State Department of Human Services for approval.

Section 3. This Resolution shall take effect immediately from and after its passage and approval.

Passed by the Council and signed by me in authentication of its passage this 10th day of December, 2020.

Hank Williams
Mayor Hank Williams

ATTEST:

Deanna Casey
City Recorder

Brown AND Caldwell

City of Central Point

Water System Master Plan

FINAL– DECEMBER 2020

FINAL

Water System Master Plan

Prepared for

City of Central Point, Oregon

December 8, 2020

Brown AND Caldwell

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List of Abbreviations

AC	asbestos cement
ADD	average day demand
AF	acre-feet
AL	action levels
ALA	American Lifelines Alliance
BC	Brown and Caldwell
$CaCO_3$	calcium carbonate
CCL	Contaminant Candidate List
CCT	corrosion control treatment
CI	cast iron
CIP	Capital Improvements Plan
City	City of Central Point
CSZ	Cascadia Subduction Zone
DBP	disinfection by-products
DI	ductile iron
DOGAMI	Oregon Department of Geology and Mineral Industries
DWS	Drinking Water Services
ENR	Engineering News Record
EPA	Environmental Protection Agency
EPS	extended period simulation
FCV	flow control valve
fps	feet per second
GIS	Geographic Information System
gpd	gallons per day
gpd/ac	gallons per day per acre
gpm	gallons per minute
gpm/ac	gallons per minute per acre
HAA5	haloacetic acids (5)
HDPE	high-density polyethylene
HGL	hydraulic grade line
I-5	Interstate 5
IFC	International Fire Code
LCR	Lead and Copper Rule
LCRR	Lead and Copper Rule revisions
MCL	maximum contaminant levels
MDD	maximum day demand
MG	million gallons
mg Cl_2/L	milligrams chlorine per liter
mg ClO_2/L	milligrams chlorine dioxide per liter
mgd	million gallons per day
mg/L	milligrams per liter
MJA	McMillen Jacobs Associates
MMD	minimum month demand
MMS	master meter station
MRDL	maximum residual disinfectant levels
MWC	Medford Water Commission
OAR	Oregon Administrative Rule
OHA	Oregon Health Authority
ORP	Oregon Resilience Plan
PGD	permanent ground deformation
PGV	peak ground velocity
PHD	peak hour demand
PRV	pressure reducing valve
PS	pump station
psi	pounds per square inch
PVC	polyvinyl chloride (pipe)
PWM	Public Works Management
QA/QC	quality assurance/quality control
RR	repair rate
RTCR	Revised Total Coliform Rule
SCADA	supervisory control and data acquisition
SDC	System Development Charge
SDWA	Safe Drinking Water Act
TCR	Total Coliform Rule
TTHM	total trihalomethanes
µg/L	microgram(s) per liter
UGB	urban growth boundary
URA	urban reserve area
USEPA	U.S. Environmental Protection Agency
UUR	unit use rates
VFD	variable frequency drive

Executive Summary

This report documents the current update to the Water System Master Plan (Master Plan) for the City of Central Point, Oregon (City). The previous Water System Master Plan was completed by Brown and Caldwell (BC) in 2009.

The Water System Master Plan Update was driven by the following factors:

- Expansion of the City's UGB
- Development and adoption of the Oregon Resilience Plan (ORP) reflecting the substantially improved understanding of seismic risks in the Pacific Northwest
- Plans to demolish the existing Shops Tank and Pump Station and planning for new facilities to meet level of service criteria
- Support upcoming contract negotiations with the Medford Water Commission (MWC)

The Water System Master Plan Update included two primary steps, which were to 1) revise the existing hydraulic computer model of the City water system and 2) update the current Master Plan that provides the basis for a Capital Improvements Plan (CIP). The model is intended to serve as a tool for the City's evaluation, planning, and design activities. The Master Plan outlines the improvement projects needed to improve and expand the City water system in the most cost-effective manner over the next 20 years (through 2040).

Description of the Existing System

The City owns and operates the water system, which services most of the residential, commercial, and industrial customers within city limits. The City also serves a few industrial customers north of the city limits west of Exit 35 on I-5 near Willow Springs Road. With the exception of the small number of customers within the city limits served directly by the MWC, the City purchases water from MWC, which is delivered to the system at three locations called master meter stations (MMSs).

The distribution system consists of three storage reservoirs, two pump stations, and a network of transmission mains and distribution piping. The system is operated as a single pressure zone. The layout of the existing distribution system facilities is shown in Figure ES-1.

Figure ES-2 provides a hydraulic schematic of the system, illustrating the relationship between the MMSs, reservoirs, and the pump stations.

Note: Figures included as part of the Executive Summary are included at the end of the section.

Water Demands

An important part of the plan is the establishment and projection of water demands. It provides the basis for water supply needs and the determination of required transmission and storage capacity. This section provides a description of both existing and future demands.

Existing water system demand scenarios were developed based on historical data for maximum day demands (MDD), average day demands (ADD), and average of minimum month demands (MMD). The base year for demand development was 2017 and the existing condition model analysis and system evaluation will use a projected 2020 population of 19,714.

Future demands calculated for 2027 and 2040 were based on population projections provided by City staff. All undeveloped land within the urban growth boundary (UGB) including 2020 UGB expansion areas were used to determine the allocation of demands in 2040.

A summary of existing and future water system demands is provided in Table ES-1.

Table ES-1. Total Future Demand

Year	Population Projection [a]	Demand (mgd)		Demand (gpm)	
		ADD	MDD	ADD	MDD
2020	19,714	2.84	7.20	1,973	5,001
2027	21,789	3.14	7.96	2,181	5,527
2030	22,920	3.30	8.37	2,294	5,814
2040	26,707	3.85	9.76	2,673	6,774

Fire flow demands are another important component of the water system plan. Fire flow demands are used to evaluate the system's capacity to supply adequate water for fire suppression. Table ES-2 lists the assigned fire flow rates for both existing and future system evaluations for each land use type in the City's planning information. Estimates are based on general information provided by the fire district. The City did not provide fire demands for any structures within the system service area that exceeded the demands listed in Table ES-2.

Table ES-2. Total Future Fire Flow Demand

Land Use	Fire flow (gpm)	Duration (hr)	City lot type code
Industrial	3,500	3	HI, LI
Institutional (public)	3,500	3	PUBLIC
Commercial	2,500	3	GC, HC, LC
Mixed use	2,000	2	MU, LMR, HMR
Multifamily residential	1,500	2	MFD, MFR, MH, MHP
Single-family residential	1,000	2	SFR

Computer Model Update

A hydraulic computer model of the city of Central Point's (City) water distribution system was updated to be used as a tool for evaluating the existing system and any proposed improvements to the system. The City has made several improvements to their water system since the last system-wide model update completed by BC for the 2009 Master Plan. Due to the 2008 recession, the City has also experienced reduced growth that did not match previous projections. Model facilities and demands were updated to match current conditions and the most recent demand projections. This section provides a basic description of the model, model scenarios, demand allocation, and model calibration.

Level of Service Goals

A description of level of service goals and other criteria to be used for evaluating the existing drinking water system and for the design of future improvements in the model is presented in Section 5. It lists the specific capacity, operations, and reliability requirements for supply, piping, pumping, and storage facilities. The criteria were developed to ensure the desired level of service to each customer served by the City and to maximize the efficiency of the future system.

Seismic Risk Evaluation and Hazard Mitigation Plan

The primary objectives of this assessment, which encompasses the City's water service area are listed below.

- Identify critical infrastructure needed to supply water during an emergency
- Evaluate geophysical hazards that pose a risk to critical facilities
- Evaluate the vulnerability of the City's backbone system to identified hazards by estimating pipeline fragility and evaluating structural vulnerabilities at critical facilities

Water supply facilities and major transmission piping are owned by MWC and were not included in this assessment. BC worked with the City to identify the backbone of the distribution system and subcontracted with McMillen Jacobs Associates (MJA) to perform the geophysical hazards and backbone evaluation as part of the overall Master Plan update, which is documented in Section 6. Development of projects and programs to improve seismic resiliency are discussed further in Section 8. A summary map of the hazard mitigation plan is shown in Figure ES-3.

System Evaluation

The level of service goals and system evaluation criteria were used to evaluate the existing and future system. A number of improvements were developed to address deficiencies identified in the evaluation. The improvements were designed to the standards laid out in the evaluation criteria.

Existing System Evaluation

The existing water system evaluation included an analysis of the City transmission piping, pumping, storage, and supply facilities. The computer model developed for this project was used to simulate the demand conditions that represent the greatest strain on the system: a 24-hour MDD simulation and a steady-state MDD plus fire flow simulation. Model results were compared to evaluation criteria. Areas in the existing system that did not meet the criteria are identified as deficiencies that should be addressed.

Water Supply

The City obtains its water through a wholesale agreement with MWC, a regional water provider that also supplies water to the city of Medford and five neighboring communities. A copy of the existing wholesale agreement is included in Appendix A. The MWC contract establishes flow limits based on time of day and time of year. The contract is renewed every 5 years and at each renewal the contract flow limits are negotiated.

Under the current contract, the City is responsible for limiting total demand on the MWC system to that flow rate, and MWC is responsible for ensuring that there is adequate capacity, water quality, and reliability in its system supply facilities. Current limits are described in Section 2.1. One challenge with the City's supply is that pressure fluctuates over a broad range at the MMSs because MWC must pump water from the Duff WTP through a series of pump stations to supplement water supply during the high demand months. Further discussion of the impacts of incoming HGL performance on system operation and recommendations for future contract limits are discussed in Section 5.2.

Water Rights

To understand their current water rights status and prepare for long-term water needs, the City along with the Cities of Ashland, Eagle Point, Jacksonville, Phoenix, and Talent and the Medford Water Commission (jointly the Partners) developed the "Water Rights Strategy for Partner Water Providers" report in February 2020, which is included in Appendix A. This document outlines a common strategy for the Partners to manage their collective water rights and supply from the Duff WTP through 2070. This strategy recommends an approach to meeting the Partners' near-term goals without jeopardizing of the Partner' water rights. Next steps needed to pursue this approach are outlined in the report.

Pump Stations

There are two pump stations in the system, which are used to boost distribution system pressure during peak hour demands. However, the City is currently planning to demolish the existing Shops tank and pump station in 2027, which led to an evaluation of needed pumping capacity in the 2020 demand scenario.

Storage

Available storage capacity was compared to the required equalization, fire, and emergency storage for the system. A summary of the storage analysis is provided in Table ES-3.

Table ES-3. Storage Analysis

Planning Horizon	Existing Storage Capacity (MG)	Required Storage Volume (MG)				Excess Storage (MG)	
		Fire	Equalization	Emergency	Total	Existing Tanks	Without Shops
2017	5.69	0.63	1.88	2.30	4.81	0.88	-0.11
2020	5.69	0.63	1.95	2.40	4.98	0.71	-0.29
2027	5.69	0.63	2.16	2.65	5.44	0.25	-0.75
2040	5.69	0.63	2.65	3.25	6.53	- 0.83	-1.83

Piping

Evaluation of the existing system piping included analysis of standard operating pressures, velocity, head loss, and fire flow capacity. Figures 7-1 and 7-2 show pressure and fire flow deficiencies in the existing system.

Water Quality

A summary of current and anticipated future regulatory requirements applicable to the City's water system is provided in Section 2.3. The City is currently meeting all water quality regulatory requirements. The water quality evaluation included an analysis of water age, coliform sampling results, disinfectant residuals, and disinfection byproduct concentrations. The results of the evaluation are summarized in Section 7.1.6.

Future System Evaluation

The 2040 scenario was evaluated first in the model to develop the improvements needed to meet the level of service goals at build-out of the future City service area. The 2027 scenario was then evaluated to determine which improvements were needed in 2027 when the City expects to complete the project to demolish the existing Shops tank and pump station project. All improvements were tested under the appropriate 24-hour extended period and fire flow conditions.

The system improvements developed through the future system evaluation are shown in Figure ES-4. Figure ES-5 shows the schematic of the future system.

Recommendations

A CIP was developed to assist the City in budgeting for the improvements needed over the next 20 years to provide the required level of service to the City water customers. The improvement projects developed in the future system analysis were developed to address hydraulic capacity constraints, water quality, seismic resiliency, and reliability. Cost estimates were prepared for each project.

The CIP is summarized in Table ES-4 below.

Table ES-4. Capital Improvements Project Summary List

Project No.[a]	2009 MP Project No.	Project name	Estimated Completion Year	Driver	Part of System Backbone	Facilities to Construct	Project Description	Direct Cost	Indirect Cost		Total Estimated Cost
									Contingency	EAC	
1		Haskell Connection	2027	Capacity Resiliency	Yes	• Disconnect 280 LF of existing 6-inch CI • 290 LF of 12-inch-diameter pipe • 280 LF of 12-inch-diameter pipe crossing Hwy 99	Development in this area has allowed the City to reconfigure their backbone system and provide a 12-inch Hwy 99/Front Street crossing and connect Haskell Street with a 12-inch-diameter pipeline from Lavender to Mac Court. It is assumed that the highway pipeline will be slipped through an existing sleeve.	$229,000	$57,000	$100,000	$387,000
2	M-1	Beall Pump Station	2027	Capacity	Yes	New pump station including: • Pump house • Two vertical turbine pumps on VFDs with a combined capacity of 3,600 gpm @ 36 TDH	New booster pump station to provide a constant hydraulic grade from supply to the system. Without this project, supply from the Beall MMS is constrained when the Vilas is in operation. The project is to be completed prior to decommissioning of the Shops pump station. Pump should be equipped with a VFD to adjust the motor speed with changes in upstream pressure and an analysis of upstream pressure should be included in pump station preliminary design. Future storage projects from MWC may change the suction head at this pump station. Land acquisition and decommissioning of existing Shops Tank and Pump Station facility not included in cost estimate.	$2,029,000	$507,000	$888,000	$3,424,000
3		Beall Lane Piping Capacity	2027	Capacity	Yes	• Replace 710 LF of 16-inch DI with 20-inch DI • 200 LF of 20-inch DI	Replace existing 16-inch diameter DI with new 20-inch DI from the new pump station site to S Haskell Street. Since the exact location of the Beall Pump Station has not been selected an allowance for an additional 200 LF of 20-inch DI pipe has been added to this project. Total cost of the additional 200 LF of 20-inch DI is approximately $190,000.	$507,000	$126,000	$222,000	$855,000
4		Beall Lane Piping Resiliency		Resiliency	Yes	Replace 1,160 LF of 12-inch AC with 16-inch DI	Replace existing 12-inch AC pipe with 16-inch restrained joint DI from Malabar Street to Snowy Butte Lane to improve hydraulic capacity and system resiliency.	$560,000	$140,000	$245,000	$945,000
5		Old Stage Storage Reservoir #2	2027	Capacity	Yes	New 1.9 MG tank	1.9 MG tank at the Old Stage tank site with a base elevation of 1,451.75 feet, diameter of 117 feet and a maximum height of 24 feet. Consider water quality needs in design, may include operational recommendations and/or chlorine boosting.	$5,790,000	$1,158,000	$1,390,000	$8,338,000
6		Bear Creek Crossing at Pine	2040	Resiliency	Yes	1,190 LF of 16-inch-diameter pipe.	There is a planned lane widening project from the Pine Street bridge across Bear Creek to the northbound I-5 on-ramp. This project would likely require realignment of the existing pipeline, which is mounted to the bridge deck. This CIP would reroute the pipeline under Bear Creek. Detailed design will recommend burial depth and joint restraint per local conditions. The existing 12-inch-diameter pipeline has a maximum velocity of 5.5 fps in the 2040 MDD scenario, which is just above the LOS criteria of 5 fps for new pipelines. Given future upsize of the I-5 crossing it is recommended that this line be increased from 12-inch to 16-inch.	$575,000	$144,000	$251,000	$970,000
7		Interstate 5 Crossing Pipeline	2040	Capacity	Yes	Install 1,660 LF of 20 inch	Replace existing 12-inch Interstate 5 crossing pipeline with a 20-inch diameter main.	$925,000	$231,000	$404,000	$1,560,000
8		Vilas Road Pipeline	2040	Capacity	Yes	Install 840-feet of 16-inch waterline.	Install hydraulic equivalent of parallel 16-inch diameter piping from Singing Grass Drive to 230 feet north of the park entrance. Project may include installation of a new parallel line or replacement with a larger main to provide the equivalent hydraulic capacity. Complete prior to Vilas Pump Station Upgrade.	$406,000	$101,000	$178,000	$685,000
9		Vilas Pump Station Upgrade	2040	Capacity	Yes	Install 5th pump	Install 5th pump to provide a pump firm capacity of reservoir pumps to 6,200 gpm. Install VFDs on new pump. Determine during detailed design if replacement will be one larger pump or replacement of one existing reservoir pump with installation of a new matching 5th pump.	$175,000	$44,000	$76,000	$295,000
10		Vilas Pump Station VFD Upgrade	2025	Operations	Yes	Install VFDs	Retrofit existing reservoir pumps to add VFDs. Investigation of pump station control panel spacing, air conditioning capacity, control programming and power supply needed to determine feasibility and cost of this improvement.	TBD	TBD	TBD	TBD
11	S-3	Downtown Small Pipe Replacement Program: Royal Heights	TBD	Resiliency	No	7,600 LF of 8-inch-diameter pipe	New 8-inch piping to replace small piping in the Royal Heights area. The 8-inch replacement piping is to reduce maintenance work and add reliability to the system. This improvement is not needed to improve hydraulic performance.	$2,599,000	$650,000	$1,137,000	$4,386,000
12		Geotechnical Investigation at Creek Crossings	TBD	Resiliency	Yes	Not applicable	Assess soil liquefaction and lateral spreading hazards relative to pipeline depth at the Upton Road crossing and other minor drainages to determine if pipe replacement for seismic resiliency is needed. See Figure 6-2 for locations.	$150,000	$0	$0	$150,000

a. Project numbers are listed to provide reference to project mapping and documentation, but do not signify order of importance.

Table ES-4. Capital Improvements Project Summary List											
Project No. [a]	2009 MP Project No.	Project name	Estimated Completion Year	Driver	Part of System Backbone	Facilities to Construct	Project Description	Direct Cost	Indirect Cost		Total Estimated Cost
									Contingency	EAC	
13		Annual Seismic Resiliency Pipe Replacement		Resiliency	Yes	440 LF of 12-inch pipe	Annually replace approximately 440 LF of existing cast-iron and asbestos cement pipe within the system backbone using restrained joint pipe. Replacement of 300 LF of pipeline at each drainage crossing also included.	$177,000	$44,000	$77,000	$298,000
14	M-3	Fire Flow Improvements near Front St and Bush		Fire Flow	Yes	450 LF of 8-inch diameter pipe 560 LF of 10-inch diameter pipe	Connect 6-inch CI with 12" DI south of intersection of Amy and Ash St. Replace existing 4-inch AC on Cedar Street from Front to 1st. Connect existing 6-inch DI to 12-inch AC from the fire station to Bush Street (alternate to use fire flow from 12" in back of lot)	$366,000	$91,000	$160,000	$617,000
15	M-4	Fire Flow Improvements on Maple		Fire Flow	No	2,780 LF of 8-inch-diameter pipe	Pipeline improvements to meet fire flow capacity requirements in the area. Replace 4-inch CI and 6-inch AC pipe along Laurel. Replace 4-inch CI on N 1st Street from Maple to Cherry.	$951,000	$238,000	$416,000	$1,605,000
16	L-1	Fire Flow on Bigham (North of Oak St)		Fire Flow	No	820 LF of 8-inch diameter pipe	Pipeline improvements on Bigham Dr. from E Pine St to Oak Street. The City completed the portion of Project L-1 from the 2009 Plan on Oak Street in 2003.	$280,000	$70,000	$123,000	$473,000
17	L-1	Fire Flow on S. 9th St		Fire Flow	No	440 LF of 8-inch diameter pipe	Pipeline improvements on S. 9th Street from south of E Pine St to Oak Street. The City completed the portion of Project L-1 from the 2009 Plan on Oak Street in 2003.	$150,000	$38,000	$66,000	$254,000
18		Fire Flow on Oak St		Fire Flow	No	1,060 LF of 8-inch diameter pipe	Replacement of existing 4-inch CI with 8-inch DI. Pipeline improvements along Oak Street from S.7 th St. to Freeman Rd.	$363,000	$91,000	$159,000	$613,000
19	L-1	Fire Flow on Bigham (South of Oak St)		Fire Flow	No	900 LF of 8-inch diameter pipe	Replacement of existing 4-inch CI with 8-inch DI. Pipeline improvements along Bigham Dr. from Oak St. to Chestnut St and along Chestnut St. from Bigham Dr. to S.7th St.	$308,000	$77,000	$135,000	$520,000
20	L-1	Fire Flow on Chestnut		Fire Flow	No	970 LF of 8-inch diameter pipe	Replacement of existing 4-inch CI with 8-inch DI. Pipeline improvements along Chestnut St. from Bigham Dr. to Freeman Rd., along pipe connection between Chestnut St. and Ash St., and along Ash St. from pipe connection to Freeman Rd.	$332,000	$83,000	$145,000	$560,000
21		Fire Flow on Ash St		Fire Flow	No	1,050 LF of 8-inch diameter pipe	Replacement of existing 4-inch CI with 8-inch DI. Pipeline improvements along Ash St. from S. 4th St to pipe connection to Chestnut St.	$359,000	$90,000	$157,000	$606,000
22		Fire Flow on Rostel St		Fire Flow	No	490 LF of 8-inch diameter pipe	Replacement of existing 4-inch CI with 8-inch DI. Pipeline improvements along Rostel St. from Cedar St. to Bush St.	$168,000	$42,000	$73,000	$283,000
23	L-2	Fire Flow on Hazel and 9th		Fire Flow	No	825 LF of 8-inch-diameter pipe	Pipeline improvements on Hazel to replace existing 4-inch CI with 8-inch DIP from N 6th Street to N 9th. The 2009 Plan included replacement of the 4-inch cast iron all the way to 2nd Street as a part of Project L-2. A portion of this project was removed because it is not needed to meet fire flow since there are no hydrants between 2nd and 6th. It is 600 feet between the hydrant on 2nd and the one on 6th, and 600 feet would be the added length of pipe replacement.	$282,000	$71,000	$123,000	$476,000
24	L-5	Fire Flow on Laurel Street		Fire Flow	No	1,440 LF of 8-inch-diameter pipe	Replacement of existing 4-inch CI with 8-inch DI from 4th Street to 9th Street.	$493,000	$123,000	$215,000	$831,000
25		Fire Flow on Manzanita		Fire Flow	No	110 LF of 8-inch diameter pipe	Replacement of existing 4-inch CI with 8-inch DI.	$38,000	$9,000	$16,000	$63,000
26		Fire Flow at Scenic Middle School	2021	Fire Flow Resiliency	Yes	900 LF of 10-inch diameter pipe	Replacement of existing 6-inch AC pipe from Scenic Ave to J7486 at middle school entrance with 12-inch diameter pipe. Replace existing 6-inch AC lateral with 10-inch pipe. This project also provides resiliency improvements for a critical facility.	$340,000	$85,000	$149,000	$574,000
27		Fire Flow on Bush Street		Fire Flow	No	864 LF of 8-inch diameter pipe	Replacement of existing 4-inch CI with 8-inch DI.	$295,000	$74,000	$129,000	$498,000
28		Fire Flow on Grand Ave		Fire Flow	No	732 LF of 8-inch diameter pipe	Replacement of existing 4-inch CI with 8-inch DI.	$250,000	$63,000	$109,000	$422,000
29		Fire Flow at Central Point Elementary	2022	Fire Flow	Yes	184 LF of 8-inch diameter pipe	Replacement of 6-inch DI lateral serving elementary school. If fire flow service by the 12-inch pipe surrounding the school can be used to provide a combined fire flow this project can be removed.	$63,000	$16,000	$27,000	$106,000
30		Fire Flow west of Vilas and Table Rock at RVSS	2040	Fire Flow	No	530 LF of 10-inch diameter pipe	Replacement of 6-inch DI lateral serving RVSS. If surrounding development provides looping this project may be reduced in size or eliminated.	$200,000	$50,000	$88,000	$338,000

a. Project numbers are listed to provide reference to project mapping and documentation, but do not signify order of importance.

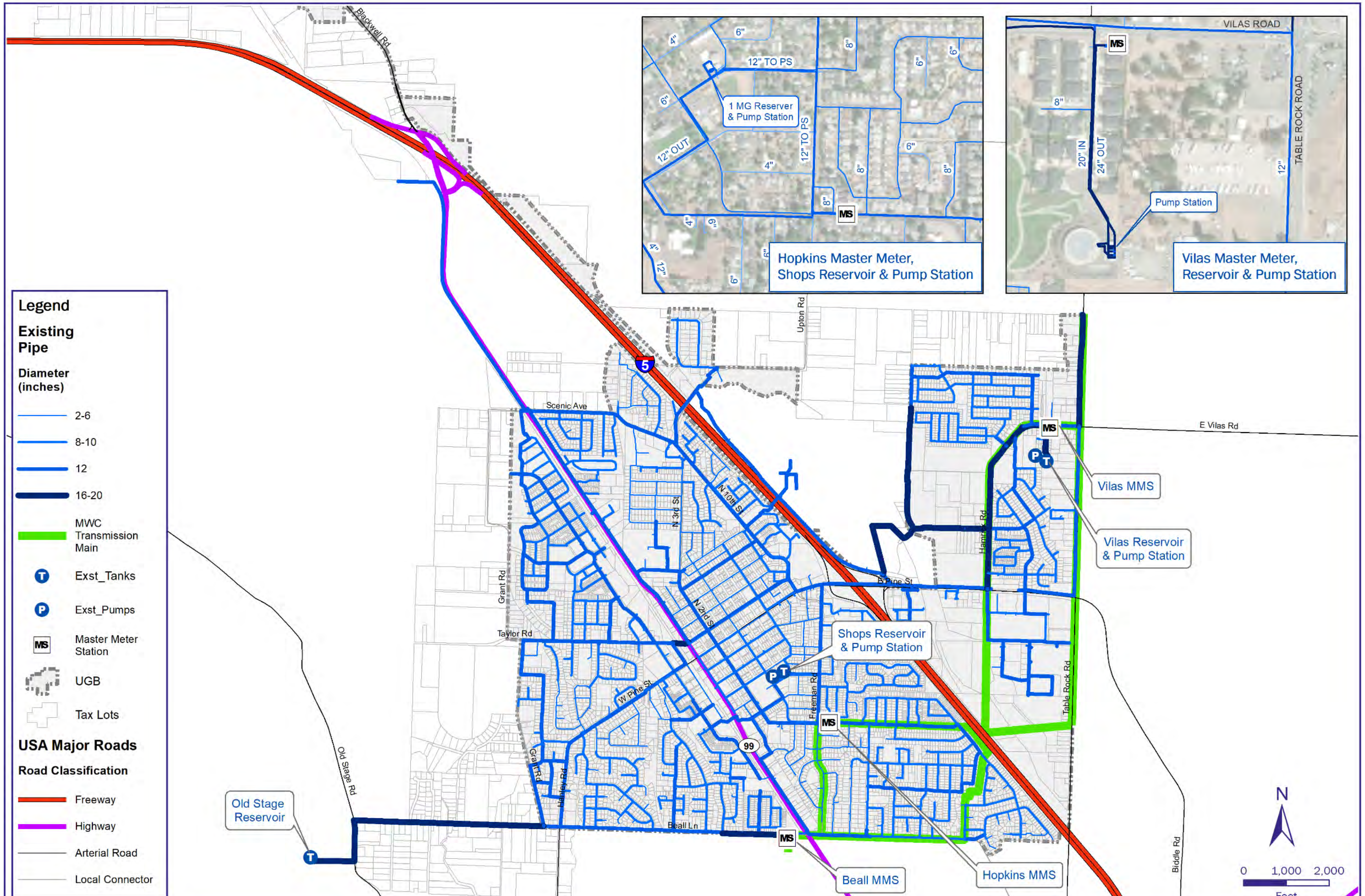

Figure ES-1. Existing water system map

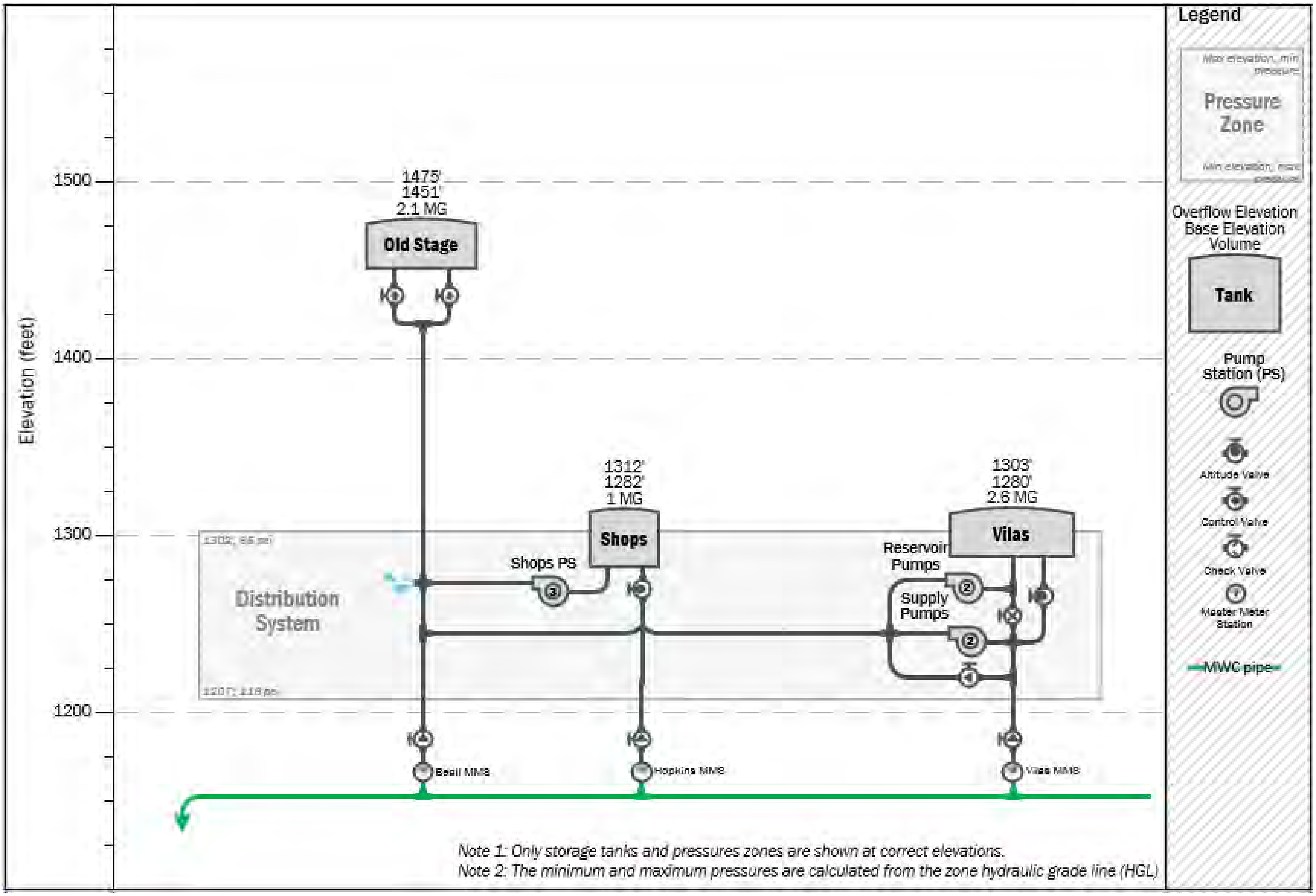

Figure ES-2. Existing system hydraulic schematic

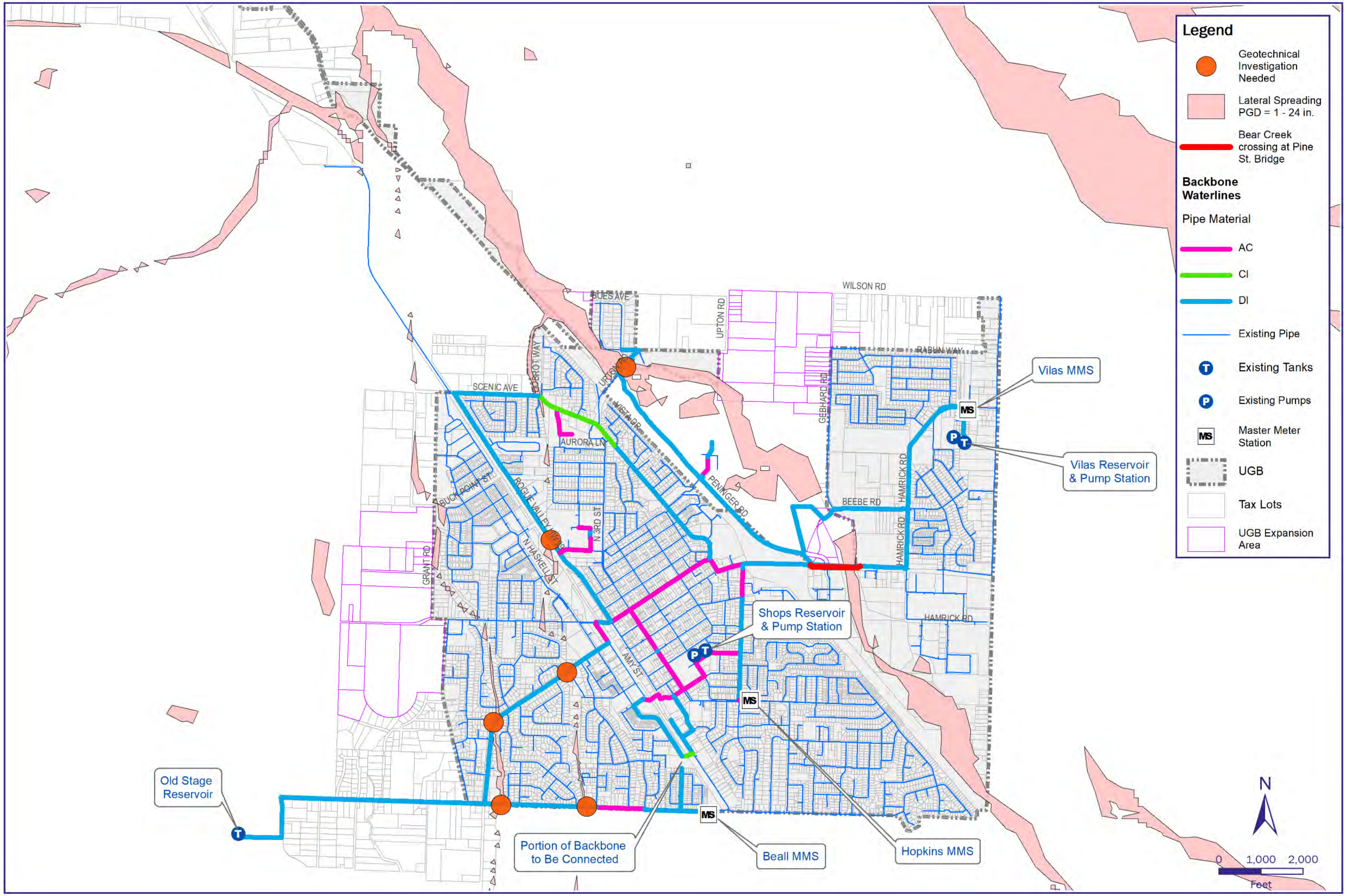

Figure ES-3. Potential repair rates per 1,000 LF

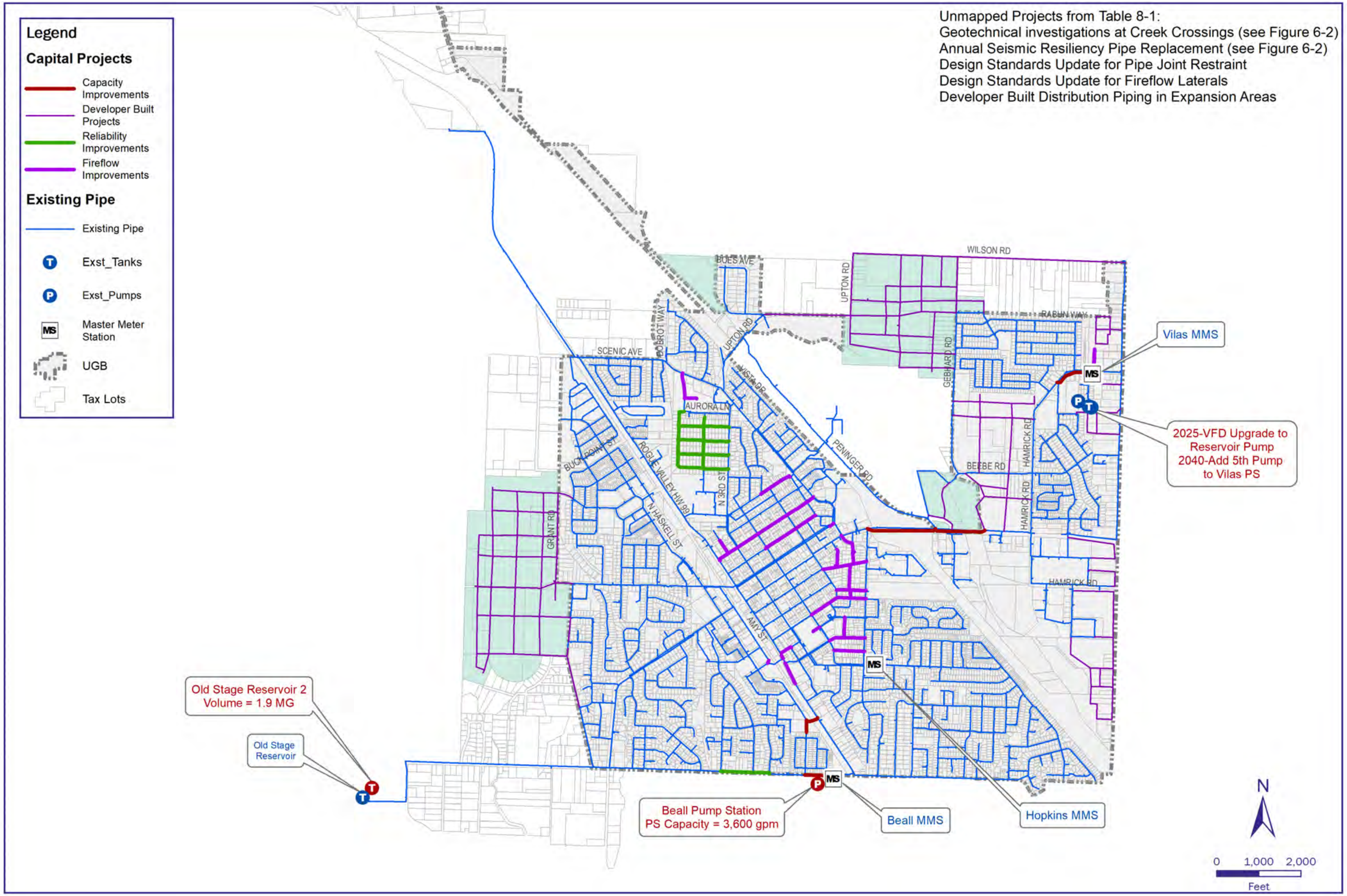

Figure ES-4. Future system layout

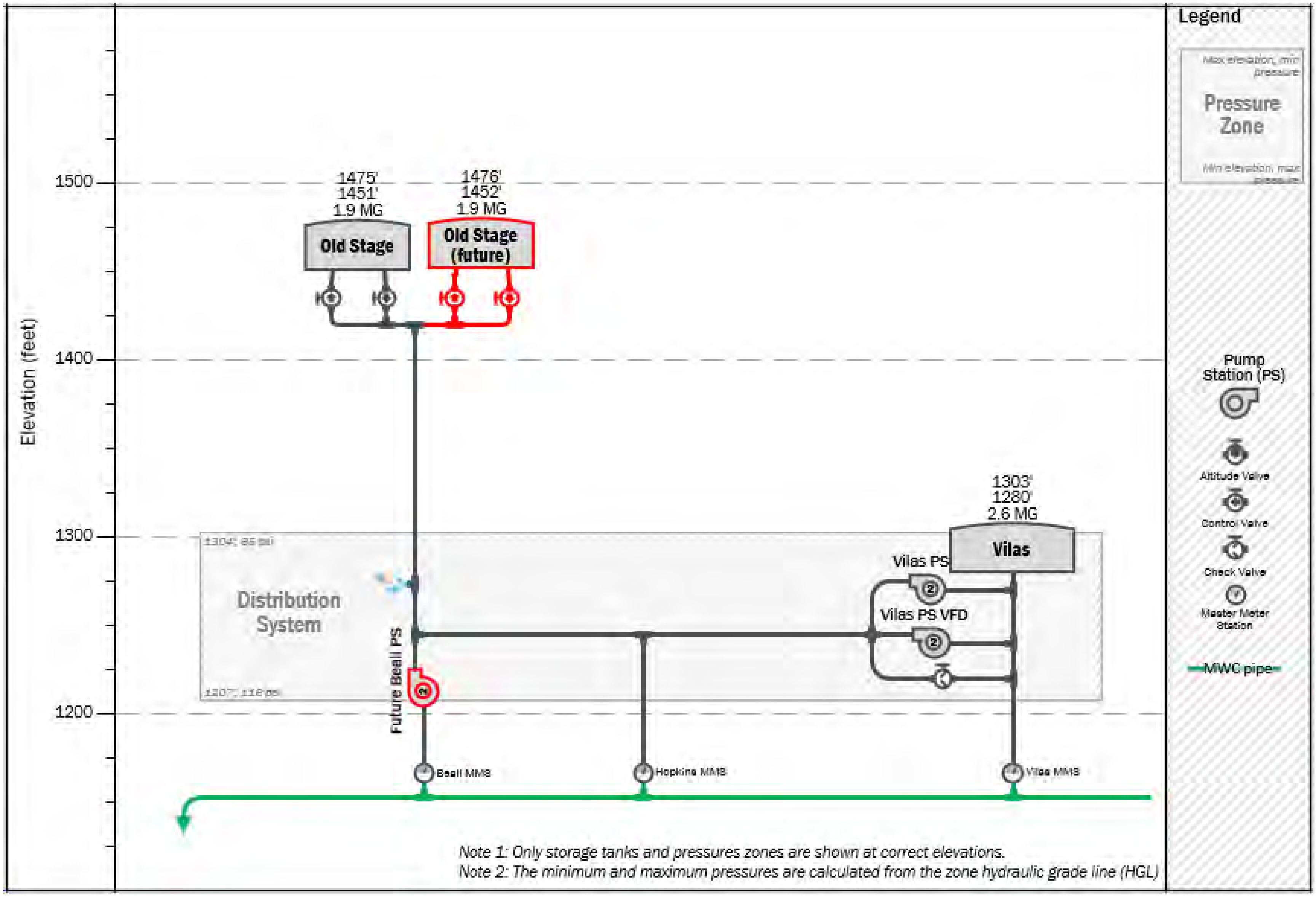

Figure ES-5. Future system layout

Section 1

Introduction

This report documents the update to the Water System Master Plan (Master Plan) for the City of Central Point, Oregon (City). The previous Water System Master Plan was completed by Brown and Caldwell (BC) in 2009. A description of the purpose and activities of the Water System Master Plan is provided in this section of the report.

1.1 Statement of Purpose

The purpose of the Water System Master Plan Update was to (1) revise the existing hydraulic computer model of the City water system and (2) update the current Master Plan that provides the basis for a Capital Improvements Plan (CIP). The model is intended to serve as a tool for the City's evaluation, planning, and design activities. The Master Plan outlines the improvement projects needed to improve and expand the City water system in the most cost-effective manner over the next 20 years (through 2040). Specific attention was given to the improvements needed to limit the City's peak demand on the MWC water system.

1.2 Study Activities

This project included updating the computer model of the Central Point water system, an evaluation of the existing water system for deficiencies, the development of projects for upgrading the water system, and the preparation of cost estimates for improvements. City staff were consulted to gain a comprehensive understanding of the water system, to ensure the accuracy of the information being analyzed, and to determine practical and effective improvement alternatives.

The Water System Master Plan Update was completed in the tasks described below.

Task 1: Project Management. This task included meetings with City personnel and internal quality assurance/quality control (QA/QC) and technical reviews. BC and City personnel held regular meetings and telephone conferences to review project progress and issues. BC conducted internal QA/QC meetings and held periodic meetings with technical experts within the company during the project.

Task 2: Update Water System Demands and Storage Analysis. BC developed updated per capita use rate and unit use rates (UURs) using customer billing data provided by the City. Future demands and allocation were calculated based on population projections and per capita use rates. BC conducted a storage analysis to evaluate available vs. required storage and how the system would be affected by the demolition of the Shops reservoir and addition of Taylor-West development.

Task 3: Field Testing and Facility Update. BC updated the water system model using City- provided geographic information system (GIS) data of water mains, valves, pumps, and reservoirs that previously were not represented in the model. BC also verified the accuracy of facility location, sizing, and controls in the model. A field testing plan was developed and executed, that included four hydrant tests, and testing at each master meter (3) and pump station (2).

Task 4: High Priority Evaluation. The updated, but uncalibrated water system model was used to obtain a conceptual estimate of near-term improvements so the City could enter projects in the City's 2-year capital budget. This effort was later updated throughout the following tasks so it is not described in this document.

Task 5: Update and Calibrate. The distribution system model was calibrated using hydraulic and dynamic calibrations to match field testing. Model controls and settings were adjusted to achieve the targeted calibration results.

Task 6: Evaluate Water System. Criteria, or level of service goals, were established with input from City staff for evaluating the existing water system and designing proposed improvements to the system. BC then used the criteria to evaluate the existing system and design improvements required to address any existing deficiencies and serve future growth in the system.

Task 7: Seismic Risk Assessment. Seismic hazards within the City's backbone pipe system serving critical facilities were reviewed to identify improvements to meet level of service criteria for time to return to service following magnitude 9.0 Cascadia Subduction Zone (CSZ) earthquake.

Task 8: Develop Capital Improvements Plan. Improvement projects developed during the water system evaluation were grouped according to priority. BC developed planning-level cost estimates for each project along with a business case evaluation for all major projects or alternatives.

Task 9: Master Plan Report. A draft version of this report was submitted to the City for review and comment. The final copy is a revision of the draft based on the comments provided by the City.

Section 2

Existing System

The City owns and operates the water system, which services most of the residential, commercial, and industrial customers within city limits. The City also serves a few industrial customers north of the city limits west of Exit 35 on I-5 near Willow Springs Road. With the exception of the small number of customers within the city limits served directly by the MWC, the City purchases water from MWC, which is delivered to the system at three locations called master meter stations (MMSs).

The distribution system consists of three storage reservoirs, two pump stations, and a network of transmission mains and distribution piping. The system is operated as a single pressure zone. A layout of the existing distribution system facilities is shown in Figure 2-1. Figure 2-2 provides a hydraulic schematic of the system, illustrating the relationship between the MMSs, reservoirs, and the pump stations.

This section summarizes the existing facilities that are included in the computer model.

2.1 Water Supply

The City obtains its water through a wholesale agreement with MWC, a regional water provider that also supplies water to the city of Medford and five neighboring communities. A copy of the existing wholesale agreement is included in Appendix A. The Medford Water Commission has two sources of supply, Big Butte Springs and the Duff Water Treatment Plant (WTP) on the Rogue River. Big Butte Springs supplies water year-round to the MWC system. When demands exceed the capacity of Big Butte Springs, the Duff WTP is brought online and usually operates from May through October.

The Medford Water Commission delivers water to the City at the three MMS locations. Each MMS has a flow control valve (FCV) and a flow meter to regulate inflow to the City's system and check valves to prevent backflow to the MWC system. Each MMS is referred to by the street name where it is located. Table 2-1 summarizes the MMS delivery points.

Table 2-1. Master Meter Station Summary

Station	Location	Supply Line Diameter (inches)	Elevation (feet)[a]	Delivery Pressure Range[b] (psi)	Resulting Hydraulic Grade (feet)[c]	
					Low	High
Beall	1253 Beall Lane	36	1,297	65-100	1,447	1,528
Hopkins	625 Hopkins Road	16	1,280	76-120	1,455	1,557
Vilas	240 Vilas Road	36	1,285	56-108	1,414	1,534

b. *Ground elevation interpolated from City contour data.*

c. *Minimum and maximum from one summer month of SCADA records (July 15 to August 15, 2019).*

d. *Delivery pressure in feet of head plus elevation.*

The MWC contract establishes flow limits based on time of day and time of year. The contract is renewed every 5 years and at each renewal the contract flow limits are negotiated. The City is responsible for limiting total demand on the MWC system to that flow rate, and MWC is responsible for ensuring that there is adequate capacity, water quality, and reliability in its system supply facilities.

The total maximum flow rates to the City specified in the current agreement dated October 2016 are as follows:

- October through April
  - 1,833 gallons per minute (gpm): 5 a.m. to 11 a.m.
  - 3,255 gpm: all other times
- May through September
  - 4,958 gpm: 5 a.m. to 11 a.m.
  - 5,700 gpm: all other times

One challenge with the City's supply is that pressure fluctuates over a broad range at the MMSs because MWC must pump water from the Duff WTP through a series of pump stations to supplement water supply during the high demand months. Operation of these pumps creates the large pressure fluctuations at the Central Point MMS delivery points. The delivery pressure ranges in Table 2-1 were compiled from a month of continuous supervisory control and data acquisition (SCADA) data from July 15 through August 15, 2019. The City reports that pressures have dropped as low as 45 pounds per square inch (psi) at the MMSs. These fluctuations are an important consideration for operation of the system and will be discussed in more detail through the system evaluation and capital improvement plan sections of the Master Plan.

2.2 Water Rights

To understand their current water rights status and prepare for long-term water needs, the City along with the Cities of Ashland, Eagle Point, Jacksonville, Phoenix, and Talent and the Medford Water Commission (jointly the Partners) developed the "Water Rights Strategy for Partner Water Providers" report in February 2020. This document outlines a common strategy for the Partners to manage their collective water rights and supply from the Duff WTP. The following goals and priorities for the Partners was established:

- Strategically manage water rights at the Duff WTP
- Secure long-term water supply for all Partners
- Eliminate the need to unnecessarily purchase additional water rights
- Retain existing water rights and create opportunities to obtain value for the water rights
- Treat other Outside Customers served by MWC equitably

A comprehensive water rights summary was prepared and evaluated against current and projected water demands to identify water supply surplus and deficits for each Partner. To achieve the previously listed goals, a recommendation to develop a coordinated approach to Partner water rights certification and water supply was established. To aid in this effort, a recommendation was also included for the establishment of an intergovernmental agreement (IGA) between the Partners to create a regional water supply. Sharing of combined water supplies would address identified water surplus and demands between Partners and would allow for efficient utilization of current water rights.

For the City specifically, this approach would be beneficial as the current water right maximum authorized rate for the City is 3.43 mgd which is below both the existing (2020) maximum daily demand (MDD) of 7.20 mgd and future (2040) MDD of 9.76 mgd.

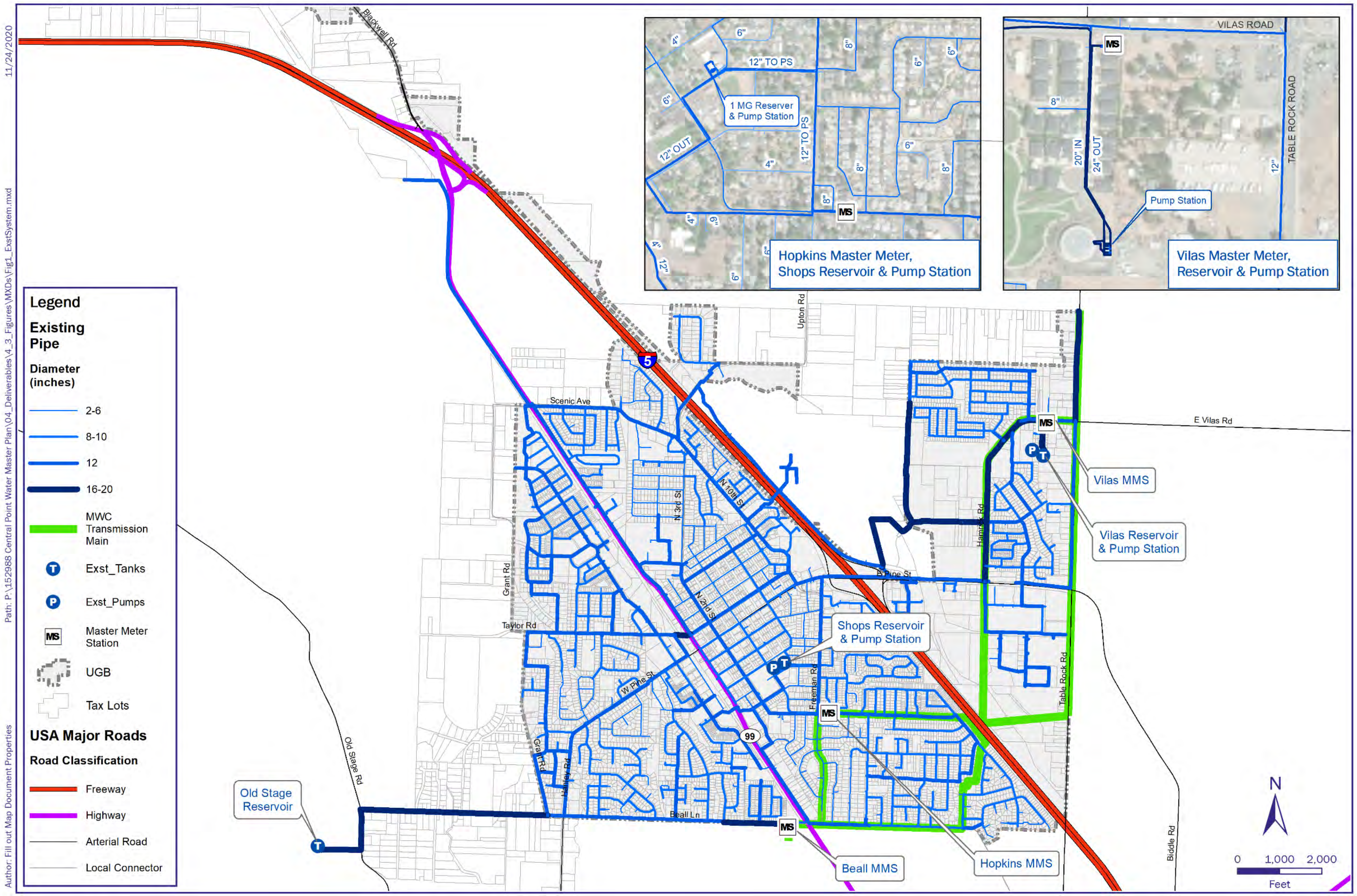

Figure 2-1. Existing water system map

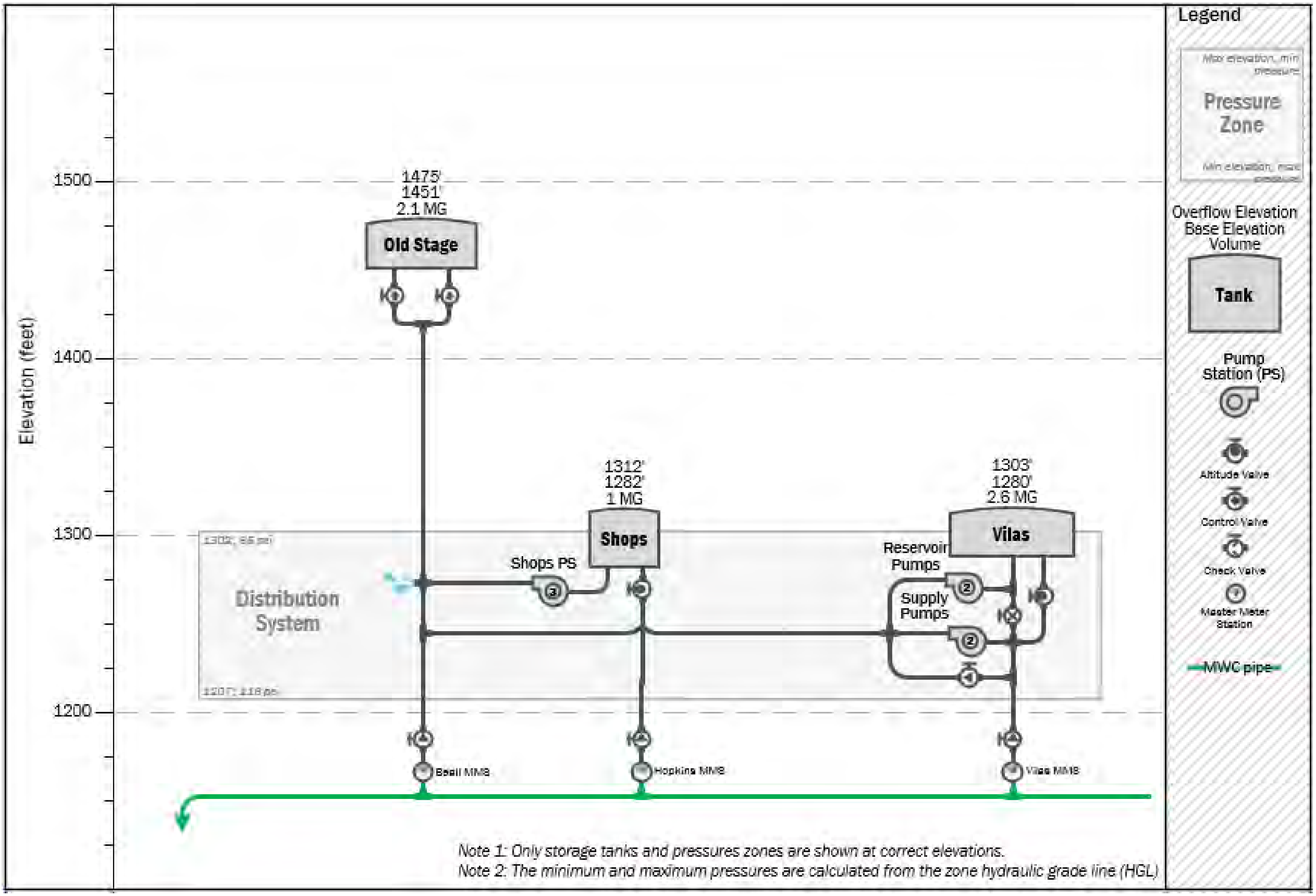

Figure 2-2. Existing system hydraulic schematic

2.3 Water Quality

A summary of regulatory requirements and future regulatory actions that were considered during the Master Plan update are included in this section. Section 7 discusses the analysis of water quality data collected between 2014 and 2019, and compliance status for each regulated constituent. Because the City distributes water but does not treat it, this analysis focuses on water quality parameters that the City must monitor at the entry points to its distribution system and throughout the distribution system, i.e., coliforms, disinfectants and disinfection by-products (DBPs), lead and copper, and any necessary monitoring mandated by the Unregulated Contaminant Monitoring Program. Other key regulated contaminants are discussed in Appendix G.

2.3.1 Safe Drinking Water Act and Regulatory Agencies

The Safe Drinking Water Act (SDWA) of 1974 requires the United States Environmental Protection Agency (USEPA) to establish and enforce drinking water standards in the United States. The SDWA also gives the states the option of accepting authority (or "primacy") for the implementation and enforcement of drinking water regulations, as long as states continue to meet certain requirements. One of the key requirements is that states must adopt regulations that are as or more stringent than the federal regulations within 2 years after they are published by the USEPA. In Oregon, primacy was granted to the Oregon Health Authority (OHA), and the OHA Public Health Division program of Drinking Water Services (DWS) is charged with regulatory enforcement.

Drinking water regulations set primary and secondary standards in the form of maximum contaminant levels (MCLs[1]), action levels (ALs[2]), maximum residual disinfectant levels (MRDLs[3]), treatment requirements, and performance standards for a wide variety of physical, chemical, biological and radiological constituents to provide water that is safe for public consumption. DWS oversees monitoring and enforcement of these standards for the City's water system. Rules specific to drinking water are codified as Oregon Administrative Rules (OARs). Oregon drinking water regulations presented in this document are based on OAR, Public Health Division, Chapter 333, Division 61, Drinking Water (OAR 333-061), effective January 1, 2020.

2.3.2 Revised Total Coliform Rule

This section presents an overview of the Revised Total Coliform Rule (RTCR). Analysis of coliform samplings conducted by the City between January 2014 and December 2019 is presented in Section 7.1.6.

The RTCR was published in the Federal Register in February 2013, with minor corrections published in February 2014. Primacy agencies needed to adopt their RTCR by April 1, 2016. The RTCR intends to increase protection of public health by reducing the potential entry of fecal contamination and other pathogens into distribution systems. Under the former Total Coliform Rule (TCR), total coliform-positive samples triggered an assay for either fecal coliforms or *Escherichia coli*. The RTCR eliminates fecal coliforms and uses only *E. coli* as an indicator of fecal contamination because it is more likely that *E. coli* originated from humans or animals than fecal coliforms. The RTCR introduces

1 "Maximum Contaminant Level" or "MCL" means the maximum allowable level of a contaminant in water delivered to the users of a public water system, except in the case of turbidity where the maximum allowable level is measured at the point of entry to the distribution system (OAR 333-061-0020(82)).

2 "Action Level" means the concentration of lead or copper in water which determines, in some cases, the treatment requirements that a water system is required to complete (OAR 333-061-0020(2)).

3 "Maximum Residual Disinfectant Level" or "MRDL" means a level of a disinfectant added for water treatment that may not be exceeded at the consumer's tap without an unacceptable possibility of adverse health effects (OAR 333-061-0020(83)).

a maximum contaminant level goal (MCLG)[4] and MCL for *E. coli* of zero and eliminates the MCLs and MCLGs for total coliforms (and fecal coliforms) that were included in the former TCR.

For a water system the size of Central Point, monitoring provisions of the RTCR are similar to the former TCR with sampling for total coliforms and *E. coli* based on population served and number of service connections and according to a Coliform Sampling Plan. Sampling and analytical requirements for Oregon systems are presented in OAR 333-061-0036(6). Because the City serves 17,025 people, it is required to collect a minimum of 15 samples per month. The number of repeat samples required when a total coliform-positive sample is detected does not change and remains at three. Repeat samples must be collected at the site where the total coliform-positive sample occurred, and within five adjacent service connections upstream and downstream of the initial sample.

Water systems needed to make sure their Coliform Sampling Plan meets the requirements of the RTCR or submit a revised plan to primacy agencies by March 31, 2016. These plans need to be revised every 10 years, or within 30 days when the City or OHA determines that it is no longer representative or when sampling sites or procedure need to be revised.

Perhaps the most substantive change within the RTCR is the “find-and-fix” requirement of assessment and corrective actions. This provision requires water systems to conduct assessments when monitoring results demonstrate the system may be vulnerable to contamination. A Level 1 Assessment or a more detailed Level 2 Assessment may be required depending on how severe and how frequent contaminations occur, as determined by the presence of total coliforms and/or *E. coli*. These assessments, or investigations, are presented in OAR 333-061-0078.

For the City, a “treatment technique violation” triggers a Level 1 Assessment when:

- Two or more total coliform-positive samples are detected in a calendar month; or
- Failure to collect every required repeat sample after any single total coliform-positive sample.

A Level 1 Assessment should be conducted by City staff or a City representative.

A Level 2 Assessment is conducted by OHA staff or a party approved by OHA when:

- There is an *E. coli* MCL exceedance as defined in OAR 333-061-0030(4)(a), which may include any of the following:

Routine Sample:	Repeat Sample:
E. coli positive	Total coliform positive
E. coli positive	Repeat sample not collected
E. coli positive	*E. coli* positive
Total coliform positive	*E. coli* positive
Total coliform positive	Total coliform positive, and *E. coli* not analyzed

- A second Level 1 Assessment is triggered in a rolling 12-month period, unless OHA has determined a likely cause for the total coliform-positive samples responsible for the first Level 1 Assessment and established that the water supplier corrected the problem.
- A Level 1 Assessment occurs in two consecutive years for systems with approved annual monitoring.

Level 1 or Level 2 Assessments aim at identifying the possible presence of sanitary defects where microbial contaminants could enter into the distribution system, or that indicate an imminent failure of an existing barrier. Examples of sanitary defects include cross-connection and backflow issues, operator issues, distribution system issues, storage issues, and disinfection issues like failure to

[4] Maximum contaminant level goal or MCLG: The level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs allow for a margin of safety (OAR 333-061-0043(2)(d)(A)).

maintain the disinfectant residual throughout the distribution system. These assessments also include a review of coliform monitoring procedures, and the likely reason(s) that the system triggered the assessment.

The RTCR did not change the requirement for water systems to measure the disinfectant residual each time a coliform sample is collected.

2.3.3 Disinfectant Residuals and Disinfection Byproducts

Drinking water regulations that pertain to maximum levels of disinfectants and DBPs that need to be maintained in distribution systems are presented hereunder. Disinfectant residuals and DBP concentrations measured in the City's distribution system and an analysis of water age and how it correlates to disinfectant residual is provided in Section 7.1.6.

Maximum residual disinfectant levels 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 Tables 2-2 and 2-3, respectively. For the City, the applicable requirements include the MRDL for free chlorine, MCL for the sum of four trihalomethanes (referred to as total trihalomethanes or TTHMs), and MCL for the sum of five haloacetic acids (referred to as HAA5). The four THMs and five HAAs that are regulated are listed in Table 2-3. Bromate and chlorite are regulated DBPs that pertain to the application of ozone and chlorine dioxide, respectively. They are included in Table 2-3 because they are part of the Disinfectants and DBP Regulations, but they do not apply to the City. Bromate needs to be monitored within the treatment plant and at the entry point to the distribution system. Chlorite does not need to be monitored because MWC does not use chlorine dioxide.

Table 2-2. Regulatory Requirements for Disinfectants

Regulated Disinfectant	Oregon	Federal	
	MRDL	MRDL	MRDLG
Chlorine	4.0 (mg Cl_2/L)	4.0 (mg Cl_2/L)	4 (mg Cl_2/L)
Chloramines	4.0 (mg Cl_2/L)	4.0 (mg Cl_2/L)	4 (mg Cl_2/L)
Chlorine dioxide	0.8 (mg ClO_2/L)	0.8 (mg ClO_2/L)	0.8 (mg ClO_2/L)

Source: OAE 333-061-0031.

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 running annual average (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 running annual averages (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 total organic carbon (TOC) removal requirements to limit DBP formation. MWC is responsible for ensuring that these requirements are met in the City's supply.

The City distributes free chlorinated water from MWC. With a population of 18,581 people, the City should conduct standard monitoring for THMs and HAA5 at four distribution system sites, or at two distribution system sites if reduced monitoring is accepted (OAR 333-061-0036(4)(c) and (d). The City was allowed to conduct reduced monitoring because it maintains LRAA of 0.040 mg/L (40 µg/L) or less for THMs and 0.030 mg/L (30 µg/L) or less for HAA5.

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 2-3. Regulatory Requirements for DBPs

Regulated DBP	Oregon	Federal	
	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

Source: OAR 333-061-0030(2)(b).

2.3.4 Lead and Copper

The section presents the Lead and Copper Rule (LCR) that is currently applicable and a discussion on the proposed revisions to this regulation (referred to here as LCRR). The corrosion control study recently completed by MWC is also presented, followed by lead and copper results measured at the City's customer taps.

2.3.4.1 Lead and Copper Rules

At the federal level, lead and copper are regulated by the LCR. Oregon's drinking water regulations present the action levels in OAR 333-061-0030(1), treatment requirements and performance standards for corrosion control in OAR 333-061-0034, and sampling and analytical requirements associated with the LCR in OAR 333-061-0036(10).

The City conducts reduced monitoring for LCR compliance, i.e., the City samples a minimum of 30 customer taps for lead and copper every 3 years. For lead and copper, compliance is determined by calculating the 90th percentiles of lead and copper concentrations, i.e., the concentrations above which only 10 percent of the results obtained during each sampling round are found. These 90th percentiles are compared with action levels for these two contaminants.

The federal and state regulatory action levels and MCLGs for lead and copper at customer taps are summarized in Table 2-4. If action levels are exceeded, other requirements could be triggered, including monitoring of water quality parameters (WQPs), corrosion control treatment (CCT), source water monitoring or treatment, public education, or lead service line replacements.

Table 2-4. Regulatory Requirements for Lead and Copper			
Contaminant	Oregon	Federal	
	Action Level (mg/L)	Action Level (mg/L)	MCLG (mg/L)
Copper	1.3	1.3	1.3
Lead	0.015	0.015	Zero

Source: OAR 333-061-0030(1).

The LCR has undergone several revisions since its original publication in 1991. The most recent review led to the draft LCRRs that were proposed by the USEPA on November 13, 2019[5]. The draft LCRR aims at reducing lead exposure in drinking water and focusing on the most at-risk communities. The LCRR proposes the existing action levels of 1.3 and 0.015 mg/L for copper and lead, respectively, based on 90th percentile concentrations of samples collected during each monitoring round. The following summarizes the most critical changes to the LCR proposed by the USEPA:

- Addition of a trigger level of 0.010 mg/L for lead, based on the 90th percentile, to compel water systems to take proactive actions. Should the 90th percentile lead level were to exceed this trigger level, systems would be required to take various actions based on whether they practice CCT, and whether they have lead service lines (LSLs) or service lines made of unknown materials. Water systems on reduced monitoring would also be required to sample annually at the standard number of distribution system sites.
- Requirement to conduct an LSL inventory within 3 years following publication of the final LCRR, and update the inventory annually. The proposed LSL inventories would include both the system and owner sides of the service lines. The purpose of these inventories is to identify the areas most affected by higher lead concentrations and revise the selection of sampling sites accordingly.
- Changes in sampling site selection to better target locations with high lead levels based on the LSL inventory. Although the number of sampling sites would remain the same and would continue to be based on population served, this provision would require water systems to sample from sites served by verified LSL. Alternate sites would only be used if the minimum required number of samples could not be collected from LSLs. This provision also includes a number of improvements to the sampling procedure, including the use of wide-mouth bottles only.
- Strengthening of CCT requirements by requesting more water systems to implement such treatment, and mandating systems that exceed the trigger level or action level for lead to re-optimize their CCT. Systems that service more than 10,000 people (which includes the City) would be affected by this provision. In addition, calcium hardness adjustment would no longer be considered a CCT.
- Addition of a “find-and-fix” approach focusing on CCT and WQPs that would require water systems to conduct additional samplings if a customer tap were to exceed 0.015 mg/L for lead. Within 5 days of this finding, systems would need to collect a WQP sample at or near the site where the lead concentration exceeded 0.015 mg/L, and collect a follow-up lead sample within 30 days at each site where lead concentrations exceeded 0.015 mg/L. Systems would need to notify the affected customer(s) within 24 hours if follow-up sample(s) exceeded 0.015 mg/L for lead. Systems would also need to recommend solutions to the primacy agency (i.e., OHA) within 6 months of the end of the monitoring period when the high lead concentrations were measured.

[5] Additional information is available at https://www.epa.gov/sdwa/lead-and-copper-rule-long-term-revisions.

- Changes to the LSL replacement program by requesting water systems with LSLs to prepare an LSL Replacement Plan within 3 years following publication of the final LCRR. Systems would need to implement this plan if their 90th percentile for lead were to exceed the trigger level of 0.010 mg/L. Systems would also be required to replace their portion of the LSL within 3 months following replacement of an owner-side LSL. Within 24 hours following replacement of a full or partial LSL, systems would need to provide pitcher filters and cartridges to each customer for 3 months and sample the affected tap within 3 to 6 months following the replacement.
- Improvement to the public education and customer notification components of the LCR to strengthen risk communication. Water systems with 90th percentile lead levels that exceed the action level of 0.015 mg/L would need to provide public education to all of their customers within 24 hours. Providing additional consumer information would also be required by water systems with LSLs under the proposed LCRR.
- Addition of a requirement for water systems to develop a list of customers that provide water to licensed schools or child-care facilities and verify this list every 5 years. Each year, a number of these facilities would need to be tested for lead such that all facilities are sampled every 5 years.

Once the final LCRR is promulgated, compliance will be required within 3 years. When this document was prepared, a final regulation was expected in the fall of 2020, which means that compliance may be required by late 2023 or early 2024.

2.3.4.2 Corrosion Control Study

MWC does not adjust pH or alkalinity to control corrosion and does not use a phosphate- or silicate-based corrosion inhibitor. However, silica is naturally present in both water sources, particularly in Duff WTP-treated water, and silica is a recognized corrosion inhibitor. In the Big Butte Springs water, pH is typically 7.0, whereas it is slightly higher at 7.2 in water treated by the Duff WTP.

The Medford Water Commission completed a corrosion control study in April 2019[6]. The study concluded that both water sources are moderately aggressive towards copper, although Duff WTP treated water is more aggressive than the Big Butte Springs water. The water sources do not tend to release lead and are only mildly aggressive towards iron. The difference in water quality between the two water sources may increase copper and iron releases when MWC changes water source. According to the corrosion control study report, lead was not released when changing water sources. Because the City mainly receives water treated by the Duff WTP when this plant is online, the effect of changing water sources is of relevance to the City. The report recommended that MWC increase the pH of the treated water and target similar pH levels in both water sources to limit metal release.

The corrosion control study report mentioned increased chloride and sulfate concentrations in water sources in 2018. This may be concerning considering that these ions have been linked to metal releases, including lead and copper. The report also highlighted that both water sources are aggressive towards cement and tend to dissolve calcium carbonate ($CaCO_3$) from pipes. This reaction may increase calcium concentrations as water travels in MWC’s distribution system and erode pipes. Increasing the pH of both water sources would help limit this challenge.

2.3.5 Potential Future Regulations

This section presents potential future regulatory actions that may impact the City, in addition to the finalization of the LCRR described in Section 2.3.4. This section also discusses three initiatives that were introduced by the 1996 Amendments to the SDWA to ensure that each drinking water regulation is periodically reviewed and revised if needed, and that contaminants requiring regulations but do not have MCLs, action levels, or treatment techniques are regulated.

[6] Black & Veatch, Water Quality and Corrosion Study Final Report, Prepared for Medford Water Commission, 15 April 2016.

At the federal level, the USEPA has modified the definition of lead-free plumbing products (pipes fittings, fixtures) to conform to the 0.25-percent weighted average of lead content level, as well as labeling requirements for devices that meet the new "lead free" definition. The regulation also includes requirements for manufacturers to certify that they are meeting these new requirements using a consistent verification process within 3 years of the final rule publication. The final rule was published on September 1, 2020, and was titled "Use of Lead Free Pipes, Fittings, Fixtures, Solder and Flux for Drinking Water."[7] As a distributor of drinking water, the City needs to ensure that anyone who installs or repairs plumbing materials meets these requirements.

2.3.5.1 Six-Year Review

The 1996 Amendments to the SDWA requires the USEPA to review, and revise if necessary, each drinking water regulation in a six-year review cycle. This review considers newly available data, health effects, changes in technology and analytical methods, 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 USEPA stated that it had initiated a reassessment of the health risks associated with exposure to total chromium and did not believed it was appropriate to revise this particular standard. The USEPA and OHA both regulate total chromium with an MCL of 0.1 mg/L. The USEPA included its regulatory requirement in the National Primary Drinking Water Regulations (NPDWR) in 1991. 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 USEPA has been assessing health effects and other relevant information to determine whether hexavalent chromium (or chromium-6) should be regulated[8].
- For Six-Year Review 3, the USEPA 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 2023.

2.3.5.2 Contaminant Candidate Lists

The Contaminant Candidate List (CCL) is a list of contaminants that are currently not subject to any proposed or promulgated federal regulations but are known or anticipated to occur in water systems and may require future regulation. The 1996 Amendments of the SDWA requires the USEPA to publish the CCL every 5 years. Each list is not limited by a fixed number of contaminants; however, the USEPA must make regulatory determinations for at least five contaminants from each list. Regulatory determinations may include the following:

1. A positive determination when a regulation is deemed necessary for a contaminant.
2. A negative determination when a regulation is not needed.
3. Are in need of further research pertaining to one or more of the following: health effects, treatability, analytical methods, and occurrence.

The CCL does not impose any requirements on water systems. The four rounds of CCLs that have taken place thus far are summarized in Table 2-5. In October 2018, the USEPA requested nominations for CCL 5 contaminants and an extensive list of 63 contaminants was proposed. The regulatory determination(s) for CCL 4 and the CCL 5 list had not been finalized when this document was prepared.

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[7] Additional information is available at https://www.epa.gov/sdwa/use-lead-free-pipes-fittings-fixtures-solder-and-flux-drinking-water.

[8] Additional information is available at https://www.epa.gov/sdwa/chromium-drinking-water.

Table 2-5. Summary of CCLs

CCL	Published	Contaminants	Regulatory Determination			
			Published	Positive	Negative	Postponed
Round 1	March 1998	50 chemicals, 10 microorganisms	July 2003	(None)	• Acanthamoeba • Aldrin • Dieldrin • Hexachlorobutadiene • Manganese • Metribuzin • Naphthalene • Sodium • Sulfate	
Round 2	February 2005	42 chemicals, 9 microorganisms	July 2008	(None)	• Boron • Dacthal mono-acid (MTP) degradate • Dacthal di-acid (TPA) degradate • 1,1-Dichloro-2,2-bis(p-chlorophenyl)ethylene (DDE) • 1,3-Dichloropropene (Telone) • 2,4-Dinitrotoluene • 2,6-Dinitrotoluene • s-Ethyl propylthiocarbamate (EPTC) • Fonofos • Terbacil • 1,1,2,2-Tetrachloroethane	Perchlorate
Round 3	October 2009	104 chemicals, 12 microorganisms	January 2016	Strontium	• Dimethoate • 1,3-dinitrotoluene • Terbufos • Terbufos sulfone	Chlorate, nitrosamines[a]
Round 4	November 2016	97 chemicals, 12 microorganisms	February 2020[b]	PFOA PFOS	• 1,1-dichloroethane • Acetochlor • Methyl bromide (bromomethane) • Metolachlor • Nitrobenzene • RDX	

a. *To be considered as part of the revision of the Stage 2 DBPR.*

b. *Preliminary Regulatory Determination.*

2.3.5.3 Unregulated Contaminant Monitoring Program

The 1996 Amendments to the SDWA require the USEPA 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 USEPA for this special monitoring and report results to the USEPA. Four rounds of Unregulated Contaminant Monitoring Rule (UCMR) monitoring have been completed thus far, the most recent Rounds 3 and 4 (i.e., UCMR 3 and UCMR 4) are summarized in Table 2-6.

Table 2-6. Summary of UCMR Monitoring				
UCMR	Published	Monitoring	List 1–Assessment Monitoring Contaminants	Sampling Sites
Round 3	May 2012	12 months between January 2013 and December 2015	• 1,2,3-trichloropropane • 1,3-butadiene • Chloromethane (methyl chloride) • 1,2-dichloroethane • Bromomethane (methyl bromide) • Chlorodifluoromethane (HCFC-22) • Bromochloromethane (halon 1011) • 1,4-dioxane • Perfluorooctanesulfonate acid (PFOS) • Perfluorooctanoic acid (PFOA) • Perfluorononanoic acid (PFNA) • Perfluorohexanesulfonic acid (PFHxS) • Perfluoroheptanoic acid (PFHpA) • Perfluorobutanesulfonic acid (PFBS)	Distribution system entry points
			• Vanadium • Molybdenum • Cobalt • Strontium • Chromium (total) • Chromium-6 • Chlorate	Distribution system entry points, and distribution system maximum residence time location
Round 4	December 2016	Four consecutive months between March 2018 and November 2020	• Total Microcystin • Microcystin-LA • Microcystin-LF • Microcystin-LR • Microcystin-LY • Microcystin-RR • Microcystin-YR • Nodularin • Anatoxin-a • Cylindrospermopsin	Distribution system entry points
		12 months between January 2018 and December 2020 for List 1 Additional Contaminants	• Germanium • Manganese • Alpha-hexachlorocyclohexane • Chlorpyrifos • Dimethipin • Ethoprop • Oxyfluorfen • Profenofos • Tebuconazole • Total Permethrin (cis- & trans-) • Tribufos • 1-butanol • 2-methoxyethanol • 2-propen-1-ol • butylated hydroxyanisole • o-toluidine • quinoline • TOC[a] • Bromide[a]	Distribution system entry points
			• HAA5 • HAA6Br[b] • HAA9[c]	DBP sampling sites

a. The City did not need to monitor for TOC or bromide.

b. HAA6Br: Bromochloroacetic acid, bromodichloroacetic acid, dibromoacetic acid, dibromochloroacetic acid, monobromoacetic acid, and tribromoacetic acid.

c. HAA9: Bromochloroacetic acid, bromodichloroacetic acid, chlorodibromoacetic acid, dibromoacetic acid, dichloroacetic acid, monobromoacetic acid, monochloroacetic acid, tribromoacetic acid, and trichloroacetic acid.

2.4 Storage Reservoirs

There are three water storage reservoirs in the City's water distribution system: the 1-MG Shops reservoir, the 2-MG Old Stage reservoir, and the 2.6 MG Vilas reservoir. Table 2-7 lists details about the three storage reservoirs.

Table 2-7. Storage Reservoir Details

Reservoir	Year Built	Type	Base Elevation (feet)	Overflow Height (feet)	Diameter (feet)	Capacity (gallons)
Shops	1962	Ground level concrete	1,282	30.25	75	1,000,000
Old Stage	1993	Partially buried concrete	1,450.75	24.25	122	2,120,000
Vilas	2013	Partially buried concrete	1,280	25.00	138	2,600,000

The Shops reservoir is a ground-level, concrete reservoir located at the City's Public Works Department maintenance shops. Water is supplied to this reservoir via a dedicated pipeline from the Hopkins MMS and through an altitude valve. Flow from the reservoir must be pumped to the hydraulic grade of the system by the Shops PS. During summer operations when system pressures drop below a set pressure, the Shops PS pumps out of the reservoir to the distribution system. During winter operations, the Shops PS is operated manually to maintain tank turnover but is otherwise not needed when the hydraulic grade from the MMS is adequate to refill the Old Stage Reservoir. The 1-MG reservoir has been identified by the City as being seismically unstable and the site for this reservoir will be reconfigured for other municipal uses by 2027. Figure 2-3 shows the 1-MG reservoir.

Figure 2-3. Shops reservoir

The Old Stage reservoir is a partially buried, concrete reservoir located at a higher elevation in the hills southwest of the city near Old Stage Road. The reservoir has separate inflow and outflow control valves to promote mixing in the reservoir. The inflow valve is an altitude valve with a check valve that only allows flow into the reservoir. The outflow valve is a flow control valve that regulates flow to prevent the reservoir from draining during summertime operations. Operations staff are challenged during summer months to maintain the chlorine residual in this tank, which will be discussed in more detail in Section 7. The Old Stage reservoir is pictured in Figure 2-4.

Figure 2-4. Old Stage reservoir

The Vilas reservoir is a partially buried, pre-stressed concrete reservoir located in Don Jones Park and near the Vilas MMS reservoir. The reservoir and adjoining PS were identified in the 2009 Master Plan and were constructed in 2012 to add fire and emergency storage to the system while also providing operational storage. The operational storage component of Vilas in combination with the Vilas PS has improved the City's ability to meet its contract terms with MWC by allowing the City to fill the Vilas reservoir during low demand periods and pump from the reservoir during high demand periods. The Vilas reservoir is shown in Figure 2-5.

Figure 2-5. Vilas reservoir

2.5 Flow Control Valves

There are eight FCVs in the City's water system, including one at each MMS—two at the Vilas tank and pump station, one at the Old Stage reservoir, and one at the Shops reservoir. Details for the flow control valves are listed in Table 2-8. Different settings are used for the MMS valves for the summer and low-demand seasons. The meter station valves frequently operate fully open during the summer without meeting the maximum flow setting due to inadequate head in the MWC system.

Table 2-8. Flow Control Valve Details

Valve	Control type	Typical Summer Setting		Typical Low demand Setting
Beall meter station	Pressure regulating	69-85 psi		70 psi
Hopkins meter station	Pressure regulating	79-90 psi		80 psi
Vilas meter station	Pressure regulating	69-95 psi		70-80 psi
Vilas pump station	Pressure regulating	69-95 psi		70-80 psi
Vilas reservoir inflow	Flow control valve	Opens during off peak hours at 1,500 gpm		1,500 gpm
Shops reservoir inflow	Flow control valve	Opens @ reservoir level <60% Closes @ reservoir level =100%		Same
Old Stage reservoir inflow	Altitude valve	Opens @ reservoir level <70% Closes @ reservoir level =100%		Same
Old Stage reservoir outflow	Percent open based on reservoir level (controls established and set by operator)	Reservoir Level	% Open	Same
		50%-100%	0-30%	

2.6 Pump Stations

Two pump stations operate within the City's water system, the Shops PS located at the Public Works Department maintenance shops, and the Vilas PS located adjacent to the Vilas reservoir in Don Jones Park. Table 2-9 shows the characteristics of each pump.

Table 2-9. Pump Station Details

Pump Station	Pump	Horsepower	Drive Type	Impeller Size (in)	Stages	Design Flow (gpm)	Design Head (feet)	Year Installed	Notes
Shops	1	40	Constant	8.52	4	900	130	1962	To be removed[a]
	2	40	Constant	8.52	4	900	130	1962	To be removed[a]
Vilas[b]	1	75	Variable	8.75	2	2,100	114	2012	AKA, supply pumps
	2	75	Variable	8.75	2	2,100	114	2012	
	4	150	Constant	9.65	3	2,100	223	2012	AKA, reservoir pumps 4, 5
	5	150	Constant	9.65	3	2,100	223	2012	

a. Shops pump station to be removed after installation of Beall pump station and removal of Shops reservoir.

b. Pump 3 is reserved for a future capacity increase.

2.6.1 Shops Pump Station

The Shops PS pumps from the Shops reservoir to the distribution system. There are two identical pumps at the PS and a pad for a third pump.

The total dynamic head for the operating point of the pumps was calculated from the suction and discharge pressures recorded in SCADA data. Flow rate through the pump station is not metered, so flow for the operating point of the pumps was calculated from the rate of change in the 1-MG reservoir level when the supply FCV to the reservoir was closed. Figure 2-6 shows the operating point compared to the manufacturer's pump curve for one pump running. The pump curve used in the model was adjusted to match the current operating point of the pumps.

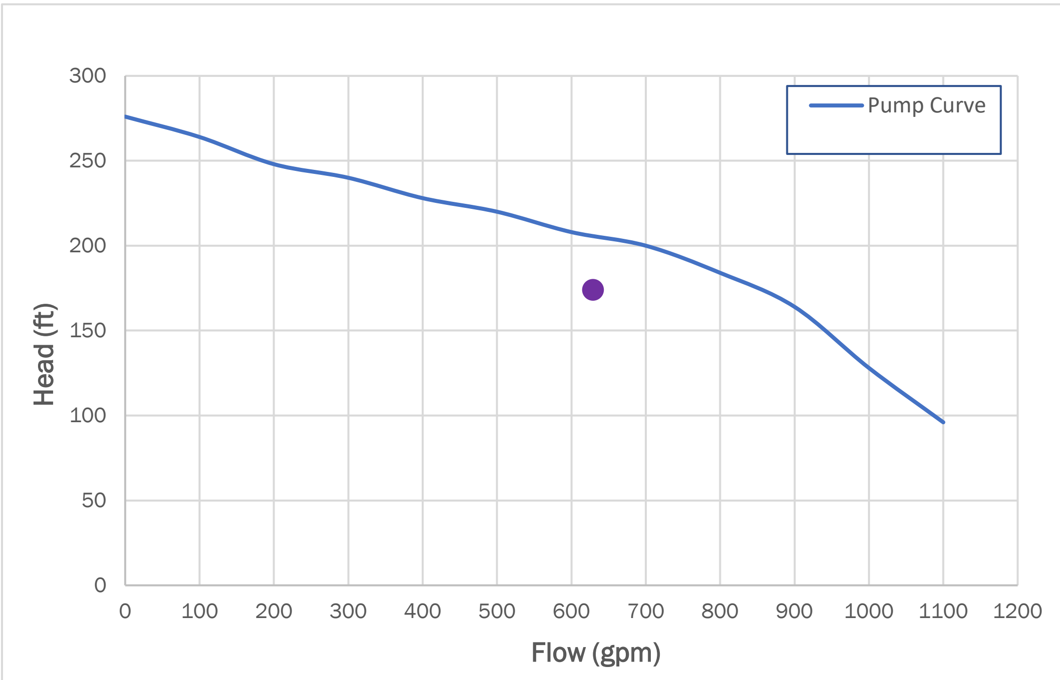


Figure 2-6. Shop pumps operating point vs. pump curve

2.6.2 Vilas Pump Station

The Vilas PS receives water from the MWC distribution system through the Vilas MMS. The major equipment at the PS includes two booster supply pumps, two reservoir pumps, a reservoir flow control valve, a pressure reducing valve (PRV) bypassing the pumps and SCADA system controls. The PRV and pumps are further described below:

- *PRV*–allows City to take supply directly on MWC HGL without pumping. Used primarily during lower demand periods when system can be supplied without exceeding contract terms and when HGL from MWC is adequate for system operation.
- *Supply pumps*–allows City to boost pressure from MWC. Used primarily during high demand periods when MWC HGL drops below the required City HGL. Controls are set to limit pumping rates within constraints of contract limits and to maintain system pressure and refill the Old Stage reservoir. Fluctuations in incoming HGL affect the flow produced by these pumps and sudden increases in incoming HGL can result in contract limit overages.
- *Reservoir pumps*–allows City to pump from operational storage to meet City peak demands while staying within contract limits. These pumps are also operated during low demand periods to boost system pressure to refill the Old Stage reservoir and also to turn over water in the Vilas reservoir.

The facility was also originally designed for addition of a future automatic backup generator, which was installed in 2020. There is also an open space for a fifth pump in the future.

Depending on the operational mode and demand conditions, water is pumped to the distribution system to maintain pressure and demand requirements or is pumped to the Old Stage reservoir to maintain its level. During peak demand periods, the supply and reservoir pumps operate to boost system pressures and mitigate peak demand draw from the MWC system by pumping from storage. During low demand periods when the incoming hydraulic grade line (HGL) from MWC is high enough to supply the system, the City will use the PRV and operate the reservoir pumps to meet morning demands and turn over water in the Vilas reservoir.

The total dynamic head for the operating point of the pumps was calculated from the suction and discharge pressures recorded in SCADA data. Flow rate through the pump station is metered and was also recorded in SCADA data.

Figures 2-7 and 2-8 below show the operating points compared to the manufacturer's pump curve for the two supply and two reservoir pumps running at full speed, respectively. These data were collected during field testing. The supply pump curve in the model was extended to match the current operating point of the pumps. No adjustments were made to the reservoir pump curve.

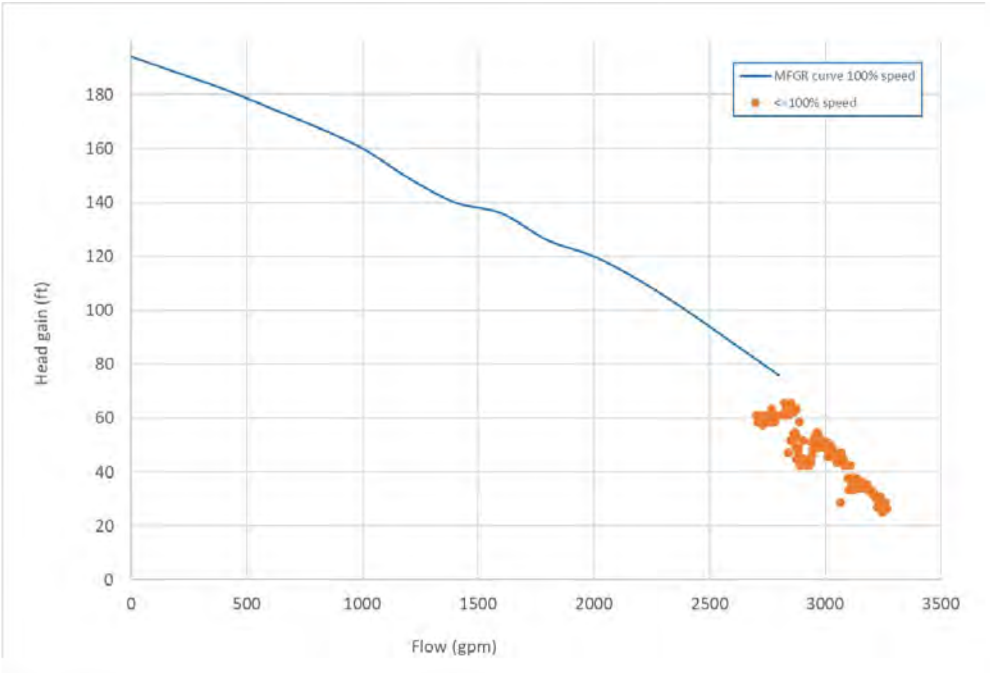


Figure 2-7. Vilas supply pumps operating point vs. pump curve

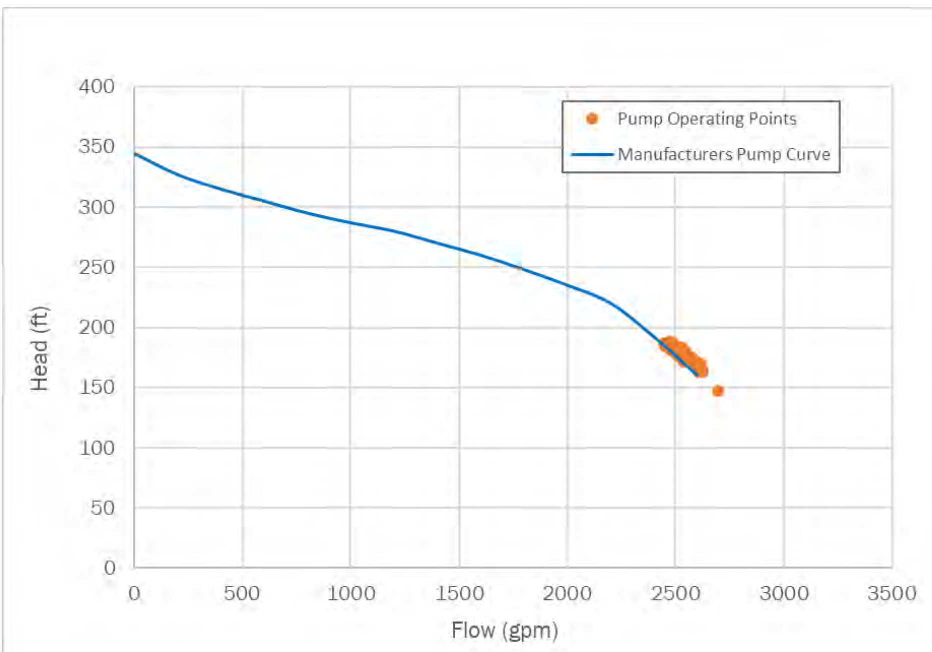


Figure 2-8. Vilas Reservoir pumps operating point vs. pump curve

Further discussion of the current operating points with respect to the manufacturer's pump curve is included in Section 7.1.3.

2.7 Pipe Network

The City's existing distribution system consists of piping ranging in diameter from 4–16 inches. The majority of the 16-inch piping serves as transmission piping from the 2-MG reservoir and the Beall and Vilas MMSs. The City has created a network of 12-inch transmission piping throughout the water system, which conveys water from the reservoirs and MMSs to the distribution mains. The total length of piping in the system is about 93 miles. Table 2-10 lists the length of piping in the water system by pipe material and diameter and Figure 2-9 shows the breakdown by material type.

Table 2-10. Water System Piping

Pipe material	Length (feet) by pipe diameter (inches)							
	4	6	8	10	12	16	>16	Total
Asbestos cement (AC)	2,282	27,061	21,944	3,346	22,032			76,665
Cast iron (CI)	33,180	7,369	689		2,217			43,455
Copper								0
Ductile iron (DI)[a]	5,305	31,561	178,924	3,263	119,312	22,985	1,783	363,133
Galvanized steel								0
Polyvinyl chloride (PVC)	510	758	7,403					8,671
Total	41,277	66,749	208,960	6,609	143,561	22,985	1,783	491,924

a. DI pipe type varies; some DI pipe includes restrained joints.

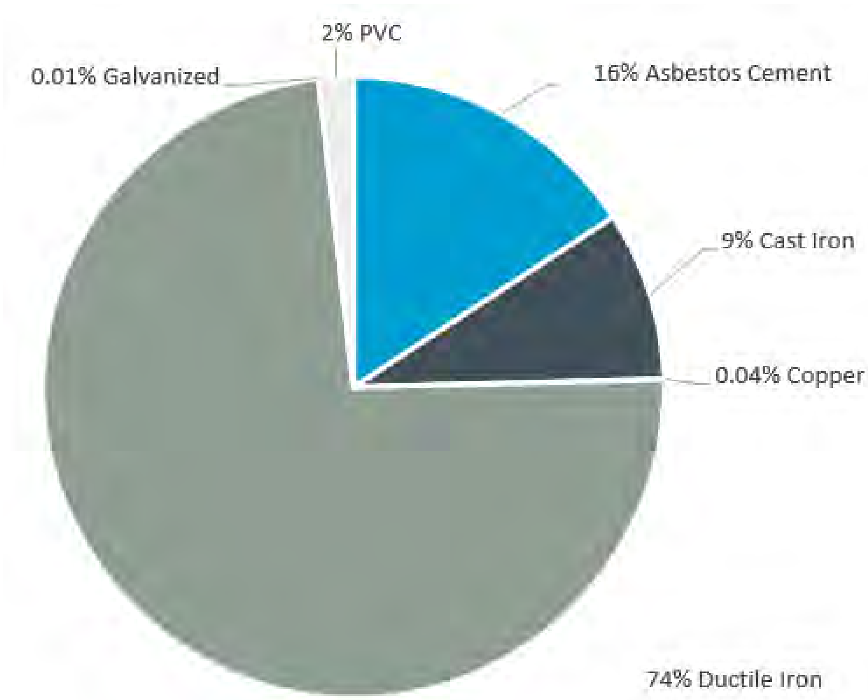


Figure 2-9. Distribution system piping by material type

Section 3

Water Demands

Existing and future water system demands were updated as part of the Central Point Water System Master Plan (Master Plan) Update. Scenarios were developed for both maximum day demand (MDD) and average day demand (ADD) circumstances. This section describes the data sources and the process used to develop updated system demands.

Data sources available for the demand update included:

- Population projections from 2018–2068 Coordinated Population Forecast (Portland State University, 2018)
- City billing records (9/20/17–12/20/18)
- Customer meter locations (received 1/05/19)
- Parcel land use type (received 1/5/19)
- SCADA records (daily total flow from 7/01/13–12/01/18)
- Vacant lands and Urban Growth Boundary (UGB) expansion areas (received 1/25/19, updated 3/4/20)

The framework for the demand update is outlined here and described in detail in the following sections.

3.1 Existing System Demands

SCADA records of total supply flow from MWC for July 2013 through December 2018 were used to determine the existing ADD and MDD. Unusually high total demand for low flow months in 2018 led to the selection of the 2017 year as the basis for total existing ADD. The historical system MDD was determined by selecting the day of maximum demand from the entire 2013-2018 period (8/25/2016) and identifying the MDD-to-ADD scaling factor of 2.53 from those data. Table 3-1 lists total system demands for each year. Based on the 2017 population of 18,929 and ADD of 2.73 mgd, the existing per capita use rate was calculated as 144 gallons per day (gpd) per person.

The existing condition model analysis and system evaluation will use a projected 2020 population of 19,714, ADD of 2.84 mgd, and MDD of 7.20 mgd.

Table 3-1. Total Existing Demand

Year	Demand (mgd)		Demand (gpm)		ADD-to-MDD Scaling Factor
	ADD	MDD	ADD	MDD	
2013 [a]	2.59	5.62	1,794	3,904	2.18
2014	2.42	6.15	1,683	4,270	2.54
2015	2.57	6.15	1,786	4,269	2.39
2016	2.69	6.83	1,871	4,742	2.53
2017	2.73	6.16	1,895	4,275	2.26
2018	3.12	6.13	2,166	4,259	1.97

a. Only 6 months of data was available for 2013, starting in July.

3.2 Future System Demands

At the time of this update, the City was in the process of amending its UGB to accommodate future growth through the year 2040. The incorporation of additional land into the City's UGB will support the projected population increase by adding the following acreages per land use classification:

- 324.8 acres of residential
- 34.7 acres of employment
- 54.9 acres of core parks
- 5 acres of open space
- 15.1 acres of Bear Creek Greenway
- 11.5 acres of right of way

The future service area includes the City's established UGB and four 20-year expansion areas.

- Taylor-West (CP-6A)
- Peninger Road (CP-3)
- Boes Avenue (CP-4D)
- Green Valley (CP-2B)

Figure 3-1 shows the location of expansion areas relative to the City's existing water system. The following subsections discuss each of the four UGB expansion areas.

3.2.1 Taylor-West (CP-6A)

The proposed Taylor-West expansion consists of approximately 236 acres that will be developed into a mix of residential parcels (low-, medium-, and high-density) as well as commercial uses. This expansion area is located on the west side of the city and will be connected to the existing distribution system along Taylor Road, Grant Road, and Twin Creeks Crossing. A skeleton network of 12-inch-diameter distribution system pipes was added to the water system model to represent development in this area and allocate system demands. Actual piping within the expansion area will be developer-built and configured to meet City standards.

3.2.2 Peninger Road (CP-3)

The proposed Peninger Road expansion area consists of approximately 34 acres of commercial, greenway, parks, and open space land use. This expansion area is served by an existing 16-inch transmission main that extends from Beebe Road across Bear Creek to the existing 12-inch pipeline on Peninger Road. A new developer-built, 12-inch-diameter distribution pipe is also planned to add a parallel pipeline from the Bear Creek crossing to Peninger Road along the proposed alignment for the extension of Beebe Road.

3.2.3 Boes Avenue (CP-4D)

The Boes Avenue expansion area consists of approximately 23 acres proposed primarily for parks and open spaces, with the exception of one, low-density residential lot. This lot is located at the end of the existing 8-inch-diameter distribution pipe on Boes Avenue. No additional distribution or transmission piping is anticipated as a result of this expansion area.

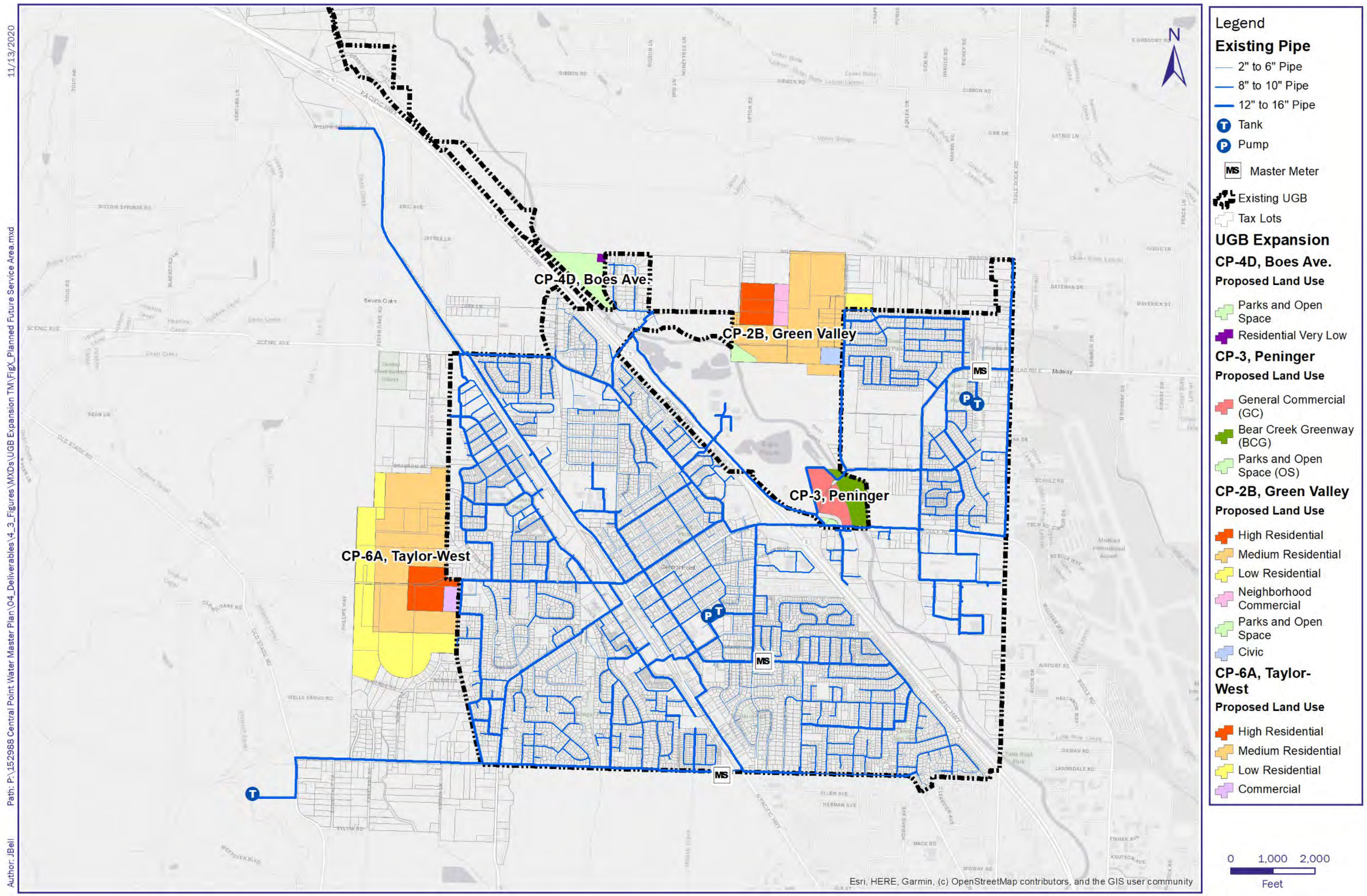


Figure 3-1. Planned future service area

3.2.4 Green Valley (CP-2B)

The proposed Green Valley expansion area consists of approximately 163 acres located in the northern portion of the city. It is expected to be developed into a mixture of low-, medium-, and high-density residential land use parcels. This area will be connected to the existing distribution system along Gebhard Road and extend up to Wilson Road to the north and Upton Road to the west. A skeleton network of 12-inch-diameter distribution system pipes was added to the water system model to represent development in this area and allocate system demands. Actual piping within the expansion area will be developer-built and configured to meet City standards. It is expected that this area will develop along Gebhard Road first and move west as infrastructure to support development in this area is progressively built out by developers.

3.2.5 Future System Demand Summary

Total system demands for future system evaluations were based on population projections and the existing per capita demand. For example, using this population projection and per capita use rate method, the 2040 total system ADD was calculated as 3.85. An ADD to MDD scaling factor of 2.53 calculated from the 2016 water demand as described above was used to project the MDD from ADD for each horizon. A 2027 demand line item was added to size improvements needed once the Shops tank and pump station is removed. A reduction in future system per capita demand due to conservation was not included in the scope of this analysis but should be considered in the next water system master plan update.

Future demands are summarized in Table 3-2 and shown in Figure 3-2.

Table 3-2. Total Future Demand

Year	Population Projection [a]	Demand (mgd)		Demand (gpm)	
		ADD	MDD	ADD	MDD
2020	19,714	2.84	7.20	1,973	5,001
2027	21,789	3.14	7.96	2,181	5,527
2030	22,920	3.30	8.37	2,294	5,814
2040	26,707	3.85	9.76	2,673	6,774

a. *Source: Portland State University, 2018.*

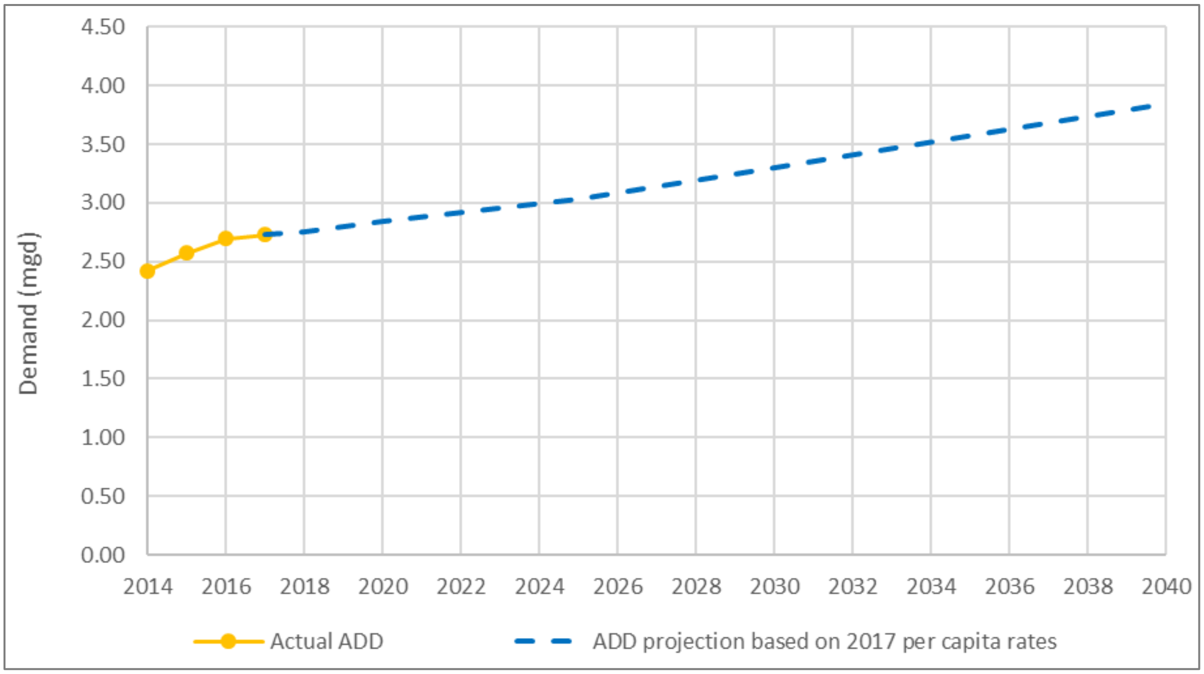


Figure 3-2. Projected demand growth

3.3 Fire Flow Demands

Fire flow demands are used to evaluate the system capacity to supply adequate water for fire suppression. Each land use type in the City's planning information was assigned a fire flow demand. Table 3-3 lists the assigned fire flow rates for both existing and future system evaluations. These estimates are based on general information provided by the fire district for the previous master plan. The City did not provide fire demands for any structures within the system service area that exceeded the demands listed in Table 3-3.

Table 3-3. Fire Flow Demands

Land use	Fire flow (gpm)	Duration (hr)	City Lot Type Code
Industrial	3,500	3	HI, LI
Institutional (public)	3,500	3	PUBLIC
Commercial	2,500	3	GC, HC, LC
Mixed use	2,000	2	MU, LMR, HMR
Multifamily residential	1,500	2	MFD, MFR, MH, MHP
Single-family residential	1,000	2	SFR

Section 4

Computer Model Update

A hydraulic computer model of the City of Central Point's (City) water distribution system was updated to be used as a tool for evaluating the existing system and any proposed improvements to the system. The City has made several improvements to their water system since the last system-wide model update completed by Brown and Caldwell (BC) for the 2009 Master Plan. Due to the 2008 recession, the City has also experienced reduced growth that did not match previous projections. Model facilities and demands were updated to match current conditions and the most recent demand projections. This section provides a basic description of the model, model scenarios, demand allocation, and model calibration.

4.1 Model Facilities and Control Strategy Update

To effectively capture recent improvements to the City's water system, the City provided GIS data of the water system pipes. This information was used to update the existing water system model for the Vilas, Hopkins, Shops, Beall, and Old Stage Reservoir facilities. Figures 2-1 and 2-2 in Section 2 of this report show the physical location and hydraulic impact of each facility within the current system.

The City has developed a control strategy in order to meet their contract limits with MWC that aims to serve the system from storage during the morning peak demand period (Drain Setting) and refill system storage while meeting system demands during the evenings (Fill Setting). The drain and fill settings described below were incorporated into the model facility controls and refined during model calibration.

4.1.1 Drain Setting

The drain setting is typically used between the hours of 4:30 a.m. and 3 p.m. The objectives of the drain setting are to use Central Point storage to meet contract limits set by MWC and to drain the 2-MG reservoir as close to 40 percent level as possible and drain the Vilas reservoir as close to 50 percent as possible to maintain the chlorine residual in the system. The actual pressure and time set points are dependent on incoming head and demand.

4.1.2 Fill Setting

The fill setting is typically used between the hours of 3:00 pm and 4:30 am. The objectives of the fill setting are to refill Central Point storage sufficiently to prepare for the morning peak demand which immediately follows this timeframe. Despite being outside of the morning peak hours, it can be challenging for the City to maintain contract limits during the evening peak while also filling storage reservoirs to prepare for the following day.

4.2 Model Scenarios

Several scenarios were created for this project to simulate system performance with different system demands and operational settings. Scenarios were also added to the model to include different facilities for future planning purposes. The scenarios included in the model can be categorized as follows:

- *Base*: This scenario was not used for evaluation purposes, only to store model facility data for the other scenarios.

- *Hydrant Tests*: HT1A, HT2A, HT3, and HT4A scenarios were developed to simulate the system at the time of each hydrant test, which were used to verify the model network.
- *2019 EPS Calibration*: This scenario simulates the system during the selected day for the dynamic model calibration, which was used to develop model controls that represent the operational settings used during MDD.
- *Existing (2020)*: These scenarios evaluate the existing system.
  - 2020ADD_SHOPS. Water age analysis
  - 2020MDD_SHOPS. MDD system evaluation with Shops in place.
- *Future*: This scenario evaluates the proposed future improvements for the 2025 planning horizon.
  - 2025MDD. MDD system evaluation without Shops.
- *Future*: These scenarios evaluate the proposed future improvements for the 2040 build-out horizon.
  - 2040ADD. Water age analysis
  - 2040MDD. MDD system evaluation.

All scenarios except for the base and hydrant test scenarios are extended period simulations of 24-hour or longer operations in the system.

4.3 Model Demands

The existing and future demands described in Section 3 of this report were allocated in the model as described below. The following descriptions explain how existing demand allocation is based on customer billing data and future demand allocation adds future developable land to the existing demand allocation.

4.3.1 Existing System Demand Allocation

Existing system demand allocation consists of appropriately distributing the total system demand in the computer model. The following steps describe how the existing system demands were assigned to the model. Figure 4-1 illustrates the process graphically.

1. Obtain billing data including addresses for each customer and calculate the MDD of each (described in Section 3).
2. Geocode (locate geographically) each of the customers either by matching the customer to a parcel or by street address.
3. Flag each junction in the model as a demand junction or non-demand junction. Non-demand junctions will not have a demand, such as junctions on a transmission pipeline or at a pump station or storage reservoir.
4. Calculate the total demand at each demand junction as the sum of the demand for the customers closest to each junction.

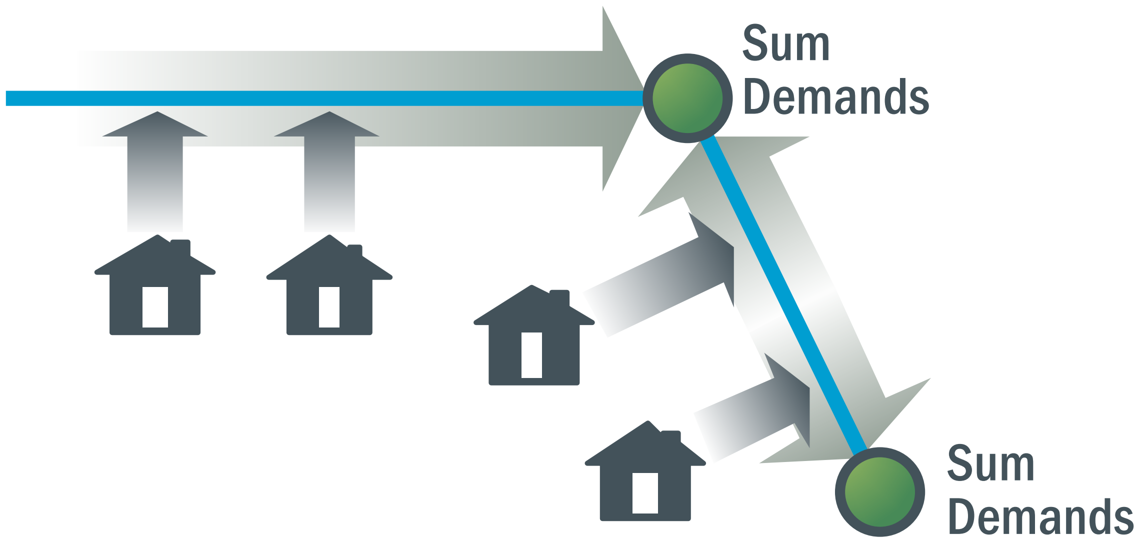


Figure 4-1. Existing demand allocation from billing data

4.3.2 Future Demand Allocation

Future system demand allocation involves distributing the projected future system demands to the appropriate nodes in the computer model. This includes accounting for infill growth within the existing limits and development of new expansion areas. In the years 2020, 2025, and 2040, the total system demand in the model is based upon population projections. The allocation of that demand is determined through application of UURs to UGB expansion areas and undeveloped land, vacant land, and under-developed land within the existing UGB.

The UURs were calculated for each land use type using the 2017 average day demands calculated from billing data for currently developed lands within the City. After using the unit use rates to apply demands to the 2040 build-out land use condition, they were scaled to meet the population-based demand projection.

The City's Planning Department provided a breakdown of zoning within the UGB, vacant lands, undeveloped/underdeveloped lands, and land use for expansion areas which was used in this analysis.

Table 4-1 lists the unit use rates per land use category that were calculated based on 2017 existing condition average day demands and will be applied to the model.

Table 4-1. 2040 Build-Out Demand Area

Land Use	Area (acres)	Unit Use Rate (gpm/ac)	Unit Use Rate (gpd/ac)
Bear Creek Greenway (BCG)	72	No demand	No demand
I-5 Highway (I5)	36	No demand	No demand
Commercial: medical district (C-2(M))	12	0.67	967
Tourist and office (C-4)	58	1.16	1,668
Thoroughfare commercial (C-5)	5	0.35	500
Civic	92	0.88	1,269
Neighborhood commercial (CN)	6	0.32	456

Table 4-1. 2040 Build-Out Demand Area			
Land Use	Area (acres)	Unit Use Rate (gpm/ac)	Unit Use Rate (gpd/ac)
Employment commercial (EC)	26	0.97	1,392
General commercial (GC)	49	0.87	1,258
High mix residential/commercial (HMR)	26	1.27	1,834
Low mix residential (LMR)	85	1.46	2,098
Industrial (M-1)	61	0.06	88
General industrial (M-2)	36	0.10	147
Medium mix residential (MMR)	36	1.60	2,307
Open space (OS)	60	0.70	1,009
Single-family residential: 10,000 (R-1-10)	28	1.34	1,928
Single-family residential: 6,000 (R-1-6)	365	1.25	1,798
Single-family residential: 8,000 (R-1-8)	393	1.25	1,803
Two-family residential (R-2)	106	1.40	2,012

There were two additional land use categories within the UGB expansion areas not represented by this analysis, High Residential and Medium Residential. The High Residential category was assigned a UUR of 1.43 and the Medium Residential category was assigned a UUR of 1.53.

The following steps describe how the future system demands were assigned to the model.

1. Build a backbone pipe network that represents major distribution mains within currently undeveloped portions of the City's UGB along expected transportation routes.
2. Obtain shapefiles of the general land use plan and develop unit-use rates for each land use category. Calculate the total demand for each land use area (described in Section 3.1).
3. Flag each junction in the expanded portion of the model as a demand junction or non-demand junction. Non-demand junctions will not have a demand, such as junctions on a transmission pipeline or at a pump station.
4. Assign demands from proposed expansion areas to demand junctions by multiplying the area of each lot and land use category with the corresponding unit-use rates. Once applied the future system model nodes now have assigned demands based on 2020 use rates.
5. Scale up demands across all demand nodes to match the total system demand projection (described in Section 3.2).

4.4 Diurnal Pattern

The daily water use pattern, or diurnal pattern, represents the fluctuation in demand over a given day. The MDD diurnal pattern was calculated from SCADA records of reservoir levels and flow rates through the MMSs from the summer of 2019. In the fall of 2019, the City experienced a malware attack that resulted in the loss of all historical SCADA data and programming. Due to the inability to obtain historical SCADA data for development of a separate ADD pattern, the same pattern was used for the MDD and ADD scenarios, shown in Figure 4-2.

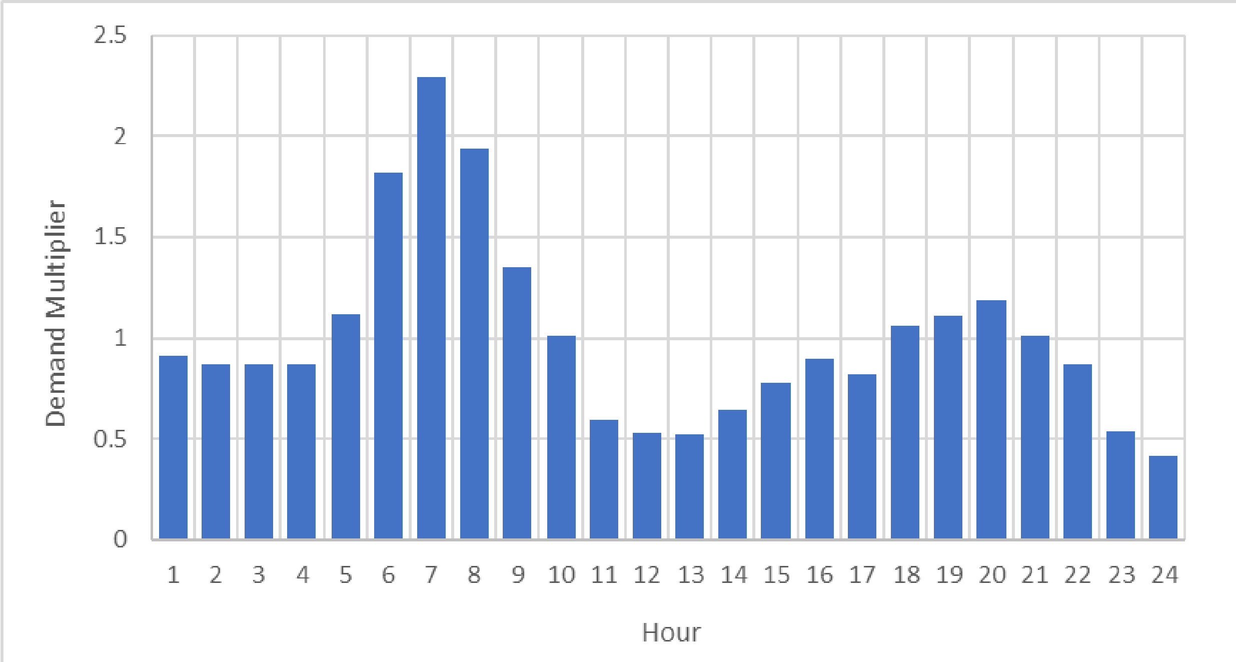


Figure 4-2. Diurnal pattern

4.4.1 Fire Flow Demand Allocation

Fire flow sets were created for the fire flow evaluation of the existing and future system. The fire demands used are listed in Table 3-3. The City's GIS shapefile of existing hydrants was incorporated into the model. Fire flow demands were assigned to these hydrants based on land use types. In the future condition model, hydrants were added to the backbone pipe network. Demands were also assigned based on identified land use types within these areas.

4.5 Model Calibration

The model was calibrated to ensure that model results are representative of actual system operations. Model calibration involves adjusting model parameters until model results match field test data. The calibration test plan created for collecting field data for the model calibration is available in Appendix B. Representatives from BC and the City then performed the field testing. Both hydraulic (steady-state) and operational (dynamic) calibrations were performed on the model.

4.5.1 Steady-State Calibration

The purpose of steady-state calibration is to verify pipe connectivity (how pipes connect to other pipes), pipe roughness factors, and the elevation of facilities (i.e., reservoirs, pumps, and valves) in the model. Field data from the four hydrant tests performed on the system were used for the steady-state calibration.

The steady-state calibration scenarios in the model were set up to represent the system on the day of testing. Demands for each scenario were scaled to match system demands at the time of the test. Pump status and reservoir levels were set to match SCADA records at the time of each test.

Adjustments were made to the model until pressures in the model matched the recorded field data from before and during the hydrant test. Some connectivity issues were corrected, and some closed isolation valves were identified in areas that were under construction at the time of the test. Roughness factors were not adjusted during calibration.

The field test data and the steady-state calibration results are summarized in Appendix C.

4.5.2 Dynamic Calibration

The purpose of dynamic calibration is to verify the operational control settings in the model (i.e., valve settings and pump on/off controls). This was done by running a 24-hour dynamic model simulation with demands from the selected day of calibration using model controls set to replicate SCADA control settings indicated by City operations staff. August 7, 2019, was the selected day for comparison of model results to the City's SCADA data because it was one of the highest demand days during the summer 2019 record which was available at the time of calibration.

Overall, the dynamic calibration verified the results of the steady-state calibration and showed that the model provides an accurate representation of the water system. Replicating the flow split from the City's overall supply through each of the MMSs was challenging given the fluctuation of incoming HGL from MWC and sensitivity of the system to pressure settings at MMS control valves. City operational staff also experience a similar challenge in balancing flows through MMSs and in regulating flow to stay within MWC contract limits. Improved control of incoming flow is discussed further in the system evaluation and capital program development sections of this report.

Graphs of dynamic calibration results which show City SCADA data from August 7, 2019, compared to model results are shown in Appendix C.

Section 5

Level of Service Goals

A description of level of service goals and other criteria to be used for evaluating the existing drinking water system and for the design of future improvements in the model is presented in this section. It lists the specific capacity, operations, and reliability requirements for supply, piping, pumping, and storage facilities. The criteria were developed to ensure the desired level of service to each customer served by the City of Central Point (City) and to maximize the efficiency of the future system.

5.1 Reference Documents

The criteria herein are based on state regulations and industry standards. Where not otherwise established, criteria are based on engineering experience. The following documents were reviewed to develop the criteria:

- *Oregon Administrative Rule (OAR) 333-061 [OAR, 2018]*. This document contains the state regulations for drinking water.
- *Recommended Standards for Water Works [WSC, 2018]*. This document, frequently referred to as the Ten State Standards, is 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 industry as a standard for the evaluation and design of water systems.
- *Manual of Water Supply Practices, M32, Computer Modeling of Water Distribution Systems [AWWA, 2012]*. This document was referenced where criteria were not provided by the documents listed above.
- *Medford Water Commission Water Distribution System Facility Plan [MWC, 2007]*. This document includes the criteria used by the Medford Water Commission (MWC) for the evaluation and design of water distribution system facilities.

5.2 Supply Criteria

The City obtains its water through a wholesale agreement with MWC (included in Appendix A) which establishes a maximum flow rate to be supplied to the City MMSs. The City is responsible for limiting total demand on the MWC system to that flow rate, and MWC is responsible to ensure that there is adequate capacity and reliability in its system supply facilities. From October through April the supply limits are currently 0.92 times 2020 ADD for the hours of 5am to 11am and 1.64 times 2020 ADD for all remaining hours. From May through September the supply limits are currently 1.14 times 2020 MDD for the hours of 5am to 11am and 0.99 times 2020 MDD for all remaining hours.

To ensure that elevated storage reservoirs in the city can be used appropriately to serve PHD, water must be supplied to the city system at a hydraulic grade that is consistently at or above the overflow elevation of the elevated storage. However, during the summer months, the incoming hydraulic grade line from MWC fluctuates and does not consistently supply the system at a high enough grade to refill storage. The City constructed the Vilas storage reservoir and pump station in 2013 to limit peaking from the MWC system. Vilas provides pumped ground storage to supplement supply from the elevated 2-MG Old Stage reservoir during PHD. The goal of this system was to fill Vilas reservoir during off-peak times from the Vilas MMS and pump from storage to meet peak hour demands and has significantly lowered the City's peak hour draw on the MWC system. However, the City's ability to meet current contract limits remains highly dependent on incoming HGL at the Vilas MMS. When incoming HGL increases, it results in an increased flow response from the supply pumps due to the lowered head gain required. In the summer of 2020, these fluctuations caused some contract limit overages. Given the difficulty of manually monitoring and operating the Vilas supply pumps to match incoming HGL, it is recommended that future contract limits provide more flexibility and allow for an additional 10% increase in demand limit from 5 am to 11 am and an additional 15% increase all other times. It is also recommended that future contracts include the allocated flow rates at the time of contract signature with an escalation based on population increase for each year within the contract time frame.

Supply criteria are summarized in Table 5-1.

Table 5-1. Supply Criteria

Criteria	Value\Description	Reference

Current Rate of Supply	• October through April
	  • 1,833 gpm from 5 a.m. to 11 a.m.
	  • 3,255 gpm all other times
	• May through September
	  • 4,958 gpm from 5 a.m. to 11 a.m.
	  • 5,700 gpm all other times
		MWC, 2016

Recommended Future Rate of Supply	• October through April
	  • 1.00 times annual ADD from 5 a.m. to 11 a.m.
	  • 1.90 times annual ADD all other times
	• May through September
	  • 1.25 times annual MDD from 5 a.m. to 11 a.m.
	  • 1.15 times annual MDD all other times
		City

Head	Maintain the hydraulic grade of the system supply high enough to recharge elevated storage reservoirs during MDD.	City
Redundant Capacity	Meet capacity requirements with the largest producing pump out of service.	WSC, 2018
Power Supply	At least two independent power sources or a standby/auxiliary source should be provided (e.g., generator).	WSC, 2018

a. 2040 rates of supply assume that the average of MDD will be provided during the morning peak. All other times assume a 15 percent increase from MDD, which is consistent with the current contract.

5.3 Pipe Criteria

Water system piping is categorized as transmission or distribution piping. Transmission piping conveys water between major facilities such as wells, pump stations, and reservoirs and from those facilities to the distribution system. Distribution piping provides local distribution of water to individual user service laterals.

Table 5-2 lists the capacity and reliability criteria for evaluating and designing the water system piping.

Table 5-2. Pipe Criteria		
Requirement	**Value\Description**	**Reference**
Diameter	As calculated to meet pressure, velocity, and head loss requirements for all flow conditions. Employ a minimum of 8 inches for distribution lateral mains in residential areas, and a minimum 12 inches in multiple-dwelling, commercial, and industrial areas.	City
Pressure		
Maximum operating	120 psi	City OAR, 2018
Minimum operating	35 psi	
Minimum during a fire	20 psi	
Velocity		
Maximum for design pipe [a]	5 feet per second (fps)	AWWA, 2017
Maximum for existing pipe	10 fps	
Fire flow performance [b]		
Residual pressure	20 psi during MDD for designated fire flow demands[1]	ICC, 2018
Maximum head loss for MDD [c]		
Transmission pipe (design)	2 feet/1,000 feet	AWWA, 2017
Distribution pipe (design)	6 feet/1,000 feet	
Reliability		
Transmission	Provide redundant supply lines to hydraulically isolated areas wherever feasible.	WSC, 2018
Distribution	Wherever possible, dead ends shall be minimized by looping. Where dead ends are installed, or low points exist, blow-offs of adequate size shall be provided for flushing.	
Location	Wherever possible, distribution pipelines shall be located on public property. Where pipelines are required to pass through private property, easements shall be obtained from the property owner and shall be recorded with the County Clerk.	OAR, 2018

a. AWWA recommends a maximum of 5 fps to avoid high head loss. The cost of adding piping to meet this criterion may exceed the benefit; therefore, this criterion is provided by way of recommendation rather than requirement.

b. Fire flow demands listed in Section 3 of the City's water master plan.

c. AWWA recommends these criteria to avoid high operating costs. The cost of adding piping to meet these criteria may exceed the benefits; therefore, these criteria are provided as recommendations rather than requirements.

5.4 Pump Station Criteria

Two types of pump stations are considered in this study: pump-storage and booster. Pump-storage pump stations pump from a storage reservoir directly to the distribution system and are frequently used to serve PHD. Booster pump stations add energy, or head, to maintain a flow rate and/or a hydraulic grade from a pressure zone or water system to another which is served by one or more storage reservoirs.

The existing Shops pump station is a pump-storage station located at the Public Works Department maintenance shops. The existing Vilas pump station has the capability to pump from the existing Vilas storage reservoir or to boost grade from the Vilas MMS. Table 5-3 summarizes the evaluation and design criteria for the existing and future pump stations.

Table 5-3. Pump Station Criteria		
Criteria	**Value\Description**	**Reference**
Minimum capacity		
Pump-storage	Designated portion of PHD (PHD minus the flow rate from elevated storage reservoirs in the system).	Engineering judgment
Booster	Supply the peak day against the required distribution system pressure.	WSC, 2018
Reliability [a]		
Redundancy	Areas served by pumps should have a minimum of two supply pumps.	WSC, 2018
Redundant pump sizing	Pumps should be sized to meet the minimum capacity requirement with the largest pump out of service (redundant fire pumps are not necessary).	WSC, 2018
Power supply	At least two independent power sources or a standby/auxiliary source (e.g., generator) should be provided.	WSC, 2018
Suction reservoirs	Wherever possible, booster pumps shall take suction from reservoirs to avoid the potential for negative pressures on the suction line which can result when the pump suction is directly connected to a distribution main.	OAR, 2018
Operations [a]		
Minimum suction pressure	Pumps that take suction from distribution mains for the purpose of serving areas of higher elevation shall be provided with a low-pressure cut-off switch on the suction side set at no less than 20 psi.	OAR, 2018
Control settings	Provide adequate range between high/low pressure or reservoir level settings to prevent excessive cycling of the pump.	WSC, 2018
Location		
Elevation	Pump stations shall be located a minimum of 3 feet above the 100-year flood elevation, or 3 feet above the highest recorded flood.	WSC, 2018

a. All three types of pump stations.

5.5 Storage Criteria

The volume of storage required for a service area typically consists of three components: equalization, fire, and emergency storage. Key characteristics of each storage type are described below.

- *Equalization storage* is used to meet demands when they exceed supply to the system (e.g., during peak demand periods). Figure 5-1 shows the City's current diurnal demand pattern versus supply along with current contract limits. The equalization storage is equal to the diagonally hatched pattern area of the figure indicating supply from reservoirs. Supply is assumed to be equal to the average of MDD and is constant throughout the day.
- *Fire storage* is reserved to supply fire demand for the duration of a fire event.
- *Emergency storage* is reserved to provide water during events such as power outages, standard maintenance procedures, natural disasters, facility failures, etc.

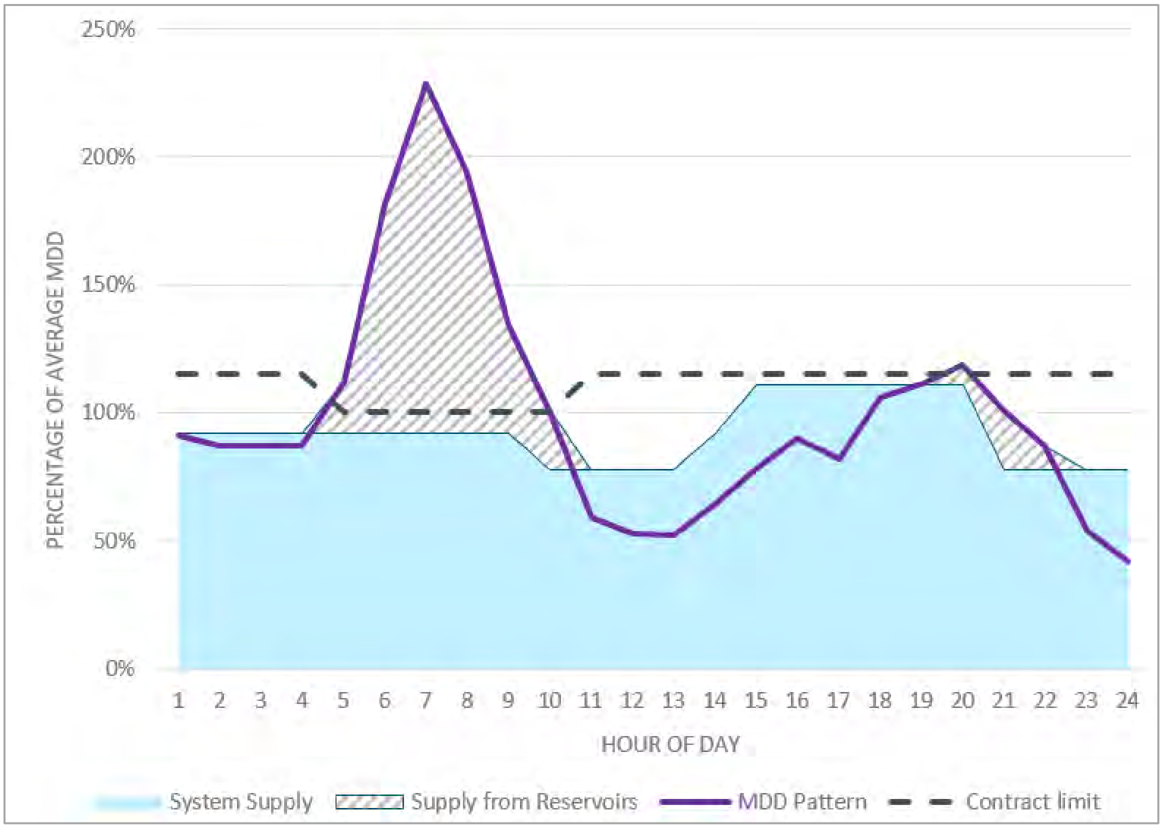


Figure 5-1. Required equalization storage

Table 5-4 summarizes the standards for determining the total volume needed to meet the three required components of storage capacity and includes guidance on storage reservoir operations.

Table 5-4. Storage Criteria

Criteria	Value\Description	Reference
Capacity		
Equalization	Volume to serve demand in excess of supply to the reservoir service area for MDD	MWC, 2018
Fire	Volume required to supply the largest needed fire flow of the service area for the required fire flow duration	WSC, 2018
Emergency	Volume is one-third of MDD	MWC, 2018
Operations		
Water quality	Excessive storage capacity should be avoided to prevent water quality issues.	WSC, 2018
Controls	Use adequate controls to prevent unintentional overflow or draining of the storage reservoirs (e.g., pump controls, altitude valves).	WSC, 2018

5.6 Seismic Performance Criteria

The seismic performance criteria for the water system are intended to ensure reasonable levels of emergency water supply in accordance with the Oregon Resilience Plan (ORP). These goals need to be tailored to account for Central Point's unique local conditions and needs. The seismic resiliency of the water system is evaluated in Section 6. Projects to improve the seismic resiliency of the system are provided in Section 8.

5.6.1 Oregon Resilience Plan Goals

The ORP sets target states of recovery for water systems after a major earthquake (OSSPAC 2013). These represent suggested long-term goals (50-year planning horizon) for water system readiness in case of a magnitude 9.0 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 5-2 provides a graphical representation as presented in the ORP, that summarizes desired recovery states for water systems in the valley, which most closely represents the geographical area that Central Point is located in. Further interpretation and discussion of this information is included below.

Table X. Target States of Recovery: Water and Wastewater Sector (Valley)–Oregon Resilience Plan

	Event Occurs	0-24 hours	1-3 days	3-7 days	1-2 weeks	2-4 weeks	1-3 months	3-6 months	6-12 months
Supply Sources		Red	Yellow		Green			X	
Backbone System		Green					X		
Supply for Critical Facilities		Yellow	Green				X		
Supply for Fire Suppression at Key Supply Points		Green		X					
Supply for Fire Suppression at Fire Hydrants		Green		Red	Yellow	Green			X
Supply to Community Distribution Points			Yellow	Green	X				
Full Distribution System Supply			Red	Yellow	Green				X

Red	*20-30 percent operational*
Yellow	*50-60 percent operational*
Green	*80-90 percent operational*
X	*90-100 percent operational*

Figure 5-2. Summary of desired recovery states for water systems

Source: OSSPAC 2013.

The City receives its water supply from MWC and does not have control over the performance of the supply source or main transmission to the City's boundary. MWC does not have a current master plan which includes a seismic risk assessment and hazard mitigation plan, but upon update of the MWC plan, the City plans to coordinate further on level of service recovery goals with MWC.

5.6.2 Seismic Evaluation Criteria

To estimate the likelihood of damage to buried water pipe in a seismic event, the American Lifelines Alliance (ALA) developed methods for estimating seismic fragility for water pipes in its April 2001 report titled *Seismic Fragility Formulations for Water Systems* (ALA 2001). These methods are based on the frequency of pipe breaks in past earthquakes and correlated this with the ground shaking and measured ground movements (e.g., from liquefaction and landslides) at the site of the break.

A break is defined as pipe damage severe enough to require a repair. Different pipe sizes, locations, and materials are accounted for by using modification factors. Water agencies frequently use these methods, listed below, to estimate the seismic resiliency of their pipe networks. Ground shaking and permanent ground deformation have different effects on pipe breakage and are evaluated separately as listed below.

- *Ground Shaking*. Ground shaking refers to transient soil deformations caused by seismic wave propagation. Ground shaking affects a wide area and can produce well-dispersed damage. The level of ground shaking at a pipeline location can be measured in terms of horizontal peak ground velocity (PGV). During this study, the PGV map from the Oregon Department of Geology and Mineral Industries (DOGAMI) for the magnitude 9.0 CSZ earthquake is reviewed and used.
- *Permanent Ground Deformation from Liquefaction and Landslide*. Strong ground shaking can also cause geologic hazards such as soil liquefaction, lateral spreading, and landslide. The amounts of these seismic geologic hazards are measured in terms of permanent ground deformation (PGD), which have more adverse impact to the pipelines. During this study, the DOGAMI PGD maps for liquefaction, lateral spreading, and landslide are verified and reviewed. Modifications are made based on the geotechnical and seismic hazard reviews. The modified maps are then used in the fragility analysis.

Based on analysis of pipe repairs required after past earthquakes, the 2001 ALA publication developed fragility curves and formulas for estimating seismic fragility. These equations, shown in Figure 5-3, relate magnitudes of PGV from ground shaking and PGD from various ground deformations to repair rates per length of pipe.

Hazard	Vulnerability Function	Lognormal Standard Deviation, β	Comment
Wave Propagation	$RR = K_1 \times 0.00187 \times PGV$	1.15	Based on 81 data points of which largest percentage (38%) was for CI pipe.
Permanent Ground Deformation	$RR = K_2 \times 1.06 \times PGD^{0.319}$	0.74	Based on 42 data points of which the largest percentage (48%) was for AC pipe.

Notes:
1. Table derived from (American Lifelines Alliance 2001, Table 4-4)
2. RR = Repairs per 1,000 feet of main pipe.
3. K_1, K_2 = Material and size factors.
4. PGV = peak ground velocity, inches/second; PGD = Permanent ground deformation, inches.
5. PGD is the maximum value of landslide displacement or the resultant of lateral spreading and vertical settlement.

Figure 5-3. Seismic fragility assessment formulation equations

Source: ALA 2001

The results from the above formulas can then be adjusted by K values to represent different pipe materials.

Section 6

Seismic Assessment

This section summarizes the seismic hazards and backbone fragility evaluation. The primary objectives of this assessment, which encompasses the City of Central Point's (City) water service area, are listed below.

- Identify critical infrastructure needed to supply water during an emergency
- Evaluate geophysical hazards that pose a risk to critical facilities
- Evaluate the vulnerability of the City's backbone system to identified hazards by estimating pipeline fragility and evaluating structural vulnerabilities at critical facilities

Water supply facilities and major transmission piping are owned by MWC and were not included in this assessment. Brown and Caldwell worked with the City to identify the backbone of the distribution system and subcontracted with McMillen Jacobs Associates (MJA) to perform the geophysical hazards and backbone evaluation as part of the overall Master Plan update, which is documented in a technical memorandum (TM) in Appendix F. The results of the TM are summarized in this section; development of projects and programs to improve seismic resiliency are discussed in Section 8.

6.1 Backbone System

To develop a map of the City's backbone, water mains extending from the City's three MMS points of supply at Beall Road, Hopkins Road, and Vilas Road were connected with the City's critical water facilities. This system was expanded upon to serve other key community needs during a seismic event (City Hall, the fire department, law enforcement, Red Cross shelters, etc.). These critical facilities and the backbone system serving them are shown in Figure 6-1.

6.2 Data Gathering

MJA performed a background information review and site reconnaissance within the City's service area. This included the following tasks:

- Review of DOGAMI seismic hazard maps for magnitude 9.0 CSV event
- Review of the geologic setting using available information
- Review of available geotechnical information in the vicinity of the water system using geotechnical logs from City facilities, Oregon Department of Transportation bridge logs, and well logs from the Oregon Water Resource Department's database.
- Visit the Shops reservoir and pump station, Old Stage reservoir, Vilas Reservoir and pump station and the Bear Creek crossing at Pine Street. The site reconnaissance noted site conditions, surface or exposed soil and rock conditions, site topography, and proximity of facilities to water bodies and steep slopes.

6.3 Geotechnical Seismic Hazards

The potential for and magnitude of four sources of seismic hazards were analyzed: liquefaction settlement, lateral spreading displacement, landslides, and strong ground shaking. Liquefaction settlement, lateral spreading displacement and landslides are quantified in inches or feet of PGD. Ground shaking is quantified in terms of PGV. Typically, the transient load from PGV is generally low, and most earthquake damage to pipelines is due to PGD.

6.3.1 Liquefaction

Liquefaction is a phenomenon affecting saturated, granular soils in which cyclic, rapid shearing from an earthquake results in a drastic loss in shear strength and a transformation to a viscous, heavy fluid. The results of soil liquefaction include loss of shear strength, loss of soil materials through sand boils or flow, flotation of buried chambers/pipes, and post-liquefaction reconsolidation (settlement).

This study quantified an estimate of liquefaction in a magnitude of post-liquefaction settlement. The analysis results are included in Appendix F (see Figure 3 of the TM) to this Master Plan. The identified zones of liquefaction hazard are within the Bear Creek corridor and at some creek crossings and maximum magnitude of post-liquefaction settlement of 2 inches.

6.3.2 Lateral Spreading

Liquefaction can result in progressive deformation of the ground known as lateral spreading. The lateral movement of liquefied soil breaks the non-liquefied soil crust into blocks that progressively move downslope or toward a free face in response to the earthquake-generated ground accelerations. Ground accelerations incrementally push these blocks downslope, accumulating displacement with each seismic shear pulse that is large enough to overcome the strength of the liquefied soil column. The potential for lateral spreading depends on the liquefaction potential of the soil, magnitude and duration of earthquake ground accelerations, post-liquefaction or strain-softened shear strength of the soil, and site topography.

The estimated lateral spreading displacements are located within the same areas as liquefaction, within the Bear Creek corridor and at some creek crossings. Maximum anticipated lateral spreading ranges from 1–24 inches of PGD. The highest hazard areas for lateral spreading is at the Pine Street and Upton Road crossings of Bear Creek.

6.3.3 Landslides

Earthquake-induced landslides can occur on slopes because of the inertial force from an earthquake adding load to a slope. The ground movement caused by landslides can be extremely large and damaging to pipelines, reservoirs, and other facilities.

Although some landslide hazards exist in the hills surrounding the Bear Creek Valley, there are no areas of concern within the vicinity of the City's water service area.

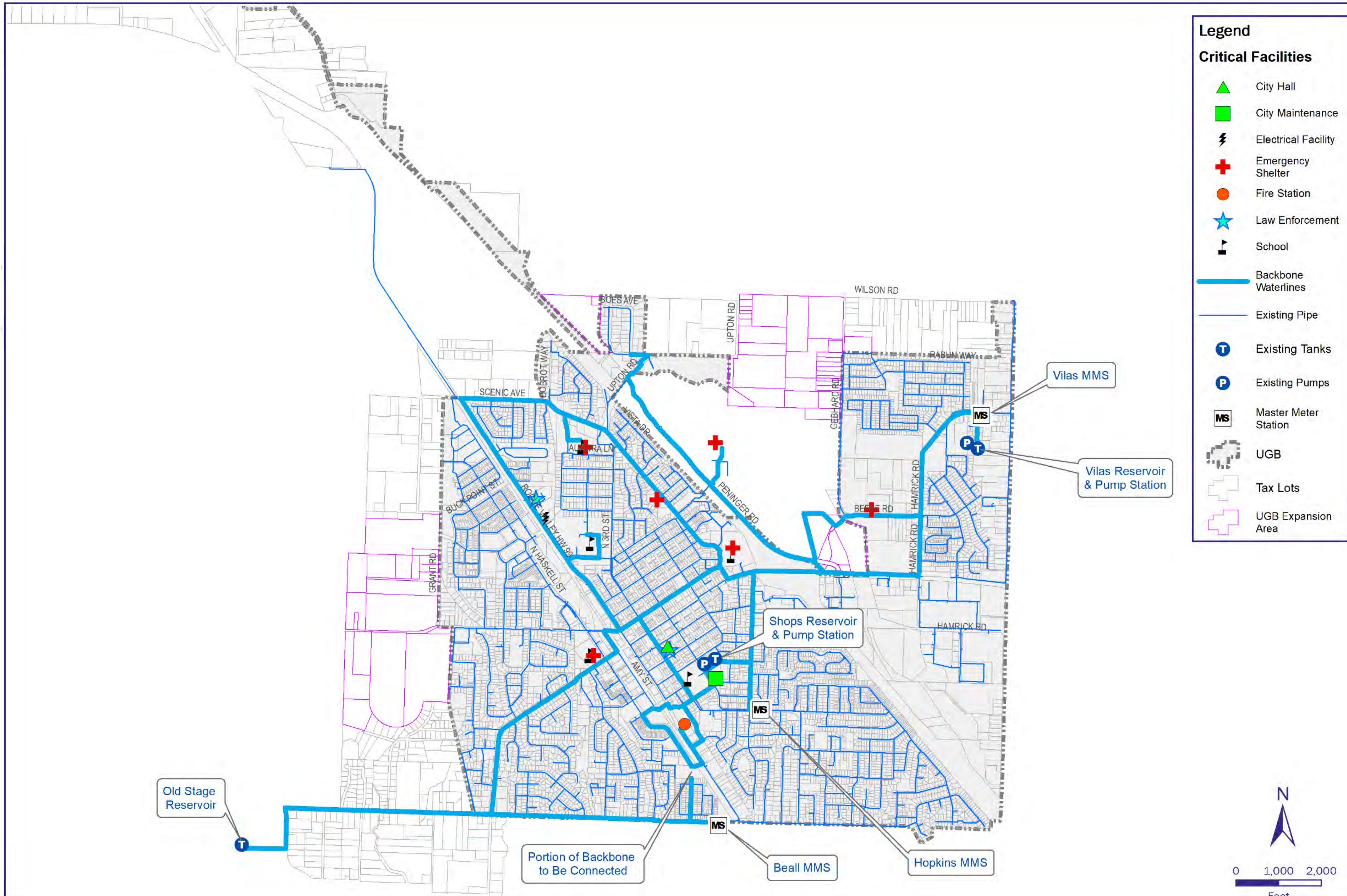


Figure 6-1. Critical facilities and backbone system

Table 6-1. Summary of System Repair Rate							
Pipeline Material	Total Length (ft)	Average RR for PGV[a]	Estimated Breaks from PGV	Estimated Leaks from PGV	Average RR for PGD*	Estimated Breaks from PGD	Estimated Leaks from PGD
AC	15,609	0.06	0.44	0.44	0	0.00	0.00
CI	2,939	0.05	0.08	0.08	0.22	0.33	0.33
DI	58,831	0.02	0.69	0.69	0.06	1.85	1.85
Total	**77,379**	**0.03**	**1.2**	**1.2**	**0.06**	**2.2**	**2.2**

a. Average repair rate (RR) is breaks per 1,000 LF of pipe.

6.6 Summary of Results

The geohazards analysis indicate that the greatest hazard associated with the magnitude 9.0 CSV event is liquefaction- and lateral spreading-induced PGD where pipelines cross creek corridors. Ground shaking is expected to result in PGV ranging from 6–8 inches per second and 13–16 inches per second.

Facilities within the backbone system including the Old Stage reservoir, Vilas reservoir and pump station and Shops reservoir and pump station have low liquefaction, lateral spreading, and landslide risk. The analyses of RR show that pipe damage due to ground shaking will be relatively low when compared to other valley communities. However, pipes in areas of PGD due to liquefaction and lateral spreading in the Bear Creek corridor and other drainages will likely sustain more damage.

Major areas of concern include the Pine Street and Upton Road crossings of Bear Creek. Based on the depth of the pipeline, the high strength of gravels from the available geotechnical information, and mechanical joint restraint, the Beebe Road crossing of Bear Creek is estimated to have a relatively low break potential. Other areas of concern are creek crossings for smaller drainages. The pipeline materials and burial depth at these locations are currently unknown.

6.7 Mitigation Plan

To improve resiliency of existing backbone pipelines and improve future installations, the following improvements are recommended to be moved forward into the City's CIP:

- Revise design standard for water pipe to push-on joints with restraining gaskets approved by the manufacturer for use only with their pipe unless otherwise stated. Gasket manufacturer options include US Pipe Field Lok 350, McWane, Sure Stop 350 and American Cast Iron Pipe, FastGrip or City-approved equal. For 12-inch and larger water mains in areas where high PGD was identified during the study require integrated restrained joints.
- Relocate the existing pipeline on the Pine Street bridge with a new crossing below the potential liquefaction and lateral spreading zone under Bear Creek. Integrate this project with an upcoming lane widening project.
- Assess soil liquefaction and lateral spreading hazards at the Upton Road crossing and where pipes cross minor drainages.
- Systematically replace asbestos cement (AC) and cast iron (CI) pipes within the City's backbone with restrained ductile iron, welded steel or high-density polyethylene (HDPE) pipe over the next 45 years. Prioritize pipeline replacement outside of opportunistic replacement in areas of PGD first, in areas of the highest PGV second and in the lowest PGV last. This recommendation would replace approximately 410 linear feet of AC and CI pipe annually.

6.3.4 Ground Shaking

The rapid and extreme shaking during an earthquake can cause transient stress and strain in pipelines that can be damaging if the pipe material and joints are not strong enough to withstand the transient ground deformations. Damage from ground shaking occurs even when there is no PGD. The intensity of ground shaking can be quantified with the PGV at a site because of an earthquake.

The analysis indicated PGV from 6–8 inches per second in fine-grained sediments to the west of Griffin Creek and from 13–16 inches per second in mixed-grain sediments east of Griffin Creek and along Bear Creek.

6.4 Seismic Hazard Assessment for Facilities

In addition to the seismic hazard study for the overall service area, MJA conducted site visits to Old Stage reservoir, Vilas reservoir and pump station and Shops reservoir and pump station and conducted a review of the geotechnical condition and seismic hazard potentials at these facilities.

- Old Stage Reservoir–Based on the geotechnical boring logs for the existing reservoir, the subsurface condition at the reservoir site consists of medium dense to very dense silty sand and of residual soil and granodiorite bedrock below. The site slope is very gentle, and the seismic hazards in terms of liquefaction, lateral spreading and landslide are very low. MJA also visited the adjacent vacant site where a new reservoir is planned. This adjacent site also has a very gentle slope, and a similar stable subsurface condition.
- Vilas Reservoir and Pump Station–This facility is located on a flat land at the west side of the city. Based on the geotechnical boring logs for the existing reservoir, the subsurface condition at the reservoir site generally consists of medium dense to very dense gravelly and cobble soils, with a deep groundwater table. The seismic hazards in terms of liquefaction, lateral spreading and landslide are very low.
- Shops Reservoir and Pump Station–This facility is located near the center of the city. There is no existing geotechnical information available for review. Geologic map and nearby well logs indicate mix-grained silty and gravelly soil condition. This site is planned to be demolished in the near future, so it was not evaluated in further detail.

6.5 Pipeline Fragility Analysis

This section presents the fragility analysis developed for the City's backbone network using the ALA approach described in Section 5.6.2. The work included compiling the City's GIS pipe data on material and diameter, which influence the K factor of the ALA approach equations. Pipeline fragility estimations were then developed using a spatial overlay of pipe data with PGD and PGV. The results of this analysis generate a value called the repair rate (RR), which indicates an estimate of the number if repairs per 1,000 feet of pipe that could be expected given a seismic hazard. Pipeline RR identified include both leaks and breaks. For planning purposes, it was assumed that 50 percent of the total repairs consist of leaks and the remaining 50 percent consist of breaks. A summary of expected repairs is listed in Table 6-1 and shown in Figure 6-2.

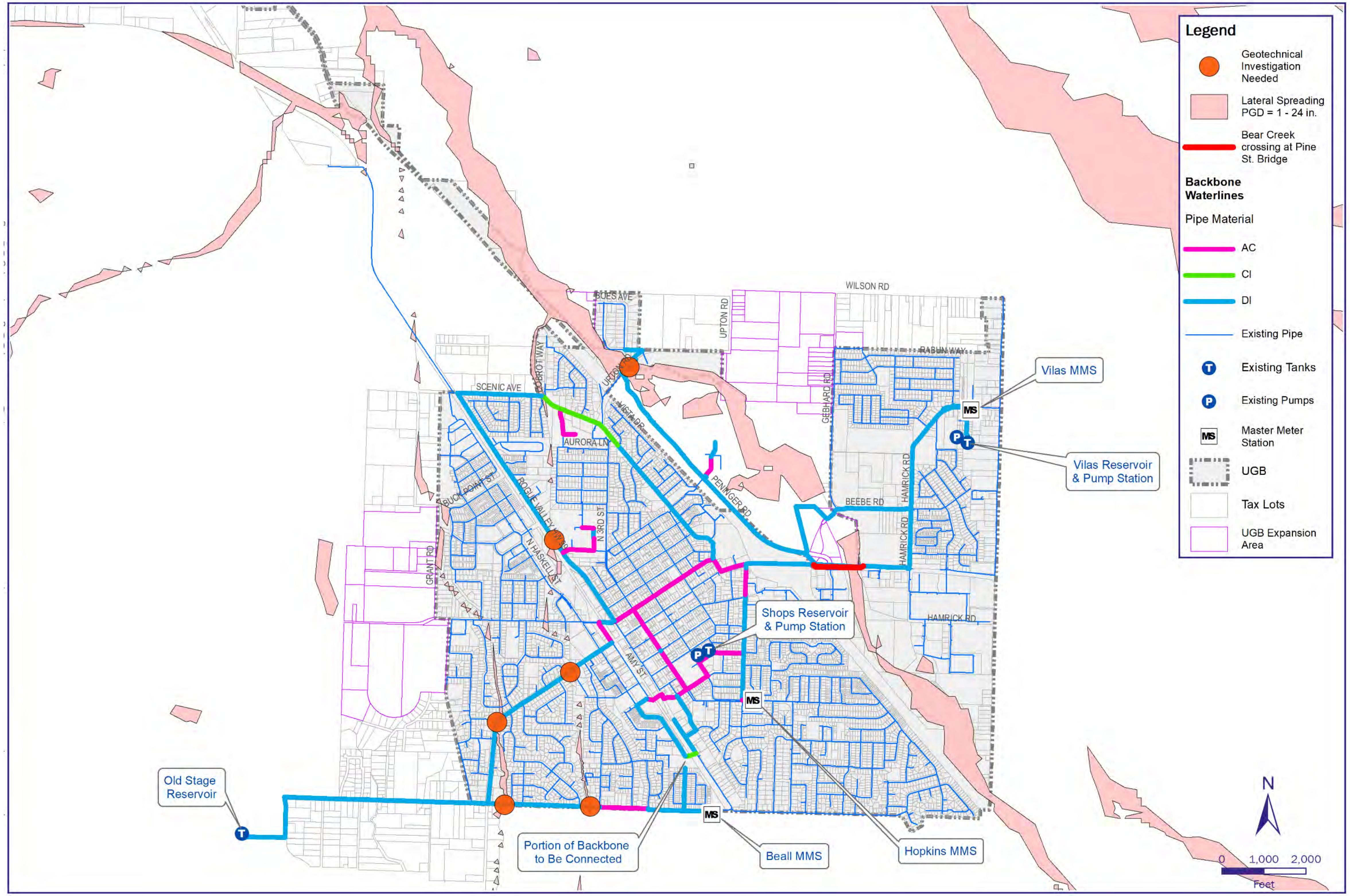


Figure 6-2. Mitigation plan summary

Section 7

System Evaluation

This section provides an evaluation of the City's water system. The methodologies used to evaluate the system included developing an updated hydraulic model and comparing system performance to level of service criteria described in Section 5. There is also a discussion on available water rights and water quality.

7.1 Existing System Evaluation

The existing system evaluation used a 2017 per capita use rate scaled to 2020 population to evaluate the current ability of the city's system to meet level of service criteria. This evaluation identifies near term issues that will be addressed in the capital program described in Section 8.

7.1.1 Water Rights

City owned water rights allow for a max authorized rate of 3.43 mgd and a total volume limit of 847 MG as described in the "Water Rights Strategy for Partner Water Providers" (2020) included in Appendix A and introduced in Section 2.2. The report indicates that the City's current demands exceed the maximum authorized rate associated with their water rights and proposes a strategy to balance water rights for Partner Cities whose demands in the next 50 years exceed their water rights with water rights held by MWC and Talent which are expected to authorize use in amounts that exceed those entities' projected water demands. The recommended approach provides plans for a near-term shared water supply strategy to meet demands through 2028.

7.1.2 Supply Analysis

The system supply is evaluated on capacity, quality and reliability. As the wholesale supplier, MWC is responsible for the water quality of supply to the system. Water quality testing performed by the City meets state and federal regulations as summarized in Section 7.1.6. The capacity and reliability of the City's supply is also heavily dependents on the capacity and reliability of the MWC water system.

As previously mentioned, the City's supply is currently limited by the following contract amounts:

- October through April
  - 1,833 gallons per minute (gpm): 5 a.m. to 11 a.m.
  - 3,255 gpm: all other times
- May through September
  - 4,958 gpm: 5 a.m. to 11 a.m.
  - 5,700 gpm: all other times

The City is responsible for serving demand greater than the amounts listed above through the duration of the contract period. As noted in Section 5.2, the City's ability to meet current contract limits remains highly dependent on incoming HGL at the Vilas MMS. Though the city is theoretically able to meet system demands given limitations in the supply contract at a certain incoming HGL, when the incoming HGL changes it results in a need for manual adjustment to system pressure settings to remain within contract limits. When these fluctuations occur during the peak morning window or toward the end of the evening peak when the City is refilling storage reservoirs it can cause contract overages. Recommendations for future supply limits are discussed in Section 5.2.

7.1.3 Pump Stations

The City currently operates two pump stations: Vilas and Shops as discussed below:

7.1.3.1 Shops Pump Station

Due to seismic instability and plans for the existing site for other community amenities, the City plans to demolish the Shops Pump Station in the near future. Capacity currently provided by the Shops Pump Station will be replaced by a new pump station located near the Beall MMS as described in Section 7.2.3.

7.1.3.2 Vilas Pump Station

The Vilas Pump Station is currently meeting level of service criteria. During field testing and model calibration it was observed that the Vilas supply pumps are operating at a higher flow than anticipated due to changes to suction head since the design of the station, which results in the current operating point being beyond the extents of the manufacturer’s curve data. The pump data were discussed with the manufacturer to determine if the pump was operating within their allowable operating range (AOR). This discussion was inconclusive as the manufacturer does not have test results for this pump beyond what is indicated on the curve. Generally, operating pumps beyond the end of a manufacturer’s curve can induce cavitation, vibration, or higher forces that cause increased wear on pump components.

City staff have not observed any unusual noise or vibration at either of the two supply pumps but given the station configuration it may be difficult to notice the signs of cavitation from the ground floor of the pump station.

It is recommended that the City complete a pump check for signs of cavitation and vibration from a pump vendor such as PumpTech. It is also recommended that the City order spare bearings, O-rings, wear rings, a mechanical seal and one replacement impeller if those items are not currently in stock.

7.1.4 Storage Analysis

The City currently operates three storage reservoirs: Vilas and Shops, both ground-storage and Old Stage which is an elevated storage reservoir. The City plans to demolish the Shops reservoir as a result of seismic stability and condition concerns.

The water system storage capacity was analyzed using the criteria presented in Section 5.5 to determine how the system will likely be affected by the demolition of the Shops tank. As indicated in Table 7-1, an additional 0.11 million gallons (MG) is needed to meet storage requirements of the existing system once the Shops reservoir is removed.

Table 7-1. Existing System Storage Analysis

Planning Horizon	Existing Storage Capacity (MG)	Required Storage Volume (MG)				Excess Storage (MG)	
		Fire	Equalization	Emergency	Total	Existing Tanks	Without Shops
2017	5.69	0.63	1.88	2.30	4.81	0.88	-0.11
2020	5.69	0.63	1.95	2.40	4.98	0.71	-0.29

7.1.5 Piping Evaluation

Evaluation of the existing system piping included analysis of standard operating pressures, velocity, head loss and fire flow capacity.

7.1.5.1 Operating Pressure

Operating pressures have improved since the last master plan update due to the installation of the Vilas Reservoir and Pump Station. There are no longer locations where the pressure drops below the minimum allowable pressure of 35 psi under PHD, minimum pressures range from 36 to 95 psi. At the lower elevations at the north end of the system along Willow Springs Road maximum pressure exceeds 120 psi with maximum pressure up to 123 psi. The high pressures occur as demand drops after the evening peak while the pump stations are operating to refill storage reservoirs.

Maximum operating pressure is shown in Figure 7-1 below.

7.1.5.2 Velocity and Head Loss

Model results show that the existing system meets the velocity requirements of less than 10 feet per second. Pipes exceeding 5 fps are highlighted on Figure 7-1 and will be reviewed in more detail in the 2040 demand scenario.

7.1.5.3 Fire Flow Deficiencies

Figure 7-2 shows areas in the system that do not have the capacity to meet fire flow requirements established in the level of service goals. The deficiencies can be categorized as follows:

1. Fire flow deficiencies where there is not enough capacity in the distribution system or adjacent hydrants to meet fire demand. This primarily occurs in the central portion of the city where 4 inch CI piping remains.
2. Fire demand locations where multiple adjacent hydrants are required to meet the demand. These are located in industrial and institutional land use zones where the hydrant is served by a 6-inch lateral. While the distribution main is sufficiently sized to address the industrial demand of 3,500 gpm, the lateral is undersized. Each of these locations were reviewed to determine if the fire flow demand could be served by multiple nearby hydrants which is discussed further in the future system analysis in Section 7.2.6.

7.1.5.4 Reliability

Overall, the city has good looping in the transmission and distribution piping. However, the following piping reliability issues were identified:

1. Single supply pipeline to the service area to the far northwest portion of the City. The prior master plan recommended a tank in this area to improve reliability for a proposed development in this area. To date the proposed development has not occurred and the City will not allow further development in this area without developer-built improvements to the water system to meet level of service criteria.
2. Single supply pipeline to the existing Old Stage Reservoir.
3. Limited connectivity between the west and east sides of the city, which are separated by Bear Creek, Interstate 5 (I-5) and further to the west by Highway 99.

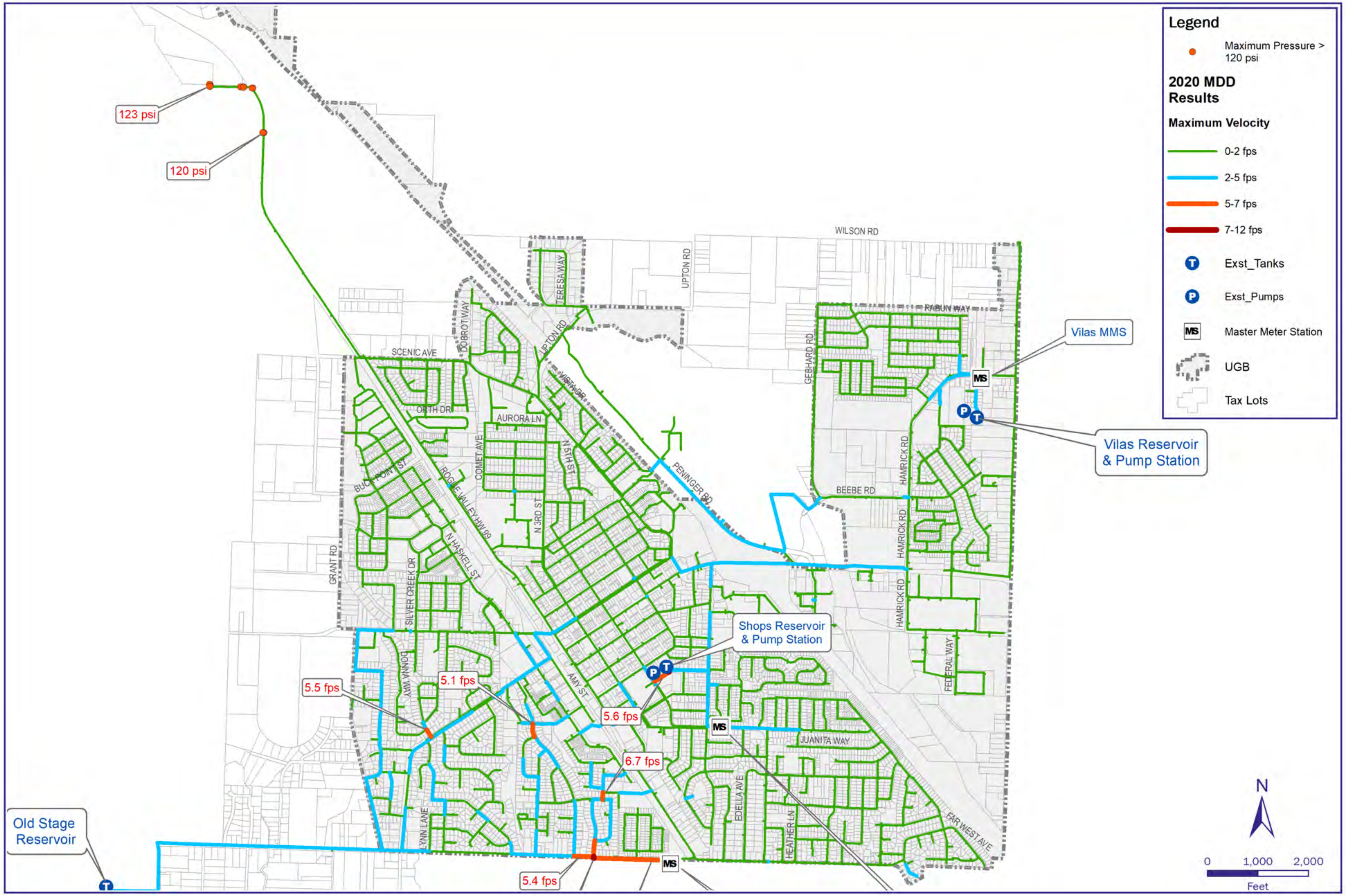


Figure 7-1. Existing system pressure and velocity results

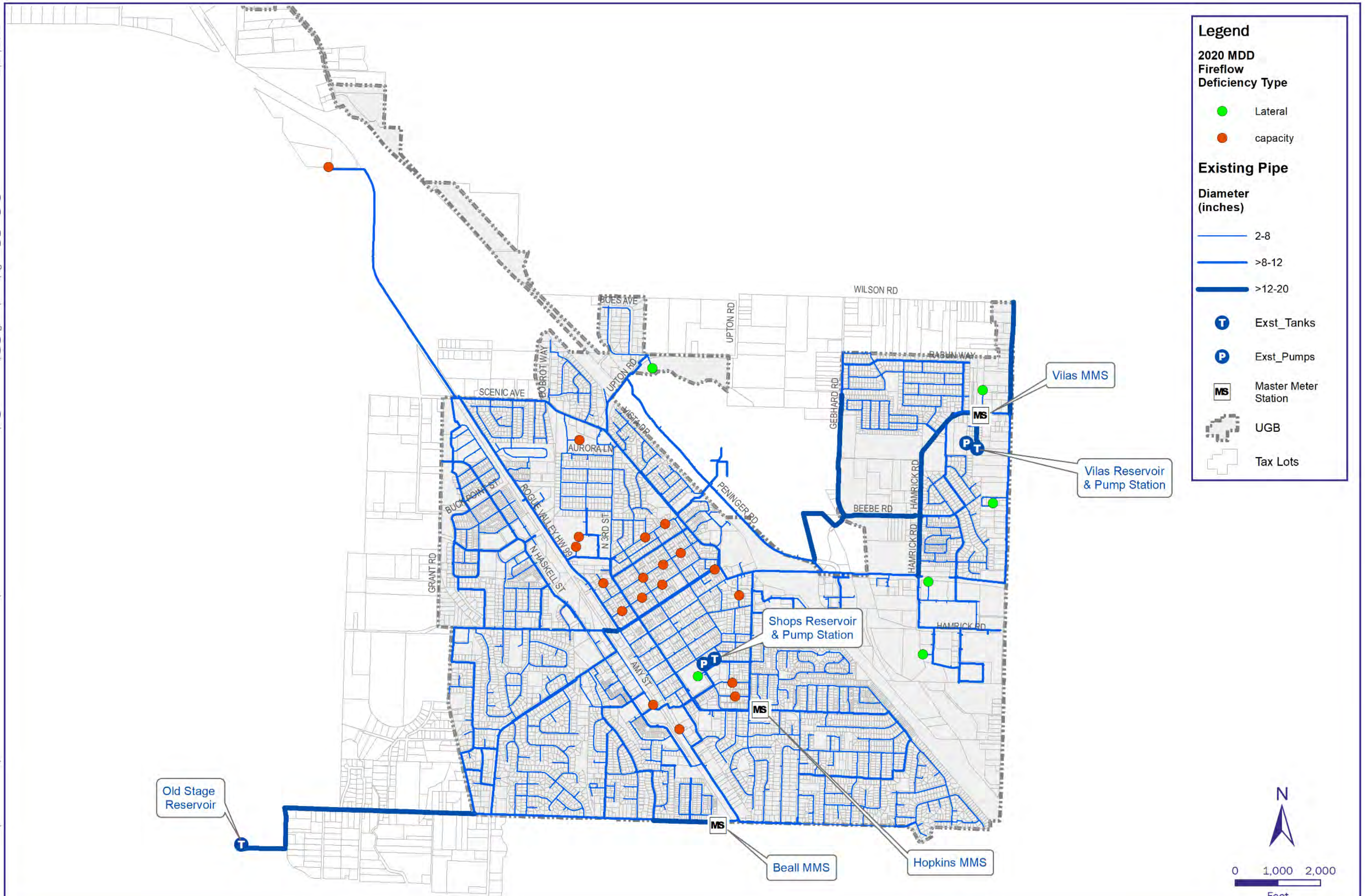


Figure 7-2. Existing system MDD fire flow evaluation results

7.1.6 Water Quality Evaluation

As mentioned in Section 2.3, this review focused on water quality parameters that the City must monitor at the entry points to its distribution system and throughout the distribution system. Because the City distributes water but does not treat it, data discussed here includes water age, coliform sampling results, disinfectant residuals, and disinfection byproduct concentrations. The results of the evaluation are summarized in this section. A map of the City's distribution system showing all sampling sites for regulatory compliance sampling is shown in Figure 7-3 below.

7.1.6.1 Water Age

A water age analysis was conducted using the City's InfoWater hydraulic model to better understand circulation of water throughout the City's distribution system and correlate disinfectant residual with water age under existing conditions. Water age can be used as a surrogate for water quality issues like low disinfectant residual or high DBP concentrations because water quality issues in a distribution system typically don't become problematic unless they are provided enough time to occur.

Water age was evaluated during average day demands and was assumed to be zero at each of the MMS entry points, which excludes time spent in the MWC system and assumes that the incoming water at each MMS is the same age. Old Stage, Vilas and Shops reservoirs were assumed to be fully mixed. During off-peak demand periods the City targets a 40 percent daily turnover in the Old Stage reservoir. The Shops facility is operated manually on an as-needed basis to maintain disinfectant residual, which occurs approximately every 3 weeks in wintertime. To reflect this method of operation, the model was first run without the Shops facility, which is reflected in Figure 7-4.

Following manual turnover in the Shops tank by operating the Shops pump station, water age spikes for approximately 2 days as the water from the Shops reservoir circulates throughout the system and then stabilizes back per the results shown in Figure 7-4. Maximum water age in the 2 days following the manual Shops tank turnover is shown in Figure 7-5.

The average chlorine residuals at each distribution system sampling site were plotted against their respective water age when the Shops facility was operated and when it was not operated. Because the Shops facility is seldomly operated, correlation between chlorine residual and water age is stronger for the "Without Shops" data—water age calculated when the Shops facility is not operated. Overall, the correlations are not strong and are largely influenced by the Erickson sampling site, which has a much higher water age of 17 hours than the other sites. Operations staff currently operate the system to achieve a 40-percent daily turnover in volume at the Old Stage Reservoir. During warm weather chlorine residual in this tank drops when adequate turnover is not maintained. This water age analysis was conducted to establish a baseline for water age to support analysis of the future system evaluation.

During low demand periods, the City monitors chlorine residual at the Shops facility and starts the pumps to turn over the tank when the chlorine residual drops, which is typically every 1–3 weeks. Given the large swings in water age due to intermittent operation of the Shops facility the, maximum water age is shown for the two different scenarios. It is recommended that the turnover frequency increase to once per week to limit water age.

Figure 7-4 shows maximum water age throughout the system under 2020 Average Day Demand (ADD) without operation of the Shops facility. Figure 7-5 shows maximum water age throughout the system under 2020 ADD immediately after turning on the Shops facility following a period of 3 weeks where the facility is off. The aged water from the tank takes approximately 24–30 hours to dissipate throughout the distribution system and return to the water age values shown in Figure 7-4.

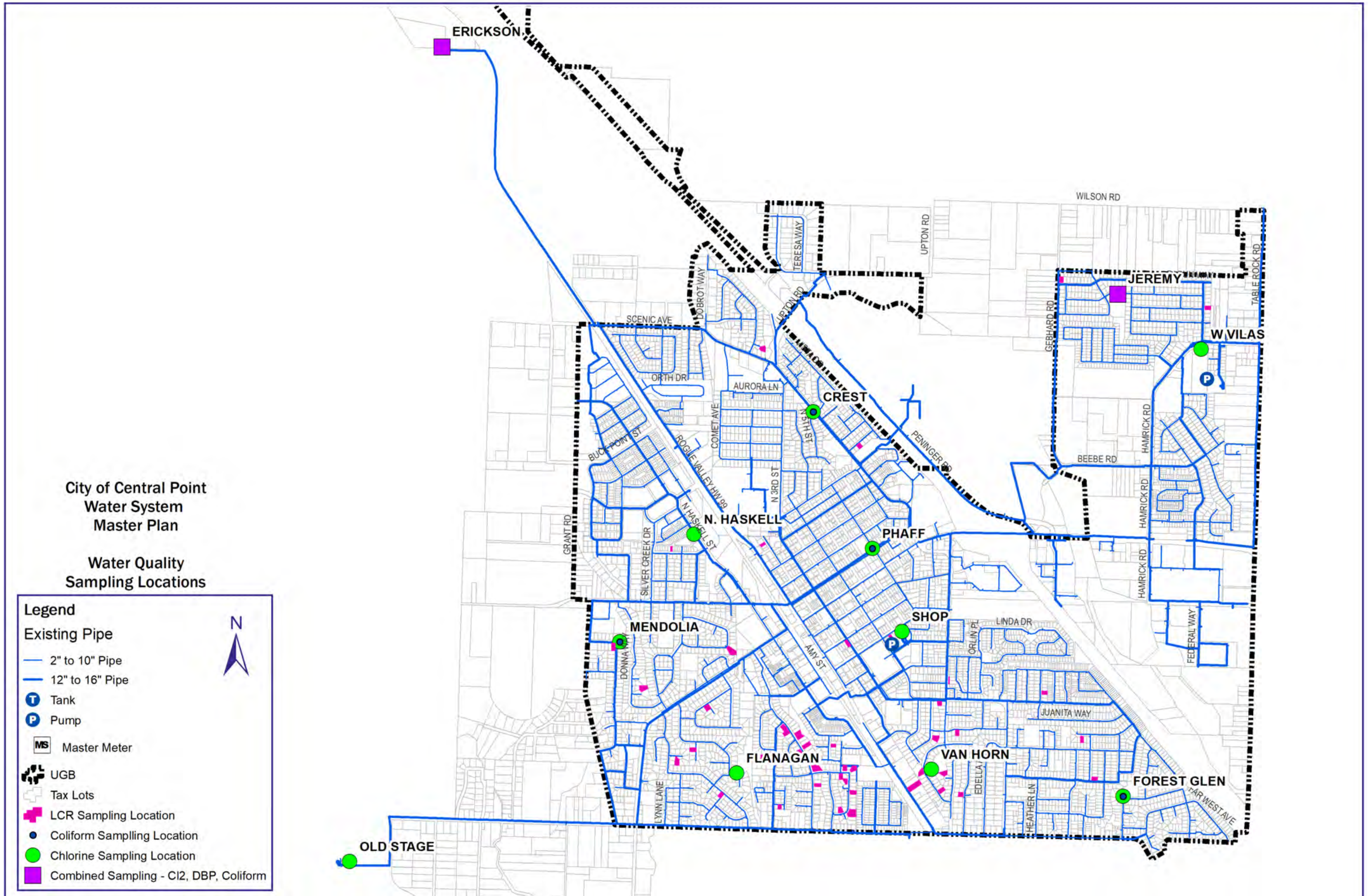


Figure 7-3. Distribution system sampling sites

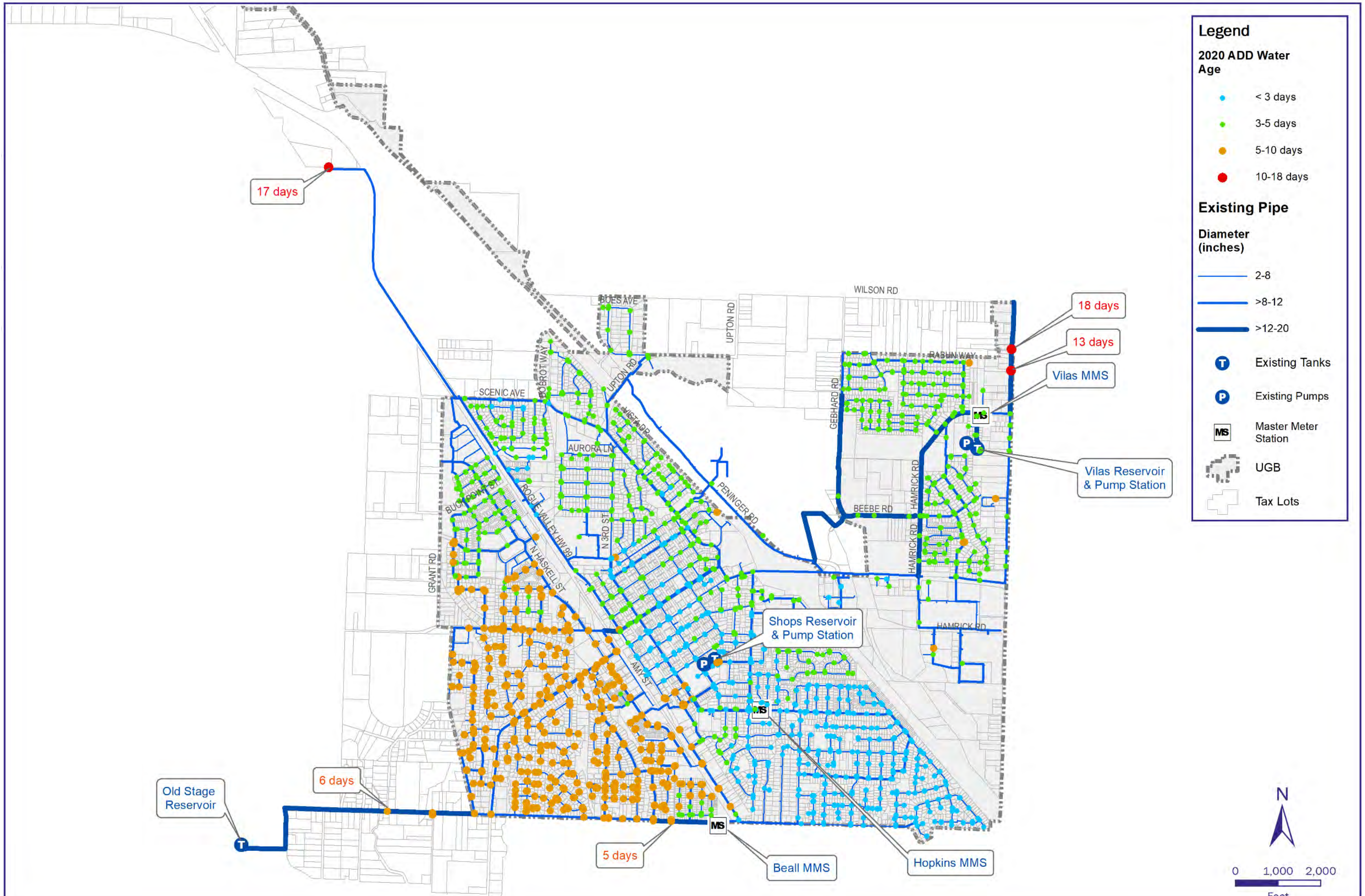


Figure 7-4. Existing water age analysis (Shops facility off)

Brown AND Caldwell

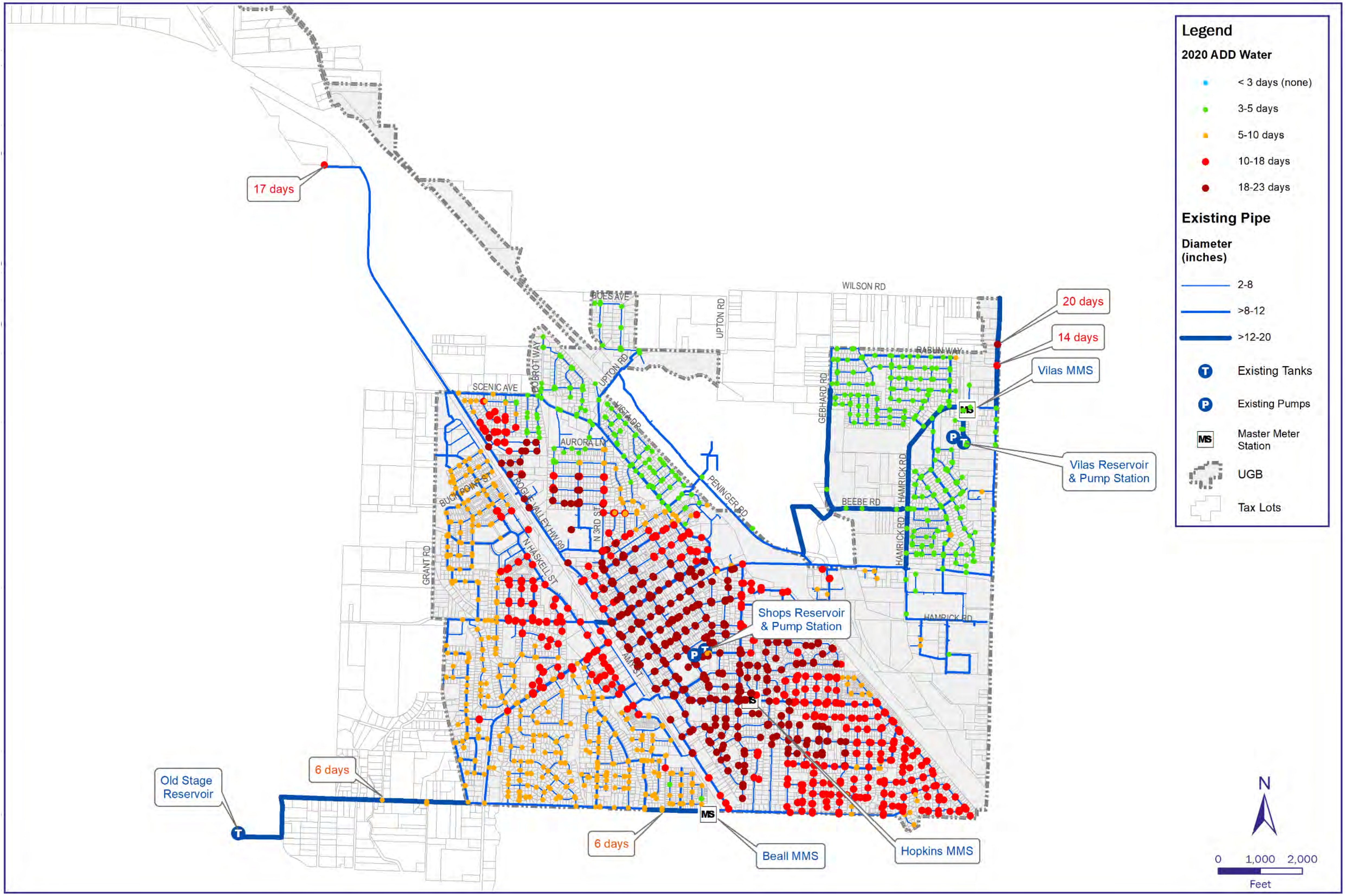


Figure 7-5. Existing water age analysis (after Shops turnover)

Brown AND Caldwell

7.1.6.2 Analysis of Coliform Sampling Results

The City collects 15 coliform samples in three sets of five, where the first set is collected during the first 3 days of each month, the second set is sampled between the 10th and 12th of each month, and the third set is collected between the 22nd and 24th of each month. The same five sites are sampled during each round.

According to the City's laboratory results and Oregon Public Health's Drinking Water Data Online website, none of the samples collected between January 1, 2014, and December 31, 2019, were positive for total coliform. In fact, the last total coliform-positive sample was collected nearly 10 years ago in June 2010, and fecal coliforms or *E. coli* were not detected.

7.1.6.3 Analysis of Disinfectant Residuals

The City measures chlorine residuals every time a coliform sample is collected, i.e., five distribution system sites are monitored each week for coliforms and chlorine residual, for a total of 15 samples per month (see Figure 7-6).

The City also measures chlorine residuals at eight additional sites in the distribution system, some of which are sampled weekly while others are sampled in rotation. Free chlorine residuals reported on the bacteriological and residual sample logs between January 2014 and December 2019 show that all samplings met compliance requirements of the Stage 1 and Stage 2 DBPRs, i.e., the RAAs were below the MRDL of 4.0 mg/L Cl_2. Results are summarized in Figure 7-6.

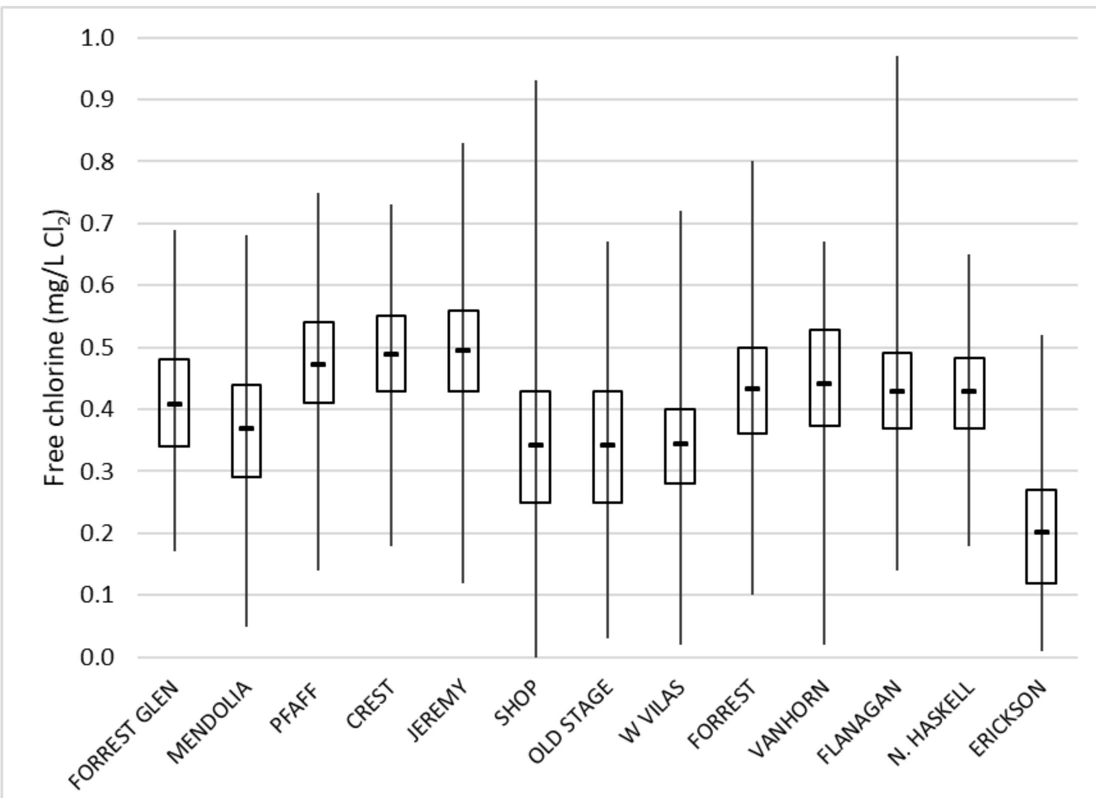


Figure 7-6. Free chlorine residuals measured in the distribution system

The vertical lines shown above represent the minimum and maximum free chlorine residuals, the bottom and top of the boxes represent the 25th and 75th percentiles, respectively, and the small dash lines inside the boxes illustrate the average residuals.

Average free chlorine residuals varied from 0.34 to 0.49 mg/L as Cl_2 at each sampling sites, except at Erickson, which showed a low average chlorine residual of 0.2 mg/L as Cl_2. This site is located at the extreme North of the City's service area at the end of a long pipeline. Water age at this site is among the highest of the City's service area, at 17 hours as shown in Figure 7-4. Although all sampling sites showed very low residuals at times, the 10th percentiles[9] of the data analyzed remained at or above 0.2 mg/L as Cl_2, except at the Shops reservoir sampling site and Old Stage Road reservoir site, as well as the Erickson site as mentioned above.

Free chlorine residuals measured between January 2014 and December 2019 at the four sites that are sampled most often are presented in Figure 7-7 below. These figures show seasonal variations and occurrences of low residual particularly in the summer and fall periods, although trends vary by sampling site.

Certain sites showed wider variations than others, and variations were more pronounced in certain years than others. For example, free chlorine residuals were lower at most sites from mid-2018 to mid-2019. The annual change in water sources from Big Butte Springs in winter to a blend of spring water and water treated by the Duff WTP in summer is certainly responsible for trends observed. Results of organic material concentration and composition or chlorine demand evaluations were not conducted as part of this analysis, but it is likely that chlorine demand is greater in the surface water treated by the Duff WTP than in Big Butte Springs water, which is more pristine.

A comparison of water age to sampled free chlorine residual is provided in Table 7-2.

Table 7-2. Summary of Water Age vs. Chlorine Residual

Sampling Location	Model Junction ID	Maximum Water Age after Shops Turnover (days)	Maximum Water Age without Shops Turnover (days)	25th Percentile, Average, 75th Percentile Free Chlorine Residuals (mg\L)
Crest	J5826	5.1	2.5	0.43, 0.49, 0.55
Jeremy	J8953	3.5	3.5	0.43, 0.49, 0.56
Pfaff	J8866	21.2	2.4	0.41, 0.47, 0.54
North Haskell	J8207	12.7	4.5	0.37, 0.43, 0.48
Vanhorn	J9305	21.2	2.9	0.37, 0.44, 0.53
Flanagan	J5238	5.1	5.0	0.37, 0.43, 0.49
Forest Glen	J6345	12.6	1.9	0.36, 0.43, 0.50
Mendolia	J5548	7.2	5.0	0.29, 0.37, 0.44
Old Stage	J8792	5.1	5.0	0.25, 0.34, 0.43
Shops	J7069	21.3	2.6	0.25, 0.34, 0.43
Erickson	J7929	17.0	16.6	0.12, 0.20, 0.27

9 Free chlorine residuals below which 10 percent of the data were found. For this particular evaluation, the 10th percentile was used as an indicator of the minimum residual above which most of the residuals were found.

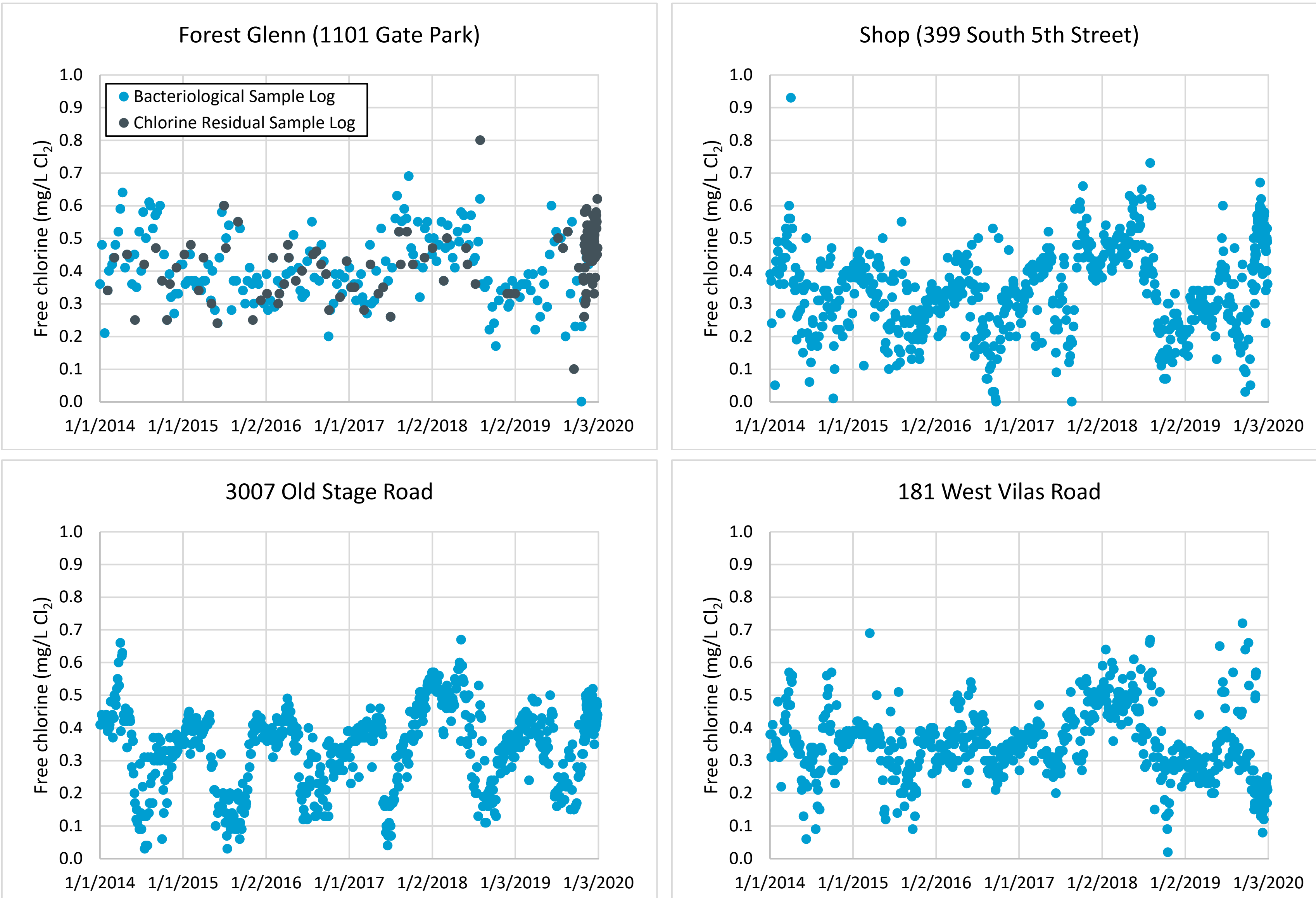


Figure 7-7. Free chlorine residuals measured at representative distribution system sampling sites

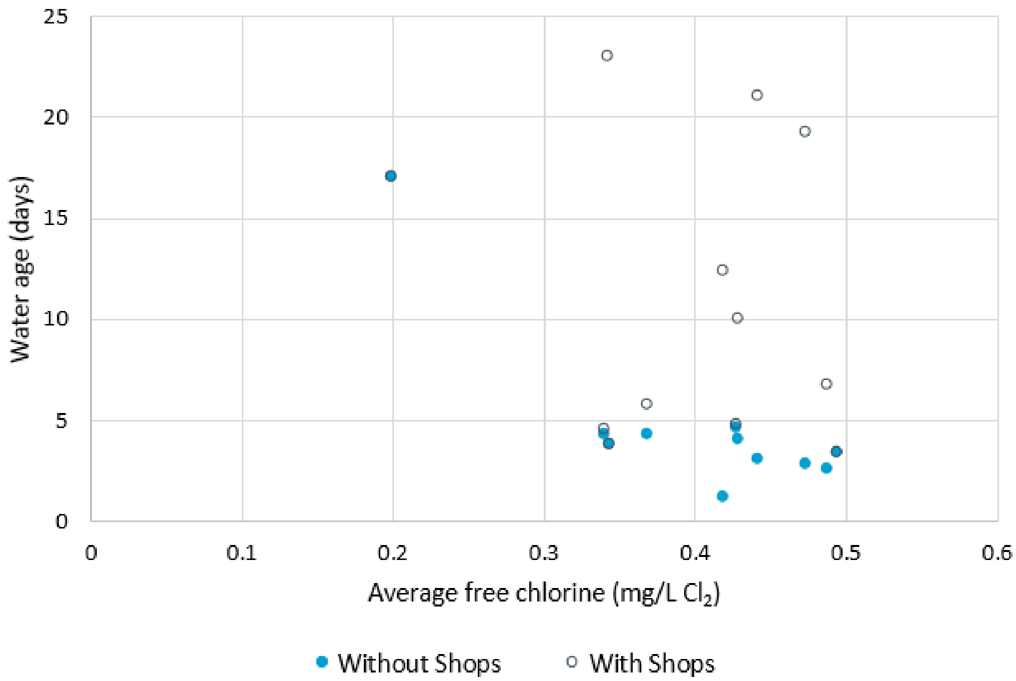


Figure 7-8. Average free chlorine residual and water age at the distribution system sampling sites

7.1.6.4 Analysis of Disinfection Byproduct Concentrations

The City collects quarterly samples at two distribution system sites. Results obtained between January 2014 and December 2019 showed average TTHM concentrations of 0.011 mg/L (11 µg/L) at the Erickson site and 0.0065 mg/L (6.5 µg/L) at the Jeremy Street site. TTHM concentrations are higher at the Erickson site because it is located at the outskirt of the service area and has a higher water age (17 hours) than the Jeremy Street site (3.4 hours). The DBP data are consistent with the chlorine residuals measured at these sites.

Figure 7-9 illustrates TTHM concentrations at both sampling sites during each sampling and highlights important seasonal variations and greater DBP concentrations in summertime when the water sources include water treated by the Duff WTP. Figure 7-10 shows LRAAs at both sites (data collected in 2013 were used to calculate the 2014 LRAAs) and indicates that the City remained in compliance with TTHM MCL requirement between 2014 and 2019.

HAA5 were often below the detection limit at the City's sampling sites, and when detected, concentrations were low (Figure 7-11). Figure 7-11 also shows important seasonal variations.

DBP data analyzed are very low in most cases and Figure 7-12 shows that the City has complied with the HAA5 LRAA regulatory requirement between 2014 and 2019.

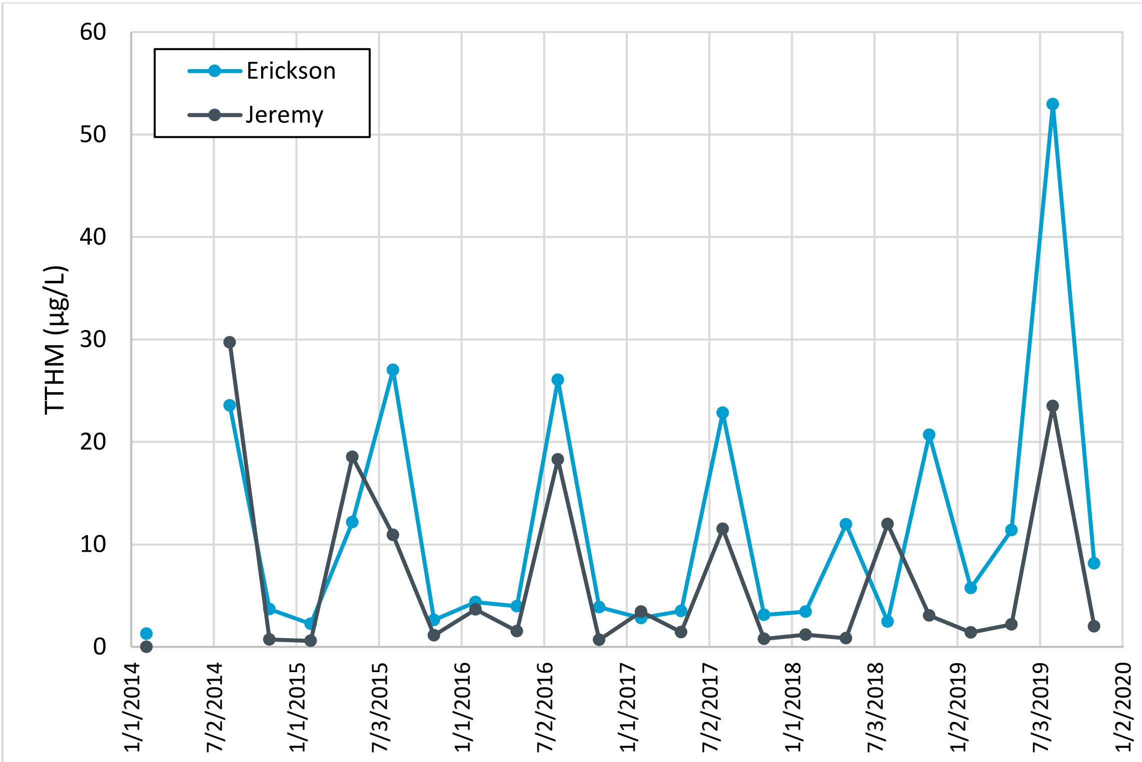


Figure 7-9. TTHM concentrations measured during each sampling in the distribution system

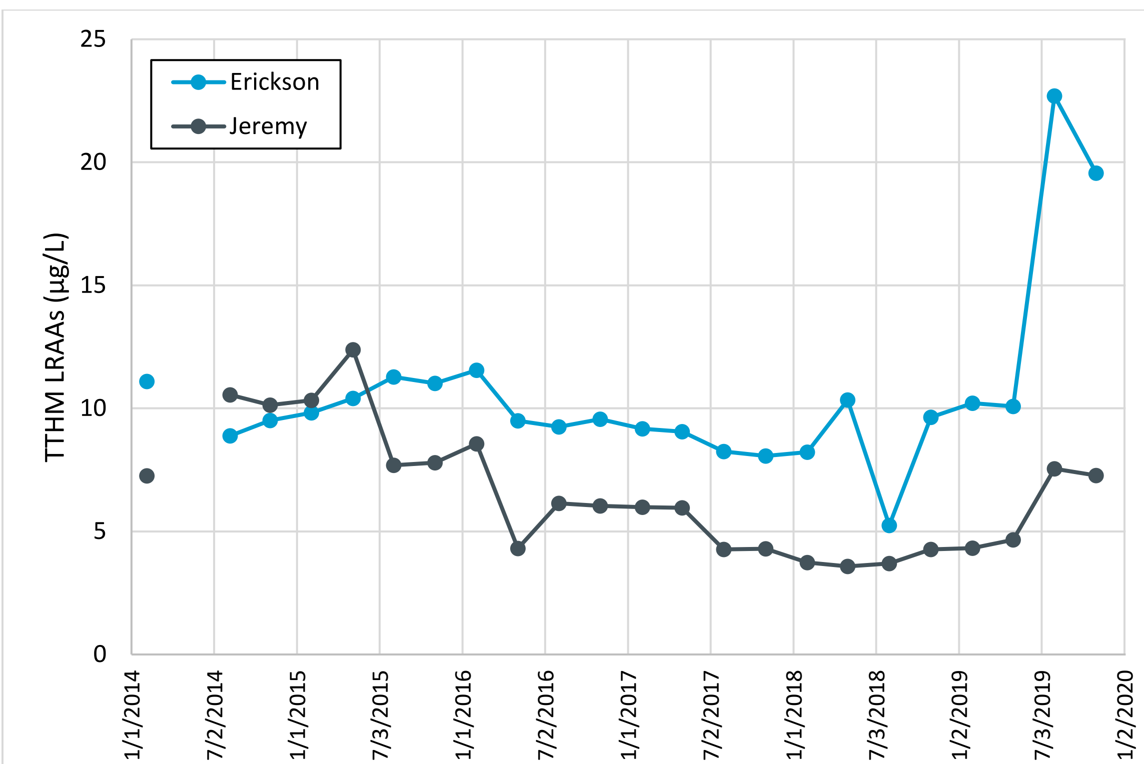


Figure 7-10. Calculated TTHM LRAAs

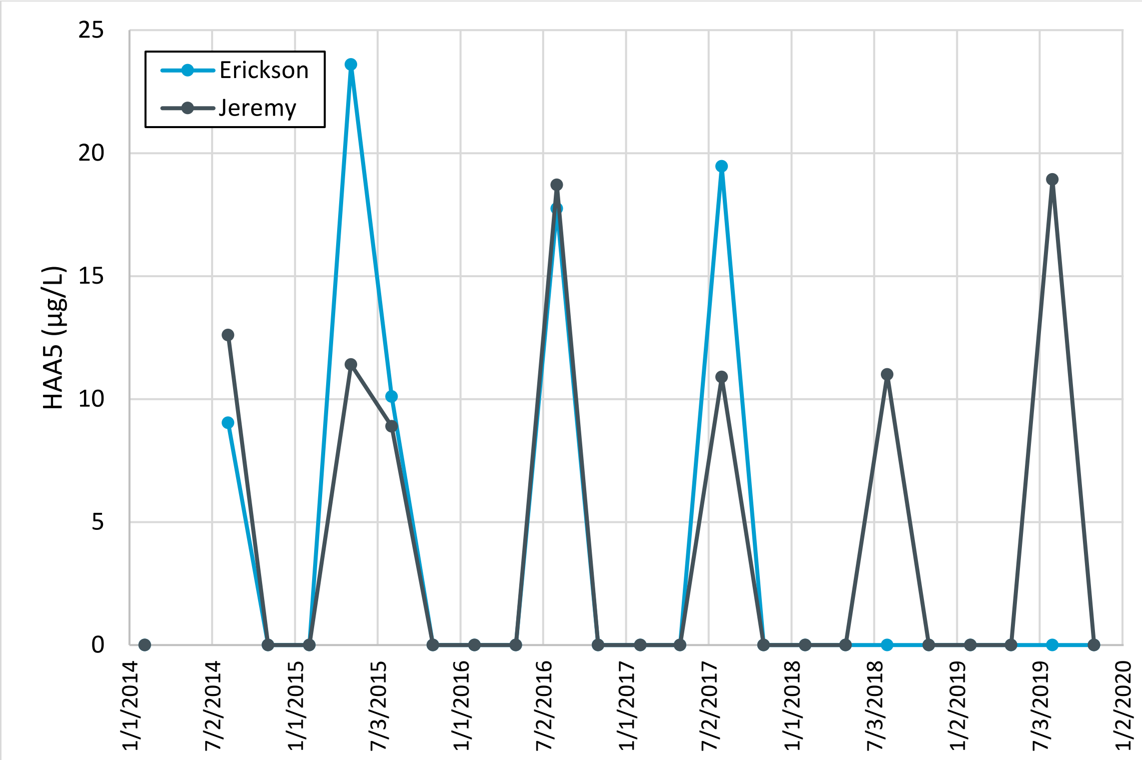


Figure 7-11. HAA5 concentrations measured during each sampling in the distribution system

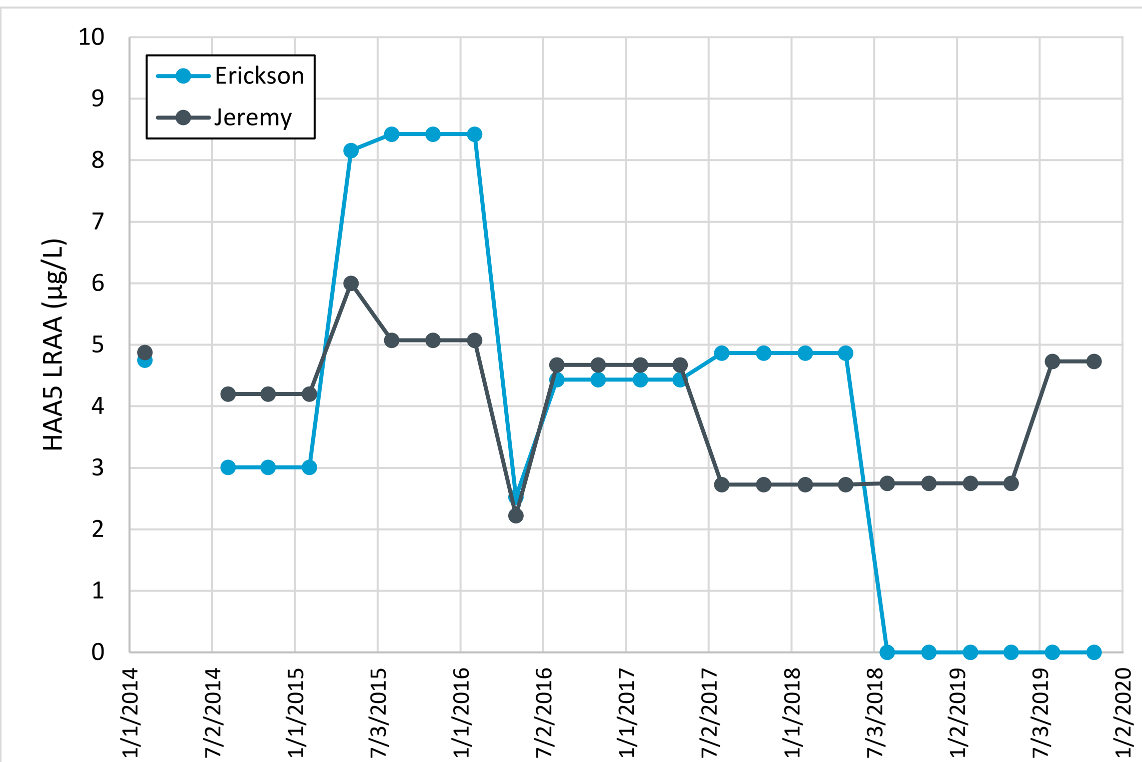


Figure 7-12. Calculated HAA5 LRAAs

7.1.6.5 Analysis of Lead and Copper Concentrations

Because the City is on reduced monitoring for lead and copper compliance sampling, it needs to collect at least 30 samples from customer taps every 3 years. The last rounds of lead and copper samplings at customer taps were conducted in 2014 and 2017, and results are summarized in Table 7-3. The 90th percentiles for lead were below the reportable limit during both samplings. The exact 90th percentiles were 0.0018 mg/L in 2014 and 0.0037 mg/L in 2017. The 90th percentiles for copper were well below the action level of 1.3 mg/L. Thus, the City complied with the LCR requirements.

Table 7-3. Summary of Lead and Copper Customer Tap Samplings

Sampling	Number of Taps Sampled	Constituent	90th Percentile
September 2014	30	Lead	<0.005 mg/L (1.8 µg/L)
		Copper	0.352 mg/L
September 2017	30	Lead	<0.005 mg/L (3.7 µg/L)
		Copper	0.441 mg/L

Because none of the lead concentrations measured exceeded the proposed trigger level of 0.010 mg/L or the action level of 0.015 mg/L at individual sampling sites, the City would also comply with the proposed LCRR requirements. In fact, only one site exceeded the reportable limit of 0.005 mg/L in September 2014 (a concentration of 0.006 mg/L was measured on Hemlock Avenue), and one site in September 2017 (a concentration of 0.008 mg/L was measured on Freeman Road).

The next sampling for lead and copper at customer taps is due in 2020. The City does not have to monitor WQPs.

7.1.6.6 Analysis of Unregulated Contaminant Monitoring Results

Monitoring results for Rounds 3 and 4 were obtained from USEPA's Occurrence Data for the Unregulated Contaminant Monitoring Rule website[10].

- During UCMR 3, the City had to monitor for the List 1 contaminants, as presented in Table 2-6. The Vilas Master Meter was used to represent distribution system entry points, and the Erickson site was used to represent maximum residence time location in the City's distribution system. Sampling were conducted during all four quarters of 2015. The only contaminants detected by the City were total chromium (<0.2-0.33 µg/L), chromium-6 (0.12-0.27 µg/L), strontium (39-78 µg/L), vanadium (2.1-14 µg/L), and chlorate (<20-318 µg/L). None of the six per- and poly-fluoroalkyl substances (PFAS) were detected.
- Data from UCMR 4 were obtained from Like for UCMR 3, the Vilas Master Meter was used to represent distribution system entry points, and the Erickson sampling site was used to represent maximum residence time location in the City's distribution system. The Blue Grass Downs Pressure Station was also added as distribution system sampling site during UCMR 4. Three samplings were conducted at the Villas Master Meter and Erickson sampling site (September 2018, and March and June 2019), and two samplings were performed at the Blue Grass Downs Pressure Station in September 2018 and March 2019.

10 https://www.epa.gov/dwucmr/occurrence-data-unregulated-contaminant-monitoring-rule#3

- Results were below the detection limits for all contaminants measured, except for manganese, which showed concentrations of 76 to 112 µg/L at the Villas Master Meter in September 2018 and June 2019. In comparison to the secondary standard for manganese (i.e., 0.05 mg/L or 50 µg/L), these concentrations are high and may lead to manganese accumulation in the distribution system, customer complaints, and chlorine decay. Interestingly, manganese was not detected in March 2019, which suggests that this contaminant is not present in the Big Butte Springs but rather comes from the Duff WTP.
- For HAAs, results varied significantly over time at each sampling site. Recognizing that the intent of the HAA monitoring was to assess the occurrence of the brominated HAA species, which are not captured well in the HAA5 reporting, results showed very low concentrations for these particular compounds. HAA6Br[11] concentrations varied from less than the detection limit to 1.8 µg/L, which indicates that bromide is not found at high concentrations in the City's water sources. As a result, the difference between HAA5 and HAA9 concentrations were small (i.e., less than 1.8 µg/L) at each site and during each sampling.

In late 2019, the USEPA solicited proposals for the fifth round of UCMR. Suggested contaminants include lithium, 10 semi-volatile organic chemicals, seven pesticides and flame retardants, 12 pharmaceutical and personal care products, four haloacetonitriles (a group of DBPs), two aldehydes, two solvents, two phenols, two microorganisms (*Legionella pneumophila* and *Mycobacterium avium*), and 29 PFAS. A draft list of contaminants and associated monitoring program for UCMR 5 is expected to be released in 2021 with a final regulatory action in late 2021. Monitoring is anticipated to be conducted between 2023 to 2025.

7.1.6.7 Summary of Observations and Recommendations

According to the Oregon Public Health's Drinking Water Data Online website, the City did not have any exceedance of regulated water quality parameters within the last 5 years, and data analyzed during the preparation of this section showed that the City complied with all regulatory requirements between 2014 and 2019. In addition, analyses conducted did not observed any trends towards potential future exceedances.

The Oregon state website indicates that the City currently serves 17,025 people, which puts it at the high end of the population range for TCR sampling. The City is encouraged to review its census data and revise the number of people served as needed. If the City exceeds 17,200 people, it will need to collect 20 samples per month instead of 15.

Lead and copper data indicated that the City met the requirements of the LCR. The following recommendations are made to help the City comply with the upcoming LCRR, should the final rule be similar to the rule that was proposed in November 2019:

- Start developing an LSL inventory that would include both the City and owner sides of the service lines.
- Identify possible future sampling sites based on the potential presence of lead service lines and service lines of unknown materials.
- Engage with MWC to discuss any potential change in corrosion control practices, such as raising pH in both water sources. This would represent "a long-term change to treatment processes" that could require the City to increase sampling.

11 HAA6Br is the sum of concentrations of bromochloroacetic acid, bromodichloroacetic acid, dibromoacetic acid, dibromochloroacetic acid, monobromoacetic acid, and tribromoacetic acid

- Start developing an LSL Replacement Plan, recognizing that such plan would be required within 3 years following the publication of the final LCRR.
- Coordinate with main replacement projects, street repairs, and other projects if service lines need to be replaced.
- Identify schools and licensed child-care facilities and develop a plan to sample these facilities.

7.2 Future System Summary

This section presents a summary of the analysis of the future 2027 and 2040 scenarios. All improvements were tested under the appropriate 24-hour extended period and fire flow conditions. Figure 7-13 below shows the layout of the future system at 2040 and Figure 7-14 shows the schematic of the future system.

7.2.1 Water Rights

City owned water rights allow for a max authorized rate of 3.43 mgd and a total volume limit of 847 MG as described in the “Water Rights Strategy for Partner Water Providers” (2020) included in Appendix A and discussed in Sections 2.2 and 7.1.1. The City is pursuing a coordinated approach with MWC and other Partner Cities that initiates a shared water supply strategy which will provide Central Point with water security through the year 2070. Details are included in the “Water Rights Strategy for Partner Water Providers” (2020) (Appendix A).

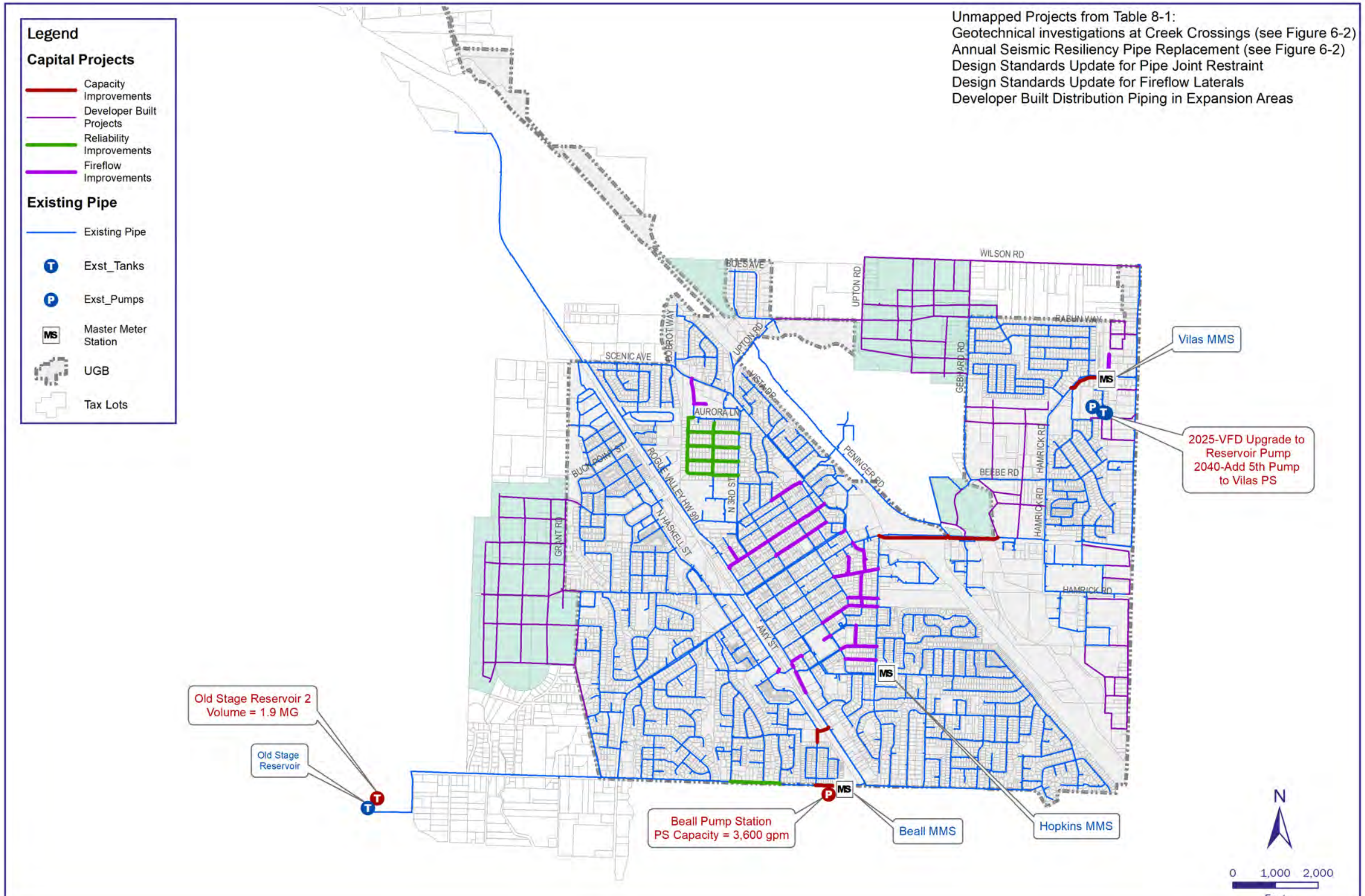


Figure 7-13. Future system layout

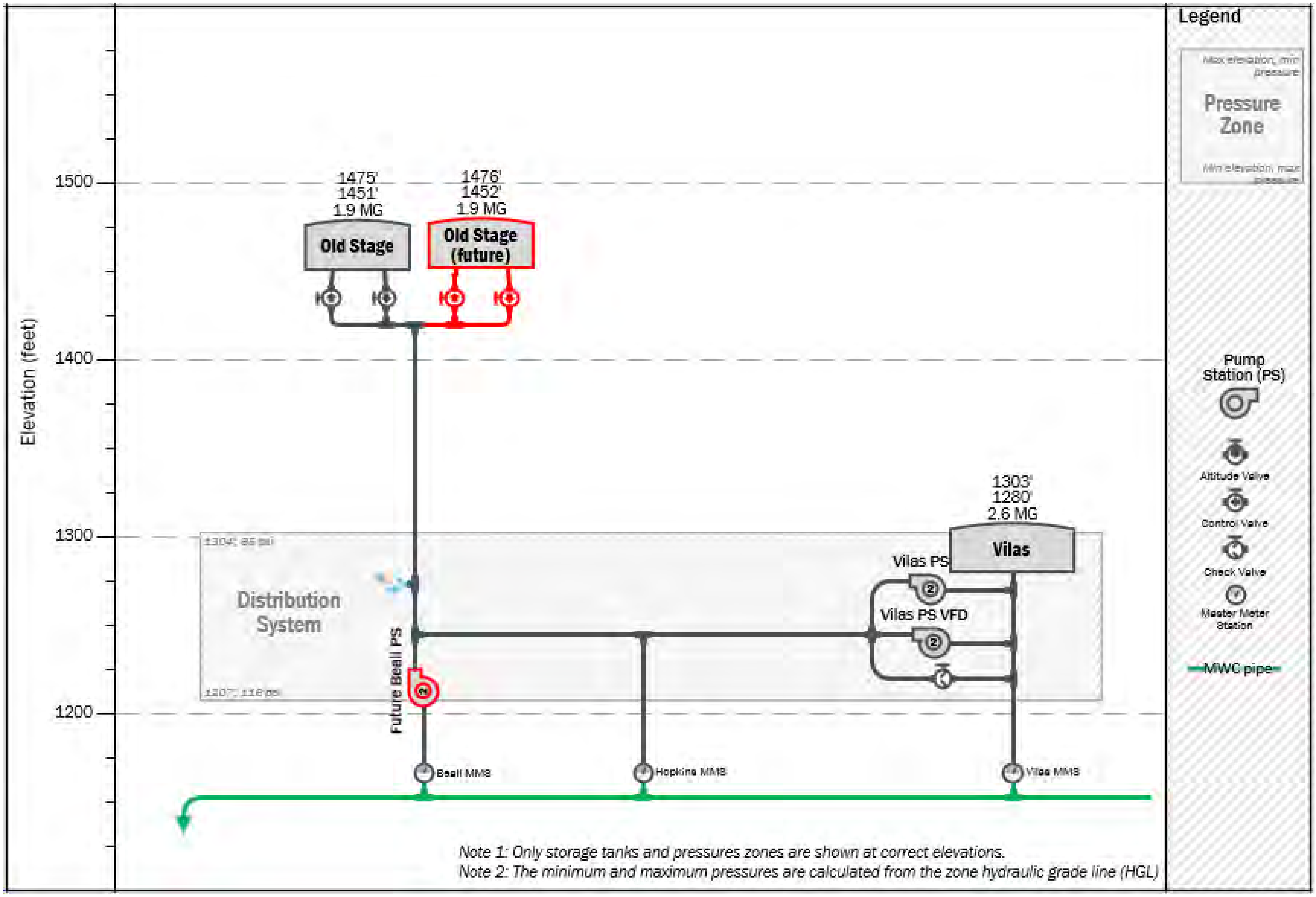


Figure 7-14. Future system schematic

7.2.2 Supply Analysis

A supply analysis was performed to determine available flow from existing and proposed reservoirs to meet peak demand and the ability of off-peak supply sources to provide enough hydraulic grade to refill reservoirs during off-peak times. The City's 2019 MDD demand diurnal curve was used to complete the 2040 MDD supply analysis, which indicates that the PHD during 2040 MDD is 15,510 gpm.

In the 2040 modeling scenario the supply was set using the same ratio of the contract limit to MDD in the current contract. Balancing supply at multiple entry points under this supply limit configuration is possible in the model, but is not expected to be achievable in the field given the anticipated fluctuation of incoming HGL. Recommended contract limit increases are discussed in Section 5.2. The modeling analysis used the following flow targets to identify capital projects and develop a future system control set:

- October through April
  - 2,157 gpm: 5 a.m. to 11 a.m.
  - 3,832 gpm: all other times
- May through September
  - 6,774 gpm: 5 a.m. to 11 a.m.
  - 7,790 gpm: all other times

Figure 7-15 illustrates the anticipated supply breakdown in the 2040 scenario.

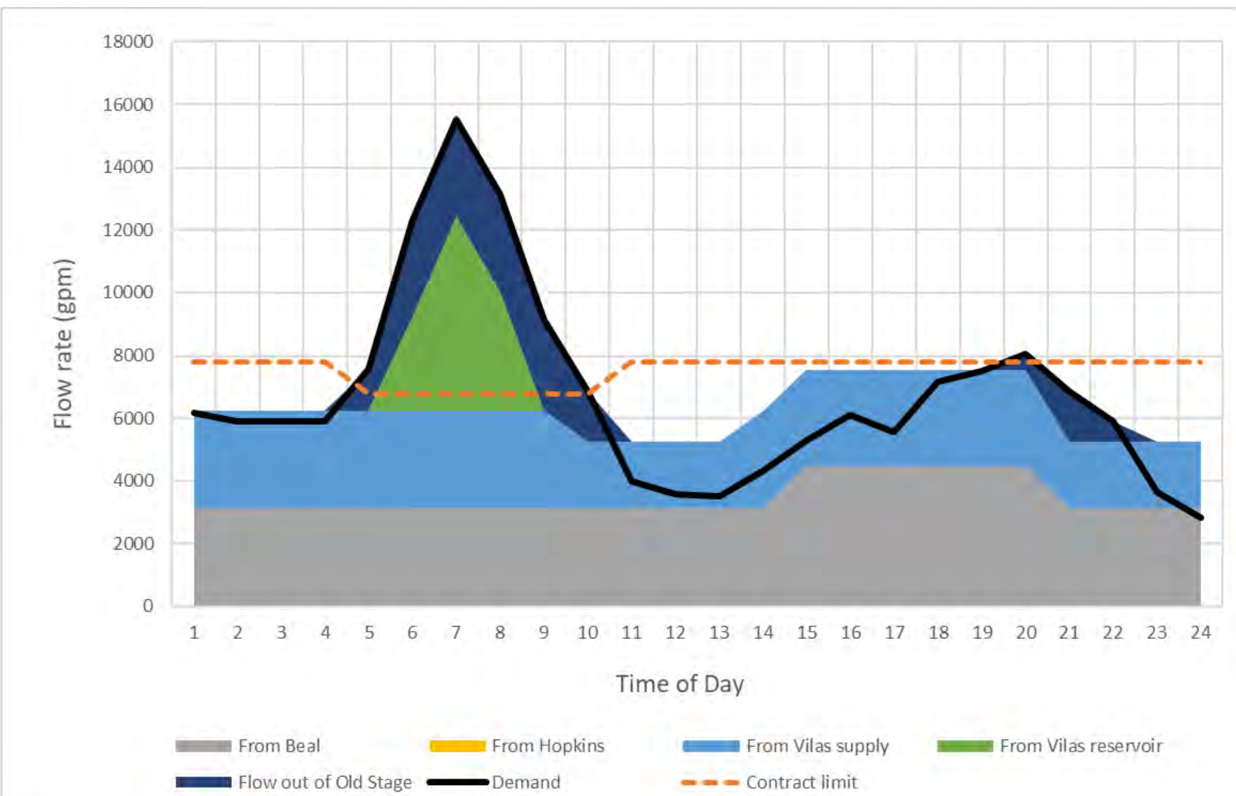


Figure 7-15. 2040 supply analysis

Variable head conditions from MWC at the master meter stations has been a challenge in sizing future pumping improvements which are integral to the supply plan. To mitigate unknown future head conditions the City coordinated with MWC to provide model runs from their hydraulic system model using the 2015 and 2035 demand scenarios that they have available. Results of that analysis as provided by MWC are included in Appendix D. The analysis indicates that there is a projected increase in incoming HGL associated with anticipated improvements within the MWC distribution system between the year 2015 and 2035. For example, at the Vilas MMS with a total projected flow of 5,000 gpm the modeled HGL is 1,440 ft in 2015 and 1,466 in 2035.

7.2.3 Pump Improvements

Due to the planned demolition of the Shops tank and pump station and increase in system demand, the following pump improvements are recommended:

- *Vilas Pump Station*. Upgrade the Vilas pump station to provide a reservoir pump firm capacity of 6,200 gpm. This will require installation of a fifth pump with variable frequency drives in the available space within the pump station and is needed toward the end of the 2040 planning period.
- *Beall Pump Station*. Construct a 3,600 gpm pump station with variable frequency drives near the Beall MMS. Maintain a parallel PRV. This is a near-term project to be completed prior to demolition of the Shops facility. HGL at the Beall MMS should be evaluated thoroughly during pre-design to refine the anticipated head conditions at this location.

To provide the City with increased operational flexibility as staff work to maintain the City's total flow from MWC at or below contract limits all future pump installations are recommended to include variable frequency drives.

7.2.4 Storage Improvements

The 2040 storage analysis was completed to identify additional storage capacity to meet level of service criteria and determine how the system will likely be affected by the demolition of the Shops tank and the expected growth in demand. Table 7-4 provides the storage analysis for the current scenario.

Table 7-4. Future System Storage Analysis

Planning Horizon	Existing Storage Capacity (MG)	Required Storage Volume (MG)				Excess Storage (MG)	
		Fire	Equalization	Emergency	Total	Existing Tanks	Without Shops
2040	5.69	0.63	2.65	3.25	6.53	- 0.83	-1.83

Under the current demand condition, without the 1 MG Shops tank in service, the City would have a storage deficiency of 0.11 MG. In 2040, the storage analysis shows that the City will need an additional 1.83 MG of storage capacity. To alleviate this deficiency, installation of a 1.9 MG tank adjacent to the existing Old Stage tank that can meet storage requirements through 2040 and beyond is recommended.

Alternate locations considered for the proposed tank included sites directly west of the new Taylor-West Development or pump-storage sites located along Hopkins Road. The sites west of Taylor-West would have required a costly transmission main extension, re-zoning, and included some of the highest land prices in the area. The model analysis discussed in Section 7.2.7 indicates that adding a tank at the existing Old Stage tank site can be completed without significant transmission main capacity improvements through 2040.

The City also considered an alternative to buy into a large storage reservoir that is in the early planning stages by MWC. Project sites for this storage project are constrained to a range of ground elevations which requires the site to be over 2 miles from the City's MMS delivery points and would require new transmission to convey flow to the City, which was estimated to be approximately four times more expensive than a new 1.9 MG storage facility. Development of City-owned storage would also provide the additional storage on the west side of the City where most of the residential development is currently occurring.

7.2.5 Water Age

A water age analysis was conducted using the City's InfoWater hydraulic model to better understand circulation of water throughout the City's distribution system and correlate disinfectant residual with water age under the future system evaluation. The City has had problems maintaining chlorine residual in the existing Old Stage tank in the past, particularly when a 40-percent daily tank turnover is not achieved. This issue prompted evaluation of water age for the existing and future system scenarios so impacts to water age from the recommended CIPs could be identified.

Water age was evaluated during average day demands and was assumed to be zero at each of the MMS entry points, which excludes time spent in the MWC system and assumes that the incoming water at each MMS is the same age. Old Stage and Vilas reservoirs were assumed to be fully mixed. The future system water age was completed for the 2040 scenario assuming constant use of the existing and future Old Stage reservoirs in addition to the Vilas reservoir. The Old stage reservoir level fluctuates 5 feet in this scenario and the Vilas reservoir fluctuates by 6.5 feet. A comparison of existing versus future water age is shown in Table 7-5. These data show that increasing storage capacity at Old Stage generally decreases water age on the east side of the City and increases water age west of Highway 99 when compared to the existing condition. Water quality should be a consideration in the design of the second reservoir at Old Stage, which could include operational recommendations and potentially chlorine boosting.

Table 7-5. Summary of Predicted 2040 Water Age vs. Chlorine Residual

Sampling Location	Model Junction ID	Existing 25th Percentile, Average, 75th Percentile Free Chlorine Residual (mg/L)	Existing Water Age without Shops Turnover (days)	2040 Water Age (days)
Crest	J5826	0.43, 0.49, 0.55	2.5	1.6
Jeremy	J8953	0.43, 0.49, 0.56	3.5	1.2
Pfaff	J8866	0.41, 0.47, 0.54	2.4	3.4
North Haskell	J8207	0.37, 0.43, 0.48	4.5	7.4
Vanhorn	J9305	0.37, 0.44, 0.53	2.9	2.9
Flanagan	J5238	0.37, 0.43, 0.49	5.0	7.6
Forest Glen	J6345	0.36, 0.43, 0.50	1.9	3.1
Mendolia	J5548	0.29, 0.37, 0.44	5.0	7.5
Old Stage	J8792	0.25, 0.34, 0.43	5.0	7.5
Shops	J7069	0.25, 0.34, 0.43	2.6	5.4
Erickson	J7929	0.12, 0.20, 0.27	16.6	13.1

7.2.6 Piping Evaluation

Piping improvements needed under 2027 and 2040 demand include new transmission piping to convey water from the MMSs to City storage and distribution and new distribution piping to achieve fire flows. Two major components of the piping evaluation analysis were the evaluation of the Old Stage reservoir transmission main and an overall evaluation of all transmission and distribution piping.

7.2.6.1 Old Stage Reservoir Transmission Analysis

The transmission capacity of the pipeline to the existing and proposed Old Stage tanks was reviewed in detail because the City has experienced water age issues with the existing Old Stage tank and expressed concerns with the current lack of a dedicated inlet/outlet main to the tank.

Figure 7-6 shows the water level in the Old Stage tanks and the expected velocity in the Old Stage transmission pipe over a 3-day period of 2040 MDD. Maximum velocities do not indicate the need for a second transmission main to the Old Stage tank and updates to the master plan will further evaluate options to improve water age/quality issues at the Old Stage site.

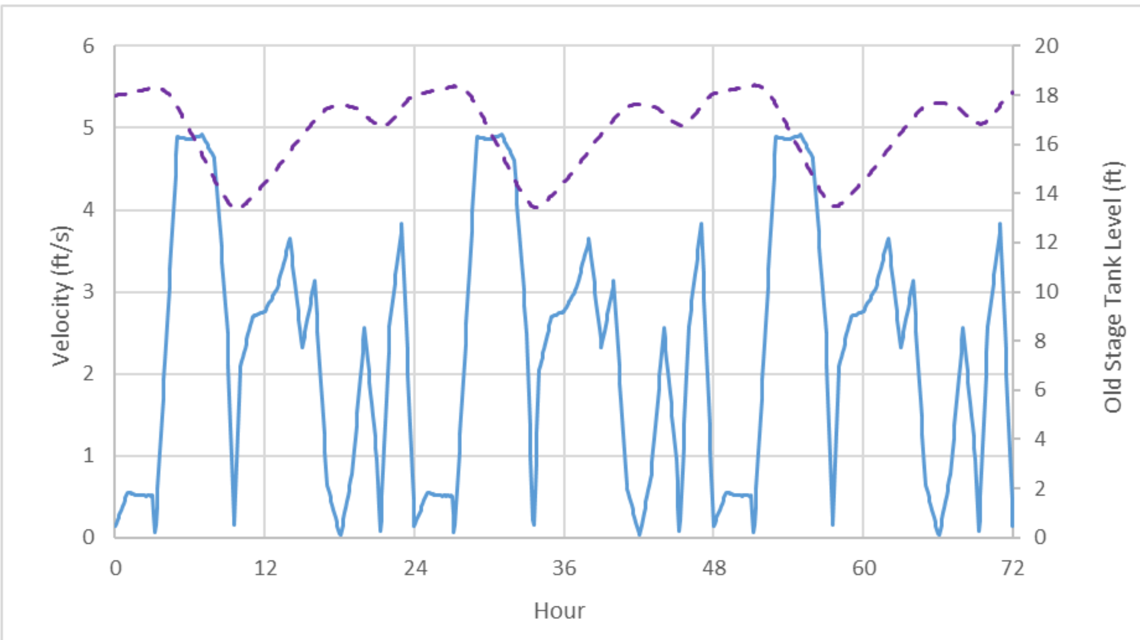


Figure 7-16. 2040 MDD tank and pump station model results

Results of the fire flow, velocity, and minimum pressure evaluations during MDD indicated that the existing Old Stage transmission main is adequate for additional system transmission to maintain level of service criteria through 2040.

7.2.6.2 Fire Flow Deficiency Analysis

An analysis of fire flow deficiencies caused by undersized hydrant laterals in industrial and institutional land use zones was evaluated under the future system condition to determine if fire flow demand could be served by multiple nearby hydrants.

Table 7-6 below summarizes these locations, which were shown as green dots on Figure 7-2. Revision to the City's design standard is recommended to require multiple hydrants or increase lateral size from 6 inches to 10 inches for hydrant laterals over 50 feet in length serving 3,500 gpm, depending on length.

Model Node ID	Hydrant ID	Location	Fire flow Demand (gpm)	Available Fire flow (gpm)	Nearby Node ID	Combined Available Fire flow (gpm)	Resolution
J8886	Not Available (NA)	Ice Cream Drive	3,500	2,400	J8695	3,530	Combined hydrants provide required fire flow demand.
J8683	NA	Biddle Road and Hamrick Rd	2,500	2,328	J8072	3,490	
J9047	NA	Table Rock Road	3,500	2,480	J8507	3,730	Serve fire flow from Table Rock Road. Complete pipe loop upon redevelopment of lot to serve fire flow within development.
J9033	NA	Rogue Valley Sewer Services Driveway	3,500	2,075	NA	NA	10-inch hydrant lateral required to serve 3,500 gpm demand.
J8732	NA	Upton Road at Crater FFA Lab	3,500	3,037	NA	NA	10-inch lateral required to serve 3,500 gpm demand.
J7466	16595	Scenic Middle School	3,500	2,222	NA	NA	Replace existing 6-inch AC pipe from Scenic Ave to J7486 with 12-inch diameter pipe. Replace existing 6-inch AC lateral with 10-inch pipe. Also provides resiliency to critical facility.
J7463	16600	Crater High School	3,500	3,450	J7462	4,380	Given proximity of available flow to demand and nearby junction no project recommended. If 6-inch AC serving hydrant 16600 is replaced, replace with 8-inch in future.
J7023	16719	Central Point Elementary	3,500	3,400	J7925 J6848 J6875	>5,000	Nearby hydrants tapped off of the 12-inch diameter line provide adequate fire flow. If 3,500 gpm is important to provide at this specific location, the lateral could be increased to 10-inches in size.

Table 7-6. Multiple Hydrant Evaluation

7.2.6.3 2027 Capacity Driven Piping Improvements

Piping system improvements needed under 2027 demand scenario to meet hydraulic level of service criteria include transmission to convey water from the MMSs to City storage and new distribution piping to achieve required fire flows. Piping improvements associated with seismic resiliency are discussed in Section 6.7 and will be carried forward into the capital improvement plan. Capacity driven piping improvements are described below and shown in Figure 7-13.

1. **South Haskell Piping.** Install 1,230 feet of 12-inch-diameter piping to complete the South Haskell Connection and replace the existing 6-inch crossing with a 12-inch-diameter pipeline. This improvement will complete a new transmission route which provides additional connectivity and hydraulic capacity between the east and west sides of Highway 99.
2. **Beall Lane Piping.** Install 1,160 feet of 16-inch-diameter piping between Malabar Street and Snowy Butte Lane. This pipeline will replace the last remaining section of 12-inch-diameter AC piping along Beall Lane. Install 710 feet of 20-inch-diameter piping between the new Beall Pump Station to South Haskell Street. This improvement reduces headloss in the transmission main to the Old Stage Reservoir and improves system resiliency.

3. **Fire Flow Improvements.** Fire flow deficiencies were identified within the existing system which will require small diameter piping improvements. There are no transmission piping projects required to meet fire flow requirements within expansion areas. These projects will be scheduled throughout the planning period to coincide with other utility improvements where possible.

7.2.6.4 2040 Capacity Driven Piping Improvements

Piping system improvements needed under 2040 demand scenario to meet hydraulic level of service criteria include transmission to convey water from the MMSs to City storage and new distribution piping to achieve required fire flows. Piping improvements associated with seismic resiliency are discussed in Section 6.7 and will be carried forward into the capital improvement plan. Capacity driven piping improvements are described below and shown in Figure 7-13.

1. **Vilas Road Pipeline.** Install a parallel 16-inch-diameter pipeline on Vilas Road from Singing Grass Lane to 230-feet north of the park entrance. This can be installed as a parallel line or a pipe replacement project with equivalent capacity. This pipeline is needed once the Vilas pump station upgrade is completed.
2. **Interstate 5 Crossing Pipeline.** Install 1,610 feet of 16-inch-diameter piping on Pine Street from the northbound I-5 on ramp to the southbound exit ramp. This pipeline provides additional east-west conveyance capacity and would replace the existing 12-inch-diameter pipeline that currently hangs from the crossing in a sleeve. An alternative to this alignment is located 1-mile to the north along Upton Road. The Upton Road alignment is 2,050 feet and would require a trenched alignment which would significantly increase the cost of this alternative. The benefit of the Upton Road crossing is improved resiliency of adding a new crossing on the north side of the system.
3. **Pine Street Crossing Pipeline.** Install 1,190 LF of 16-inch-diameter pipe along Pine Street from the east side of the Bear Creek to the Interstate 5 Crossing Pipeline at the northbound onramp. This pipeline is currently 12-inch and is driven primarily by a road widening project and for seismic resiliency, however given the replacement it is recommended that the pipeline be increased to 16 inches to meet level of service criteria for new pipelines to maintain velocity under 5 fps.
4. **Fire flow Improvements.** Fire flow deficiencies were identified within the existing system which will require small diameter piping improvements. There are no transmission piping projects required to meet fire flow requirements within expansion areas. These projects will be scheduled throughout the planning period to coincide with other utility improvements where possible.

Section 8

Capital Improvements Program

This section presents the Capital Improvements Plan (CIP) for the City of Central Point's (City) water system and summarizes the City's financial plan to execute the CIP.

8.1 Capital Improvements Plan

A CIP was developed to assist the City in budgeting for the improvements needed over the next 20 years to provide the required level of service to the City water customers. The improvement projects developed in the future system analysis were developed to address hydraulic capacity constraints, water quality, seismic resiliency, and reliability. Cost estimates were prepared for each project.

Table 8-1 below lists the improvements and probable estimates of costs.

Figure 8-1 shows the location of the proposed improvement projects. Figures 8-2 through 8-9 present the details of each improvement project.

Note: All figures included in Section 8 are presented at the end of the section

8.2 Description of Cost Estimates

Cost estimates provided in Table 8-1 are based on a budgetary, planning-level, and engineer's opinion of probable project costs. The detailed cost estimates are included in Appendix E. The costs for each recommended improvement are presented in present-day value. The cost information should be updated regularly using the Engineering News Record (ENR) Construction Cost Index value to account for fluctuations in construction cost over time. The ENR Construction Cost Index at the time the cost estimates were prepared was 11,311.24 (ENR, September 2019).

Unit costs were developed from Brown and Caldwell's (BC's) recent project experience in the area and were verified with information from bid tabs on projects recently constructed for the City and MWC. All unit prices represent installed costs and include excavation, bedding, backfill, compaction, materials, appurtenances, and delivery to the site. Allowances for Contingency and EAC (Engineering, Legal, Administration, and Construction Management Services) are included in the cost estimates. All estimates include 25 percent for construction contingency and 15 percent for EAC.

The cost estimates are based on BC's perception of current conditions in the project location. The estimates reflect BC's professional opinion of accurate costs at this time and are subject to change. BC has no control over variances in the cost of labor, materials, equipment, services provided by others, contractor's method of determining prices, competitive bidding or market conditions, practices, or bidding strategies. BC cannot and does not warrant or guarantee that proposals, bids, or actual construction costs will not vary from the costs presented herein.

8.3 Non-Capital Recommendations

Throughout the planning process several non-capital recommendations were developed to address current and future regulatory requirements and improve system operation. These recommendations are summarized below with reference to the section where they are described in further detail:

- Renegotiate supply contract with MWC in 2021 with additional flexibility and allow for an additional 10 percent increase in demand limit from 5 a.m. to 11 a.m. and an additional 15 percent increase all other times. It is also recommended that future contracts include the allocated flow rates at the time of contract signature with an escalation based on population increase for each year within the contract time frame. See Section 5.2.
- Include conservation planning measures in next water master plan update. See Section 3.2.5.
- Revise design standards for DI pipe to require push-on joints with restraining gaskets approved by the manufacturer for use only with their pipe unless otherwise stated. Gasket manufacturer options include U.S. Pipe Field Lok 350, McWane, Sure Stop 350 and American Cast Iron Pipe, FastGrip or City approved equal. Mains 12 inches and larger in areas where PGD was identified during the study require integrated restrained joints and City approval of the pipe design. See Section 6.7.
- Revise design standards to require multiple hydrants or increase lateral size from 6 inches to 10 inches for hydrant laterals over 50 feet in length serving 3,500 gpm demands is recommended, depending on length. See Section 7.2.6.
- Increase frequency of Shops tank turnover in low demand months from once every 1 to 3 weeks to once per week.
- Make the following changes based on anticipated LCRR. See Section 7.1.6.7.
  - Start developing an LSL inventory that would include both the City and owner sides of the service lines.
  - Identify possible future sampling sites based on the potential presence of lead service lines and service lines of unknown materials.
  - Engage with MWC to discuss any potential change in corrosion control practices, such as raising pH in both water sources. This would represent “a long-term change to treatment processes” that could require the City to increase sampling.
  - Start developing an LSL Replacement Plan, recognizing that such plan would be required within 3 years following the publication of the final LCRR.
  - Coordinate with main replacement projects, street repairs, and other projects if service lines need to be replaced.
  - Identify schools and licensed child-care facilities and develop a plan to sample these facilities.

8.4 City Financial Plan

The City reviews water utility rates annually and hires an outside consultant every 10 years to review the rates to make additional adjustments, as needed. City staff and the financial consultant reviewed the CIP presented in this Master Plan against the results of the water rate study and System Development Charge (SDC) Study. In summary, the CIP will be funded by three main sources. The main source of funding will come from the City’s water rates based upon the updated model. Annual water rate adjustments are done every April. Water rates will pay for 65 percent of the overall improvements. The remaining 35 percent will be paid for from SDCs and long-term bonding. The City currently has one water bond that paid for construction of the Vilas Water Reservoir and pump station; the bond is scheduled to be paid off in 2030. Repayment of the bond has already been incorporated into the annual rates.

Table 8-1. Capital Improvements Project Summary List

Project No. [a]	2009 MP Project No.	Project name	Estimated Completion Year	Driver	Part of System Backbone	Facilities to Construct	Project Description	Direct Cost	Indirect Cost		Total Estimated Cost
									Contingency	EAC	
1		Haskell Connection	2027	Capacity Resiliency	Yes	Disconnect 280 LF of existing 6-inch CI 290 LF of 12-inch diameter pipe 280 LF of 12-inch diameter pipe crossing Hwy 99	Development in this area has allowed the City to reconfigure their backbone system and provide a 12-inch Hwy 99/Front Street crossing and connect Haskell Street with a 12-inch-diameter pipeline from Lavender to Mac Court. It is assumed that the highway pipeline will be slipped through an existing sleeve.	$229,000	$57,000	$100,000	$387,000
2	M-1	Beall Pump Station	2027	Capacity	Yes	New pump station including: Pump house Two vertical turbine pumps on VFDs with a combined capacity of 3,600 gpm @ 36 TDH	New booster pump station to provide a constant hydraulic grade from supply to the system. Without this project, supply from the Beall MMS is constrained when the Vilas is in operation. The project is to be completed prior to decommissioning of the Shops pump station. Pump should be equipped with a VFD to adjust the motor speed with changes in upstream pressure and an analysis of upstream pressure should be included in pump station preliminary design. Future storage projects from MWC may change the suction head at this pump station. Land acquisition and decommissioning of existing Shops Tank and Pump Station facility not included in cost estimate.	$2,029,000	$507,000	$888,000	$3,424,000
3		Beall Lane Piping Capacity	2027	Capacity	Yes	Replace 710 LF of 16-inch DI with 20-inch DI 200 LF of 20-inch DI	Replace existing 16-inch diameter DI with new 20-inch DI from the new pump station site to S Haskell Street. Since the exact location of the Beall Pump Station has not been selected an allowance for an additional 200 LF of 20-inch DI pipe has been added to this project. Total cost of the additional 200 LF of 20-inch DI is approximately $190,000.	$507,000	$126,000	$222,000	$855,000
4		Beall Lane Piping Resiliency		Resiliency	Yes	Replace 1,160 LF of 12-inch AC with 16-inch DI	Replace existing 12-inch AC pipe with 16-inch restrained joint DI from Malabar Street to Snowy Butte Lane to improve hydraulic capacity and system resiliency.	$560,000	$140,000	$245,000	$945,000
5		Old Stage Storage Reservoir #2	2027	Capacity	Yes	New 1.9 MG tank	1.9 MG tank at the Old Stage tank site with a base elevation of 1,451.75 feet, diameter of 117 feet and a maximum height of 24 feet. Consider water quality needs in design, may include operational recommendations and/or chlorine boosting.	$5,790,000	$1,158,000	$1,390,000	$8,338,000
6		Bear Creek Crossing at Pine	2040	Resiliency	Yes	1,190 LF of 16-inch-diameter pipe.	There is a planned lane widening project from the Pine Street bridge across Bear Creek to the northbound I-5 on-ramp. This project would likely require realignment of the existing pipeline, which is mounted to the bridge deck. This CIP would reroute the pipeline under Bear Creek. Detailed design will recommend burial depth and joint restraint per local conditions. The existing 12-inch-diameter pipeline has a maximum velocity of 5.5 fps in the 2040 MDD scenario, which is just above the LOS criteria of 5 fps for new pipelines. Given future upsize of the I-5 crossing it is recommended that this line be increased from 12-inch to 16-inch.	$575,000	$144,000	$251,000	$970,000
7		Interstate 5 Crossing Pipeline	2040	Capacity	Yes	Install 1,660 LF of 20-inch	Replace existing 12-inch Interstate 5 crossing pipeline with a 20-inch diameter main.	$925,000	$231,000	$404,000	$1,560,000
8		Vilas Road Pipeline	2040	Capacity	Yes	Install 840-feet of 16-inch waterline.	Install hydraulic equivalent of parallel 16-inch diameter piping from Singing Grass Drive to 230 feet north of the park entrance. Project may include installation of a new parallel line or replacement with a larger main to provide the equivalent hydraulic capacity. Complete prior to Vilas Pump Station Upgrade.	$406,000	$101,000	$178,000	$685,000
9		Vilas Pump Station Upgrade	2040	Capacity	Yes	Install 5th pump	Install 5th pump to provide a pump firm capacity of reservoir pumps to 6,200 gpm. Install VFDs on new pump. Determine during detailed design if replacement will be one larger pump or replacement of one existing reservoir pump with installation of a new matching 5th pump.	$175,000	$44,000	$76,000	$295,000
10		Vilas Pump Station VFD Upgrade	2025	Operations	Yes	Install VFDs	Retrofit existing reservoir pumps to add VFDs. Investigation of pump station control panel spacing, air conditioning capacity, control programming and power supply needed to determine feasibility and cost of this improvement.	TBD	TBD	TBD	TBD
11	S-3	Downtown Small Pipe Replacement Program: Royal Heights	TBD	Resiliency	No	7,600 LF of 8-inch-diameter pipe	New 8-inch piping to replace small piping in the Royal Heights area. The 8-inch replacement piping is to reduce maintenance work and add reliability to the system. This improvement is not needed to improve hydraulic performance.	$2,599,000	$650,000	$1,137,000	$4,386,000
12		Geotechnical Investigation at Creek Crossings	TBD	Resiliency	Yes	Not applicable	Assess soil liquefaction and lateral spreading hazards relative to pipeline depth at the Upton Road crossing and other minor drainages to determine if pipe replacement for seismic resiliency is needed. See Figure 6-2 for locations.	$150,000	$0	$0	$150,000
13		Annual Seismic Resiliency Pipe Replacement		Resiliency	Yes	440 LF of 12-inch pipe	Annually replace approximately 440 LF of existing cast-iron and asbestos cement pipe within the system backbone using restrained joint pipe. Replacement of 300 LF of pipeline at each drainage crossing also included.	$177,000	$44,000	$77,000	$298,000
14	M-3	Fire Flow Improvements near Front St and Bush		Fire Flow	Yes	450 LF of 8-inch diameter pipe 560 LF of 10-inch diameter pipe	Connect 6-inch CI with 12" DI south of intersection of Amy and Ash St. Replace existing 4-inch AC on Cedar Street from Front to 1st. Connect existing 6-inch DI to 12-inch AC from the fire station to Bush Street (alternate to use fire flow from 12" in back of lot)	$366,000	$91,000	$160,000	$617,000
15	M-4	Fire Flow Improvements on Maple		Fire Flow	No	2,780 LF of 8-inch-diameter pipe	Pipeline improvements to meet fire flow capacity requirements in the area. Replace 4-inch CI and 6-inch AC pipe along Laurel. Replace 4-inch CI on N 1st Street from Maple to Cherry.	$951,000	$238,000	$416,000	$1,605,000
16	L-1	Fire Flow on Bigham (North of Oak St)		Fire Flow	No	820 LF of 8-inch diameter pipe	Pipeline improvements on Bigham Dr. from E Pine St to Oak Street. The City completed the portion of Project L-1 from the 2009 Plan on Oak Street in 2003.	$280,000	$70,000	$123,000	$473,000

Table 8-1. Capital Improvements Project Summary List											
Project No.[a]	2009 MP Project No.	Project name	Estimated Completion Year	Driver	Part of System Backbone	Facilities to Construct	Project Description	Direct Cost	Indirect Cost		Total Estimated Cost
									Contingency	EAC	
17	L-1	Fire Flow on S. 9th St		Fire Flow	No	440 LF of 8-inch diameter pipe	Pipeline improvements on S. 9th Street from south of E Pine St to Oak Street. The City completed the portion of Project L-1 from the 2009 Plan on Oak Street in 2003.	$150,000	$38,000	$66,000	$254,000
18		Fire Flow on Oak St		Fire Flow	No	1,060 LF of 8-inch diameter pipe	Replacement of existing 4-inch CI with 8-inch DI. Pipeline improvements along Oak Street from S.7 th St. to Freeman Rd.	$363,000	$91,000	$159,000	$613,000
19	L-1	Fire Flow on Bigham (South of Oak St)		Fire Flow	No	900 LF of 8-inch diameter pipe	Replacement of existing 4-inch CI with 8-inch DI. Pipeline improvements along Bigham Dr. from Oak St. to Chestnut St and along Chestnut St. from Bigham Dr. to S.7th St.	$308,000	$77,000	$135,000	$520,000
20	L-1	Fire Flow on Chestnut		Fire Flow	No	970 LF of 8-inch diameter pipe	Replacement of existing 4-inch CI with 8-inch DI. Pipeline improvements along Chestnut St. from Bigham Dr. to Freeman Rd., along pipe connection between Chestnut St. and Ash St., and along Ash St. from pipe connection to Freeman Rd.	$332,000	$83,000	$145,000	$560,000
21		Fire Flow on Ash St		Fire Flow	No	1,050 LF of 8-inch diameter pipe	Replacement of existing 4-inch CI with 8-inch DI. Pipeline improvements along Ash St. from S. 4th St to pipe connection to Chestnut St.	$359,000	$90,000	$157,000	$606,000
22		Fire Flow on Rostel St		Fire Flow	No	490 LF of 8-inch diameter pipe	Replacement of existing 4-inch CI with 8-inch DI. Pipeline improvements along Rostel St. from Cedar St. to Bush St.	$168,000	$42,000	$73,000	$283,000
23	L-2	Fire Flow on Hazel and 9th		Fire Flow	No	825 LF of 8-inch-diameter pipe	Pipeline improvements on Hazel to replace existing 4-inch CI with 8-inch DIP from N 6th Street to N 9th. The 2009 Plan included replacement of the 4-inch cast iron all the way to 2nd Street as a part of Project L-2. A portion of this project was removed because it is not needed to meet fire flow since there are no hydrants between 2nd and 6th. It is 600 feet between the hydrant on 2nd and the one on 6th, and 600 feet would be the added length of pipe replacement.	$282,000	$71,000	$123,000	$476,000
24	L-5	Fire Flow on Laurel Street		Fire Flow	No	1,440 LF of 8-inch-diameter pipe	Replacement of existing 4-inch CI with 8-inch DI from 4th Street to 9th Street.	$493,000	$123,000	$215,000	$831,000
25		Fire Flow on Manzanita		Fire Flow	No	110 LF of 8-inch diameter pipe	Replacement of existing 4-inch CI with 8-inch DI.	$38,000	$9,000	$16,000	$63,000
26		Fire Flow at Scenic Middle School	2021	Fire Flow Resiliency	Yes	900 LF of 10-inch diameter pipe	Replacement of existing 6-inch AC pipe from Scenic Ave to J7486 at middle school entrance with 12-inch diameter pipe. Replace existing 6-inch AC lateral with 10-inch pipe. This project also provides resiliency improvements for a critical facility.	$340,000	$85,000	$149,000	$574,000
27		Fire Flow on Bush Street		Fire Flow	No	864 LF of 8-inch diameter pipe	Replacement of existing 4-inch CI with 8-inch DI.	$295,000	$74,000	$129,000	$498,000
28		Fire Flow on Grand Ave		Fire Flow	No	732 LF of 8-inch diameter pipe	Replacement of existing 4-inch CI with 8-inch DI.	$250,000	$63,000	$109,000	$422,000
29		Fire Flow at Central Point Elementary	2022	Fire Flow	Yes	184 LF of 8-inch diameter pipe	Replacement of 6-inch DI lateral serving elementary school. If fire flow service by the 12-inch pipe surrounding the school can be used to provide a combined fire flow this project can be removed.	$63,000	$16,000	$27,000	$106,000
30		Fire Flow west of Vilas and Table Rock at RVSS	2040	Fire Flow	No	530 LF of 10-inch diameter pipe	Replacement of 6-inch DI lateral serving RVSS. If surrounding development provides looping this project may be reduced in size or eliminated.	$200,000	$50,000	$88,000	$338,000

a. Project numbers are listed to provide reference to project mapping and documentation, but do not signify order of importance.

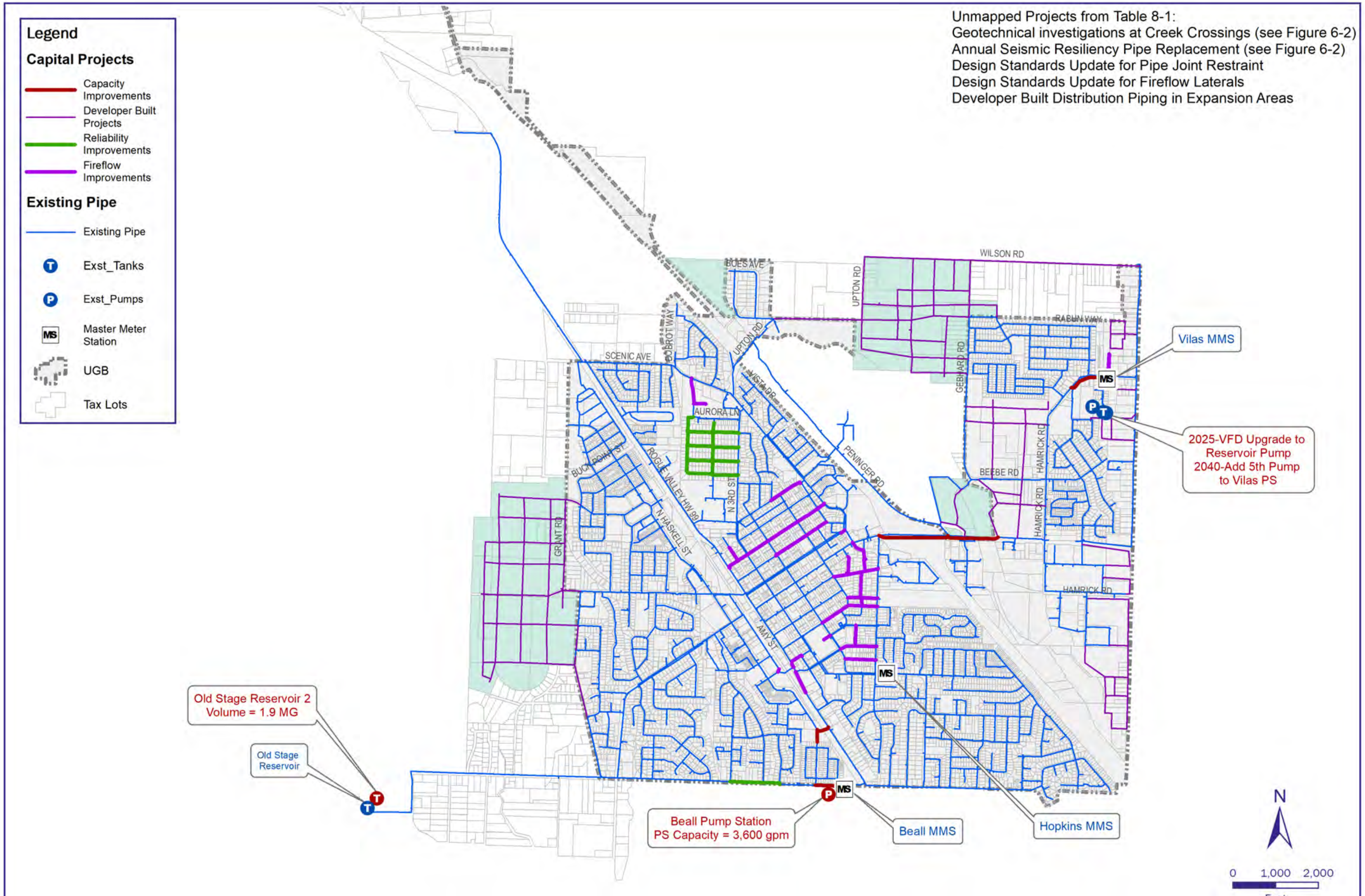
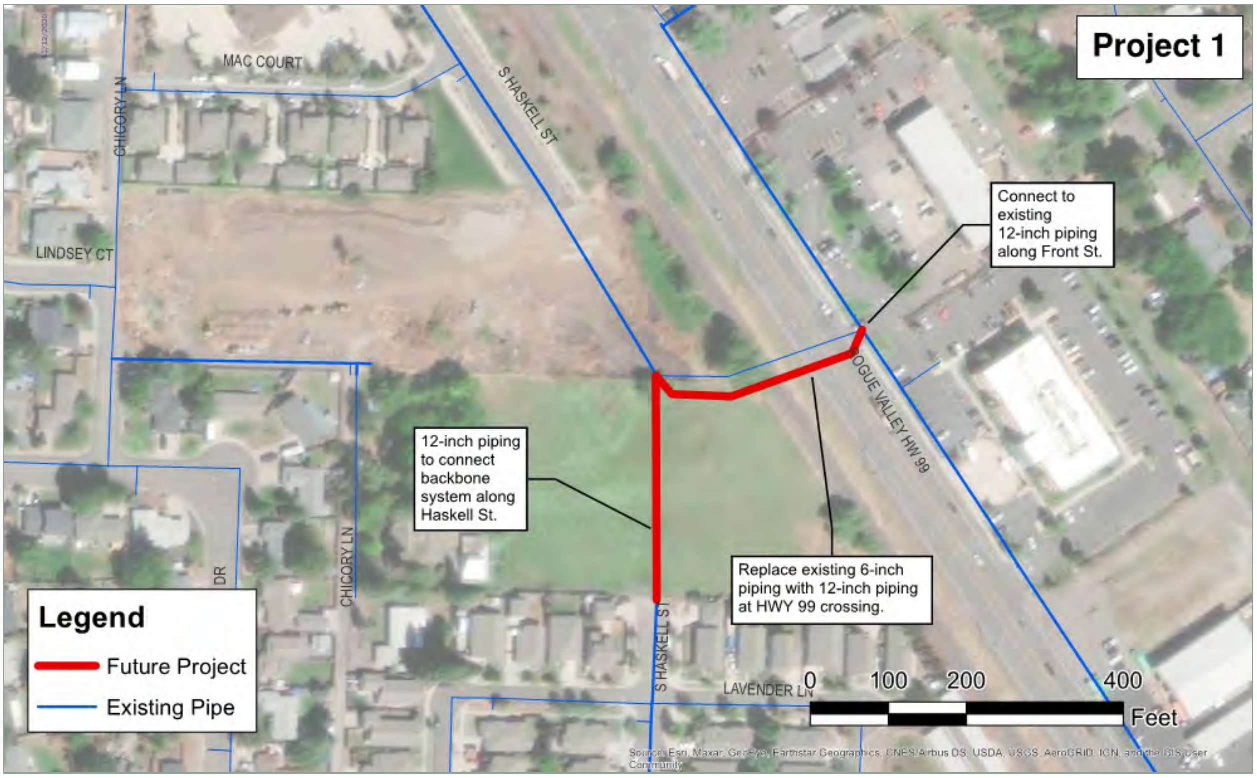
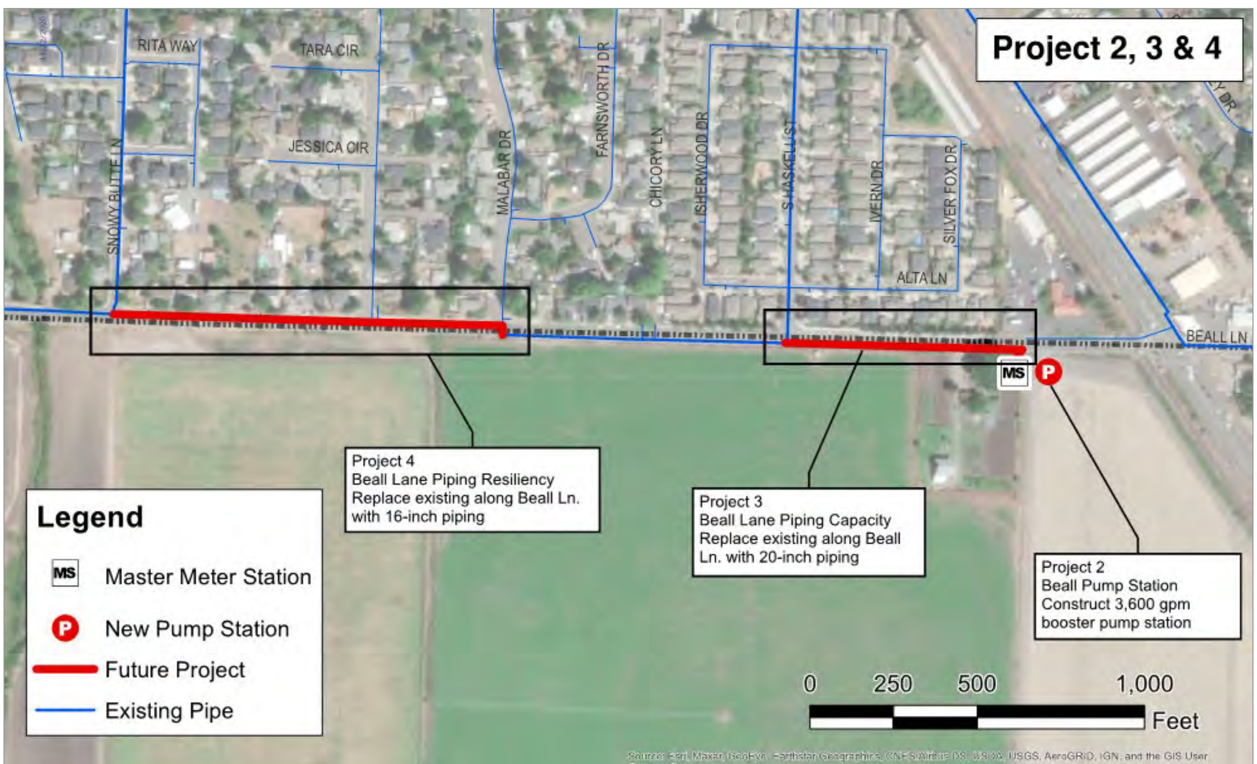


Figure 8-1. Capital Improvement Projects

Brown AND Caldwell

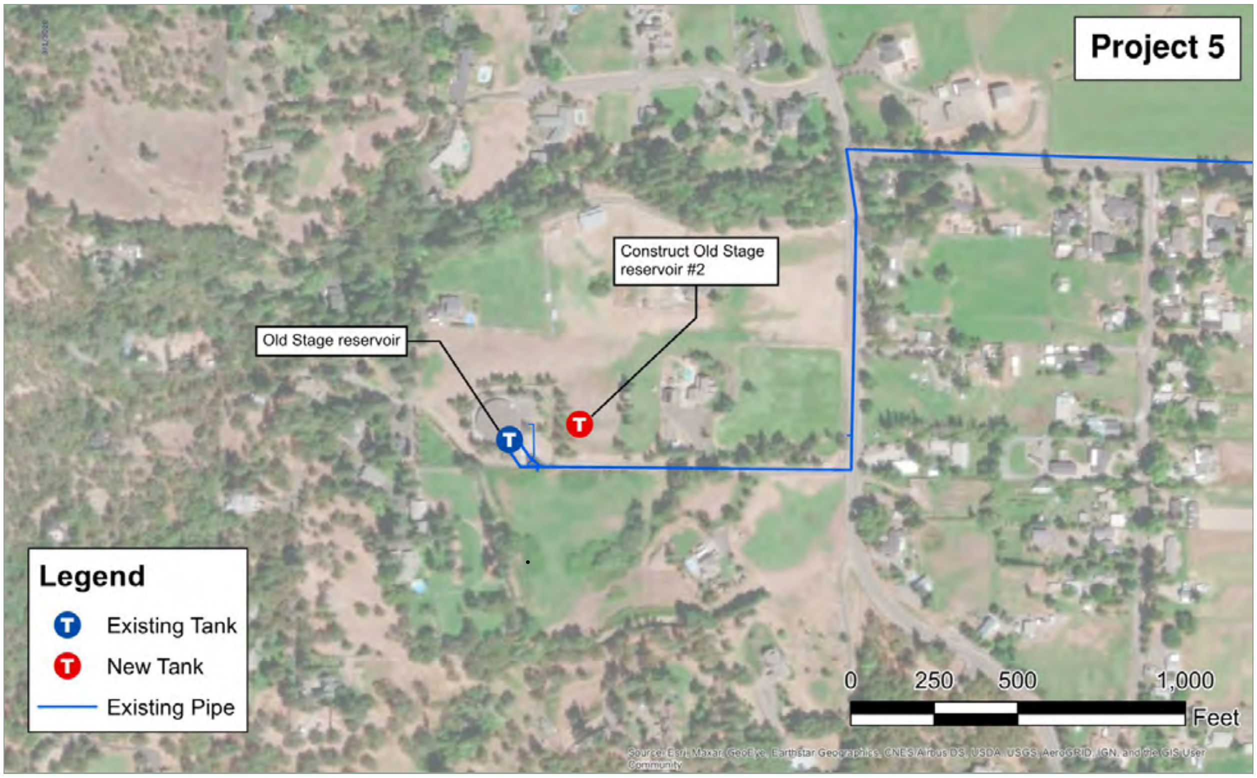


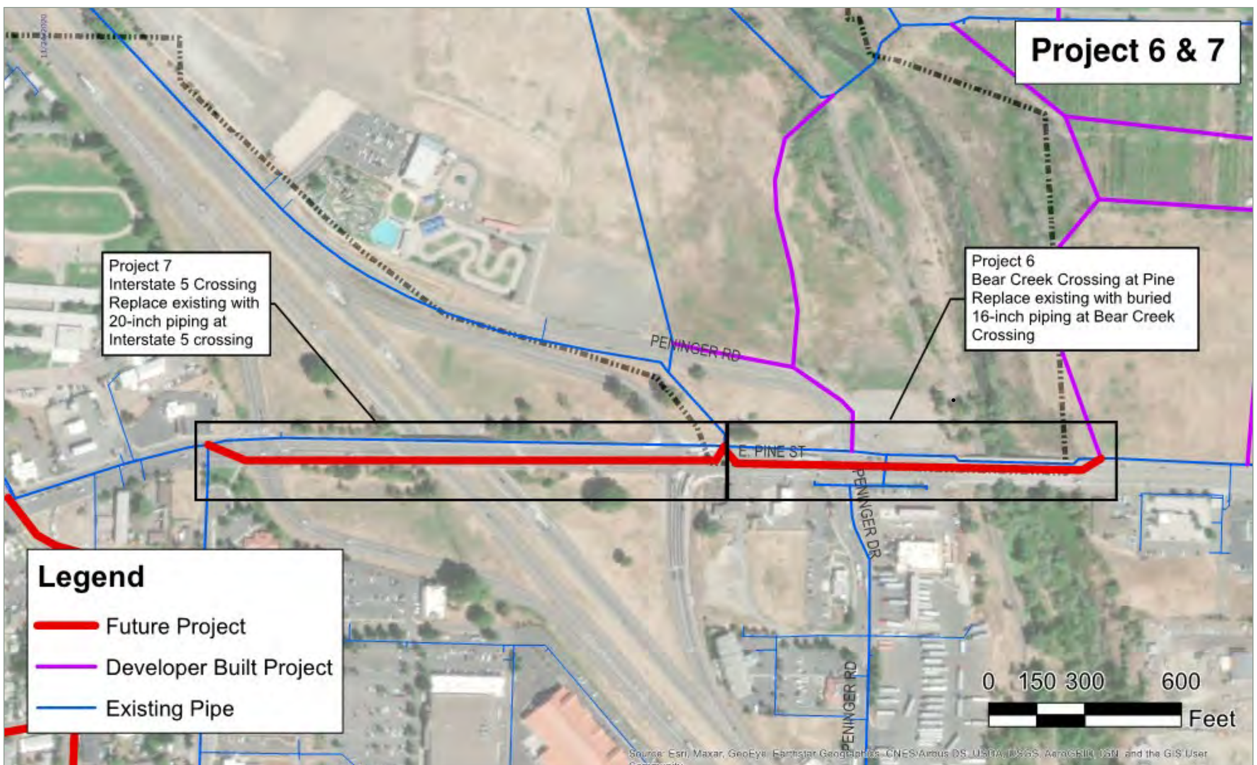


CITY OF CENTRAL POINT

WATER SYSTEM MASTER PLAN

Figure 8-2. Improvement Projects 1, 2, 3, and 4



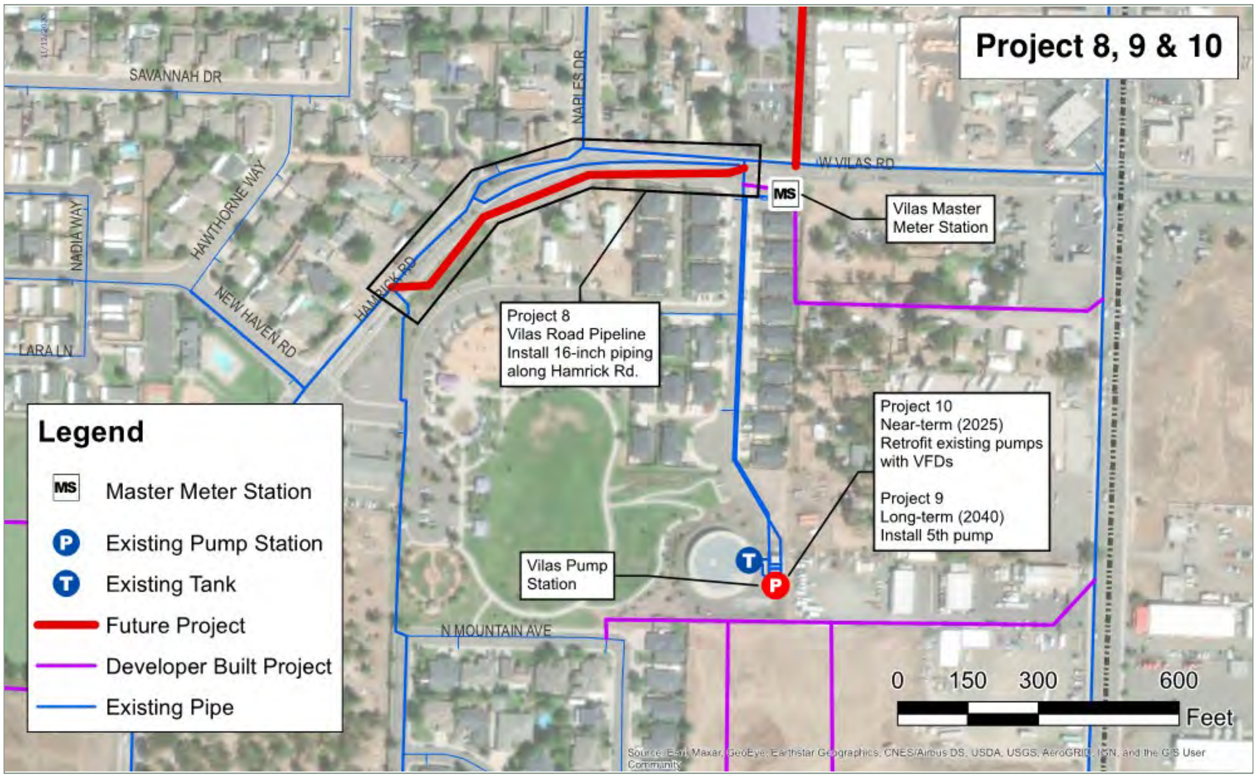


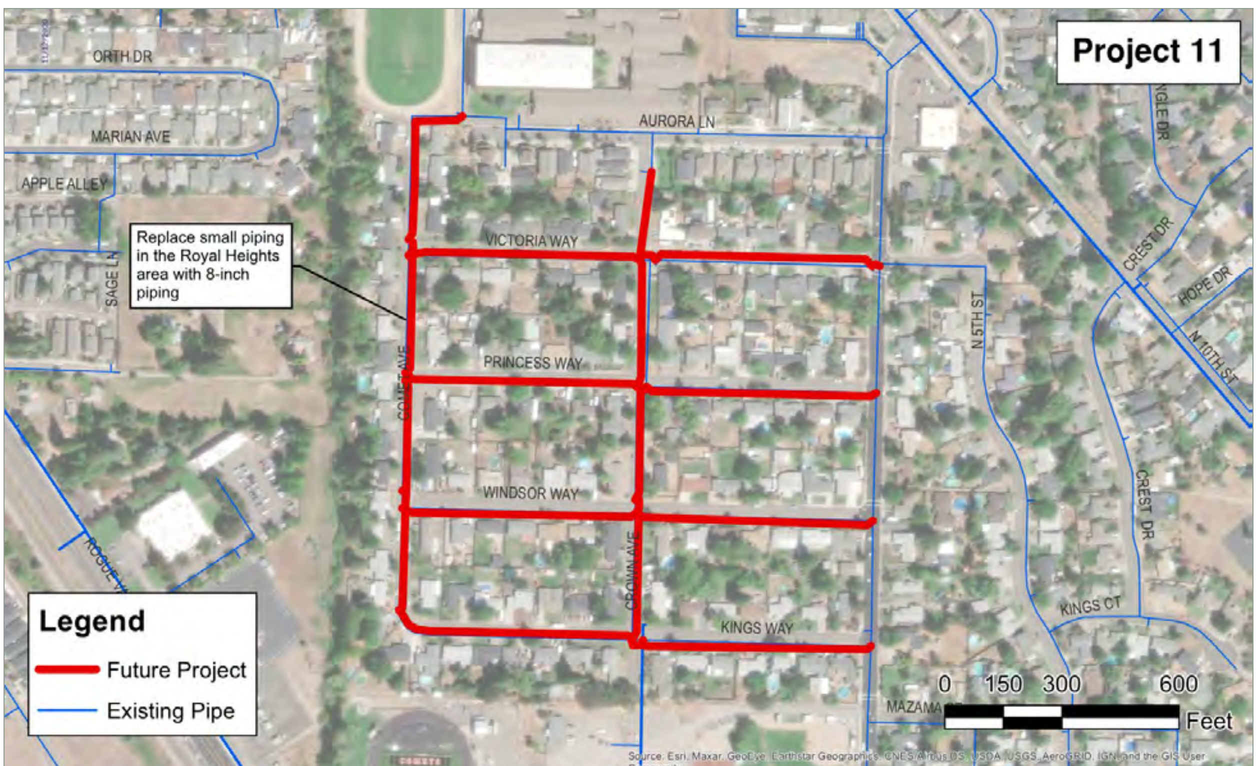
Brown AND Caldwell

CENTRAL POINT

CITY OF CENTRAL POINT
WATER SYSTEM MASTER PLAN

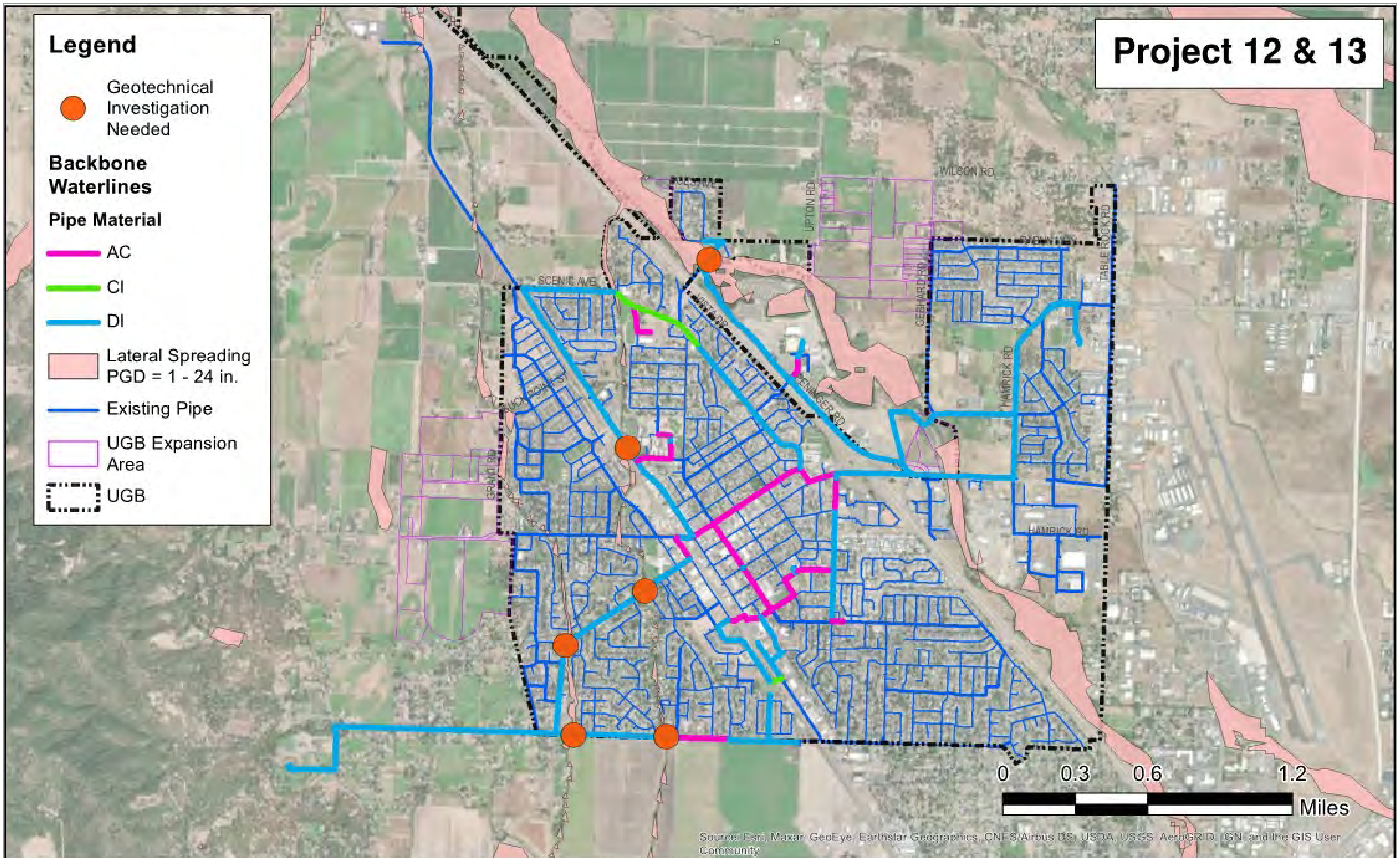
Figure 8-3. Improvement Projects 5, 6, and 7





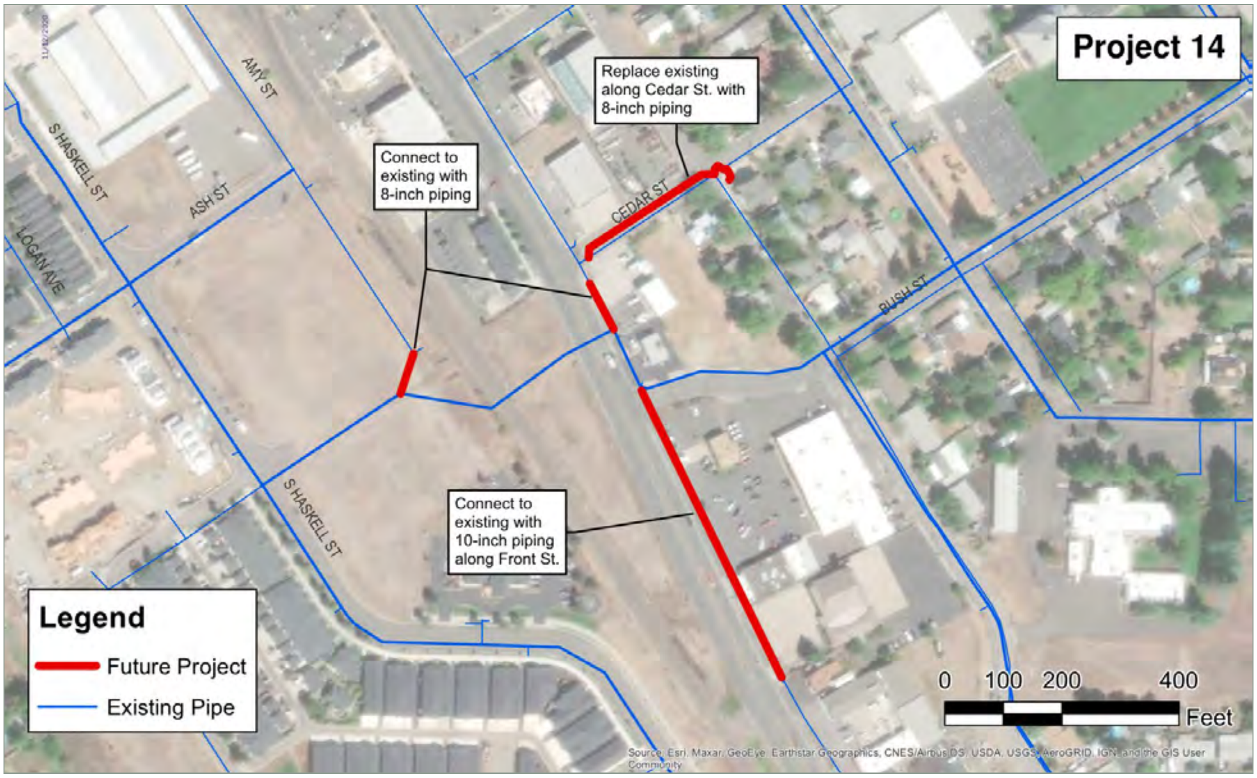
CITY OF CENTRAL POINT
WATER SYSTEM MASTER PLAN

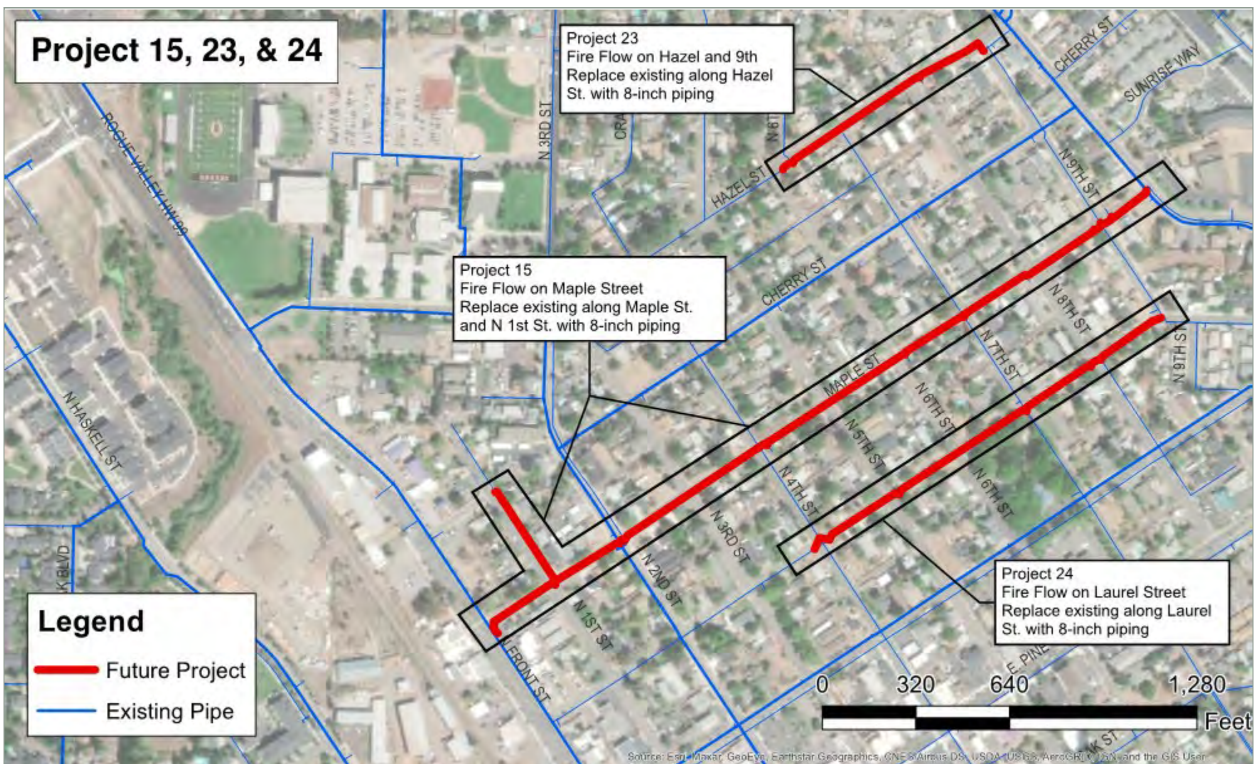
Figure 8-4. Improvement Projects 8–11



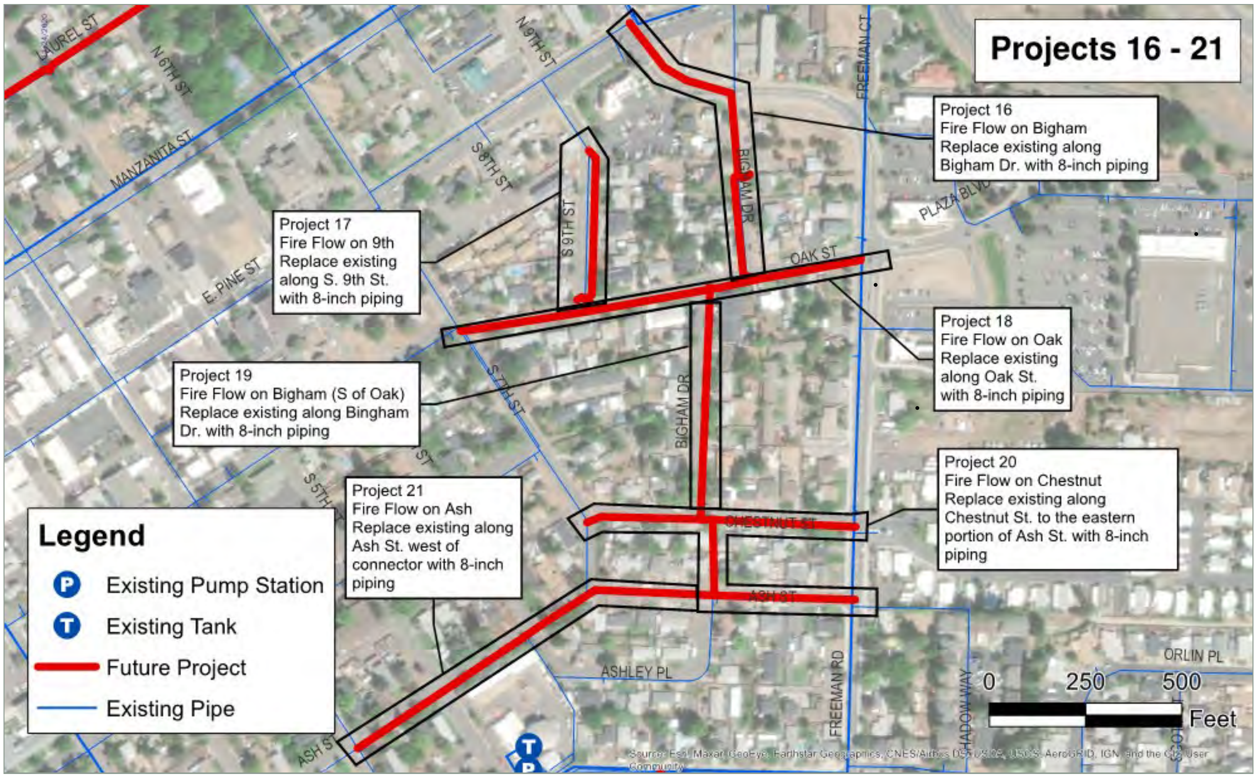
CITY OF CENTRAL POINT
WATER SYSTEM MASTER PLAN

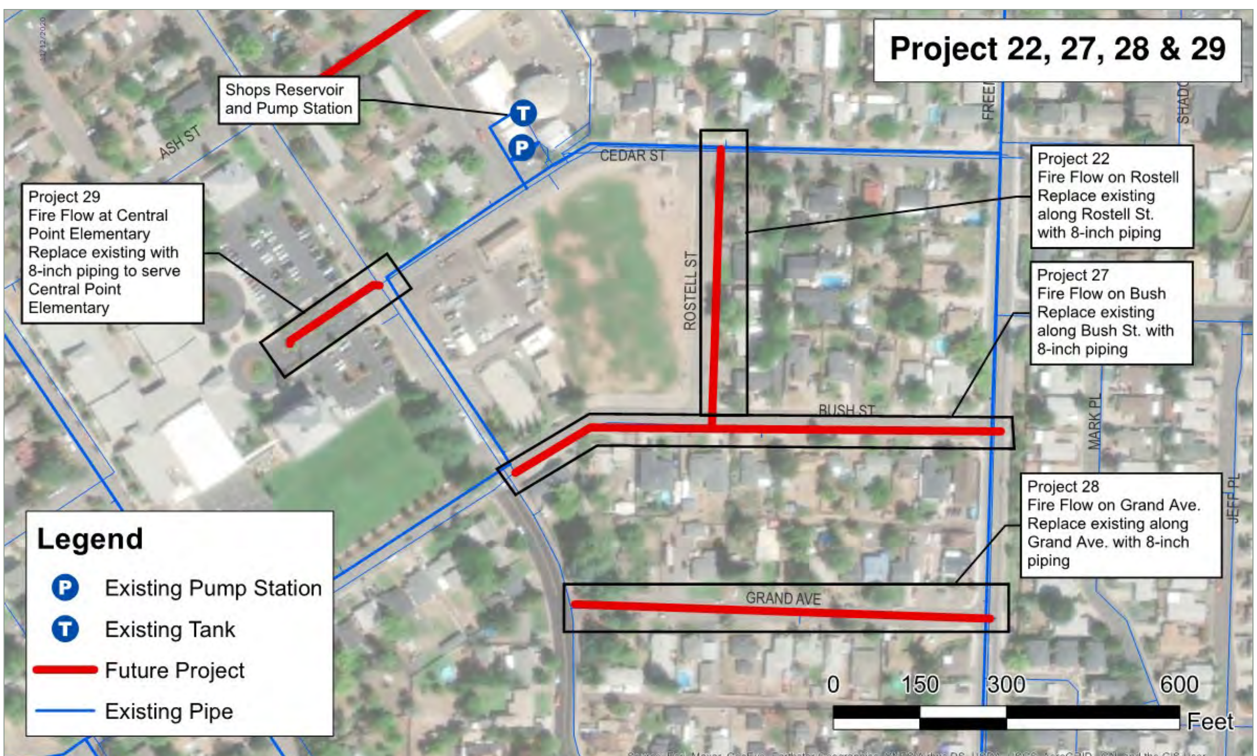
Figure 8-5. Improvement Projects 12 and 13





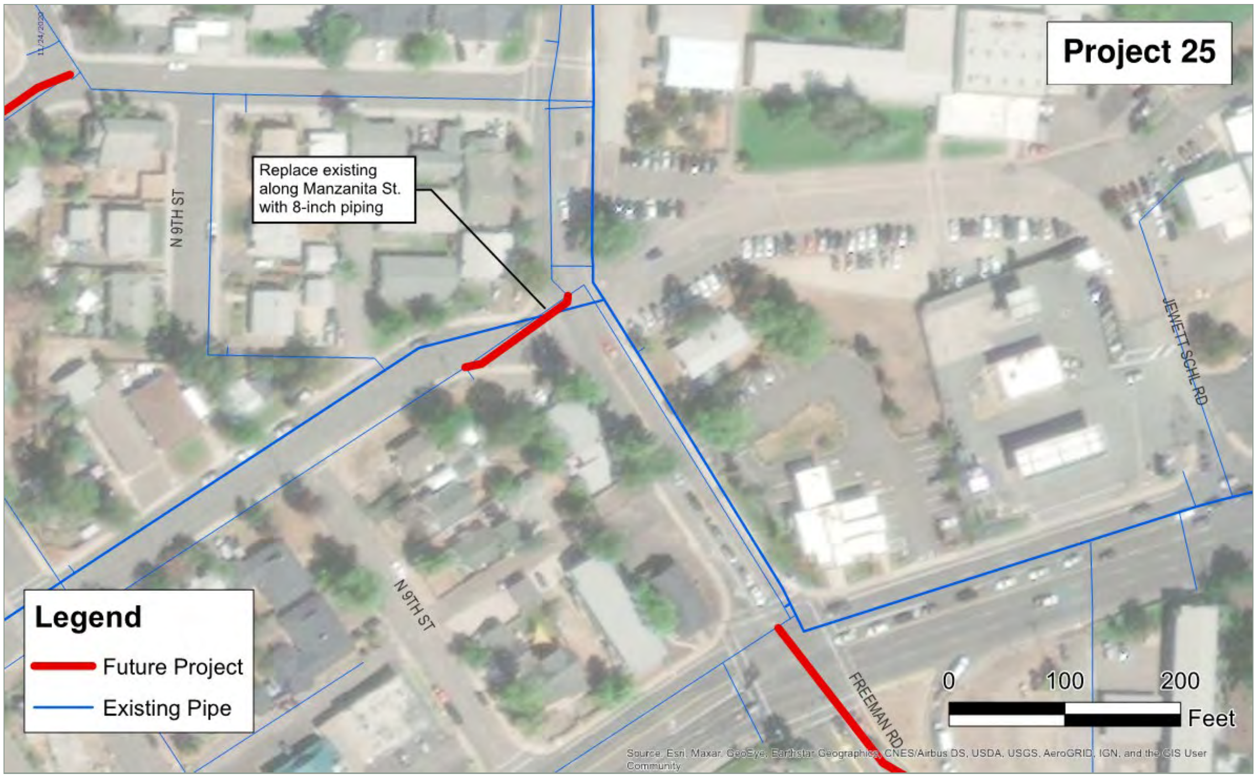
Brown AND Caldwell	CENTRAL POINT	**CITY OF CENTRAL POINT** WATER SYSTEM MASTER PLAN **Figure 8-6. Improvement Projects 14, 15, 23, and 24**

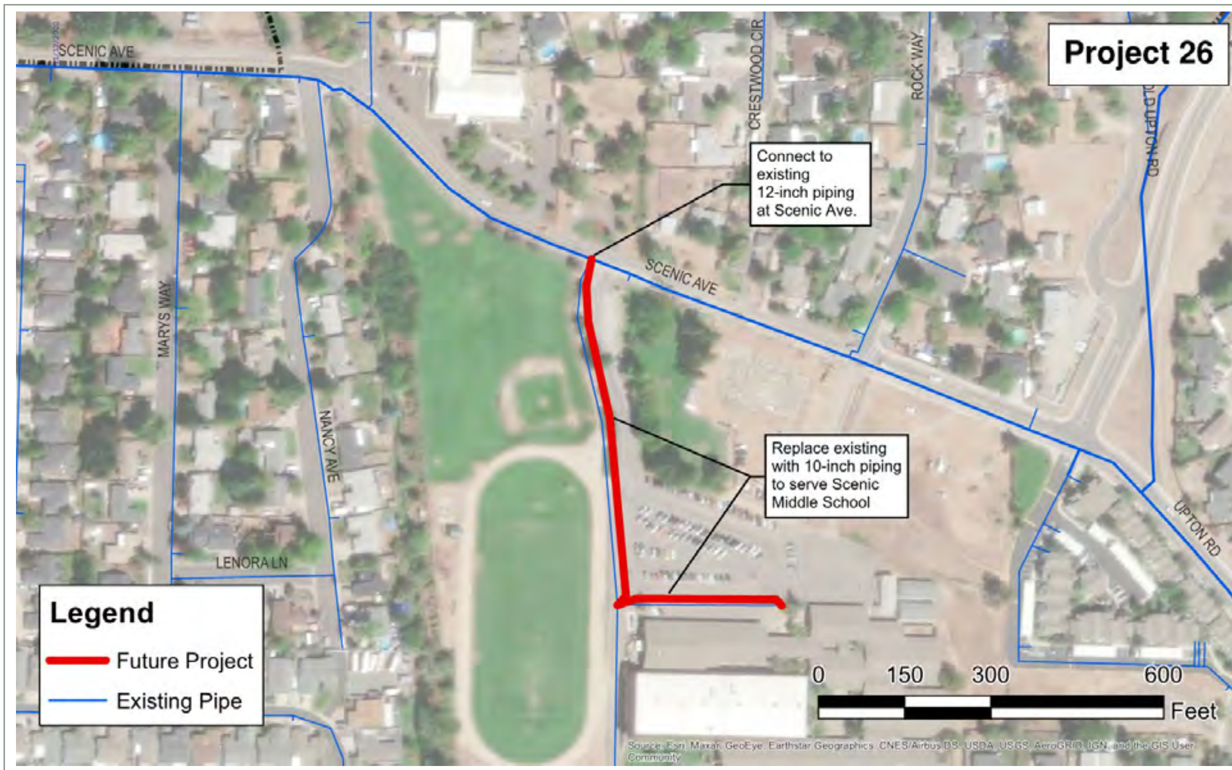




CITY OF CENTRAL POINT
WATER SYSTEM MASTER PLAN

Figure 8-7. Improvement Projects 16–22 and 27–29



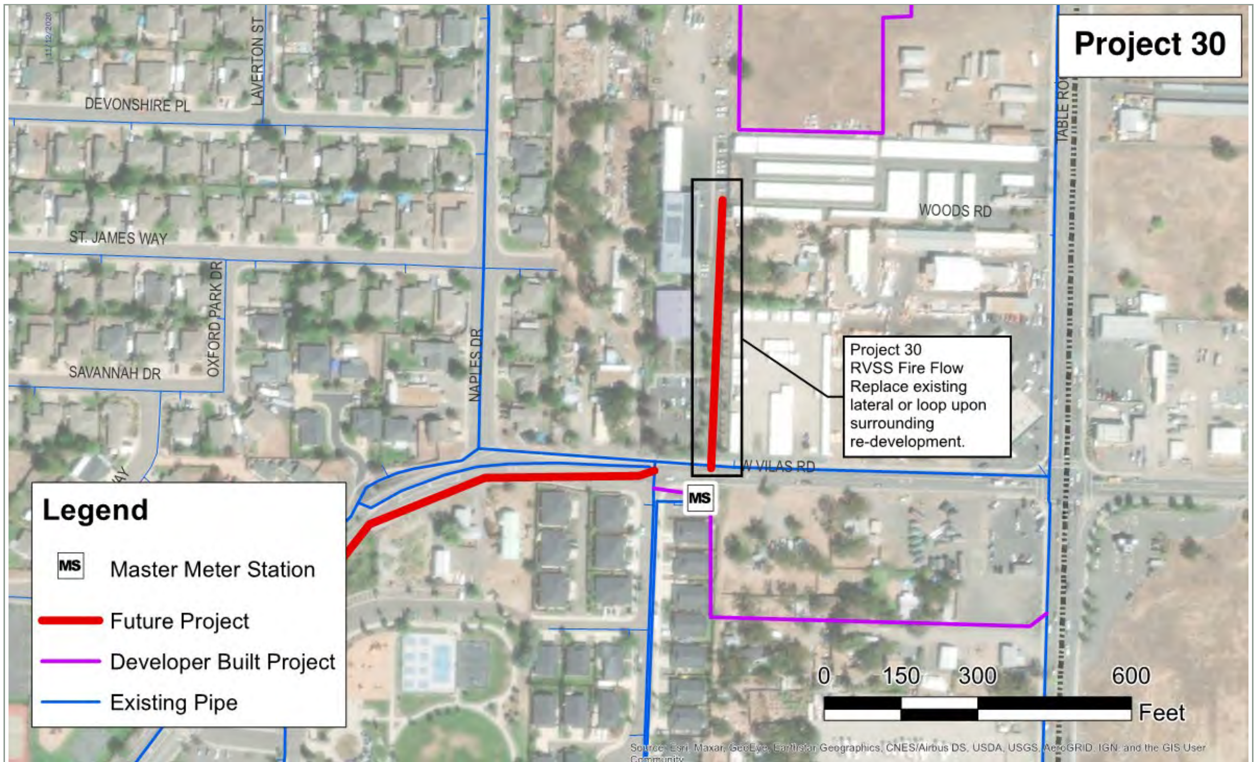


Brown AND Caldwell

CENTRAL POINT

CITY OF CENTRAL POINT
WATER SYSTEM MASTER PLAN

Figure 8-8. Improvement Projects 25 and 26



Brown AND Caldwell

CENTRAL POINT

CITY OF CENTRAL POINT
WATER SYSTEM MASTER PLAN

Figure 8-9. Improvement Project 30

Section 9

Operations & Maintenance

The City's public works department includes 6.95 Full time equivalents (FTEs) in construction management and operations that currently support the distribution system. The operations and maintenance of the City's distribution system is led by the City Water Division Supervisor. Currently staffing levels are adequate to support existing commitments, project obligations and program implementation.

The Water Division Supervisor's role includes oversight of the City's asset management program, which is supported through the use of Cartegraph OMS. The Cartegraph system was implemented in 2014 and allows the City to:

- Track progress of a preventative maintenance schedule
- Track labor and material costs
- Track spare parts inventory
- Assign work order tasks

9.1 Preventative Maintenance Schedule

The City follows a regular maintenance schedule to maintain the current assets within the distribution system. These activities help to proactively identify issues and prolong the operating life of assets. Table 9-1 lists the various maintenance activities conducted by the City, when they occur during the calendar year and their target frequencies.

Table 9-1. Preventative Maintenance Schedule

Month	Description of Maintenance	Target Frequency
January	Air release valve maintenance	1/year
February	Larger meter testing (2 inches and larger) Quarterly flush points	1/year 1/year
March	Hydrant inspections & flow testing Automatic control valve maintenance	Every 2 years 1/year
April	Hydrant inspections & flow testing Shops facility valve exercising	Every 2 years 1/year
May	Hydrant inspections & flow testing Quarterly flush points	Every 2 years 1/year
June	Small meter inspections Actuate Old Stage Reservoir valves	Every 2 years 1/year
July	Small meter inspections	1/year
August	Valve actuations Quarterly flush points	1/year
September	Valve actuations	1/year
October	Valve actuations	1/year
November	Annual flush points	1/year
December	Valve actuation at MMSs	1/year

9.2 Current Labor and Maintenance Costs

Labor and Maintenance costs for water system assets were reviewed using the City's Cartegraph system database. Records from July 1, 2017, through June 30, 2019, were used to compile average annual labor hours and labor costs associated with the maintenance activities for each asset. The number of assets within the City's water system was compiled from available GIS information and email correspondence with City staff. Assets from GIS were included as part of the system where the "OWNER=CITY" and "STATUS=IN USE".

Table 9-2 lists the labor cost per unit asset activity developed to estimate the labor cost per maintenance activity averaged over the total count of each system asset class owned by the City.

Table 9-2. Annual O&M Efforts Summary

Asset	System Asset Count	Activity	Labor Hours[a]	Labor Cost[b]	Labor Cost per Unit Asset Activity
ARV	245	Inspection	63	$4,715	$19.25
		Repair	2	$225,113	$0.46
Hydrant	968	Inspection	101	$7,598	$7.85
		Repair	44	$3,334	$3.44
Meter	6,199	Inspection	320	$23,996	$3.87
		Repair	12	$884	$0.14
Main[c]	2,000	Flush	66	$4,917	$2.46
Lateral[d]	6,199	Repair	141	$11,125	$1.79
		Replacement	233	$17,485	$2.82
Valve	2,708	Inspection	201	$13,444	$4.96
		Repair	57	$4,080	$1.51
Control Valve	7	Rebuild	33	$2,456	$350.89
Pump	2	Oil Change	4	$300	$150
Storage Tank	3	Clean	NA	NA	-

NA=Not Available

a. Rounded to the nearest hour.

b. Rounded to the nearest dollar.

c. Includes pipes 8 inches in diameter and larger.

d. Number of laterals assumed to be the same as the number of meters.

9.3 Future Labor and Maintenance Costs

Each of the capital improvement projects were evaluated to anticipate future needs associated with each project beyond construction completion. Current labor and maintenance costs were reviewed in addition to discussions with City staff to qualitatively assess required future effort. For most projects (i.e., pipe replacement), the additional anticipated maintenance effort is considered to be negligible. Since pipe replacement projects do not add additional pipe length to the system, City staff effort beyond current levels is not anticipated. For projects where new infrastructure is proposed where infrastructure did not exist before (i.e., new piping), labor and maintenance efforts to maintain these assets is assumed to increase.

Table 9-3 lists each capital project with a summary of anticipated future labor and maintenance.

Table 9-3. Project Implementation Future Labor and Maintenance Summary

Project No.	Project Name	Future Labor and Maintenance Considerations
1	Haskell Connection	New piping will require routine effort associated with the following maintenance activities: • Pipe segment flushing, repair, and replacement • Valve, hydrant and meter inspection and repairs
2	Beall Pump Station	New pump station will require periodic observation/inspection of the following: • Mechanical seals and parts for leaks • Issues with vibration, heat, or noise • Discharge pressure and flows
3	Beall Lane Piping	Pipe replacement project. No additional effort anticipated.
4	Old Stage Storage Reservoir #2	New storage tank will require: • Adequate reservoir turnover, chlorine residual, and mixing • Routine draining, cleaning, and inspection
5	Bear Creek Crossing at Pine	Pipe replacement project. No additional effort anticipated.
6	Interstate 5 Crossing Pipeline	Pipe replacement project. No additional effort anticipated.
7	Vilas Road Pipeline	Pipe replacement project. No additional effort anticipated.
8	Vilas Pump Station Upgrade	Installation of additional pump will require periodic observation/inspection of the following: • Mechanical seals and parts for leaks • Issues with vibration, heat, or noise • Discharge pressure and flows
9	Front Street AC Replacement	Pipe replacement project. No additional effort anticipated.
10	Downtown Small Pipe Replacement Program: Royal Heights	Pipe replacement project. No additional effort anticipated.
11	Geotechnical investigation at Creek Crossings	Geotechnical report. No additional effort anticipated.
12	Annual Seismic Resiliency Pipe Replacement	Pipe replacement project. No additional effort anticipated.
13	Fire Flow Improvements near Front St and Bush	New piping will require routine effort associated with the following maintenance activities: • Pipe segment flushing, repair, and replacement • Valve, hydrant and meter inspection and repairs

Table 9-3. Project Implementation Future Labor and Maintenance Summary		
Project No.	Project Name	Future Labor and Maintenance Considerations
14	Fire Flow Improvements on Laurel	Pipe replacement project. No additional effort anticipated.
15	Fire Flow on Bigham and 9th	Pipe replacement project. No additional effort anticipated.
16	Fire Flow on Hazel and 9th	Pipe replacement project. No additional effort anticipated.
17	Fire Flow on Maple Street	Pipe replacement project. No additional effort anticipated.
18	Fire Flow on Manzanita	Pipe replacement project. No additional effort anticipated.
19	Fire Flow at Scenic Middle School	Pipe replacement project. No additional effort anticipated.
20	Fire Flow on Bush Street	Pipe replacement project. No additional effort anticipated.
21	Fire Flow on Grand Ave	Pipe replacement project. No additional effort anticipated.
22	Fire Flow at Central Point Elementary	Pipe replacement project. No additional effort anticipated.

9.3.1 Resiliency Considerations

To increase the resiliency of the capital improvement projects, it is recommended that additional pipe replacement parts are acquired and stored in case of emergency. The access and availability of pipe segments, joints, and associated valves may be extremely limited in an emergency event such as an earthquake. The City should prioritize 12-inch and 16-inch pipe segments as part of their stockpile as these sizes comprise the majority of the sizes utilized as part of the backbone system.

Section 10

Limitations

This document was prepared solely for the city of Central Point, Oregon in accordance with professional standards at the time the services were performed and in accordance with the contract between the city of Central Point and Brown and Caldwell dated November 2018. This document is governed by the specific scope of work authorized by the city of Central Point; it is not intended to be relied upon by any other party except for regulatory authorities contemplated by the scope of work. We have relied on information or instructions provided by the city of Central Point and other parties and, unless otherwise expressly indicated, have made no independent investigation as to the validity, completeness, or accuracy of such information.

Section 11

References

Black & Veatch, Water Quality and Corrosion Study Final Report, Prepared for Medford Water Commission, 15 April 2016.

Coordinated Population Forecast for Jackson County, its Urban Growth Boundaries (UGB), and Area Outside UGBs, 2018 - 2068, Population Research Center, Portland State University, June 30, 2018.

City of Central Point Water System Master Plan, Brown and Caldwell, December 2009

Manual of Water Supply Practices, M32, Computer Modeling of Water Distribution Systems [AWWA, 2012].

Medford Water Commission Water Distribution System Facility Plan [MWC, 2007].

Oregon Administrative Rule (OAR) 333-061 [OAR, 2018].

Recommended Standards for Water Works [WSC, 2018].

Appendix A: Water Supply Documentation

Current wholesale supply agreement between the City of Central Point and MWC

Water Rights Strategy for Partner Water Providers

WHOLESALE WATER SERVICE AGREEMENT

THIS WATER SERVICE AGREEMENT (Agreement), made and entered in duplicate to commence on the first day of October, **2016**, between the City of Central Point, a municipal corporation of the State of Oregon, acting as purchaser (Central Point), and the City of Medford, a municipal corporation of the State of Oregon, acting by and through its Board of Water Commissioners, acting as vendor (MWC), together referred to as the Parties.

RECITALS:

1) MWC is an entity established under the Home Rule Charter (Charter) adopted by the citizens of the City of Medford, comprised of five citizens appointed by the Mayor and confirmed by the City Council, to manage the Water Fund for the purpose of supplying inhabitants of the City of Medford with water; and

2) Under Section 19 of the Charter, the MWC is authorized to sell water and/or supply facilities outside the legal boundaries of the City of Medford, only if said water and/or supply facilities are surplus to the needs of the inhabitants of the City of Medford, and meet certain conditions of MWC Resolution No. 1058; and

3) Under the Charter, the MWC is authorized to set rates for City of Medford inhabitants, and to make all necessary rules and regulations for the sale, disposition and use of water and water service from the City of Medford water system, and the MWC has adopted such rules and regulations; and

4) Per the MWC's projections, reports and plans, the MWC finds it has surplus water and supply facilities capacity available in its system to serve Central Point; and

5) Central Point desires to purchase surplus treated and transported water from MWC from October through April, and purchase surplus supply facilities treatment and transport services for Central Point's own water appropriated under Central Point's own state-issued water rights from May through September;

NOW, THEREFORE, for and in consideration of the foregoing and of the mutual promises herein, the Parties mutually agree as follows:

AGREEMENT:

ARTICLE 1. SCOPE OF SURPLUS WATER SUPPLY AND SERVICE

Subject to Article 3 of this Agreement, MWC agrees to supply surplus water up to a combined (from all connections) maximum of **1833** gallons per minute (GPM) for the months of October through April, and surplus facilities capacity to treat and transport water up to a combined (from all connections) maximum of **4958** GPM for the months of May through September. Central Point agrees to provide sufficient water storage as part of its water system to assure that the maximum rate of withdrawal in GPM by Central Point is not exceeded with the following exceptions.

During the 5 year term of this agreement the following conditions will be complied with: The above flow rates will not be exceeded between the hours of 5 am and 11 am. During all other hours the maximum flow rate will not exceed 5700 gallons per minute (GPM) in the summer and 3255 gallons per minute (GPM) in the winter. Notwithstanding the foregoing, in the event this agreement is renewed in October 2021, the maximum flow rates specified in this article may be recalculated by MWC based on future total source supply and future 2020 maximum month demand percentages, and such flow rates will be required over an entire 24 hour period.

Upon written request by Central Point, this Agreement may be amended to provide supplemental supply and service to Central Point if MWC determines that it has surplus capacity for Central Point's use, and Central Point agrees to reimburse MWC the reasonable cost of providing such supplemental supply and service.

ARTICLE 2. CENTRAL POINT DISTRIBUTION SYSTEM EMERGENCY

Upon notice to MWC by Central Point of a distribution system emergency, MWC will use its best efforts to provide supplemental water supply or services during the emergency.

For purpose of this agreement, "distribution system emergency" means: Any human or natural caused event that disables or impairs the distribution system such that its use constitutes an immediate threat to human life or health.

ARTICLE 3. MWC CONNECTIONS

MWC owns and is responsible for the construction, extension, maintenance, and operation of the MWC system up to the point of and including the master Central Point meter(s). Central Point shall pay all costs of connections to the MWC system including initial metering, initial and ongoing backflow protection, and annual testing of the backflow device, all in accordance with MWC standards. MWC shall monthly read and annually test the master meter(s) and provide readings and test results to Central Point.

Central Point's water supply is provided by the following master meter(s) with backflow connections to MWC:

- 10" Turbine Meter on Beall Lane, Central Point, Oregon
- 10" Turbine Meter on Hopkins Road, Central Point, Oregon
- 10" Compact Fireline Meter on Vilas Road, Central Point, Oregon

Temporary emergency connections to MWC with prior approval can be provided at the following location(s):

N/A

The following special conditions concerning connections to MWC apply:

- MWC agrees Central Point may serve the Seven Oaks Interchange "Area of Mutual Planning Concern".

ARTICLE 4. MWC REGULATIONS

Water service under this Agreement shall be in accordance with Section 30 SURPLUS WATER and Section 31 PROVISIONS RELATING TO UTILITY AND MUNICIPAL CUSTOMERS of the MWC Regulations Governing Water Service (Regulations), as now in effect or as may be amended. If there is any inconsistency between this Agreement and the Regulations, the Regulations control. Notwithstanding the foregoing, nothing herein is intended to relieve MWC of its obligation to supply surplus water in accordance with the terms of this Agreement, except as dictated by Federal/State regulations outside the control of MWC. The Parties acknowledge that implementation of this Agreement and the Regulations are subject to federal or state directives.

MWC shall promptly provide Central Point a copy of any amendments to the Regulations.

ARTICLE 5. URBANIZATION POLICY

Central Point agrees to provide water and services to customers within Central Point city limits, or as otherwise approved by MWC in MWC Resolution No. 1058, as may be amended. Central Point may provide water and services outside of city limits, but within its urban growth boundary, provided that the property requesting service has signed an irrevocable consent to annex to Central Point, or as otherwise approved in writing by MWC. The current general water service map covering city limits and urban growth boundaries for Central Point is attached to this Agreement as Exhibit A. Central Point shall promptly notify MWC and provide a revised map as city limits and urban growth boundaries are modified.

ARTICLE 6. MEETING FUTURE WATER DEMANDS

Water and water services provided by MWC under this Agreement are pursuant to water rights held by the MWC and Central Point. Nothing in this Agreement shall be construed to confer upon either party a legal or beneficial interest in each other's water rights, or to prevent either party from seeking additions or alterations to their water rights as deemed necessary.

Central Point shall acquire and maintain such water rights as needed to meet the demand within its service area during the months of May through September. Central Point may use the MWC intake facility, located at the intersection of Table Rock Road and the Rogue River in White City, as the designated point of diversion for Central Point water rights. MWC shall cooperate in the perfection of any Central Point water rights. Central Point currently holds water rights with a diversion point on the Rogue River at the MWC Intake Facility site at the rate of **4.176** cubic feet per second and/or volume of **1113.6** acre feet. Delivery of such Central Point water through MWC facilities shall be subject to the same terms and conditions as delivery of surplus MWC water. MWC shall measure and record at its Robert A. Duff Water Treatment Plant the amount of water withdrawn from the Rogue River by MWC and its municipal water service customers under each of their respective water rights. In its monthly water service invoice, MWC shall provide water use data for Central Point. Central Point shall provide MWC updated demand projections.

ARTICLE 7. SYSTEM DEVELOPMENT CHARGES

Pursuant to Resolution No. 774, MWC has established Water System Development Charges (SDCs) and supporting methodology to finance future MWC transmission and treatment facilities expansions. SDCs apply to all new customers, including customers of municipal wholesale customers served by MWC. Central Point shall collect SDCs set by MWC from new Central Point customers. MWC reviews the SDCs annually and reserves the right, in its sole discretion, to modify or replace the SDCs with a different financing mechanism for system improvements.

All SDCs collected by Central Point will be held in a separate account and forwarded to MWC along with an accounting of the number and sizes of the services installed. Central Point shall provide MWC with a copy of the section within the annual Central Point audit that shows accounting of MWC SDCs collected during the audited year. MWC shall, in turn, provide Central Point an annual accounting of all SDCs collected.

MWC utilizes a utility basis for determining the water usage rate it charges Central Point. Under this rate analysis, Central Point is required to pay a return on investment for its share of the facilities paid for by MWC. Facilities funded by SDCs shall not be included in the return on investment portion of the rate analysis.

MWC shall render technical assistance to Central Point in determining SDCs. MWC shall defend Central Point against any legal action or appeals which may arise over the development, methodology, or implementation of the SDCs. Central Point shall cooperate and support MWC in the defense, but shall not be obligated to incur any monetary obligation in such defense.

Upon termination of this Agreement, the following refund policy shall apply:

(a) MWC shall return to Central Point its prorated share of the unexpended balance of the SDCs fund. This prorated share shall be based upon the actual unexpended SDCs collected by Central Point for the specific facilities funded by the SDCs, plus the interest earned.

(b) MWC shall return to Central Point a prorated share of the depreciated plant value of the specific MWC facilities funded by the SDCs and already installed. The prorated share shall be a percentage based upon the total amount of SDCs paid by Central Point divided by the total SDCs collected and used to fund the facility, not including interest earned during the years in which the SDCs were collected.

(c) In order to avoid a financial hardship, MWC shall develop a reasonable schedule of up to five (5) years for repayment of the depreciated value of the specific MWC facilities funded by the SDCs.

(d) At the request of Central Point, the MWC shall provide an accounting of the refunds made pursuant to this section.

ARTICLE 8. PAYMENTS TO MWC

Central Point shall pay monthly for all water and services provided by MWC at MWC's scheduled wholesale rates then in place. Payment shall be made within ten (10) days after the meeting of the Central Point's Council following receipt by Central Point of a statement of charges from MWC.

MWC reserves the right, in its sole discretion, to change (with prior written notification of a rate study review) said rate at any time upon sixty (60) days written notice to Central Point, following rate procedures and protocols in the MWC Regulations.

ARTICLE 9. TERM OF AGREEMENT

This term of this Agreement shall be five (5) years from its commencement. Central Point may, at its option, extend the term for three additional five-year periods, which periods would run through October of **2026, 2031**, and **2036** respectively. Extensions shall be subject to the same terms and conditions as this Agreement. Written notice of the election to exercise a five-year extension of this Agreement must be given to MWC not later than January 1st of the year in which the Agreement would otherwise expire. If Central Point fails to provide MWC such notice, this Agreement shall be deemed canceled at the end of the term then in effect. MWC shall continue service for a reasonable period, determined in MWC's sole discretion, to allow Central Point to secure other sources of water. Provided, however, Section 19 of the Charter of the City of Medford limits the term of water service contracts to 20 years and, therefore, the obligations of MWC under this Agreement, including renewal periods, shall not exceed that period of time.

ARTICLE 10. ASSIGNMENTS

Central Point shall make no assignment of this Agreement without written permission from MWC. Any approved assignee or successor shall agree to be bound by the terms and conditions of this Agreement.

ARTICLE 11. WATER CURTAILMENT PLAN

During periods of drought or emergency, Central Point shall be subject to the MWC Water Curtailment Plan, per MWC Resolution No. 1345, unless Central Point has in effect a state-approved and adopted Water Curtailment Plan at least as stringent as that of MWC. In the event of a conflict between the Central Point plan and the MWC plan, the MWC plan shall control. The MWC shall give Central Point as much advance warning as possible prior to curtailment of water supplies. The level of curtailment shall be determined by MWC based on the severity of the anticipated shortage. Central Point shall be responsible for enforcing the MWC curtailment plan or the above mentioned Central Point plan in its service area.

MWC will require and apply emergency curtailment of water use in an equitable, fair, and consistent manner consistent with Resolution 1345. Continued service during periods of emergency shall neither be construed as a waiver nor limitation of any kind on any water rights held by MWC, or a waiver or curtailment of any water rights held by Central Point, nor as affecting any other terms in this Agreement.

ARTICLE 12. ANNUAL WATER QUALITY REPORTING

MWC will gather annual water quality data and prepare informational reports as required under state Consumer Confidence Reporting (CCR) rules. These CCR reports will include water quality information for MWC and all participating municipal water customers. Annual costs involved will be proportionally shared among participating municipal water customers and billed separately to each.

Statistical data necessary to create the CCR report for the prior year must be provided by Central Point to MWC no later than April 1st of each year. If bulk mailing is the primary distribution method utilized, Central Point shall also provide MWC with postal routes covering their respective service areas by April 1st of the delivery year. MWC reserves the right to utilize other approved delivery methods (e.g.; electronic), which may impact responsibilities for Central Point.

In the event that Central Point receives water into its system that is supplied by an entity other than MWC, the composite MWC report for that year will not include data for Central Point. Central Point shall be responsible for preparation of its own annual CCR, and MWC will provide MWC data by April 1st of the delivery year.

MWC maintains water quality test points throughout the MWC system and one specifically at the master meter location(s) of Central Point. These test points are used to collect water samples for meeting required state water quality parameters on a weekly, monthly, and annual basis. All information collected is of public record and is accessible through state or MWC databases. Responsibility for water quality is transferred to Central Point at the point of the master meter location(s), except where water quality problems are attributable to MWC.

ARTICLE 13. MUTUAL INDEMNITY

To the extent allowed by law, Central Point and MWC shall each defend, indemnify and hold the other, and their officers, employees, and agents harmless from any and all claims, suits, actions, or losses arising solely out of the acts and omissions of the Party's own officers, employees, or agents while acting under this agreement.

ARTICLE 14. PARTIAL INVALIDITY

If any term, covenant, condition, or provision of this Agreement is found by a court of competent jurisdiction to be invalid, void, or unenforceable, the remainder of the provisions hereof shall remain in force and effect, and shall in no way be affected, impaired, or invalidated thereby.

ARTICLE 15. INTEGRATION

This Agreement represents the entire understanding of MWC and Central Point as to those matters contained herein. No prior oral or written understanding shall be of any force or effect with respect to those matters covered herein. This Agreement may not be modified or altered except in writing signed by both parties.

ARTICLE 16. DEFAULT

For purposes of this Agreement "default" means failure to comply with any of the terms of this Agreement. If either party determines that a default has occurred, it shall provide the other party written notice of the default, which such party shall have thirty days in which (a) to cure the default, (b) show that the default is of such a nature that it cannot be reasonably cured within thirty days, or (c) show that no default occurred.

MWC and Central Point will work in good faith to amicably resolve the default. If after thirty days of the notice of default, MWC determines, in its sole discretion, that Central Point is unable or unwilling to cure the default within a reasonable time, MWC may impose escalating penalties as follows: (a) ten percent surcharge for a period of thirty days; (b) twenty percent surcharge for the next thirty days; and (c) termination of this Agreement. Such penalties are in addition to any other remedies at law or equity that may be available to MWC. Failure to issue notice of default or to enforce its remedies under this Article 16 shall not preclude MWC from taking such action for future defaults.

If after thirty days, Central Point determines, in its sole discretion, that MWC is unable or unwilling to cure the default within a reasonable time, Central Point may terminate this Agreement and pursue any other remedies at law or in equity that may be available to Central Point.

ARTICLE 17. FORCE MAJEURE

Neither party hereto shall be liable for delays in performance under this Agreement by reason of fires, floods, earthquakes, acts of God, wars, strikes, embargoes, necessary plant repairs or replacement of equipment, of any other cause whatsoever beyond the control of such party, whether similar or dissimilar to the causes herein enumerated. This clause does not include causes related to water supply and demand planning or failure to engage in such planning.

ARTICLE 18. DISPUTE RESOLUTION

If a dispute arises out of or relates to this contract, and if the dispute cannot be settled through negotiation, the parties agree first to try to settle the dispute by non-binding mediation before resorting to litigation or other process. The parties agree to share equally the costs of mediation.

IN WITNESS WHEREOF, the parties hereto have caused this Agreement to be signed by their proper officers on the dates noted below.

THE CITY OF MEDFORD
BY AND THROUGH ITS
BOARD OF WATER COMMISSIONERS

Leigh Johnson, Chair

Karen Spoonts, City Recorder

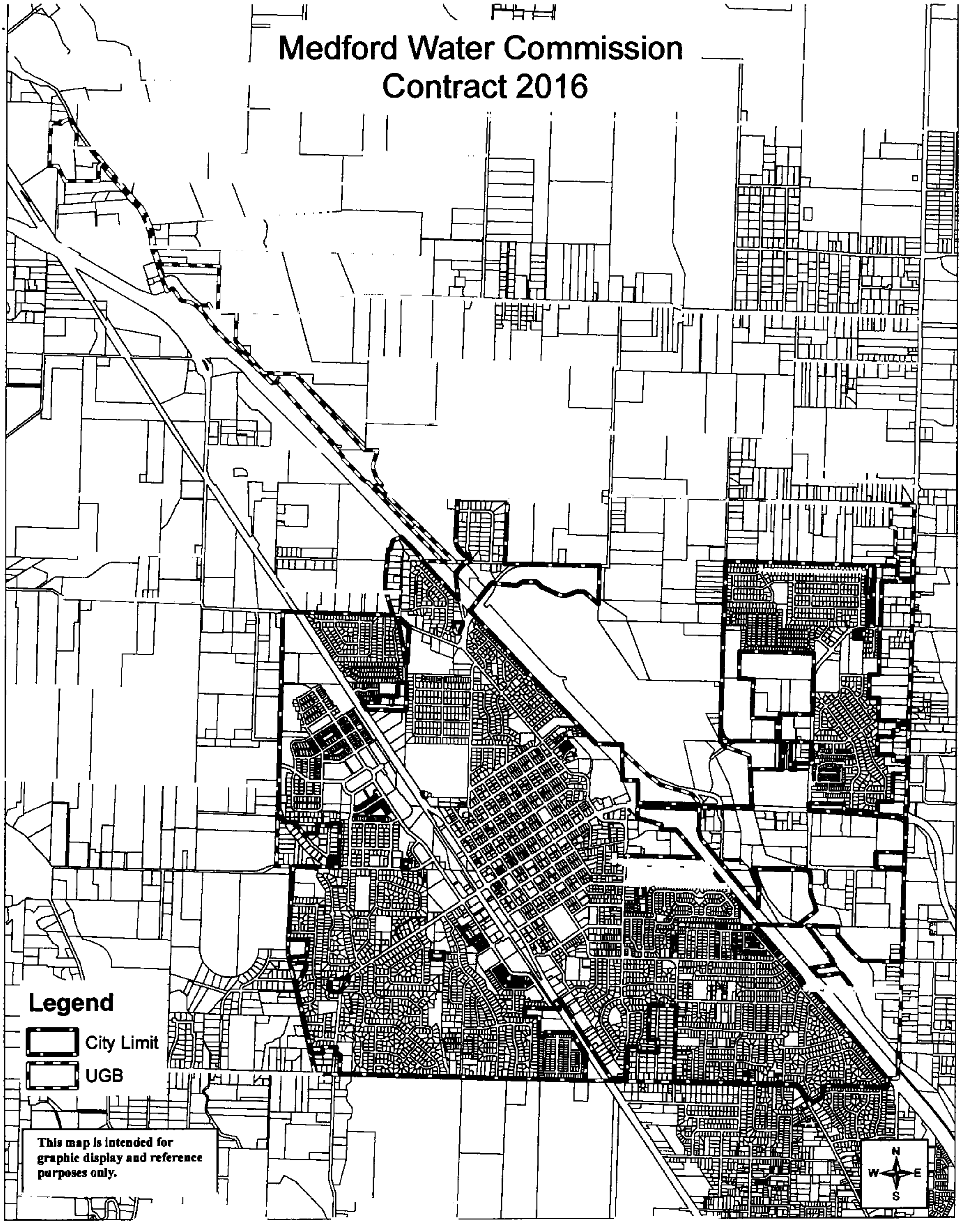
October 5 2016
Date

THE CITY OF CENTRAL POINT

Mayor

City Recorder

9/28/2016
Date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Water Rights Strategy for Partner Water Providers

FEBRUARY 2020

Submitted by:

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CITY OF ASHLAND
CENTRAL POINT
CITY OF EAGLE POINT OREGON
jacksonville OREGON
MEDFORD WATER COMMISSION
CITY OF PHOENIX O•R•E•G•O•N
CITY OF TALENT 1910

February 7, 2020

Executive Summary

Water Rights Strategy for Partner Water Providers

I. Introduction

GSI Water Solutions, Inc. (GSI) is assisting the Partner Water Providers (Partners) to develop a water rights strategy. The Partners include the Cities of Ashland, Central Point, Eagle Point, Jacksonville, Phoenix, and Talent (jointly the Partner Cities) and Medford Water Commission (MWC).[1] In early 2019, the Partners signed a Cooperative Agreement to develop the strategy recognizing the benefits of mutual cooperation and the vital importance of providing source water to their respective customers for public health, safety and welfare, and for sustaining economic development.

The water rights strategy focuses on the Partners' water rights and water supply associated with the MWC Duff Water Treatment Plant (Duff WTP) on the Rogue River. During the months of May through September (peak season), much of the MWC's water supply and all of the Partner Cities' water supply is treated at the Duff WTP. During this peak season period, the Partner Cities currently rely on water rights they have obtained and hold Treat and Transport agreements with the MWC.

As the Partners plan for their long-term water supply needs, it is important that they have a full understanding of the status of their water rights and develop a common strategy to protect and secure them. The water rights strategy is intended to meet those needs.

II. Process

To develop the water rights strategy, GSI initially prepared a comprehensive water rights summary, which enabled the Partners to develop a shared understanding of the water rights at the Duff WTP. Next, GSI developed a consolidated water demand projection for each of the Partners, which included the maximum anticipated demands for the years 2030, 2040 and 2070. GSI then compared the Partners' individual and collective demands with their water rights. This evaluation showed that some of the Partners' water rights will likely provide them with sufficient supply past the year 2070, while other Partners' water rights do not provide sufficient water supply to meet current demands. The evaluation also showed that if the Partners shared their water supplies, they would have sufficient supply to meet all of their demands through 2070.

[1] MWC's customers include customers within the City of Medford, White City, Elk City and Charlotte Ann Water Districts, as well as other customers served by MWC outside of its service area (Outside Customers).

III. Goals, Interests and Priorities for Water Rights Strategy

The above-described differences between the Partners' water rights and projected water demands demonstrate the value of a strategy related to the Partner water rights at the Duff WTP. The strategy is intended to meet the following goals, interests, and priorities:

- Ensure that the water rights at the Duff WTP are strategically managed.
- Secure a long-term water supply for all Partners.
- Eliminate the need for Partners to unnecessarily purchase additional water rights.
- Retain each Partners' ownership of its existing water rights and create opportunities to obtain value for the water rights.
- Treat White City, Elk City and Charlotte Ann Water Districts, and other customers served by MWC outside of its service area (Outside Customers) equitably.

IV. Strategic Management of Partners' Existing Water Rights

A. Reasons for Developing Coordinated Approach to Water Rights and Water Use

GSI recommends that the Partners consider developing a coordinated approach to managing their water rights and water supply. This coordination could include not only coordinated management of the water rights at the Duff WTP, but also creation of an opportunity for the Partners to share their combined water supplies. Coordination will also be necessary to strategically secure the 20 existing water rights at the Duff WTP. Additionally, if the Partners established a combined water supply, it could address the imbalances between water rights and projected water demands that have been previously described, and eliminate the need for the purchase of additional water rights to meet their individual needs. Further, establishing a combined water supply could provide the Partners with some level of supply redundancy; that is, the arrangement could enable each Partner to obtain water from more than one source of supply.

B. Conceptual Framework for Water Supply Sharing

GSI and the Partners considered multiple approaches to sharing water supply. Based on GSI's understanding of the Partners' goals, interests, and priorities, as well as the Partners' water supplies and demands, GSI recommended an approach that provides an opportunity to meet the Partners' near-term and long-term goals without jeopardizing any of the Partners' water rights. In addition, the Partners would pool their water rights to establish a diverse water rights portfolio.

Under the recommended option, the Partner Cities and MWC would enter into an intergovernmental agreement (IGA) to work together on regional water supply. The IGA would describe how the water rights and water supply would be shared, which would occur in two phases. Until the Duff WTP capacity was expanded to 100 cfs in approximately 2028, the Partner Cities and the Outside Customers would share their water supplies. MWC could track each entity's water use and compare that with the entity's individual water rights to determine whether any compensation was required for use of another entity's water rights. Additionally, the Partners would follow an agreed-upon strategy to request water right certificates for their water rights.

In the second phase of this option, the MWC would modify its agreements with the Partner Cities and Outside Customers and would begin to provide them with surplus water. The water rights held by the MWC and the Partner Cities would be placed into a regional water supply pool, which would be managed by the MWC. This would result in the Partners having a diverse water supply portfolio. The Partner Cities would retain ownership of their water rights, and the IGA would include a mechanism by which any of the Partner Cities could withdraw from the group.

The MWC would compensate the Partner Cities for any Operation and Management (O&M) costs it incurred associated with contracts for stored water that was being used by the Partners. The MWC would also provide Partner Cities with compensation (based on negotiations between each Partner City and the MWC) for water rights used by the Partners. The rate the Partner Cities pay to the MWC would reflect these expenses.

V. Summary of Recommended Option

The option recommended by GSI provides an approach to meeting the Partners' near-term and long-term water supply goals without jeopardizing any of the Partners' collective water rights. In the near term, the recommended option provides a method for the Partner Cities and MWC on behalf of the Outside Customers to initiate a shared water supply strategy. It then changes relatively quickly to reset the relationship with the MWC, which would then provide surplus water supply to the Partner Cities and Outside Customers. In addition, the Partners would pool their water rights to establish a diverse water rights portfolio. Finally, this option minimizes water rights transactions, such as extensions of time for permits and transfers, and decreases the risks associated with these transactions.

VI. Next Steps

Establishing a water sharing agreement will require completing a series of steps or actions. The following is a brief summary of some of the actions that will be required:

- The Partners' staff communicate with their councils/boards, and seek approval to develop a scope of work to develop an IGA.
- Staff develop the scope of work for drafting the IGA, and take the scope of work to city councils/ board for approval.
- Staff develop a draft IGA.
- Staff take the draft IGA to their city councils/board for review and approval.

FINAL MEMORANDUM

Water Rights Strategy for Partner Water Providers

To: Partner Water Providers

From: Adam Sussman, GSI Water Solutions, Inc.

Kimberly Grigsby, GSI Water Solutions, Inc.

Date: February 10, 2020

1. Introduction

GSI Water Solutions, Inc. (GSI), is assisting the Partner Water Providers (Partners) to develop a water rights strategy. The Partners include the Cities of Ashland, Central Point, Eagle Point, Jacksonville, Phoenix, and Talent (jointly the Partner Cities), and the Medford Water Commission (MWC). The water rights strategy focuses on the Partners' water rights associated with the Duff Water Treatment Plant (Duff WTP) on the Rogue River. During the months of May through September, much of the MWC's water supply and all of the Partner Cities' water supply is treated at the Duff WTP.

In developing this strategy, GSI previously prepared a comprehensive water rights table summarizing the Partner water rights, a consolidated water demand projection for each of the Partners, and a comparison of the Partners' individual and collective demands compared to their water rights. GSI has also prepared a summary of regional water sharing agreements. These documents are provided after this technical memorandum for documentation and reference. This memorandum builds on those previous efforts, provides a water right and water supply strategy for the Partners, and prepares the Partners for taking additional steps in developing a regional water supply partnership.

2. Background

The following is a brief historical perspective related to the MWC and Partner Cities, and a summary of the work completed as part of this project.

2.1 Historical Background

The City of Medford's Charter that created the MWC only allowed it to sell surplus water to areas outside of its city limits. Consequently, up until the early 1970s, the MWC supplied all major customers (cities and water districts) through Surplus Water Agreements. Although these 5-year agreements clearly stated only "surplus water" would be provided, through careful planning, the MWC ensured it had sufficient surplus water to meet these customer demands.

In the early 1970s, when the City of Phoenix joined the water system, the MWC changed its policy and required all new major non-resident customers to secure water supply for the peak season (May through September) under their own water rights. As a result, the MWC water supply contract with Phoenix is a "Treat and Transport" agreement wherein the City of Phoenix obtained water rights and MWC treated and transported that water to the City of Phoenix. This same policy was used when the City of Talent was added to the system in the 1990s and when the City of Ashland was added to the water system recently.

In the 1990s, MWC's long-range planning indicated that it would cease to have sufficient surplus water supply for all its non-resident customers in 30 to 40 years. At that point, the MWC met with the Cities of Eagle Point, Central Point, and Jacksonville to discuss two options for securing additional water supply: (1) have MWC obtain additional water rights; or (2) have the Cities of Eagle Point, Central Point, and Jacksonville obtain their own water rights similar to the arrangements made by the Cities of Phoenix and Talent. The latter option was selected because it would be more efficient for the cities to obtain new water rights and would avoid the need for the MWC to pass on the costs of securing the rights to the cities. Over the past 15 to 20 years, the cities have been obtaining water rights needed to meet their peak season demands, and all new water supply contracts with MWC are Treat and Transport agreements.

For the other non-resident customers without their own water rights, MWC added a surcharge as a method to obtain funding to purchase water rights to meet their demands.

2.2 Project Background

As the Partners plan for their long-term water supply needs, it is important that they have a full understanding of the status of their water rights and develop a common strategy to protect and secure the water rights to ensure adequate water supplies for future generations. This water rights strategy memorandum provides the framework for the Partners' efforts to plan for that future water supply.

In a previous component of this project, GSI compared the Partners' existing water rights with their projected water demands. (See GSI's memorandum Comparison of Water Rights and Projected Water Demands of Partner Providers for Water Rights Strategy (dated September 11, 2019) for the full evaluation.) For each Partner, GSI compared the combined maximum authorized rates[1] associated with its water rights (if any) to the projected average day and maximum day demands (MDD) during the 50-year planning period (2020 to 2070). Table 1 below summarizes this assessment. The entries in the table shown in red indicate demands that exceed each Partner's maximum authorized rate associated with its water rights.

Table 1. Total Maximum Authorized Rates and MDD Projections (Medium Scenarios)

Partner	Water Right Maximum Authorized Rates (mgd)	Project MDD (mgd)[1]			
		2019	2030	2040	2070
Ashland	N/A	3.0	3.00	3.00	3.00
Central Point	3.43	7.09	8.37	9.76	15.01
Eagle Point	4.05	4.06	4.52	5.00	6.74
Jacksonville	N/A	1.61	1.88	2.16	3.28
MWC	123.35[2]	47.55	53.53	59.16	73.08
Phoenix	5.24	2.2	2.63	3.13	5.07
Talent	N/A	2.14	2.45	2.82	4.21
Total	**136.1**	**67.65**	**76.4**	**85.0**	**110.4**

Notes

[1] Red indicates demands that exceed the maximum authorized rate associated with water rights

[2] Includes 26.4 mgd of capacity from Big Butte Springs and approximately 96.9 mgd of water rights at the Duff WTP.

MDD: maximum day demand

mgd: million gallons per day

MWC: Medford Water Commission

[1] "Rate" is the instantaneous speed at which water can be diverted from the source. Municipalities often describe rates in million gallons per day (mgd). Water rights generally have rates in cubic feet per second (cfs).

The second component of this evaluation was to compare each Partner's projected water demands with the maximum volume[2] that can be diverted under their water rights. This evaluation considered the period from May 1 through September 30 when the Partner Cities divert water under their individual water rights, and year-round for the MWC. The maximum volumes used in the evaluation were either the volumes stated in the water rights (if any) or calculated based on the water rights' maximum authorized rates and period of use. The projected volume of future demands was based on each Partner's historical water use by month. Table 2 provides a comparison of the total volume limit of each Partner's water rights and their projected future water demand volumes.

Table 2. Water Right Volume Limits and Demands within Water Right Period of Use (in MG)

Partner	Total Volume Limit (MG)	Projected Demands (MG)			
		2019	2030	2040	2070
Ashland	326	310	326	326	326
Central Point	847	669	791	922	1,418
Eagle Point	606	367	445	453	610
Jacksonville	196	174	202	232	353
MWC	35,387	5,022	9,629	10,682	13,280
Phoenix	326	174	338	402	651
Talent	421	180	205	236	352
Total	**38,108**	**6,896**	**11,890**	**13,207**	**16,944**

Notes

MG: million gallons

MWC: Medford Water Commission

Overall, this evaluation showed that the projected demands for MWC and Talent were expected to be within the limits of their water rights. However, four of the seven Partners were projected to have demands exceeding either the rate or volume limitations in their water rights at some time during the 50-year planning period for this project. (For purposes of this assessment, it was assumed Ashland will need the full volume of its water right by approximately 2030.)

3. Goals, Interests, and Priorities for Water Rights Strategy

The above-described differences between the Partners' water rights and projected water demands demonstrate the value of a strategy related to the Partner water rights at the Duff WTP. The strategy is intended to meet the following goals, interests, and priorities, which have been identified by the Partners.

The Partners want to ensure that the water rights associated with the Duff WTP on the Rogue River are strategically managed. Of primary importance is ensuring that no water is "left on the table" after being certificated. If the Partners certificate water rights with a total authorized rate of diversion that exceeds the system capacity of the Duff WTP, the Oregon Water Resources Department (OWRD) could potentially "tie together" the certificates. In other words, the use under the water rights could be limited even when the capacity of the Duff WTP was expanded, as further described in Section 4.1.

[2] Volume is the amount of water that can be diverted during a year and is generally measured in million gallons (MG).

The Partners are also seeking to ensure that they have long-term water supply security. As described above, some of the Partner Cities are projected to have demands during the next 50 years that exceed the rate and/or volume limitations on their existing water rights. At the same time, the water rights held by the MWC and Talent are expected to authorize use in amounts that exceed those entities' projected water demands. Opportunities exist to coordinate the management of the Partners' water rights to ensure sufficient long-term water supplies for the individual Partners as well as the group as a whole. These opportunities could eliminate the need for any of the Partner Cities to purchase additional water rights.

GSI also understands that the Partners' goals for this project include retaining ownership of their existing water rights and understanding the opportunities to obtain value for the water rights held by each Partner.

Finally, MWC serves water to White City, two water districts (Elk City and Charlotte Ann), and other customers outside of the MWC service area. As a matter of equity, the Partners believe these "Outside Customers" should be considered as part of the water supply strategy.

4. Strategic Management of Partners' Existing Water Rights

4.1 Water Rights Overview

Several water rights processes are relevant to establishing a strategy for managing the Partners' existing water rights. Of particular significance are the processes for extending the development timelines for permits and transfers, and for certification of water rights. Key elements of these processes are summarized below.

Both water use permits and final orders approving transfers include development deadlines. The deadline is the date by which the water right holder is expected to use all of the water as authorized under the permit or transfer. If full development (water use) under the permit or transfer has not occurred, the water right holder must apply for an extension of time if it wishes to retain the entire water right.

The extension of time processes for permits and transfers differs significantly. The process to extend a transfer is relatively simple, it currently does not include an opportunity for comment, and does not include the imposition of additional conditions on the water right. On the other hand, extensions of time for municipal use permits can be more complex and include additional risks. The extension application requires a significant amount of information and analysis; notice of the proposed extension is provided to the public; and protests can be filed against the extension. In addition, for the first extension after 2005 of a municipal permit issued prior to November 2, 1998, the Oregon Department of Fish and Wildlife (ODFW) must recommend conditions on the undeveloped (unused) portion of the permit to maintain the persistence of fish species listed under the Endangered Species Act that are affected by use of water under the permit. The need for recommended conditions from ODFW causes prolonged delays in the extension process and can result in conditions that significantly reduce or preclude use of the undeveloped portion of the permit. Historically, ODFW has not recommended fish persistence conditions on "secondary permits" (permits authorizing the use of stored water): however, GSI cannot be certain that this practice will continue in the future. The extension process also results in loss of access to the undeveloped portion of a permit until the permit holder gets approval of a water management and conservation plan giving it access to that water (commonly referred to as "green light water").

After development of a permit or transfer is complete, the water right holder develops a claim of beneficial use (COBU) and requests a water right certificate. When multiple water rights divert water and are treated at a shared point of diversion and water treatment plant, municipalities must certificate the water right carefully. As previously stated, if the Partners certificate water rights with a total authorized rate of diversion that exceeds the system capacity of the Duff WTP, the certificates could potentially be "tied together." This could occur if, as an example, a certificate was issued that resulted in a total combined maximum authorized rate of diversion of 75 cfs in combination with all existing certificates at that point of diversion, but the water treatment plant had a capacity of 70 cfs. In that circumstance OWRD could limit use of that certificate, in combination with the other existing certificates, to 70 cfs. This limitation could remain in place even after the water treatment plant capacity was expanded, with a resulting loss of access to 5 cfs under the water rights.

Two other issues related to certification of water rights are important to understand. First, permits authorizing the use of water for municipal purposes can be "partially perfected." This means that an entire municipal permit does not have to be certificated all at once. Instead, the municipality can request a certificate for a portion of its permit. The smallest increment that can be certificated is 25 percent of the authorized rate (or volume). Partial perfection is not available for water right transfers.

Second, it should be understood that when calculating the total authorized rate for water rights associated with a water treatment plant, OWRD adds together the stated authorized rates of all water right certificates. Under current OWRD practice and written policy, certificates for the use of stored water with only volume limitations (no rate limitations) do not "count" toward the total maximum authorized rate for the certificates at a water treatment plant.

With these processes and risks in mind, GSI has developed a water rights certification strategy that is intended to certificate water rights as soon as possible after they are fully developed but that prevents the water rights from being tied together and reduces the risks associated with delayed certification of water rights after the associate development deadlines.

4.2 Water Rights Certification Strategy

In developing the following certification strategy, GSI considered multiple factors:

- **Type of water right** – permit for the use of natural flow, "secondary" permit to use stored water, or a transfer.
- **Development deadline** – date that the transfer or permit needs to be completed to avoid obtaining another extension of time.
- **Projected demand for the water** – the water right holder's anticipated ability to use the full rate or volume authorized by the water right.
- **Water right limitations** – permit conditions/considered limitations on the water right, such as fish persistence conditions.
- **Equity** – is the WTP capacity being saved for water right certification being equably distributed?

GSI has summarized the water rights certification strategy in Table 3, which generally focuses on the water right development deadlines. The table shows the current capacity of the Duff WTP (70 cfs), as well as the planned future capacities (100 cfs, 131 cfs, 162 cfs, and 193 cfs). The recommended transactions are listed according to the system capacity at which they would occur. Emphasis on any particular factor may change as new information becomes available, and in response to any new OWRD policies or rules.

Duff WTP – Existing Capacity – 70 cfs. At the current 70 cfs capacity, the table shows the certificated water rights and water rights for which certificate requests are currently pending. Note that a certificate request is pending for Phoenix's Permit S-47672 but has been on hold due to insufficient capacity at the Duff WTP to avoid having the right tied together with other existing certificates.

The recommended transactions at the 70 cfs capacity include requesting water right certificates for Central Point's Transfer T-9900 and Eagle Point's Transfer T-10614. These transactions reflect that Central Point and Eagle Point are projected to have sufficient demands to demonstrate full development of the transfers, and the transfers have near-term development deadlines (October 1, 2030). If the City of Ashland has used at least 250 acre-feet (25 percent of the total authorized volume of 1,000 acre-feet) prior to September 7, 2021, Ashland could partially certificate its Permit S-54337. (As this permit does not include a rate limitation, under current OWRD policy, obtaining a certificate would not affect the comparison of system capacity to the total rate of water right certificates.) For any remaining portion of the permit that is not used prior to September 7, 2021, Ashland would need to apply for an extension of time. Since this permit was issued after 1998, it would not be subject to fish persistence conditions as part of the permit extension process.

Duff WTP Capacity – 100 cfs in approximately 2028. Once the Duff WTP capacity is expanded to 100 cfs, additional water right certificates could be requested. As a first step, the hold on the certificate request for Phoenix's Permit S-47672 could be removed and a certificate issued. Based on Phoenix's projected demands and development deadlines, GSI recommends that it request certificates for Transfers T-10960 and T-12221. Assuming that the cities had sufficient demand to demonstrate use of the water, certificates could also be requested for Phoenix's Permit S-52650 and Jacksonville's Permit S-54974. One opportunity to utilize the remaining system capacity would be to partially certificate a portion of the MWC's "withdrawal permit" (Permit S-54935). Since this permit does not include a stated rate limitation (it authorizes the use of all of the unappropriated water in the Big Butte Creek Basin), the minimum rate of use required for certification is not entirely clear. For purposes of this example, GSI has used 25 percent of 50 cfs, which is the rate MWC has previously used for Permit S-54935 for planning purposes. (Due to the lack of a stated rate, partial certification of Permit S-54935 is expected to require a significant amount of coordination with OWRD.) Finally, a certificate could be requested for the remainder of Ashland's Permit S-54337 at the 100 cfs system capacity (or at any time that the Ashland has used the entire 1,000 acre-feet of authorized volume).

Duff WTP Capacity – 131 cfs in approximately 2036. When the Duff WTP has a system capacity of 131 cfs, GSI recommends partial certification of a 31 cfs portion of MWC's Rogue River permit (Permit S-23210).

Duff WTP Capacity – 162 cfs. At a system capacity of 162 cfs, MWC would complete certification of its Permit S-23210 and partially certificate a 22.85 cfs portion of its Permit S-54935. Depending on the timeline for expansion of the Duff WTP and the MWC's demands, an extension of time may be required for the undeveloped portion of Permit S-54935. (The current development deadline is October 1, 2056.)

Duff WTP Capacity – 193 cfs. Finally, when the Duff WTP has a capacity of 193 cfs, the MWC could complete certification of its Permit S-54935. Talent's Permit S-53898, which has a development deadline of October 1, 2065, could also be certificated as soon as the City has sufficient demand to show the use of the full 759 acre-feet.

Note that the above-described approach to strategically certificating water rights assumes that each Partner is certificating its water rights based on its own water use. A discussion of the recommended certification strategy that incorporates water supply sharing is provided below. Finally, this is a planning-level evaluation based on the best available information; periodic review and update of this water rights certification strategy should be conducted.

Table 3. Water Rights Certification Strategy for Partners' Water Rights at Duff WTP without Water Sharing

Step	Action	Rate (cfs)	Development Deadline	Total Rate in Water Right Certificate Status (cfs)
Duff WTP - Existing Capacity – 70 cfs				
Current Status - Existing Certificates and Pending COBUs				
	Central Point's Certificate 93754	1.13	N/A	65.26
	Central Point's Certificate 93755	1.13	N/A	
	Eagle Point's Certificate 88552	0.90	N/A	
	Eagle Point's Certificate 89864	1.25	N/A	
	Jacksonville's Certificate 87360	*No rate* (400 AF)	N/A	
	MWC's Certificate 86832	60.85	N/A	
	Talent's Certificate 91134	*No rate* (533 AF)	N/A	
	Central Point's Transfer T-10465	1.20	10/1/2014	66.46
	Eagle Point's Transfer T-10527	0.50	10/1/2013	66.96
	*Phoenix's Permit S-47672 (COBU on hold)**	*5.0*	*10/1/2001*	*(71.96)*
Transactions				
1	Certificate Central Point's Transfer T-9900	1.846	10/1/2030	68.806
2	Certificate Eagle Point's Transfer T-10614	1.15	10/1/2030	69.956
3	Partially Certificate Ashland's Permit S-54337 to extent it is developed (if at least 25%) and extend deadline for remainder of permit	*No rate* (1,000 AF)	9/7/2021	69.956
	Total at this capacity			**69.956 cfs**
Duff WTP Capacity – 100 cfs in approximately 2028				
4	Certificate Phoenix's Permit S-47672	5.0	10/1/2001	74.956
5	Certificate Eagle Point's Transfer T-10960	1.77	10/1/2030	76.726
6	Certificate Eagle Point's Transfer T-12221	0.7	10/1/2030	77.426
7	Certificate Phoenix's Permit S-52650	3.1	10/1/2030	80.526
8	Certificate Jacksonville's Permit S-54974	*No rate* (200 AF)	11/19/2035	80.526
9	Partially certificate MWC's Permit S-54935 (estimated rate)	19.474	10/1/2056	100
10	Certificate remainder of Ashland's Permit S-54337 when developed	*No rate* (TBD AF)	TBD	100
	Total at this capacity			**100.0 cfs**
Duff WTP Capacity – 131 cfs in approximately 2036				
11	Partially certificate MWC's Permit S-23210	31	10/1/2050	131
	Total at this capacity			**131.0 cfs**
Duff WTP Capacity – 162 cfs (date TBD)				
12	Partially certificate remainder of MWC's Permit S-23210	8.15	10/1/2050	139.15
13	Partially certificate MWC's Permit S-54935 (estimated rate)	22.85	10/1/2056	162.0
14	Extend MWC's Permit S-54935 as needed		10/1/2056	
	Total at this capacity			**162.0 cfs**
Duff WTP Capacity – 193 cfs (date TBD)				
15	Certificate remainder of MWC's Permit S-54935 (estimated rate)	7.676	10/1/2056	169.676
16	Certificate Talent's Permit S-53898	*No rate* (759 AF)	10/1/2065	169.676
	Total at this capacity			**169.676 cfs**

Notes

AF: acre-feet

COBU: claim of beneficial use

cfs: cubic feet per second

MG: million gallons

MWC: Medford Water Commission

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5. Coordinated Water Rights Management

5.1 Reasons for Developing Coordinated Approach to Water Rights and Water Use

GSI recommends that the Partners consider developing a coordinated approach to water rights certification and water supply. This coordination could include not only coordinated management of the water rights associated with the Duff WTP, but also creation of an opportunity for the Partners to share their combined water supplies.

There are several reasons the Partners may want to consider adopting a coordinated approach to the management of the water rights and water use at the Duff WTP. First, coordination will be necessary to strategically certificate the 20 water rights that currently have authorized points of diversion at the Duff WTP consistent with the strategy described above. As previously discussed, failure to certificate the water rights in a strategic manner could result in water rights being tied together.

Additionally, if the Partners established a combined water supply, it could address the imbalances between water rights and projected water demands that have been previously described,[3] and eliminate the need for the Partners to purchase additional water rights to meet their individual needs. For example, the City of Central Point likely requires all of its water rights to meet its current demands, but the City of Talent's projected demands indicate its water rights will meet demands past 2070. To address this situation, the cities with supply shortages could potentially purchase additional water rights (although this could exacerbate the complexity of the water right certification strategy described above), or the cities with supply shortfalls could potentially participate in a water sharing agreement with the Partners, including those that have excess supply. The latter approach (shared water supply) fulfills multiple functions. It provides needed water supply for the cities with supply shortfalls, and it also could provide value to Partners with under-utilized water rights. It could also facilitate certification of water rights prior to their development deadlines.

Further, establishing a combined water supply could provide the Partners with some level of supply redundancy. For the most part, individual Partner's water rights authorize water use from single sources. For example, the water rights held by the Cities of Ashland, Jacksonville, Phoenix, and Talent all authorize the use of stored water from Lost Creek Reservoir. The MWC's water rights at the Duff WTP come from natural flow from the Rogue River and one of its tributaries, the Big Butte Creek watershed. Additionally, Eagle Point's water rights authorize the use of stored water from Four Mile Lake and Fish Lake Reservoirs, and from North and South Fork Little Butte Creeks, which also convey the stored water from the reservoirs. This reliance on a single or related sources of water supply exposes each Partner to some level of risk. If, for example, a source of supply such as Lost Creek Reservoir became unavailable due to contamination or unexpected dam maintenance, the Partners that rely exclusively on that source of water supply in the summer could be without an authorized water source. Additionally, a Partner that relied exclusively on natural flow water rights could be more affected by a severe drought than Partners with access to stored water. By combining their water supplies, the Partners would have access to the multiple sources authorized by their water rights, which would provide some level of supply redundancy and resiliency that could offset the impacts of some of the above-described scenarios.

5.2 Examples of Water Sharing and Governance Structures

GSI has reviewed a number of regional partnerships in Oregon that have been developed to share water supply. These partnerships are generally established through intergovernmental agreements (IGAs) that establish the terms under which the partnerships operate. GSI developed a memorandum that provides information regarding various components of the governance structure of these entities, including partnership

[3] It should be noted that municipalities can serve water for municipal use outside of the authorized place of use identified in their water rights as long as it does not interfere with or impair prior vested water rights. Additionally, GSI understands that holders of contracts for use of stored water from Lost Creek Lake storage project are not precluded from providing water supply to other entities.

governance, sharing of assets, and access to additional water supplies. (See GSI's draft memorandum Examples of Regional Water Sharing, [dated October 14, 2019] for more details.)

GSI's review of various IGAs found that water sharing partnerships established multiple methods for sharing assets such as water rights. The members can continue to hold their water rights, or the partnership entity can hold the water rights. The IGAs also governed how members could obtain access to additional water supply and determined what (if any) compensation was required for the use of the additional water beyond that authorized by an individual member's water rights. The Partners may want to review the alternatives described in the GSI memorandum to identify approaches to these issues that would meet their needs.

Finally, the various IGAs demonstrated that water sharing partnerships could be governed in a variety of ways, including by a new entity that is established through the IGA or by an existing entity. For the Partners, these options could assume a number of forms including the following:

- **Partner City Group Managed by MWC** – the Partner Cities form a group and the MWC provides management (staff/administration).
- **Partner City Group Managed by Cities** – the Partner Cities form a group and one or more cities take on the role of staffing/administration/management of the group.
- **Governance by MWC with Committees** – MWC manages the Partner group with input from committees with representatives from the Partner Cities' city councils.
- **New Entity** – the Partner Cities and the MWC form a group and create a governing body to manage the new group.
- **Combination Approach** – For example, in the near term (10 to 20 years) the Partner Cities form a group and the MWC provides management. In the longer term, the Partner Cities and the MWC form a group with its own governing body.

5.3 Conceptual Frameworks for Three Water Supply Sharing Options

Based on GSI's understanding of the Partners' goals, interests, and priorities (as described in Section 3), as well as the Partners' water supplies and demands, GSI has developed conceptual frameworks for three alternative water sharing options. The options are being referred to as Option 1 – Lost Creek Equity Option, Option 2 – Surplus Water Option, and Option 3 – Hybrid Option. Each of these options is described in more detail below.

GSI has provided relatively simple frameworks for each option, which are intended as examples for how the Partners could share water supply. (The intent is to create a framework for further discussion among the Partners, rather than to define the terms under which water sharing should occur.) It is worth noting that, in addition to establishing a method for sharing water supply, a cooperative agreement could also establish a mechanism for additional collaboration, such as coordinated emergency management, and water curtailment and conservation planning.

Option 1 – Lost Creek Reservoir Equity Option

This option is a potential short-term approach that focuses only on the Partner Cities and Outside Customers sharing supply.

As an initial step under Option 1, the Partner Cities and the Outside Customers served by MWC would enter into an IGA that would establish a governance structure under which the partnership would operate. As an initial step, the IGA would create a partnership (entity) comprised of the Partner Cities, and the MWC would provide administrative and management services to the partnership. (The MWC would likely also enter the agreement on behalf of the Outside Customers.)

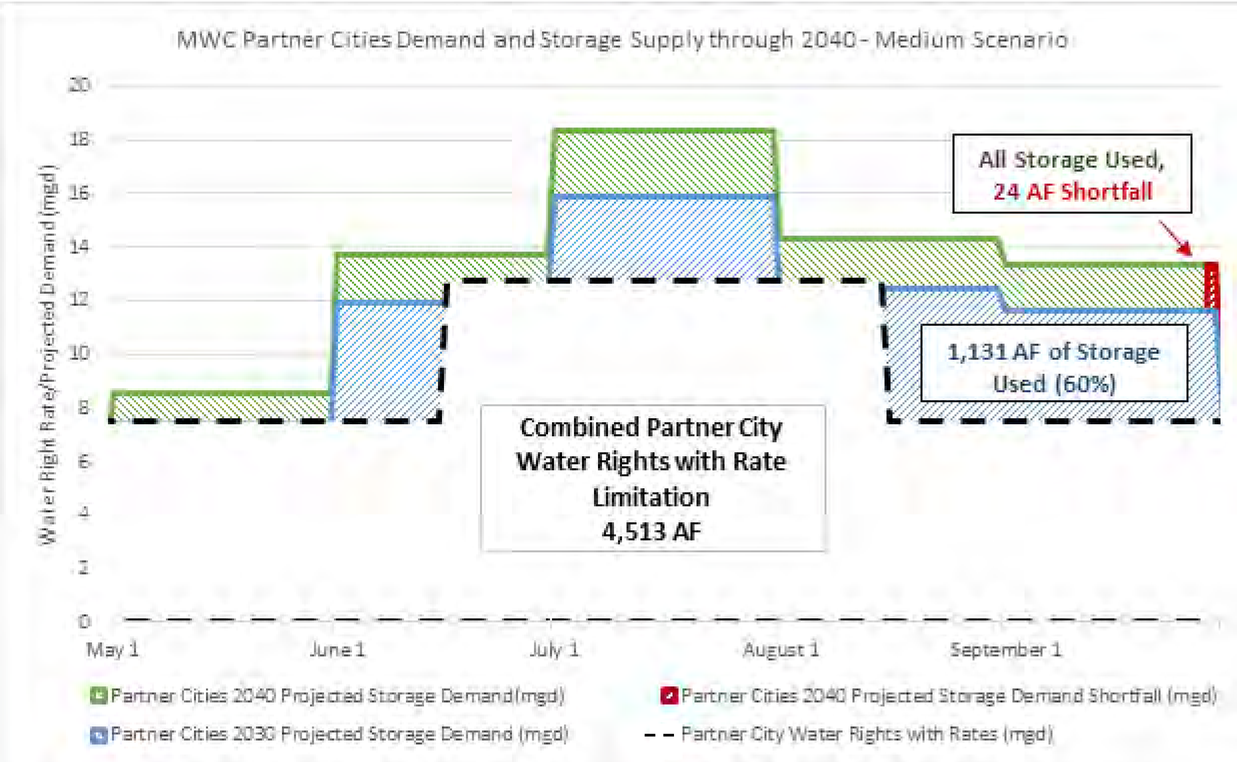
This option is based on the following considerations: (1) the Partner Cities are expected to have sufficient water rights to meet their combined projected demands until approximately 2040; (2) the Partner Cities are of fairly similar size and have relatively similar amounts of water supply (particularly relative to the MWC) and the Outside Customers will obtain similar water supplies; and (3) an entity consisting of the Partner Cities and Outside Customers only will be easier to implement in the near term and will allow for a demonstration of success and provide time to consider other long-term structures.

Under this option, the MWC would likely purchase additional stored water from Lost Creek Reservoir (and obtain the necessary water right[s] to use the stored water) on behalf of the Outside Customers. This would put the Outside Customers in positions similar to those of the Partner Cities, which is viewed by the Partners as an equitable result.

The IGA would describe how the water rights and water supply would be shared. GSI anticipates that the Partner Cities and Outside Customers would share their water supplies, but each would continue to hold (own) their individual water rights. (As previously described, the exception would be that the MWC would hold water rights for the Outside Customers.) In its role of assisting to manage the entity, MWC could track each city's water use and compare that to its individual water rights to determine whether any compensation was required for use of other Partner Cities' water rights. The MWC would compare each Partner City's and the Outside Customers' water use to the maximum authorized rate (if any) and volume (if any) under that entity's existing water right(s). This assessment could occur on a daily basis, or at any other interval selected by the group. The comparison would need to also consider any limitations on the entity's use of water, such as limitations based on access to green light water. If the MWC determined that a Partner City or Outside Customer had used more water than was authorized by its water rights, the MWC would determine the amount of "excess" water use. How the excess use was allocated among other water rights and the compensation for use of excess water are details that would need to be agreed upon during development of the Partner City IGA.

Figure 1 provides an illustration of how the Partner Cities could meet their projected shared water supply if they pooled their existing water rights. Based on an assessment of the Partner Cities' combined authorized rate (for water rights with rate limitations) and the authorized volumes (for "volume-only" water rights), GSI projects that the Partner Cities would have sufficient water supply to meet the combined projected demands in 2030 and to meet almost all of the combined demands by 2040.

Figure 1. Collective Water Supply to Meet Partner City Demands through 2040



Through the process outlined above, the MWC could also determine when a Partner was ready to certificate a water right. The Partners would follow the water right certification strategy described in Table 4. The water sharing agreement could allow Partner Cities to use other Partner Cities' water demands to help demonstrate full development of their water rights. The end result would likely be the ability for some cities to avoid the need to request an extension of time or to certificate their water rights more quickly. Specifically, assuming OWRD's policy for certificating stored water rights does not change, in addition to the natural flow water rights held by Central Point and Eagle Point (approximately 3 cfs), it is possible that the City of Ashland could demonstrate full development (use of the entire 1,000 acre-feet of stored water) of its Permit S-54337 to minimize the risks associated with OWRD's permit extension process, rather than needing to partially certificate its permit and request to extend its September 7, 2021 development deadline. (This assumes that a water sharing agreement was implemented prior to the September 7, 2021 development deadline for Ashland's Permit S-54337 and use of the full volume could be demonstrated.)

Additionally, assuming OWRD's policy for certificating stored water rights does not change, the goal would be to certificate Jacksonville's and Talent's volume-only permits (Permits S-54974 and S-53898, respectively) after expansion of the Duff WTP to a capacity of 100 cfs, or sooner, as agreed to by the Partners. This assumes these actions would not negatively impact the ability to certificate the other Partners' water rights, and all the requirements of seeking a certificate can be met. These modifications to the previous water rights certification strategy (shown in Table 3) are in red text in Table 4.

It should be understood that the water right certification strategy shown in Table 4 is the current plan, but it could change as a result of changes in OWRD rules or policies.

As a second step under this option, the Partners would continue to explore options for long-term regional water supply for meeting their water demands after their existing supply is insufficient.

Table 4. Water Right Strategy Summary for Partners' Water Rights at Duff WTP with Water Sharing

Step	Action	Rate (cfs)	Development Deadline	Total Rate in Water Right Certificate Status (cfs)
Duff WTP - Existing Capacity – 70 cfs				
Current Status - Existing Certificates and Pending COBUs				
	Central Point's Certificate 93754	1.13	N/A	65.26
	Central Point's Certificate 93755	1.13	N/A	
	Eagle Point's Certificate 88552	0.90	N/A	
	Eagle Point's Certificate 89864	1.25	N/A	
	Jacksonville's Certificate 87360	*No rate* (400 AF)	N/A	
	MWC's Certificate 86832	60.85	N/A	
	Talent's Certificate 91134	*No rate* (533 AF)	N/A	
	Central Point's Transfer T-10465	1.20	10/1/2014	66.46
	Eagle Point's Transfer T-10527	0.50	10/1/2013	66.96
	*Phoenix's Permit S-47672 (COBU on hold)**	*5.0*	*10/1/2001*	*(71.96)*
Transactions				
1	Certificate Central Point's Transfer T-9900	1.846	10/1/2030	68.806
2	Certificate Eagle Point's Transfer T-10614	1.15	10/1/2030	69.956
3	**Certificate Ashland's Permit S-54337***	***No rate* (1,000 AF)**	**9/7/2021**	**69.956**
		Total at this capacity		**69.956 cfs**
Duff WTP Capacity – 100 cfs in approximately 2028				
4	**Certificate Jacksonville's Permit S-54974***	***No rate* (200 AF)**	**11/19/2035**	**69.956 cfs**
5	**Certificate Talent's Permit S-53898***	***No rate* (759 AF)**	**10/1/2065**	**69.956 cfs**
6	Certificate Phoenix's Permit S-47672	5.0	10/1/2001	74.956
7	Certificate Eagle Point's Transfer T-10960	1.77	10/1/2030	76.726
8	Certificate Eagle Point's Transfer T-12221	0.7	10/1/2030	77.426
9	Certificate Phoenix's Permit S-52650	3.1	10/1/2030	80.526
10	Partially certificate MWC's Permit S-54935 (estimated rate)	19.474	10/1/2056	100
		Total at this capacity		**100 cfs**
Duff WTP Capacity – 131 cfs in approximately 2036				
11	Partially certificate MWC's Permit S-23210	31	10/1/2050	131
		Total at this capacity		**131 cfs**
Duff WTP Capacity – 162 cfs (TBD)				
12	Partially certificate remainder of MWC's Permit S-23210	8.15	10/1/2050	139.15
13	Partially certificate MWC's Permit S-54935 (estimated rate)	22.85	10/1/2056	162.0
14	Extend MWC's Permit S-54935 as needed		10/1/2056	
		Total at this capacity		**162.0 cfs**
Duff WTP Capacity – 193 cfs (TBD)				
15	Certificate remainder of MWC's Permit S-54935 (estimated rate)	7.676	10/1/2056	169.676
		Total at this capacity		**169.676 cfs**

Notes

* These steps assume that certificating the "volume-only" water rights would not negatively impact the ability to certificate the other Partner water rights, and all elements of seeking a certificate can be met.

AF: acre-feet cfs: cubic feet per second

COBU: claim of beneficial use MWC: Medford Water Commission

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Option 2 – Surplus Water Option

Under this option, MWC's water rights are prioritized for certification and MWC provides surplus water to the Partner Cities.

As an initial step, the Partner Cities and MWC (and MWC on behalf of the Outside Customers) would enter into an IGA that would establish a governance structure under which the partnership would operate. The MWC would provide surplus water to the Partner Cities and Outside Customers. MWC's existing agreements with the Partner Cities and Outside Customers would be modified accordingly.

The certification strategy for the water rights at the Duff WTP under this option would be changed to place a priority on certificating the MWC's "legislative withdrawal" permit (Permit S-54935). The Partner Cities' would request extensions of time for their water rights (permits and transfers) to allow the capacity at the Duff WTP to be used to partially certificate the MWC's permit. Extension applications for both permits and transfers require review and approval by OWRD. After the MWC permits had been certificated, the water rights held by the Partner Cities would then be certificated. The certification strategy under this option is summarized in Table 5.

The second part of this option is to put the Partner Cities' water rights into a regional water supply pool, which would be managed by the MWC. This would result in a diverse water supply portfolio for the Partners. The Partner Cities would retain ownership of their water rights, and the IGA would include a mechanism by which any of the Partner Cities could withdraw from the group.

The MWC would compensate the Partner Cities for any Operation and Management (O&M) costs they incurred associated with contracts for stored water that was being used by the Partners. The MWC would also provide Partner Cities with compensation (based on negotiations between each City and the MWC) for water rights used by the Partners. The rate the Partner Cities would pay to the MWC would reflect these expenses.

If the Partners required additional water supply or mitigation to meet their water supply needs in the future, the resources associated with the Outside Customers could be used to purchase additional stored water or mitigation.

Table 5. Water Rights Certification Strategy for Partners' Water Rights at Duff WTP under Option 2 – Surplus Water

Step	Action	Rate (cfs)	Development Deadline	Total Rate in Water Right Certificate Status (cfs)
Duff WTP - Existing Capacity – 70 cfs				
Current Status - Existing Certificates and Pending COBUs				
	Central Point's Certificate 93754	1.13	N/A	65.26
	Central Point's Certificate 93755	1.13	N/A	
	Eagle Point's Certificate 88552	0.90	N/A	
	Eagle Point's Certificate 89864	1.25	N/A	
	Jacksonville's Certificate 87360	*No rate* (400 AF)	N/A	
	MWC's Certificate 86832	60.85	N/A	
	Talent's Certificate 91134	*No rate* (533 AF)	N/A	
	Central Point's Transfer T-10465	1.20	10/1/2014	66.46
	Eagle Point's Transfer T-10527	0.50	10/1/2013	66.96
	*Phoenix's Permit S-47672 (COBU on hold)**	*5.0*	*10/1/2001*	*(71.96)*
Transactions				
1	Extend Ashland's Permit S-54337	*No rate* (1,000 AF)	9/7/2021	--
	Total at this capacity			**66.96 cfs**
Duff WTP Capacity – 100 cfs in approximately 2028				
2	Certificate Phoenix's Permit S-47672	5.0	10/1/2001	71.96
3	Partially certificate MWC's Permit S-54935 (estimated rate)	28.04	10/1/2056	100
4	Extend Eagle Point's Transfer T-10960	1.77	10/1/2030	--
5	Extend Eagle Point's Transfer T-12221	0.7	10/1/2030	--
6	Extend Phoenix's Permit S-52650	3.1	10/1/2030	--
7	Extend Central Point's Transfer T-9900	1.846	10/1/2030	--
8	Extend Eagle Point's Transfer T-10614	1.15	10/1/2030	--
9	Extend Jacksonville's Permit S-54974	*No rate* (200 AF)	11/19/2035	--
	Total at this capacity			**100 cfs**
Duff WTP Capacity – 131 cfs in approximately 2036				
10	Partially certificate MWC's Permit S-23210	31	10/1/2050	131
	Total at this capacity			**131 cfs**
Duff WTP Capacity – 162 cfs (TBD)				
11	Certificate remainder of MWC's Permit S-23210	8.15	10/1/2050	139.15
12	Certificate remainder of MWC's Permit S-54935 (estimated rate)	21.96	10/1/2056	161.11
13	Certificate Eagle Point's Transfer T-12221	0.7	TBD	161.81
	Total at this capacity			**161.81 cfs**
Duff WTP Capacity – 193 cfs (TBD)				
14	Certificate Talent's Permit S-53898	*No rate* (759 AF)	10/1/2065	161.81
15	Certificate Eagle Point's Transfer T-10960	1.77	TBD	163.58
16	Certificate Phoenix's Permit S-52650	3.1	TBD	166.68
17	Certificate Central Point's Transfer T-9900	1.846	TBD	168.526
18	Certificate Eagle Point's Transfer T-10614	1.15	TBD	169.676
19	Certificate Jacksonville's Permit S-54974	*No rate* (200 AF)	TBD	169.676
	Total at this capacity			**169.676 cfs**

Notes

AF: acre-feet — cfs: cubic feet per second

COBU: claim of beneficial use — MWC: Medford Water Commission

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Option 3 – Hybrid Option

The final option includes a two-part approach with initial water sharing by the Partner Cities and Outside Customers, followed by creation of a broader approach to regional water supply.

Under Option 3, the Partner Cities and MWC (and MWC on behalf of the Outside Customers) would enter into an IGA to work together on regional water supply. (The MWC would likely also enter the agreement on behalf of the Outside Customers, which were previously described.)

The IGA would describe how the water rights and water supply would be shared. Until the Duff WTP was expanded to 100 cfs in 2028, the Partner Cities and Outside Customers would share their water supplies. Given the short timeline for this step, the Outside Customers would likely bring financial resources to the group. Similar to Option 1, MWC could track individual entity water use and compare that to their individual water rights to determine whether any compensation was required for use of other entities' water rights. How the excess use was allocated among other water rights and the compensation for use of excess water are details that would need to be agreed upon during development of the IGA. This approach would remain in place until the Duff WTP was expanded to 100 cfs, which is expected to occur in 2028.

Through the process outlined above, the MWC could also determine when a Partner was ready to certificate a water right. The Partners would follow the water right certification strategy described in Table 4. It should be understood that the water right certification strategy shown in Table 4 is the current plan, but it could change as a result of changes in OWRD rules or policies.

The second step for Option 3 would begin after the capacity of the Duff WTP was increased to 100 cfs. At that time, the MWC would modify its agreements with the Partner Cities and Outside Customers and would begin to provide them with surplus water. The water rights held by the MWC and the Partner Cities would be placed into a regional water supply pool, which would be managed by the MWC. This would result in the Partners having a diverse water supply portfolio. The Partner Cities would retain ownership of their water rights, and the IGA would include a mechanism by which any of the Partner Cities could withdraw from the group.

The MWC would compensate the Partner Cities for any Operation and Management (O&M) costs they incurred associated with contracts for stored water that was being used by the Partners. The MWC would also provide Partner Cities with compensation (based on negotiations between each Partner City and the MWC) for water rights used by the Partners. The rate the Partner Cities pay to the MWC would reflect these expenses. If the Partners required additional water supply or mitigation to meet their water supply needs, the Outside Customers could provide resources or additional water rights for stored water.

5.4 Recommended Option

Based on GSI's professional experience and understanding of the Partners' goals, GSI recommends Option 3 (Hybrid Option).

Option 1 (Lost Creek Reservoir Equity Option) provides a good first step towards an approach to regional water sharing, but it leaves unresolved the need for a long-term water supply sharing strategy. This approach does not create a broad regional partnership but continues the existing relationship with the MWC under Treat and Transport agreements.

Option 2 (Surplus Water Option) establishes a regional partnership and resets the Partner Cities' relationship with the MWC in the near term. However, it creates significant concerns about the associated water rights transactions. The extensions of time that would be required for the Partner Cities' permits and transfers pose risks to those water rights due, in part, to the opportunity for third parties to protest the extensions. There is some risk that these processes could result in the imposition of restrictive conditions or denial of the requested extensions.

Option 3 (Hybrid Option) provides an approach to meeting the Partners' near-term and long-term goals without jeopardizing any of the Partners' water rights. In the near term, Option 3 provides a method for the Partner Cities to initiate a shared water supply strategy. It then changes relatively quickly to reset the relationship with the MWC, which would then provide surplus water supply to the Partner Cities. In addition, the Partners would pool their water rights to establish a diverse water rights portfolio. Option 3 also minimizes water rights transactions, such as extensions of time for permits and transfers, and decreases the risks associated with these transactions.

6. Next Steps

Establishing a water sharing agreement will require completing a series of steps or actions. The following is a brief summary of some of the actions that will be required:

- MWC Staff will need to discuss governance structures and IGA approaches and components with the MWC Board for preliminary approval to move forward with Partner Cities.
- Staff will need to discuss governance structures and IGA approaches and components with their city councils/board.
- As part of the communications with councils/boards, staff would seek approval to develop a scope of work to develop an IGA. The IGA would be built on the framework and principles of the initial IGA that formed the Partners' cooperative agreement, including the following:
  - Coordinating a water right and water supply strategy will improve the current and long-term reliability of individual and collective water supplies and is in the highest public interest.
  - Providing reliable sources of water to all of the Partners' respective customers for public health, safety and welfare, and for sustaining economic development is of vital importance.
  - Recognizing the important role each utility plays in meeting the water supply needs of the Rogue Valley Region.
- Develop the scope of work for drafting the IGA and take the scope of work to city councils/board for approval.
- A draft IGA will need to be developed and agreed to by staff.
- Staff will need to take the draft IGA to their city councils/board for review and approval.

Summary Table for Partners' Water Rights at Duff Water Treatment Plant

Application	Permit	Certificate	Transfer	Source(s)	Priority Date	Development Deadlines	Type of Beneficial Use	Maximum Rate (cfs)	Maximum Volume (AF)	Period Of Use	Conditions	Status
Ashland												
S-85733	S-54337	--	--	Lost Creek Reservoir	8/11/2003	9/7/2021	Municipal	*No rate*	1,000	Year-round	• Submit WMCP within 3 years of issuance • Install measuring device • Install fish screen/by-pass • Shall not obstruct fish passage without contacting ODFW	In permit status
							Total	**N/A**	**1,000**			
Central Point												
N/A	N/A	~~32748~~	T-9900	Rogue River	9/22/1888	10-01-2030	Municipal	1.846	666.0	April 1 – Nov. 1	• Install measuring device • Install fish screen/by-pass	In transfer status (extended to 2030)
N/A	N/A	~~32742~~										
N/A	N/A	~~32746~~										
N/A	N/A	~~32728~~										
E-194	E-19	93754	~~T-10120~~	North & South Forks Little Butte Creek	7/23/1909	N/A	Municipal & Industrial	1.13	*No duty*	April 1 – Oct. 1	• Install measuring device • Install fish screen/by-pass	Certificated right
S-589	S-407	93755	~~T-10120~~	Four Mile Lake and Fish Lake Reservoirs	3/31/1910	N/A	Municipal & Industrial	1.13	*No duty*	April 1 – Oct. 1	• Install measuring device • Install fish screen/by-pass	Certificated right
N/A	N/A	~~80566~~	T-10465	North & South Forks Little Butte Creek	9/14/1899	10-01-2014	Municipal	1.20	447.6	April 1 – Oct. 1	• Install measuring device • Install fish screen/by-pass	Transfer with COBU pending
N/A	N/A	~~80567~~			9/14/1899							
E-194	E-19	~~80569~~			7/23/1909							
S-589	S-407	~~80571~~		Four Mile Lake Reservoir, waters draining into Cascade Canal, and Fish Lake Reservoir	3/31/1910							
S-3036	S-1705	~~80574~~		Antelope Creek	6/24/1913							
							Total	**5.306**	**1113.6**			

Summary Table for Partners' Water Rights at Duff Water Treatment Plant (cont.)

Application	Permit	Certificate	Transfer	Source(s)	Priority Date	Development Deadlines	Type of Beneficial Use	Maximum Rate (cfs)	Maximum Volume (AF)	Period Of Use	Conditions	Status
Eagle Point												
S-589	S-407	88552	~~T-9973~~	Four Mile Lake & Fish Lake Reservoirs	3/31/1910	N/A	Municipal	0.90	321.3	April 1 – Oct. 31	• Install measuring device • Install fish screen/by-pass	Certificated right
S-589	S-407	~~83263~~	T-10527	Four Mile Lake Reservoir & waters draining into Cascade Canal & Fish Lake Reservoir	3/31/1910	10-01-2013	Municipal	0.50	181.5	April 1 – Oct. 31	• Install fish screen/by-pass	Transfer with COBU pending
S-589	S-407	~~84949~~	T-10614	Four Mile Lake Reservoir & waters draining into Cascade Canal & Fish Lake Reservoir	3/31/1910	10-01-2030	Municipal	1.15	273.7	April 1 – Oct. 31	• Install measuring device • Install fish screen/by-pass	In transfer status (extended to 2030)
E-194	E-19	~~83381~~	T-10960	North & South Fork Little Butte Creeks	7/23/1909	10/1/2030	Municipal	1.77	520.3	April 1 – Oct. 1	• Operate measuring device • Install fish screen/by-pass	In transfer status (extended to 2030)
S-589	S-407	~~83383~~		Four Mile Lake Reservoir, waters draining into Cascade Canal, and Fish Lake Reservoir	3/31/1910					April 1 – Oct. 31		
S-589	S-407	89864	~~T-10160~~	Four Mile Lake Reservoir, waters draining into Cascade Canal and Fish Lake Reservoir	3/31/1910	N/A	Municipal	1.25	356.94	April 1 – Oct. 31	• Install measuring device • Install fish screen/by-pass	Certificated right
E-194	E-19	~~83381~~	T-12221	North & South Forks Little Butte Creek	7/23/1909	10/1/2030	Municipal	0.70	207.2	April 1 – Oct. 1	• Operate approved fish screen	In transfer status
S-589	S-407	~~83383~~		Four Mile Lake Reservoir & waters draining into Cascade Canal & Fish Lake Reservoir	3/31/1910					April 1 – Oct. 31		
							Total	**6.27**	**1860.94**			
Jacksonville												
S-80641	S-53445	87360	--	Lost Creek Reservoir	10/10/1995	N/A	Municipal	*No rate*	400.0	Year-round	• Install fish screen/by-pass	Certificated right
S-88088	S-54974	--	--	Lost Creek Reservoir	5/21/2015	11/19/2035	Municipal	*No rate*	200.0	May 1 – Sept. 1	• Install measuring device • Install fish screen and passage	In permit status
							Total	**N/A**	**600**			

Summary Table for Partners' Water Rights at Duff Water Treatment Plant (cont.)

Application	Permit	Certificate	Transfer	Source(s)	Priority Date	Development Deadlines	Type of Beneficial Use	Maximum Rate (cfs)	Maximum Volume (AF)	Period Of Use	Conditions	Status
Medford Water Commission												
S-29527	S-23210	86832	--	Rogue River	10/22/1954	N/A	Municipal	60.85	*No duty*	Year-round		Certificated right
S-29257	S-23210	--	--	Rogue River	10/22/1954	10/1/2050	Municipal	39.15	*No duty*	Year-round	• "Fish persistence" conditions • MWC currently has access to 7.5 cfs	In permit status
S-10120	S-54935	--	Permit amendment T-11916	"Big Butte Creek, the springs and all tributaries thereof"	5/28/1925	10/1/2056	Municipal	*"All remaining unappropriated waters of Big Butte Creek…" (50 cfs)*	*No duty*	Year-round	• Install measuring device • Install fish screen • MWC currently has access to 3.1 cfs	In permit status
							Total	**~ 150**	**N/A**			
Phoenix												
S-60890	S-47672	--	--	Lost Creek Reservoir	10/9/1980	10-01-2001 COBU on hold	Municipal	5.00	400.0	Year-round		In permit status with COBU pending (currently on hold)
S-71996	S-52650	--	--	Lost Creek Reservoir	11/15/1991	10/1/2030	Municipal	3.10	600.0	Year-round	• Access to water beyond 516.27 AF must be authorized through an approved WMCP. • Install measuring device • Install fish screen	In permit status
							Total	**8.1**	**1,000**			
Talent												
S-84029	S-53898	--	--	Lost Creek Reservoir	12/28/1998	10-01-2065	Municipal	*No rate*	759.0	May 1 – Oct. 31	• Access to water must be authorized through an approved WMCP. • Install measuring device • Install fish screen/by-pass • Shall not obstruct fish passage without contacting ODFW	In permit status
S-84029	S-53898	91134	--	Lost Creek Reservoir	12/28/1998	N/A	Municipal	*No rate*	533.0	May 1 – Oct. 31	• Install measuring device • Install fish screen • Shall not obstruct fish passage without contacting ODFW	Certificated right
							Total	**N/A**	**1,292**			

GSI Water Solutions, Inc.

Memorandum

To: Partner Water Providers

Cc: Adam Sussman (GSI); Kim Grigsby (GSI)

From: Ronan Igloria

Date: August 5, 2019

Re: **Water Demand Projections of Partner Water Providers for Water Rights Strategy -**

Medford Water Commission (MWC) contracted with GSI Water Solutions, Inc. (GSI) to develop a water rights strategy for the "Partner Water Providers" (Partners). The Partners include MWC and the Cities of Ashland, Central Point, Eagle Point, Jacksonville, Phoenix, and Talent. This memo summarizes the consolidated water demand projections from each of the Partners, which will be compared against anticipated water supply to develop a water rights and supply strategy in a future deliverable.

Approach

As an initial step for developing the consolidated demand projections, GSI obtained the most recent water demand projections from each of the Partners. GSI extended the demand projections for each Partner to a common planning period (2020 to 2070) by assuming the demand growth rate of the last year in the original demand projection continues to year 2070. For the most part, this approach maintains consistency with the methods and assumptions used by each Partner in developing the original demands. These methods generally involved a per capita water use factor, population served under an assumed growth rate, and peaking factor relating average day and maximum day demands. GSI did not analyze or update the historical water use, population growth, and water use factors defined by each Partner. The original demand projections that did not provide a low, medium and high projected demand were assumed to correspond to a "medium" demand growth scenario for each Partner. A "low" and "high" demand growth scenario were then established relative to the medium demand growth rate for those Partners.

Reference Documents

Existing water demand projections were compiled from available planning documents dated 2013 to 2018. The only exception is Central Point, which provided relevant data directly for use in this analysis because the City is currently working on its demand projections. Table 1 provides a summary of the primary planning documents or references used to consolidate and align the various demand projections.

Table 1. Summary of Water Demand Projection Reference Documents

Partner	Demand Planning Period	Planning Document (and year completed)
Ashland	2017-2037	Water Master Plan (2016-Draft)
Central Point	Not applicable	Data provided directly by Central Point (2019)
Eagle Point	Not applicable	Data provided directly by Eagle Point (2019)
Jacksonville	2011-2033	Water System Master Plan (2013)
MWC*	2015-2060	Water Management and Conservation Plan (2017)
Phoenix	2018-2040	Water Management and Conservation Plan (Dec. 2018)
Talent	2018-2040	Water Master Plan Update (Dec. 2018)

** MWC water service area includes City of Medford, White City and water districts adjacent to City of Medford (as delineated in the 2017 MWC WMCP).*

Table 2 summarizes the water use factors derived from the last year of the existing demand projections. These factors were assumed to be consistent through the extended planning period (2070).

Table 2. Summary of Water Use Factors

Partner	Per Capita ADD Water Use Factor (gallons per day)	Peaking Factor (MDD:ADD)
Ashland[1]	139	2.04
Central Point	140	2.50
Eagle Point	177	2.49
Jacksonville	220	2.34
MWC[2]	243	2.00
Phoenix[3]	155 to 160	2.60 to 3.00
Talent	122	2.60 to 2.72

[1] Per capita ADD derived from 208 gpd/ERU presented in 2016 WMCP assuming 1.5 persons per ERU.
[2] Effective value accounting for per capita water use by City of Medford, White City and water districts.
[3]Per capita ADD derived from 270-280 gpd/ERU presented in 2018 WMCP assuming 1.7 persons per ERU.

Demand Scenarios

The Partners requested that GSI extend the demand projections to a 50-year planning period, i.e. 2020 to 2070, and develop low, medium and high demand scenarios for the extended projections. The original demand projections for Cities of Talent and Phoenix included "low," "average," and "high" demand scenarios. GSI extended these two Cities' scenarios from their current planning period to 2070 using the demand growth rates assumed at the end of the original 2040 planning periods. The other Cities had only one demand projection scenario, which was assumed to be the "medium" growth scenario in this analysis. GSI developed high demand scenarios with an incremental increase in the demand growth rate percentage for the medium scenario. GSI established low demand scenarios with an incremental reduction in the demand growth rate percentage for the medium scenario. Table 3 provides a description of the growth rates and how they were established. In general, the magnitude of the incremental increase or decrease used for the high and low demand scenarios was proportional to the magnitude of the medium demand growth rate, and was assumed to be "normally distributed" (same incremental change for high and for low) unless the City provided initial feedback to GSI that the low and high percent change increments should be "skewed."

Ashland receives supplemental water supply from MWC to help meet peaking demands. For Ashland, the demand from MWC supplies is based on the existing intergovernmental agreement (IGA), which allows Ashland to receive 2.13 mgd as an average supply. Based on the IGA, GSI assumed that the 2.13 mgd corresponds to the ADD demand. Low and high scenarios were not defined for Ashland. In the future, Ashland can request up to a total of 3.0 mgd by paying future SDC rates on remaining 0.87 mgd.

Table 3 summarizes the "low," "medium," and "high" demand scenario assumptions applied for each Partner. Because the ADD:MDD peaking factors were assumed to remain constant through the planning period, the percent increase in demand growth for the low, medium, and high demand scenario are the same for ADD and MDD.

Table 3. Summary of Annual Percent Increase in Demand Used to Define Low, Medium and High Demand Scenarios for Each Partner

Partner (City)	Low	Medium	High	Notes
Ashland	Not Applicable			Assumed current IGA terms apply for the 50-year planning period (2.1 mgd ADD; 3.0 mgd MDD).
Central Point	1.15%	1.40%	1.65%	1.4% demand growth obtained from original demand projection. Low and high scenarios decreased or increased this rate by 0.25%.
Eagle Point	0.75%	1.00%	1.30%	1.0% medium demand growth assumption provided by City in email communication on July 3, 2019. Low and high scenarios of 0.75% and 1.3%, were also provided by the City.
Jacksonville	0.90%	1.40%	1.65%	1.4% demand growth used in original demand projection. The growth rate for the high scenario was increased by only 0.25% compared to a reduction of 0.5% for the low scenario, because the City does not anticipate a UGB expansion during the planning period, which likely minimizes the potential for greater rate of demand growth.
MWC	1.0% to 0.5%	1.2% to 0.7%	1.4% to 0.9%	Demand growth assumed in the demand projection from 2017 WMCP changes over time (decreases over the planning period from 1.2% to 0.7%). The growth rate was increased by 0.2% for the high demand scenario, and decreased by 0.2% for the low demand scenario.
Phoenix	0.60%	1.60%	2.20%	Range of growth rates based on scenarios in original demand projection.
Talent	1.20%	1.30%	1.50%	Range of growth rates based on scenarios in original demand projection.

Results

Tables 4 and 5 present summaries of ADD and MDD projections, respectively, for the Partners for the milestone years between 2020 and 2070 under the medium scenario.

Table 4. ADD Projections for Partner Water Providers (Medium Scenario) (mgd)

Partner	2020 (present)	2030 (10 years)	2040 (20 years)	2070 (50 years)
Ashland	2.10	2.10	2.10	2.10
Central Point	2.84	3.30	3.85	5.92
Eagle Point	1.64	1.82	2.01	2.70
Jacksonville	0.70	0.80	0.92	1.40
MWC*	23.6	26.38	29.26	36.38
Phoenix	0.79	0.93	1.10	1.78
Talent	0.81	0.92	1.06	1.58
Total	**32.5**	**36.3**	**40.3**	**51.8**

** MWC water service area includes City of Medford, White City and water districts adjacent to City of Medford (as delineated in the 2017 MWC WMCP).*

Table 5. MDD Projections for Partner Water Providers (Medium Scenario) (mgd)

Partner	2020 (present)	2030 (10 years)	2040 (20 years)	2070 (50 years)
Ashland	3.00	3.00	3.00	3.00
Central Point	7.20	8.37	9.76	15.01
Eagle Point	4.10	4.52	5.00	6.74
Jacksonville	1.64	1.88	2.16	3.28
MWC*	48.10	53.53	59.16	73.08
Phoenix	2.23	2.63	3.13	5.07
Talent	2.16	2.45	2.82	4.21
Total	**68.4**	**76.4**	**85.0**	**110.4**

** MWC water service area includes City of Medford, White City and water districts adjacent to City of Medford (as delineated in the 2017 MWC WMCP).*

Figure 1 shows the total ADD and MDD for all Partners for the three demand scenarios (low, medium, and high).

As shown in Figure 1 the total projected ADD ranges from 38.1 to 42.0 mgd in year 2040, and from 45.5 to 57.5 mgd in year 2070, based on the three scenarios. The total MDD ranges from 80.4 to 89.7 mgd in year 2040, and from 96.8 to 125.0 mgd in year 2070, based on these scenarios.

Figure 2 illustrates the proportion of the total water demand for each Partner over the planning period under the medium scenario. Attachment A includes plots of the demand projection scenarios of ADD and MDD for each Partner. Attachment B includes the corresponding tabulated annual water demand projections for each Partner under each scenario.

Figure 1. Total Average Day and Maximum Day Demand Scenarios for Partners

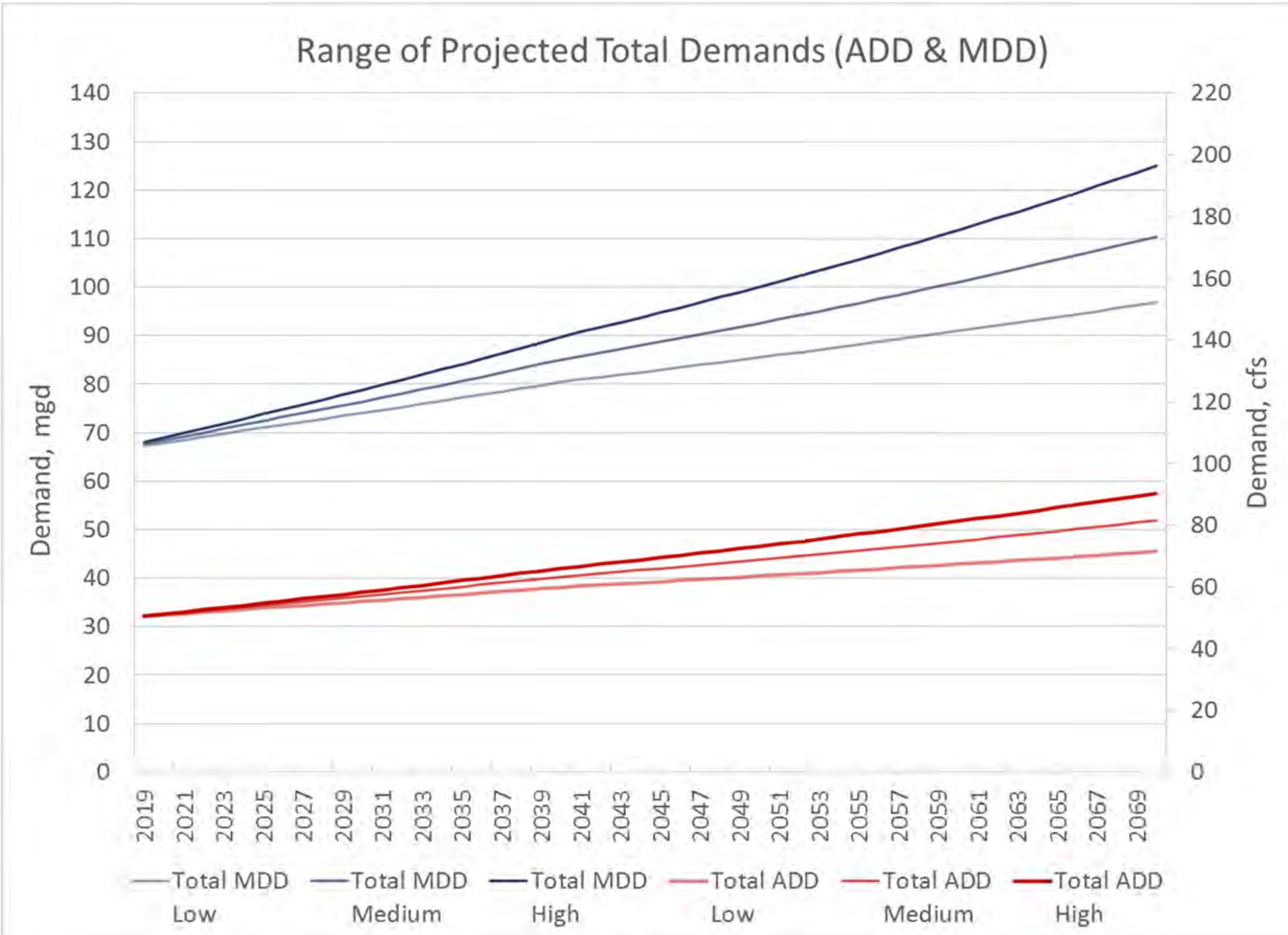
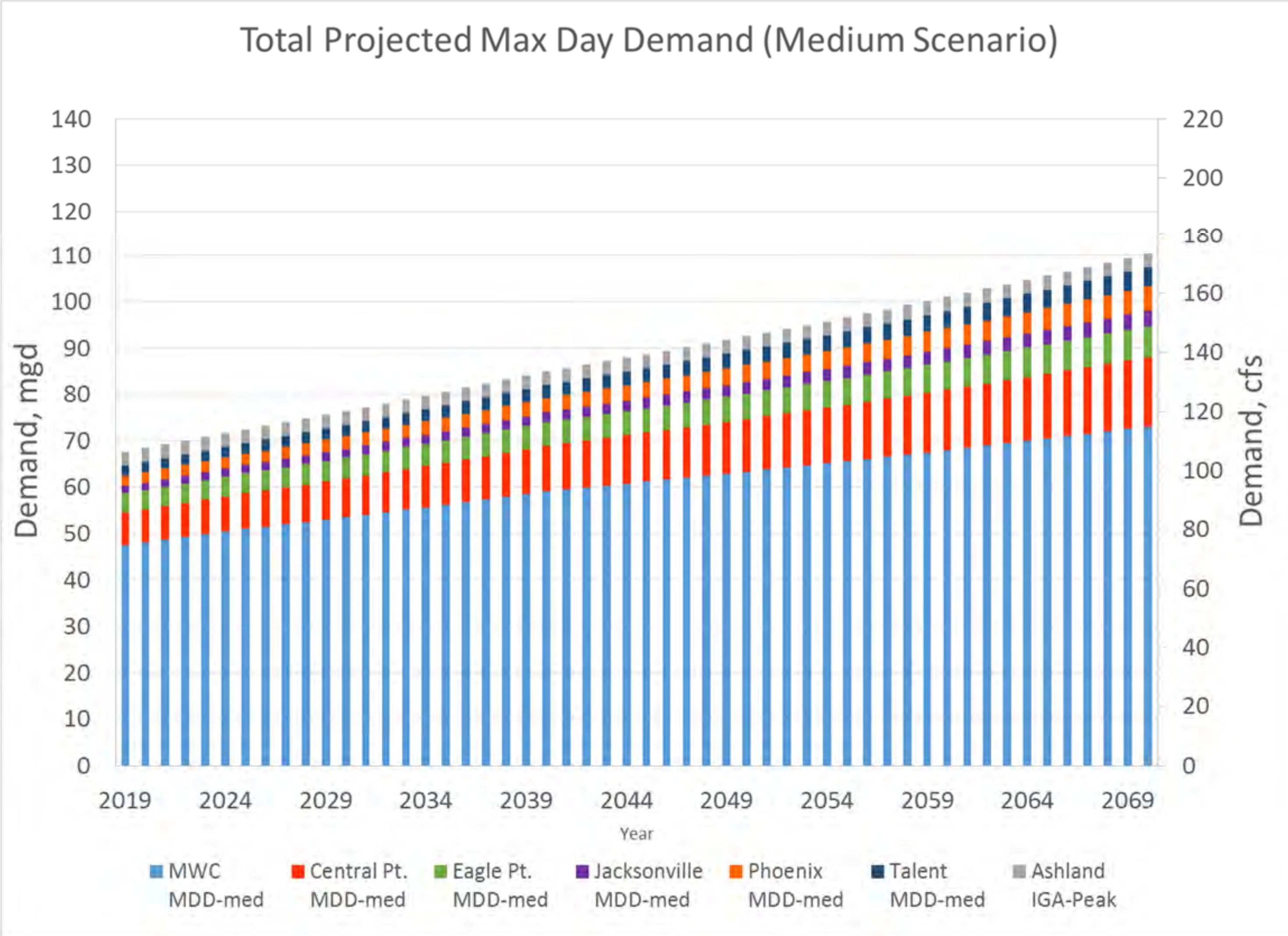
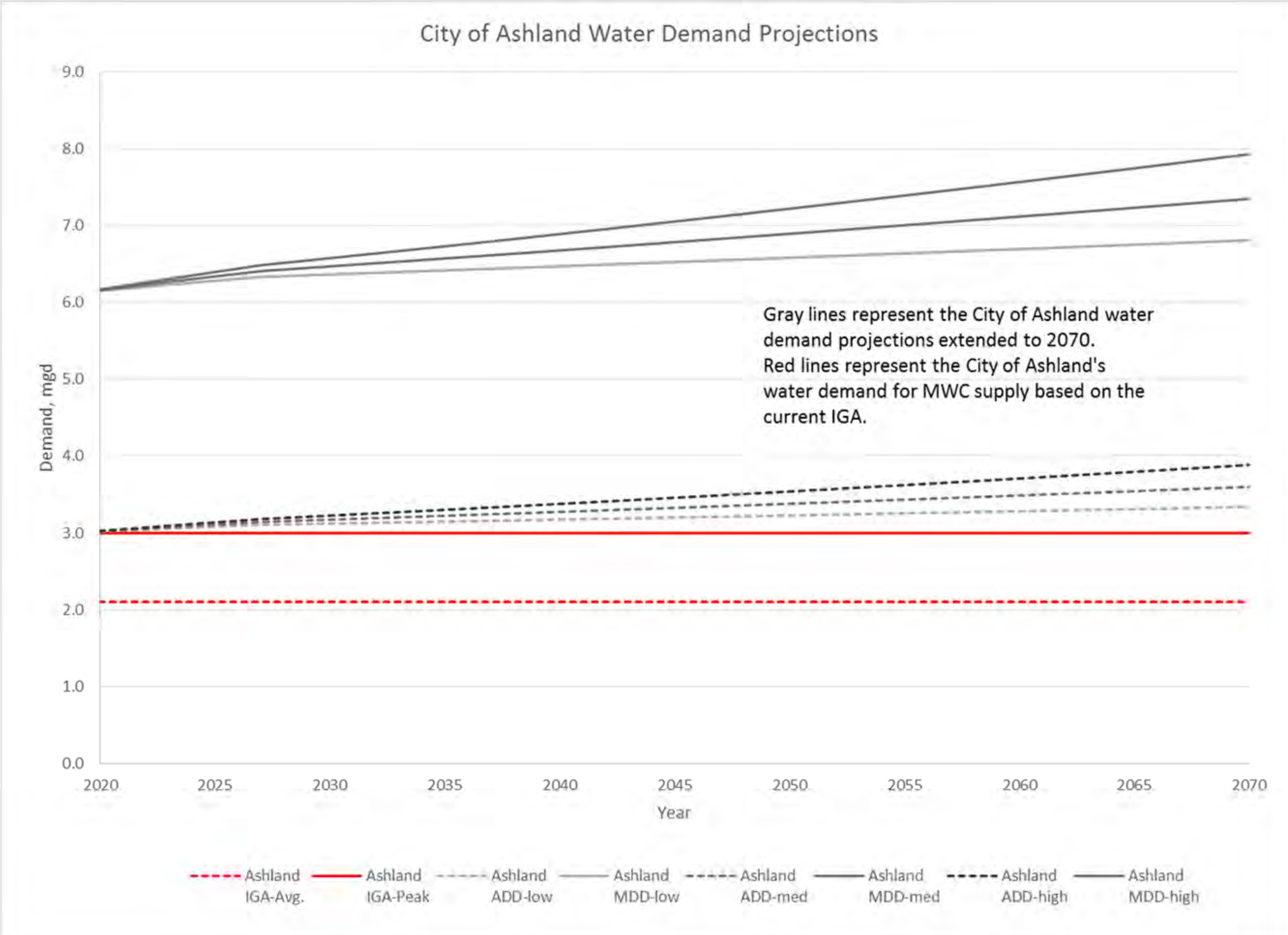
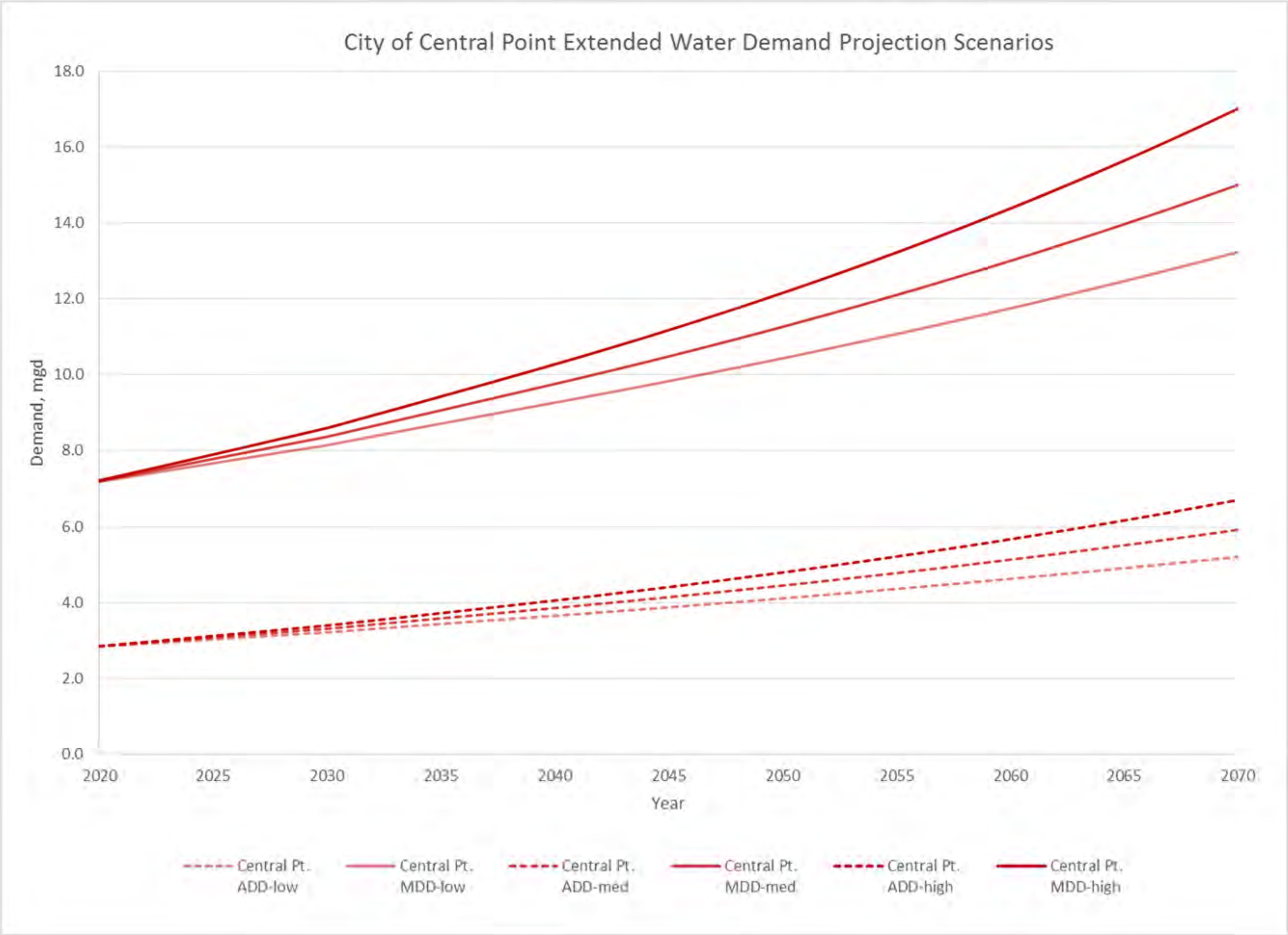


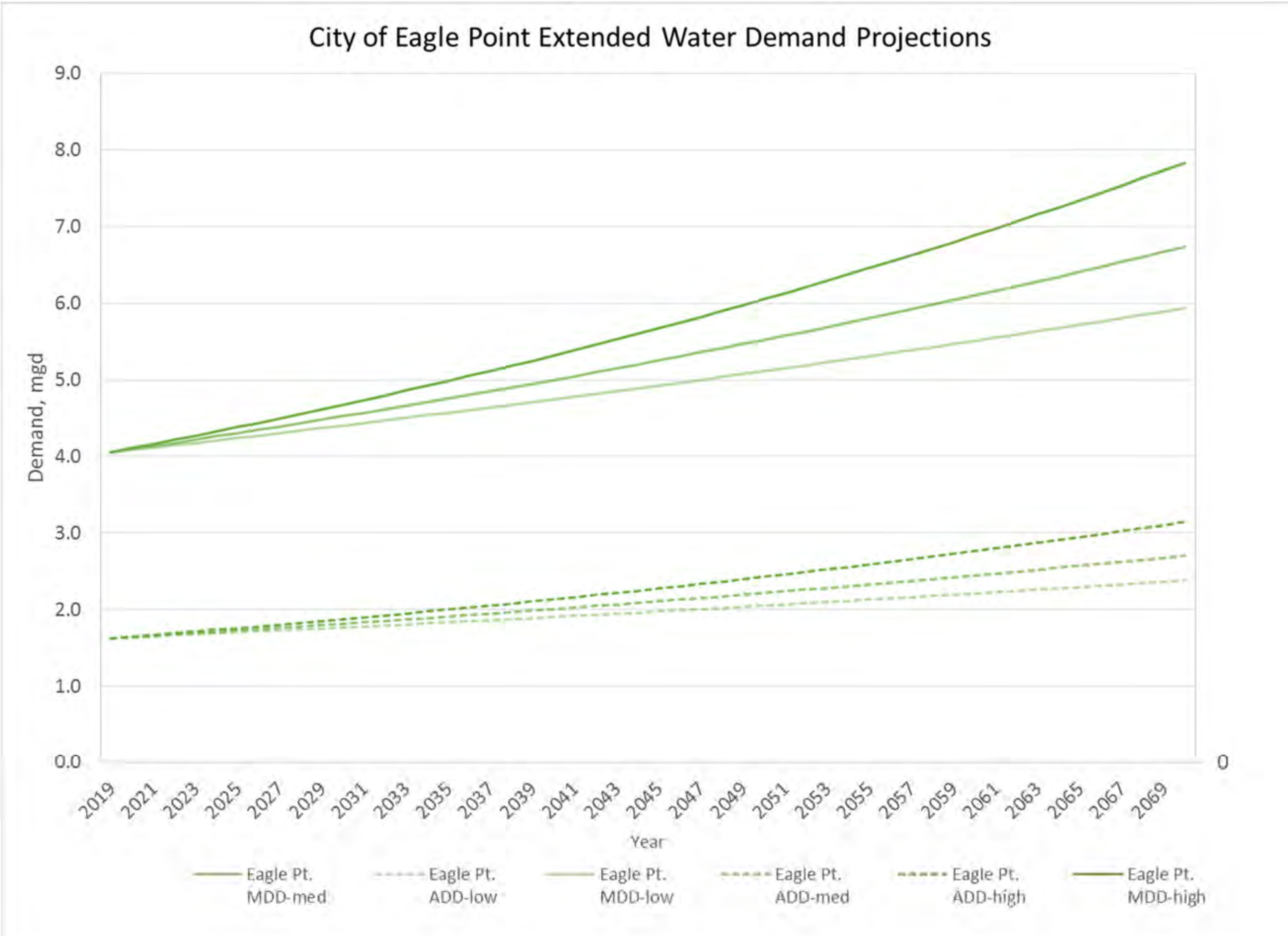
Figure 2. Cumulative Maximum Day Demand (Medium Scenario) for Partner Water Providers

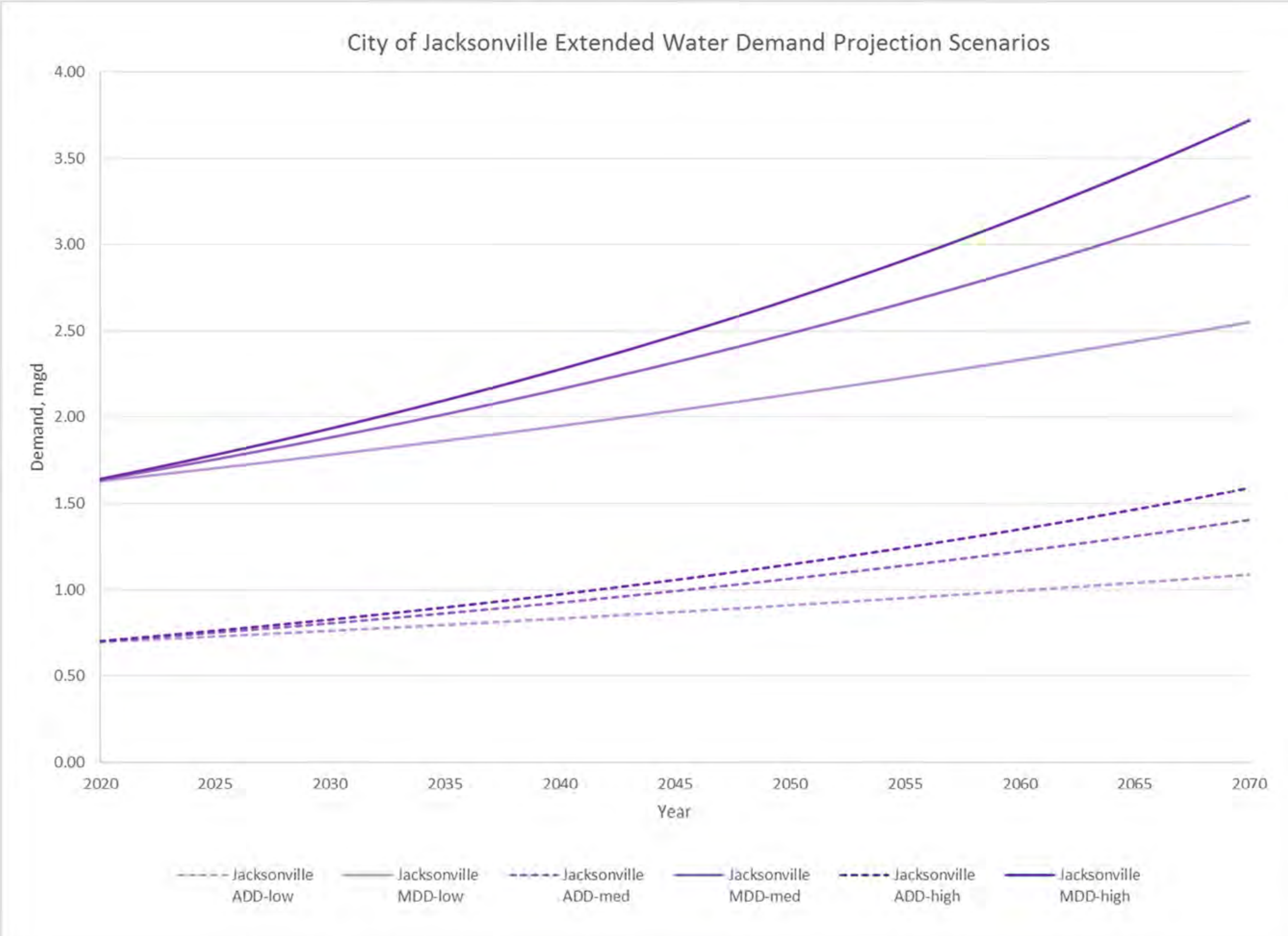


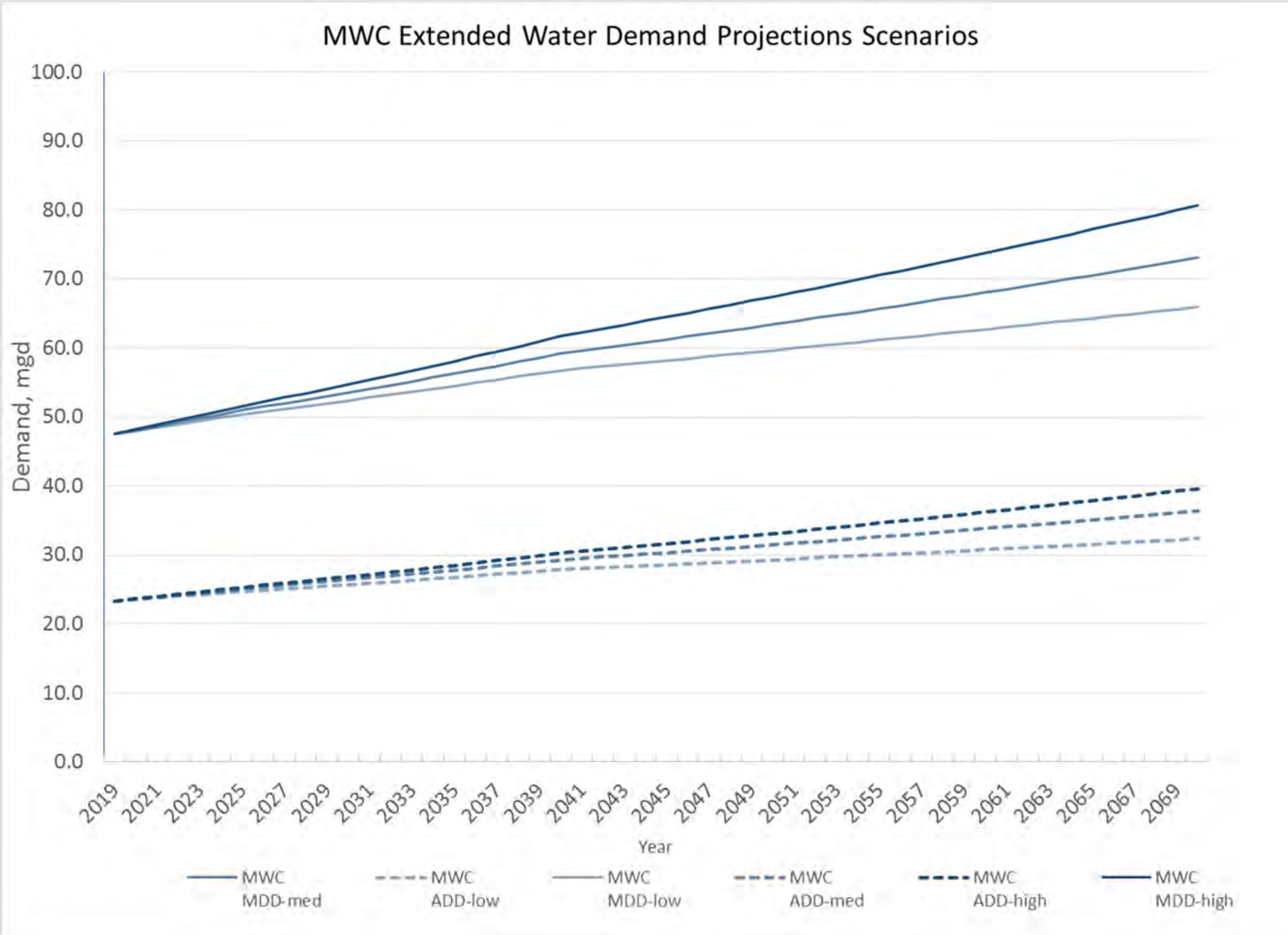
Attachment A
Plots of ADD and MDD Scenarios for Each Partner

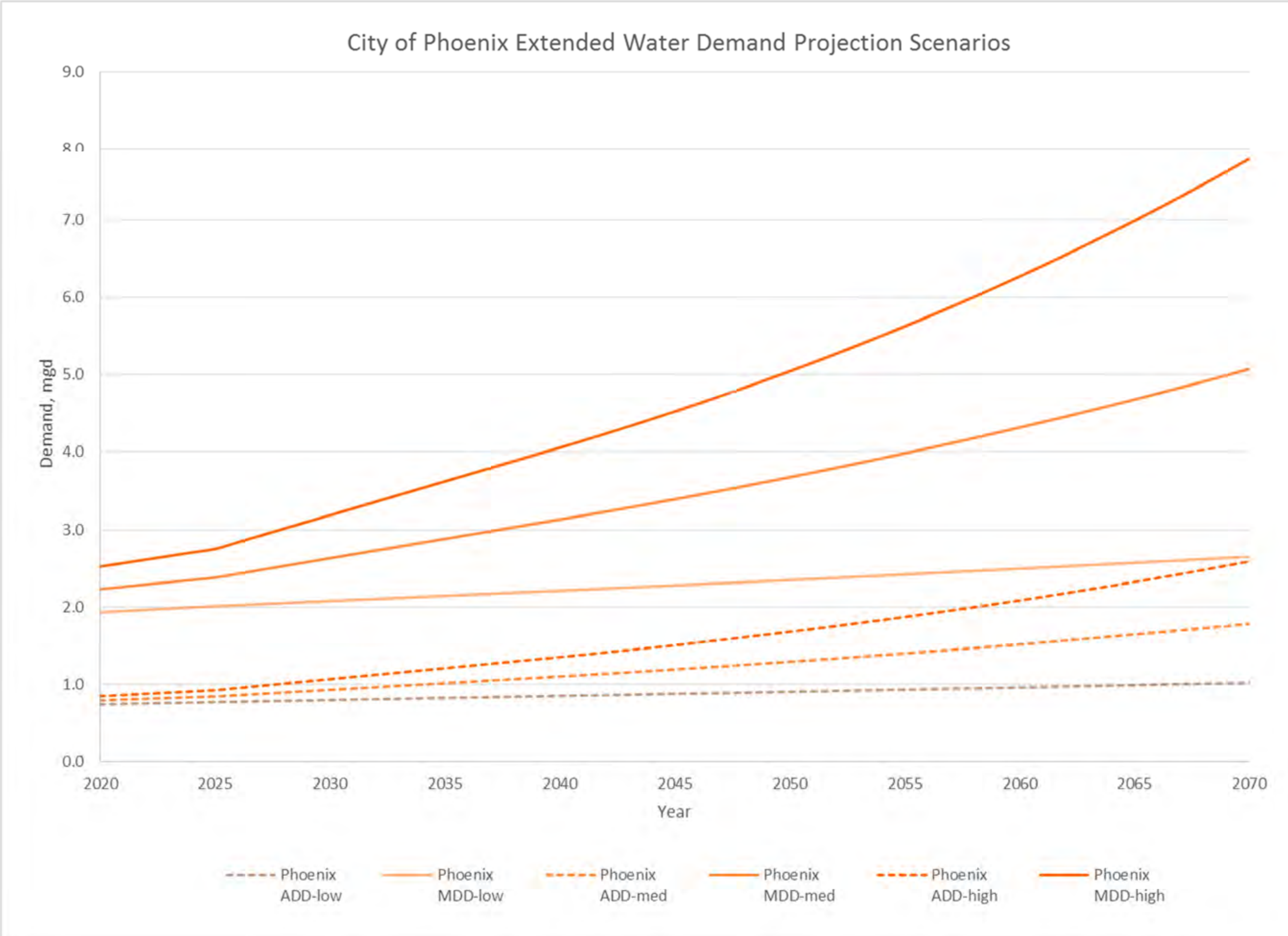

City of Ashland Water Demand Projections
Demand, mgd
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
2020
2025
2030
2035
2040
2045
2050
2055
2060
2065
2070
Year
Gray lines represent the City of Ashland water demand projections extended to 2070.
Red lines represent the City of Ashland's water demand for MWC supply based on the current IGA.
Ashland IGA-Avg.
Ashland IGA-Peak
Ashland ADD-low
Ashland MDD-low
Ashland ADD-med
Ashland MDD-med
Ashland ADD-high
Ashland MDD-high

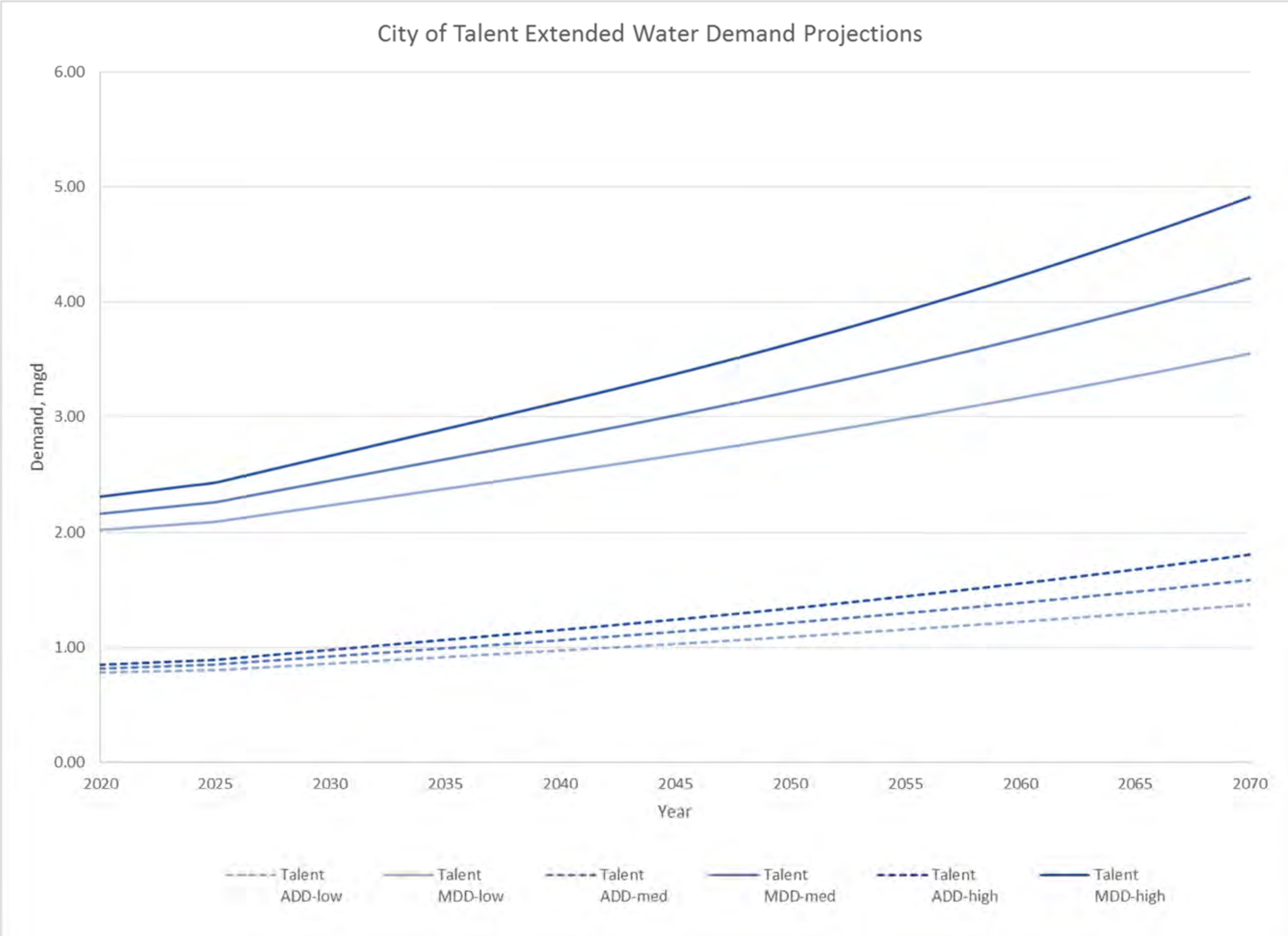

City of Central Point Extended Water Demand Projection Scenarios
Demand, mgd
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
2020
2025
2030
2035
2040
2045
2050
2055
2060
2065
2070
Year
Central Pt. ADD-low
Central Pt. MDD-low
Central Pt. ADD-med
Central Pt. MDD-med
Central Pt. ADD-high
Central Pt. MDD-high


City of Eagle Point Extended Water Demand Projections
Demand, mgd
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
0
2019
2021
2023
2025
2027
2029
2031
2033
2035
2037
2039
2041
2043
2045
2047
2049
2051
2053
2055
2057
2059
2061
2063
2065
2067
2069
Year
Eagle Pt. MDD-med
Eagle Pt. ADD-low
Eagle Pt. MDD-low
Eagle Pt. ADD-med
Eagle Pt. ADD-high
Eagle Pt. MDD-high


City of Jacksonville Extended Water Demand Projection Scenarios
Demand, mgd
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
2020
2025
2030
2035
2040
2045
2050
2055
2060
2065
2070
Year
Jacksonville ADD-low
Jacksonville MDD-low
Jacksonville ADD-med
Jacksonville MDD-med
Jacksonville ADD-high
Jacksonville MDD-high


MWC Extended Water Demand Projections Scenarios
Demand, mgd
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
2019
2021
2023
2025
2027
2029
2031
2033
2035
2037
2039
2041
2043
2045
2047
2049
2051
2053
2055
2057
2059
2061
2063
2065
2067
2069
Year
MWC MDD-med
MWC ADD-low
MWC MDD-low
MWC ADD-med
MWC ADD-high
MWC MDD-high


City of Phoenix Extended Water Demand Projection Scenarios
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Demand, mgd
2020
2025
2030
2035
2040
2045
2050
2055
2060
2065
2070
Year
Phoenix ADD-low
Phoenix MDD-low
Phoenix ADD-med
Phoenix MDD-med
Phoenix ADD-high
Phoenix MDD-high


City of Talent Extended Water Demand Projections
Demand, mgd
6.00
5.00
4.00
3.00
2.00
1.00
0.00
2020
2025
2030
2035
2040
2045
2050
2055
2060
2065
2070
Year
Talent ADD-low
Talent MDD-low
Talent ADD-med
Talent MDD-med
Talent ADD-high
Talent MDD-high

Attachment B

Tabulated Water Demands for Each Partner

Italicized/blue font in the table represents years that were extended beyond the most recent demand projection available.

	Ashland						-0.15%	-0.15%	0.15%	0.15%
Year	**Ashland IGA-Avg.**	**Ashland IGA-Peak**	Ashland ADD-med	Ashland MDD-med	Medium PF	Medium % growth	Ashland ADD-low	Ashland MDD-low	Ashland ADD-high	Ashland MDD-high
2019	**2.10**	**3.00**	3.01	6.13	2.04		3.01	6.13	3.01	6.13
2020	**2.10**	**3.00**	3.02	6.16	2.04	0.6%	3.02	6.15	3.03	6.17
2021	**2.10**	**3.00**	3.04	6.20	2.04	0.6%	3.03	6.18	3.05	6.22
2022	**2.10**	**3.00**	3.06	6.23	2.04	0.6%	3.04	6.21	3.07	6.26
2023	**2.10**	**3.00**	3.08	6.27	2.04	0.6%	3.06	6.23	3.09	6.31
2024	**2.10**	**3.00**	3.09	6.31	2.04	0.6%	3.07	6.26	3.12	6.35
2025	**2.10**	**3.00**	3.11	6.34	2.04	0.5%	3.08	6.28	3.14	6.40
2026	**2.10**	**3.00**	3.13	6.37	2.04	0.5%	3.09	6.31	3.16	6.44
2027	**2.10**	**3.00**	3.14	6.41	2.04	0.5%	3.11	6.33	3.18	6.49
2028	**2.10**	**3.00**	3.15	6.43	2.04	0.3%	3.11	6.34	3.20	6.52
2029	**2.10**	**3.00**	3.16	6.45	2.04	0.3%	3.12	6.36	3.21	6.55
2030	**2.10**	**3.00**	3.17	6.47	2.04	0.3%	3.12	6.37	3.23	6.58
2031	**2.10**	**3.00**	3.18	6.49	2.04	0.3%	3.13	6.38	3.24	6.61
2032	**2.10**	**3.00**	3.19	6.51	2.04	0.3%	3.13	6.39	3.26	6.64
2033	**2.10**	**3.00**	3.20	6.53	2.04	0.3%	3.14	6.40	3.27	6.67
2034	**2.10**	**3.00**	3.22	6.55	2.04	0.3%	3.14	6.41	3.29	6.70
2035	**2.10**	**3.00**	3.23	6.57	2.04	0.3%	3.15	6.42	3.30	6.73
2036	**2.10**	**3.00**	3.24	6.59	2.04	0.3%	3.15	6.43	3.32	6.76
2037	**2.10**	**3.00**	3.25	6.62	2.04	0.3%	3.16	6.44	3.33	6.80
2038	***2.10***	***3.00***	*3.26*	*6.64*	*2.04*	*0.3%*	*3.16*	*6.45*	*3.35*	*6.83*
2039	***2.10***	***3.00***	*3.27*	*6.66*	*2.04*	*0.3%*	*3.17*	*6.46*	*3.36*	*6.86*
2040	***2.10***	***3.00***	*3.28*	*6.68*	*2.04*	*0.3%*	*3.17*	*6.47*	*3.38*	*6.89*
2041	*2.10*	*3.00*	*3.29*	*6.70*	*2.04*	*0.3%*	*3.18*	*6.48*	*3.40*	*6.92*
2042	*2.10*	*3.00*	*3.30*	*6.72*	*2.04*	*0.3%*	*3.19*	*6.49*	*3.41*	*6.96*
2043	*2.10*	*3.00*	*3.31*	*6.74*	*2.04*	*0.3%*	*3.19*	*6.51*	*3.43*	*6.99*
2044	*2.10*	*3.00*	*3.32*	*6.76*	*2.04*	*0.3%*	*3.20*	*6.52*	*3.44*	*7.02*
2045	*2.10*	*3.00*	*3.33*	*6.79*	*2.04*	*0.3%*	*3.20*	*6.53*	*3.46*	*7.06*
2046	*2.10*	*3.00*	*3.34*	*6.81*	*2.04*	*0.3%*	*3.21*	*6.54*	*3.48*	*7.09*
2047	*2.10*	*3.00*	*3.35*	*6.83*	*2.04*	*0.3%*	*3.21*	*6.55*	*3.49*	*7.12*
2048	*2.10*	*3.00*	*3.36*	*6.85*	*2.04*	*0.3%*	*3.22*	*6.56*	*3.51*	*7.16*
2049	*2.10*	*3.00*	*3.37*	*6.87*	*2.04*	*0.3%*	*3.22*	*6.57*	*3.53*	*7.19*
2050	*2.10*	*3.00*	*3.38*	*6.90*	*2.04*	*0.3%*	*3.23*	*6.58*	*3.54*	*7.22*
2051	*2.10*	*3.00*	*3.39*	*6.92*	*2.04*	*0.3%*	*3.23*	*6.59*	*3.56*	*7.26*
2052	*2.10*	*3.00*	*3.41*	*6.94*	*2.04*	*0.3%*	*3.24*	*6.61*	*3.58*	*7.29*
2053	*2.10*	*3.00*	*3.42*	*6.96*	*2.04*	*0.3%*	*3.25*	*6.62*	*3.59*	*7.32*
2054	*2.10*	*3.00*	*3.43*	*6.98*	*2.04*	*0.3%*	*3.25*	*6.63*	*3.61*	*7.36*
2055	*2.10*	*3.00*	*3.44*	*7.01*	*2.04*	*0.3%*	*3.26*	*6.64*	*3.63*	*7.39*
2056	*2.10*	*3.00*	*3.45*	*7.03*	*2.04*	*0.3%*	*3.26*	*6.65*	*3.64*	*7.43*
2057	*2.10*	*3.00*	*3.46*	*7.05*	*2.04*	*0.3%*	*3.27*	*6.66*	*3.66*	*7.46*
2058	*2.10*	*3.00*	*3.47*	*7.07*	*2.04*	*0.3%*	*3.27*	*6.67*	*3.68*	*7.50*
2059	*2.10*	*3.00*	*3.48*	*7.10*	*2.04*	*0.3%*	*3.28*	*6.68*	*3.70*	*7.53*
2060	*2.10*	*3.00*	*3.49*	*7.12*	*2.04*	*0.3%*	*3.28*	*6.70*	*3.71*	*7.57*
2061	*2.10*	*3.00*	*3.50*	*7.14*	*2.04*	*0.3%*	*3.29*	*6.71*	*3.73*	*7.60*
2062	*2.10*	*3.00*	*3.52*	*7.17*	*2.04*	*0.3%*	*3.30*	*6.72*	*3.75*	*7.64*
2063	*2.10*	*3.00*	*3.53*	*7.19*	*2.04*	*0.3%*	*3.30*	*6.73*	*3.77*	*7.68*
2064	*2.10*	*3.00*	*3.54*	*7.21*	*2.04*	*0.3%*	*3.31*	*6.74*	*3.78*	*7.71*
2065	*2.10*	*3.00*	*3.55*	*7.23*	*2.04*	*0.3%*	*3.31*	*6.75*	*3.80*	*7.75*
2066	*2.10*	*3.00*	*3.56*	*7.26*	*2.04*	*0.3%*	*3.32*	*6.76*	*3.82*	*7.79*
2067	*2.10*	*3.00*	*3.57*	*7.28*	*2.04*	*0.3%*	*3.32*	*6.78*	*3.84*	*7.82*
2068	*2.10*	*3.00*	*3.58*	*7.30*	*2.04*	*0.3%*	*3.33*	*6.79*	*3.85*	*7.86*
2069	*2.10*	*3.00*	*3.60*	*7.33*	*2.04*	*0.3%*	*3.34*	*6.80*	*3.87*	*7.90*
2070	*2.10*	*3.00*	*3.61*	*7.35*	*2.04*	*0.3%*	*3.34*	*6.81*	*3.89*	*7.93*

Italicized/blue font in the table represents years that were extended beyond the most recent demand projection available.

	Central Point				-0.25%	-0.25%	0.25%	0.25%
Year	**Central Pt. ADD-med**	**Central Pt. MDD-med**	*Medium PF*	*Medium % growth*	Central Pt. ADD-low	Central Pt. MDD-low	Central Pt. ADD-high	Central Pt. MDD-high
2019	**2.79**	**7.09**	*2.54*		2.79	7.09	2.79	7.09
2020	**2.84**	**7.20**	*2.54*	*1.6%*	2.83	7.18	2.84	7.22
2021	**2.89**	**7.32**	*2.54*	*1.6%*	2.87	7.28	2.89	7.35
2022	**2.93**	**7.43**	*2.54*	*1.6%*	2.90	7.38	2.95	7.49
2023	**2.98**	**7.55**	*2.54*	*1.6%*	2.94	7.48	3.00	7.63
2024	**3.02**	**7.67**	*2.54*	*1.5%*	2.98	7.57	3.05	7.76
2025	**3.07**	**7.79**	*2.54*	*1.5%*	3.02	7.67	3.11	7.90
2026	**3.12**	**7.90**	*2.54*	*1.5%*	3.06	7.77	3.16	8.04
2027	**3.16**	**8.02**	*2.54*	*1.5%*	3.09	7.86	3.22	8.18
2028	**3.21**	**8.14**	*2.54*	*1.5%*	3.13	7.96	3.27	8.32
2029	**3.25**	**8.25**	*2.54*	*1.4%*	3.17	8.05	3.33	8.46
2030	**3.30**	**8.37**	*2.54*	*1.4%*	3.21	8.15	3.38	8.60
2031	**3.36**	**8.51**	*2.54*	*1.7%*	3.25	8.26	3.45	8.76
2032	**3.41**	**8.65**	*2.54*	*1.6%*	3.30	8.38	3.51	8.93
2033	**3.47**	**8.79**	*2.54*	*1.6%*	3.34	8.49	3.58	9.09
2034	**3.52**	**8.93**	*2.54*	*1.6%*	3.38	8.60	3.64	9.26
2035	**3.58**	**9.07**	*2.54*	*1.6%*	3.43	8.71	3.71	9.43
2036	**3.63**	**9.20**	*2.54*	*1.5%*	3.47	8.83	3.78	9.60
2037	**3.69**	**9.34**	*2.54*	*1.5%*	3.52	8.94	3.84	9.77
2038	**3.74**	**9.48**	*2.54*	*1.5%*	3.56	9.05	3.91	9.94
2039	**3.80**	**9.62**	*2.54*	*1.5%*	3.60	9.16	3.98	10.11
2040	**3.85**	**9.76**	*2.54*	*1.4%*	3.65	9.27	4.04	10.28
2041	*3.91*	*9.90*	*2.54*	*1.4%*	*3.69*	*9.38*	*4.11*	*10.45*
2042	*3.96*	*10.04*	*2.54*	*1.4%*	*3.73*	*9.49*	*4.18*	*10.63*
2043	*4.02*	*10.19*	*2.54*	*1.4%*	*3.78*	*9.60*	*4.25*	*10.81*
2044	*4.08*	*10.34*	*2.54*	*1.4%*	*3.82*	*9.72*	*4.33*	*10.99*
2045	*4.14*	*10.49*	*2.54*	*1.4%*	*3.87*	*9.83*	*4.40*	*11.18*
2046	*4.20*	*10.64*	*2.54*	*1.4%*	*3.92*	*9.95*	*4.47*	*11.37*
2047	*4.26*	*10.79*	*2.54*	*1.4%*	*3.96*	*10.07*	*4.55*	*11.56*
2048	*4.32*	*10.95*	*2.54*	*1.4%*	*4.01*	*10.19*	*4.63*	*11.76*
2049	*4.38*	*11.10*	*2.54*	*1.4%*	*4.06*	*10.31*	*4.70*	*11.96*
2050	*4.44*	*11.27*	*2.54*	*1.4%*	*4.11*	*10.44*	*4.78*	*12.16*
2051	*4.51*	*11.43*	*2.54*	*1.4%*	*4.16*	*10.56*	*4.87*	*12.36*
2052	*4.57*	*11.59*	*2.54*	*1.4%*	*4.21*	*10.69*	*4.95*	*12.57*
2053	*4.64*	*11.76*	*2.54*	*1.4%*	*4.26*	*10.81*	*5.03*	*12.79*
2054	*4.71*	*11.93*	*2.54*	*1.4%*	*4.31*	*10.94*	*5.12*	*13.00*
2055	*4.77*	*12.10*	*2.54*	*1.4%*	*4.36*	*11.07*	*5.20*	*13.22*
2056	*4.84*	*12.28*	*2.54*	*1.4%*	*4.41*	*11.21*	*5.29*	*13.45*
2057	*4.91*	*12.46*	*2.54*	*1.4%*	*4.46*	*11.34*	*5.38*	*13.68*
2058	*4.98*	*12.64*	*2.54*	*1.4%*	*4.52*	*11.48*	*5.47*	*13.91*
2059	*5.06*	*12.82*	*2.54*	*1.4%*	*4.57*	*11.61*	*5.57*	*14.14*
2060	*5.13*	*13.00*	*2.54*	*1.4%*	*4.62*	*11.75*	*5.66*	*14.38*
2061	*5.20*	*13.19*	*2.54*	*1.4%*	*4.68*	*11.89*	*5.76*	*14.63*
2062	*5.28*	*13.38*	*2.54*	*1.4%*	*4.74*	*12.03*	*5.85*	*14.87*
2063	*5.35*	*13.57*	*2.54*	*1.4%*	*4.79*	*12.18*	*5.95*	*15.13*
2064	*5.43*	*13.77*	*2.54*	*1.4%*	*4.85*	*12.32*	*6.05*	*15.38*
2065	*5.51*	*13.97*	*2.54*	*1.4%*	*4.91*	*12.47*	*6.16*	*15.64*
2066	*5.59*	*14.17*	*2.54*	*1.4%*	*4.97*	*12.62*	*6.26*	*15.91*
2067	*5.67*	*14.38*	*2.54*	*1.4%*	*5.03*	*12.77*	*6.37*	*16.18*
2068	*5.75*	*14.58*	*2.54*	*1.4%*	*5.09*	*12.92*	*6.47*	*16.45*
2069	*5.84*	*14.79*	*2.54*	*1.4%*	*5.15*	*13.08*	*6.58*	*16.73*
2070	*5.92*	*15.01*	*2.54*	*1.4%*	*5.21*	*13.23*	*6.70*	*17.02*

Italicized/blue font in the table represents years that were extended beyond the most recent demand projection available.

	Eagle Point				-0.25%	-0.25%	0.30%	0.30%
Year	**Eagle Pt. ADD-med**	**Eagle Pt. MDD-med**	*Medium PF*	*Medium % growth*	Eagle Pt. ADD-low	Eagle Pt. MDD-low	Eagle Pt. ADD-high	Eagle Pt. MDD-high
2019	**1.63**	**4.06**	*2.49*		1.63	4.06	1.63	4.06
2020	**1.64**	**4.10**	***2.49***	*1.0%*	1.64	4.09	1.65	4.11
2021	**1.66**	**4.14**	***2.49***	*1.0%*	1.65	4.12	1.67	4.16
2022	**1.68**	**4.18**	***2.49***	*1.0%*	1.66	4.15	1.69	4.22
2023	**1.69**	**4.22**	***2.49***	*1.0%*	1.68	4.18	1.71	4.27
2024	**1.71**	**4.26**	***2.49***	*1.0%*	1.69	4.21	1.74	4.33
2025	**1.73**	**4.30**	***2.49***	*1.0%*	1.70	4.24	1.76	4.38
2026	**1.75**	**4.35**	***2.49***	*1.0%*	1.72	4.27	1.78	4.44
2027	**1.76**	**4.39**	***2.49***	*1.0%*	1.73	4.31	1.80	4.50
2028	**1.78**	**4.44**	***2.49***	*1.0%*	1.74	4.34	1.83	4.56
2029	**1.80**	**4.48**	***2.49***	*1.0%*	1.75	4.37	1.85	4.61
2030	**1.82**	**4.52**	***2.49***	*1.0%*	1.77	4.40	1.88	4.67
2031	**1.83**	**4.57**	***2.49***	*1.0%*	1.78	4.44	1.90	4.74
2032	**1.85**	**4.62**	***2.49***	*1.0%*	1.79	4.47	1.93	4.80
2033	**1.87**	**4.66**	***2.49***	*1.0%*	1.81	4.50	1.95	4.86
2034	**1.89**	**4.71**	***2.49***	*1.0%*	1.82	4.54	1.98	4.92
2035	**1.91**	**4.76**	***2.49***	*1.0%*	1.83	4.57	2.00	4.99
2036	***1.93***	***4.80***	***2.49***	*1.0%*	*1.85*	*4.60*	*2.03*	*5.05*
2037	***1.95***	***4.85***	***2.49***	*1.0%*	*1.86*	*4.64*	*2.05*	*5.12*
2038	***1.97***	***4.90***	***2.49***	*1.0%*	*1.88*	*4.67*	*2.08*	*5.18*
2039	***1.99***	***4.95***	***2.49***	*1.0%*	*1.89*	*4.71*	*2.11*	*5.25*
2040	***2.01***	***5.00***	***2.49***	*1.0%*	*1.90*	*4.74*	*2.13*	*5.32*
2041	*2.03*	*5.05*	*2.49*	*1.0%*	*1.92*	*4.78*	*2.16*	*5.39*
2042	*2.05*	*5.10*	*2.49*	*1.0%*	*1.93*	*4.82*	*2.19*	*5.46*
2043	*2.07*	*5.15*	*2.49*	*1.0%*	*1.95*	*4.85*	*2.22*	*5.53*
2044	*2.09*	*5.20*	*2.49*	*1.0%*	*1.96*	*4.89*	*2.25*	*5.60*
2045	*2.11*	*5.25*	*2.49*	*1.0%*	*1.98*	*4.93*	*2.28*	*5.67*
2046	*2.13*	*5.31*	*2.49*	*1.0%*	*1.99*	*4.96*	*2.31*	*5.75*
2047	*2.15*	*5.36*	*2.49*	*1.0%*	*2.01*	*5.00*	*2.34*	*5.82*
2048	*2.17*	*5.41*	*2.49*	*1.0%*	*2.02*	*5.04*	*2.37*	*5.90*
2049	*2.19*	*5.47*	*2.49*	*1.0%*	*2.04*	*5.07*	*2.40*	*5.97*
2050	*2.22*	*5.52*	*2.49*	*1.0%*	*2.05*	*5.11*	*2.43*	*6.05*
2051	*2.24*	*5.58*	*2.49*	*1.0%*	*2.07*	*5.15*	*2.46*	*6.13*
2052	*2.26*	*5.63*	*2.49*	*1.0%*	*2.08*	*5.19*	*2.49*	*6.21*
2053	*2.28*	*5.69*	*2.49*	*1.0%*	*2.10*	*5.23*	*2.53*	*6.29*
2054	*2.31*	*5.74*	*2.49*	*1.0%*	*2.11*	*5.27*	*2.56*	*6.37*
2055	*2.33*	*5.80*	*2.49*	*1.0%*	*2.13*	*5.31*	*2.59*	*6.46*
2056	*2.35*	*5.86*	*2.49*	*1.0%*	*2.15*	*5.35*	*2.62*	*6.54*
2057	*2.38*	*5.92*	*2.49*	*1.0%*	*2.16*	*5.39*	*2.66*	*6.63*
2058	*2.40*	*5.98*	*2.49*	*1.0%*	*2.18*	*5.43*	*2.69*	*6.71*
2059	*2.42*	*6.04*	*2.49*	*1.0%*	*2.19*	*5.47*	*2.73*	*6.80*
2060	*2.45*	*6.10*	*2.49*	*1.0%*	*2.21*	*5.51*	*2.76*	*6.89*
2061	*2.47*	*6.16*	*2.49*	*1.0%*	*2.23*	*5.55*	*2.80*	*6.98*
2062	*2.50*	*6.22*	*2.49*	*1.0%*	*2.24*	*5.59*	*2.84*	*7.07*
2063	*2.52*	*6.28*	*2.49*	*1.0%*	*2.26*	*5.63*	*2.87*	*7.16*
2064	*2.55*	*6.35*	*2.49*	*1.0%*	*2.28*	*5.68*	*2.91*	*7.25*
2065	*2.57*	*6.41*	*2.49*	*1.0%*	*2.30*	*5.72*	*2.95*	*7.35*
2066	*2.60*	*6.47*	*2.49*	*1.0%*	*2.31*	*5.76*	*2.99*	*7.44*
2067	*2.62*	*6.54*	*2.49*	*1.0%*	*2.33*	*5.81*	*3.03*	*7.54*
2068	*2.65*	*6.60*	*2.49*	*1.0%*	*2.35*	*5.85*	*3.07*	*7.64*
2069	*2.68*	*6.67*	*2.49*	*1.0%*	*2.36*	*5.89*	*3.10*	*7.74*
2070	*2.70*	*6.74*	*2.49*	*1.0%*	*2.38*	*5.94*	*3.15*	*7.84*

Italicized/blue font in the table represents years that were extended beyond the most recent demand projection available.

	Jacksonville				-0.50%	-0.50%	0.25%	0.25%
Year	**Jacksonville ADD-med**	**Jacksonville MDD-med**	*Medium PF*	*Medium % growth*	Jacksonville ADD-low	Jacksonville MDD-low	Jacksonville ADD-high	Jacksonville MDD-high
2019	**0.69**	**1.61**	*2.34*		0.69	1.61	0.69	1.61
2020	**0.70**	**1.64**	*2.34*	*1.4%*	0.70	1.63	0.70	1.64
2021	**0.71**	**1.66**	*2.34*	*1.4%*	0.70	1.64	0.71	1.67
2022	**0.72**	**1.68**	*2.34*	*1.4%*	0.71	1.66	0.72	1.70
2023	**0.73**	**1.71**	*2.34*	*1.4%*	0.72	1.67	0.74	1.72
2024	**0.74**	**1.73**	*2.34*	*1.4%*	0.72	1.69	0.75	1.75
2025	**0.75**	**1.76**	*2.34*	*1.4%*	0.73	1.70	0.76	1.78
2026	**0.76**	**1.78**	*2.34*	*1.4%*	0.73	1.72	0.77	1.81
2027	**0.77**	**1.80**	*2.34*	*1.4%*	0.74	1.73	0.79	1.84
2028	**0.78**	**1.83**	*2.34*	*1.4%*	0.75	1.75	0.80	1.87
2029	**0.79**	**1.86**	*2.34*	*1.4%*	0.75	1.77	0.81	1.90
2030	**0.80**	**1.88**	*2.34*	*1.4%*	0.76	1.78	0.83	1.93
2031	**0.82**	**1.91**	*2.34*	*1.4%*	0.77	1.80	0.84	1.97
2032	**0.83**	**1.94**	*2.34*	*1.4%*	0.78	1.81	0.85	2.00
2033	**0.84**	**1.96**	*2.34*	*1.4%*	0.78	1.83	0.87	2.03
2034	***0.85***	***1.99***	*2.34*	*1.4%*	*0.79*	*1.85*	*0.88*	*2.06*
2035	***0.86***	***2.02***	*2.34*	*1.4%*	*0.80*	*1.86*	*0.90*	*2.10*
2036	***0.87***	***2.05***	*2.34*	*1.4%*	*0.80*	*1.88*	*0.91*	*2.13*
2037	***0.89***	***2.07***	*2.34*	*1.4%*	*0.81*	*1.90*	*0.93*	*2.17*
2038	***0.90***	***2.10***	*2.34*	*1.4%*	*0.82*	*1.91*	*0.94*	*2.20*
2039	***0.91***	***2.13***	*2.34*	*1.4%*	*0.83*	*1.93*	*0.96*	*2.24*
2040	***0.92***	***2.16***	*2.34*	*1.4%*	*0.83*	*1.95*	*0.97*	*2.28*
2041	*0.94*	*2.19*	*2.34*	*1.4%*	*0.84*	*1.97*	*0.99*	*2.31*
2042	*0.95*	*2.22*	*2.34*	*1.4%*	*0.85*	*1.98*	*1.01*	*2.35*
2043	*0.96*	*2.25*	*2.34*	*1.4%*	*0.86*	*2.00*	*1.02*	*2.39*
2044	*0.98*	*2.29*	*2.34*	*1.4%*	*0.86*	*2.02*	*1.04*	*2.43*
2045	*0.99*	*2.32*	*2.34*	*1.4%*	*0.87*	*2.04*	*1.06*	*2.47*
2046	*1.00*	*2.35*	*2.34*	*1.4%*	*0.88*	*2.06*	*1.07*	*2.51*
2047	*1.02*	*2.38*	*2.34*	*1.4%*	*0.89*	*2.08*	*1.09*	*2.55*
2048	*1.03*	*2.42*	*2.34*	*1.4%*	*0.89*	*2.09*	*1.11*	*2.60*
2049	*1.05*	*2.45*	*2.34*	*1.4%*	*0.90*	*2.11*	*1.13*	*2.64*
2050	*1.06*	*2.48*	*2.34*	*1.4%*	*0.91*	*2.13*	*1.15*	*2.68*
2051	*1.08*	*2.52*	*2.34*	*1.4%*	*0.92*	*2.15*	*1.17*	*2.73*
2052	*1.09*	*2.56*	*2.34*	*1.4%*	*0.93*	*2.17*	*1.18*	*2.77*
2053	*1.11*	*2.59*	*2.34*	*1.4%*	*0.94*	*2.19*	*1.20*	*2.82*
2054	*1.12*	*2.63*	*2.34*	*1.4%*	*0.94*	*2.21*	*1.22*	*2.86*
2055	*1.14*	*2.66*	*2.34*	*1.4%*	*0.95*	*2.23*	*1.24*	*2.91*
2056	*1.15*	*2.70*	*2.34*	*1.4%*	*0.96*	*2.25*	*1.26*	*2.96*
2057	*1.17*	*2.74*	*2.34*	*1.4%*	*0.97*	*2.27*	*1.29*	*3.01*
2058	*1.19*	*2.78*	*2.34*	*1.4%*	*0.98*	*2.29*	*1.31*	*3.06*
2059	*1.20*	*2.82*	*2.34*	*1.4%*	*0.99*	*2.31*	*1.33*	*3.11*
2060	*1.22*	*2.86*	*2.34*	*1.4%*	*1.00*	*2.33*	*1.35*	*3.16*
2061	*1.24*	*2.90*	*2.34*	*1.4%*	*1.01*	*2.35*	*1.37*	*3.21*
2062	*1.25*	*2.94*	*2.34*	*1.4%*	*1.01*	*2.37*	*1.39*	*3.26*
2063	*1.27*	*2.98*	*2.34*	*1.4%*	*1.02*	*2.40*	*1.42*	*3.32*
2064	*1.29*	*3.02*	*2.34*	*1.4%*	*1.03*	*2.42*	*1.44*	*3.37*
2065	*1.31*	*3.06*	*2.34*	*1.4%*	*1.04*	*2.44*	*1.47*	*3.43*
2066	*1.33*	*3.10*	*2.34*	*1.4%*	*1.05*	*2.46*	*1.49*	*3.48*
2067	*1.35*	*3.15*	*2.34*	*1.4%*	*1.06*	*2.48*	*1.51*	*3.54*
2068	*1.36*	*3.19*	*2.34*	*1.4%*	*1.07*	*2.51*	*1.54*	*3.60*
2069	*1.38*	*3.24*	*2.34*	*1.4%*	*1.08*	*2.53*	*1.56*	*3.66*
2070	*1.40*	*3.28*	*2.34*	*1.4%*	*1.09*	*2.55*	*1.59*	*3.72*

Italicized/blue font in the table represents years that were extended beyond the most recent demand projection available.

	MWC				-0.20%	-0.20%	0.20%	0.20%
Year	**MWC ADD-med**	**MWC MDD-med**	*Medium PF*	*Medium % growth*	MWC ADD-low	MWC MDD-low	MWC ADD-high	MWC MDD-high
2019	**23.32**	**47.55**	*2.04*		23.32	47.55	23.32	47.55
2020	**23.60**	**48.10**	*2.04*	*1.2%*	23.54	48.00	23.64	48.19
2021	**23.89**	**48.65**	*2.04*	*1.2%*	23.77	48.46	23.96	48.85
2022	**24.18**	**49.22**	*2.04*	*1.2%*	24.00	48.93	24.29	49.51
2023	**24.47**	**49.79**	*2.03*	*1.2%*	24.23	49.40	24.62	50.19
2024	**24.77**	**50.38**	*2.03*	*1.2%*	24.47	49.88	24.95	50.88
2025	**25.07**	**50.97**	*2.03*	*1.2%*	24.70	50.37	25.30	51.57
2026	**25.33**	**51.47**	*2.03*	*1.0%*	24.90	50.76	25.60	52.18
2027	**25.58**	**51.97**	*2.03*	*1.0%*	25.09	51.16	25.90	52.80
2028	**25.85**	**52.48**	*2.03*	*1.0%*	25.29	51.56	26.21	53.43
2029	**26.11**	**53.00**	*2.03*	*1.0%*	25.49	51.96	26.52	54.06
2030	**26.38**	**53.53**	*2.03*	*1.0%*	25.69	52.37	26.83	54.70
2031	**26.65**	**54.06**	*2.03*	*1.0%*	25.89	52.79	27.15	55.36
2032	**26.93**	**54.60**	*2.03*	*1.0%*	26.10	53.21	27.48	56.02
2033	**27.21**	**55.14**	*2.03*	*1.0%*	26.31	53.64	27.81	56.69
2034	**27.49**	**55.70**	*2.03*	*1.0%*	26.52	54.07	28.14	57.37
2035	**27.78**	**56.26**	*2.03*	*1.0%*	26.73	54.50	28.48	58.06
2036	**28.07**	**56.82**	*2.02*	*1.0%*	26.95	54.94	28.83	58.77
2037	**28.36**	**57.40**	*2.02*	*1.0%*	27.17	55.39	29.17	59.48
2038	***28.66***	***57.98***	*2.02*	*1.0%*	*27.39*	*55.84*	*29.53*	*60.20*
2039	***28.96***	***58.56***	*2.02*	*1.0%*	*27.61*	*56.29*	*29.89*	*60.93*
2040	***29.26***	***59.16***	*2.02*	*1.0%*	*27.84*	*56.75*	*30.25*	*61.67*
2041	*29.47*	*59.57*	*2.02*	*0.7%*	*27.98*	*57.03*	*30.52*	*62.22*
2042	*29.69*	*59.98*	*2.02*	*0.7%*	*28.12*	*57.32*	*30.80*	*62.78*
2043	*29.90*	*60.40*	*2.02*	*0.7%*	*28.26*	*57.60*	*31.07*	*63.35*
2044	*30.11*	*60.82*	*2.02*	*0.7%*	*28.40*	*57.89*	*31.35*	*63.92*
2045	*30.33*	*61.24*	*2.02*	*0.7%*	*28.54*	*58.18*	*31.64*	*64.49*
2046	*30.55*	*61.67*	*2.02*	*0.7%*	*28.68*	*58.47*	*31.92*	*65.07*
2047	*30.77*	*62.10*	*2.02*	*0.7%*	*28.83*	*58.77*	*32.21*	*65.66*
2048	*30.99*	*62.53*	*2.02*	*0.7%*	*28.97*	*59.06*	*32.50*	*66.25*
2049	*31.21*	*62.97*	*2.02*	*0.7%*	*29.11*	*59.35*	*32.79*	*66.85*
2050	*31.44*	*63.41*	*2.02*	*0.7%*	*29.26*	*59.65*	*33.08*	*67.45*
2051	*31.67*	*63.86*	*2.02*	*0.7%*	*29.41*	*59.95*	*33.38*	*68.06*
2052	*31.90*	*64.31*	*2.02*	*0.7%*	*29.55*	*60.25*	*33.68*	*68.67*
2053	*32.13*	*64.76*	*2.02*	*0.7%*	*29.70*	*60.55*	*33.99*	*69.29*
2054	*32.36*	*65.22*	*2.02*	*0.7%*	*29.85*	*60.85*	*34.29*	*69.91*
2055	*32.60*	*65.68*	*2.01*	*0.7%*	*30.00*	*61.16*	*34.60*	*70.54*
2056	*32.84*	*66.14*	*2.01*	*0.7%*	*30.15*	*61.46*	*34.91*	*71.17*
2057	*33.08*	*66.61*	*2.01*	*0.7%*	*30.30*	*61.77*	*35.23*	*71.81*
2058	*33.32*	*67.08*	*2.01*	*0.7%*	*30.45*	*62.08*	*35.54*	*72.46*
2059	*33.56*	*67.56*	*2.01*	*0.7%*	*30.60*	*62.39*	*35.86*	*73.11*
2060	*33.81*	*68.04*	*2.01*	*0.7%*	*30.76*	*62.70*	*36.19*	*73.77*
2061	*34.06*	*68.52*	*2.01*	*0.7%*	*30.91*	*63.02*	*36.51*	*74.44*
2062	*34.31*	*69.01*	*2.01*	*0.7%*	*31.06*	*63.33*	*36.84*	*75.10*
2063	*34.56*	*69.51*	*2.01*	*0.7%*	*31.22*	*63.65*	*37.17*	*75.78*
2064	*34.81*	*70.00*	*2.01*	*0.7%*	*31.38*	*63.97*	*37.51*	*76.46*
2065	*35.07*	*70.50*	*2.01*	*0.7%*	*31.53*	*64.29*	*37.84*	*77.15*
2066	*35.33*	*71.01*	*2.01*	*0.7%*	*31.69*	*64.61*	*38.18*	*77.85*
2067	*35.59*	*71.52*	*2.01*	*0.7%*	*31.85*	*64.93*	*38.53*	*78.55*
2068	*35.85*	*72.03*	*2.01*	*0.7%*	*32.01*	*65.25*	*38.87*	*79.25*
2069	*36.12*	*72.55*	*2.01*	*0.7%*	*32.17*	*65.58*	*39.22*	*79.97*
2070	*36.38*	*73.08*	*2.01*	*0.7%*	*32.33*	*65.91*	*39.58*	*80.69*

Italicized/blue font in the table represents years that were extended beyond the most recent demand projection available.

	Phoenix											
Year	Phoenix ADD-med	Phoenix MDD-med	Medium PF	Medium % growth	Phoenix ADD-low	Phoenix MDD-low	Low PF	Low % growth	Phoenix ADD-high	Phoenix MDD-high	High PF	High % growth
2019	0.78	2.20	2.82		0.74	1.92	2.60		0.83	2.48	3.00	
2020	0.79	2.23	2.82	1.4%	0.74	1.93	2.61	0.8%	0.84	2.52	3.00	1.8%
2021	0.80	2.26	2.83	1.3%	0.75	1.95	2.61	0.8%	0.86	2.57	3.00	1.8%
2022	0.81	2.29	2.83	1.3%	0.75	1.96	2.61	0.8%	0.87	2.61	2.99	1.8%
2023	0.82	2.32	2.83	1.3%	0.76	1.98	2.61	0.8%	0.89	2.66	2.99	1.7%
2024	0.83	2.35	2.83	1.3%	0.76	1.99	2.61	0.8%	0.90	2.70	2.99	1.7%
2025	0.84	2.38	2.83	1.3%	0.77	2.01	2.61	0.8%	0.92	2.75	2.99	1.7%
2026	0.86	2.43	2.83	2.1%	0.78	2.02	2.61	0.7%	0.95	2.84	2.99	3.2%
2027	0.87	2.48	2.84	2.1%	0.78	2.04	2.61	0.7%	0.98	2.92	2.99	3.1%
2028	0.89	2.53	2.84	2.0%	0.79	2.05	2.61	0.7%	1.01	3.01	2.99	3.0%
2029	0.91	2.58	2.84	2.0%	0.79	2.06	2.61	0.7%	1.03	3.10	3.00	2.9%
2030	0.93	2.63	2.84	1.9%	0.80	2.08	2.61	0.6%	1.06	3.19	3.00	2.8%
2031	0.94	2.68	2.84	1.9%	0.80	2.09	2.61	0.6%	1.09	3.27	3.00	2.7%
2032	0.96	2.73	2.84	1.9%	0.81	2.10	2.61	0.6%	1.12	3.36	3.00	2.7%
2033	0.98	2.78	2.84	1.8%	0.81	2.12	2.60	0.6%	1.15	3.45	3.00	2.6%
2034	1.00	2.83	2.84	1.8%	0.82	2.13	2.60	0.6%	1.18	3.54	3.00	2.5%
2035	1.01	2.88	2.84	1.8%	0.82	2.14	2.60	0.6%	1.21	3.62	3.00	2.5%
2036	1.03	2.93	2.84	1.7%	0.83	2.16	2.60	0.6%	1.24	3.71	3.00	2.4%
2037	1.05	2.98	2.84	1.7%	0.83	2.17	2.60	0.6%	1.26	3.80	3.00	2.4%
2038	1.07	3.03	2.84	1.7%	0.84	2.18	2.60	0.6%	1.29	3.89	3.01	2.3%
2039	1.08	3.08	2.84	1.7%	0.84	2.20	2.60	0.6%	1.32	3.97	3.01	2.2%
2040	1.10	3.13	2.85	1.6%	0.85	2.21	2.60	0.6%	1.35	4.06	3.01	2.2%
2041	1.12	3.18	2.85	1.6%	0.86	2.22	2.60	0.6%	1.38	4.15	3.01	2.2%
2042	1.14	3.23	2.85	1.6%	0.86	2.24	2.60	0.6%	1.41	4.24	3.01	2.2%
2043	1.15	3.28	2.85	1.6%	0.87	2.25	2.60	0.6%	1.44	4.33	3.01	2.2%
2044	1.17	3.34	2.85	1.6%	0.87	2.26	2.60	0.6%	1.47	4.43	3.01	2.2%
2045	1.19	3.39	2.85	1.6%	0.88	2.28	2.60	0.6%	1.51	4.53	3.01	2.2%
2046	1.21	3.45	2.85	1.6%	0.88	2.29	2.60	0.6%	1.54	4.63	3.01	2.2%
2047	1.23	3.50	2.85	1.6%	0.89	2.31	2.60	0.6%	1.57	4.73	3.01	2.2%
2048	1.25	3.56	2.85	1.6%	0.89	2.32	2.60	0.6%	1.61	4.83	3.01	2.2%
2049	1.27	3.62	2.85	1.6%	0.90	2.33	2.60	0.6%	1.64	4.94	3.01	2.2%
2050	1.29	3.68	2.85	1.6%	0.90	2.35	2.60	0.6%	1.68	5.05	3.01	2.2%
2051	1.31	3.74	2.85	1.6%	0.91	2.36	2.60	0.6%	1.71	5.16	3.01	2.2%
2052	1.33	3.80	2.85	1.6%	0.91	2.38	2.60	0.6%	1.75	5.27	3.01	2.2%
2053	1.36	3.86	2.85	1.6%	0.92	2.39	2.60	0.6%	1.79	5.39	3.01	2.2%
2054	1.38	3.92	2.85	1.6%	0.93	2.41	2.60	0.6%	1.83	5.50	3.01	2.2%
2055	1.40	3.99	2.85	1.6%	0.93	2.42	2.60	0.6%	1.87	5.63	3.01	2.2%
2056	1.42	4.05	2.85	1.6%	0.94	2.43	2.60	0.6%	1.91	5.75	3.01	2.2%
2057	1.45	4.12	2.85	1.6%	0.94	2.45	2.60	0.6%	1.95	5.88	3.01	2.2%
2058	1.47	4.18	2.85	1.6%	0.95	2.46	2.60	0.6%	2.00	6.01	3.01	2.2%
2059	1.49	4.25	2.85	1.6%	0.95	2.48	2.60	0.6%	2.04	6.14	3.01	2.2%
2060	1.52	4.32	2.85	1.6%	0.96	2.49	2.60	0.6%	2.09	6.27	3.01	2.2%
2061	1.54	4.39	2.85	1.6%	0.97	2.51	2.60	0.6%	2.13	6.41	3.01	2.2%
2062	1.57	4.46	2.85	1.6%	0.97	2.52	2.60	0.6%	2.18	6.55	3.01	2.2%
2063	1.59	4.53	2.85	1.6%	0.98	2.54	2.60	0.6%	2.23	6.69	3.01	2.2%
2064	1.62	4.61	2.85	1.6%	0.98	2.56	2.60	0.6%	2.28	6.84	3.01	2.2%
2065	1.65	4.68	2.85	1.6%	0.99	2.57	2.60	0.6%	2.33	6.99	3.01	2.2%
2066	1.67	4.76	2.85	1.6%	0.99	2.59	2.60	0.6%	2.38	7.15	3.01	2.2%
2067	1.70	4.83	2.85	1.6%	1.00	2.60	2.60	0.6%	2.43	7.30	3.01	2.2%
2068	1.73	4.91	2.85	1.6%	1.01	2.62	2.60	0.6%	2.48	7.46	3.01	2.2%
2069	1.75	4.99	2.85	1.6%	1.01	2.63	2.60	0.6%	2.54	7.63	3.01	2.2%
2070	1.78	5.07	2.85	1.6%	1.02	2.65	2.60	0.6%	2.59	7.80	3.01	2.2%

Italicized/blue font in the table represents years that were extended beyond the most recent demand projection available.

	Talent											
Year	**Talent ADD-med**	**Talent MDD-med**	*Medium PF*	*Medium % growth*	Talent ADD-low	Talent MDD-low	*Low PF*	*Low % growth*	Talent ADD-high	Talent MDD-high	*High PF*	*High % growth*
2019	**0.81**	**2.14**	*2.65*		0.77	2.00	*2.59*		0.84	2.28	*2.72*	
2020	**0.81**	**2.16**	*2.65*	*0.9%*	0.78	2.02	*2.59*	*0.7%*	0.85	2.31	*2.73*	*1.1%*
2021	**0.82**	**2.18**	*2.65*	*0.9%*	0.78	2.03	*2.60*	*0.7%*	0.86	2.33	*2.73*	*1.1%*
2022	**0.83**	**2.20**	*2.66*	*0.9%*	0.79	2.05	*2.60*	*0.7%*	0.86	2.36	*2.73*	*1.0%*
2023	**0.84**	**2.22**	*2.66*	*0.9%*	0.79	2.06	*2.60*	*0.7%*	0.87	2.38	*2.73*	*1.0%*
2024	**0.84**	**2.24**	*2.66*	*0.9%*	0.80	2.08	*2.61*	*0.7%*	0.88	2.41	*2.73*	*1.0%*
2025	**0.85**	**2.26**	*2.66*	*0.9%*	0.80	2.09	*2.61*	*0.7%*	0.89	2.43	*2.73*	*1.0%*
2026	**0.86**	**2.30**	*2.66*	*1.7%*	0.81	2.12	*2.61*	*1.4%*	0.91	2.48	*2.73*	*1.9%*
2027	**0.88**	**2.33**	*2.66*	*1.6%*	0.82	2.15	*2.61*	*1.4%*	0.92	2.52	*2.73*	*1.9%*
2028	**0.89**	**2.37**	*2.66*	*1.6%*	0.83	2.18	*2.61*	*1.3%*	0.94	2.57	*2.73*	*1.8%*
2029	**0.91**	**2.41**	*2.66*	*1.6%*	0.85	2.20	*2.61*	*1.3%*	0.96	2.62	*2.73*	*1.8%*
2030	**0.92**	**2.45**	*2.66*	*1.5%*	0.86	2.23	*2.61*	*1.3%*	0.98	2.66	*2.73*	*1.8%*
2031	**0.93**	**2.48**	*2.66*	*1.5%*	0.87	2.26	*2.61*	*1.3%*	0.99	2.71	*2.73*	*1.8%*
2032	**0.95**	**2.52**	*2.66*	*1.5%*	0.88	2.29	*2.61*	*1.3%*	1.01	2.76	*2.73*	*1.7%*
2033	**0.96**	**2.56**	*2.66*	*1.5%*	0.89	2.32	*2.60*	*1.3%*	1.03	2.80	*2.73*	*1.7%*
2034	**0.98**	**2.60**	*2.66*	*1.5%*	0.90	2.35	*2.60*	*1.2%*	1.05	2.85	*2.72*	*1.7%*
2035	**0.99**	**2.63**	*2.66*	*1.4%*	0.91	2.38	*2.60*	*1.2%*	1.06	2.90	*2.72*	*1.6%*
2036	**1.00**	**2.67**	*2.66*	*1.4%*	0.92	2.41	*2.60*	*1.2%*	1.08	2.94	*2.72*	*1.6%*
2037	**1.02**	**2.71**	*2.66*	*1.4%*	0.94	2.43	*2.60*	*1.2%*	1.10	2.99	*2.72*	*1.6%*
2038	**1.03**	**2.75**	*2.66*	*1.4%*	0.95	2.46	*2.60*	*1.2%*	1.12	3.04	*2.72*	*1.6%*
2039	**1.05**	**2.78**	*2.66*	*1.4%*	0.96	2.49	*2.60*	*1.2%*	1.13	3.08	*2.72*	*1.5%*
2040	**1.06**	**2.82**	*2.66*	*1.3%*	0.97	2.52	*2.60*	*1.2%*	1.15	3.13	*2.72*	*1.5%*
2041	*1.07*	*2.86*	*2.66*	*1.3%*	*0.98*	*2.55*	*2.60*	*1.2%*	*1.17*	*3.18*	*2.72*	*1.5%*
2042	*1.09*	*2.90*	*2.66*	*1.3%*	*0.99*	*2.58*	*2.60*	*1.2%*	*1.19*	*3.23*	*2.72*	*1.5%*
2043	*1.10*	*2.94*	*2.66*	*1.3%*	*1.00*	*2.61*	*2.60*	*1.2%*	*1.20*	*3.27*	*2.72*	*1.5%*
2044	*1.12*	*2.97*	*2.66*	*1.3%*	*1.02*	*2.64*	*2.60*	*1.2%*	*1.22*	*3.32*	*2.72*	*1.5%*
2045	*1.13*	*3.01*	*2.66*	*1.3%*	*1.03*	*2.67*	*2.60*	*1.2%*	*1.24*	*3.37*	*2.72*	*1.5%*
2046	*1.15*	*3.05*	*2.66*	*1.3%*	*1.04*	*2.70*	*2.60*	*1.2%*	*1.26*	*3.43*	*2.72*	*1.5%*
2047	*1.16*	*3.10*	*2.66*	*1.3%*	*1.05*	*2.73*	*2.60*	*1.2%*	*1.28*	*3.48*	*2.72*	*1.5%*
2048	*1.18*	*3.14*	*2.66*	*1.3%*	*1.06*	*2.76*	*2.60*	*1.2%*	*1.30*	*3.53*	*2.72*	*1.5%*
2049	*1.20*	*3.18*	*2.66*	*1.3%*	*1.08*	*2.79*	*2.60*	*1.2%*	*1.32*	*3.58*	*2.72*	*1.5%*
2050	*1.21*	*3.22*	*2.66*	*1.3%*	*1.09*	*2.83*	*2.60*	*1.2%*	*1.34*	*3.64*	*2.72*	*1.5%*
2051	*1.23*	*3.27*	*2.66*	*1.3%*	*1.10*	*2.86*	*2.60*	*1.2%*	*1.36*	*3.69*	*2.72*	*1.5%*
2052	*1.24*	*3.31*	*2.66*	*1.3%*	*1.11*	*2.89*	*2.60*	*1.2%*	*1.38*	*3.75*	*2.72*	*1.5%*
2053	*1.26*	*3.35*	*2.66*	*1.3%*	*1.13*	*2.92*	*2.60*	*1.2%*	*1.40*	*3.80*	*2.72*	*1.5%*
2054	*1.28*	*3.40*	*2.66*	*1.3%*	*1.14*	*2.96*	*2.60*	*1.2%*	*1.42*	*3.86*	*2.72*	*1.5%*
2055	*1.29*	*3.44*	*2.66*	*1.3%*	*1.15*	*2.99*	*2.60*	*1.2%*	*1.44*	*3.92*	*2.72*	*1.5%*
2056	*1.31*	*3.49*	*2.66*	*1.3%*	*1.16*	*3.03*	*2.60*	*1.2%*	*1.46*	*3.98*	*2.72*	*1.5%*
2057	*1.33*	*3.54*	*2.66*	*1.3%*	*1.18*	*3.06*	*2.60*	*1.2%*	*1.48*	*4.04*	*2.72*	*1.5%*
2058	*1.35*	*3.58*	*2.66*	*1.3%*	*1.19*	*3.10*	*2.60*	*1.2%*	*1.51*	*4.10*	*2.72*	*1.5%*
2059	*1.37*	*3.63*	*2.66*	*1.3%*	*1.21*	*3.13*	*2.60*	*1.2%*	*1.53*	*4.16*	*2.72*	*1.5%*
2060	*1.38*	*3.68*	*2.66*	*1.3%*	*1.22*	*3.17*	*2.60*	*1.2%*	*1.55*	*4.23*	*2.72*	*1.5%*
2061	*1.40*	*3.73*	*2.66*	*1.3%*	*1.23*	*3.20*	*2.60*	*1.2%*	*1.58*	*4.29*	*2.72*	*1.5%*
2062	*1.42*	*3.78*	*2.66*	*1.3%*	*1.25*	*3.24*	*2.60*	*1.2%*	*1.60*	*4.36*	*2.72*	*1.5%*
2063	*1.44*	*3.83*	*2.66*	*1.3%*	*1.26*	*3.28*	*2.60*	*1.2%*	*1.62*	*4.42*	*2.72*	*1.5%*
2064	*1.46*	*3.88*	*2.66*	*1.3%*	*1.28*	*3.32*	*2.60*	*1.2%*	*1.65*	*4.49*	*2.72*	*1.5%*
2065	*1.48*	*3.94*	*2.66*	*1.3%*	*1.29*	*3.35*	*2.60*	*1.2%*	*1.67*	*4.56*	*2.72*	*1.5%*
2066	*1.50*	*3.99*	*2.66*	*1.3%*	*1.31*	*3.39*	*2.60*	*1.2%*	*1.70*	*4.63*	*2.72*	*1.5%*
2067	*1.52*	*4.04*	*2.66*	*1.3%*	*1.32*	*3.43*	*2.60*	*1.2%*	*1.73*	*4.70*	*2.72*	*1.5%*
2068	*1.54*	*4.10*	*2.66*	*1.3%*	*1.34*	*3.47*	*2.60*	*1.2%*	*1.75*	*4.77*	*2.72*	*1.5%*
2069	*1.56*	*4.15*	*2.66*	*1.3%*	*1.35*	*3.51*	*2.60*	*1.2%*	*1.78*	*4.84*	*2.72*	*1.5%*
2070	*1.58*	*4.21*	*2.66*	*1.3%*	*1.37*	*3.55*	*2.60*	*1.2%*	*1.80*	*4.91*	*2.72*	*1.5%*

Memorandum

To: Partner Water Providers

From: Adam Sussman, GSI Water Solutions, Inc.
Kimberly Grigsby, GSI Water Solutions, Inc.

Date: September 11, 2019

Re: **Comparison of Water Rights and Projected Water Demands of Partner Water Providers for Water Rights Strategy**

Introduction

GSI Water Solutions, Inc. (GSI) is assisting the "Partner Water Providers" (Partners) develop a water rights strategy. The Partners include Medford Water Commission (MWC) and the Cities of Ashland, Central Point, Eagle Point, Jacksonville, Phoenix, and Talent. GSI has previously prepared a comprehensive water rights table summarizing the Partner water rights and a consolidated water demand projection for each of the Partners. This memorandum compares the projected demands to the Partners' water rights. GSI will use this information to develop a water right and supply strategy in a future deliverable.

Background

As an initial deliverable for the water rights strategy process, GSI developed a water rights table that summarized each of the Partners' water rights. **Table 1** provides information regarding the total rate (in cfs), total volume (in acre-feet) and season of use. . (A copy of the full water rights table is provided in **Attachment A**.)

Table 1. Summary of Partner Water Rights

Partner	Maximum Rate		Maximum Volume		Period of Use
	(cfs)	(mgd)	(AF)	(MG)	
Ashland	N/A	N/A	1,000	325.8	Year-round
Central Point	5.31	3.43	1113.6	362.9	April 1 - Oct. 1
Eagle Point	6.27	4.05	1860.9	606.4	April 1 - Oct. 1
Jacksonville	N/A	N/A	600	195.5	May 1 - Sept. 1
MWC "Duff WRs"	150.0[1]	96.95	N/A	N/A	Year-round
Phoenix	8.10	5.24	1000	325.8	Year-round
Talent	N/A	N/A	1292	421	May 1 - Oct. 1
Total	**169.7**	**109.7**	**6867**	**2237**	

1. MWC "Duff WRs" includes 50 cfs as an estimate of the rate of water available under the "withdrawal permit" S-54935

GSI developed demand projections to 2070 for each of the Partners by obtaining their most recent water demand projections and extending them to a common planning period (2020 to 2070). For each Partner, GSI assumed their demand growth rate of the last year in their original demand projection continued to year 2070. Using this approach, GSI developed "extended" projected average day demands (ADDs) and maximum day demands (MDDs) for each Partner. GSI also developed low, medium and high demand scenarios for the extended projections for those Partners that had not previously developed a range of demand scenarios. (See GSI's memorandum *Water Demand Projections of Partner Water Providers for Water Rights Strategy* (dated August 5, 2019) provides a detailed description of the methodology used.) **Figure 1** shows the projected total ADD and MDD for all Partners for the three demand scenarios (low, medium, and high) during the 2020 to 2070 planning period. **Figure 2** illustrates the proportion of the total MDD for each Partner over the planning period under the medium scenario.

Figure 1. Total Average Day and Maximum Day Demand Scenarios for Partners

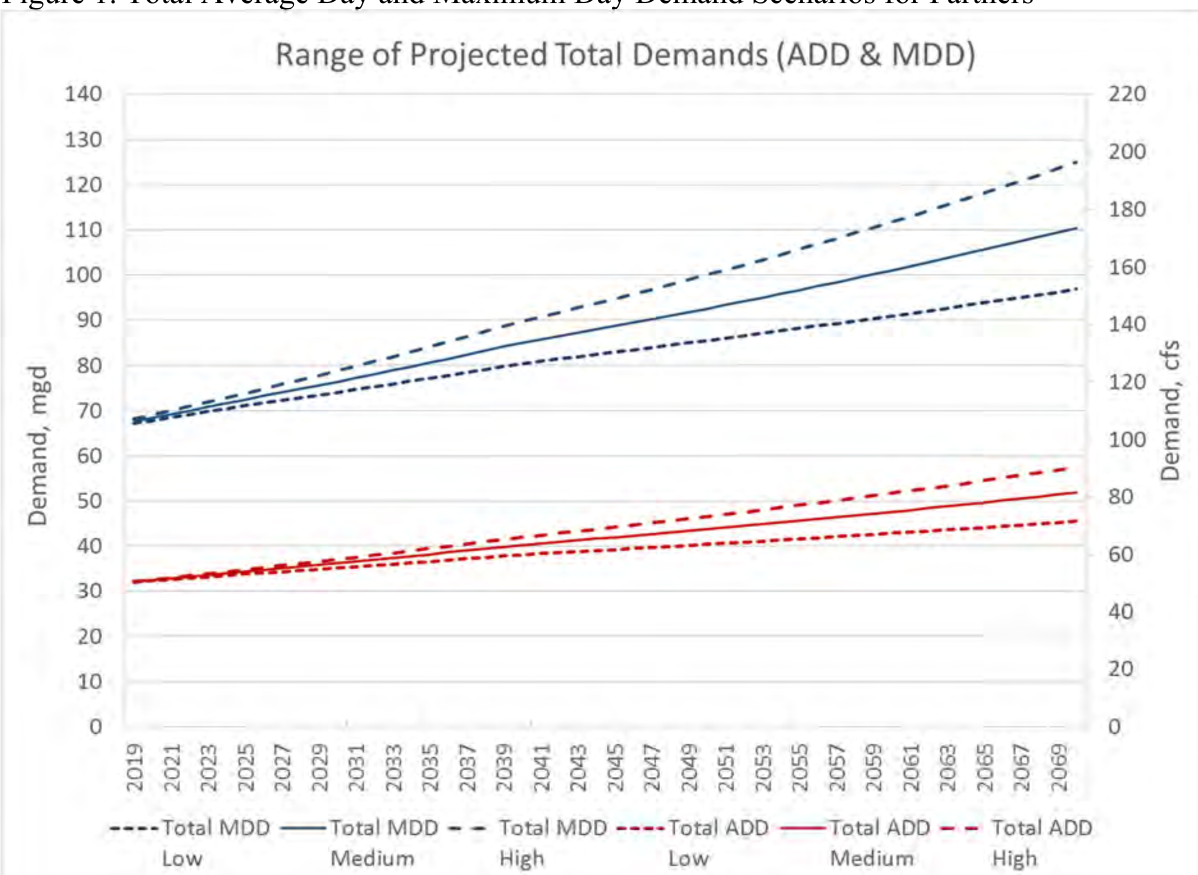
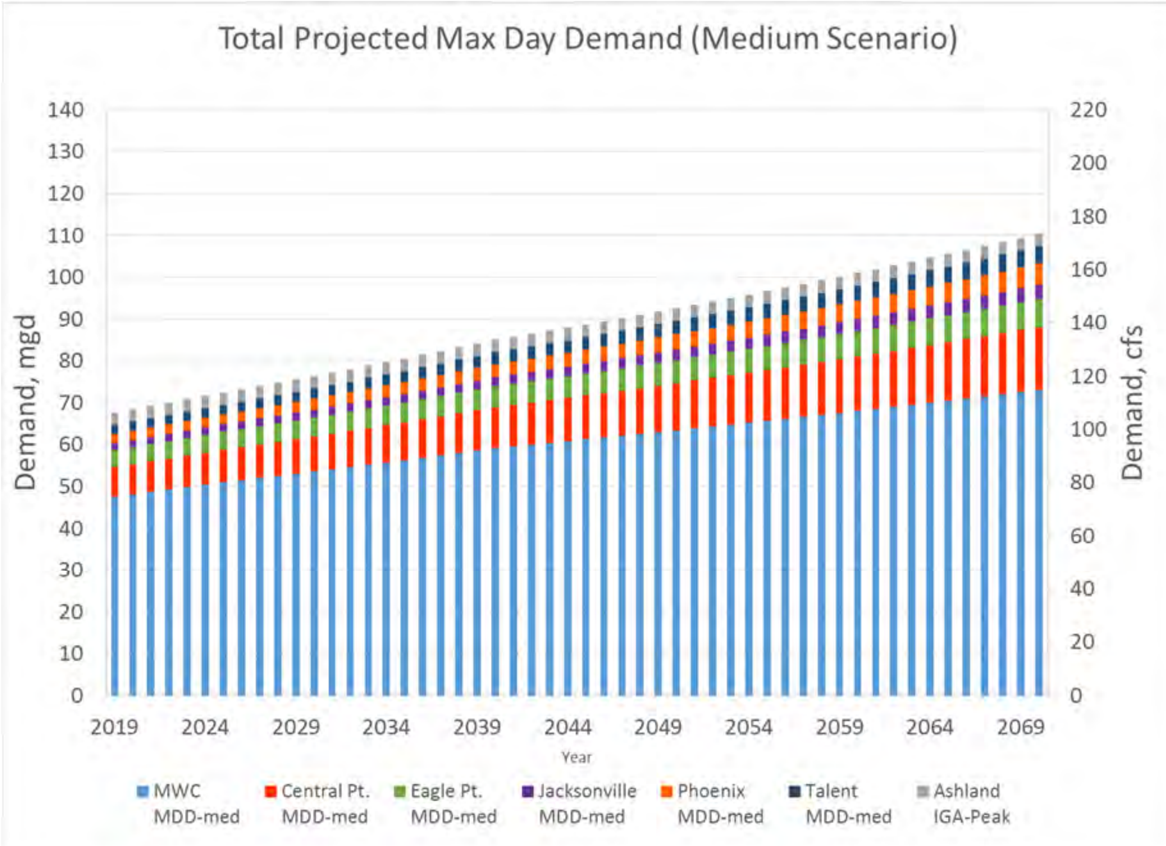


Figure 2. Cumulative Maximum Day Demand (Medium Scenario) for Partner Water Providers



Approach

To compare the Partner's existing water rights with their projected demands, GSI made the following assumptions:

- MWC's water rights for Big Butte Springs authorize year-round use of 40.8 cfs (26.4 mgd)
- Partner cities divert water under their own water rights from May 1 to September 31
- MWC's Permit S-54935 (its "withdrawal permit") could provide water supply of up to approximately 50 cfs (32.3 mgd)
- Ashland can receive 4.6 cfs (3.0 mgd) from the Duff Water Treatment Plant under a revised intergovernmental agreement (IGA)
- The Partners can obtain access to the undeveloped portions of their permits (through an updated and approved Water Management Plan) in the future

Based on these assumptions, GSI compared the Partners' projected water demands to the water rights under their existing water rights. This comparison included an assessment of both instantaneous rate limitations and annual volume limitations associated with the Partners' water rights. Aside from the assumptions described above, the assessment did not evaluate the reliability of the sources of supply authorized by the Partners' water rights. This issue will be addressed in in a future deliverable.

Comparison of Water Rights and Projected Water Demands

GSI compared each Partners' projected demands to both the instantaneous rate and annual volume limitations associated with their water rights. In addition, GSI compared the Partners' combined demands with the limitations associated with their combined water rights.

Comparison of Water Rights Maximum Authorized Rates

For each Partner, GSI compared the combined maximum authorized rates associated with their water rights (if any) to the projected average day and maximum day demands during the 50-year planning period (2020 to 2070).

Most, but not all, water rights include a stated maximum authorized rate of diversion. For most Partners, these stated maximum authorized rates were added together to obtain the Partner's combined maximum authorized rate. The water rights held by three of the Partners (Ashland, Jacksonville and Talent) do not include maximum authorized rates. (These water rights provide only annual volume limitations, which are discussed below.) Consequently, this comparison is not relevant to those cities.

This evaluation was based on each Partner's ability to meet its projected peak demands, which are expected to occur during the summer months. The MWC meets its peak demands using water from both the Rogue River and Big Butte Springs. For this reason, GSI considered MWC's maximum authorized rate to be 123.3 mgd (189.9 cfs). This total is based on the MWC's approximately 96.9 mgd (150 cfs) of water rights with points of diversion at the Duff Water Treatment Plant (WTP) and the 26.4 mgd (40.8 cfs) of water supply that MWC can receive from Big Butte Springs (96.9 mgd + 26.4 mgd = 123.2 mgd).

GSI also compared the combined maximum authorized rates for all of the Partners' water rights with their projected demands. **Table 2** provides a summary of GSI's comparison of the Partners' maximum authorized rates to their projected MDDs under the medium scenario. The projected MDDs shown in red exceed the maximum authorized rate for that city's water rights. **Attachment B** provides graphs comparing the maximum authorized rates (if applicable) to the Partners' projected ADDs and MDDs during the planning period.

Table 2. Total Maximum Authorized Rates and MDD Projections (Medium Scenarios)

Partner	Water Right Maximum Authorized Rates (mgd)	Project MDD (mgd)		
		2030	2040	2070
Ashland	N/A	3.00	3.00	3.00
Central Point	3.43	8.37	9.76	15.01
Eagle Point	4.05	4.52	5.00	6.74
Jacksonville	N/A	1.88	2.16	3.28
MWC	123.35[1]	53.53	59.16	73.08
Phoenix	5.24	2.63	3.13	5.07
Talent	N/A	2.45	2.82	4.21
Total	**136.1**	**76.4**	**85.0**	**110.4**

[1] Includes 26.4 mgd of capacity from Big Butte Springs and approximately 96.9 mgd of water rights at the Duff WTP

The comparison indicates that two of the Partners existing water rights are likely not sufficient to meet projected maximum day demands, while the remaining Partners have no rate limitation or sufficient water right rates to meet their projected demands in the near term. The projected MDDs for Central Point and Eagle Point are expected to exceed the maximum authorized rates on their individual water rights in the near terms under the medium demand scenario. Central Point's current MDD is expected to exceed its 3.43 mgd (5.31 cfs) maximum authorized rate. Eagle Point's MDD is expected to exceed its 4.05 mgd (6.27 cfs) water right rate limitation by 2020. The MDDs through 2070 for MWC and Phoenix are projected to be less than the rate limitations on their respective water rights under the medium scenario. (Under the high demand scenario, MWC's demands continue to be less than its water rights rate limitations, but Phoenix's demands are projected to exceed its rate limitations in 2052.)

The comparison also indicates that the Partners' total combined water right rate limitations exceed their total projected MDDs throughout the 50 year planning period. The combined maximum authorized rate for all the Partner water rights is 136.1 mgd; the combined Partner MDD in 2070 is 110.4 mgd under the medium scenario and 125.0 mgd under the high scenario.

Comparison of Water Rights Maximum Authorized Volumes

The second component of this water rights evaluation was to compare the Partners' projected water demands to the maximum volume that can be diverted under their water rights. For the Partner Cities, this evaluation considered the period from May 1 through September 30 when they divert water under their individual water rights. This evaluation considered year-round water demands and water rights for the MWC. For Ashland, the existing IGA can be revised to allow a maximum rate of 3 mgd. GSI has assumed that Ashland would not use more water under the IGA than its water right's volume limitation of 326 MG (1,000 AF).

As shown in the water rights table in Attachment A, many of the water rights held by the Partners have stated maximum volumes. For those water rights without stated maximum volumes, GSI calculated the maximum volume by multiplying the maximum authorized rate by the relevant time period (365 days for MWC, or May 1 through September 30 for Partner Cities). Central Point holds water rights both with and without stated maximum volumes. For that city, the stated volume limit and the calculated volume limited were added together. **Table 3** provides a summary of the volume limits for each Partner.

Table 3. Partners' Water Rights Maximum Volumes

Partner City	Stated Volume Limit (MG)	Calculated Volume Limit (MG)	Total Volume Limit (MG)
Ashland	326	N/A	**326**
Central Point	363	484	**847**
Eagle Point	606	N/A	**606**
Jacksonville	196	N/A	**196**
MWC	N/A	35,387	**35,387**
Phoenix	326	N/A	**326**
Talent	421	N/A	**421**
		Total (MG)	***38,108***
		Total (AF)	***116,949***

To determine the projected volume of demands for the Partners, GSI used the projected ADD from the previously described demand projections and multiplied it by 365 to get an annual demand for a given year. Next, GSI used information about monthly water use provided by the Partners to develop a monthly distribution of annual demands. (A copy of the monthly distribution for each Partner is provided in **Attachment C**.) The calculated annual demand volume for each Partner was then divided among the 12 months of the year based on the monthly distribution. As an example, **Attachment D** provides the monthly water demands projected for each Partner in 2030 under the medium scenario.

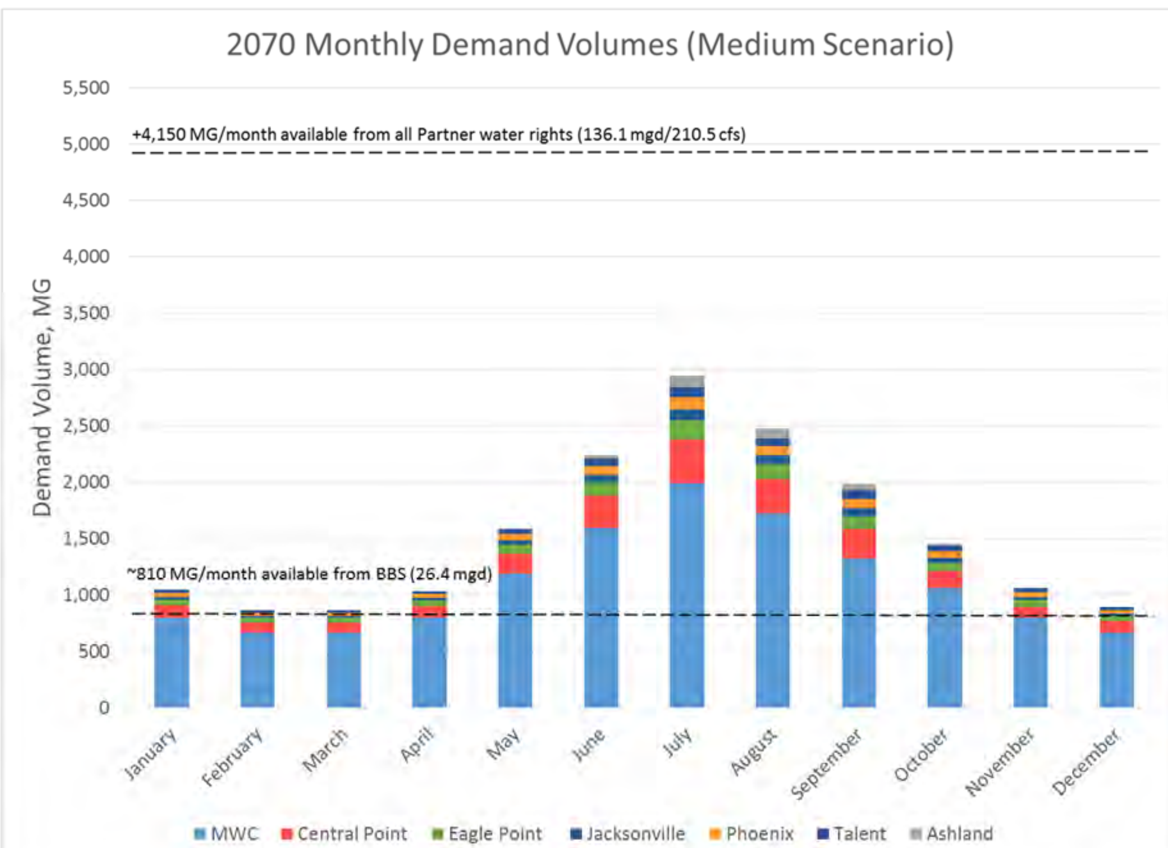
As a final step, GSI compared each Partners' total volume limitations (shown in Table 3) with their projected demands. Under the medium demand scenario, the projected 2030 and 2040 demands are within authorized volume limitations for most Partners. The projected 2070 demands (under the medium scenario), however, exceeded the volume limitations for all of the Partners except MWC and Talent. **Table 4** shows the Partners' total volume limitations and projected demands for 2030, 2040 and 2070. Volumes in red exceed the Partner's current total water right volume limitation.

Table 4. Water Right Volume Limits vs. Demands within Water Right Period of Use (in MG)

Partner	Total Volume Limit (MG)	Projected Demands (MG)		
		2030	2040	2070
Ashland	326	280	280	280
Central Point	847	791	922	1,418
Eagle Point	606	445	453	610
Jacksonville	196	202	232	353
MWC	35,387	9,629	10,682	13,280
Phoenix	326	338	402	651
Talent	421	205	236	352
Total	**38,108**	**11,890**	**13,207**	**16,944**

As shown in Table 4 and **Figure 3**, if the Partners combined their water rights, their total demands would be well within their total water right volume limitations.

Figure 3. Total Combined Volume Limitations and 2070 Monthly Demands (Medium Scenario)



Summary

GSI compared the maximum authorized rate and volume associated with each Partner's water rights to their projected average day and maximum day demands during the 50-year planning period (2020 to 2070).

The comparison of authorized water right rates to projected demands showed that Central Point and Eagle Point are expected to have MDDs that exceed their water right rate limitations by 2030. The comparison of authorized volume limitations to projected demands showed that Jacksonville and Phoenix are expected to have total demands during the period from May 1 through September 30 that exceed their water right volume limitations by 2030. By 2070, only MWC and Talent are projected to have sufficient volume limitations to meet their projected demands.

If the Partners' water rights and demands are combined, however, the combined water right rate authorizations and annual volume authorizations exceed the combined projected demands during the entire planning period.

Attachment A
Water Rights Table

Summary Table for Partners' Water Rights at Duff Water Treatment Plant

Application	Permit	Certificate	Transfer	Source(s)	Priority Date	Development Deadlines	Type of Beneficial Use	Maximum Rate (cfs)	Maximum Volume (AF)	Period Of Use	Conditions	Status
Ashland												
S-85733	S-54337	--	--	Lost Creek Reservoir	8/11/2003	9/7/2021	Municipal	*No rate*	1,000	Year-round	• Submit WMCP within 3 years of issuance • Install measuring device • Install fish screen/by-pass • Shall not obstruct fish passage without contacting ODFW	In permit status
								Total	**N/A**	**1,000**		
Central Point												
N/A	N/A	~~32748~~	T-9900	Rogue River	9/22/1888	10-01-2030	Municipal	1.846	666.0	April 1 – Nov. 1	• Install measuring device • Install fish screen/by-pass	In transfer status (extended to 2030)
N/A	N/A	~~32742~~										
N/A	N/A	~~32746~~										
N/A	N/A	~~32728~~										
E-194	E-19	93754	~~T-10120~~	North & South Forks Little Butte Creek	7/23/1909	N/A	Municipal & Industrial	1.13	*No duty*	April 1 – Oct. 1	• Install measuring device • Install fish screen/by-pass	Certificated right
S-589	S-407	93755	~~T-10120~~	Four Mile Lake and Fish Lake Reservoirs	3/31/1910	N/A	Municipal & Industrial	1.13	*No duty*	April 1 – Oct. 1	• Install measuring device • Install fish screen/by-pass	Certificated right
N/A	N/A	~~80566~~	T-10465	North & South Forks Little Butte Creek	9/14/1899	10-01-2014	Municipal	1.20	447.6	April 1 – Oct. 1	• Install measuring device • Install fish screen/by-pass	Transfer with COBU pending
N/A	N/A	~~80567~~			9/14/1899							
E-194	E-19	~~80569~~			7/23/1909							
S-589	S-407	~~80571~~		Four Mile Lake Reservoir, waters draining into Cascade Canal, and Fish Lake Reservoir	3/31/1910							
S-3036	S-1705	~~80574~~		Antelope Creek	6/24/1913							
							Total	**5.306**	**1113.6**			

Summary Table for Partners' Water Rights at Duff Water Treatment Plant (cont.)

Application	Permit	Certificate	Transfer	Source(s)	Priority Date	Development Deadlines	Type of Beneficial Use	Maximum Rate (cfs)	Maximum Volume (AF)	Period Of Use	Conditions	Status
Eagle Point												
S-589	S-407	88552	~~T-9973~~	Four Mile Lake & Fish Lake Reservoirs	3/31/1910	N/A	Municipal	0.90	321.3	April 1 – Oct. 31	• Install measuring device • Install fish screen/by-pass	Certificated right
S-589	S-407	~~83263~~	T-10527	Four Mile Lake Reservoir & waters draining into Cascade Canal & Fish Lake Reservoir	3/31/1910	10-01-2013	Municipal	0.50	181.5	April 1 – Oct. 31	• Install fish screen/by-pass	Transfer with COBU pending
S-589	S-407	~~84949~~	T-10614	Four Mile Lake Reservoir & waters draining into Cascade Canal & Fish Lake Reservoir	3/31/1910	10-01-2030	Municipal	1.15	273.7	April 1 – Oct. 31	• Install measuring device • Install fish screen/by-pass	In transfer status (extended to 2030)
E-194	E-19	~~83381~~	T-10960	North & South Fork Little Butte Creeks	7/23/1909	10/1/2030	Municipal	1.77	520.3	April 1 – Oct. 1	• Operate measuring device • Install fish screen/by-pass	In transfer status (extended to 2030)
S-589	S-407	~~83383~~		Four Mile Lake Reservoir, waters draining into Cascade Canal, and Fish Lake Reservoir	3/31/1910					April 1 – Oct. 31		
S-589	S-407	89864	~~T-10160~~	Four Mile Lake Reservoir, waters draining into Cascade Canal and Fish Lake Reservoir	3/31/1910	N/A	Municipal	1.25	356.94	April 1 – Oct. 31	• Install measuring device • Install fish screen/by-pass	Certificated right
E-194	E-19	~~83381~~	T-12221	North & South Forks Little Butte Creek	7/23/1909	10/1/2030	Municipal	0.70	207.2	April 1 – Oct. 1	• Operate approved fish screen	In transfer status
S-589	S-407	~~83383~~		Four Mile Lake Reservoir & waters draining into Cascade Canal & Fish Lake Reservoir	3/31/1910					April 1 – Oct. 31		
							Total	**6.27**	**1860.94**			
Jacksonville												
S-80641	S-53445	87360	--	Lost Creek Reservoir	10/10/1995	N/A	Municipal	*No rate*	400.0	Year-round	• Install fish screen/by-pass	Certificated right
S-88088	S-54974	--	--	Lost Creek Reservoir	5/21/2015	11/19/2035	Municipal	*No rate*	200.0	May 1 – Sept. 1	• Install measuring device • Install fish screen and passage	In permit status
							Total	**N/A**	**600**			

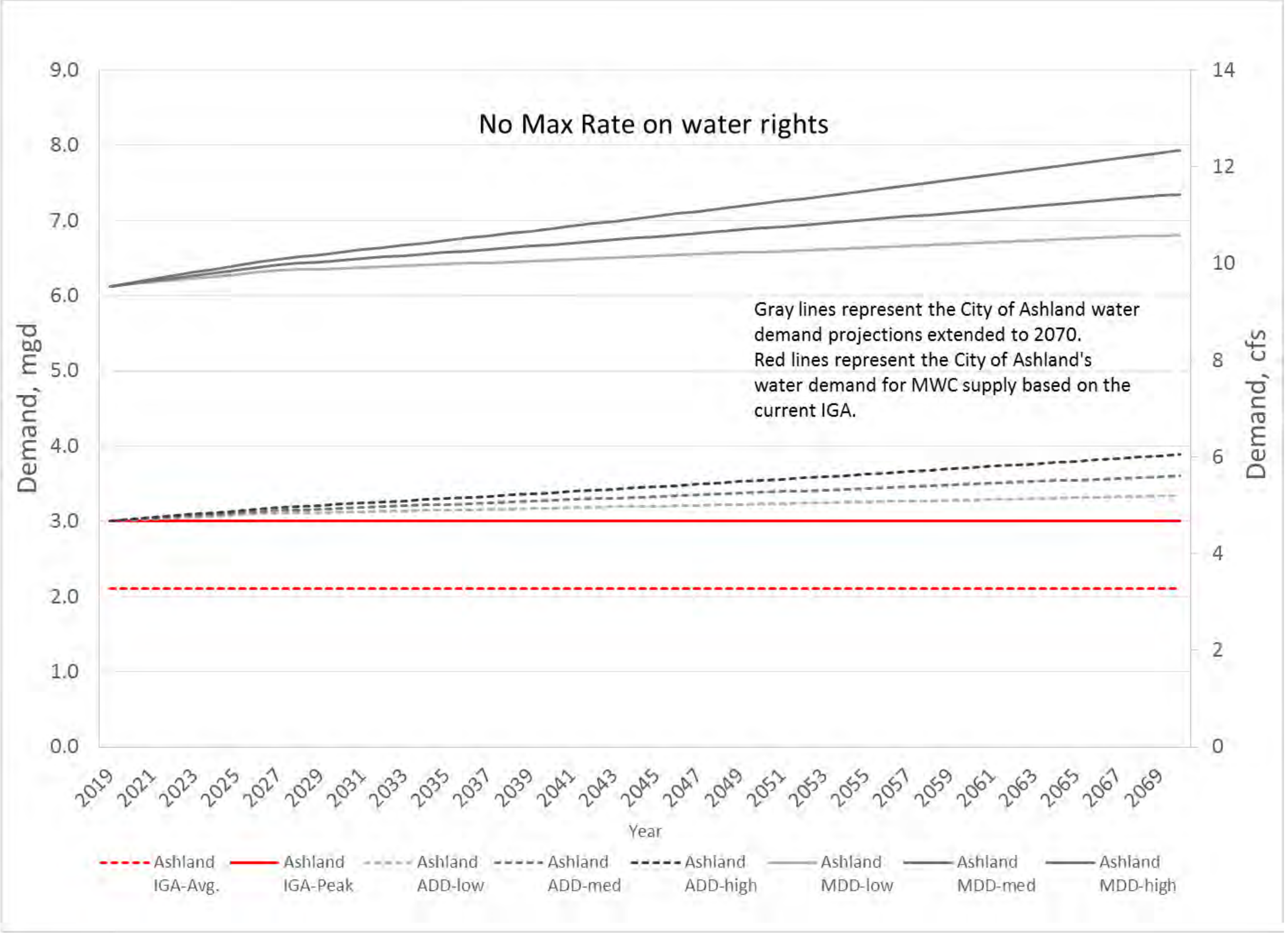
Summary Table for Partners' Water Rights at Duff Water Treatment Plant (cont.)

Application	Permit	Certificate	Transfer	Source(s)	Priority Date	Development Deadlines	Type of Beneficial Use	Maximum Rate (cfs)	Maximum Volume (AF)	Period Of Use	Conditions	Status
Medford Water Commission												
S-29527	S-23210	86832	--	Rogue River	10/22/1954	N/A	Municipal	60.85	*No duty*	Year-round		Certificated right
S-29257	S-23210	--	--	Rogue River	10/22/1954	10/1/2050	Municipal	39.15	*No duty*	Year-round	• "Fish persistence" conditions • MWC currently has access to 7.5 cfs	In permit status
S-10120	S-54935	--	Permit amendment T-11916	"Big Butte Creek, the springs and all tributaries thereof"	5/28/1925	10/1/2056	Municipal	*"All remaining unappropriated waters of Big Butte Creek…" (50 cfs)*	*No duty*	Year-round	• Install measuring device • Install fish screen • MWC currently has access to 3.1 cfs	In permit status
							Total	**~ 150**	**N/A**			
Phoenix												
S-60890	S-47672	--	--	Lost Creek Reservoir	10/9/1980	10-01-2001 COBU on hold	Municipal	5.00	400.0	Year-round		In permit status with COBU pending (currently on hold)
S-71996	S-52650	--	--	Lost Creek Reservoir	11/15/1991	10/1/2030	Municipal	3.10	600.0	Year-round	• Access to water beyond 516.27 AF must be authorized through an approved WMCP. • Install measuring device • Install fish screen	In permit status
							Total	**8.1**	**1,000**			
Talent												
S-84029	S-53898	--	--	Lost Creek Reservoir	12/28/1998	10-01-2065	Municipal	*No rate*	759.0	May 1 – Oct. 31	• Access to water must be authorized through an approved WMCP. • Install measuring device • Install fish screen/by-pass • Shall not obstruct fish passage without contacting ODFW	In permit status
S-84029	S-53898	91134	--	Lost Creek Reservoir	12/28/1998	N/A	Municipal	*No rate*	533.0	May 1 – Oct. 31	• Install measuring device • Install fish screen • Shall not obstruct fish passage without contacting ODFW	Certificated right
							Total	**N/A**	**1,292**			

Attachment B

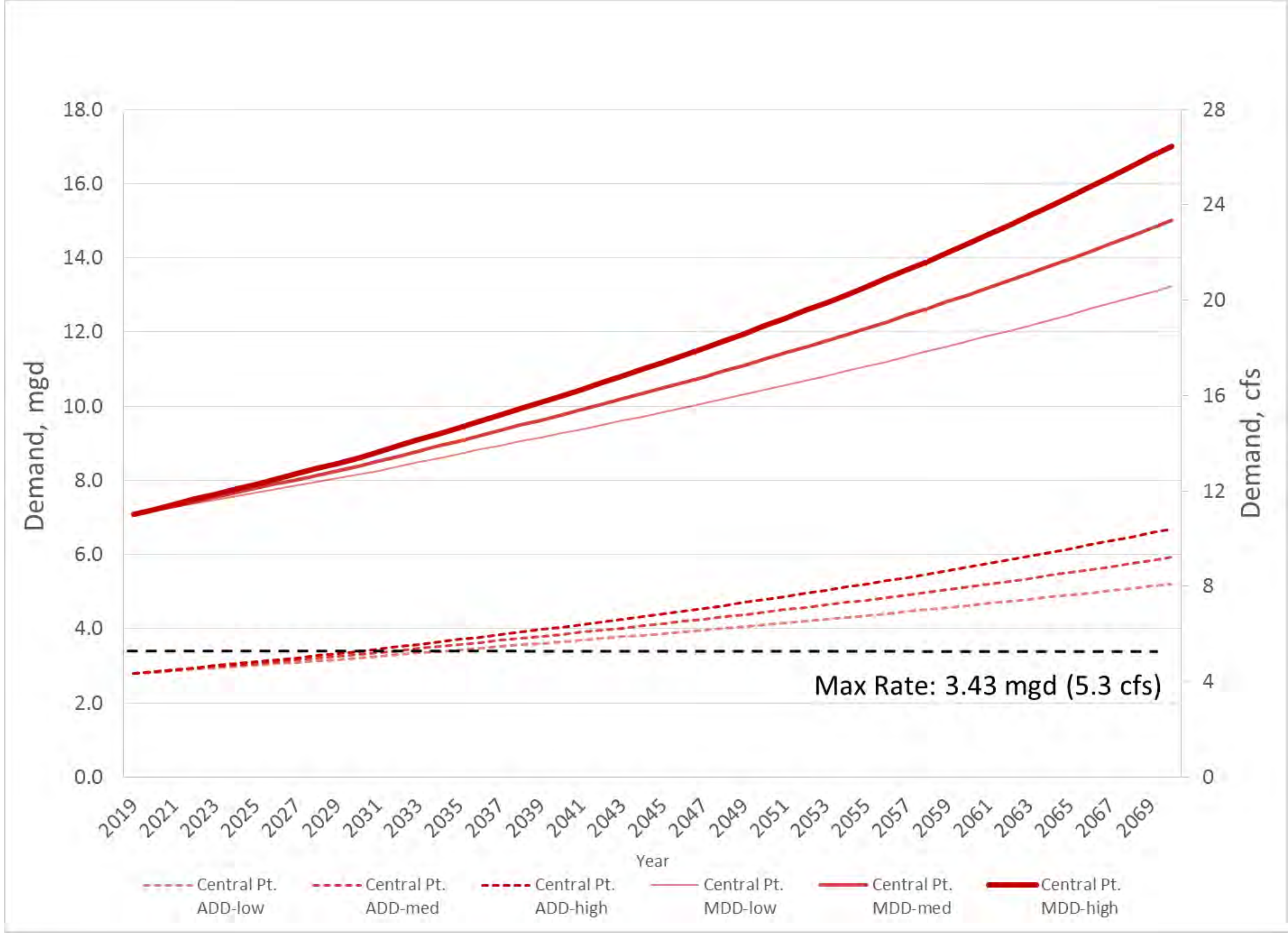
Maximum Authorized Rates Compared to ADDs and MDDs

Ashland – Max Rate vs. Demands



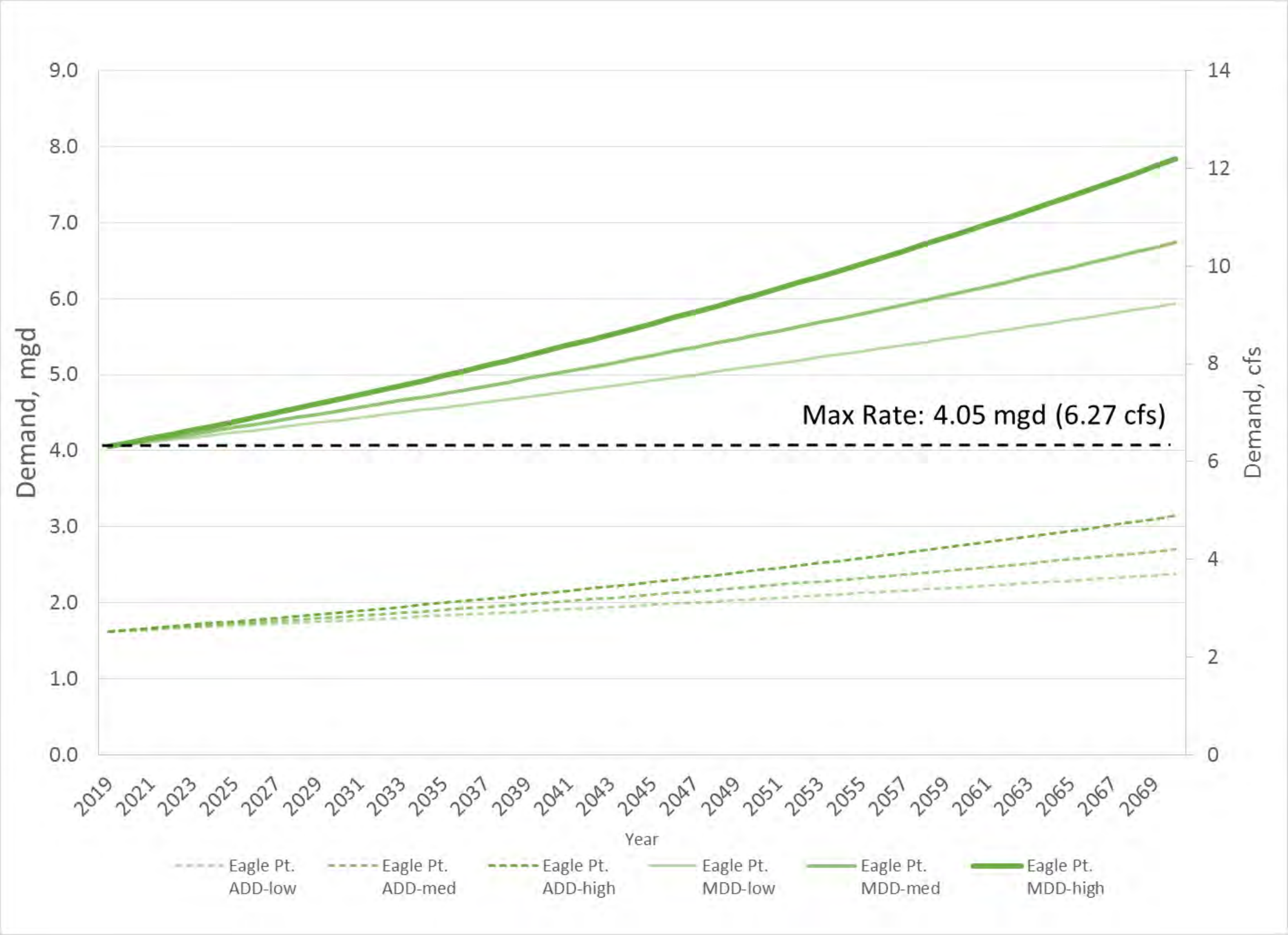
GSI Water Solutions, Inc.

Central Point – Max Rate vs. Demands



GSI Water Solutions, Inc.

Eagle Point – Max Rate vs. Demands



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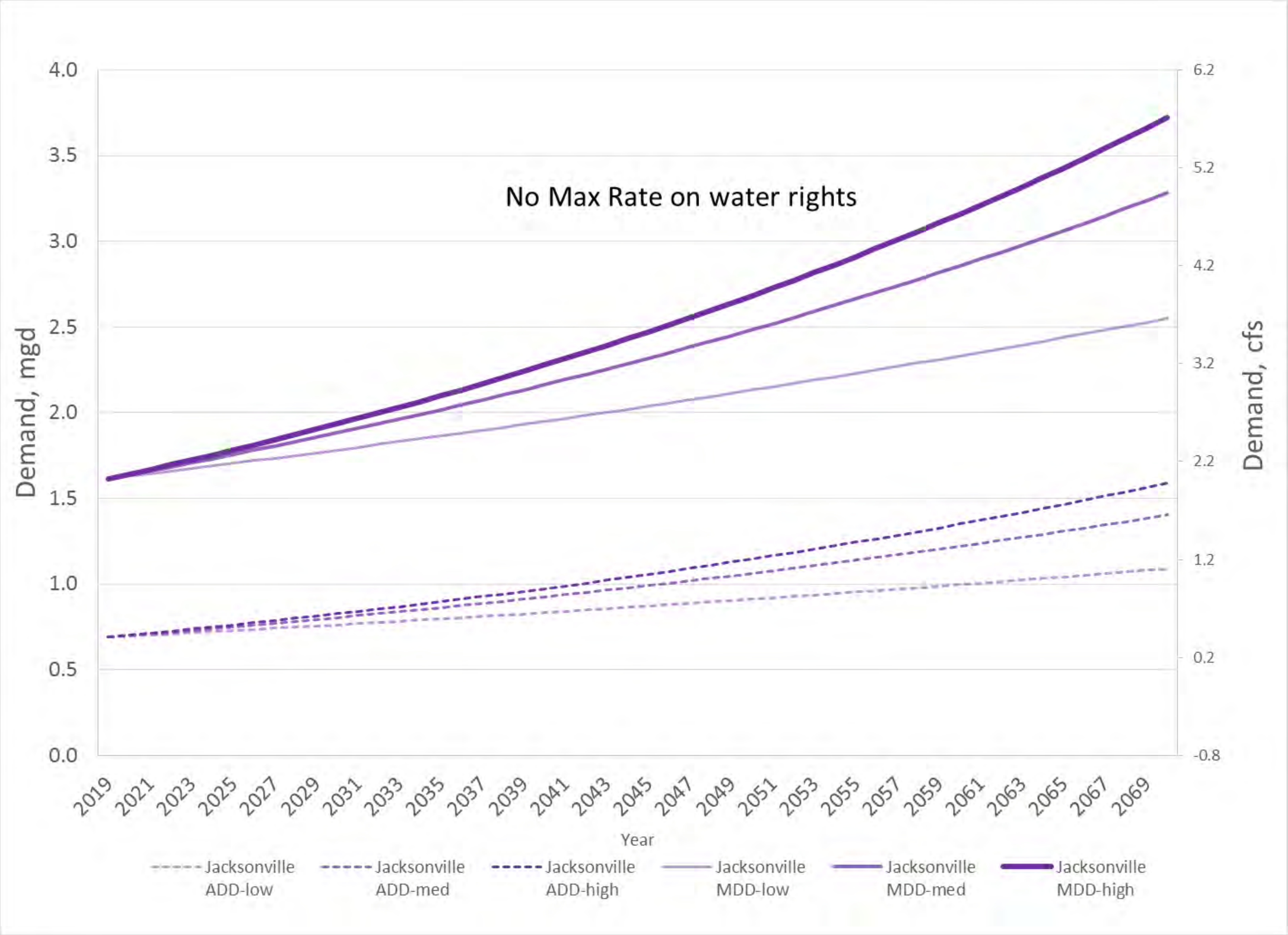
Jacksonville – Max Rate vs. Demand



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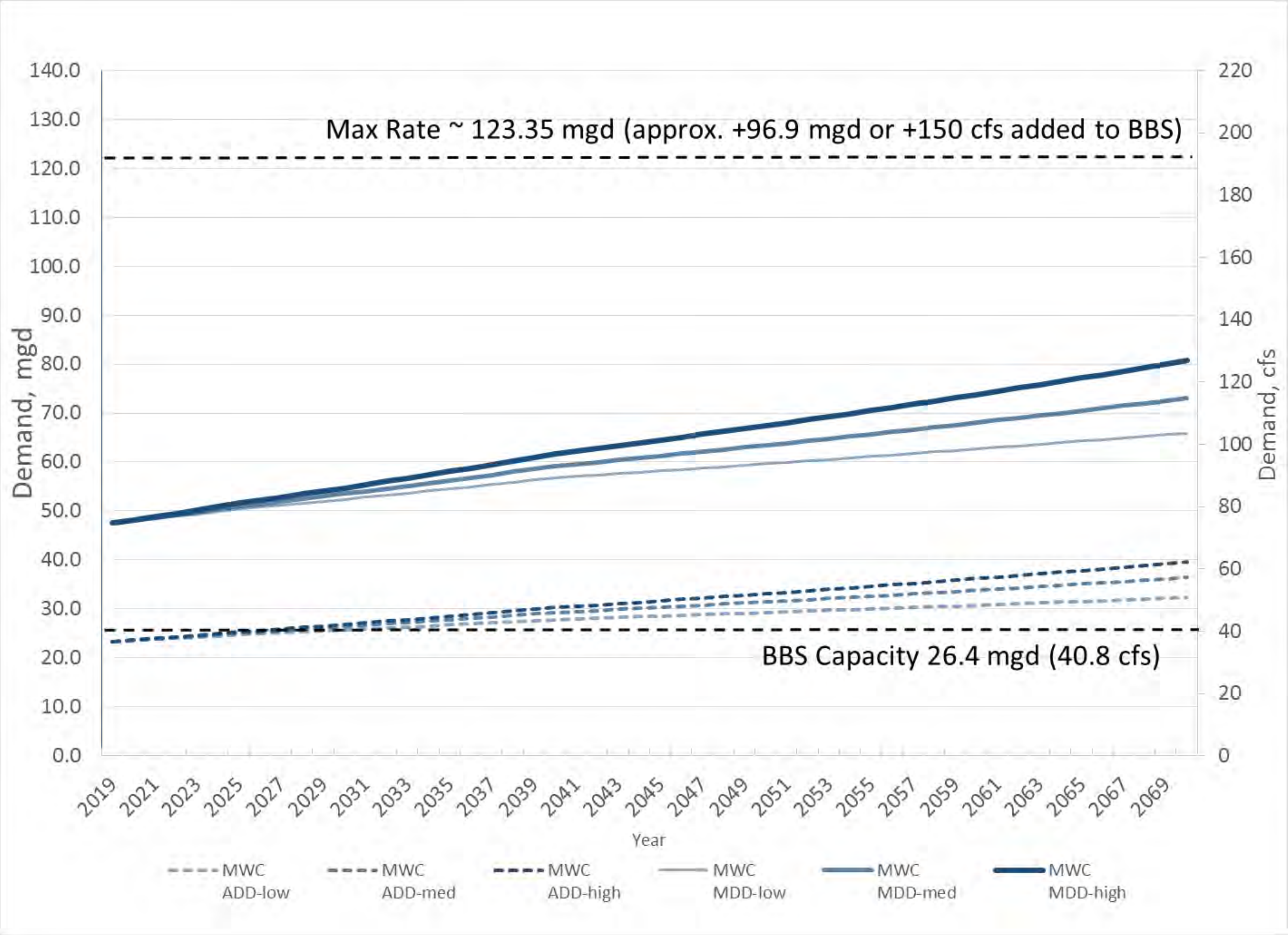
MWC – Max Rate vs. Demand



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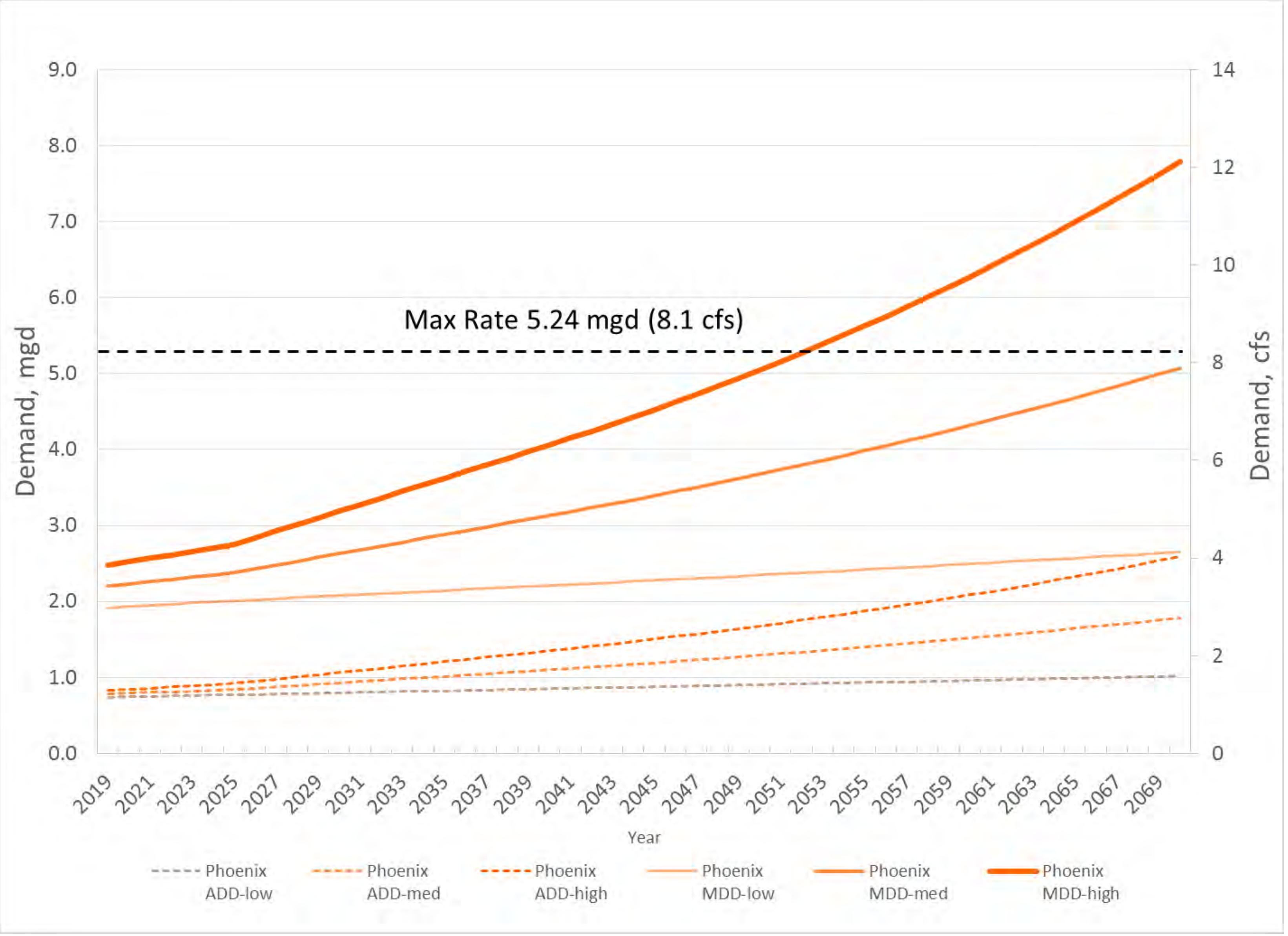
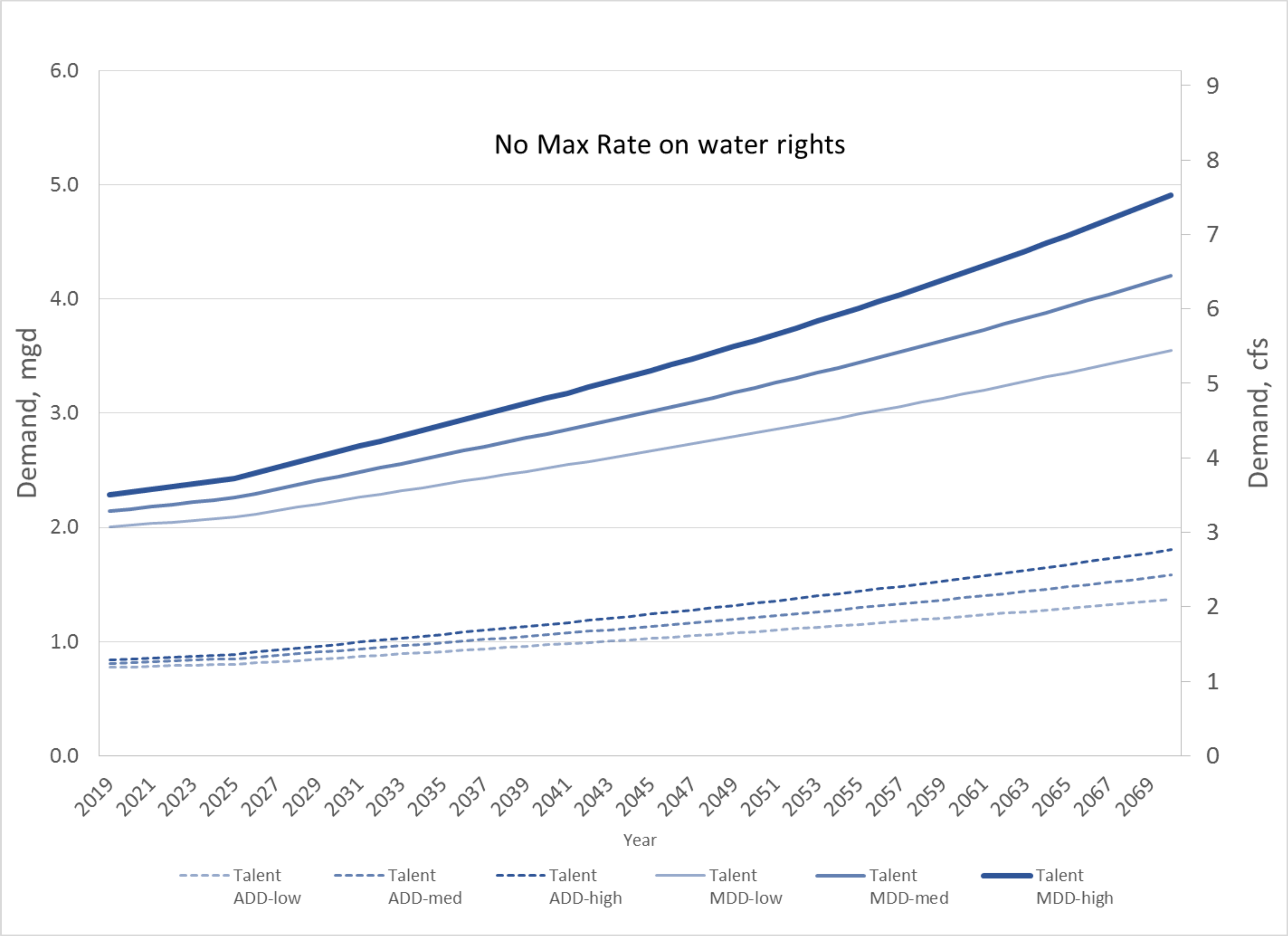
Phoenix – Max Rate vs. Demands

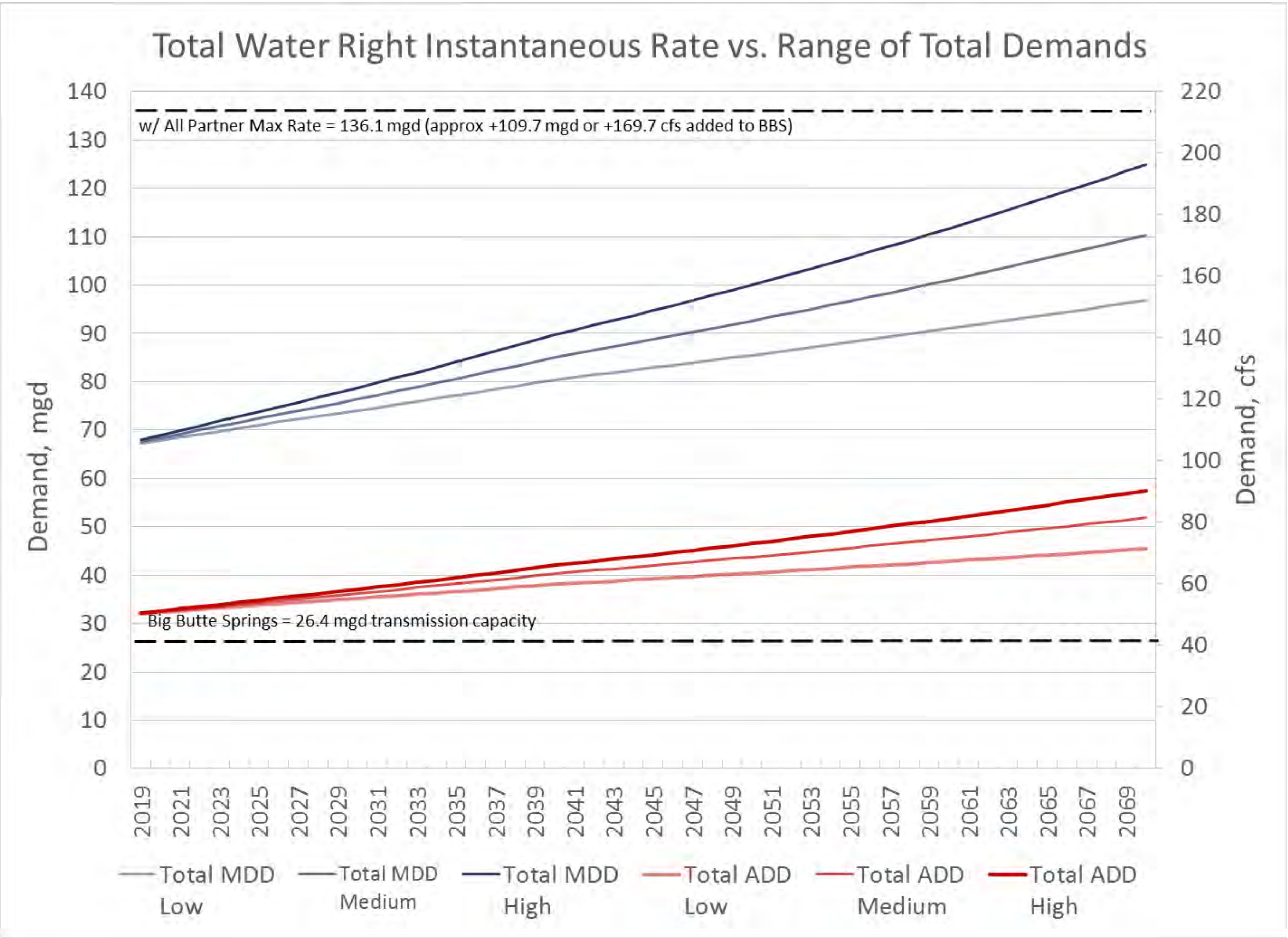


GSI Water Solutions, Inc.

Talent – Max Rate vs. Demands



GSI Water Solutions, Inc.



GSI Water Solutions, Inc.

Attachment C

Monthly Distribution of Partners’ Water Use

Monthly Distribution of Annual Demands

Month	Ashland	Central Point	Eagle Point	Jacksonville	MWC	Phoenix	Talent
January	0%	5.0%	5.5%	4.1%	6%	5.4%	5.4%
February	0%	4.0%	4.4%	3.2%	5%	4.4%	4.4%
March	0%	4.0%	4.3%	3.4%	5%	4.4%	4.4%
April	0%	4.8%	5.3%	4.2%	6%	4.8%	4.8%
May	0%	8.1%	8.2%	7.1%	9%	8.5%	8.5%
June	10%	13.3%	12.3%	12.9%	12%	11.6%	11.6%
July	35%	18.1%	16.5%	19.5%	15%	16.0%	16.0%
August	30%	14.1%	13.3%	15.5%	13%	12.1%	12.1%
September	20%	12.0%	11.5%	13.8%	10%	12.8%	12.8%
October	5%	7.1%	7.7%	7.2%	8%	9.3%	9.3%
November	0%	4.5%	6.4%	5.1%	6%	6.1%	6.1%
December	0%	4.9%	4.6%	3.8%	5%	4.5%	4.5%
Total	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*

GSI Water Solutions, Inc.

Attachment D
Monthly Water Demands for Each Partner in 2030
(Medium Scenario)

2030 Monthly Demands
(Medium Scenario in MG)

	Ashland	Central Point	Eagle Point	Jacksonville	MWC	Phoenix	Talent	Total
ADD (mgd)	**3.00**	**3.30**	**1.82**	**0.80**	**26.38**	**0.93**	**0.92**	
Annual (MG)	**280**	**1,205**	**663**	**294**	**9,629**	**338**	**336**	**12,744**
January	-	60.6	36.5	12.1	577.8	18.2	18.1	**723**
February	-	48.3	29.2	9.4	481.5	14.9	14.8	**598**
March	-	48.6	28.4	10.1	481.5	15.0	14.9	**598**
April	-	58.4	35.0	12.4	577.8	16.4	16.2	**716**
May	-	97.3	54.3	20.8	866.6	28.6	28.4	**1,096**
June	28.0	160.4	81.3	37.9	1,155.5	39.3	39.0	**1,541**
July	97.9	218.3	109.6	57.3	1,444.4	54.1	53.7	**2,035**
August	83.9	169.8	88.0	45.6	1,251.8	41.0	40.7	**1,721**
September	55.9	144.8	76.4	40.6	962.9	43.4	43.1	**1,367**
October	14.0	85.2	51.3	21.1	770.3	31.4	31.2	**1,005**
November	-	53.9	42.4	15.0	577.8	20.7	20.6	**730**
December	-	58.9	30.4	11.3	481.5	15.1	15.0	**612**

GSI Water Solutions, Inc.

Memorandum

To: Partner Water Providers

From: Tim Henkle, GSI Water Solutions, Inc.
Kimberly Grigsby, GSI Water Solutions, Inc.
Adam Sussman, GSI Water Solutions, Inc.

Date: October 18, 2019

Re: Examples of Regional Water Sharing

GSI Water Solutions, Inc. (GSI) is assisting the "Partner Water Providers" (Partners) understand opportunities and methods to cooperatively share water supplies. (The Partners include Medford Water Commission (MWC) and the Cities of Ashland, Central Point, Eagle Point, Jacksonville, Phoenix, and Talent.) This regional approach has precedent in Oregon. Other Oregon water providers have found regional water sharing to be an effective method to strengthen collective water supply and to address water supply challenges in their particular regions. This memorandum highlights elements of regional partnerships that may be useful to the Partners as they contemplate the development of an Intergovernmental Agreement.

For this memorandum, GSI references six intergovernmental agreements (IGAs):

- Joint Water Commission (JWC)
- Cites of Lake Oswego and Tigard Partnership (LOT)
- City of Gresham and Rockwood People's Utility District (Gresham-Rockwood)
- Yamhill Regional Water Authority (YRWA)
- North Clackamas County Water Commission (NCCWC)
- Willamette Intake Facilities Commission (WIFC)

These IGAs define the terms under which these partnerships operate, including how the members pool and share assets. Assets include water rights, real property, and infrastructure, among other assets. This memorandum describes multiple topics addressed in these agreements, including partnership governance, pooling and sharing of assets, access to additional supplies, and mutual forecasting.

Governance
Governance refers to the method by which a regional partnership is organized and governs the affairs of the partnership. The IGAs researched for this memorandum describe two types of management structures: establishment of a commission, and reliance on the members' governing bodies to manage the partnership; however, there may be several other alternative approaches for the Partners to consider.

The commission form of governance is common among partnerships with more than two members. In this structure, a governing body (typically called a commission or board) is formed through the IGA and is made up of representatives from each of the members. In most cases, the members are equally represented, as in the case of the JWC, YRWA, and the WIFC. GSI identified multiple approaches to the management of the activities of the commissions. The IGAs for the JWC, YRWA, and WIFC direct one of the members to carry out the directives of the commission. Alternatively, as in the case of the NCCWC, the commission is given the responsibility to hire and manage employees. Some commissions, like the WIFC, establish committees made up of the members to oversee specific business affairs of the commission—these committees include management, operations, and finance committees, which operate under the authority of the commission.

In the second form of governance identified in the IGAs, the members' governing bodies, for example a city council or utility board, operate and manage the members' assets. Day-to-day operations and maintenance of jointly held assets may, however, be left to one of the members, leaving the governing bodies of the members with decision-making responsibilities associated with budgeting and finance, acquisitions and dispositions, policy development, and other significant business affairs. The LOT and Gresham-Rockwood IGAs direct the managing members' activities through committees that are made up of the representatives from the members. This structure is common among partnerships with only two members.

For the Partners, governance options to consider for further discussion could include:

1) Use an existing entity, such as the MWC, to manage the partnership along with committees to gather input from partnership members on particular topics.

2) Formation of a Partner Cities entity that is managed (staff/admin) by the MWC.

3) Formation of a Partner Cities entity that is managed by the Partner Cities.

4) Formation of a new entity that includes MWC and the Partner Cities.

5) Some combination of the above or one governance structure for the short term (10-20 years) with consideration of a different approach in the longer-term.

Pooling and Sharing of Assets
The partnerships researched for this memorandum primarily were formed to pool and share assets, such as water supplies/water rights. The water rights typically continue to be held in the members' names. For example, in the Gresham-Rockwood IGA, Rockwood holds the two groundwater rights listed in the members' IGA, but Gresham gains access to these rights

through the IGA, which specifies a minimum rate of supply available for use by Gresham. Alternatively, the partnership entity, such as a commission, may hold water rights for use by the members. The partnership can hold water rights as the result of assignments of rights to the partnership from the members. For example, two members assigned the NCCWC water rights that make up the largest portion of the pooled rights. A partnership also may apply for new water rights in the name of the partnership. For example, the JWC applied for and obtained a surface water right for use by the members.

The referenced IGAs also address sharing water supply infrastructure. Ownership of infrastructure can be conveyed to the water supply partnership entity, or the individual members can retain ownership of the infrastructure. Members may buy into existing infrastructure or members may attain ownership through participation in construction of shared infrastructure. The entities created by the IGA (such as commissions) generally manage the shared infrastructure.

Access to Additional Supplies

One of the purposes of forming a partnership is to allow members to gain access to additional water supplies in order to supplement members' existing supplies. Some of the IGAs referenced expressly allow such arrangements when excess supplies exist. These IGAs require compensation to the members that provide the additional water supplies. The NCCWC requires compensation be paid to the provider by the user based on the "cost of service." The NCCWC's IGA references the American Water Works Association's M1 Manual for the method of calculating the cost of service.

Some IGAs afford members an opportunity to lease excess water supply capacity, whether water rights or infrastructure, to other members when a member recognizes the need in advance for access to additional supply (e.g. water rights) or additional infrastructure capacity. The benefit of this arrangement is that leasing can provide the member seeking additional water supply longer-term access to that supply. While leasing may not be an element that the Partner Water Providers are considering at this time, the method by which lease rates are established may be instructive for the Partner Water Providers in determining the cost of water when water is shared among members. The JWC IGA describes that leasing rates are based on the value of assets used. Specifically, rates are established by "…using the depreciated replacement cost value of the infrastructure used to obtain the supply at a pre-determined interest rate over the remaining life of the asset." The JWC has the authority to confirm that the water provider has extra capacity to lease in order to avoid an over-allocation of the commission's shared resources.

Mutual Forecasting

Some partnerships utilize mutual forecasting as a means to ensure enough shared capacity exists to meet the members' near-term demands and to identify future deficiencies in supplies required to meet forecasted demands. The LOT IGA requires the members to forecast their demands ten years into the future on an annual basis. The JWC IGA requires a ten-year forecast in addition to a requirement that the members describe the sources by which the members will meet these demands. The partnerships' managing entities (e.g. a commission) typically coordinate this forecasting process.

Conclusion/IGA Framework for Partner Water Providers

The concept the Partner Water Providers are contemplating is a bit unique in that it will initially focus only on pooling existing water rights/water supply. However, the IGAs found and researched provide good examples and concepts for the framework of a regional entity IGA, which will be further described in the Water Rights Strategy for Partner Water Providers and subsequent phases of this project.

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Appendix B: Calibration Testing Plan TM

Brown and Caldwell, May 16, 2019

Brown AND Caldwell

6500 SW Macadam Ave, Suite 200
Portland, OR 97239

T: 503.244.7005

Technical Memorandum

Prepared for: City of Central Point

Project Title: Water System Master Plan Update

Project No.: 152988

Technical Memorandum [No. 1]

Subject: Calibration Testing Plan

Date: May 16, 2019

To: Matt Samitore

From: Janice Bell

Copy to: Mike McClenathan

Prepared by: Janice Bell

Janice Bell, Brown and Caldwell

Limitations:

This document was prepared solely for City of Central Point in accordance with professional standards at the time the services were performed and in accordance with the contract between The City of Central Point and Brown and Caldwell dated 12/18/2018. This document is governed by the specific scope of work authorized by The City of Central Point; it is not intended to be relied upon by any other party except for regulatory authorities contemplated by the scope of work. We have relied on information or instructions provided by The City of Central Point and other parties and, unless otherwise expressly indicated, have made no independent investigation as to the validity, completeness, or accuracy of such information.

Table of Contents

List of Figures

System testing overview figures and detailed test site figures are included in Attachment A.

List of Tables

Section 1: Introduction

This Technical Memorandum (TM) describes the calibration testing to be performed for the City of Central Point (City). It includes a discussion of the personnel, preparation and necessary equipment for testing, collection of SCADA data, test procedures and test locations.

The data gathered during testing will be used to calibrate a computer model of the City water distribution system. The purpose of calibration testing is to document actual operating conditions that occur in the water distribution system. The test data will be compared with computer model output to confirm that the model provides accurate results.

Calibration testing will consist of hydrant flow tests, pump tests and pressure verification at master meter stations and pressure stations. Hydrant tests are performed by flowing a hydrant and recording pressures at a nearby hydrant.

Section 2: Personnel, Preparation and Necessary Equipment

2.1 Personnel

Two representatives from Brown and Caldwell will be present to coordinate the calibration testing and to collect and record test data. Two City staff members will be needed to install testing/monitoring equipment provided by Brown and Caldwell, help in data collection, and operate system hydrants, valves, pumps, etc.

2.2 Preparation

Effort is needed from City staff to prepare for testing. City staff should verify that all SCADA pressure/flow/level monitoring equipment is functioning properly prior to the start of testing.

City staff should visit or review each of the sites proposed for hydrant tests to verify that the flushing flow will not damage property or cause a significant disturbance to the community. Specifically, City staff should check for the following:

1. Identified test hydrants or flushing valves can be accessed safely and are operational.
2. Drainage at the test sites is adequate to allow water to flow away from the sites without flooding nearby properties.
3. Flow diffusers can be positioned in a way that will not spray nearby structures or cause excessive erosion.

2.3 Equipment

Brown and Caldwell will provide hydrant testing equipment. The City is requested to provide two hydrant keys, two valve wrenches and two 3-inch pipe wrenches to assist with testing. Table 1 lists the equipment needed for the calibration testing. Brown and Caldwell will check their equipment prior to the day of testing to verify that it is functional and accurate.

Table 1. Required Equipment for Calibration Testing		
Item	Quantity	Provided By
Hydrant key	2	City
Valve wrench	2	City
3-inch Pipe Wrench	2	City
Crescent wrench sets	2	BC
Tape measure	2	BC
Radios	2	BC
Flow-metering hydrant diffuser	2	BC
Pressure logger	15	BC
Motor logger	8	BC
Calibrated 200 psi pressure gauge	2	BC
Hydrant caps and connectors for attaching loggers/gauges		BC

Section 3: Collection of SCADA Data

Data will be collected from the City's SCADA system database for the week the testing takes place. The City has provided BC with a link for direct download of their SCADA database, which will be used to download data from the week of testing. The following data will be collected:

- Pump or pump station flow, suction pressure (when available), and discharge pressure
- Master meter station flow, suction pressure and discharge pressure
- Pressure station pressure
- Tank water levels

Section 4: Test Procedures and Agenda

Three types of field tests will be performed: hydrant tests, master meter tests, and pump tests. Each test should follow the procedures described below. Before performing the tests, pressure and motor loggers will be installed. The anticipated testing schedule is:

- June 25th (afternoon) – Meet with City staff to review plan
- June 26th – Install loggers and perform field testing
- June 27th – Complete testing and remove loggers

All data and comments should be recorded on the forms provided by Brown and Caldwell. During the testing period, any valves in the system that are known or suspected to be closed as well as any pipe breaks or other water system emergency should be reported to the Brown and Caldwell representatives.

4.1 Install Pressure and Motor Loggers

Pressure loggers will be installed at predetermined locations throughout the system, including at hydrants, pump stations, master meter stations and pressure stations. Motor loggers will be installed at all pumps. See Section 5 for a summary of test locations.

Pressure loggers should be installed as close to the pump as possible, on the pump side of any valves. Pressure loggers at master meter stations will be installed at both the suction and discharge side of the meter. Before installing pressure loggers, the connection should be flushed to clear any debris or rust that may interfere with the pressure reading.

4.2 Hydrant Test Procedures

The objective of hydrant tests is to obtain instantaneous flow and pressure data at various locations throughout the distribution system. The fire flow tests must "stress" the distribution system so that the calibration data will reflect the system's reactions to a range of operating conditions. To accomplish this, water is released during each test from one or more hydrants until a minimum pressure drop of 5 psi (10 psi desired) is experienced at the test location. Up to six fire flow tests will be performed throughout the system. Test locations are strategically located to obtain good overall flow and pressure measurements for the City. (Note: These tests are not the same as hydrant tests performed to determine available flow from a hydrant.) The steps for setting up the fire flow tests are listed in Table 2.

Table 2. Hydrant Test Procedures

Step	General Description	Detailed Description
1.	Verify test location	Verify that the test locations match the locations on the map. If other hydrants were used, mark the test hydrants on the map.
2.	Attach gauge to the pressure hydrant	Flush the pressure hydrant and attach 2 pressure gauges to the hydrant. Make sure both gauges read the same pressure (within a few psi). If the gauges do not read the same pressure, use another gauge and figure out if one of the gauges is broken.
3.	Attach diffuser to the flow hydrant	Flush the flow hydrant and attach a hydrant diffuser to the hydrant. Before attaching the hydrant diffuser, make sure the piezo tube is lined up so that if you look into the diffuser from the 2½" connection side, the hole in the piezo tube faces you directly. Between tests, attach the pressure gauge from the diffuser to a hydrant along with another gauge and compare pressures to make sure the diffuser gauge is still reading pressures correctly.
4.	Record the pressure at the pressure hydrant	
5.	Open the hydrant	By radio or hand signal, the test coordinator at the pressure hydrant instructs the person operating the flow hydrant to start flowing the hydrant. The hydrant is opened SLOWLY until a minimum 5 psi pressure (10 psi if possible) drop is observed at the pressure test site hydrant. If a sufficient pressure drop cannot be obtained, turn the hydrant off SLOWLY, add another diffuser to the other hydrant nozzle or a nearby hydrant (record which hydrant is used), and re-start the test at step 4.
6.	Record the pressure at the pressure hydrant the flow from the flow hydrant	When the pressure at the pressure hydrant stabilizes (usually one to five minutes), the coordinator records the time and pressure and signals the flow hydrant operator to record the flow.
7.	Close the hydrant	Coordinator instructs the flow hydrant to be closed SLOWLY.
8.	Record the pressure again at the pressure hydrant	
9.	Remove the pressure gauges and hydrant diffusers	

Notes

The following items should be noted throughout the tests.

- Any valves in the system that are known or suspected to be closed should be marked on the field maps.

- If hydrants identified on the map are not operational, cannot be accessed, or could cause flooding or erosion problems, find nearby hydrants to perform the test. Mark the new locations on the map.
- If flowing a hydrant, never allow the pressure to drop below 20 psi. The EPA requires a minimum pressure of 20 psi at all times, otherwise there is a possibility of contamination from backflow.

4.3 Pump Tests

The objective of pump tests is to compare the actual pump performance with the manufacturers pump cure and adjust the model as necessary. Pressure loggers and SCADA data will provide the most effective data to achieve this objective. However, single operating point test for each pump will also be useful. Pressure gauges will be attached to the piping upstream and downstream of each pump where pressure gauges are not already attached or if the attached gauges are not functioning. While the pump is running, the pump flow rate and upstream and downstream pressures will be recorded. The steps for setting up the pump test are listed in Table 3.

Table 3. Pump Test Procedures

Step	Description
1.	Review the Health and Safety Plan
2.	Attach the pressure gauge on the discharge side and the suction side (if specified in Table 5). Note: if there are gauges on the pump, remove them and use the testing gauges if possible. (The vibration of pumps can cause the existing gauges to be inaccurate).
3.	Record the time, flow rate, and pressure before, during and after operating the pumps. Record speed for pumps that have a VFD. The pump should be operated long enough that the readings stabilize (at least 5 minutes). Record specifically which pumps are operating during the test.

4.4 Pressure Station Verification

Pressure station verification will be performed to confirm that the SCADA system is recording accurate pressure readings. The tests will provide a single pressure reading for each pressure station. Calibrated pressure gauges should be used to read the pressure at five of the active pressure stations and each of the three master meter stations. The steps for performing the pressure station verification are listed in Table 4.

Table 4. Pressure Station Test Procedures

Step	Description
1.	Review the Health and Safety Plan
2.	Attach a calibrated pressure gauge as close as possible to the SCADA system pressure sensor. If a ¼" tap is not accessible on the piping next to the SCADA sensor, the pressure gauge should be attached at the closest hose-bib or hydrant. In this case, the difference in elevation between the SCADA sensor and pressure gauge should be recorded.
3.	Record pressure and time of reading.

Section 5: Test Locations

Table 5 lists the locations for hydrant flow tests and the anticipated pressure drop at several hydrant flow rates. These locations are also shown in Attachment A. Table 6 provides a summary of logger locations.

Table 5. Hydrant Test Locations				
Test No.	Flow Hydrant		Pressure Hydrant	
	Address	Lat/Lon	Address	Lat/Lon
1	406 Stone Point Drive	42.384303 -122.929664	425 Bridge Creek Drive	42.384646 -122.929981
2	655 Brandon Street	42.364949 -122.924291	567 Brandon Street	42.365298 -122.925577
3	170 Ridgeway Avenue	42.379421 -122.886824	2921 Brookside Drive	42.380495 -122.887349
4	502 Columbine Way	42.371374 -122.899317	820 Columbine Way	42.371453 -122.900166

Table 6. Loggers Locations			
Location	Pressure Loggers	Motor Loggers	Notes
Shops PS	1	2	Pressure logger at pump discharge, 1 motor logger per pump
Vilas PS	1	4	Pressure logger at pump discharge, 1 motor logger per pump
Vilas MMS	2	-	
Hopkins MMS	2	-	
Beall MMS	2	-	
Distribution system, various locations	5		Loggers to be installed at pressure stations to verify pressures in the system

Section 6: Field Work Health and Safety Awareness

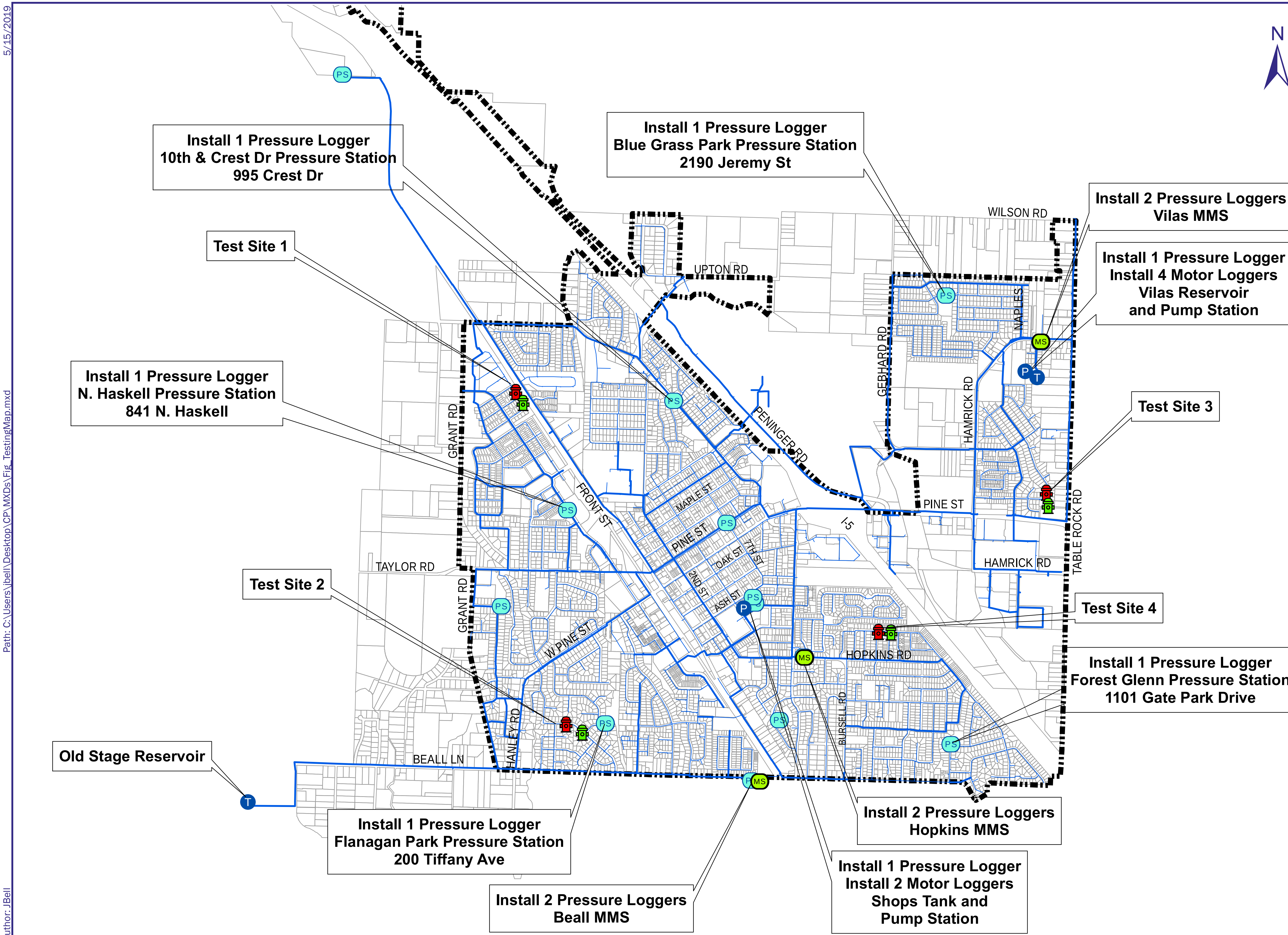
Brown and Caldwell will adhere to the project Field Work Safety Plan (FWSP) found in Attachment B. As indicated in the FWSP, Brown and Caldwell representatives shall be required to wear safety glasses and steel toe boots while conducting field testing and visiting system facilities such as pump houses, tanks, wells, etc. It is assumed that confined space entry will not be required for the testing. If confined space entry is required, the FWSP will need to be modified.

Attachment A: Calibration Plan Figures

5/15/2019

Path: C:\Users\jbell\Desktop\CP\MXDs\Fig_TestingMap.mxd

Author: JBell



City of Central Point Water System Master Plan

Testing Overview

Existing Pipe

- 2" to 10" Pipe
- 12" to 16" Pipe
- MS Master Meter Station
- PS Pressure Station
- T Tank
- P Pump
- Flow
- Residual Pressure
- UGB
- Tax Lots

0 1,000 2,000

Feet

Brown AND Caldwell

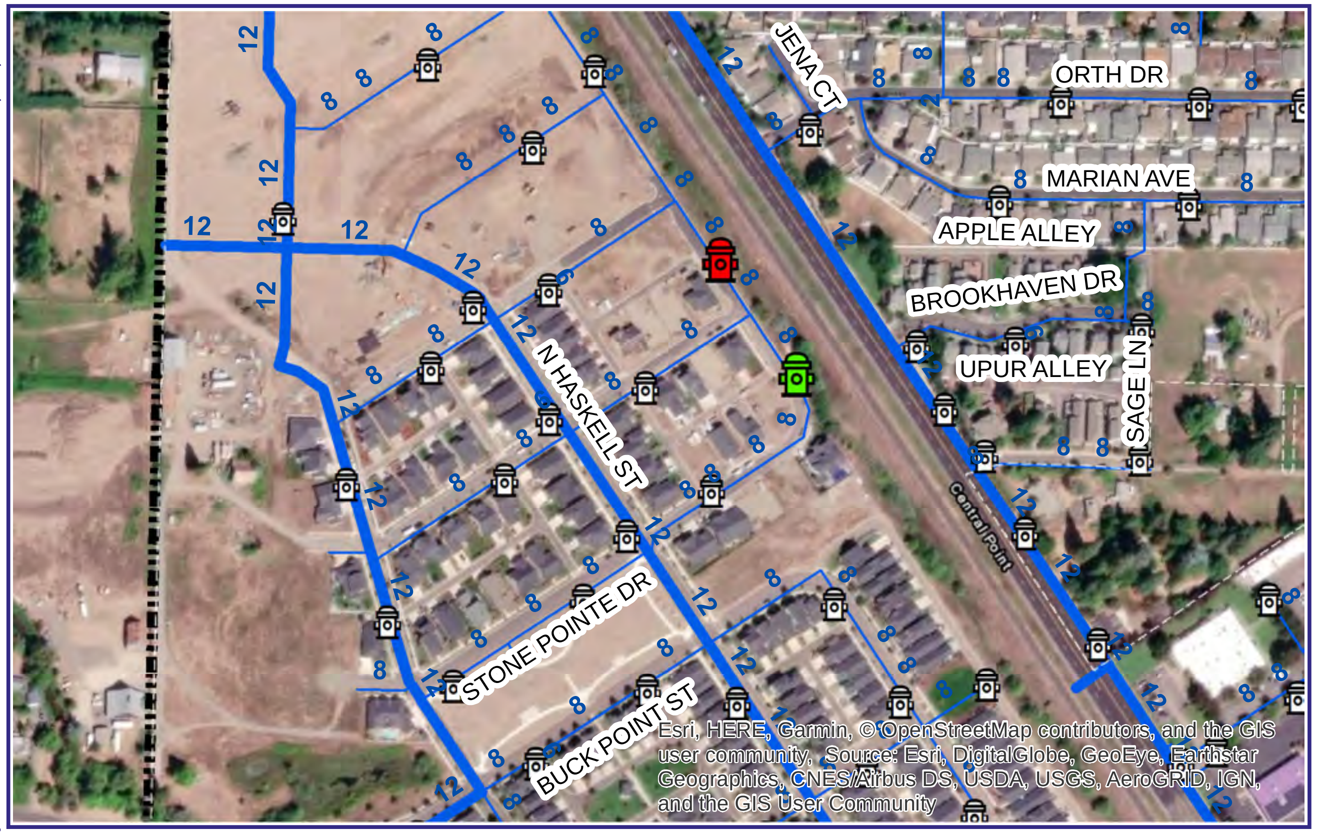
City of Central Point Water System Master Plan

Testing Locations

- Master Meter Station
- Pressure Station
- Tank
- Pump
- Flow
- Residual Pressure
- UGB
- Tax Lots

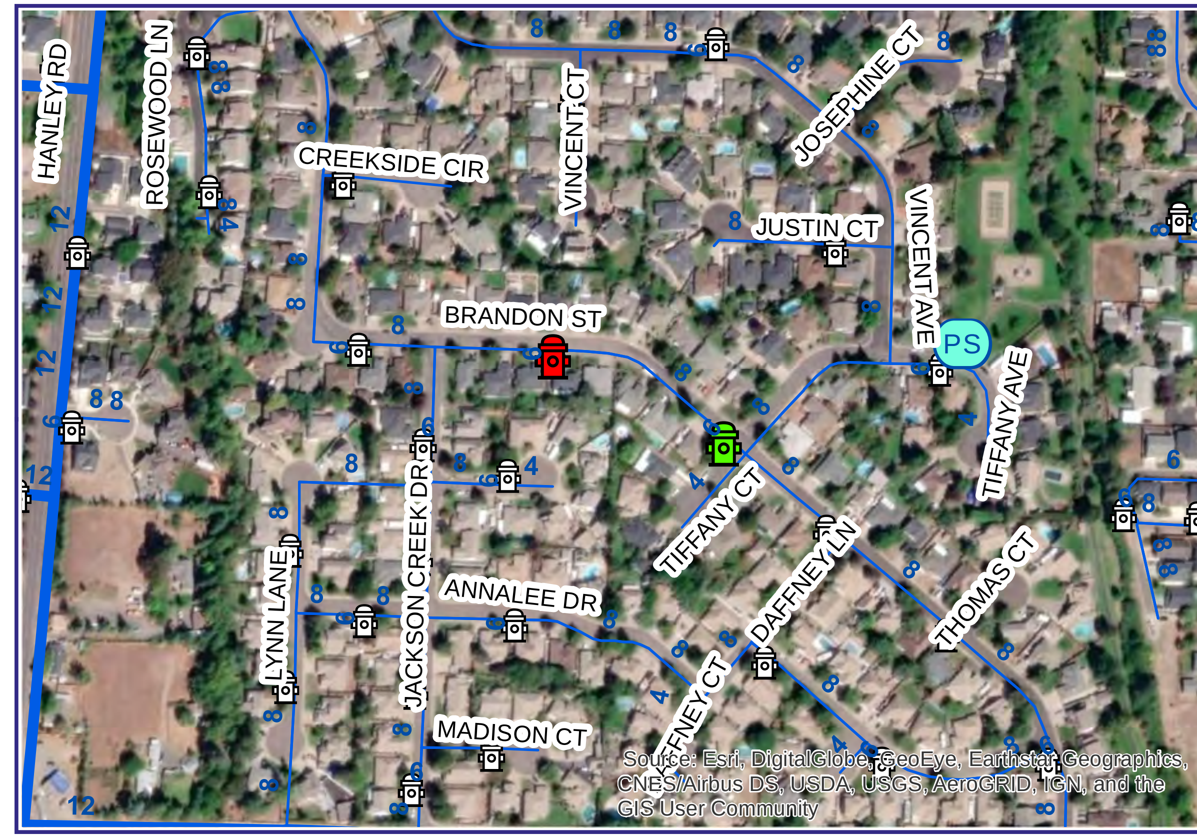
N

0 200 400
Feet



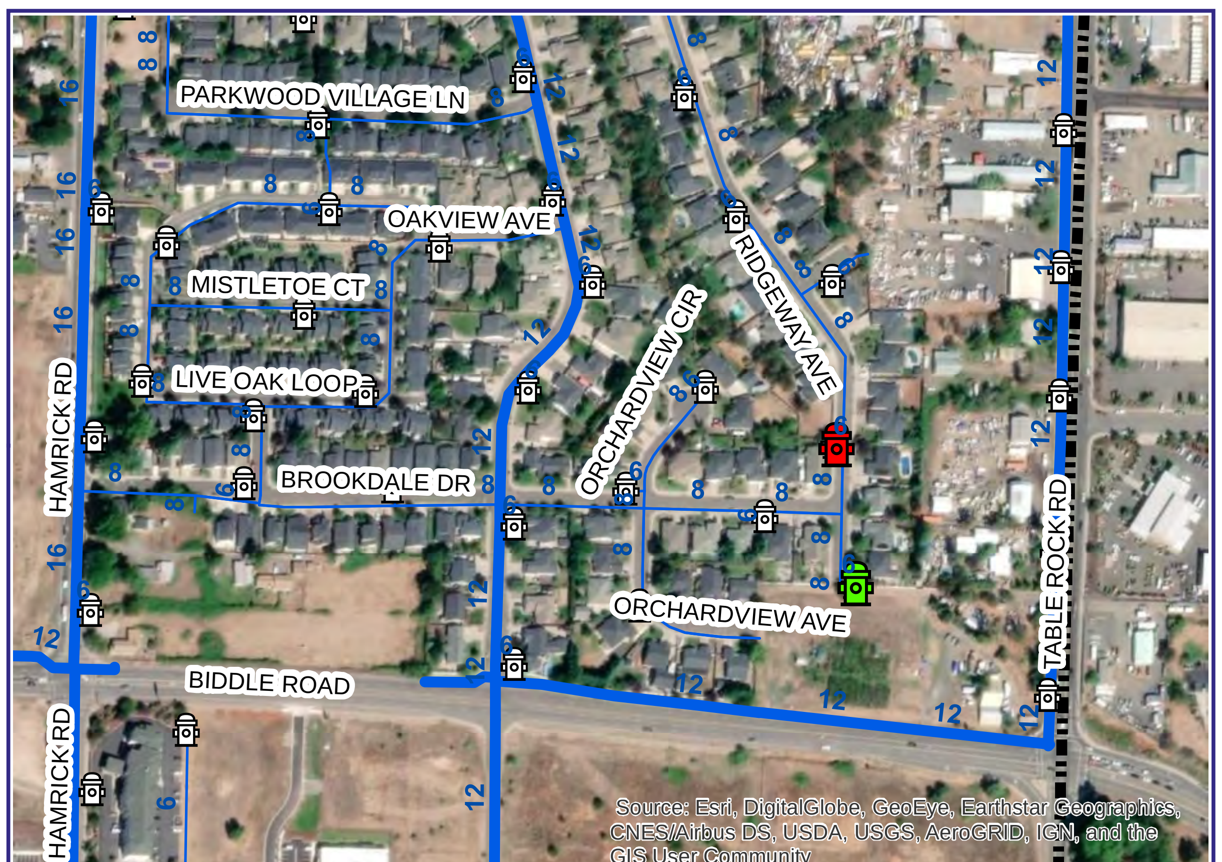
Hydrant Test Site 1

Flow Hydrant: 406 Stone Pointe, Pressure Hydrant: 425 Bridge Creek



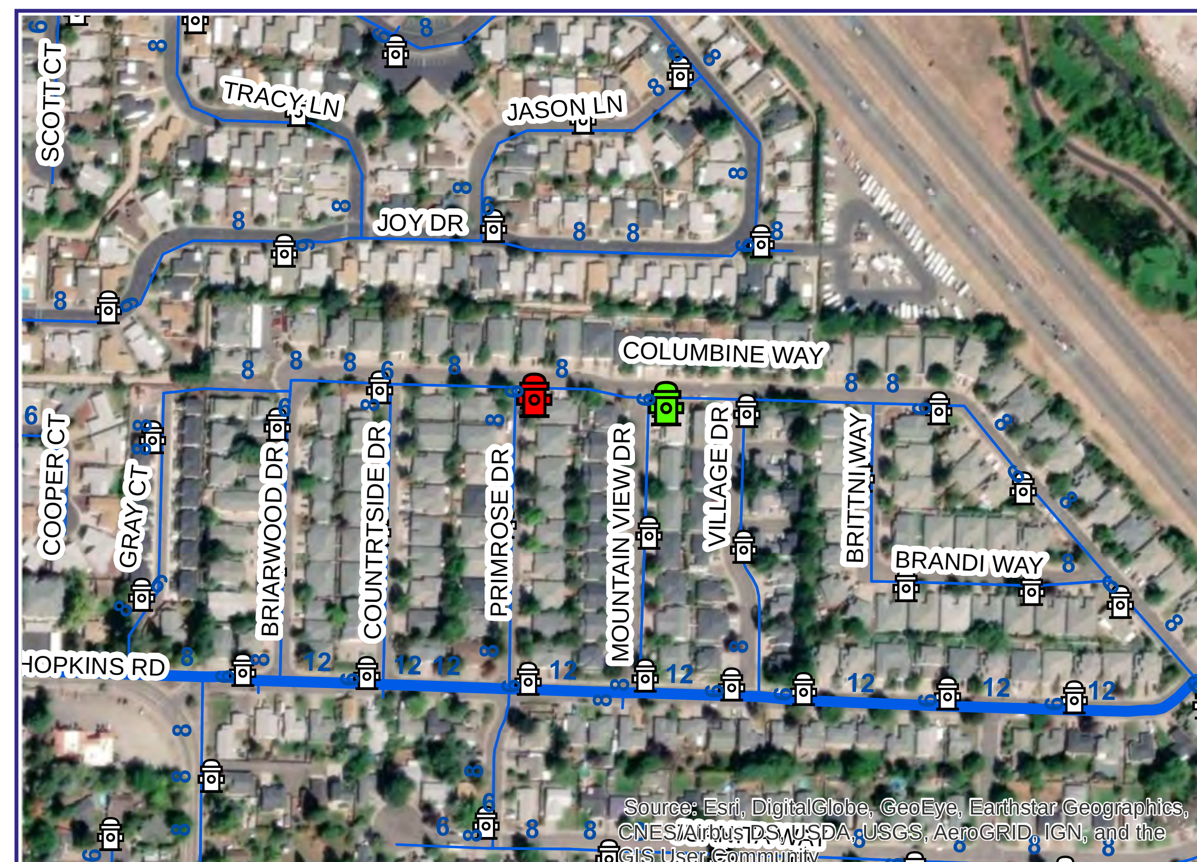
Hydrant Test Site 2

Flow Hydrant: 655 Brandon, Pressure Hydrant: 567 Brandon



Hydrant Test Site 3

Flow Hydrant: 170 Ridgeway, Pressure Hydrant: 2921 Brookside



Hydrant Test Site 4

Flow Hydrant: 502 Columbine, Pressure Hydrant: 820 Columbine

Brown AND Caldwell

5/15/2019

Path: C:\Users\jbell\Desktop\CP\MXDs\Fig_TestingMap_HydrantLocations.mxd

Author: JBell

Attachment B: Field Work Safety Plan (FWSP)

Field Work Safety Plan (FWSP) – Short Form

This Health and Safety (H&S) Plan template is intended for Brown and Caldwell (BC) projects where low hazard activities that require limited H&S planning and controls (e.g. site walkthroughs, surveys, visits, client meetings, non-construction observation, etc.) will be conducted by BC personnel or subcontractors.

GENERAL INFORMATION

Project Name:
Central Point Water System Master Plan Update

Project No:
152988

Address of Project/Site:
City of Central Point

Client Name:
Matt Samitore

Project Manager (PM) Approval (*print and sign*):
Jacob Young [signature] **Date:** 5-11-19

Safety Manager (SM) Approval (*print and sign*):
Ryan Jones on behalf of Ken Hoff [signature] **Date:** 5/16/19

Proposed Date(s) of Field Activities (*from/to*): Week of June 24th

Description of Field Work Activities:
BC will be assisting with installation of pressure loggers and supervising hydrant flow testing at specified locations. BC employee supervising tests will be Colin Ricks. Janice Bell will be assisting with the field work. City staff will operate all hydrants.

EMERGENCY CONTACT INFORMATION

Incident Intervention	(888) 449-7787	**BC Project Manager (PM)**	Jacob Young 801-316-9816 (c) 801-214-4549
Local Police	Central Point Police Department 155 South 2nd Street Central Point, OR 97502 911	**BC Safety Manager (SM)**	Kenneth Hoff 407-661-9519
Local Hospital *(Route Map Attached)*	Providence Medford Medical Center 1111 Crater Lake Ave, Medford, OR 97504 (541) 732-5000	**BC Electrical Safety Officer**	Eric Campbell 206-749-2223
		BC Risk Manager **BC Workers Comp.**	Yolanda Harden 925-210-2494 Maria Aguirre 925-210-2488
Local Ambulance	911	**Client Contact**	Matt Samitore 541-664-3321, ext 205 (c) XXX-XXX-XXX
Local Fire Dept.	600 S Front St Central Point, OR 97502 (701) 540-8591		

ADDITIONAL INFORMATION or CONTROLS

Field Staff Contact Info:
Janice Bell (BC) 541-490-3675, Colin Ricks (BC) 801-722-5111, Mike McClenathan (City Ops Lead) 541-890-0801

- **Work is not permitted:**
  - **In or around any exposed electrical components.**
  - **Around hazardous chemicals stored or used at the JVWCD facilities**

BC employees will not enter confined spaces at any of the project sites.

POTENTIAL HAZARDS

(Click on box to select - check all that apply)

Physical Hazards:

- ☒ Driving/Vehicle Operation
- ☐ Housekeeping
- ☐ Overhead Utilities
- ☐ Stairway or Ladder Use
- ☐ Electrical Hazards
- ☐ Arc Flash
- ☐ Confined Spaces
- ☐ Heavy/Mobile Equipment
- ☐ Drilling
- ☐ ATV or UTV Use
- ☐ Building Collapse
- ☐ Drum Handling
- ☐ Other:
- ☒ Work On or Near Roadways
- ☐ Noise
- ☐ Underground Utilities
- ☐ Portable Hand and Power Tools
- ☐ Energy/System Isolation
- ☐ Equipment Refueling
- ☐ Excavations
- ☐ Fire/Explosion
- ☒ High-Pressure Hazards
- ☐ Working On or Near Water
- ☒ Fatigue
- ☐ Mobile Data Collection
- ☐ Other:
- ☒ Slips, Trips and Falls
- ☐ Materials and Equipment Handling or Lifting
- ☐ Elevated Platforms/Working Surfaces
- ☐ Removing/Replacing Manhole Covers
- ☐ Personal Safety - Violence/Crime Prone Areas
- ☐ Personal Safety - Forested Areas
- ☐ Personal Safety - Hunting Areas
- ☐ Personal Safety - Shooting Ranges
- ☐ Preserved Laboratory Sample Kits
- ☐ Groundwater Sampling
- ☐ Working at Night
- ☐ Other:
- ☐ Other:

Chemical Hazards (specify):

None, finished drinking water only

Natural Phenomena Hazards:

- ☒ Sunburn
- ☒ Lightning/Electrical Storms
- ☒ Earthquakes
- ☐ Other:
- ☒ Heat Stress
- ☐ Hurricanes/Nor' Easters
- ☐ Flooding
- ☐ Cold Stress
- ☐ Tornados and Strong/Straight Line Winds
- ☐ Snow/Freezing Rain

Biological Hazards:

- ☐ Bloodborne Pathogens/Sanitary Waste
- ☐ Venomous Insects
- ☐ Fire Ants (Venomous Insects)
- ☐ Spiders/Scorpions
- ☐ Alligators
- ☐ Rodents
- ☐ Mosquitoes
- ☐ Ticks
- ☒ Pets/Farm Animals
- ☐ Chiggers
- ☐ Other Mammals/Predators
- ☐ Poisonous Plants
- ☐ Phragmites
- ☐ Snakes
- ☐ Other:

Other Hazards (specify)/Remarks:

None

CONTROLS AND PERSONEL PROTECTIVE EQUIPMENT

(Click on box to select - check all that apply)

HAZARD AWARENESS

A FWSP briefing must be conducted and documented on the BC H&S Plan Review Acknowledgement form for all personnel covered by this H&S Plan along with completion of a Daily Tailgate Meeting for each day this project is active in the field. BC personnel are to eliminate or minimize their exposure to potentially hazardous conditions identified unless appropriate, SM-Approved hazard controls are in place.

Head/Eye/Foot Protection:

☐ ANSI-approved Hard Hat ☒ ANSI-approved Safety Glasses ☒ ASTM-approved Steel/Safety Toe Boots

☐ Rubber boots/Waders ☐ Other (specify):

Body Protection:

☒ ANSI-Approved High Visibility Vest ☐ Work Clothes ☐ Coveralls ☐ Other (specify):

Hand Protection:

☐ Leather ☐ Chemical (Nitrile) ☐ Other (specify):

Hearing Protection:

☐ Ear Plugs ☐ Ear Muffs ☐ Other (specify):

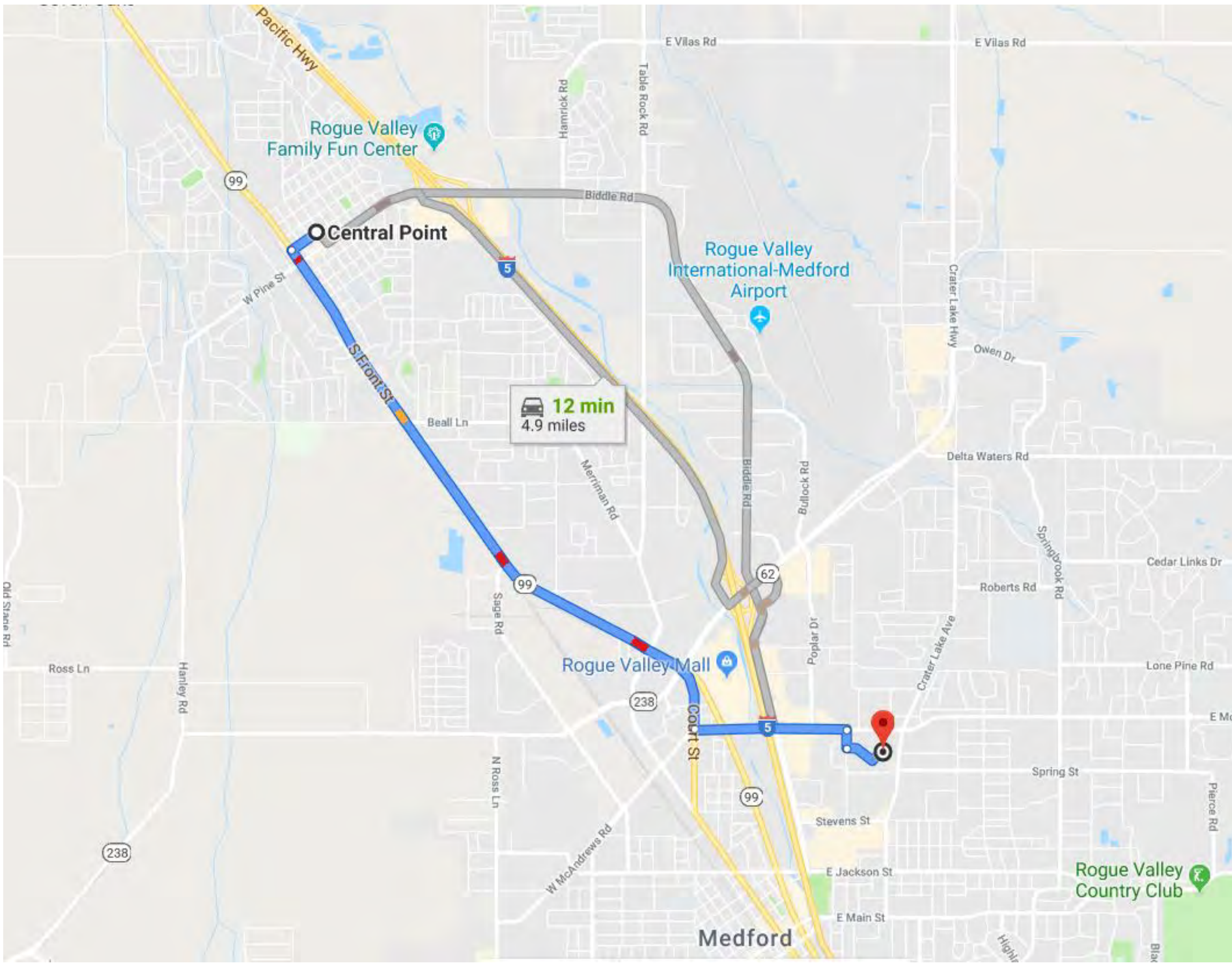
Miscellaneous Protection/Equipment:

☒ First Aid Kit ☒ Mobile Phone ☒ Fluids/Drinking Water ☐ Full Body Harness/Lanyard

☐ Eyewash ☒ Sunscreen/Sunshade ☐ Insect/tick control ☐ Other (specify):

Other PPE/Equipment/Remarks:

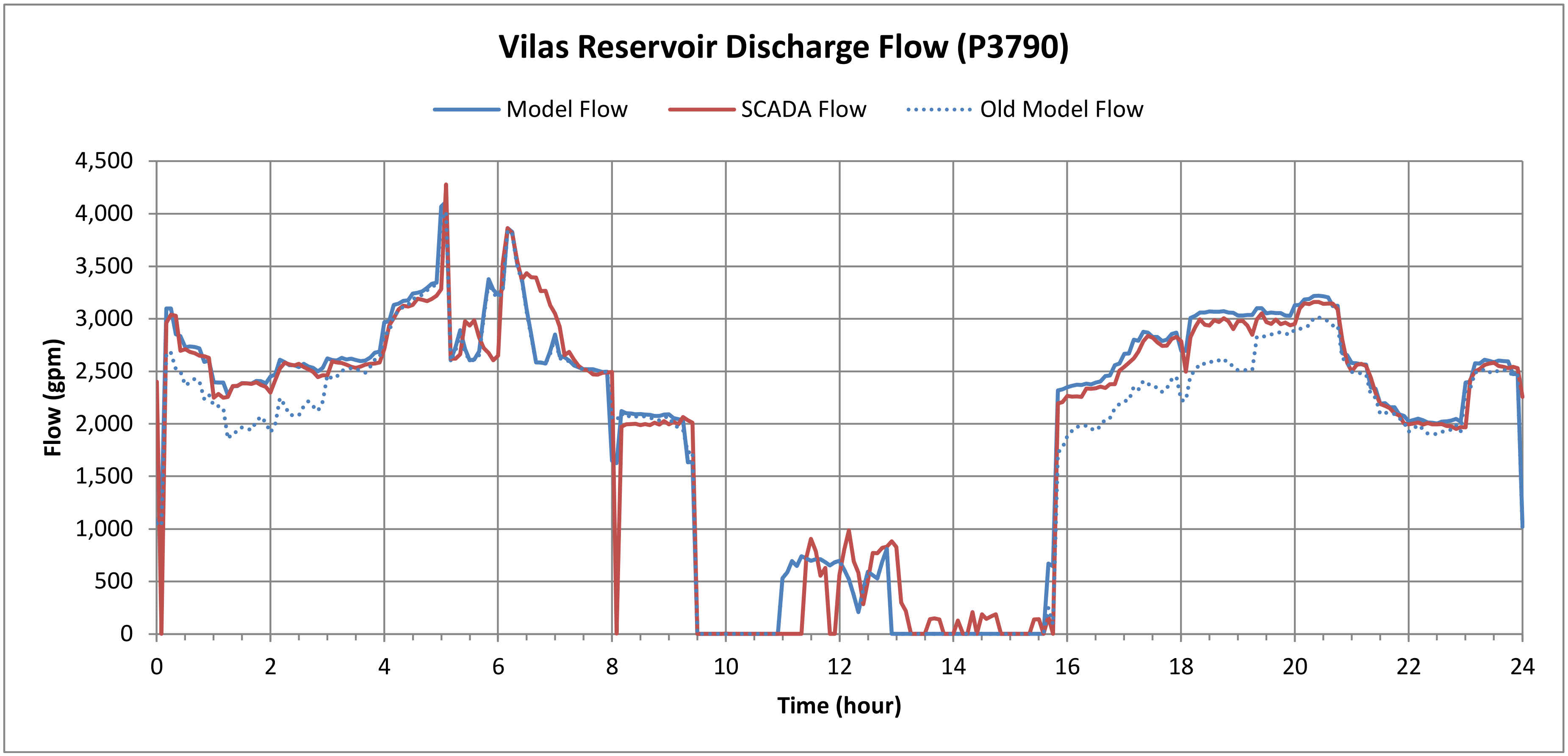
HOSPITAL LOCATION MAP



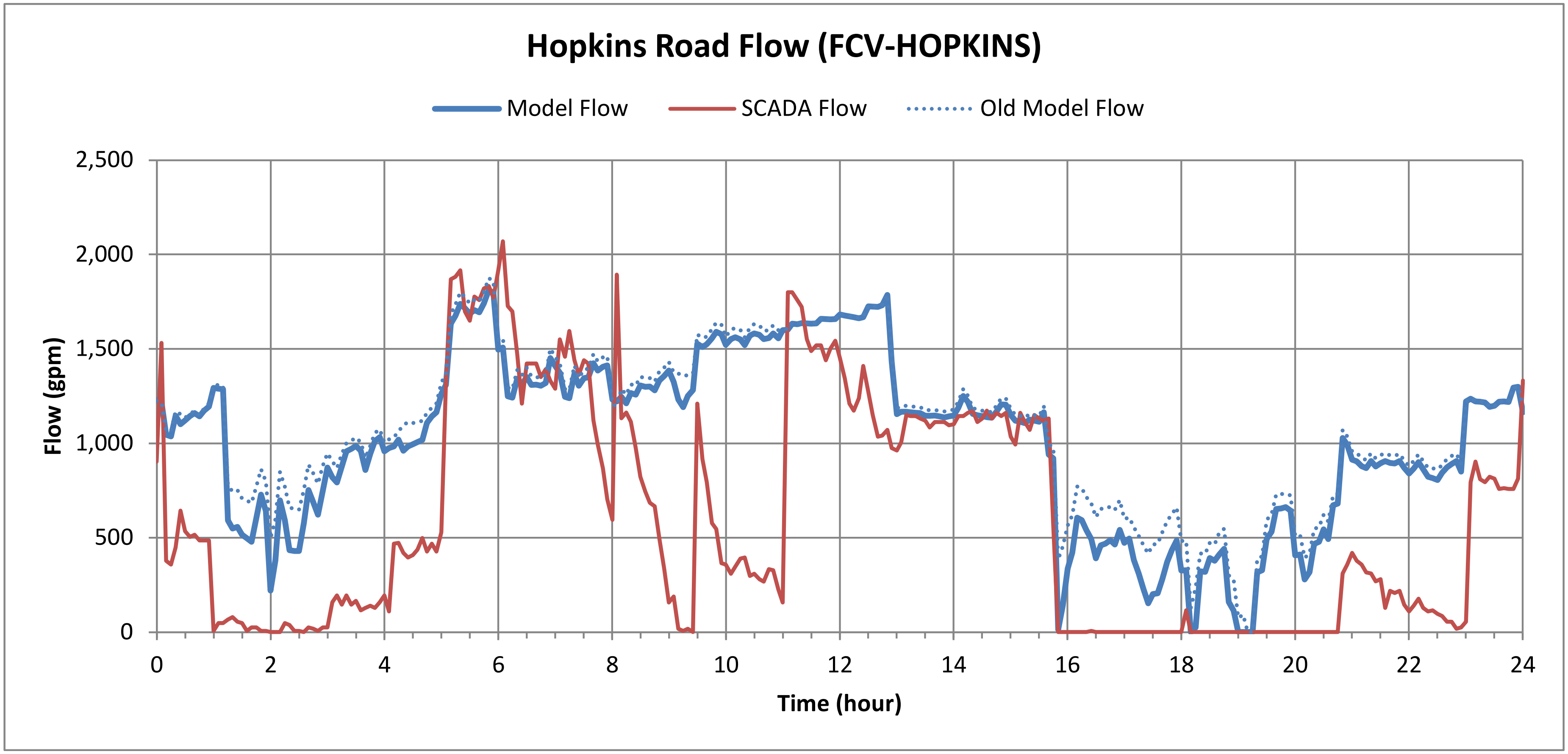
HOSPITAL DIRECTIONS:	HOSPITAL INFORMATION:
Testing will occur throughout town, so directions are from the center of town. Take Hwy 99 south from Central Point approximately 3.2 miles to E McAndrews Road. Cross over I-5 to Royal Ave. Turn right onto Royal Avenue and follow signs to ER within hospital complex. If coming from I-5, take Crater Lake Hwy (Hwy 62) exit, turn L onto Crater Lake Hwy, cross over the freeway and then turn right onto Biddle Road. Take a L onto E McAndrews Road and a right onto Royal Avenue and follow signs to ER within hospital complex.	Providence Medford Medical Center 1111 Crater Lake Ave, Medford, OR 97504 (541) 732-5000

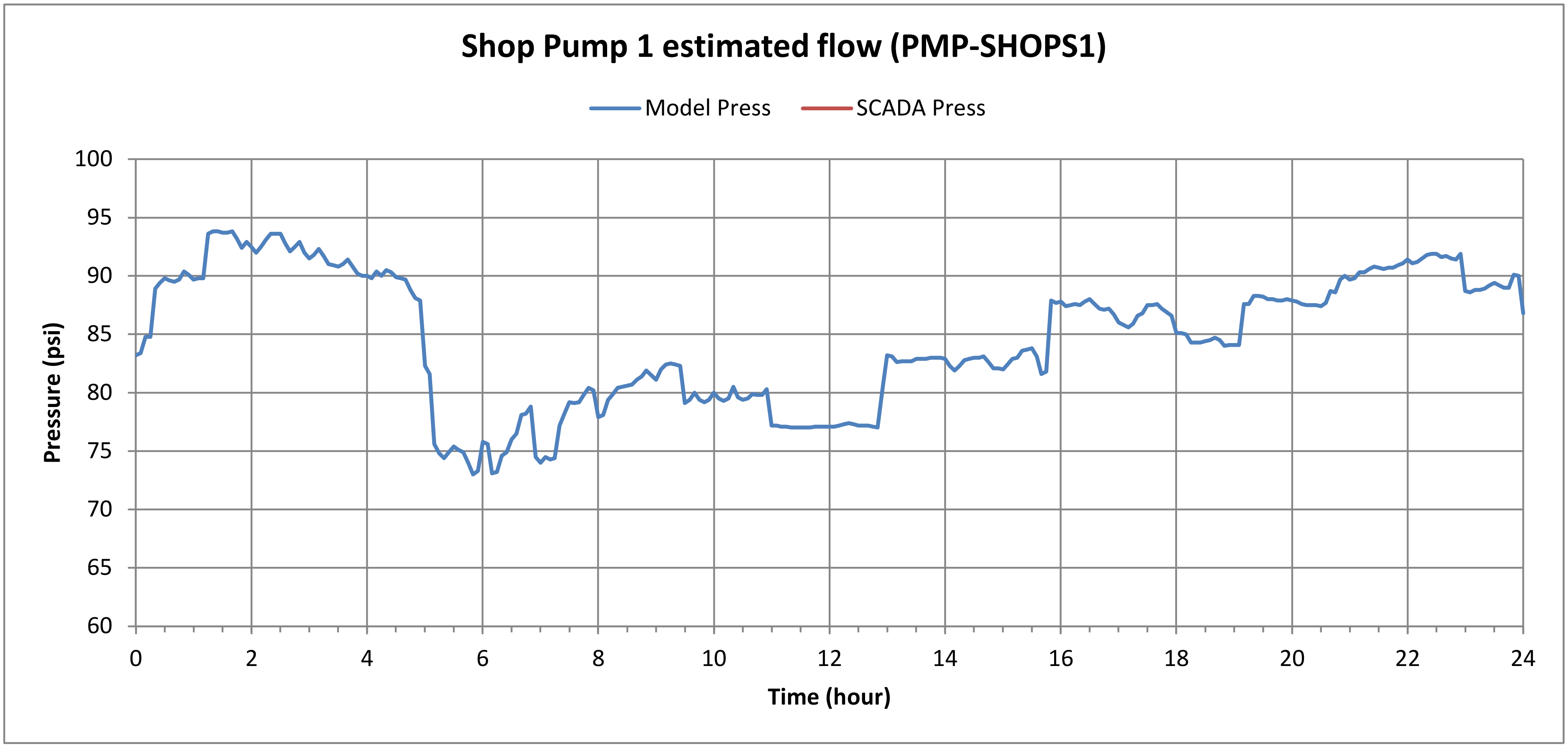
Appendix C: Calibration Results

Table C-1. Steady-State Calibration Results													
Test No.	Model pressure junction	Model flow junction	Date, 2019	Field Readings				Hydrant flow	Model Results		Model – Field Difference		Notes
				Before Time	Before Pressure	During Time	During Pressure		Before pressure	During pressure	Before	During	
HT1	J9385	J9383	6/26	2:34 pm	100.4	2:36 pm	95.0	2,370	103.2	93.6	2.7	-1.4	Hydrant test stopped after first trial due to inadequate pressure drop. Results indicate test after installation of a second hydrant diffuser to gain adequate pressure drop.
HT2	J5164	J5235	6/26	2:08 pm	78.4	2:10 pm	73.8	2,078	79.3	71.8	1.0	-2.0	Hydrant test stopped after first trial due to inadequate pressure drop. Results indicate test after installation of a second hydrant diffuser to gain adequate pressure drop. Results with the Shops pump off in the model.
HT3	J9154	J6126	6/26	1:02 pm	76.7	1:04 pm	65.5	1,308	79.0	65.2	2.2	-0.3	The City checked valves north of this test. Shutting off this line in the model made during pressures more closely match during pressure, but given that the City specifically checked this line the line north of the test was left on in the model.
HT4	J6662	J6669	6/26	1:35 pm	85.3	1:38 pm	77.7	2,159	85.9	76.2	0.6	-1.4	Hydrant test stopped after first trial due to inadequate pressure drop. Results indicate test after installation of a second hydrant diffuser to gain adequate pressure drop.

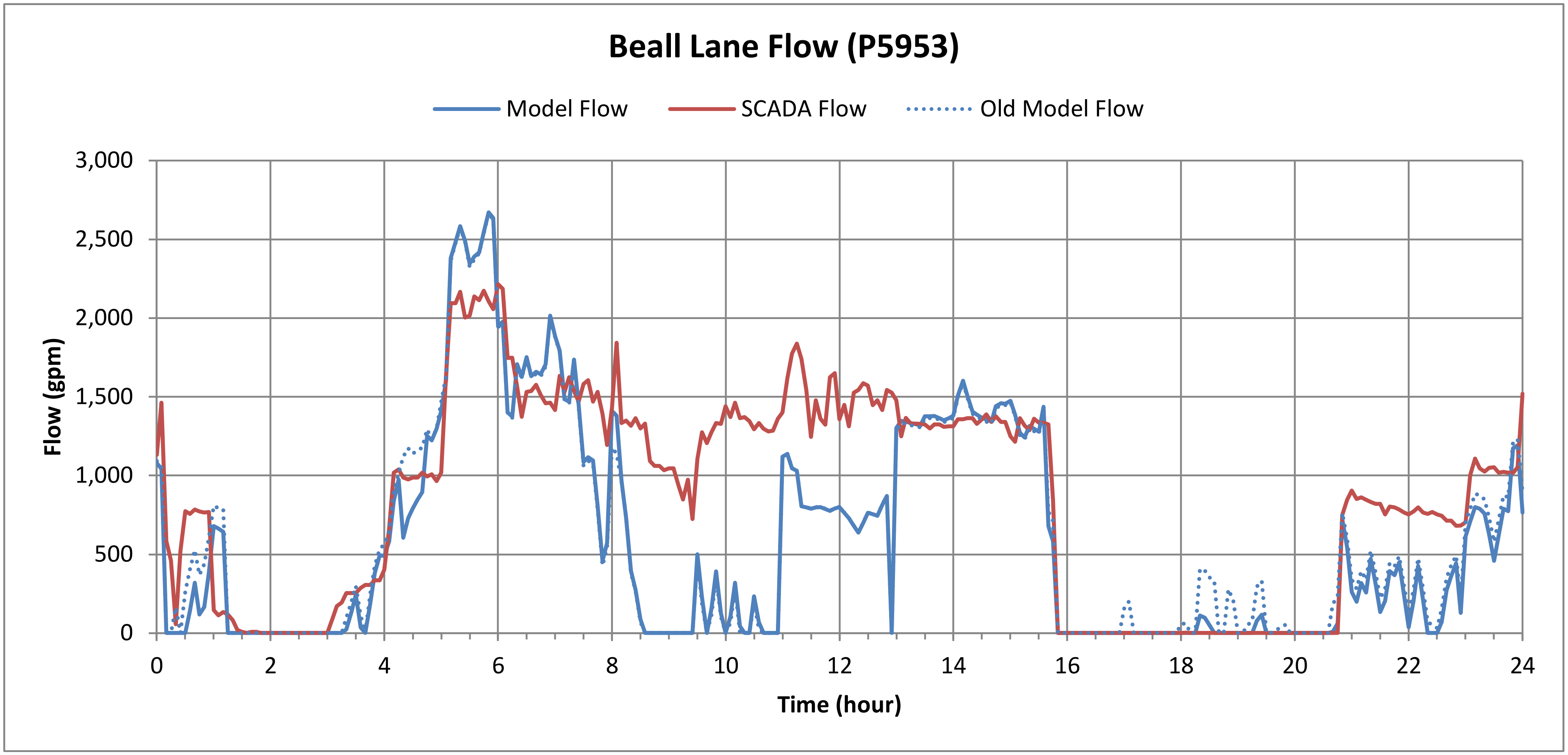


Vilas Reservoir Discharge Flow (P3790)
Model Flow
SCADA Flow
Old Model Flow
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
Flow (gpm)
0
2
4
6
8
10
12
14
16
18
20
22
24
Time (hour)


Hopkins Road Flow (FCV-HOPKINS)
Model Flow
SCADA Flow
Old Model Flow
2,500
2,000
1,500
1,000
500
0
Flow (gpm)
0
2
4
6
8
10
12
14
16
18
20
22
24
Time (hour)

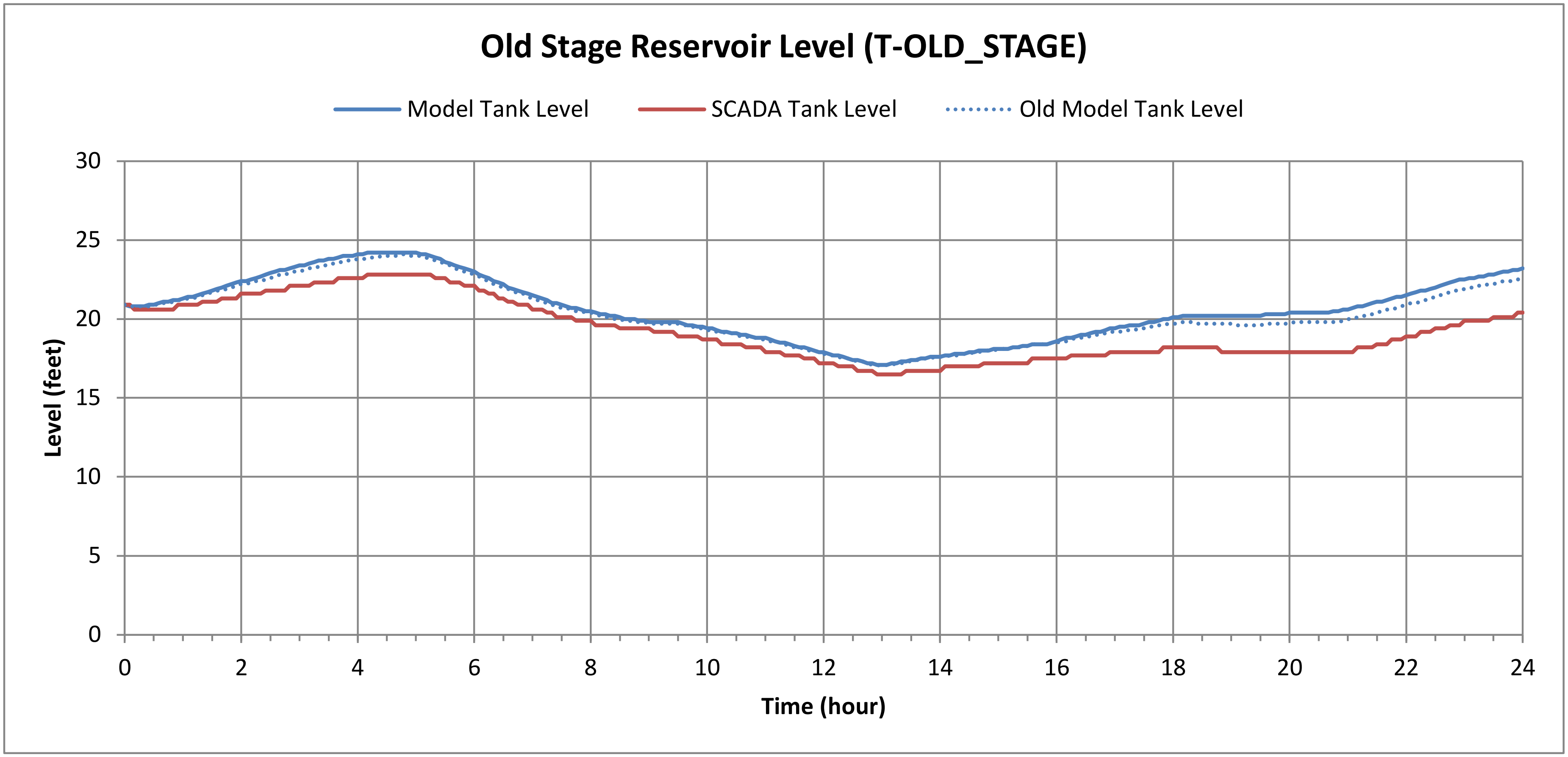


Shop Pump 1 estimated flow (PMP-SHOPS1)
Model Press
SCADA Press
100
95
90
85
80
75
70
65
60
Pressure (psi)
0
2
4
6
8
10
12
14
16
18
20
22
24
Time (hour)

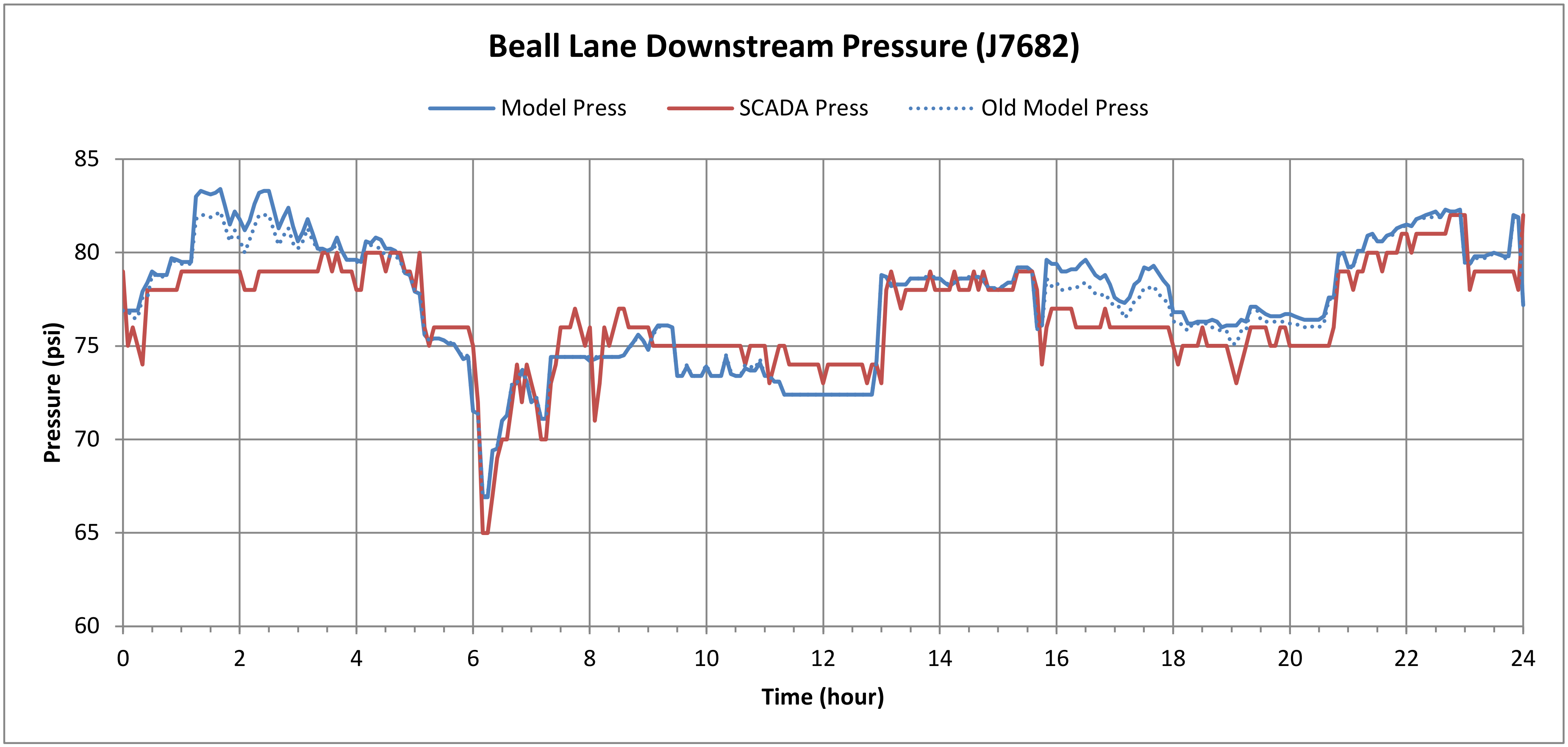


Beall Lane Flow (P5953)
Model Flow
SCADA Flow
Old Model Flow
Flow (gpm)
3,000
2,500
2,000
1,500
1,000
500
0
0
2
4
6
8
10
12
14
16
18
20
22
24
Time (hour)

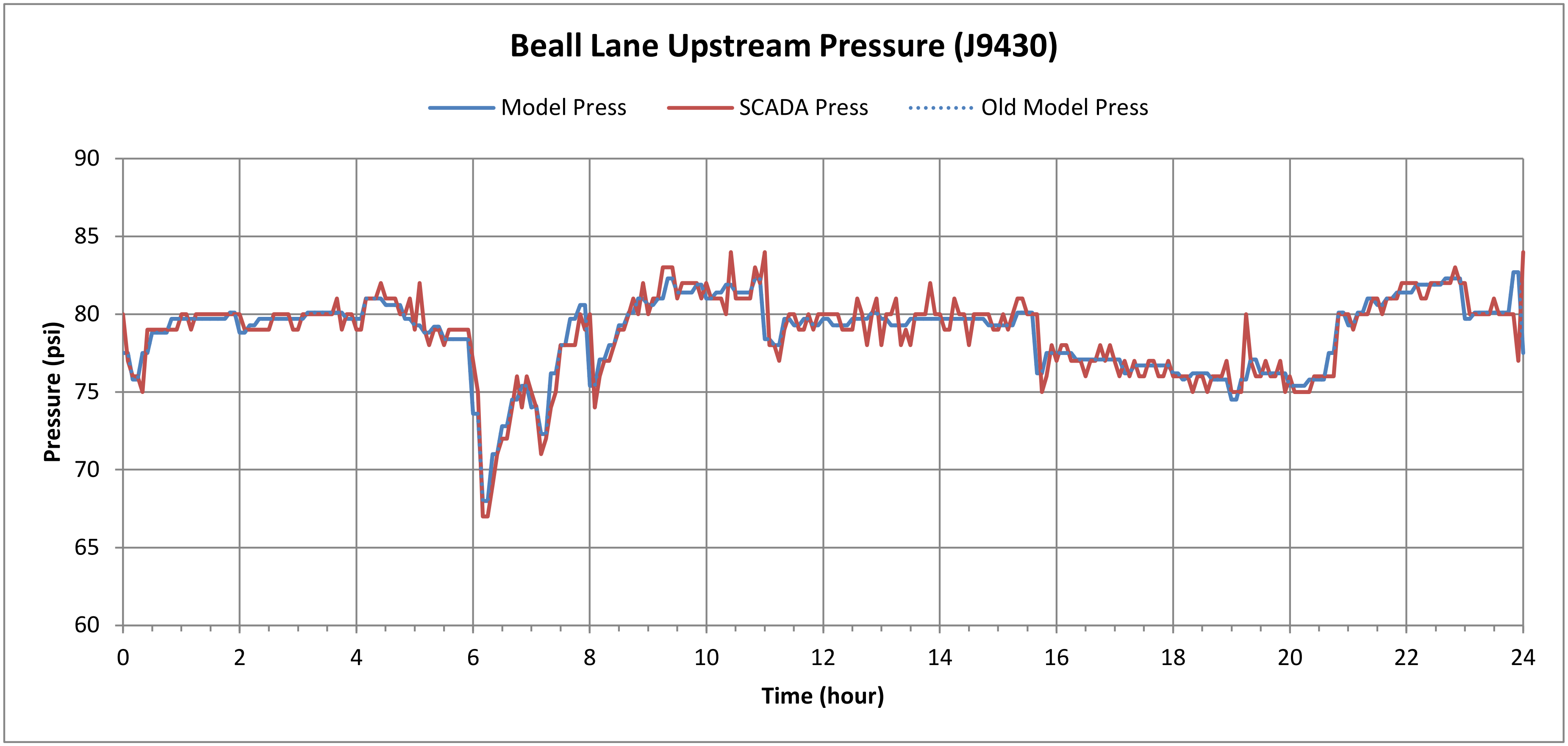

Shops Reservoir Level (T-SHOPS)
Model Tank Level
SCADA Tank Level
Old Model Tank Level
Level (feet)
30
25
20
15
10
5
0
0
2
4
6
8
10
12
14
16
18
20
22
24
Time (hour)

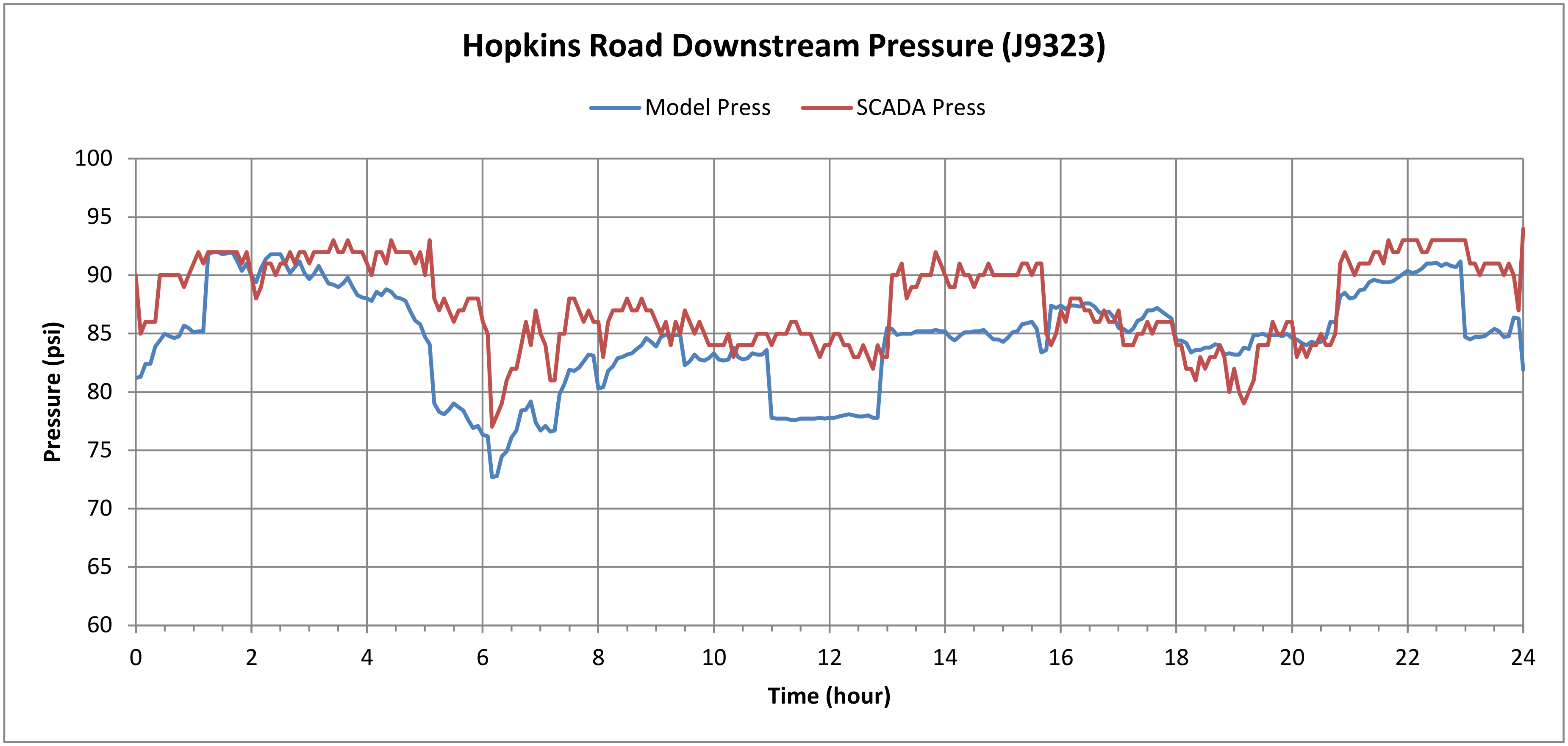


Old Stage Reservoir Level (T-OLD_STAGE)
Model Tank Level
SCADA Tank Level
Old Model Tank Level
Level (feet)
30
25
20
15
10
5
0
0
2
4
6
8
10
12
14
16
18
20
22
24
Time (hour)

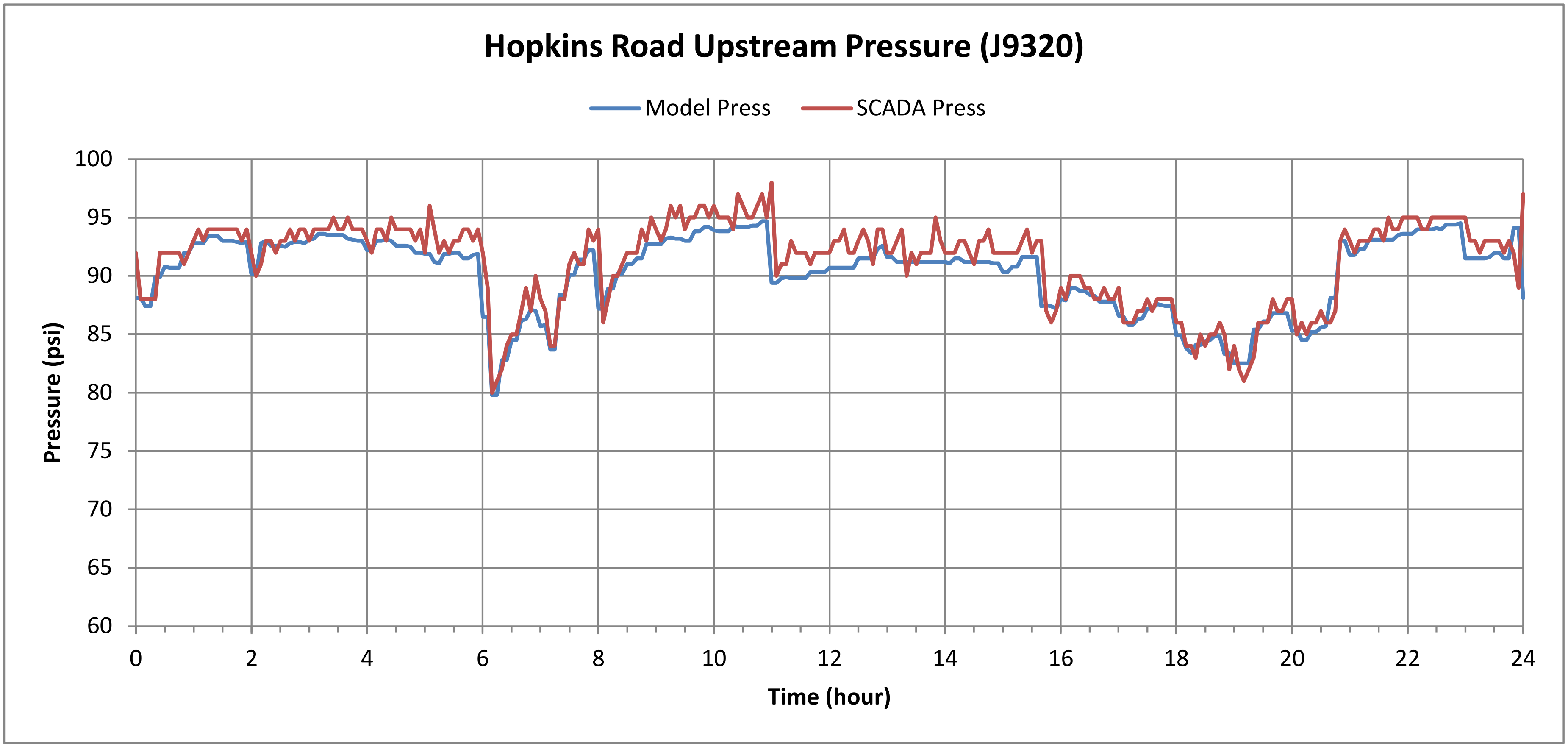


Beall Lane Downstream Pressure (J7682)
Model Press
SCADA Press
Old Model Press
Pressure (psi)
85
80
75
70
65
60
0
2
4
6
8
10
12
14
16
18
20
22
24
Time (hour)

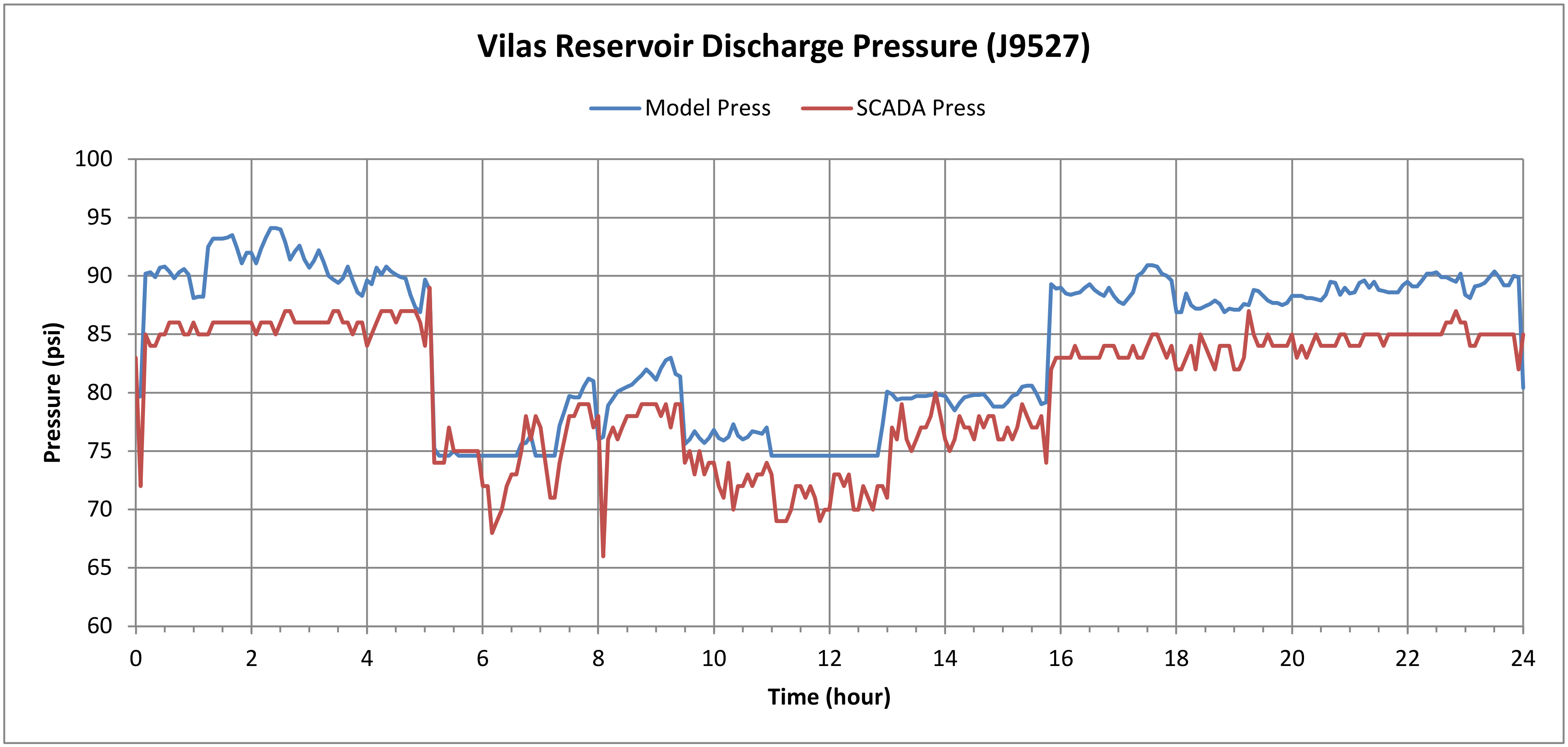

Beall Lane Upstream Pressure (J9430)
Model Press
SCADA Press
Old Model Press
Pressure (psi)
90
85
80
75
70
65
60
0
2
4
6
8
10
12
14
16
18
20
22
24
Time (hour)



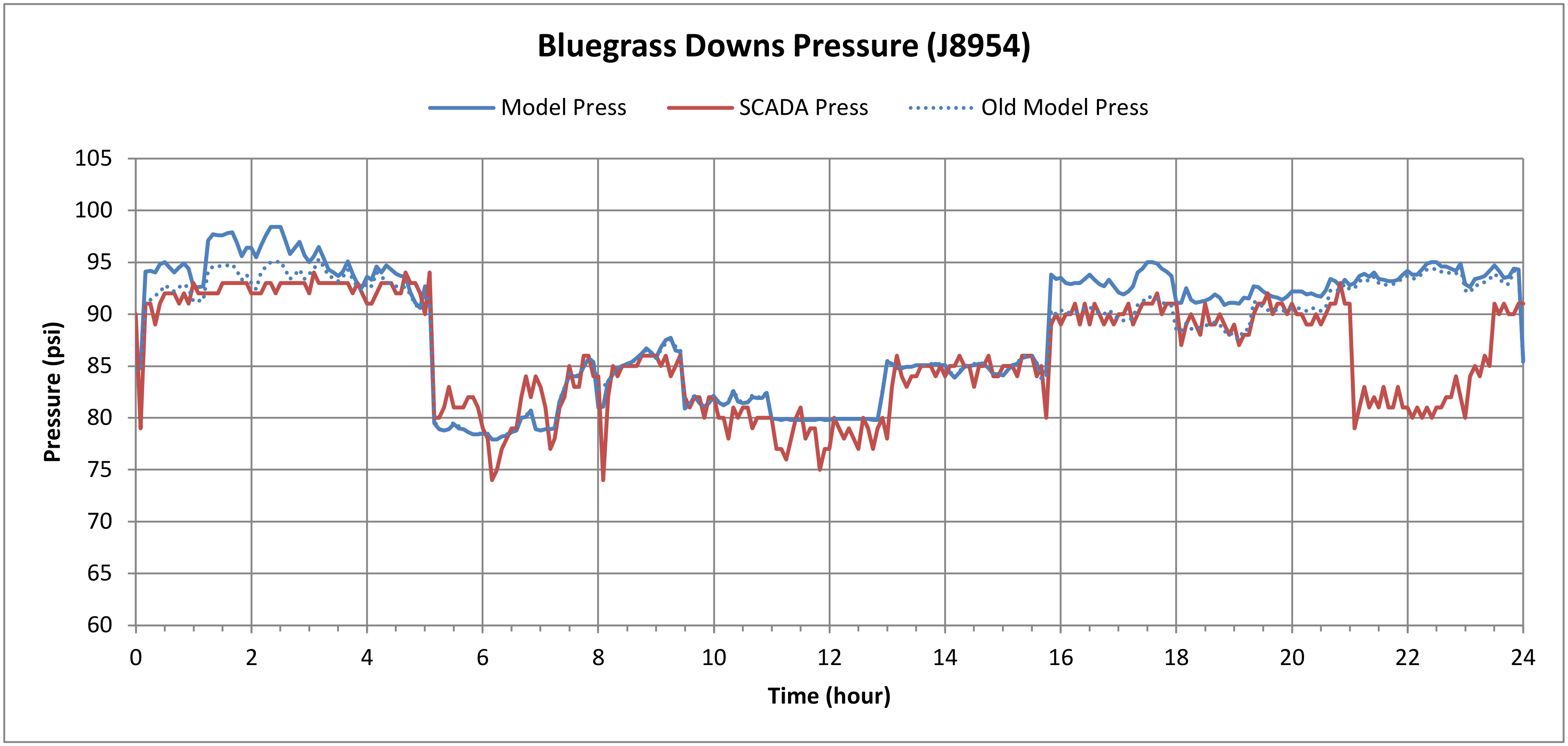
Hopkins Road Downstream Pressure (J9323)
Model Press
SCADA Press
100
95
90
85
80
75
70
65
60
Pressure (psi)
0
2
4
6
8
10
12
14
16
18
20
22
24
Time (hour)



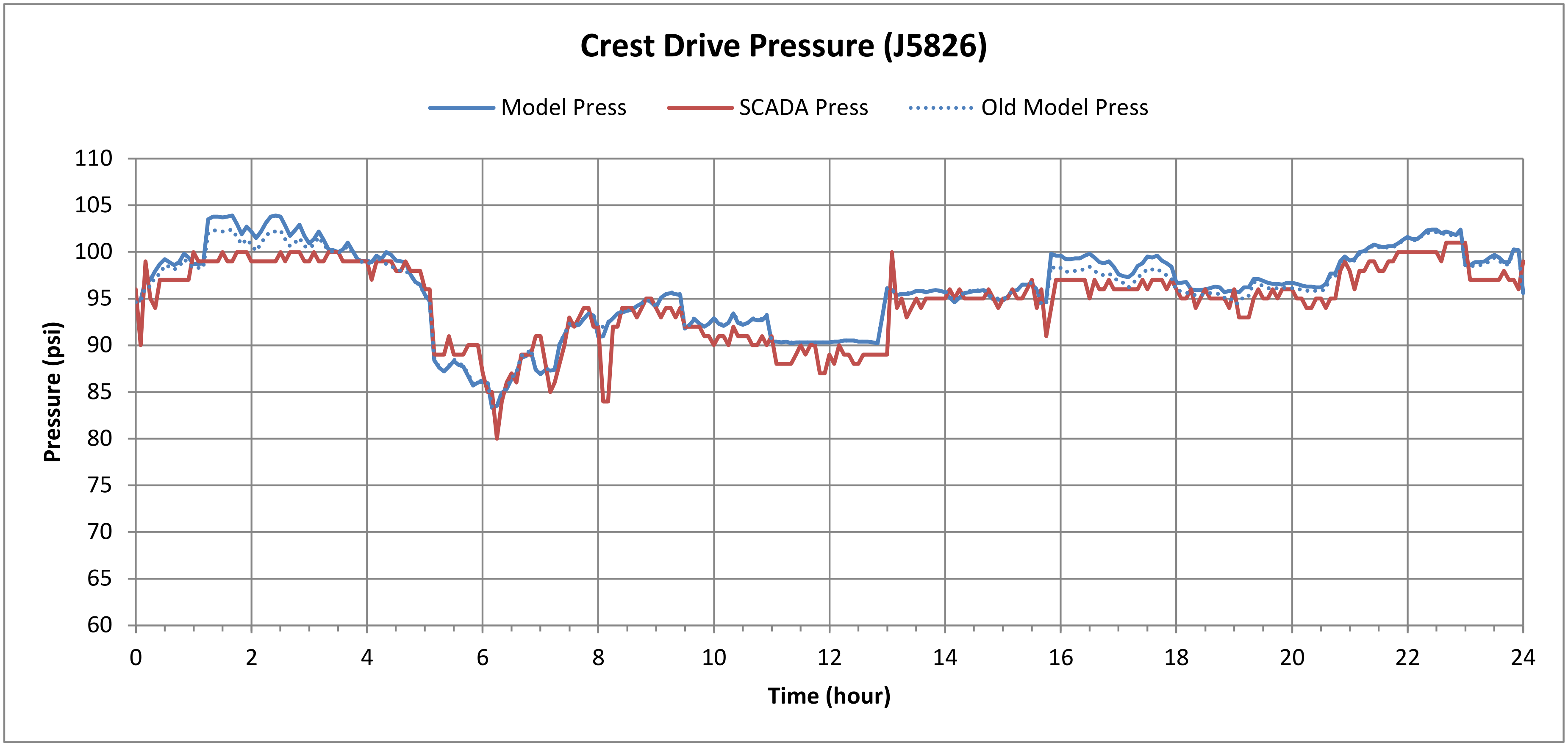
Hopkins Road Upstream Pressure (J9320)
Model Press
SCADA Press
Pressure (psi)
100
95
90
85
80
75
70
65
60
0
2
4
6
8
10
12
14
16
18
20
22
24
Time (hour)



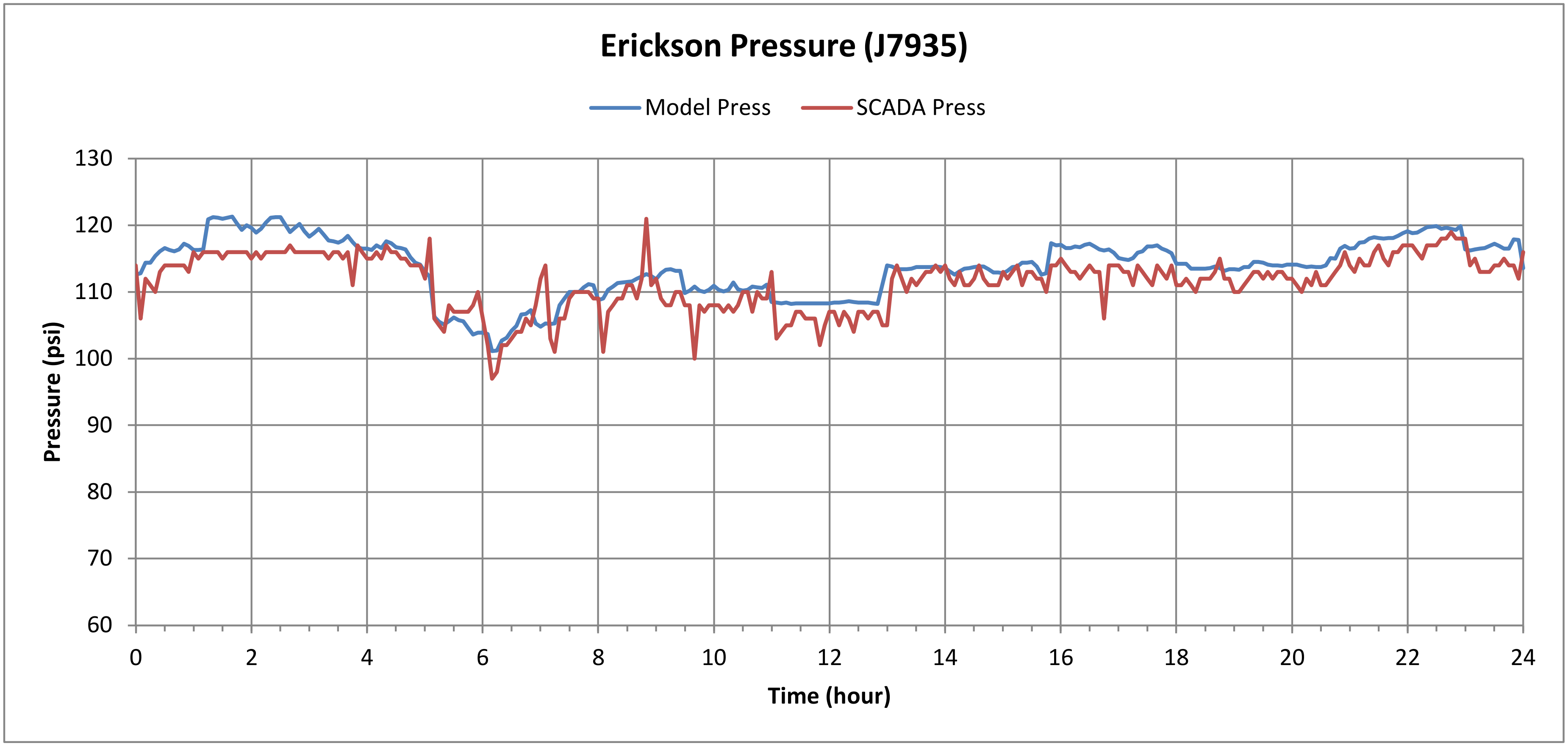
Vilas Reservoir Discharge Pressure (J9527)
Model Press
SCADA Press
Pressure (psi)
100
95
90
85
80
75
70
65
60
0
2
4
6
8
10
12
14
16
18
20
22
24
Time (hour)



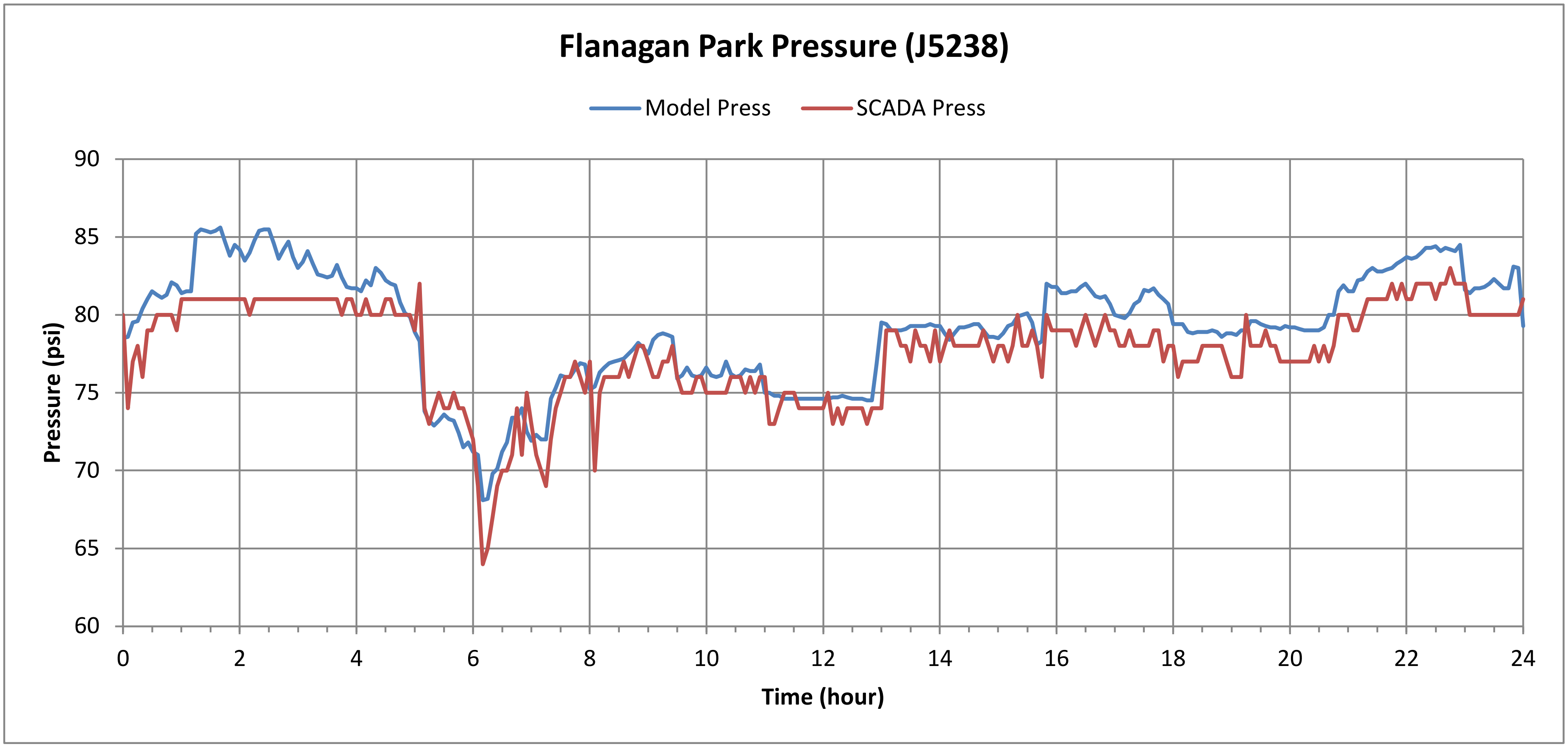
Bluegrass Downs Pressure (J8954)
Model Press
SCADA Press
Old Model Press
Pressure (psi)
105
100
95
90
85
80
75
70
65
60
0
2
4
6
8
10
12
14
16
18
20
22
24
Time (hour)

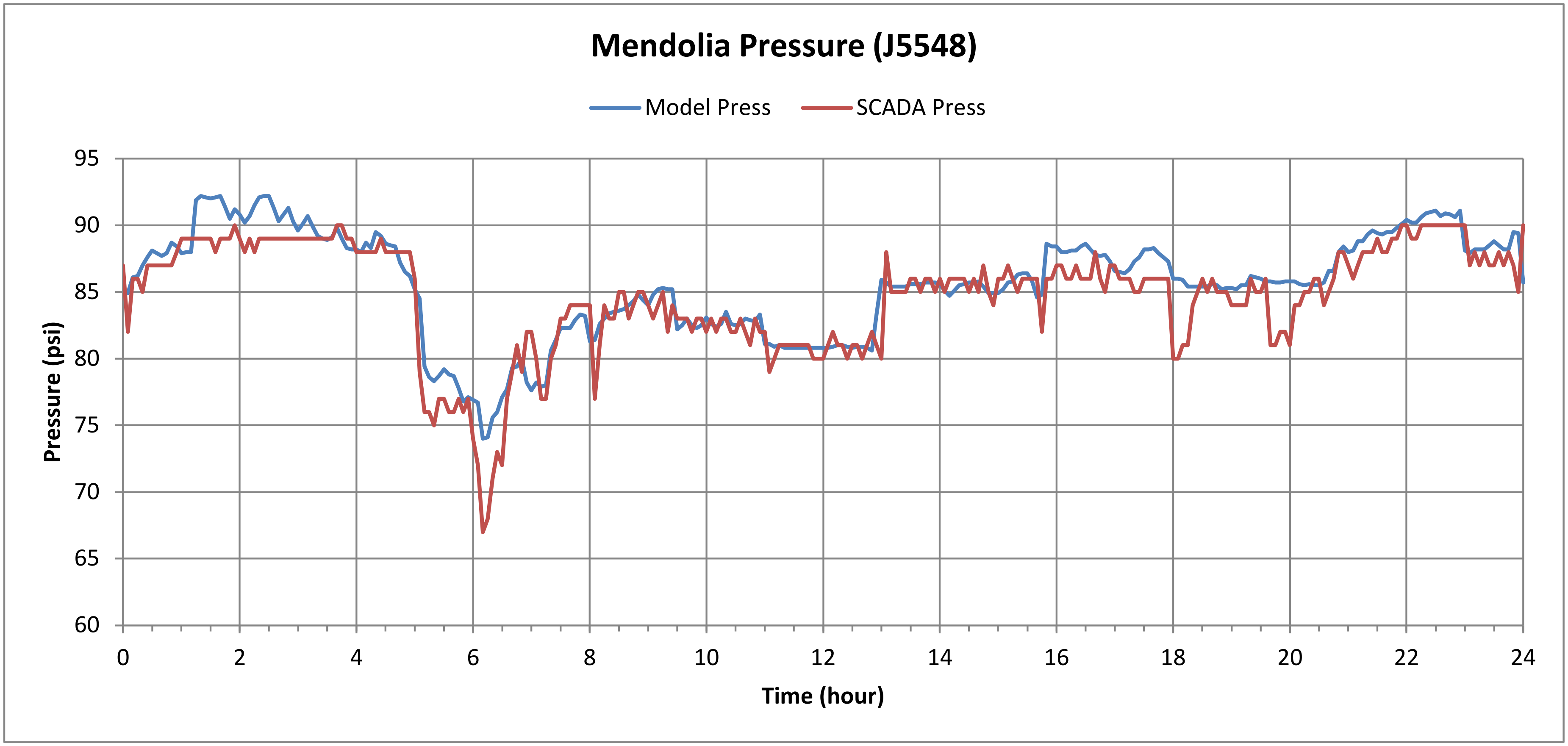


Crest Drive Pressure (J5826)
Model Press
SCADA Press
Old Model Press
110
105
100
95
90
85
80
75
70
65
60
Pressure (psi)
0
2
4
6
8
10
12
14
16
18
20
22
24
Time (hour)

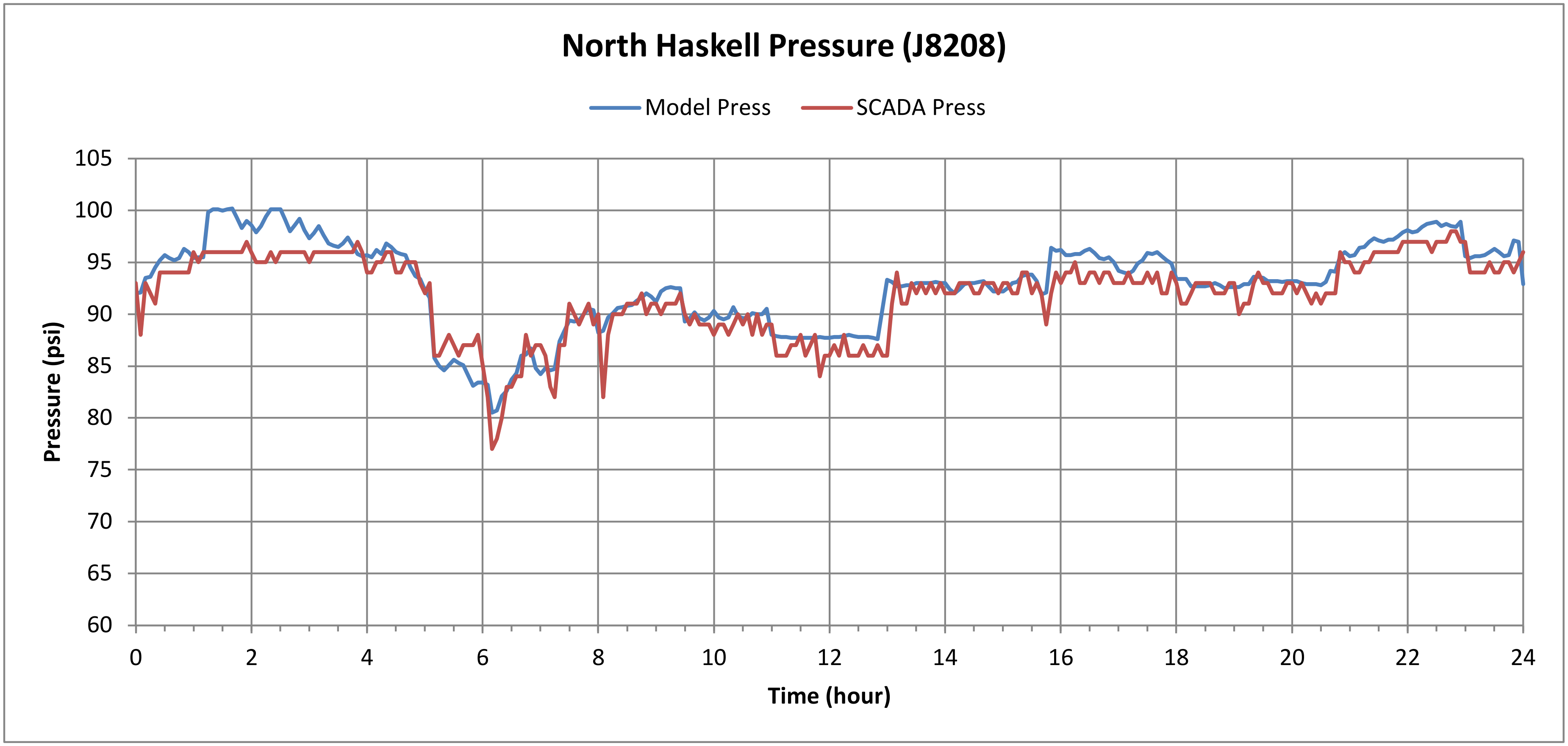


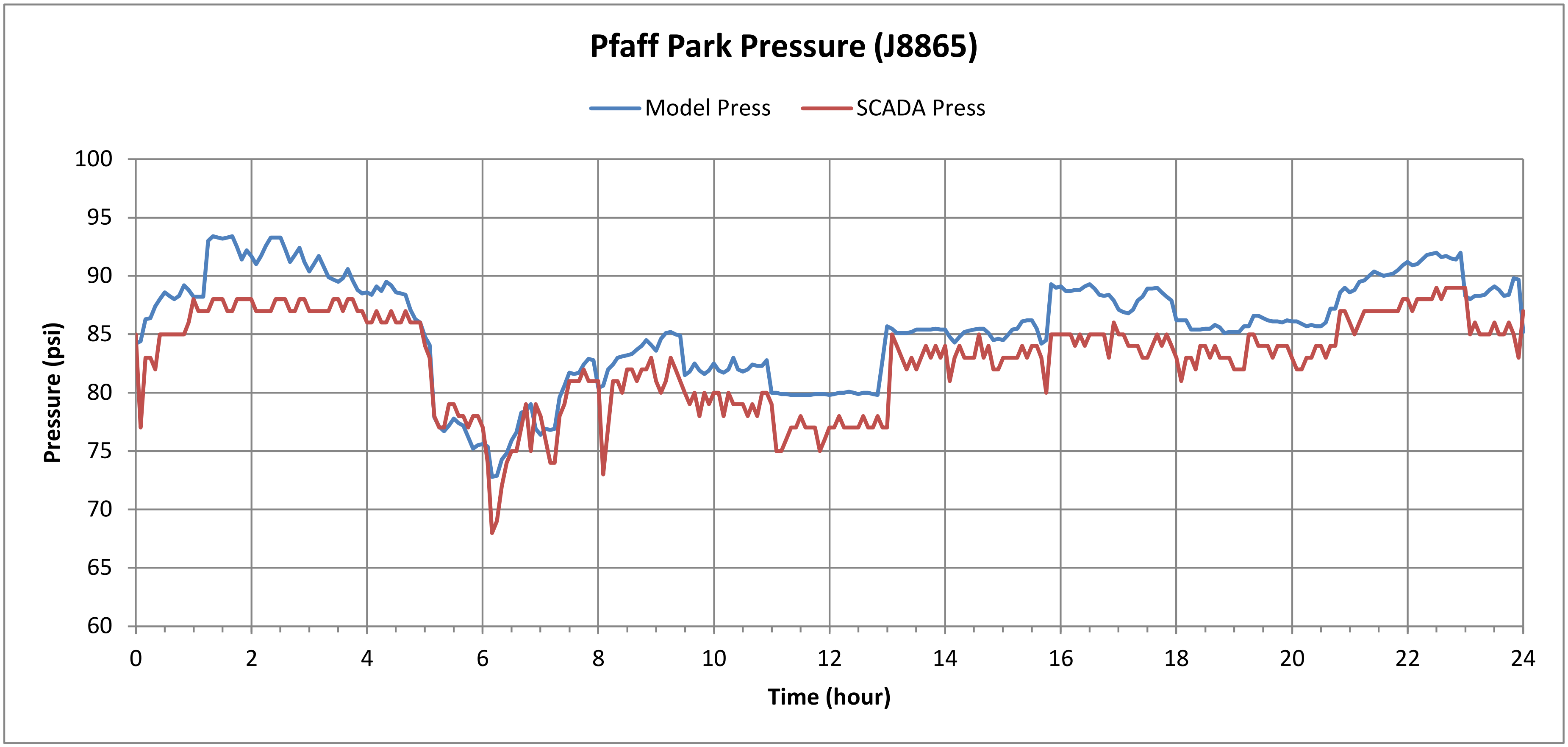
Erickson Pressure (J7935)
Model Press
SCADA Press
130
120
110
100
90
80
70
60
Pressure (psi)
0
2
4
6
8
10
12
14
16
18
20
22
24
Time (hour)


Flanagan Park Pressure (J5238)
Model Press
SCADA Press
90
85
80
75
70
65
60
Pressure (psi)
0
2
4
6
8
10
12
14
16
18
20
22
24
Time (hour)

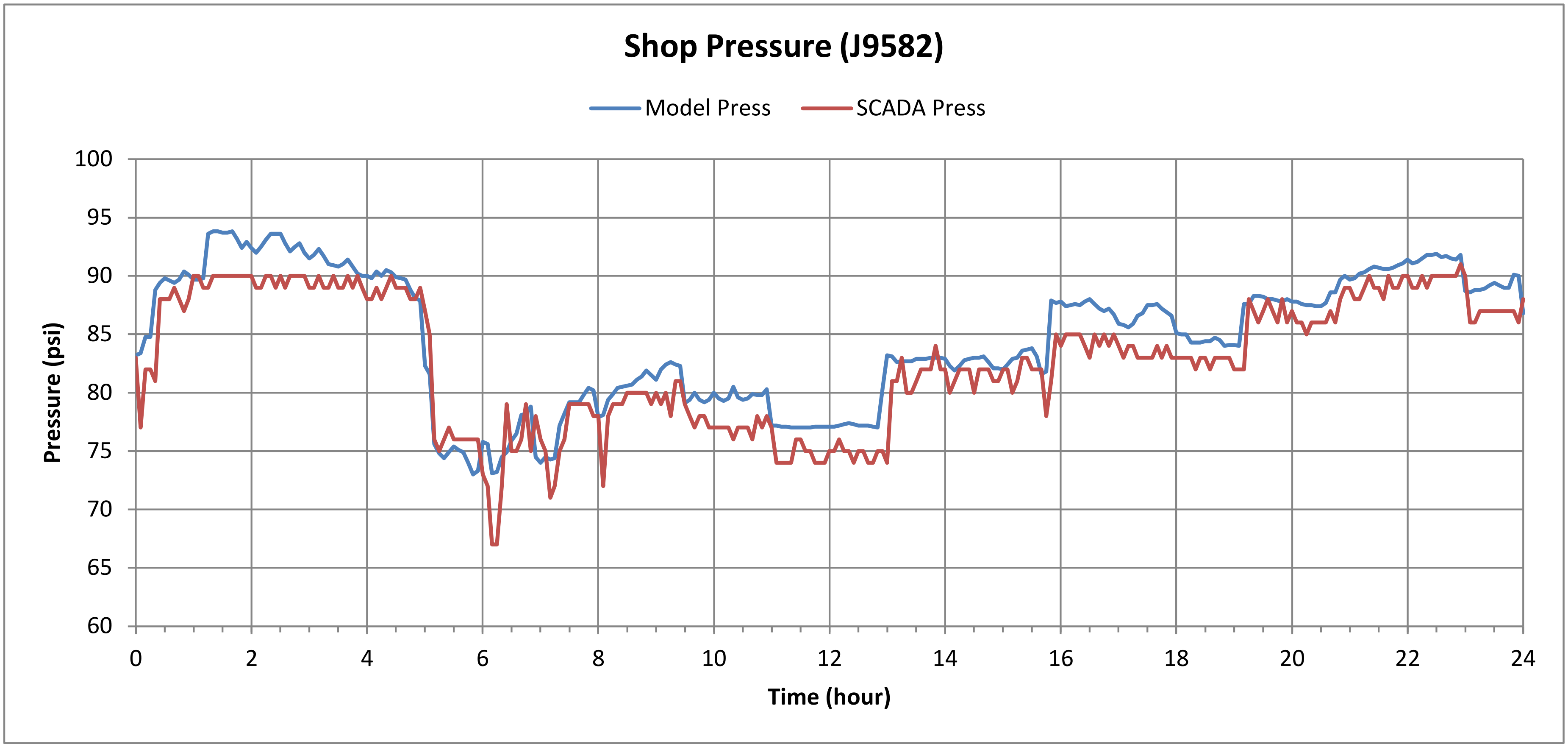


Mendolia Pressure (J5548)
Model Press
SCADA Press
Pressure (psi)
95
90
85
80
75
70
65
60
0
2
4
6
8
10
12
14
16
18
20
22
24
Time (hour)


North Haskell Pressure (J8208)
Model Press
SCADA Press
Pressure (psi)
105
100
95
90
85
80
75
70
65
60
0
2
4
6
8
10
12
14
16
18
20
22
24
Time (hour)



Pfaff Park Pressure (J8865)
Model Press
SCADA Press
100
95
90
85
80
75
70
65
60
0
2
4
6
8
10
12
14
16
18
20
22
24
Pressure (psi)
Time (hour)


Shop Pressure (J9582)
Model Press
SCADA Press
Pressure (psi)
100
95
90
85
80
75
70
65
60
0
2
4
6
8
10
12
14
16
18
20
22
24
Time (hour)

Appendix D: MWC Head Analysis

Run Summary

To supplement the previously provided results that were under ADD and PHD conditions,
MDD simulations were performed for:

- 2015 MDD
- 2035 MDD

The delivered flow to one of master meters was varied for a constant pump status in the MWC system.
Flows to the other two master meters was kept constant. This scenario was repeated for each master meter.
Demand in the MWC system remained constant for each scenario.
Flows ranges at each of the delivery points was provided by Central Point.

Operational status of MWC facilities included the following:

2015 MDD (Reverse Flow)

Duff HSPS Operation

Pumps On: 1 , 4, 5

Control Station Operation

Rossanley: 1 pump on
Conrad: 1 pump on
Martin: 1 pump on

2035 MDD (Reverse Flow)

Duff HSPS Operation

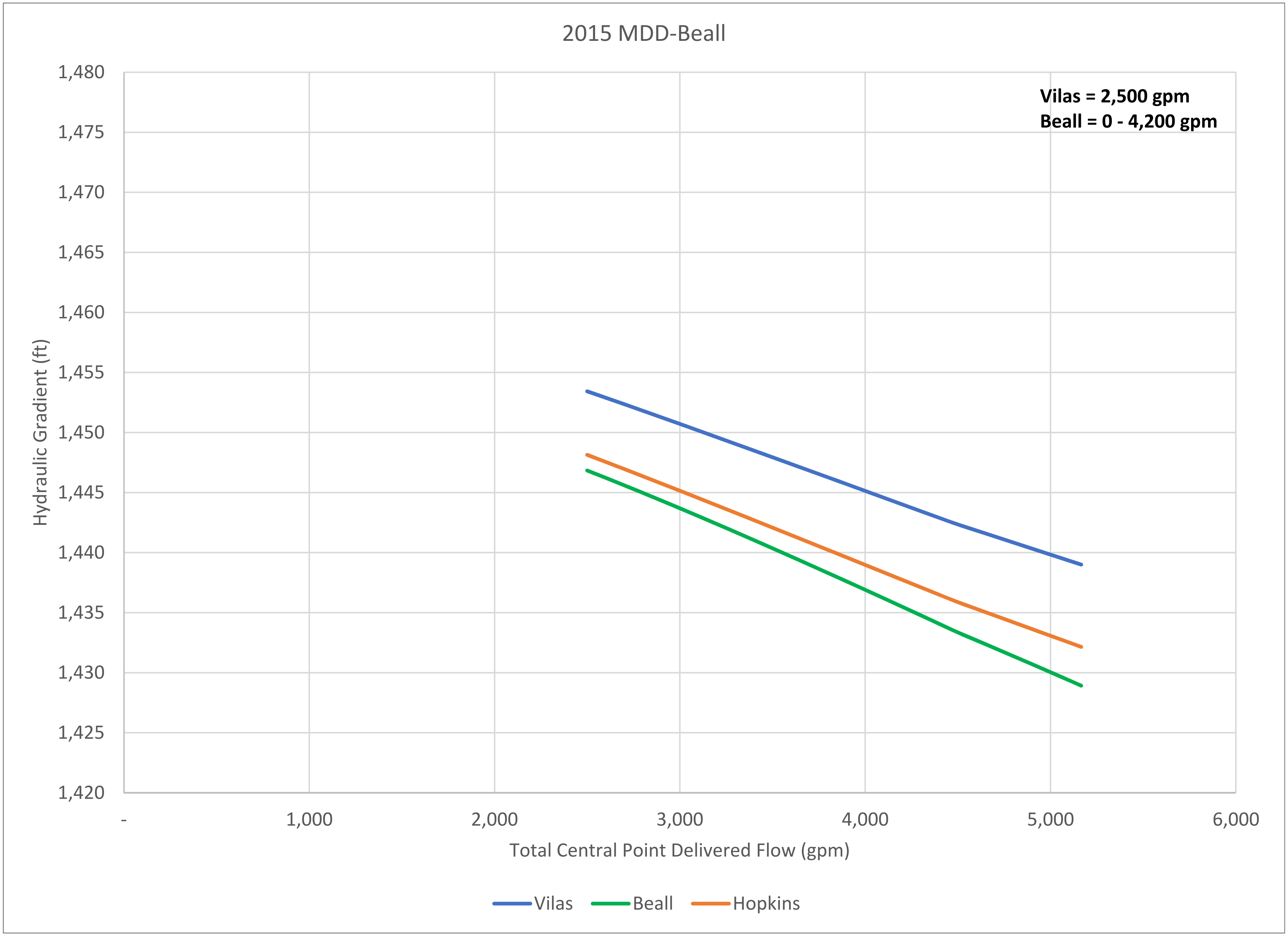
Pumps On: 1 , 2, 4, 5 (includes pump capacity increase)

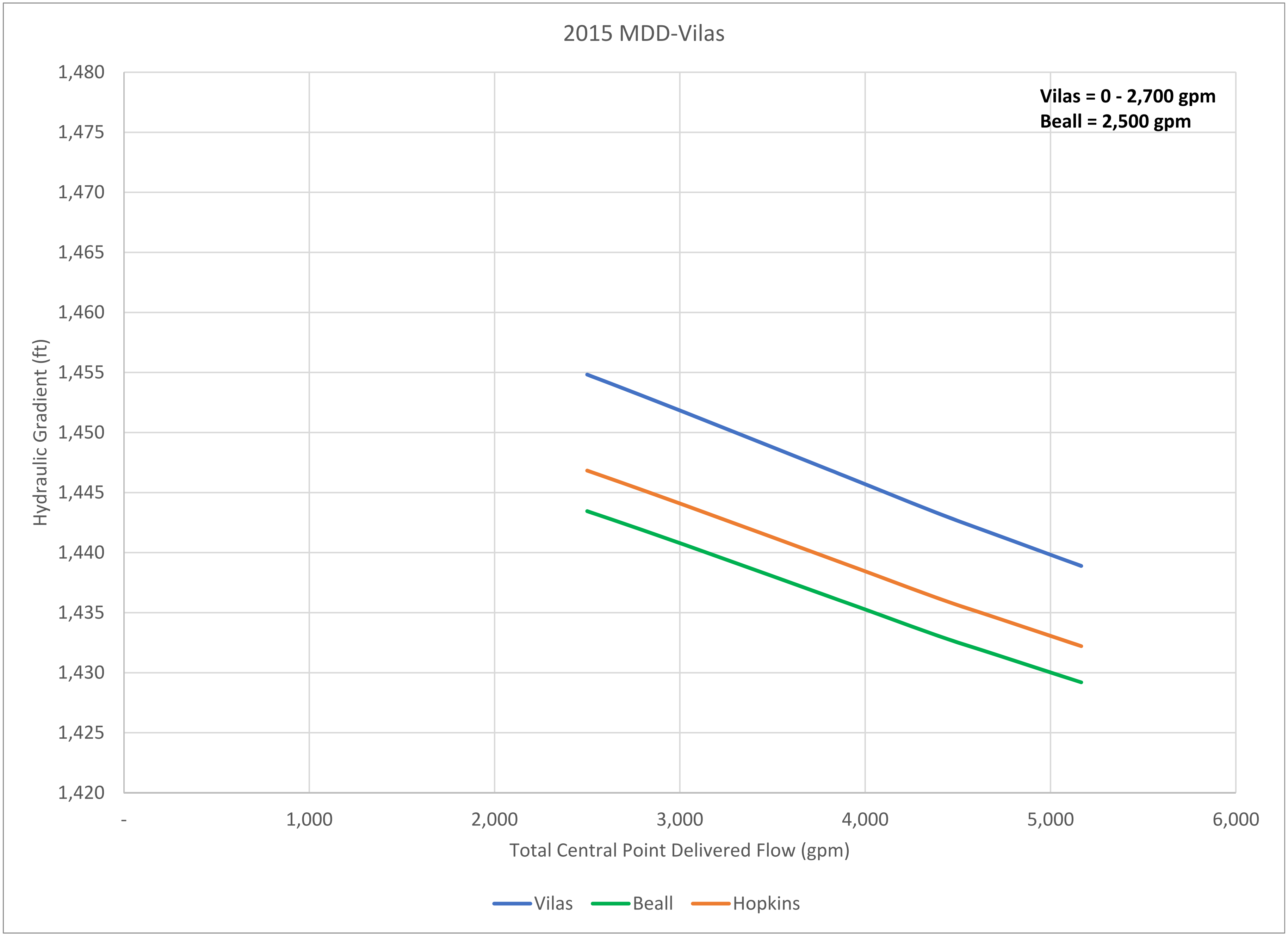
Control Station Operation

Rossanley: 2 pumps on
Conrad: 2 pumps on
Martin: 2 pumps on

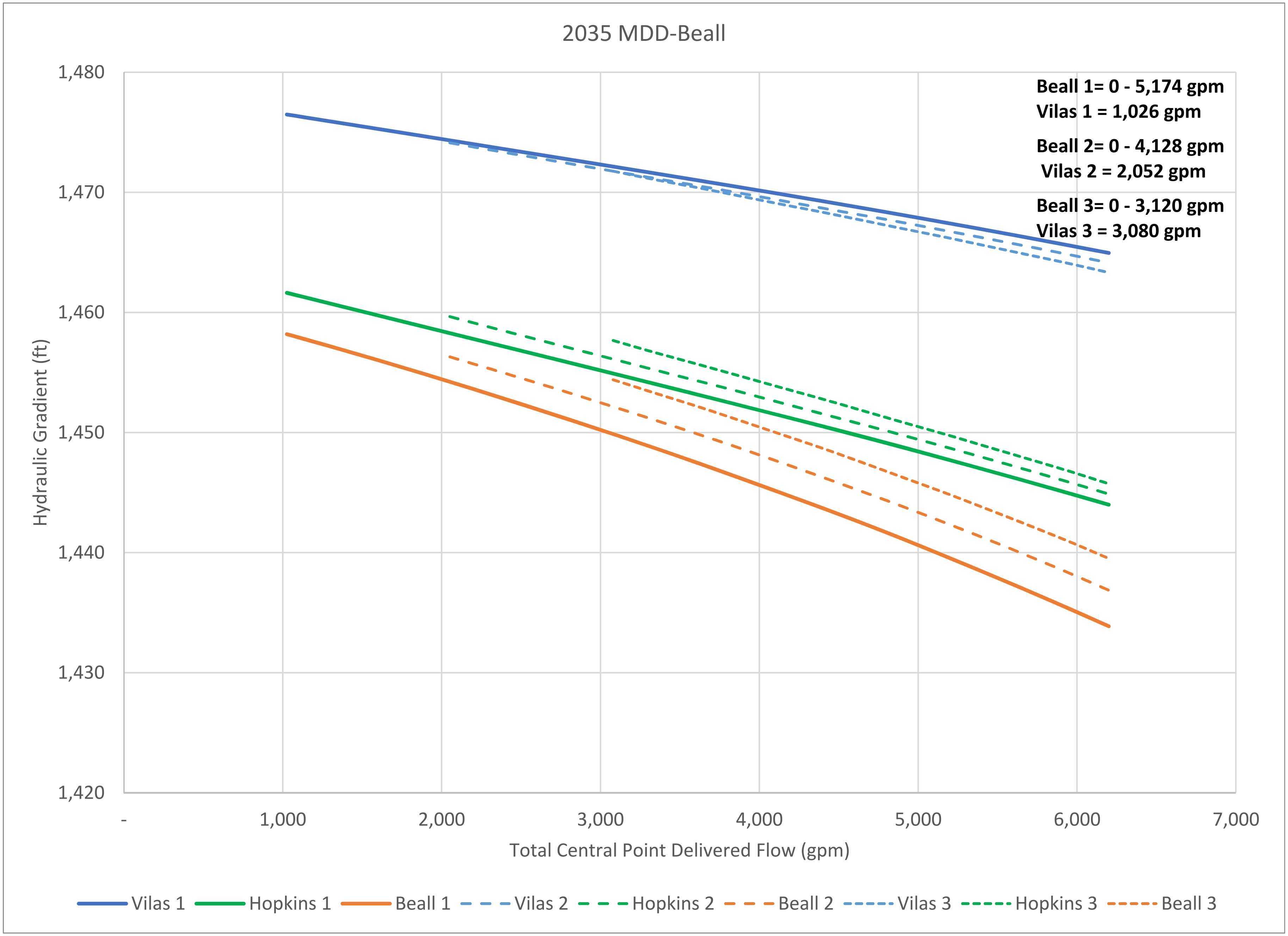
New Tank HGL

Run 1: 1480 HGL

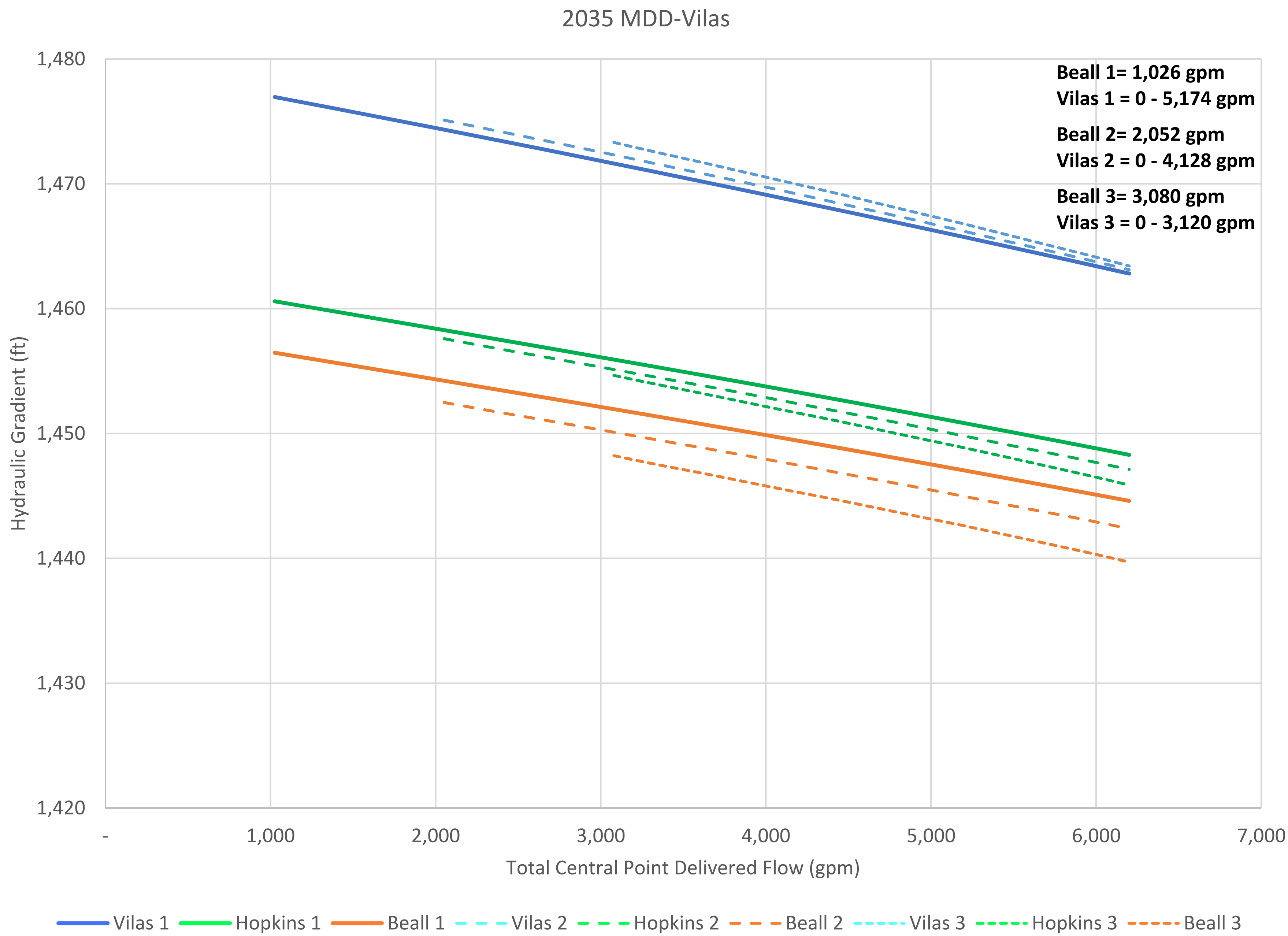

2015 MDD-Beall
Vilas = 2,500 gpm
Beall = 0 - 4,200 gpm
Hydraulic Gradient (ft)
1,480
1,475
1,470
1,465
1,460
1,455
1,450
1,445
1,440
1,435
1,430
1,425
1,420
-
1,000
2,000
3,000
4,000
5,000
6,000
Total Central Point Delivered Flow (gpm)
Vilas
Beall
Hopkins



2015 MDD-Vilas
Vilas = 0 - 2,700 gpm
Beall = 2,500 gpm
Hydraulic Gradient (ft)
1,480
1,475
1,470
1,465
1,460
1,455
1,450
1,445
1,440
1,435
1,430
1,425
1,420
-
1,000
2,000
3,000
4,000
5,000
6,000
Total Central Point Delivered Flow (gpm)
Vilas
Beall
Hopkins



2035 MDD-Beall
Beall 1= 0 - 5,174 gpm
Vilas 1 = 1,026 gpm
Beall 2= 0 - 4,128 gpm
Vilas 2 = 2,052 gpm
Beall 3= 0 - 3,120 gpm
Vilas 3 = 3,080 gpm
Hydraulic Gradient (ft)
1,480
1,470
1,460
1,450
1,440
1,430
1,420
-
1,000
2,000
3,000
4,000
5,000
6,000
7,000
Total Central Point Delivered Flow (gpm)
Vilas 1
Hopkins 1
Beall 1
Vilas 2
Hopkins 2
Beall 2
Vilas 3
Hopkins 3
Beall 3


2035 MDD-Vilas
Beall 1= 1,026 gpm
Vilas 1 = 0 - 5,174 gpm
Beall 2= 2,052 gpm
Vilas 2 = 0 - 4,128 gpm
Beall 3= 3,080 gpm
Vilas 3 = 0 - 3,120 gpm
Hydraulic Gradient (ft)
1,480
1,470
1,460
1,450
1,440
1,430
1,420
-
1,000
2,000
3,000
4,000
5,000
6,000
7,000
Total Central Point Delivered Flow (gpm)
Vilas 1
Hopkins 1
Beall 1
Vilas 2
Hopkins 2
Beall 2
Vilas 3
Hopkins 3
Beall 3

Appendix E: Cost Estimates

Central Point Water System Master Plan Update
All costs produced in 2019 dollars
Capital Improvement Project Cost Estimate

		Project ID:	**CIP-1**		**CIP-2**		**CIP-3**		**CIP-4**		**CIP-5**		**CIP-6**		**CIP-7**	
		Project Name:	**Haskell Connection**		**Beall Pump Station**		**Beall Lane Piping Capacity**		**Beall Lane Piping Resiliency**		**Old Stage Reservoir #2**		**Bear Creek Crossing at Pine Street**		**Interstate 5 Crossing Pipeline**	
Description	**Unit**	**Unit Costs**	**Qty**	**Total**	**Qty**	**Total**	**Qty**	**Total**	**Qty**	**Total**	**Qty**	**Total**	**Qty**	**Total**	**Qty**	**Total**
Ductile Iron Pipe - Mechanically Restrained Joints																
8-inch, CL54	LF	$ 342	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -
10-inch, CL54	LF	$ 378	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -
12-inch, CL54	LF	$ 402	570	$ 229,140		$ -	-	$ -	-	$ -		$ -	-	$ -		$ -
16-inch, CL52	LF	$ 483		$ -	-	$ -		$ -	1,160	$ 560,280	-	$ -	1,190	$ 574,770	-	$ -
18-inch, CL52	LF	$ 512	-	$ -	-	$ -		$ -	-	$ -	-	$ -		$ -	-	$ -
20-inch, CL52	LF	$ 557		$ -		$ -	910	$ 506,870	-	$ -		$ -		$ -	1,660	$ 924,620
24-inch, CL52	LF	$ 811	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -
Pre-stressed Concrete Tank																
1,900,000 Gallons, 1/2 Below Grade	EA	$ 5,790,000	-	$ -	-	$ -	-	$ -	-	$ -	1	$ 5,790,000	-	$ -	-	$ -
Pump Stations																
Beall Pump Station, 3,600 gpm, 36 ft TDH	LS	$ 2,029,000	-	$ -	1	$ 2,029,000	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -
Vilas - 5th Pump Installation	LS	$ 175,000	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -
Additional Studies	LS	Varies	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -
Total Direct Cost				**$ 229,140**		**$ 2,029,000**		**$ 506,870**		**$ 560,280**		**$ 5,790,000**		**$ 574,770**		**$ 924,620**
Contingency		25%		$ 57,285		$ 507,250		$ 126,718		$ 140,070		$ 1,158,000		$ 143,693		$ 231,155
Subtotal				$ 286,425		$ 2,536,250		$ 633,588		$ 700,350		$ 6,948,000		$ 718,463		$ 1,155,775
Design/Construction Administration		20%		$ 57,285.00		$ 507,250		$ 126,718		$ 140,070		$ 694,800		$ 143,693		$ 231,155
Permitting		5%		$ 14,321.25		$ 126,813		$ 31,679		$ 35,018		$ 347,400		$ 35,923		$ 57,789
Adminstration		10%		$ 28,642.50		$ 253,625		$ 63,359		$ 70,035		$ 347,400		$ 71,846		$ 115,578
EAC Sub-Total				$ 100,249		$ 887,688		$ 221,756		$ 245,123		$ 1,389,600		$ 251,462		$ 404,521
Total Cost				**$ 386,674**		**$ 3,423,938**		**$ 855,343**		**$ 945,473**		**$ 8,337,600**		**$ 969,924**		**$ 1,560,296**

Central Point Water System Master Plan Update
All costs produced in 2019 dollars
Capital Improvement Project Cost Estimate

Project ID:			CIP-8		CIP-9		CIP-10		CIP-11		CIP-12		CIP-13		CIP-14	
Project Name:			Vilas Road Pipeline		Vilas Pump Station Upgrade		Vilas Pump Station VFD Upgrade		Downtown Small Pipe Replacement Program: Royal Heights		Geotechnical investigation at creek crossings		Annual Seismic Resiliency Pipe Replacement		Fire Flow Improvements near Front St and Bush	
Description	**Unit**	**Unit Costs**	**Qty**	**Total**	**Qty**	**Total**			**Qty**	**Total**	**Qty**	**Total**	**Qty**	**Total**	**Qty**	**Total**
Ductile Iron Pipe - Mechanically Restrained Joints							**Cost TBD**									
8-inch, CL54	LF	$ 342	-	$ -	-	$ -	-	$ -	7,600	$ 2,599,200	-	$ -	-	$ -	450	$ 153,900
10-inch, CL54	LF	$ 378	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -	560	$ 211,680
12-inch, CL54	LF	$ 402	-	$ -		$ -	-	$ -	-	$ -	-	$ -	440	$ 176,880		$ -
16-inch, CL52	LF	$ 483	840	$ 405,720	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -
18-inch, CL52	LF	$ 512		$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -
20-inch, CL52	LF	$ 557		$ -		$ -		$ -	-	$ -	-	$ -	-	$ -		$ -
24-inch, CL52	LF	$ 811	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -
Pre-stressed Concrete Tank																
1,900,000 Gallons, 1/2 Below Grade	EA	$ 5,790,000	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -
Pump Stations																
Beall Pump Station, 3,600 gpm, 36 ft TDH	LS	$ 2,029,000	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -
Vilas - 5th Pump Installation	LS	$ 175,000	-	$ -	1	$ 175,000	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -
Additional Studies	LS	Varies	-	$ -	-	$ -	-	$ -	-	$ -	1	$ 150,000	-	$ -	-	$ -
Total Direct Cost				**$ 405,720**		**$ 175,000**		**$ -**		**$ 2,599,200**				**$ 176,880**		**$ 365,580**
Contingency		25%		$ 101,430		$ 43,750		$ -		$ 649,800				$ 44,220		$ 91,395
Subtotal				$ 507,150		$ 218,750		$ -		$ 3,249,000				$ 221,100		$ 456,975
Design/Construction Administration		20%		$ 101,430		$ 43,750		$ -		$ 649,800				$ 44,220		$ 91,395
Permitting		5%		$ 25,358		$ 10,938		$ -		$ 162,450				$ 11,055		$ 22,849
Adminstration		10%		$ 50,715		$ 21,875		$ -		$ 324,900				$ 22,110		$ 45,698
EAC Sub-Total				$ 177,503		$ 76,563		$ -		$ 1,137,150				$ 77,385		$ 159,941
Total Cost				**$ 684,653**		**$ 295,313**		**$ -**		**$ 4,386,150**		**$ 150,000**		**$ 298,485**		**$ 616,916**

Central Point Water System Master Plan Update
All costs produced in 2019 dollars
Capital Improvement Project Cost Estimate

		Project ID:	CIP-15		CIP-16		CIP-17		CIP-18		CIP-19		CIP-20		CIP-21	
		Project Name:	Fire Flow Improvements on Maple		Fire Flow on Bigham (E Pine St to Oak St)		Fire Flow on 9th (between E Pine St and Oak St)		Fire Flow on Oak (7th to Freeman)		Fire Flow on Bigham (S of Oak St) to West on Chestnut		Fire Flow on Chestnut (E of Bigham), connector to Ash St and east along Ash St		Fire Flow on Ash St (W of connector to Chestnut St)	
Description	**Unit**	**Unit Costs**	**Qty**	**Total**	**Qty**	**Total**	**Qty**	**Total**	**Qty**	**Total**	**Qty**	**Total**	**Qty**	**Total**	**Qty**	**Total**
Ductile Iron Pipe - Mechanically Restrained Joints																
8-inch, CL54	LF	$ 342	2,780	$ 950,760	820	$ 280,440	440	$ 150,480	1,060	$ 362,520	900	$ 307,800	970	$ 331,740	1,050	$ 359,100
10-inch, CL54	LF	$ 378	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -
12-inch, CL54	LF	$ 402	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -
16-inch, CL52	LF	$ 483	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -
18-inch, CL52	LF	$ 512		$ -		$ -		$ -		$ -		$ -		$ -		$ -
20-inch, CL52	LF	$ 557		$ -		$ -		$ -		$ -		$ -		$ -		$ -
24-inch, CL52	LF	$ 811	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -
Pre-stressed Concrete Tank																
1,900,000 Gallons, 1/2 Below Grade	EA	$ 5,790,000	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -
Pump Stations																
Beall Pump Station, 3,600 gpm, 36 ft TDH	LS	$ 2,029,000	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -
Vilas - 5th Pump Installation	LS	$ 175,000	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -
Additional Studies	LS	Varies	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -
Total Direct Cost				**$ 950,760**		**$ 280,440**		**$ 150,480**		**$ 362,520**		**$ 307,800**		**$ 331,740**		**$ 359,100**
Contingency		25%		$ 237,690		$ 70,110		$ 37,620		$ 90,630		$ 76,950		$ 82,935		$ 89,775
Subtotal				$ 1,188,450		$ 350,550		$ 188,100		$ 453,150		$ 384,750		$ 414,675		$ 448,875
Design/Construction Administration		20%		$ 237,690		$ 70,110		$ 37,620		$ 90,630		$ 76,950		$ 82,935		$ 89,775
Permitting		5%		$ 59,423		$ 17,528		$ 9,405		$ 22,658		$ 19,238		$ 20,734		$ 22,444
Adminstration		10%		$ 118,845		$ 35,055		$ 18,810		$ 45,315		$ 38,475		$ 41,468		$ 44,888
EAC Sub-Total				$ 415,958		$ 122,693		$ 65,835		$ 158,603		$ 134,663		$ 145,136		$ 157,106
Total Cost				**$ 1,604,408**		**$ 473,243**		**$ 253,935**		**$ 611,753**		**$ 519,413**		**$ 559,811**		**$ 605,981**

Central Point Water System Master Plan Update
All costs produced in 2019 dollars
Capital Improvement Project Cost Estimate

		Project ID:	**CIP-22**		**CIP-23**		**CIP-24**		**CIP-25**		**CIP-26**		**CIP-27**		**CIP-28**	
		Project Name:	**Fire Flow on Rostell**		**Fire Flow on Hazel and 9th**		**Fire Flow on Laurel Street**		**Fire Flow on Manzanita**		**Fire Flow at Scenic Middle School**		**Fire Flow on Bush St**		**Fire Flow on Grand Ave**	
Description	**Unit**	**Unit Costs**	**Qty**	**Total**	**Qty**	**Total**	**Qty**	**Total**	**Qty**	**Total**	**Qty**	**Total**	**Qty**	**Total**	**Qty**	**Total**
Ductile Iron Pipe - Mechanically Restrained Joints																
8-inch, CL54	LF	$ 342	490	$ 167,580	825	$ 282,150	1,440	$ 492,480	110	$ 37,620	-	$ -	864	$ 295,488	732	$ 250,344
10-inch, CL54	LF	$ 378	-	$ -	-	$ -	-	$ -	-	$ -	900	$ 340,200	-	$ -	-	$ -
12-inch, CL54	LF	$ 402	-	$ -		$ -	-	$ -		$ -	-	$ -	-	$ -	-	$ -
16-inch, CL52	LF	$ 483	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -
18-inch, CL52	LF	$ 512		$ -	-	$ -		$ -	-	$ -		$ -		$ -	-	$ -
20-inch, CL52	LF	$ 557		$ -		$ -		$ -	-	$ -		$ -		$ -	-	$ -
24-inch, CL52	LF	$ 811	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -
Pre-stressed Concrete Tank																
1,900,000 Gallons, 1/2 Below Grade	EA	$ 5,790,000	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -
Pump Stations																
Beall Pump Station, 3,600 gpm, 36 ft TDH	LS	$ 2,029,000	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -
Vilas - 5th Pump Installation	LS	$ 175,000	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -
Additional Studies	LS	Varies	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -
Total Direct Cost				**$ 167,580**		**$ 282,150**		**$ 492,480**		**$ 37,620**		**$ 340,200**		**$ 295,488**		**$ 250,344**
Contingency		25%		$ 41,895		$ 70,538		$ 123,120		$ 9,405		$ 85,050		$ 73,872		$ 62,586
Subtotal				$ 209,475		$ 352,688		$ 615,600		$ 47,025		$ 425,250		$ 369,360		$ 312,930
Design/Construction Administration		20%		$ 41,895		$ 70,538		$ 123,120		$ 9,405		$ 85,050		$ 73,872		$ 62,586
Permitting		5%		$ 10,474		$ 17,634		$ 30,780		$ 2,351		$ 21,263		$ 18,468		$ 15,647
Adminstration		10%		$ 20,948		$ 35,269		$ 61,560		$ 4,703		$ 42,525		$ 36,936		$ 31,293
EAC Sub-Total				$ 73,316		$ 123,441		$ 215,460		$ 16,459		$ 148,838		$ 129,276		$ 109,526
Total Cost				**$ 282,791**		**$ 476,128**		**$ 831,060**		**$ 63,484**		**$ 574,088**		**$ 498,636**		**$ 422,456**

Central Point Water System Master Plan Update
All costs produced in 2019 dollars
Capital Improvement Project Cost Estimate

			Project ID:	CIP-29		CIP-30	
			Project Name:	Fire Flow at Central Point Elementary		Fire Flow at RVSS	
Description	**Unit**	**Unit Costs**		**Qty**	**Total**	**Qty**	**Total**
Ductile Iron Pipe - Mechanically Restrained Joints							
8-inch, CL54	LF	$	342	184	$ 62,928	-	$ -
10-inch, CL54	LF	$	378	-	$ -	530	$ 200,340
12-inch, CL54	LF	$	402	-	$ -	-	$ -
16-inch, CL52	LF	$	483	-	$ -	-	$ -
18-inch, CL52	LF	$	512		$ -	-	$ -
20-inch, CL52	LF	$	557		$ -	-	$ -
24-inch, CL52	LF	$	811	-	$ -	-	$ -
Pre-stressed Concrete Tank							
1,900,000 Gallons, 1/2 Below Grade	EA	$	5,790,000	-	$ -	-	$ -
Pump Stations							
Beall Pump Station, 3,600 gpm, 36 ft TDH	LS	$	2,029,000	-	$ -	-	$ -
Vilas - 5th Pump Installation	LS	$	175,000	-	$ -	-	$ -
Additional Studies	LS	Varies		-	$ -	-	$ -
Total Direct Cost					**$ 62,928**		**$ 200,340**
Contingency		25%			$ 15,732		$ 50,085
Subtotal					$ 78,660		$ 250,425
Design/Construction Administration		20%			$ 15,732		$ 50,085
Permitting		5%			$ 3,933		$ 12,521
Adminstration		10%			$ 7,866		$ 25,043
EAC Sub-Total					$ 27,531		$ 87,649
Total Cost					**$ 106,191**		**$ 338,074**

Appendix F: Seismic Hazards and Backbone Fragility Evaluation

McMillen Jacobs Associates, August 4, 2020

Technical Memorandum

To:	Janice Bell, P.E.	Project:	Central Point Water System
From:	Wolfe Lang, Devin Roth	cc:	
Date:	August 4, 2020	Job No.:	6139.0
Subject:	Seismic Hazards and Backbone Fragility Evaluation		

1.0 Introduction

The City of Central Point (City) is updating their water system master plans. As part of the study, a seismic resiliency evaluation of the water system is required in conjunction with the Oregon Resilience Plan (ORP). The City has contracted Brown and Caldwell to provide professional services for the master plan updates and resilience study. Brown and Caldwell has retained McMillen Jacobs Associates (McMillen Jacobs) to conduct seismic hazard evaluation and backbone pipe vulnerability assessment.

This memorandum presents the results of our evaluation. The following tasks were completed in accordance with our scope of work:

1. Review of DOGAMI seismic hazard maps for a magnitude 9.0 CSZ event in the City's service area;
2. Review of available geological information;
3. Review of available geotechnical boring and well log information to verify DOGAMI seismic hazard maps;
4. Site reconnaissance to address key geological and geotechnical assumptions and to examine areas that are potentially prone to failures from lateral spreading and seismic landslide hazards;
5. Develop estimates of strong ground shaking, liquefaction-induced settlement, lateral spreading displacement, seismic landslide slope instability, and develop maps illustrating these hazards in relation to the City's backbone system;
6. Conduct pipe fragility analysis for the backbone pipe system under strong ground shaking and seismic ground deformation, and;
7. Develop this memorandum summarizing the results of our evaluations and including seismic hazards and fragility maps.

These tasks were completed at the identified critical water facilities and backbone pipes as shown on Figures 1 to 6. In the following sections, we present the results of the data review, seismic hazards evaluation, pipe fragility assessment, and a summary of geotechnical hazards along the backbone system.

2.0 Background Information Review and Site Reconnaissance

McMillen Jacobs performed background information review and site reconnaissance. We reviewed geologic and seismic hazards literature, available geotechnical information, various construction drawings and reports for the Central Point Water System and in adjacent areas.

2.1 Geologic Setting

The Central Point/Medford area is underlain at depth by Cretaceous age sedimentary rock called the Hornbrook Formation (Wells 1956). This formation consists of hard conglomerate and sandstone overlain by mudstone with thick sandstone interbeds (Beaulieu and Hughes 1977). This older formation is overlain across most of eastern part of the city by early Tertiary sedimentary rocks consisting of sandstone and siltstone. The Tertiary rocks thin toward the west, however, and are probably not present west of Bear Creek. Up to 60 feet of unconsolidated gravel, sand and silt deposited by streams during the Pleistocene epoch overlie the older rock units from a little east of Bear Creek to the western margins of the valley floor. Recent alluvium is present along the Bear Creek channel.

Throughout much of the Bear Creek valley, dark brown clayey soils have developed from weathering of the underlying alluvial materials. These soils have a low permeability and are subject to ponding and locally to high ground water.

2.2 Subsurface Data

McMillen Jacobs reviewed the available geotechnical information in the vicinity of the water system, the material was in the form of geotechnical logs from City facilities and ODOT bridge logs, and well logs from the Oregon Water Resource Department's database. Where possible, this data was used to confirm or revise the extents of mapped geologic and hazard layers from the DOGAMI O-13-06 and to conduct soil liquefaction potential evaluation.

Our research found 7 documents containing useful geotechnical information. We show a summary of these documents in Table 1. These included geotechnical reports, drilling logs, and existing plans. These reports contain a total of 13 useful boring logs.

Table 1: Geotechnical Documents Reviewed

	Source	Document	Number of Borings	Boring Depth (Feet)
1	ODOT	Br08542Drw15240EPineStP&E	2	60
2	ODOT	Br19630Drw62291FDS 1of2_BearCrBrPineStJackCo	3	60
5	ODOT	Br19630Drw62291FDS 2of2_BearCrBrPineStJackCo	3	60
4	ODOT	19789-01. Exit 33 Off-Ramp	1	30
6	City	FINAL 4517rpt Central Point 3.0 MG Reservoir	3	30 - 45
7	City	Beebe Rd Sewer, B-3, 2000	1	19

In addition to the detailed geotechnical data listed above, we also used the Oregon Water Resources Department (OWRD) Well Log database to verify the subsurface data in areas not covered by the above documents. There are hundreds of well logs in the area, but the quality of the data is inconsistent. We reviewed 25 logs with useful information, covering the entire water system area. Table 2 is a summary of the OWRD well logs used; their locations are mapped in Figures 1 through 5. Please note that the mapped locations of these logs have a very low accuracy.

Table 2: Oregon Water Resources Department Well Logs Reviewed

	Backbone Area	OWRD Log No.	Depth (Ft)		Zone	OWRD Log No.	Depth
1	Old Stage	JACK 12622	240	14	Bear Creek	JACK 60994	20
2	Old Stage	JACK 12637	86	15	Bear Creek	JACK 60992	20
3	Old Stage	JACK 12640	140	16	Bear Creek	JACK 12260	50
4	Old Stage	JACK 12641	88	17	Bear Creek	JACK 12239	100
5	Old Stage	JACK 12642	226	18	Bear Creek	JACK 12242	140
6	Old Stage	JACK 12651	60	19	Bear Creek	JACK 12248	120
7	Old Stage	JACK 55170	700	20	Backbone	JACK 53851	24
8	Old Stage	JACK 55195	140	21	Backbone	JACK 58634	15
9	Old Stage	JACK 55267	340	22	Backbone	JACK 61095	20
10	Old Stage	JACK 58065	400	23	Backbone	JACK 61316	20
11	Beebe Xing	JACK 12286	50	24	Backbone	JACK 62205	40
12	Beebe Xing	JACK 53853	20	25	Backbone	JACK 62563	30
13	Beebe Xing	JACK 61181	140				

2.3 Site Reconnaissance

On May 5th, 2020 we performed a geotechnical reconnaissance for the following water facilities of the City:

- Shops Tank and Pump Station;
- Old Stage Reservoir;
- Vilas Reservoir and Pump Station;
- Bear Creek Crossing at Pine Street.

These facilities are shown in Figures 1 through 5 and are part of the critical facilities in the Seismic backbone system. During the reconnaissance, we noted site conditions, surface or exposed soil and rock conditions, site topography, proximity to bodies of water and steep slopes. Selected photographs from the site visits are provided in Appendix A. Our assessment of the site visits and reviewed data is discussed in Section 5.

3.0 Seismic Hazard Evaluation and Mapping

Recent earthquakes in Japan, New Zealand, Chile and elsewhere, and an increased understanding of the Cascadia Subduction Zone (CSZ), have increased the recognition of the earthquake hazard in Oregon. In 2011, Oregon legislature passed a resolution directing the Oregon Seismic Safety Policy Advisory Commission (OSSPAC) to prepare the Oregon Resilience Plan (ORP). The purpose of the ORP is to set policy direction for protecting lives and maintaining economic and commercial activity following a magnitude 9.0 CSZ earthquake (Oregon Resilience Plan 2013).

Recent studies indicate that there have been numerous large-magnitude earthquakes generated from the CSZ (Goldfinger et al., 2012). These records extend as far back as approximately 10,000 years and indicate an average recurrence of about 500 to 530 years for great earthquakes (larger than M 8.0) that rupture along the entire length of the CSZ (from Cape Mendocino, California to Northern Vancouver Island, British Columbia). The previous CSZ earthquake occurred in January 1700 (Satake, et al., 1996) and is estimated to have been a M 9.0 event. Studies by the USGS (Goldfinger et al., 2012; OSSPAC, 2013) indicate that there is a 7 to 12 percent probability of a great CSZ event impacting the entire Pacific Northwest region. A more recent study by University of Oregon (Goldfinger et al., 2016) estimates that a CSZ earthquake with a magnitude greater than 8.5 has a probability of occurrence on the order of 16 to 22 percent over the next 50 years.

Earthquake hazards within the Project area include earthquakes generated from several sources:

- Crustal faults;
- Within the deep subducted portion of the Juan de Fuca Plate, along the CSZ (referred to as intraslab sources); and
- Along the locked zone of the Cascadia Subduction Zone fault interface capable of producing great, megathrust events.

Large subduction zone earthquakes are characterized by a long duration of significant ground shaking. The 2010 subduction zone earthquake in Maule, Chile resulted in approximately 100 seconds of significant ground shaking. The 2011 subduction zone earthquake in Tohoku, Japan resulted in between about 2 to 3 minutes of significant ground shaking. For comparison, crustal earthquakes with similar seismogenic characteristics exhibited significant ground shaking for about 10 to 20 seconds (specifically the 2010-2011 Christ Church, New Zealand sequences, 1999 Chi-Chi, Taiwan, and 1983 Coalinga, California earthquakes).

Due to the long duration of ground shaking, a CSZ earthquake is generally expected to cause higher levels of permanent ground deformation (PGD) than crustal and intraslab sources. Permanent ground deformations pose critical seismic risks to the City’s water system seismic backbone.

In some instances, for structures and facilities (pump stations, treatment plants, reservoir, dam), the seismic design criteria are governed by other code-based procedures (ASCE 7-16, OSSC 2014, Oregon Dam Safety). Typically, these code-based procedures require use of the Maximum Considered Earthquake (MCE) ground motion. The MCE ground motion is derived from USGS Seismic Hazard

Maps and represents the most server earthquake effects. The MCE is a probabilistically derived composite event that is aggregated from all potential earthquake sources that could impact a site and having a return interval of 2,475 years. For comparison, the ORP M9.0 scenario is roughly analogous to a 500-year return interval event.

As part of the ORP, The OSSPAC created a Cascadia Earthquake Scenario workgroup which was charged with developing a description of the likely ground motions (velocity and accelerations) and permanent ground deformations (PGD) to be expected from a M9.0 CSZ event. The workgroup, along with the Oregon Department of Geology and Mineral Industries (DOGAMI), developed M9.0 earthquake scenario maps, which are included in the DOGAMI Open-File Report O-13-06. Of primary interest in these earthquake scenario maps are the following seismic hazards, which formed the baseline levels in our evaluations of seismic hazards:

- Peak Ground Velocity (DOGAMI O-13-06 Plate 2)
- Liquefaction Probability (DOGAMI O-13-06 Plate 3)
- Lateral Spreading PGD (DOGAMI O-13-06 Plate 4)
- Seismic Landslide PGD (DOGAMI O-13-06 Plate 6)

We used the M9.0 CSZ event as the basis of our analyses to be consistent with the ORP and the City's approach. Seismic hazards that pose the most risk to the City's water system include strong ground shaking (peak ground velocity and accelerations), liquefaction, lateral spreading, and seismic-induced landslides. In our hazard evaluations, we overlaid the City's seismic backbone onto the DOGAMI maps as a starting point. As discussed subsequently, we refined and updated the DOGAMI maps in areas that we found appropriate based on field observations, subsurface data and geotechnical engineering analysis.

3.1 Geologic Map

The geologic map data presented in Figure 1 is derived from the Oregon Geologic Data Compilation Release 6 compiled by DOGAMI, which shows the mapped surficial geologic units in the vicinity of the Central Point Water System backbone pipelines. This mapping corresponds to the descriptions of the geology discussed above. As shown on Figure 1, most of the backbone infrastructure is located within recent sediment formations, with fine-grained materials predominant to the west of Griffin Creek and mixed-grained materials to the east and north, especially along Bear Creek.

The coarse- and mixed-grained geologic units such as alluvial silts and sands may be susceptible to develop large PGD from liquefaction and lateral spreading include alluvial silts and sands. These materials may be present along Bear Creek, and to a lesser extent along smaller drainages.

3.2 Peak Ground Velocity

The intensity of ground shaking at a site is known as peak ground velocity (PGV). The rapid and extreme shaking during an earthquake can cause transient stress and strain in pipelines that can be damaging if the pipe material and joints are not strong enough to withstand the transient ground deformations. Damage from ground shaking occurs even when there is no permanent ground deformation.

A map of estimated levels of PGV for the Central Point area is shown on Figure 2. Because the magnitude of PGV is dependent on the ground material through which seismic waves pass, we altered the extents of PGV values shown in the 2013 DOGAMI maps to better represent the increased shaking potential present in coarse- and mixed-grained. These extents now correspond to the units show in the Geology Map (Figure 1). In the fine-grained sediments prevalent to the east of Griffin Creek ground velocities range from 6 - 8 inches per second; in the mixed-grained sediments to west of Griffin Creek and along Bear Creek ground velocities reach 13 - 16 inches per second.

3.3 Liquefaction Settlement

Liquefaction is a phenomenon in which ground shaking from an earthquake transforms soil from a solid state to a viscous fluid state. Soils that are susceptible to liquefaction are generally sands and non-plastic to low-plastic silts that are saturated (below groundwater level). Silts and silty soils with a plasticity index less than 7 are generally considered to be susceptible to liquefaction. The results of soil liquefaction include loss of shear strength, loss of soil materials through sand boils or flow, flotation of buried chambers/pipes, and post-liquefaction reconsolidation (settlement).

To assess the liquefaction potential in the area, we first reviewed the published DOGAMI Liquefaction Probability map which indicates generally low liquefaction potential along the backbone pipelines, except in areas crossing Bear Creek, and other smaller drainages where moderate liquefaction potential is present. These assessments are based on the assumed liquefaction susceptibility for the mapped soil types, assumed groundwater depths, and ground shaking magnitude.

During our data review process, we identified a few areas along the pipelines where the DOGAMI mapping overestimated liquefaction hazards. Based on a review of geotechnical data along backbone, we were able to reassess the seismic liquefaction hazard and made the following revisions:

- DOGAMI maps the Pine St overcrossing of Interstate 5 as a high hazard area. We believe this classification is due to steep slopes of the abutments and does not reflect the predicted behavior of an engineered slope. Therefore, we reclassified liquefaction potential as low, matching the surrounding area;
- DOGAMI maps the entire Bear Creek channel as a high hazard area. Analysis of geotechnical borings in the Beebe Street Crossing of Bear Creek location show the pipe is mostly located below the liquefiable layer and that the underlaying layer is composed of high-strength gravels. Therefore, we reclassified liquefaction potential as low.

Based on these revisions to the liquefaction potential map, we developed an updated liquefaction settlement map for the Central Point Water System backbone (see Figure 3).

As stated earlier, due to the geologic setting, liquefaction settlement only poses a risk to water pipelines, at some creek crossings. Liquefaction settlement estimates at this crossing are on the order of 2 inches.

Also, moderate lateral spreading deformation is anticipated at these locations. Recommendations to characterize this site are provided later in this memo.

3.4 Lateral Spreading

Liquefaction can result in progressive ground deformation known as lateral spreading. Lateral spreading generally occurs along river/creek banks and within sloping ground areas. The lateral movement and loss of support of the liquefied soil breaks the overlying non-liquefied soil “crust” into blocks that progressively move downslope or toward a free face in response to the earthquake generated ground accelerations. Each cycle of loading from the earthquake incrementally pushes these blocks downslope. The potential and magnitude of lateral spreading depends on the liquefaction potential of the soil, the magnitude and duration of earthquake ground accelerations, the site topography, and the post-liquefaction strength of the soil. Lateral spreading can result in both vertical and horizontal components of PGD, but for discussion purposes and this screening-level of analysis, the reported estimates of PGD can be considered horizontal. A map of the water system backbone with estimated levels of lateral spreading PGD is shown on Figure 4.

Within the study area, the lateral spreading hazard generally follows creek channels. Like liquefaction settlement, the primary lateral spreading risk for the backbone pipe is at the Pine Street crossing and Upton Street crossing of Bear Creek. Lateral spreading PGD on the order of 1 to 2 feet are possible at this location. A site-specific lateral spreading study should be performed to characterize the hazard and develop mitigation strategies, as discussed in more detail later in this memo. At Beebe Street crossing, the available geotechnical information indicates low lateral spreading potential.

3.5 Seismic Landslides

Earthquake induced landslides can occur on slopes due to the inertial force from an earthquake adding load to a slope. The ground movement due to landslides can be extremely large and damaging to pipelines and other structures. A map of the estimated levels of seismic landslide PGD is shown on Figure 5.

Although some landslide hazards exist in the hills surrounding the Bear Creek Valley, there are no areas of concern within the vicinity of Central Point Water System.

4.0 Water System Backbone Fragility Evaluation and Mapping

McMillen Jacobs performed a seismic fragility evaluation to assess the vulnerability of the Central Point Water System backbone using the methods published in the report Seismic Fragility Formulations for Water Systems, American Lifelines Alliance, 2001 (ALA). The evaluation relies on the GIS data provided by the City and applies the seismic ground motions discussed above to produce a value called “repair rate” or RR in units of breaks per 1000-feet of pipe.

4.1 Seismic Fragility Methodology

The ALA method considers the primary seismic effects causing pipeline breakage to be ground shaking intensity (PGV) and permanent ground deformations (PGD). The capacity of a pipeline to resist these effects is determined by materials, size, joints and soil corrosivity. The effects from ground shaking are mainly the transient ground movement by wave propagation and potential ground amplification, these effects are termed PGV, in units of inches per second. Seismic induced ground deformations can result from surface fault rupture, landslide, slope failure, soil liquefaction, lateral spreading, and differential settlement. For each section of pipe, the maximum of these is the PGD term, in units of inches. Typically, the transient load from ground shaking is generally low, and most earthquake damage to pipelines is due to PGD.

The ALA method provides two functions for estimating the likelihood of pipeline damage to a pipeline network in a seismic event, these methods are shown in Table 3. The fragility functions produce a result term called repair rate (RR) in units of breaks per 1000 feet of pipeline. These methods are empirical fragility functions developed by correlating the frequency of pipe damage, including leaks or breaks, which were severe enough to require repairs in past earthquakes and correlating with the ground shaking and PGD at the site of the repair. The K terms are a function of pipe properties, such as material and diameter, these can either increase or decrease the base pipe break rate.

Table 3: ALA Fragility Functions

Hazard	Vulnerability Function	Lognormal Standard Deviation, β	Comment
Wave Propagation	$RR = K_1 \times 0.00187 \times PGV$	1.15	Based on 81 data points of which largest percentage (38%) was for CI pipe.
Permanent Ground Deformation	$RR = K_2 \times 1.06 \times PGD^{0.319}$	0.74	Based on 42 data points of which the largest percentage (48%) was for AC pipe.

Notes:
1. Table derived from (American Lifelines Alliance 2001, Table 4-4)
2. RR = Repairs per 1,000 feet of main pipe.
3. K_1, K_2 = Material and size factors.
4. PGV = peak ground velocity, inches/second; PGD = Permanent ground deformation, inches.
5. PGD is the maximum value of landslide displacement or the resultant of lateral spreading and vertical settlement.

4.2 Pipeline Fragility Evaluation

Applying the ALA fragility functions discussed above, McMillen Jacobs evaluated the fragility of the backbone pipelines in the Central Point Water System using GIS software to overlay mapped PGV and PGD hazards to the geolocated water system data provided by the City. Table 4 summarizes ground shaking driven (PGV) pipeline breakage by pipe material. We illustrate the repair rate categories in the Ground Shaking Fragility Map, Figure 6. Repair rates are grouped into 3 categories, 0.01, 0.02, and 0.03 breaks per 1000 feet.

Table 4: Estimated breaks due to shaking by pipeline material

Pipeline Material	Pipeline Length (ft)	Estimated Breaks by PGV
AC	15609	0.44
CI	2939	0.08
DI	58831	0.69
Total	**77379**	**1.2**

Note: Estimated breaks are back calculated from RR per pipeline segment length.

Table 5 summarizes ground deformation driven (PGD) pipeline breakage by pipe material. Repair rates are grouped into 4 categories, 0, 0 – 1.0, 1.0 – 2.0, and 2.0 - 3.0 breaks per 1000 feet. We illustrate these categories in the Ground Motion Fragility Map, Figure 7. The sum of these repair rates is presented in Figure 8.

Table 5: Estimated breaks due to displacement by pipeline material

Pipeline Material	Pipeline Length (ft)	Estimated Breaks by PGD
AC	15609	0.00
CI	2939	0.33
DI	58831	1.85
Total	**77379**	**2.2**

Notes: Estimated breaks are back calculated from RR per pipeline segment length.

The values used for PGV and PGD used for the fragility calculation are from the revised seismic hazards maps discussed in the previous section. For pipeline properties, we used the information from the City's GIS system. Typically, ductile iron (DI) pipes have better seismic performance than cast iron (CI) and asbestos concrete (AC) pipes (American Lifelines Alliance, 2001). However, regular DI pipe without joint restraint is not considered to be an earthquake resilient pipe material. Whereas welded steel pipe, HDPE pipes and DI pipes with earthquake resilient joints are considered to be earthquake resilient materials.

Our analyses results show that pipe damage due to ground shaking will be low. However, pipes in areas of large PGD, due to liquefaction generated lateral spreading near drainages, will likely suffer more. This is consistent with observations of pipe systems after previous earthquakes. Historically most damage occurs as a result of large PGD.

For the City's backbone system, DI pipes are utilized at the creek crossing locations which have high ground deformation potentials, and we estimated around 2 breaks for the DI pipes at these high PGD zones. Based on the depth of the pipeline, and the high strength of the gravels from the available geotechnical information at this location, we estimate that the Beebe Rd crossing of Bear Creek would likely have a lower break potential. For other crossings, geotechnical and pipe design information is not available for review, and we consider them may have higher break potential based on the mapped relatively seismic hazards.

The pipeline repair rates identified by the assessment include both leaks and breaks. For planning purposes, we recommend assuming that 50 percent of the total repairs consist of leaks and the remaining 50 percent consist of breaks. To improve the seismic resiliency of the backbone pipelines, we recommend the following pipe improvement elements according to their considered priorities:

- Within the scheduled resiliency improvement period suggested by ORP (in the next 45 years) systematically replace the AC and CI pipes with more seismic resilient pipe systems. Experiences and lesson learned from previous earthquakes show that flexible pipe systems, such as welded steel pipe, DI pipe with restrained joints, and HDPE pipe, had a much lower break rates than the more rigid and segmental DI, AC and other concrete pipes.
- Assess the soil liquefaction and lateral spreading hazards at the Upton Street Crossing of Bear Creek and improve the seismic performance of this crossing according to the seismic ground deformation hazard level.
- Relocate the existing pipeline on the Pine Street bridge with a new crossing below the potential liquefaction and lateral spreading zone under Bear Creek.
- Assess local conditions where pipes cross minor drainages. Some of these hazards may be overstated if the actual depth of the pipeline is below the region of liquefiable soil.

5.0 Seismic Hazard Assessment and Recommendations for Critical Facilities

In addition to the seismic hazard study for the overall service area, we conducted site visits to Old Stage Reservoir, Vilas Reservoir and Pump Station and Shops Tank and Pump Station. We also conducted review on the geotechnical condition and seismic hazard potentials.

- **Old Stage Reservoir** – Based on the geotechnical boring logs for the existing reservoir, the subsurface condition at the reservoir site consists of medium dense to very dense silty sand and of residual soil and granodiorite bedrock below. The site slope is very gentle, and the seismic hazards in terms of liquefaction, lateral spreading and landslide are very low. We also visited the adjacent vacant site where a new reservoir is planned. This adjacent site also has a very gentle slope, and we also anticipated a similar stable subsurface condition.

- **Vilas Reservoir and Pump Station** – This facility is located on a flat land at the east side of the City. Based on the geotechnical boring logs for the existing reservoir, the subsurface condition at the reservoir site generally consists of medium dense to very dense gravelly and cobble soils, with a deep groundwater table. The seismic hazards in terms of liquefaction, lateral spreading and landslide are very low.

- **Shops Tank and Pump Station –** This facility is located near the center of the City. There is no existing geotechnical information available for review. Geologic map and nearby well logs indicate mix-grained silty and gravelly soil condition. The seismic hazards in terms of liquefaction, lateral spreading and landslide are considered to be low.

6.0 Conclusions and Recommendations

As discussed in the previous sections, the seismic hazards across the City of Central Point's backbone water system are generally low. Major seismic hazard concerns are the relative high liquefaction and lateral spreading potentials at the Pine Street and Upton Street Crossings of Bear Creek. In other areas, the estimated pipe fragility rate is relatively low for the backbone pipes. However, AC and CI pipes are considered to have higher seismic vulnerabilities in comparison to the DI pipe in the backbone system.

Based on our review of subsurface conditions and the site topographic conditions, we conclude that the seismic hazards at the City's reservoir locations are generally low under a magnitude 9.0, CSZ-level earthquake. The adjacent site to the Old Stage Reservoir has a very gentle slope, and the seismic landslide hazards is considered to be low.

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Principal Engineer

Devin Roth, E.I.
Staff Engineer

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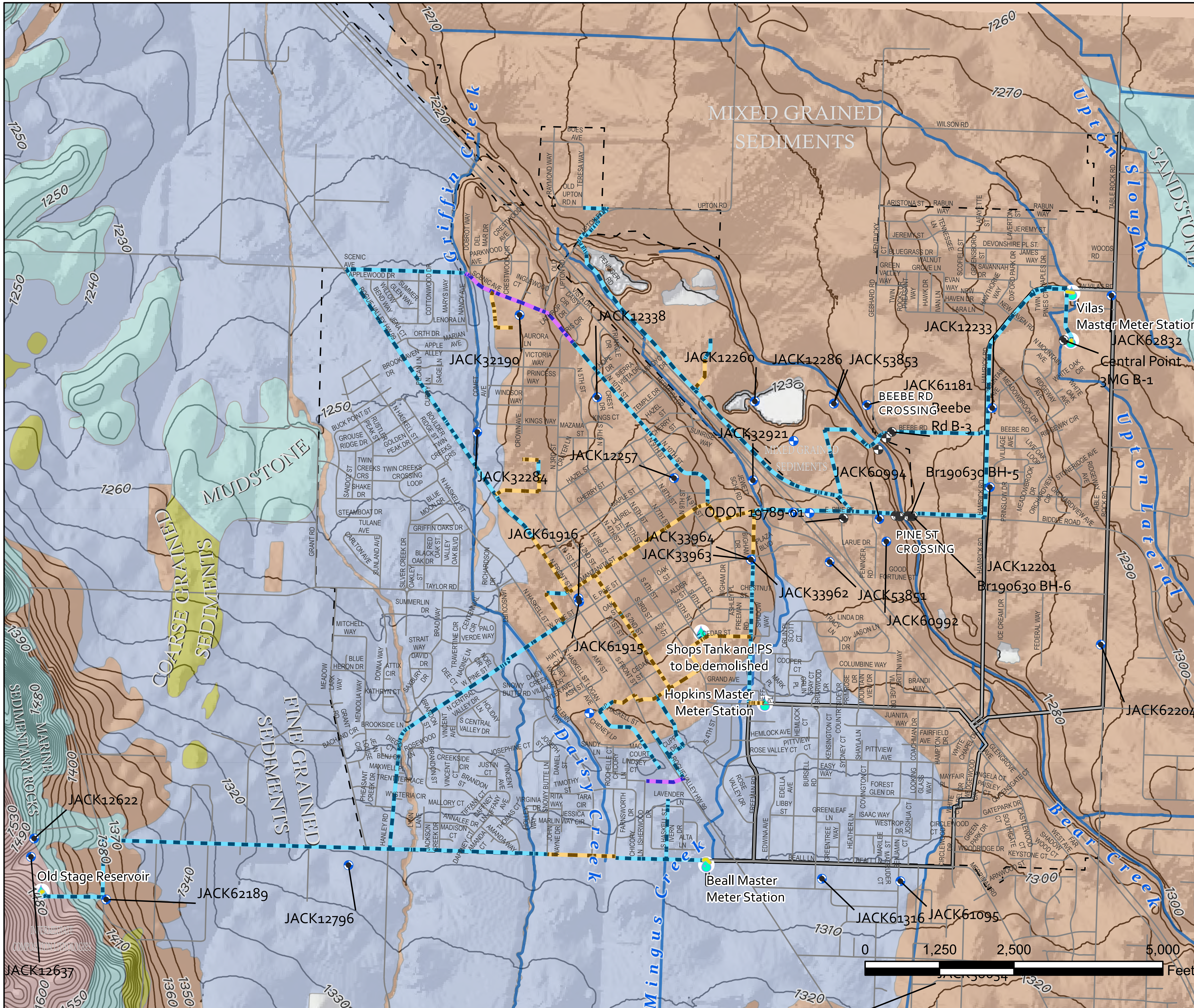
Figures



Analyzed Geotech Log
Reviewed (OWR well log)
Water Facility
Streams_Canals
Medford Water Mains
2019 UGB
Contour interval 10 feet

Geology

Coarse grained sediments
Fine grained sediments
Mixed grained sediments
Plutonic Rocks
Sedimentary rocks (Marine/Terrestrial)

Backbone

Material

AC
CI
DI
Planned

NOTES:
Geology data shown are derived from DOGAMI Open-File-Report O-13-06.

1 inch equals 1,667 feet

CENTRAL POINT WATER SYSTEM SEISMIC RESILIENCE EVALUATION

GEOLOGY
SEISMIC HAZARDS MAP

McMILLEN JACOBS ASSOCIATES

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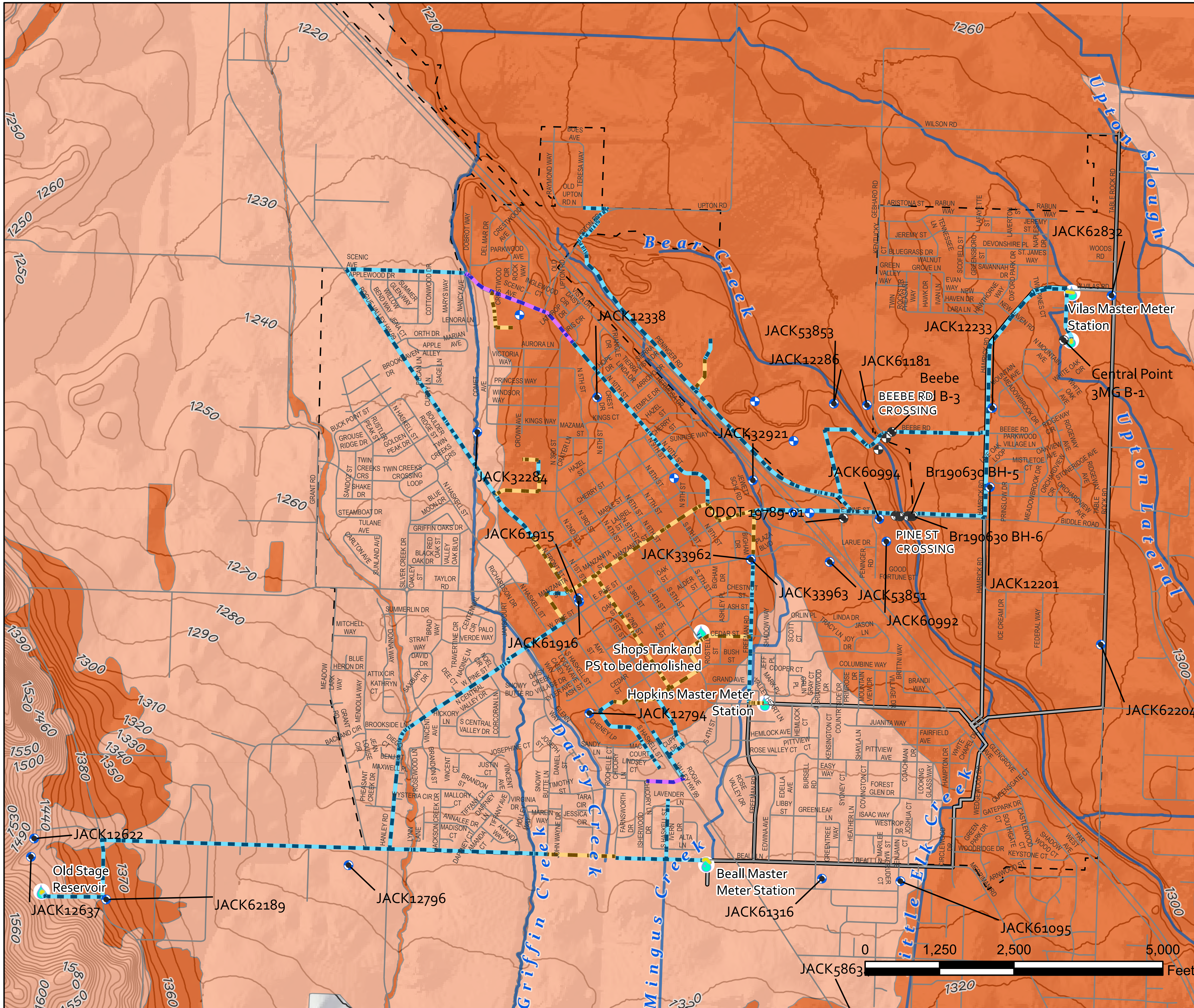
FIGURE 1



- Analyzed Geotech Log
- Reviewed (OWR well log)
- Water Facility
- Streams_Canals
- Medford Water Mains
- 2019 UGB
- Contour interval 10 feet

Peak Ground Velocity (PGV)

- 6 - 8 in/sec
- 13 - 16 in/sec

Backbone

Material

- AC
- CI
- DI
- Planned

NOTES:
Peak Ground Velocity data shown are derived from DOGAMI Open-File-Report O-13-06.

1 inch equals 1,667 feet

CENTRAL POINT WATER SYSTEM SEISMIC RESILIENCE EVALUATION

PEAK GROUND VELOCITY SEISMIC HAZARDS MAP

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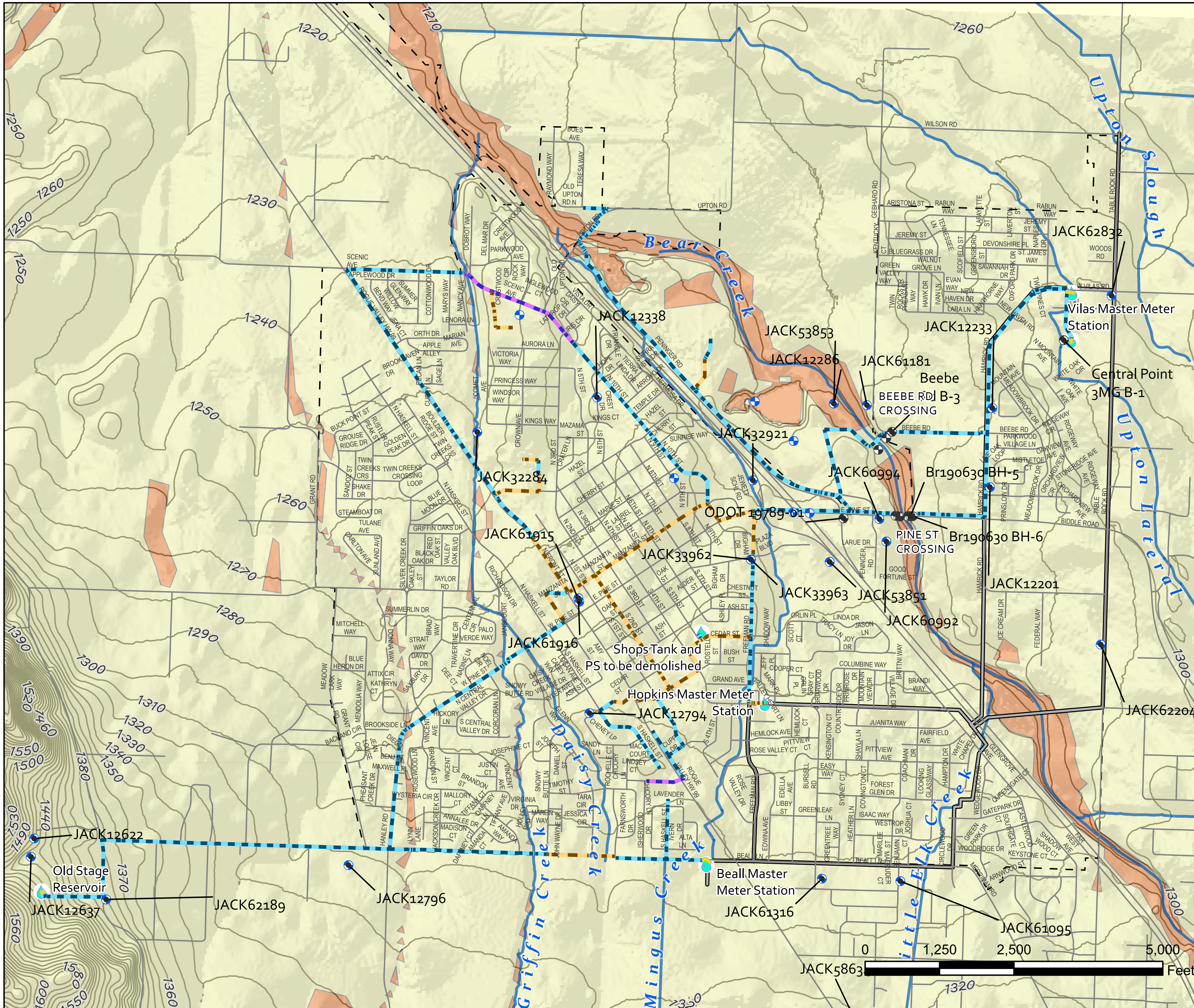
AUG 2020

FIGURE 2



Analyzed Geotech Log
Reviewed (OWR well log)
Water Facility
Streams_Canals
Medford Water Mains
2019 UGB
Contour interval 10 feet

Liquefaction Settlement (in)
0 in
0 - 2 in

Backbone
Material
AC
CI
DI
Planned

NOTES:
Liquefaction Settlement data shown are derived from DOGAMI Open-File-Report O-13-06.
1. DOGAMI overestimates seismic hazards in the vicinity of the Pine Street I-5 overcrossing, due to artificial slopes. Boring analysis shows low to very low liquefaction hazard.

1 inch equals 1,667 feet

CENTRAL POINT WATER SYSTEM SEISMIC RESILIENCE EVALUATION

LIQUEFACTION SETTLEMENT SEISMIC HAZARDS MAP

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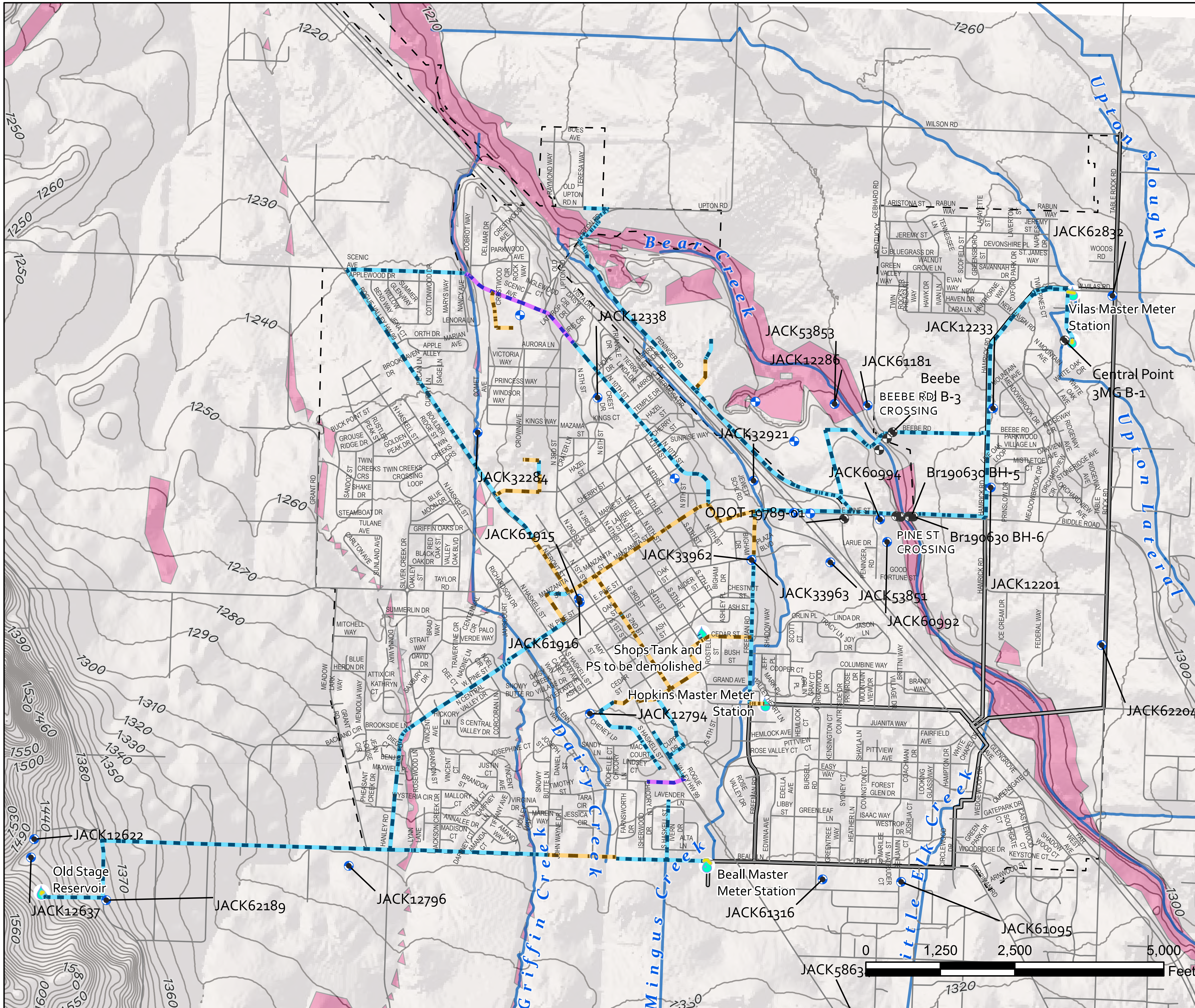
FIGURE 3



Analyzed Geotech Log
Reviewed (OWR well log)
Water Facility
Streams_Canals
Medford Water Mains
2019 UGB
Contour interval 10 feet

Lateral Spreading PGD (in)

0 in.
1 - 24 in.

Backbone

Material

AC
CI
DI
Planned

NOTES:
Lateral Spreading data shown are derived from DOGAMI Open-File-Report O-13-06.
1. DOGAMI overestimates seismic hazards in the vicinity of the Pine Street I-5 overcrossing, due to artificial slopes. Boring analysis shows low to very low liquefaction hazard.

1 inch equals 1,667 feet

CENTRAL POINT WATER SYSTEM SEISMIC RESILIENCE EVALUATION

LATERAL SPREADING SEISMIC HAZARDS MAP

N

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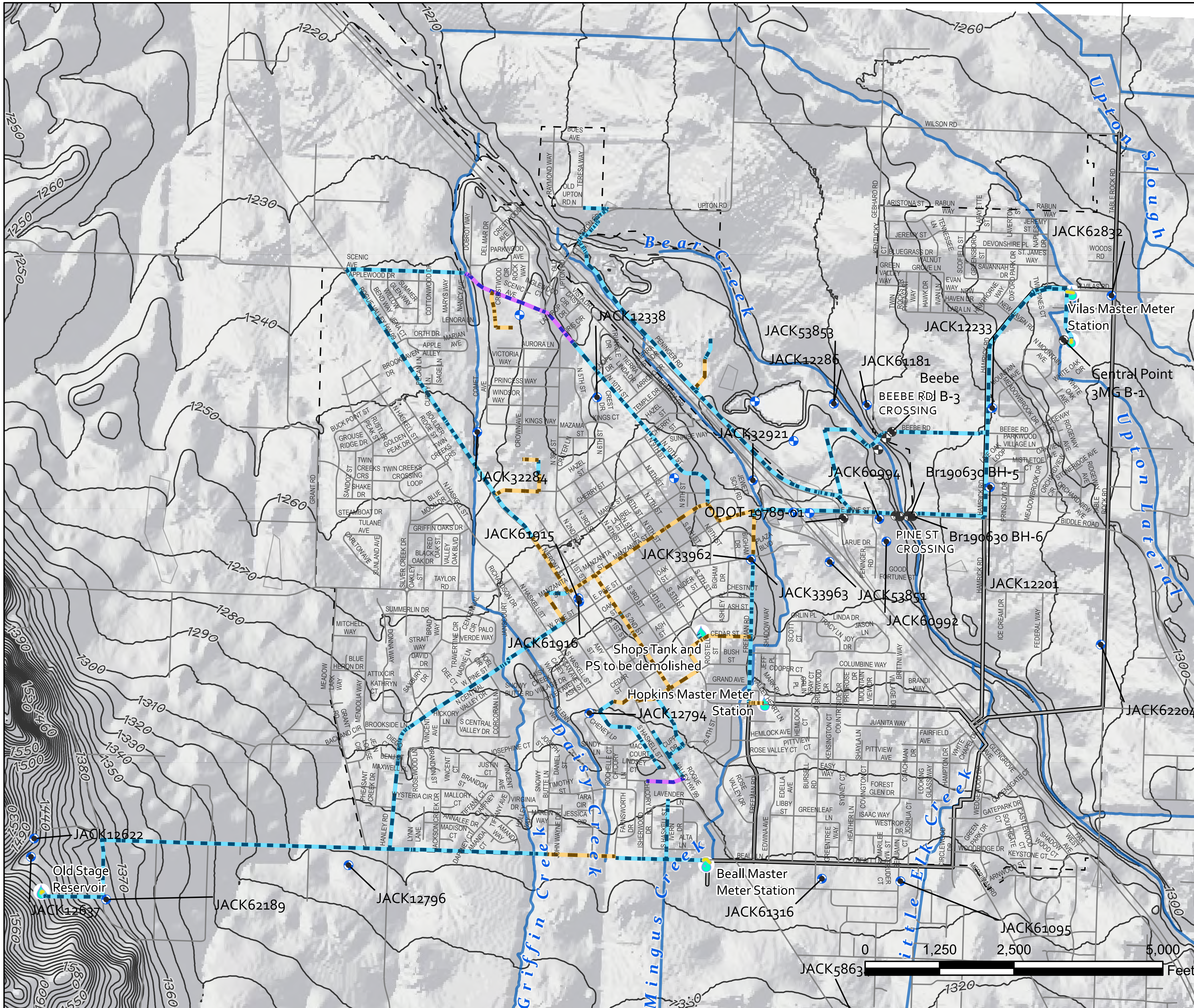
FIGURE 4



Analyzed Geotech Log
Reviewed (OWR well log)
Water Facility
Streams_Canals
Medford Water Mains
2019 UGB
Contour interval 10 feet

Landslide PGD (ft)

0 ft

Backbone

Material

AC
CI
DI
Planned

NOTES:
Seismic Landslide data shown are derived from DOGAMI Open-File-Report O-13-06.
1. DOGAMI overestimates seismic hazards in the vicinity of the Pine Street I-5 overcrossing, due to artificial slopes. Boring analysis shows low to very low liquefaction hazard.

1 inch equals 1,667 feet

CENTRAL POINT WATER SYSTEM SEISMIC RESILIENCE EVALUATION

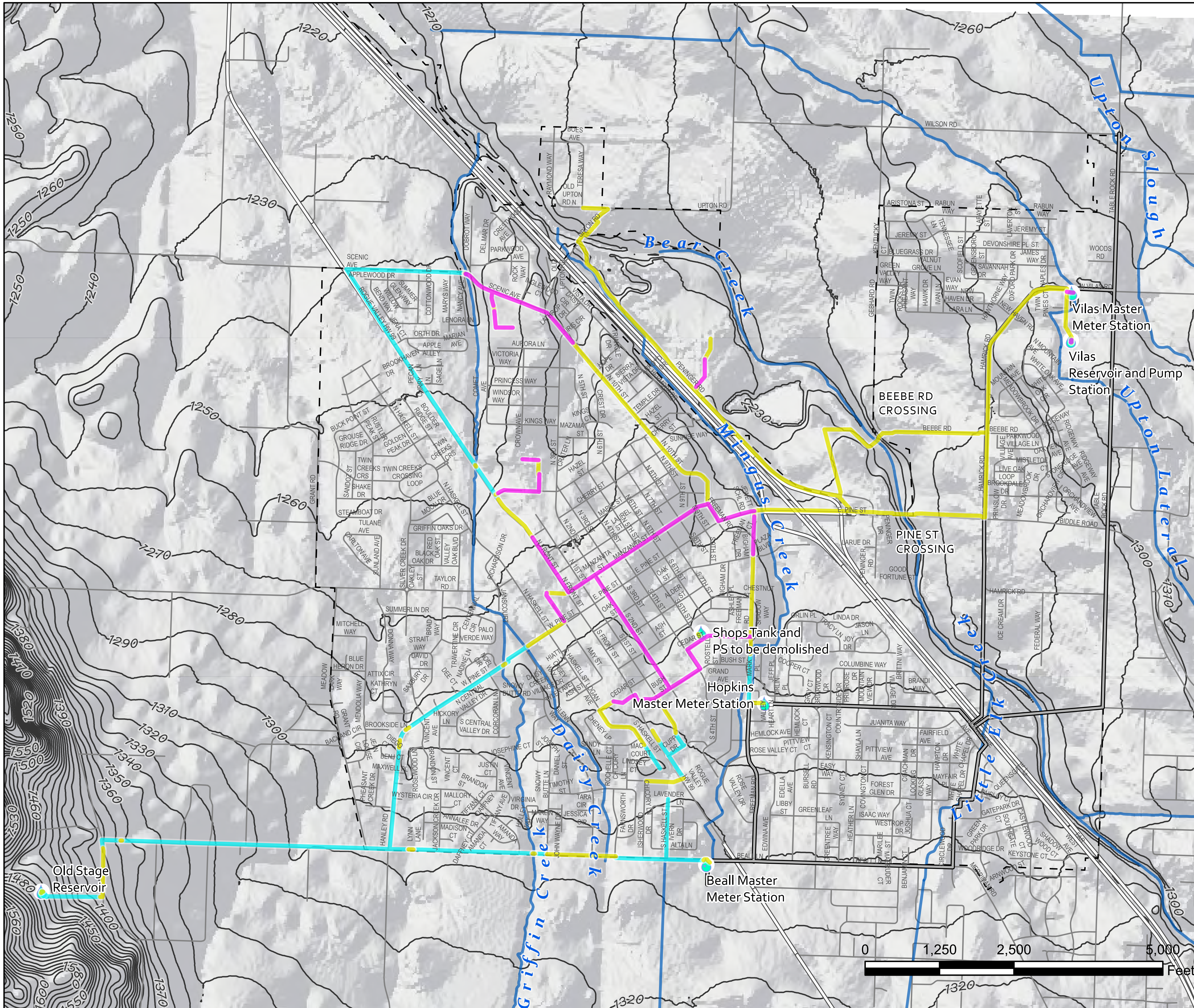
SEISMIC LANDSLIDE SEISMIC HAZARDS MAP

N

McMILLEN JACOBS ASSOCIATES

AUG 2020

FIGURE 5



- Water Facility
- Streams_Canals
- Medford Water Mains
- Contour interval 10 feet

Backbone Fragility Analysis - Ground Shaking

Repair Rate (Breaks per 1000 feet)

- ≤0.01 - 24,748 feet
- ≤0.02 - 36,331 feet
- ≤0.03 - 16,299 feet

NOTES:
Ground Shaking Pipe Fragility Map data shown are derived from DOGAMI Open-File-Report O-13-06.

1 inch equals 1,667 feet

CENTRAL POINT WATER SYSTEM SEISMIC RESILIENCE EVALUATION

GROUND SHAKING PIPE FRAGILITY MAP

N

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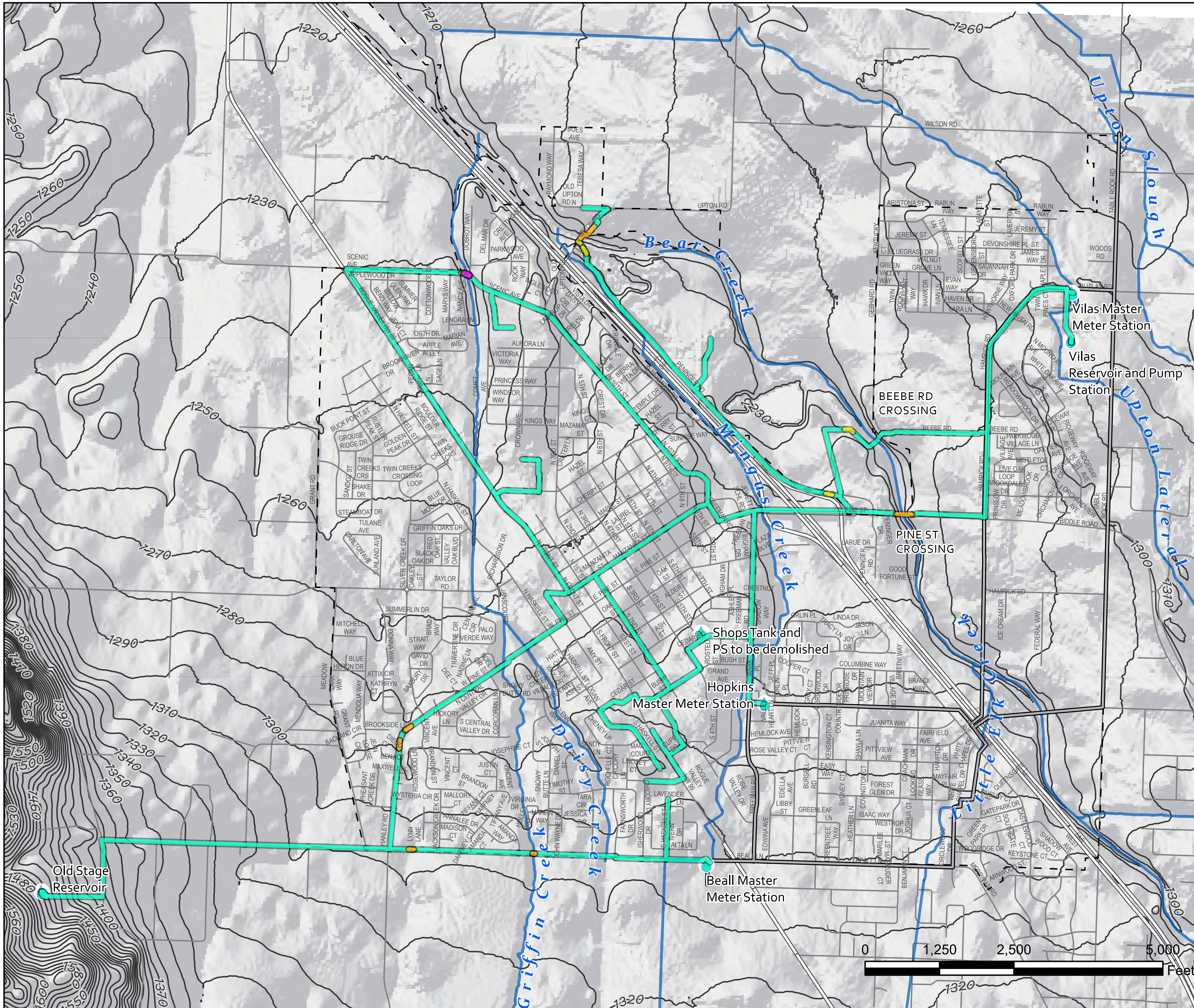
FIGURE 6



Water Facility

Streams_Canals

Medford Water Mains

Contour interval 10 feet

Backbone Fragility Analysis - Deformation

Repair Rate (Breaks per 1000 feet)

- 0 - 75,633 feet
- 0 - 1.0 - 596 feet
- 1.0 - 2.0 - 1,068 feet
- 2.0 - 3.0 - 82 feet

NOTES:
Deformation Pipe Fragility Map data shown are derived from DOGAMI Open-File-Report O-13-06.

1 inch equals 1,667 feet

CENTRAL POINT WATER SYSTEM SEISMIC RESILIENCE EVALUATION

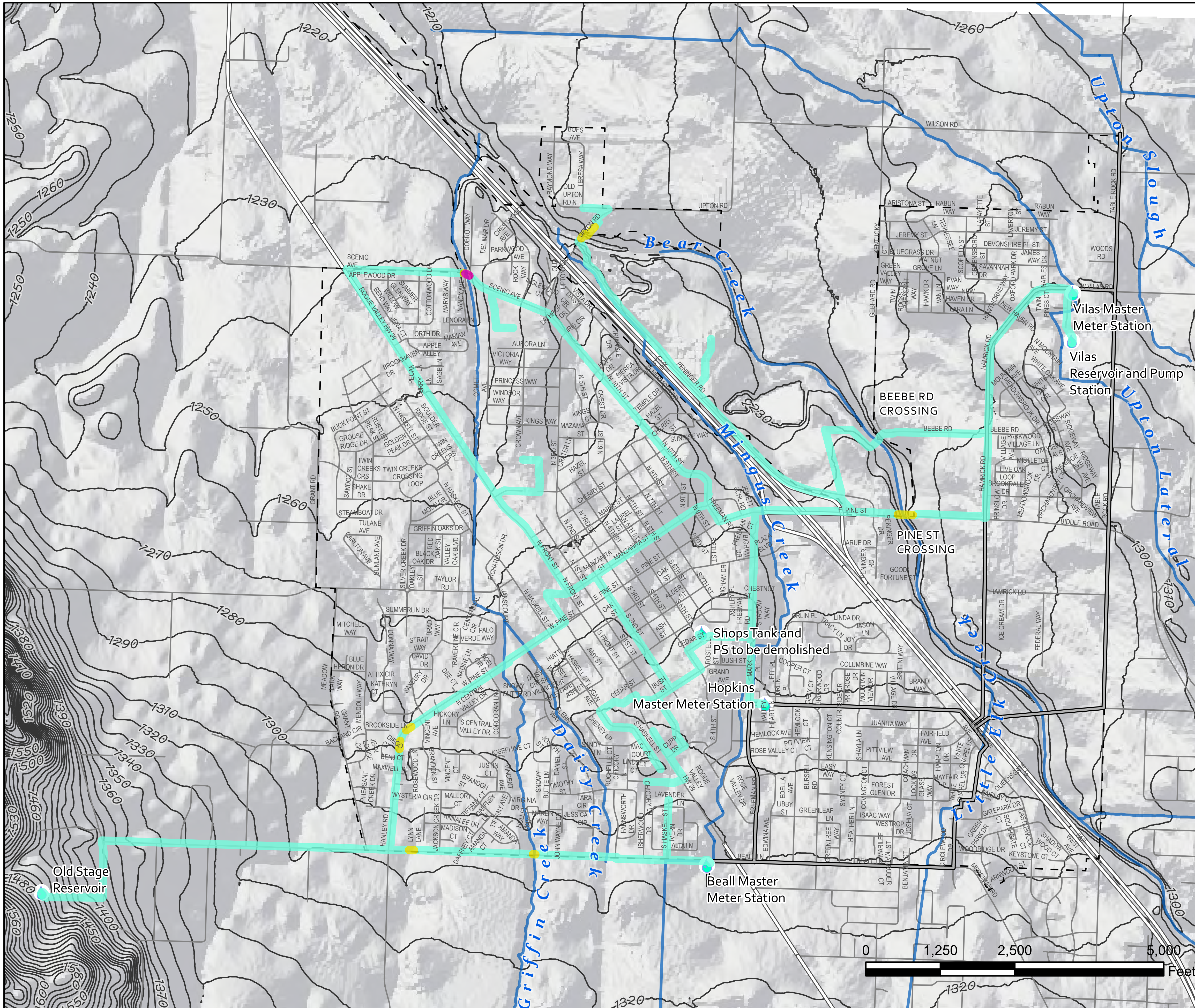
DEFORMATION PIPE FRAGILITY MAP

N

McMILLEN JACOBS ASSOCIATES

AUG 2020

FIGURE 7



NOTES:
Cumulative Pipe Fragility Map data shown are derived from DOGAMI Open-File-Report O-13-06.

1 inch equals 1,667 feet

CENTRAL POINT WATER SYSTEM SEISMIC RESILIENCE EVALUATION

CUMULATIVE PIPE FRAGILITY MAP

N

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FIGURE 8

Appendix A

Site Visit Photos

Photo 1: Shops Tank

Photo 2: Old Stage Reservoir (near entrance looking at southeast side of reservoir)

Photo 3: Old Stage Reservoir (looking at east side of reservoir)

Photo 4: Adjacent Site to Old Stage Reservoir (looking to the northwest)

Photo 5: Adjacent Site to Old Stage Reservoir (looking to the west)

Photo 6: Vilas Reservoir (looking at the entrance and north side of reservoir)

Photo 7: Pine Street Bridge and Pipe on the Beidge

Photo 8: Bear Creek North of Pine Street Bridge

Appendix G: Water Quality Contaminant Lists

Main Drinking Water Contaminants Regulated by the Oregon Health Authority

The regulated contaminants that pertain to the City were discussed in Section 2.3. The regulatory requirements that pertain to other contaminants of importance are presented in this appendix.

1.1 Inorganic Chemicals

At the federal level, inorganic contaminants are regulated by the Chemical Contaminant Rules, which is included in the National Primary Drinking Water Regulations (NPDWRs). The regulatory requirements for arsenic were revised in 2001 under a separate rule: the Arsenic Rule. In Oregon, inorganic contaminants are presented in OAR 333-061-0030(1) and the monitoring requirements are detailed in OAR 333-061-0036(2)(a). Table 1 presents the Oregon MCLs, as well as indicators of the federal regulations, i.e., MCLs and MCLGs. At the federal level, lead and copper are included in two regulations: as inorganic chemicals, and in the Lead and Copper Rule (LCR). The LCR was discussed in Section 2.3.4.1. Because inorganic chemicals need to be measured at entry points of the distribution system, these parameters are monitored by MWC.

Table 1. Regulatory Requirements for Inorganic Chemicals

Regulated Contaminant	Oregon	Federal	
	MCL (mg/L 1)	MCL (mg/L 1)	MCLG (mg/L 1)
Antimony	0.006	0.006	0,006
Arsenic	0.010	0.010	Zero
Asbestos (MFL [2])	7 MFL	7 MFL	7 MFL
Barium	2	2	2
Beryllium	0.004	0.004	0.004
Cadmium	0.005	0.005	0.005
Chromium, Total	0.1	0.1	0.1
Copper [3]	1.3	1.3	1.3
Cyanide	0.2	0.2	0.2
Fluoride	4.0	4.0	4.0
Lead [3]	0.015	0.015	0
Mercury (inorganic)	0.002	0.002	0.002
Nitrate (as nitrogen, N)	10 as N	10	10
Nitrite (as N)	1 as N	1	1
Nitrate + Nitrite (as N)	10 as N	--	--
Selenium	0.05	0.05	0.05
Thallium	0.002	0.002	0.0005

[1] Concentrations are provided in mg/L, unless otherwise noted.

[2] MFL: Million fibers per liter; for fibers greater than 10 µm long.

[3] Action Level, as discussed in Section 2.3.4.1.

1.2 Organic Chemicals

From a regulatory perspective, organic chemicals in drinking water include volatiles organic chemicals (VOCs) and non-volatile synthetic organic chemicals (SOCs). At the federal level, organic contaminants are regulated by the Chemical Contaminant Rules, which is part of the NPDWRs. In Oregon, these contaminants are presented in OAR 333-061-0030(2) and the monitoring requirements are detailed in OAR 333-061-0036(3). Because the lists of VOCs and SOCs are extensive and because the City does not need to monitor them (organic chemicals are measured at entry points to the distribution system), they are not listed in this appendix.

1.3 Radioactivity

At the federal level, radionuclides are regulated by the Radionuclides Rules, which is part of the NPDWRs. In Oregon, these contaminants are presented in OAR 333-061-0030(5) and the monitoring requirements are detailed in OAR 333-061-0036(7). The federal and state regulatory requirements are summarized in Table 2. Although radionuclides have been found in some groundwater sources, they are not commonly present in most surface water sources.

Table 2. Regulatory Requirements for Radionuclides

Regulated Contaminant	Oregon	Federal	
	MCL	MCL	MCLG
Gross alpha particle activity (including radium-226 but not radon or uranium)	15 pCi/L	15 pCi/L	Zero
Gross beta particle activity	4 mrem/year	4 mrem/year	Zero
Radium-226 + Radium-228	5 pCi/L	5 pCi/L	Zero
Uranium	30 µg/L	30 µg/L	Zero

1.4 Secondary Contaminants

The USEPA has established National Secondary Drinking Water Regulations (NSDWRs) that set non-mandatory, non-enforceable water quality standards for several contaminants. Exception is made for fluoride, which has both primary and secondary standards, as well as lead and copper, which have Action Levels. Oregon regulates the same contaminants with the addition of hardness, and they are also non-enforceable in Oregon. Secondary contaminants are presented in OAR 333-061-0030(6) and the monitoring requirements are detailed in OAR 333-061-0036(8). The secondary standards are summarized in Table 3.

Table 3. Regulatory Requirements for Secondary Contaminants		
Contaminant	**Oregon**	**Federal**
	MCL (mg/L [1])	**MCL (mg/L [1])**
Color	15 Units	15 Units
Corrosivity	Non-corrosive	Non-corrosive
Foaming Agents (MBAS)	0.5	0.5
pH	6.5-8.5	6.5-8.5
Hardness (as $CaCO_3$)	250	--
Odor	3 TON [2]	3 TON [2]
Total Dissolved Solids (TDS)	500	500
Aluminum	0.05-0.2	0.05-0.2
Chloride	250	250
Copper	1	1.0
Fluoride	2.0	2.0
Iron	0.3	0.3
Manganese	0.05	0.05
Silver	0.1	0.1
Sulfate	250	250
Zinc	5.0	5

[1] Concentrations are provided in mg/L, unless otherwise noted.

[2] TON: Threshold Odor Units.

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