FINAL REPORT | NOVEMBER 2023

Southeast Medford Facilities Plan

PREPARED FOR

Medford Water

PREPARED BY

WEST YOST
Water. Engineered.

Southeast Medford Facilities Plan

Prepared for

Medford Water

Project No. 1014-30-22-01

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FINAL REPORT | NOVEMBER 2023

Table of Contents

Table of Contents

Table of Contents

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

LIST OF ACRONYMS AND ABBREVIATIONS

AACE	Advancement of Cost Engineering
ADD	Average Day Demand
AWWA	American Water Works Association
CCI	Construction Cost Index
CIP	Capital Improvement Program
City	City of Medford
DU	Dwelling Unit
ENR	Engineering News Record
EPS	Extended Period Evaluation
ERU	Equivalent Residential Unit
gpcd	Gallons Per Capita Per Day
gpd/acre	Gallons Per Day Per Day Acre
gpd/DU	Gallons Per Day Per Dwelling Units
HGL	Hydraulic Grade Line
I-5	Interstate 5
LF	Linear Feet
MDD	Maximum Day Demand
MG	Million Gallon
mgd	Million Gallons Per Day
mls	Mean Sea Level
MW	Medford Water

NEC	National Electric Code
NRW	Non-Revenue Water
O&M	Operations and Maintenance
PHD	Peak Hour Demand
PRC	Population Research Center
PRV	Pressure Reducing Valve
PS	Pump Station
psi	Pounds Per Square Inch
RFP	Request for Proposal
SCADA	Supervisory Control and Data Acquisition
SEMFP	Southeast Medford Facilities Plan
SFR	Single Family Residential
UGB	Urban Growth Boundary
WDSFP	Water Distribution System Facilities Plan
WUF	Water Use Factor

Executive Summary

ES.1 OVERVIEW AND INTRODUCTION

Medford Water (MW) owns and operates a municipal water system that serves the City of Medford (City) and surrounding communities. The City is located within Jackson County, approximately 25 miles north of the California-Oregon border. MW's service area is largely contained by the City's Urban Growth Boundary (UGB), though MW also supplies wholesale water to two adjacent water districts and six nearby cities.

The City of Medford recently incorporated large urban growth areas into its southeastern City limits and is planning for additional areas to be added soon. The City has coordinated several planning meetings with local landowners to discuss development and infrastructure needs. MW is anticipating significant growth and needs an updated facilities plan for the southeast area that provides a strategy for pumping, storage, and major transmission mains to accommodate the planned growth. In December 2021, MW published a request for proposals (RFP) for the design of the new Zone 2 Pump Station at Barnett Reservoir project. The project included the design of a new pump station at the Barnett Reservoir site and approximately 3,000 linear feet (LF) of pipeline to connect the new pump station into the surrounding Zone 2 distribution system adjacent to the existing Barnett Reservoir. The project included two phases. The first phase involved preparing this Southeast Medford Facilities Plan (SEMFP). The SEMFP provides a long-range planning document to support infrastructure sizing and timing of required system improvements for the southeast area of the City. The second phase of the work will involve developing a Basis of Design Report for the Zone 2 Pump Station and pipeline, based on sizing recommendations in the SEMFP. West Yost West Yost prepared the SEMFP, with support from Jacobs on the hydraulic modeling.

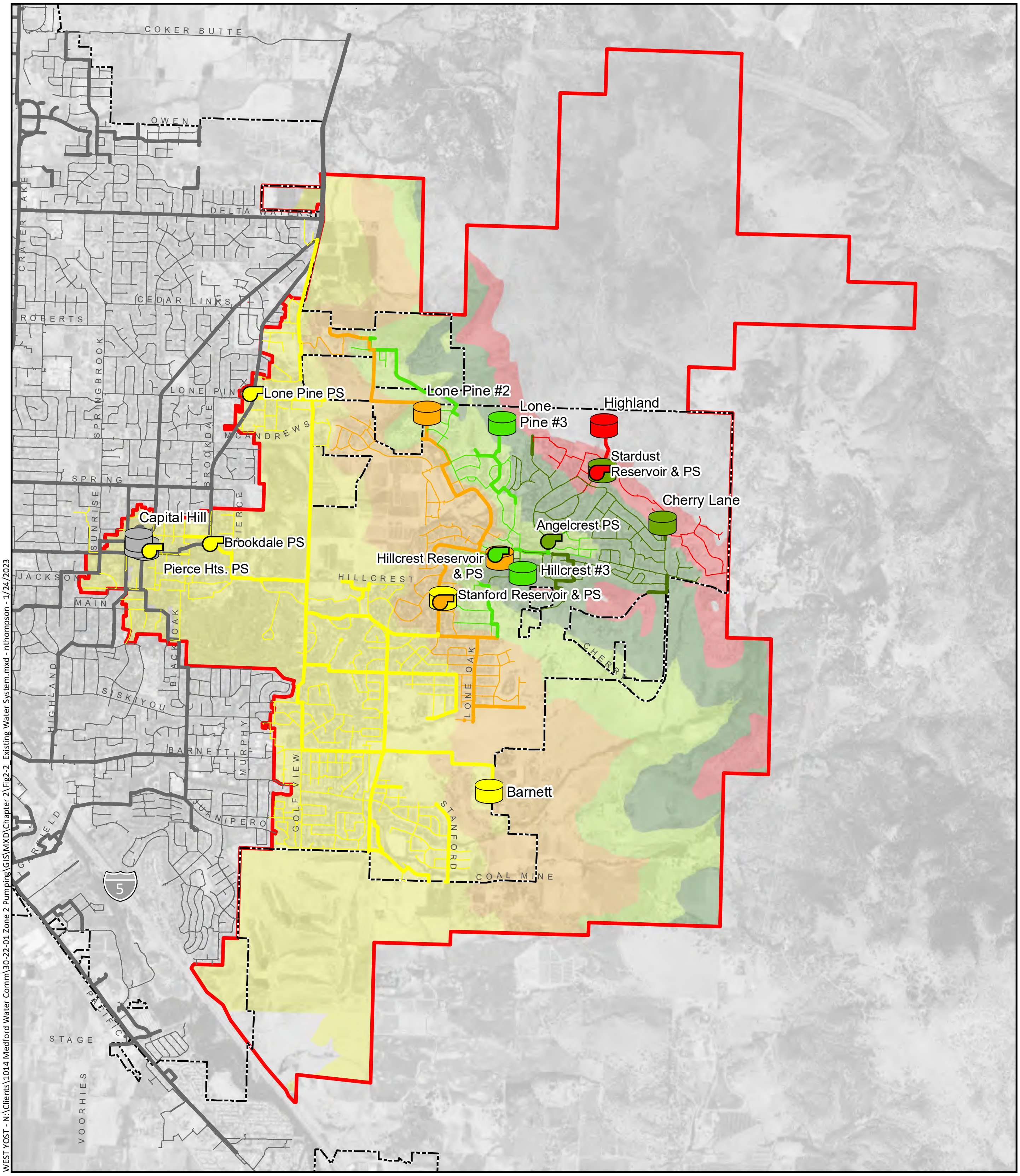
The main objectives of the SEMFP include the following:

- **Define Study Area.** The Study Area encompasses the entirety of Zones 1 through 5 and is generally bounded by the existing MW Pressure Zone 1 boundary to the west, Interstate 5 (I-5) to the south, and the UGB and/or Urban Reserve boundary to the east and north. The Study Area was established so that growth and future water demands could be projected, and associated infrastructure could be sized for this area. Chapter 2 presents information about the Study Area and existing system.
- **Define Water System Design and Operational Criteria and Water Demands.** Water system demands were defined for existing and future conditions. Chapter 3 describes MW's historical, current and projected near-term and future water demands for the SEMFP Study Area.
- **Size Facilities.** Pumping and storage needs to support existing and future demands were summarized using the water demand and water system design and operational criteria. Updated design and operational criteria were developed to size water system facilities. Chapter 4 presents this information.
- **Perform Hydraulic Analysis.** Hydraulic modeling was conducted for various configurations of proposed facilities in the SE area to evaluate preferred siting and sizing of proposed facilities. Chapter 5 presents the results of the hydraulic analysis.
- **Prepare Planning Level Costs.** Planning level capital costs were developed for each of the identified improvements for the near term (10-year), UGB buildout (2040) and Urban Reserve Buildout (2070). An Equivalent Residential Unit (ERU) capacity evaluation was prepared to establish the development capacity within the SE Medford area and assist with assignment of development fees as appropriate. Chapter 6 presents the findings from this evaluation.
- **Prepare Report.** This report documents the findings and recommendations for the SEMFP.

ES.2 EXISTING SE MEDFORD AREA WATER FACILITIES (CHAPTER 2)

Figure ES-1 shows the existing water distribution network overlaid with the Study Area and pressure zone boundaries. Topography generally increases in elevation from west to east. MW's pressure zones to run in thin bands from north to south across the Study Area.

MW operates nine (9) storage reservoirs within the five pressure zones in the Study Area. The reservoirs are gravity tanks, meaning that pump stations pump to supply these tanks, and drain by gravity when pumps are not operating. MW operates seven (7) pump stations within the five pressure zones in the Study Area. The locations of each reservoir and pump station are shown on Figure ES-1, with key information for each facility provided in Chapter 2.



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SE Plan Study Area
City Limit
Existing Reservoir
Pump Station

Pipelines

Diameter <12"
Diameter ≥ 12"

Pressure Zone

Other Zones
Zone 1
Zone 2
Zone 3
Zone 4
Zone 5

N

0 2,000 4,000
Feet

WEST YOST

Figure ES-1

Existing Water System

Medford Water
Southeast Medford Water
Facilities Plan

ES.3 WATER DEMANDS (CHAPTER 3)

Existing (2020) average daily water production for the SE Area is approximately 3.27 million gallons per day (mgd). Average Day (ADD), Maximum Day (MDD) and Peak Hour Demands (PHD) were calculated for each pressure zone. The ADD for the SE study area is 0.65 mgd. The corresponding MDD is 1.15 mgd, and PHD is 3.27 mgd for the SE study area. Growth within the SE Area is projected to occur mostly due to residential development. Projected water demands from these developments were calculated using land use data and the City's unit water use factors, which were updated as part of this SEMFP.

This SEMFP evaluates system needs through buildout of the UGB (2040) and buildout of the Urban Reserve (2070) boundaries. To build a level of flexibility into future demand projections, a range of water demands were projected for the 2040 and 2070 timeframes. Residential densities and water use factors were selected as parameters for bracketing water demands between a low-end projection and high-end projection. The average daily water use is expected to increase to 6.71 mgd (low end projection) and 7.7 mgd (high end projection) by 2040.

The additional projected water supply requirements for the UGB and Urban Reserve areas are presented in Table ES3-1. By 2040, the water supply requirement is projected to increase by approximately 105 to 135 percent for the entire Study Area. By 2070, the water supply requirement is projected to increase by approximately 153 to 196 percent for the SE Study Area.

Table ES-1 Summary of Projected Water Supply Requirements

Timeframe	Low End Projection, mgd	High End Projection, mgd	Percent Increase from Existing Demands
Existing	3.27		
Buildout of UGB (~2040)	6.71	7.7	105-135
Buildout of Urban Reserve (~2070)	8.27	9.49	153-196

ES.4 SYSTEM PERFORMANCE AND OPERATIONS CRITERIA (CHAPTER 4)

This chapter defines the recommended performance and operational criteria for MW's water distribution system. The criteria were developed with input from MW staff. For the potable water system, these criteria include the recommendations for the required fire flow and flow duration, definition of emergency events, system pumping capacity, system storage capacity (equalization, fire flow, and emergency components), minimum and maximum system pressures, and maximum pipeline velocity and head loss. Some areas in the existing water system may not currently meet the updated criteria developed in this plan. These criteria are for planning of future water system improvements.

ES.5 SYSTEM EVALUATION (CHAPTER 5)

West Yost conducted an evaluation of MW's existing and future water system within the Study Area and its ability to meet the recommended performance and operational criteria under future water demand conditions. This evaluation is comprised of two components, a facilities capacity evaluation and a performance evaluation. The facilities capacity evaluation was performed to determine the size of future storage and pumping facilities to support future demands and develop alternatives. Subsequently, a performance evaluation was conducted to evaluate the proposed distribution system's ability to meet recommended operational and design criteria (i.e., required pressures, velocities, or fire flows) under maximum day demand, peak hour demand, and maximum day demand plus fire flow scenarios.

A schematic view of existing and proposed infrastructure is shown in Figure ES-2. This figure shows the storage and pumping facilities necessary to meet the pumping and storage capacity requirements in the near term (10-Year) and buildout of the UGB (2040) and Urban Reserve (2070) planning horizons. A piping network was developed to connect the storage and pump station improvements and hydraulic modeling was performed to assess the performance of the proposed network. The proposed network of pipelines and facilities was developed with a strategy to create a looped system to serve upper zones in the Study Area. Figures showing the proposed waterline improvements are presented in Figures ES-3, ES-4 and ES-5. Figure ES-3 shows the infrastructure proposed for the near term (10-year) planning horizon. Figure ES-4 shows the infrastructure proposed for the buildout of the UGB planning horizon. Figure ES-5 shows the infrastructure proposed for the buildout of the Urban Reserve planning horizon.

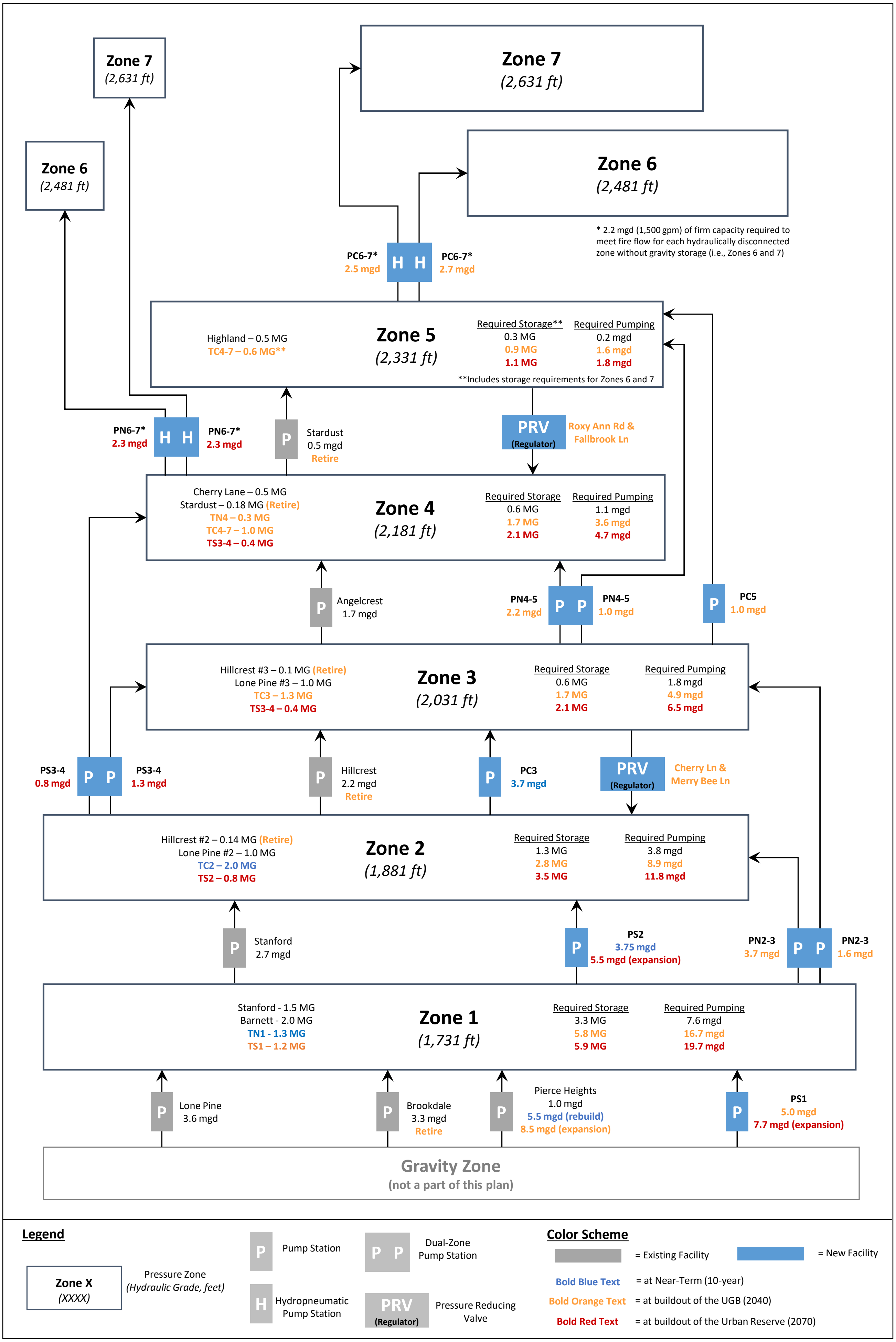
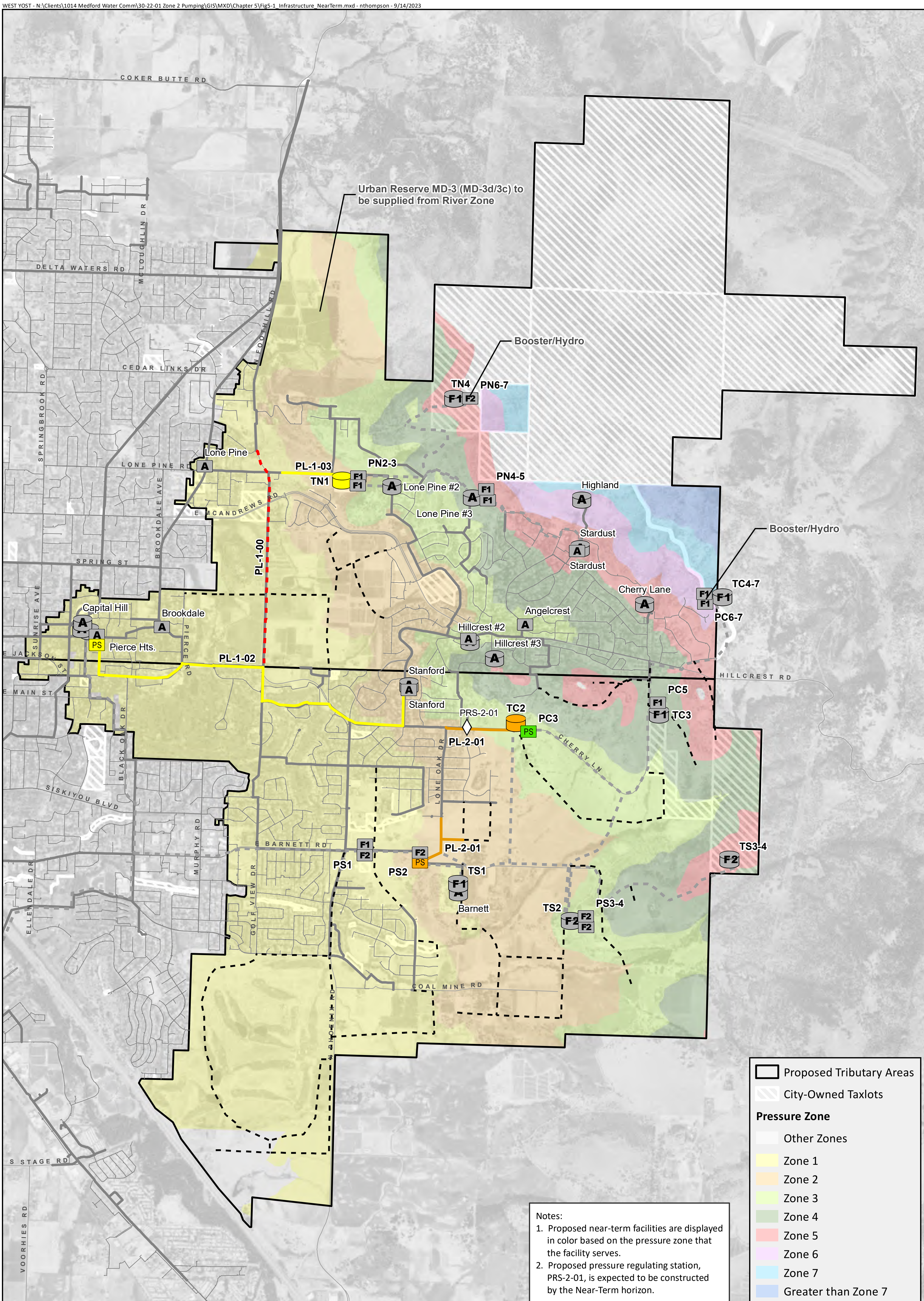


Figure ES-2. Schematic of Recommended Infrastructure
Medford Water
Southeast Medford Facilities Plan



	Proposed Tributary Areas
	City-Owned Taxlots

Pressure Zone

- Other Zones
- Zone 1
- Zone 2
- Zone 3
- Zone 4
- Zone 5
- Zone 6
- Zone 7
- Greater than Zone 7

Notes:

1. Proposed near-term facilities are displayed in color based on the pressure zone that the facility serves.
2. Proposed pressure regulating station, PRS-2-01, is expected to be constructed by the Near-Term horizon.

A Active/Existing PS

F1 Proposed PS 2040

F2 Proposed PS 2070

A Active/Existing Tank

F1 Proposed Tank 2040

F2 Proposed Tank 2070

Proposed PRV/Flow Control Station

Recommended Transmission Pipelines for Near-Term Horizon (10-Year)

- Zone 1
- Zone 2
- Zone 3
- Zone 4
- Zone 5

On-Going Transmission Pipeline Projects

Assumed Developer In-Tract Pipelines

Existing Pipelines

- < 12" Diameter
- ≥ 12" Diameter

N

0 1,250 2,500

Scale in Feet

WEST YOST

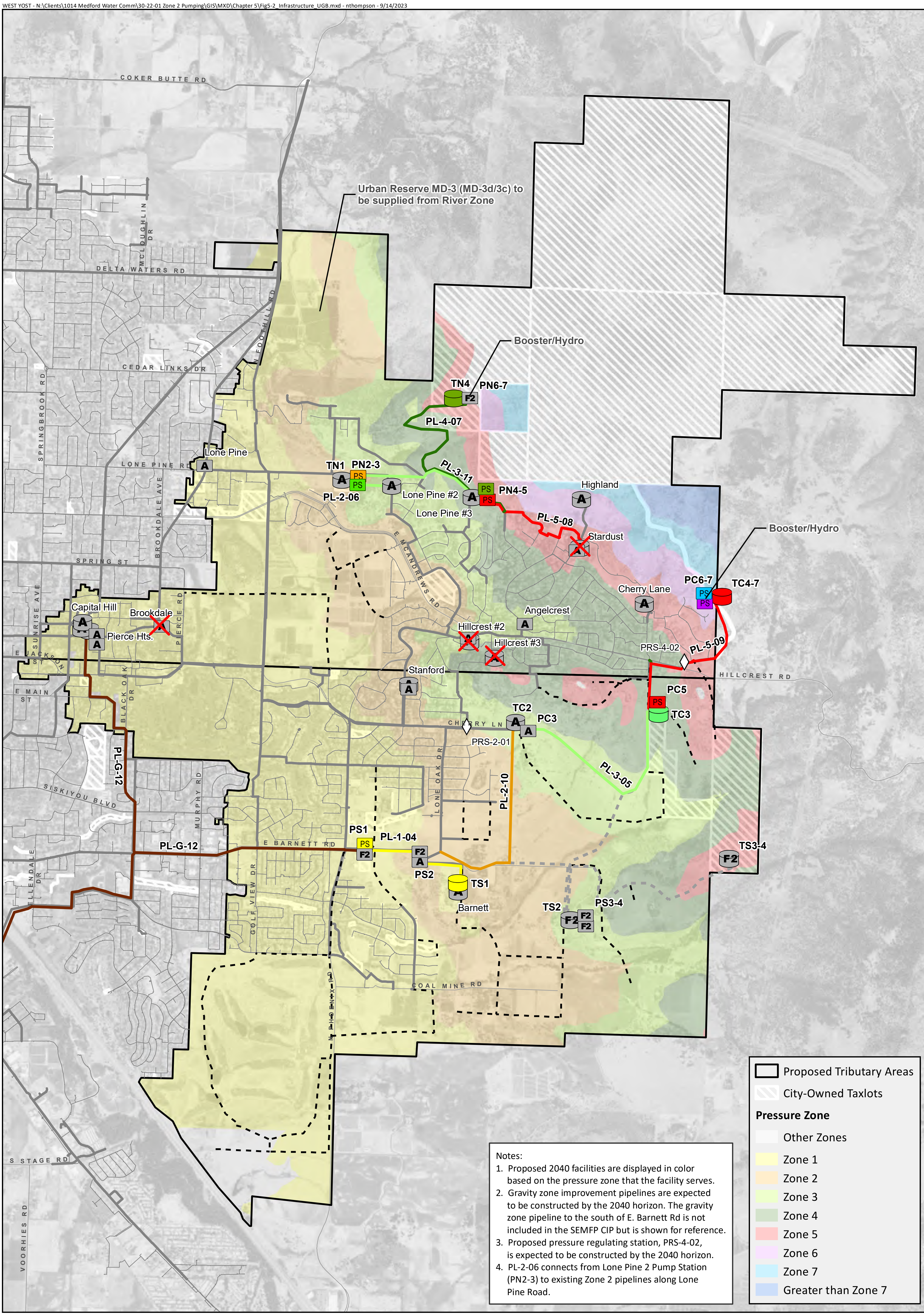
Figure ES-3

Proposed Infrastructure for Near-Term Horizon (10-Year)

Medford Water Commission

Southeast Medford

Facilities Plan



A Active/Existing PS
F1 Proposed PS 2040
F2 Proposed PS 2070
A Active/Existing Tank
F1 Proposed Tank 2040
F2 Proposed Tank 2070

Proposed PRV/Flow Control Station

Recommended Transmission Pipelines for UGB Horizon (2040)

- Zone 1
- Zone 2
- Zone 3
- Zone 4
- Zone 5

Gravity Zone Improvements

Recommended Transmission Pipelines After UGB Horizon

Assumed Developer In-Tract Pipelines

Existing Pipelines

< 12" Diameter

≥ 12" Diameter

N

0 1,250 2,500

Scale in Feet

WEST YOST

Figure ES-4

Proposed Infrastructure for Buildout of the Urban Growth Boundary

Medford Water Commission

Southeast Medford Facilities Plan

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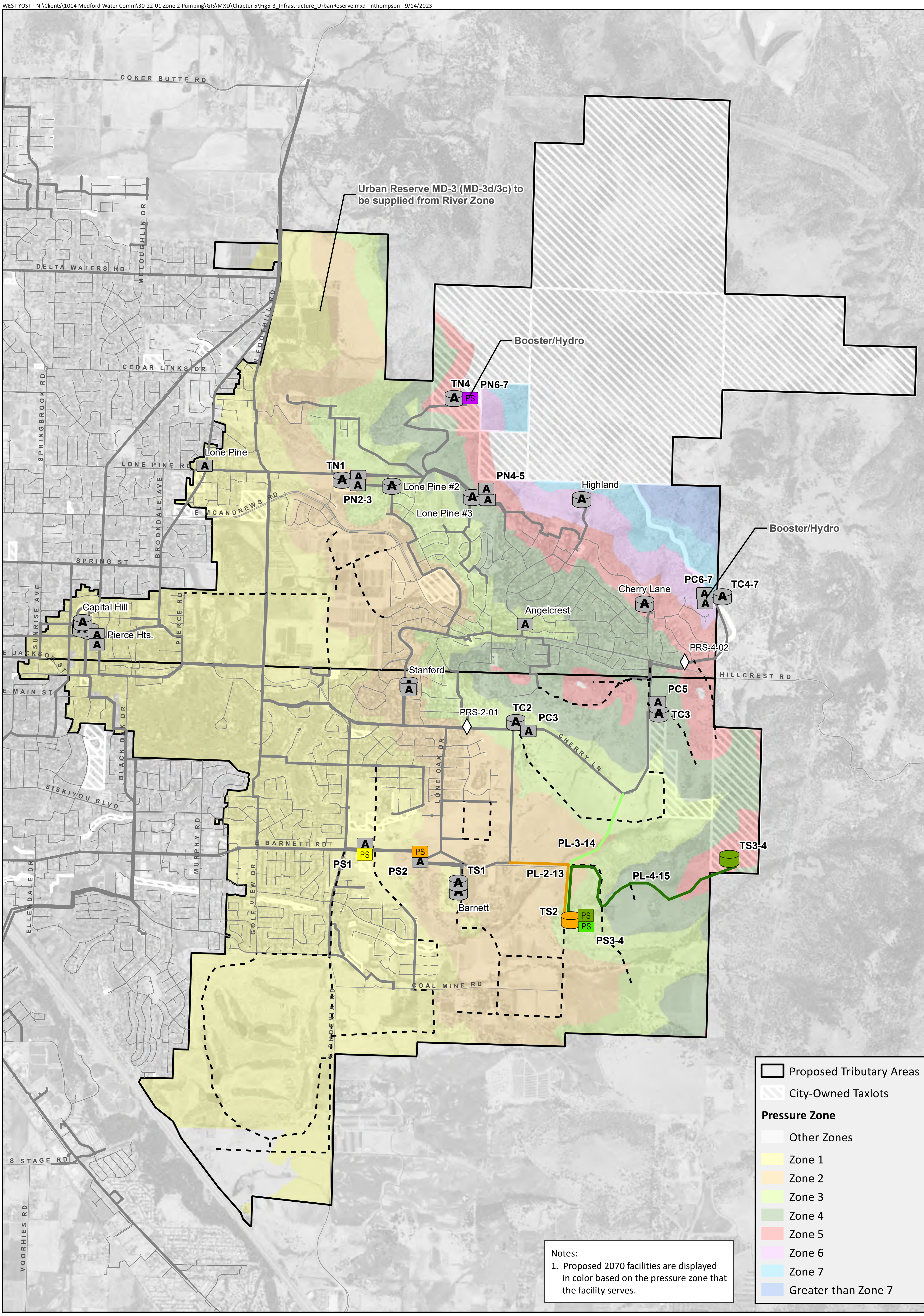


A Active/Existing PS
F1 Proposed PS 2040
F2 Proposed PS 2070
A Active/Existing Tank
F1 Proposed Tank 2040
F2 Proposed Tank 2070

Proposed PRV/Flow Control Station

Recommended Transmission Pipelines for Urban Reserve Boundary (2070)
- Zone 1
- Zone 2
- Zone 3
- Zone 4
- Zone 5

Assumed Developer In-Tract Pipelines

Existing Pipelines
- < 12" Diameter
- ≥ 12" Diameter

0 1,250 2,500
Scale in Feet

WEST YOST

Figure ES-5

Proposed Infrastructure for Buildout of the Urban Reserve Boundary

Medford Water Commission
Southeast Medford
Facilities Plan

ES.6 FINDINGS AND RECOMMENDATIONS (CHAPTER 6)

A summary of the recommended improvement projects to address the water system capacity and renewal and replacement needs is provided in Table ES-2. West Yost and the City reviewed the capital improvement program and developed a prioritized list of projects and implementation timeframe based on the results from the distribution system analysis and the City's identified needs. Projects are placed on the schedule based on their priority, to address most critical needs first. Cost estimates were developed for the recommended improvements, including both opinions of probable construction costs and capital costs.

Table ES-2. Summary of Recommended Capital Improvements for the SE Medford Area[a]

Improvement Timeline	Improvement Summaries	Capital Cost, dollars M[b]
Near-Term (10-Yr)	• **Storage Reservoirs -** New Zone 2 and Zone 1 storage tanks to serve future growth • **Booster Pump Stations -** New Zone 2, Zone 3, and replacement of Pierce Heights to meet increasing demand and replace aging infrastructure • **Pipelines -** New Zone 1 and Zone 2 pipelines to increase capacity • **Pressure Reducing Station -** PRV to provide flow in emergencies	37
Urban Growth Boundary Buildout (2040)	• **Storage Reservoirs -** New Zone 1, Zone 3 and Zone 4 storage tanks to serve future growth • **Booster Pump Stations -** New Zone 1, Zone 5 stations to meet increasing demand and replace aging infrastructure. New dual-zone stations to supply water to Zones 2 and 3, Zones 4 and 5, and Zones 6 and 7. Expand Pierce Heights firm capacity • **Pipelines -** New pipelines in all Zones to increase system connectivity • **Pressure Reducing Station -** PRV to provide redundant flow to Zone 4	61.4
Buildout of the Urban Reserve (2070)	• **Storage Reservoirs -** New Zone 2 and Zones 3-4 storage tanks to serve future growth • **Booster Pump Stations -** Additional firm capacity at PS1 and PS2 to serve growth outside the UGB. New dual-zone station at TS2 site. New Dual-Zone hydropneumatic pump station at TN4 to serve growth in Zones 6 and 7 • **Pipelines -** New Zone 2, Zone 3 and Zone 4 pipelines to increase connectivity in urban reserve area	21.1
Total Recommended Capital Improvement Plan for SE Medford Area		**$119.5**

(a) Costs are rounded to the nearest thousand dollars. Improvements in this table are considered 'backbone' improvements. Smaller, in-tract, improvements are not included and are assumed to be constructed by future development proponents.

(b) Capital cost is equal to the construction cost with a 30 percent markup for engineering, construction management, and program implementation. Refer to Appendix E for details.

The recommended total estimated capital cost to implement recommended projects is approximately \$119.5M. The total near-term (10-year) capital cost is approximately \$37M, an additional \$61.4M and \$21M in improvements is required to adequately serve growth at buildout of the UGB and Urban Reserve, respectively.

This chapter also presents an equivalent residential unit (ERU) analysis. The ERU analysis was prepared to (1) characterize in terms of equivalent residential units, how much additional demand is being projected, and (2) to assist Medford Water in estimating the proportionate cost of recommended improvements per ERU. The ERU factors summarized in Table 6-3 are intended to assist MW when assessing a project, to determine how many ERUs are being proposed and thus easily determine the appropriate proportionate costs for different developments. In addition to this evaluation, a capacity evaluations were expanded and were evaluated in more detail by ERUs to confirm that planned pumping and storage improvements are sufficiently sized to support the planned level of development for each of the evaluated time periods (i.e., existing, buildout of the UBG [2040], and buildout of the UR [2070]). Refer to Appendix H for more details.

CHAPTER 1
Introduction

1.1 BACKGROUND AND PURPOSE

Medford Water (MW) owns and operates a municipal water system that serves the City of Medford (City) and surrounding communities. The City is located within Jackson County, approximately 25 miles north of the California-Oregon border. MW's service area is largely contained by the City's Urban Growth Boundary (UGB), though MW also supplies wholesale water to two adjacent water districts and six nearby cities.

MW's 2017 Water Distribution System Facilities Plan (WDSFP) identified the need for a new Zone 2 pump station (PS), to be sited near Barnett Reservoir to provide pumping from Zone 1 to Zone 2. The PS is needed to provide additional supply to Zone 2 and supplement the existing Stanford PS, which is currently the only pump station supplying Zones 2 and above and is quickly reaching its capacity.

The City of Medford recently incorporated large urban growth areas into its southeastern City limits and is planning for additional areas to be added soon. The City has coordinated several planning meetings with local landowners to discuss development and infrastructure needs. MW is anticipating significant growth and needs an updated master plan that provides a strategy for pumping, storage, and major transmission mains to accommodate the planned growth. Additionally, in December 2021, MW published a request for proposals (RFP) for the design of the new Zone 2 Pump Station at Barnett Reservoir project. The project included the design of a new pump station at the Barnett Reservoir site and approximately 3,000 linear feet (LF) of pipeline to connect the new pump station into the surrounding Zone 2 distribution system adjacent to the existing Barnett Reservoir.

West Yost was selected for the project after a proposal and interview selection process. During the scoping of the project elements, it was determined the proposed infrastructure sizing in the southeast area of MW's service area was not yet confirmed, therefore the sizing of the Zone 2 Pump Station was not defined. Therefore, Medford embarked on this study so that growth and associated infrastructure needs within the southeast service area could be defined, including the Zone 2 pump station.

This study was part of the first phase of the scope of work which involved the West Yost team developing the Southeast Medford Facilities Plan (SEMFP). The second phase of the work, building off this study, will involve development of a Basis of Design Report for the Zone 2 Pump Station and pipeline. The SE Plan provides recommend sizing for the Zone 2 PS while providing a long-range planning document to support infrastructure sizing and timing of required system improvements for the southeast area of the City.

1.2 OBJECTIVES

The main objectives of the SE Plan include the following:

- **Define Study Area.** The Study Area encompasses the entirety of Zones 1 through 5 and is generally bounded by the existing MW Pressure Zone 1 boundary to the west, Interstate 5 (I-5) to the south, and the UGB and/or Urban Reserve boundary to the east and north. The study area was established so that growth and future water demands could be projected, and associated infrastructure could be sized for this specific area. The Study Area and existing system information are presented in Chapter 2.
- **Define Water System Design and Operational Criteria and Water Demands.** Water system demands and diurnal curves were defined for existing and future conditions. Chapter 3 describes MW's historical, current and projected near-term and future water demands for the SE Plan Study Area.

- **Facilities Sizing.** The project team prepared tables summarizing pumping and storage needs to support existing and future demands using the water demand and water system design and operational criteria. The project team established updated design and operational criteria, which was used to size water system facilities. This information is presented in Chapter 4.
- **Perform Hydraulic Analysis.** Jacobs performed hydraulic modeling of various configurations of proposed facilities in the SE area to evaluate preferred siting and sizing of proposed facilities. The results of the Hydraulic Analysis are presented in Chapter 5.
- **Planning Level Costs.** Planning level capital costs were developed for each of the identified improvements for the near term (10-year), UGB buildout (2040) and Urban Reserve Buildout (2070). An Equivalent Residential Unit (ERU) capacity evaluation is presented in Chapter 6 to establish the development capacity within the SE Medford area and assist with assignment of development fees as appropriate. The findings are presented in Chapter 6.
- **Prepare Report.** West Yost prepared this report documenting the findings and recommendations for the SEMFP.

1.3 CONTENTS AND ORGANIZATION

This report is organized into the following chapters:

- Executive Summary
- Chapter 1: Introduction
- Chapter 2: Existing SE Medford Area Water Facilities
- Chapter 3: Water Demands
- Chapter 4: System Performance and Operations Criteria
- Chapter 5: System Evaluation
- Chapter 6: Findings and Recommendations

1.4 ACKNOWLEDGEMENTS

The development of this study could not have been possible without the key involvement and assistance of MW staff. In particular, the following staff provided comprehensive information, significant input and important insights throughout the development of this study:

- Andy Huffman, Senior Capital & Special Projects Manager
- Rachel Lanigan, Senior Engineer
- Brad Taylor, General Manager
- Brian Runyen, Engineering Manager
- Ken Johnson, Systems Operations

The following team members contributed to the Project:

- Daphne Marcyan, Project Manager, QA/QC
- Bobby Vera, Project Engineer, SEMFP Lead
- Charles Duncan, Principal-in-Charge, QA/QC
- Polly Boissevain, Technical Advisor, QA/QC
- Nick Szigeti, Staff Engineer
- Nolan Thompson, Staff Engineer
- Jennifer Henke, Hydraulic Modeling, Jacobs
- Pat Van Duser, Project Manager for Hydraulic Modeling, Jacobs

CHAPTER 2
Existing Southeast Area Water Facilities

This chapter describes the study area used to define the boundaries of this this plan as well as MW's existing water distribution system which currently provides water service to this area. In general, the majority water system information contained in this chapter is based on information provided in 2017 WDSFP, and other available data provided to West Yost by MW. The following sections of this chapter describe the key components of the City's existing water system:

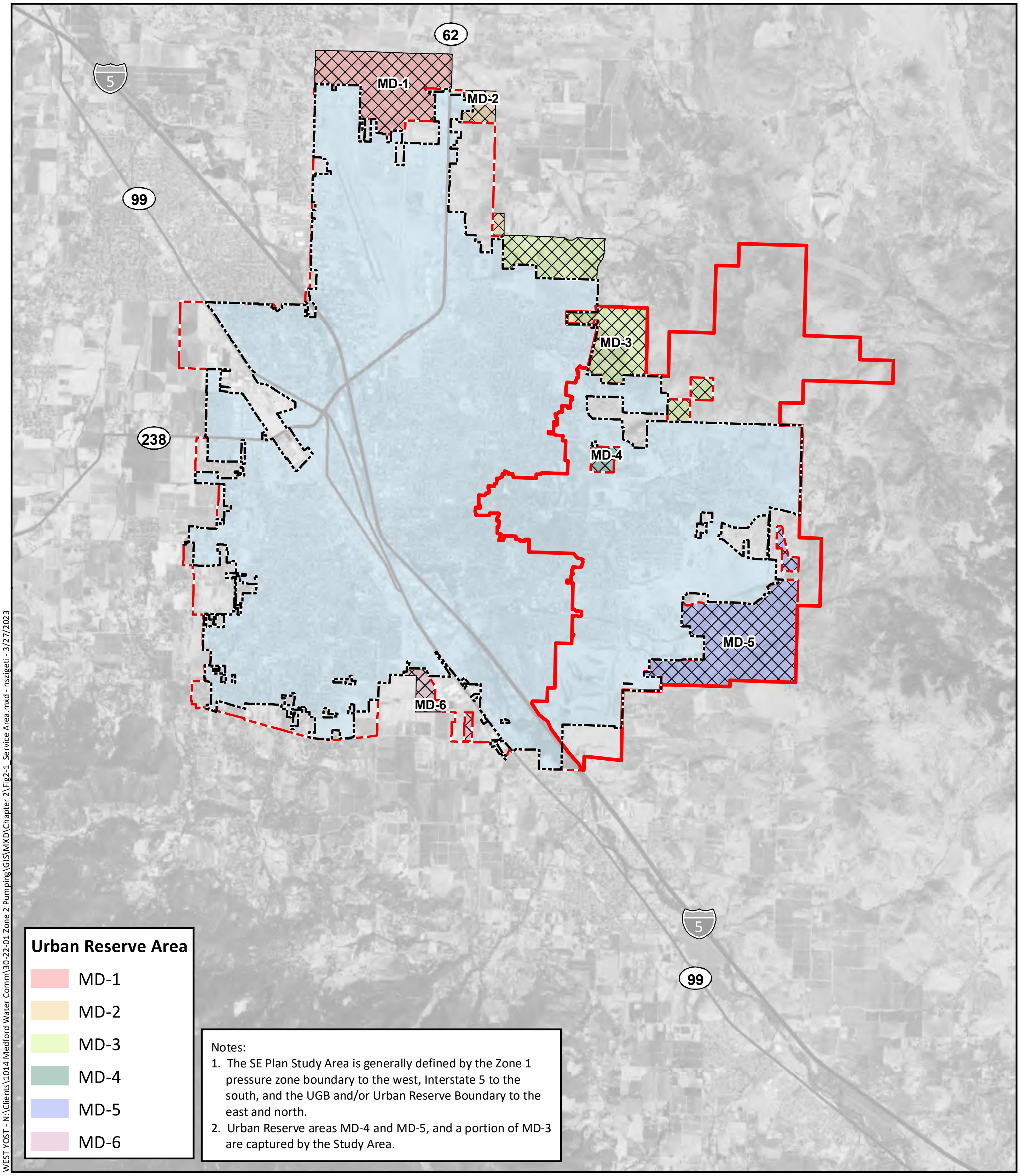
- MW Overview
- SEMFP Study Area
- SE Medford Existing Water System
  - Pressure Zones
  - Storage Tanks
  - Pump Stations
  - Pipelines

2.1 MEDFORD WATER COMMISSION OVERVIEW

MW owns and operates a public water system that largely serves the City, but also supplies surrounding communities. The City is located within Jackson County, approximately 25 miles north of the California-Oregon border. MW's service area is largely contained by the City's Urban Growth Boundary (UGB), though MW also supplies wholesale water to two adjacent water districts and six nearby cities.

2.2 SEMFP STUDY AREA

The SEMFP Study Area is approximately 13 square miles located in the southeast portion of the City's planned future growth limits. Figure 2-1 illustrates the Study Area in relation to the City's planning boundaries. The Study Area encompasses the entirety of Zones 1 through 5 and is generally bounded by the existing MW Pressure Zone 1 boundary to the west, I-5 to the south, and the UGB and/or Urban Reserve boundary to the east and north. As discussed in subsequent chapters, this study area was established so that growth and future water demands could be projected, and associated infrastructure could be sized for this specific area.



SE Plan Study Area
Medford City Limit
Medford Urban Growth Boundary
Medford Urban Reserve Boundary

N

0 4,000 8,000
Feet

Figure 2-1

SE Plan Study Area

Medford Water
Southeast Medford Water
Facilities Plan

2.3 SOUTHEAST MEDFORD EXISTING WATER SYSTEM

The following sections describe MW's existing water system within the Study Area. The existing water distribution system is shown on Figure 2-2. A schematic of the existing water distribution system, prepared by Jacobs as part of the 2017 WDSFP, is shown on Figure 2-3.

2.3.1 Pressure Zones

MW currently serves customers in five (5) pressure zones within the Study Area. Table 2-1 presents the existing range of customer service elevations in feet above mean sea level (msl) within each pressure zone. MW's pressure zones are based on elevations so that appropriate static pressures are provided to customers in the pressure zone. In the future, a sixth and seventh zone may be required if growth extends to the planned UGB and within the urban reserve areas[1]. It is worth nothing, as discussed in subsequent chapters, that the minimum pressure criterion is being revised to 40 pounds per square inch (psi) in this plan, which is higher than previously provided. MW may choose to implement the new minimum pressure criterion with existing customers, which would require rezoning some existing areas. Table 2-2 presents the recommended customer service elevations for achieving the new pressure zone criterion, and adjusting for changes in storage levels (i.e. no longer using reservoir overflow as the Nominal Hydraulic Grade for customers).

Figure 2-2 shows the existing water distribution network overlaid with the pressure zone boundaries. Topography generally increases in elevation from west to east and is marked by several ravines. This causes MW's pressure zones to extend in thin bands north to south across the Study Area.

Table 2-1. Summary of Existing Pressure Zones[(a)]

Zone	Nominal Hydraulic Grade, feet msl[(b)]	Minimum Service Elevation, feet msl	Maximum Service Elevation, feet msl	Range of Static Pressures, psi[(c)]
1	1,731	1,485	1,630	35 to 100 psi
2	1,881	1,630	1,780	
3	2,031	1,780	1,930	
4	2,181	1,930	2,085	
5	2,331	2,085	2,235	
6 (Future)	2,481	2,235	2,385	
7 (Future)	2,631	2,385	2,535	

(a) MW 2017 WDSFP, Table 2-1. High customer elevations in each zone were previously based on a pressure criterion of 35 psi minimum, and assuming a full reservoir tank.
(b) Nominal hydraulic grade is defined by the overflow elevation of reservoirs serving the pressure zone (See Table 2-3).
(c) Static pressure range is based on the existing nominal hydraulic grade minus the minimum and maximum service elevations and does not include dynamic head losses.

[1] A small portion of the City's UGB extends to elevations beyond a seventh pressure zone, however, this area is steep and unlikely to be developed. Elevations greater than the future Zone 7 have been excluded from the SEMFP.

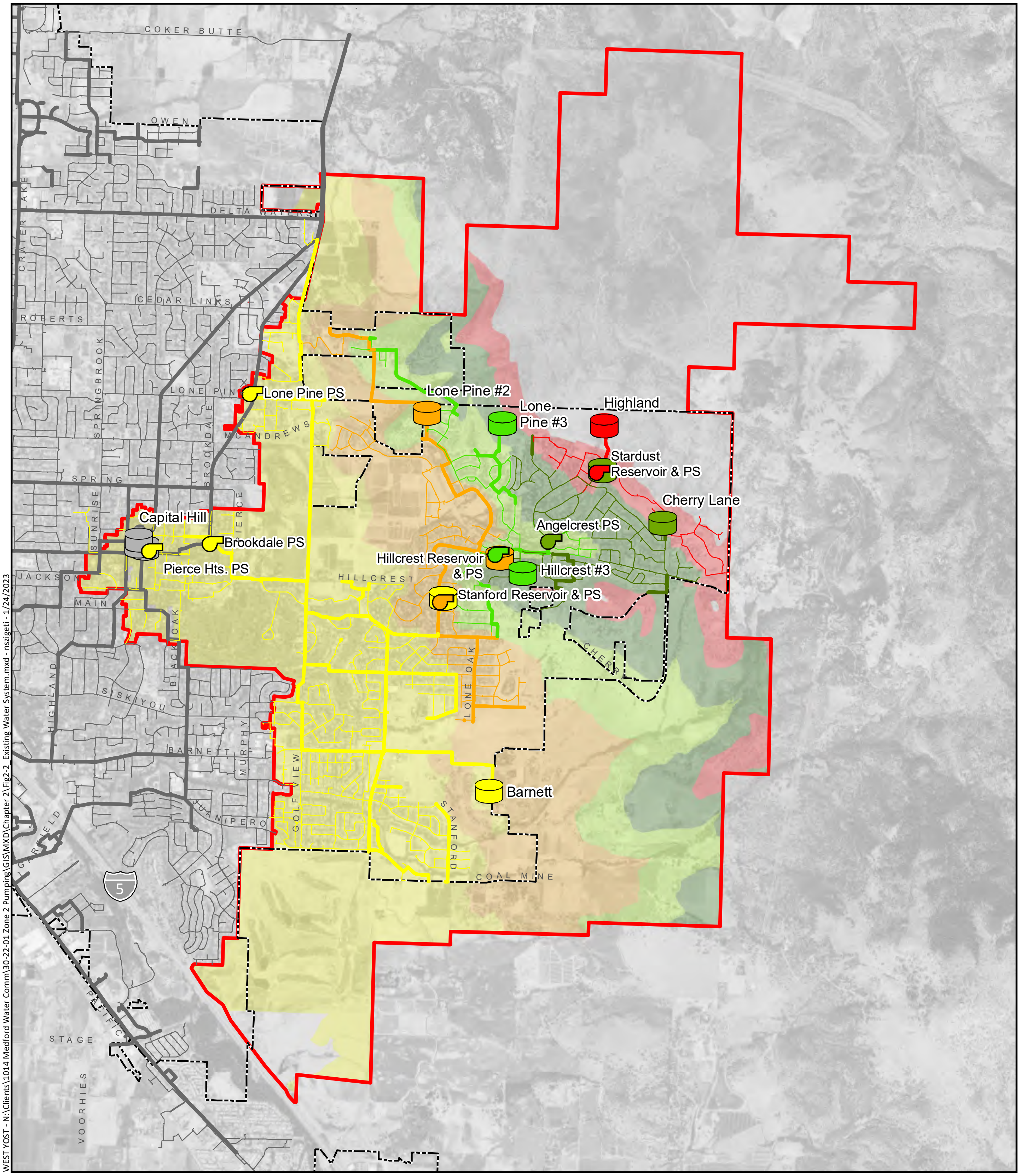
Table 2-2. Recommended Changes to Pressure Zone Service Elevations[a]

Zone	Lowest Assumed Hydraulic Grade, feet msl[b]	Target Minimum Service Elevation, feet msl	Target Maximum Service Elevation, feet msl	Range of Static Pressures, psi[c]
1	1,715	1,480	1,620	40 to 100 psi
2	1,868	1,620	1,775	
3	2,014	1,775	1,920	
4	2,170	1,920	2,075	
5	2,320	2,075	2,225	
6 (Future)	2,481	2,225	2,375	
7 (Future)	2,631	2,375	2,525	

(a) Customer elevations are based on providing a minimum pressure of 40 psi when tank levels are at the bottom of equalizing storage. Elevation is based on the National Geodetic Vertical Datum of 1929 (NAVD 29).

(b) Nominal hydraulic grade is defined by the overflow elevation of reservoirs serving the pressure zone (See Table 2-3).

(c) Static pressure range is based on the existing nominal hydraulic grade minus the minimum and maximum service elevations and does not include dynamic head losses.



WEST YOST - N:\Clients\1014 Medford Water Comm\30-22-01 Zone 2 Pumping\GIS\MXD\Chapter 2\Fig2-2 Existing Water System.mxd - nszigeti - 1/24/2023

SE Plan Study Area
City Limit
Existing Reservoir
Pump Station

Pipelines

Diameter <12"
Diameter ≥ 12"

Pressure Zone

Other Zones
Zone 1
Zone 2
Zone 3
Zone 4
Zone 5

N

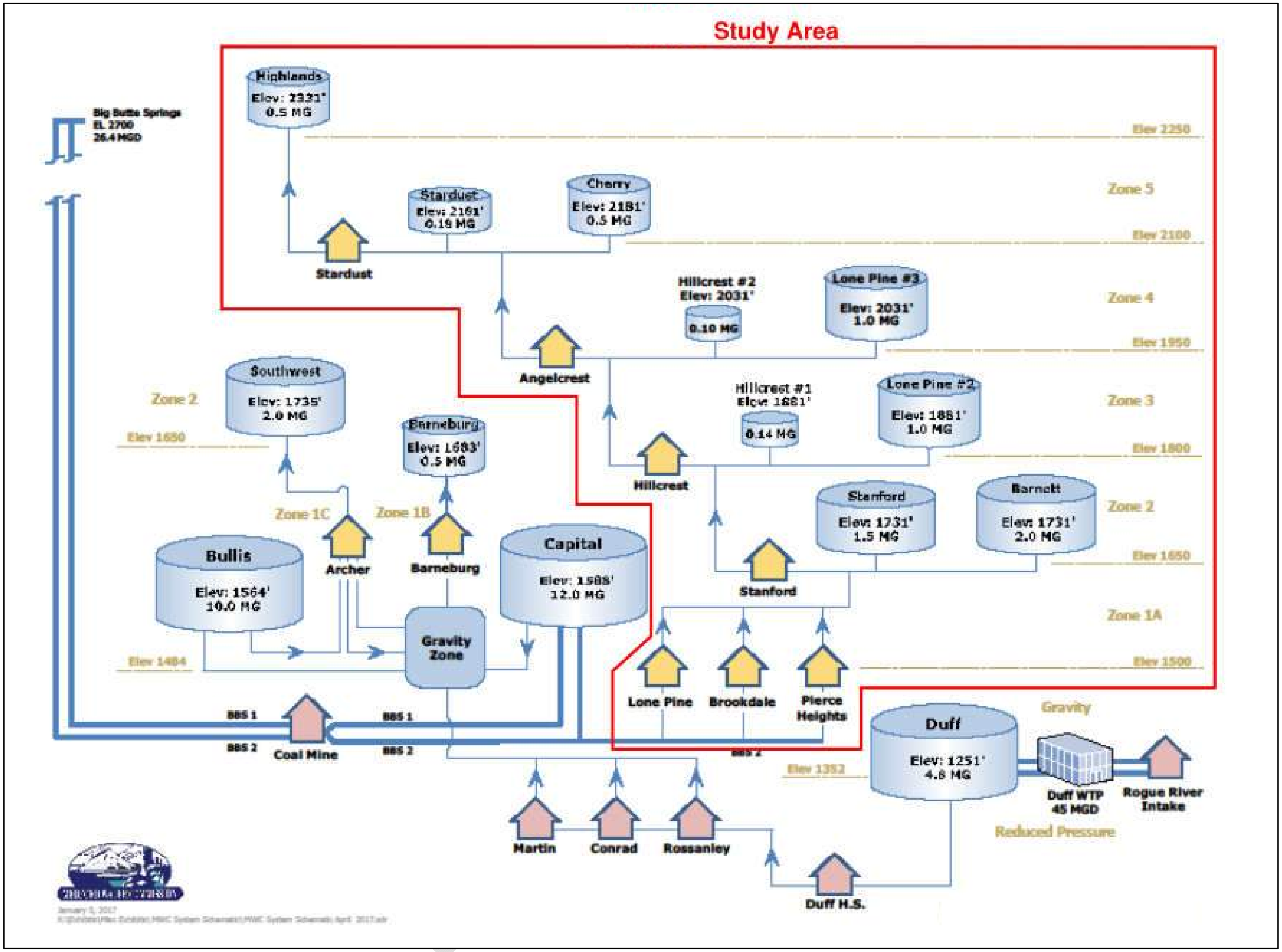
0 2,000 4,000
Feet

WEST YOST

Figure 2-2

Existing Water System

Medford Water
Southeast Medford Water
Facilities Plan



Source: 2017 WDSFP, prepared by Jacobs.

Figure 2-3. Existing Water System Schematic

2.3.2 Storage Reservoirs

MW operates nine (9) storage reservoirs within the five pressure zones in the Study Area. These reservoirs are gravity-tanks, meaning that pump stations pump to supply these tanks, and when full are allowed to drain by gravity. The nominal storage capacity within the Study Area currently totals 6.92 million gallons (MG)[2], with the majority of the storage currently sited in the lower zones, which have larger demands. The location of each reservoir is shown on Figure 2-2, with key information for each facility shown summarized in Table 2-3.

Table 2-3. Summary of Existing Storage Reservoirs

Pressure Zone	Nominal Hydraulic Grade Line (HGL), feet	Supporting Storage Facility	Material	Year Built	Reservoir Capacity, MG	Total Zone Storage, MG
Zone 1	1,731	Stanford	Concrete	1971	1.50	3.50
		Barnett	Concrete	1983	2.00	
Zone 2	1,881	Hillcrest #1	Concrete	1972	0.14	1.14
		Lone Pine #2	Concrete	2005	1.00	
Zone 3	2,031	Hillcrest #2	Concrete	1972	0.10	1.10
		Lone Pine #3	Concrete	2006	1.00	
Zone 4	2,181	Stardust	Concrete	1972	0.18	0.68
		Cherry Lane	Concrete	1996	0.50	
Zone 5	2,331	Highlands	Concrete	1996	0.50	0.50
					Total	**6.92**

Source: Medford Water 2017 WDSFP, Table 2-2.

2.3.3 Pump Stations

MW operates seven (7) pump stations within the five pressure zones in the Study Area. Pump station locations are shown on Figure 2-2, with key information for each facility shown in Table 2-4. Lone Pine, Brookdale, and Pierce Heights Pump Stations supply the Study Area from the Gravity Zone, and fill the reservoirs in Zone 1 (e.g., Stanford and Barnett). The remaining pump stations incrementally pump upward to the higher pressures to fill their respective reservoirs. The size and number of pumps varies at each pump station, as shown in Table 2-4, and some pump station contain auxiliary pumps. These auxiliary pumps are propane powered pumps and are not used on a regular basis, rather are intended to provide redundancy in the event of a power failure. As described in subsequent chapters, firm pumping capacity is defined as total pumping capacity at each pumping facility, minus auxiliary pumps and minus the largest unit at each facility. Total pumping capacity assumes all pumps except auxiliary pumps are running.

[2] The three Capital Hill reservoirs (12 MG) are also located within the Study Area but do not serve the Study Area by gravity.

Table 2-4. Summary of Existing Pump Stations

Pressure Zone	Pump Station	Pump ID	HP	Flow, gpm	Firm Capacity gpm	Firm Capacity mgd	Total Capacity[a] gpm	Total Capacity[a] mgd	Total Firm Capacity, mgd
Zone 1	Lone Pine	1	100	1,500	2,500	3.60	5,500	7.92	7.86
		2	75	1,000					
		3	100	1,500					
		Aux[b]	100	1,500					
	Brookdale	1	100	1,880	2,259	3.25	4,689	6.75	
		2	100	1,729					
		3	30	530					
		Aux[b]	50	550					
	Pierce Heights	1	100	1,300	700	1.01	2,000	2.88	
		2	75	700					
Zone 2	Stanford	1	25	440	1,840	2.65	3,640	5.24	2.65
		2	100	1,800					
		3	75	1,400					
Zone 3	Hillcrest	1	25	490	1,490	2.15	2,490	3.59	2.15
		2	60	1,000					
		3	60	1,000					
Zone 4	Angelcrest	1	30	600	1,200	1.73	1,800	2.59	1.73
		2	30	600					
		3	30	600					
Zone 5	Stardust	1	25	350	350	0.50	1,750	2.52	0.5
		2	50	800					
		Aux[b]	70	600					

Source: MWC 2017 WDSFP, Table 2-3, and information provided by MW.

(a) Firm capacity assumes the largest pump is reserved as a stand-by unit. Auxiliary pumps are not considered in this calculation.
(b) Auxiliary pumps are propane pumps reserved for emergency use.

2.3.4 Distribution Pipelines

Table 2-5 and Table 2-6 summarize MW's existing pipelines by diameter and material type, respectively, within the Study area. MW's existing water system within the Study Area consists of approximately 76 miles of pipelines. The 2017 WDSFP (summarized in *Chapter 4 System Performance and Operation Criteria* of this report) defined transmission pipelines to be greater than or equal to 16-inches. Figure 2-2, however, indicates that 12-inch pipelines are integral to the backbone water system within the Study Area. These are indicated this way since the Study Area is more focused as compared to the rest of the water system. As such, transmission mains within the Study Area are defined as pipelines 12-inches to 18-inches in diameter and distribution pipeline sizes are less than 12 inches in diameter. In addition, over 90 percent of the pipelines in the Study area are comprised of Ductile Iron.

Table 2-5. Summary of Existing Pipelines by Diameter

Pipeline Diameter, inches	Length of Pipelines, feet	Length of Pipelines, miles	Percent of Water System, percent
2	3,459	0.7	0.9
3	1,539	0.3	0.4
4	21,325	4.0	5.3
6	63,513	12.0	15.9
8	198,604	37.6	49.6
10	15,929	3.0	4.0
12	61,108	11.6	15.3
16	33,081	6.3	8.3
18	1,514	0.3	0.4
Total	**400,072**	**75.8**	**100.0%**

Source: Potable water pipelines shapefile provided by Medford Water, as of March 9, 2022.

Table 2-6. Summary of Existing Pipelines by Material

Pipeline Material	Length of Pipelines, feet	Length of Pipelines, miles	Percent of Water System, percent
Cast Iron	27,954	5.3	7.0
Ductile Iron	365,734	69.3	91.4
Galvanized Steel	767	0.1	0.2
Polyvinyl Chloride	4,348	0.8	1.1
Steel	1,269	0.2	0.3
Total	**400,072**	**75.8**	**100.0%**

Source: Potable water pipelines shapefile provided by Medford Water, as of March 9, 2022.

CHAPTER 3
Water Demands

This chapter describes MW's historical, current, and projected near-term and future water demands for the SEMFP Study Area. The projected near-term and future demands are based on refined water use factors and planned future development from the City of Medford's 2007 Comprehensive Plan (with Amendments up to the 2018 Amendment) along with other, more recent City planning assumptions. Projected near-term and future water demands will be used to evaluate the capacity of the MW water system to reliably deliver water to its customers in the Study Area.

The following sections of this chapter present MW's historical and current water demands in the Study Area, along with planned future development, projected water demands, and future water supply required for buildout of the urban growth boundary (2040) and urban reserve boundary (2070):

- Existing Water Use
- Peak Water Use
- Existing and Future Land Use and Growth Projections
- Unit Water Use Factors
- Future Water Demand Projections
- Comparison to Population-Base Growth Projections

3.1 EXISTING WATER USE

The following sections summarize the historical water supply, consumption, and non-revenue water for the Study Area.

3.1.1 Existing SE Area Water Supply

Table 3-1 summarizes water supply for the Study Area from calendar year 2020. This information is from MW's 2020 pump station flow data which represents all supply to each zone within the SE area.

Table 3-1. Existing SE Area Water Supply

Pressure Zone	2020 Water Supply, mgd
1	1.92
2	0.52
3	0.30
4	0.42
5	0.11
Total	**3.27**

Source: 2020 Pump Station Flow Data provided by Medford Water.

3.1.2 Existing SE Area Water Consumption

Water consumption is directly measured by customer meter records. As of 2022, MW has approximately 4,800 metered water use accounts that serve various customer types within the Study Area. Table 3-2 summarizes the number of customers by meter type. As shown in Table 3-2, the predominant customer type in the Study Area is Single-Family residential, which accounts for approximately 95 percent of the total number of water meters. Multi-family residential accounts make up approximately 2 percent of the total metered accounts and non-residential metered accounts make up approximately 3 percent of the total metered accounts.

Table 3-2. Customer Types within the Study Area as of March 2022

Customer Type	Number of Meters	Customer Type as % of Total Accounts
Residential		
Single Family	4,602	95
Multi-Family	90	2
Residential Subtotal	4,692	97
Non-Residential		
Commercial	128	3
MW Facilities	11	<1
Non-Residential Subtotal	139	3
Total	**4,831**	**100%**

Source: Water meter shapefile "Meters.shp" provided by Medford Water staff March 2022.

Table 3-3 summarizes MW's 2020 water consumption by customer type within the Study Area. Residential customers account for an average of 90 percent of the total consumption but make up approximately 97 percent of the total metered accounts as shown in Table 3-2. Non-residential customers account for about 10 percent of the total consumption but make up only 3 percent of the total metered accounts.

Table 3-3. Existing Consumption by Customer Type

Customer Type	Consumption, MG	Customer Type as % of Total Consumption
Residential		
Single Family	844	85
Multi-Family	46	5
Residential Subtotal	890	90
Non-Residential		
Commercial	95	10
MW Facilities	2	<1
Non-Residential Subtotal	97	10
Total	**987**	**100%**

Source: Water meter shapefile "Meters.shp" provided by Medford Water staff March 2022. Consumption data is based on 2020 water use.

3.1.3 Non-Revenue Water

Non-Revenue Water (NRW) is the difference between the quantity of water supplied and the quantity of water consumed or metered. Customer water use typically does not equal the total water production because of unmeasured system losses. Water utilities strive to minimize the amount of NRW; however, it is difficult to eliminate entirely. There are various reasons why the total customer water use is less than the total amount of water supplied by MW including system losses such as leakage, errors in measurement, and unmetered usage.

An estimate of NRW is required for water system planning to project future water production needs, as a system will always have some amount of water loss. NRW ranging from 5 to 10 percent is typical for many water utilities. Table 3-4 summarizes the NRW for the Study Area. NRW is calculated by taking the difference between water supply and water consumption, and then computing NRW as a percentage of supply. Based on previous evaluations performed by MW, the NRW system-wide has been estimated between 9 and 14 percent, which includes areas outside of City limits. The values shown on Table 3-4 compares supply and consumption data for the Study Area and show that NRW is approximately 17 percent. This is similar to the NRW estimated in MW's 2017 WDSFP, where NRW was estimated at 17 percent using 2015 information.

For planning purposes, 10 percent NRW will be assumed for future water demand projects to account for decreased water loss associated with new infrastructure serving new development and/or rehabilitation and replacement activities that are planned by MW to replace aging infrastructure.

Table 3-4. Non-Revenue Water within SE Medford Area

2020 Supply[(a)], MG	2020 Consumption[(b)], MG	NRW, MG	NRW as % of Production
1,194	987	206	17.3

(a) 2020 water supply data was provided to Jacobs from MW.
(b) Refer to Table 3-3.

3.2 PEAK WATER USE

Water system facilities are generally sized to meet peak demand conditions. The peaking conditions of most concern for facility sizing (e.g., supply, pumping and storage) are typically maximum day plus fire flow demand or peak hour demand. This section reviews historical peak water use for the Study Area, and includes a discussion of the maximum day demand, peak hour demand and hourly variations of demand during the maximum demand day.

3.2.1 Maximum Day and Peak Hour Demand

Table 3-5 summarizes the average, maximum day, and peak hour demands and the corresponding peaking factors for each pressure zone in the Study Area. Maximum day water use occurred on July 18, 2021[1] and was identified using 2021 Supervisory Control and Data Acquisition (SCADA) data for facilities serving the Study Area. SCADA data was reviewed to determine the maximum day demand for each pressure zone in

[1] July 2021 SCADA Data provided by MW for Zones 1 – 5

the Study Area. Separate peaking factors for each pressure zone were calculated, as these factors typically vary according to the distribution of land uses and the size of pressure zones.

Table 3-5. Summary of Maximum Day and Peak Hour Peaking Factors

Pressure Zone	Average Day Demand[(a)] (ADD), mgd	Maximum Day Demand[(b)] (MDD), mgd	Peak Hour Demand[(b)] (PHD), mgd	Maximum Day Peaking Factor (MDD/ADD)	Peak Hour Peaking Factor (PHD/MDD)
1	1.92	3.31	9.41	1.7	2.8
2	0.52	1.06	3.02	2.0	2.8
3	0.30	0.34	1.25	1.1	3.7
4	0.42	0.84	2.22	2.0	2.6
5	0.11	0.20	0.46	1.9	2.3
Average	**0.65**	**1.15**	**3.27**	**1.8**	**2.8**

(a) Average day demand data is based on 2020 consumption calculated from MW's water meter shapefile "Meters.shp" provided by MW staff March 2022.
(b) Maximum day demand and peak hour demands are based on 2021 SCADA data.

3.2.2 Recommended Demand Peaking Factors

Table 3-6 summarizes the recommended peaking factors for this plan. These peaking factors will be subsequently used to evaluate and size distribution system pipelines, storage and reservoir pumping facilities.

For planning purposes, the maximum day peaking factors for the existing Study Area pressure zones (Zones 1 through 5) calculated in Table 3-5 are recommended to be used for the future system analysis. The average peak hour peaking factor calculated in Table 3-5 is recommended for all pressure zones. Current land uses in these pressure zones is generally representative of future growth, as discussed in later sections, which supports using peaking factors similar to current day trends.

MW does not currently serve customers above Zone 5, though land use in this pressure zone is projected to be predominantly residential, similar to Zones 2 through 5. For Zones 6 and 7, a maximum day demand peaking factor of 2.0 times the average day demand is considered appropriate compared to the calculated peaking factors for Zones 2 through 5 and industry standards.

Table 3-6. Summary of Maximum Day and Peak Hour Peaking Factors for Future System Evaluation		
Pressure Zone	Maximum Day Peaking Factor (times the average day demand)	Peak Hour Peaking Factor(a) (times the maximum day demand)
1	1.7	2.8
2	2.0	
3	1.1	
4	2.0	
5	1.9	
6 (Future)	2.0(b)	
7 (Future)	2.0(b)	

(a) Calculated as the average peaking factor of pressure zones 1-5
(b) Recommended to be 2.0 times the average day demand to remain consistent with trends in the upper zones..

3.2.3 Maximum Day Diurnal Demand

A maximum day demand diurnal curve was developed for each pressure zone in the Study Area. The diurnal curves were calculated from 2021 SCADA data. Curves were prepared by calculating the hourly demand and average daily demand and dividing each hourly demand by the average daily demand to get hourly normalized values. These normalized values are then multiplied by the future daily demand to estimate hourly demands for future conditions. Figure 3-1 shows the maximum day with peak hour diurnal patterns, which represent the average diurnal patterns over the period from July 18 – July 21, 2021. These diurnal patterns will also be applied in the hydraulic model for evaluating the future distribution system and proposed infrastructure alternatives (discussed in Chapter 5 System Evaluation).

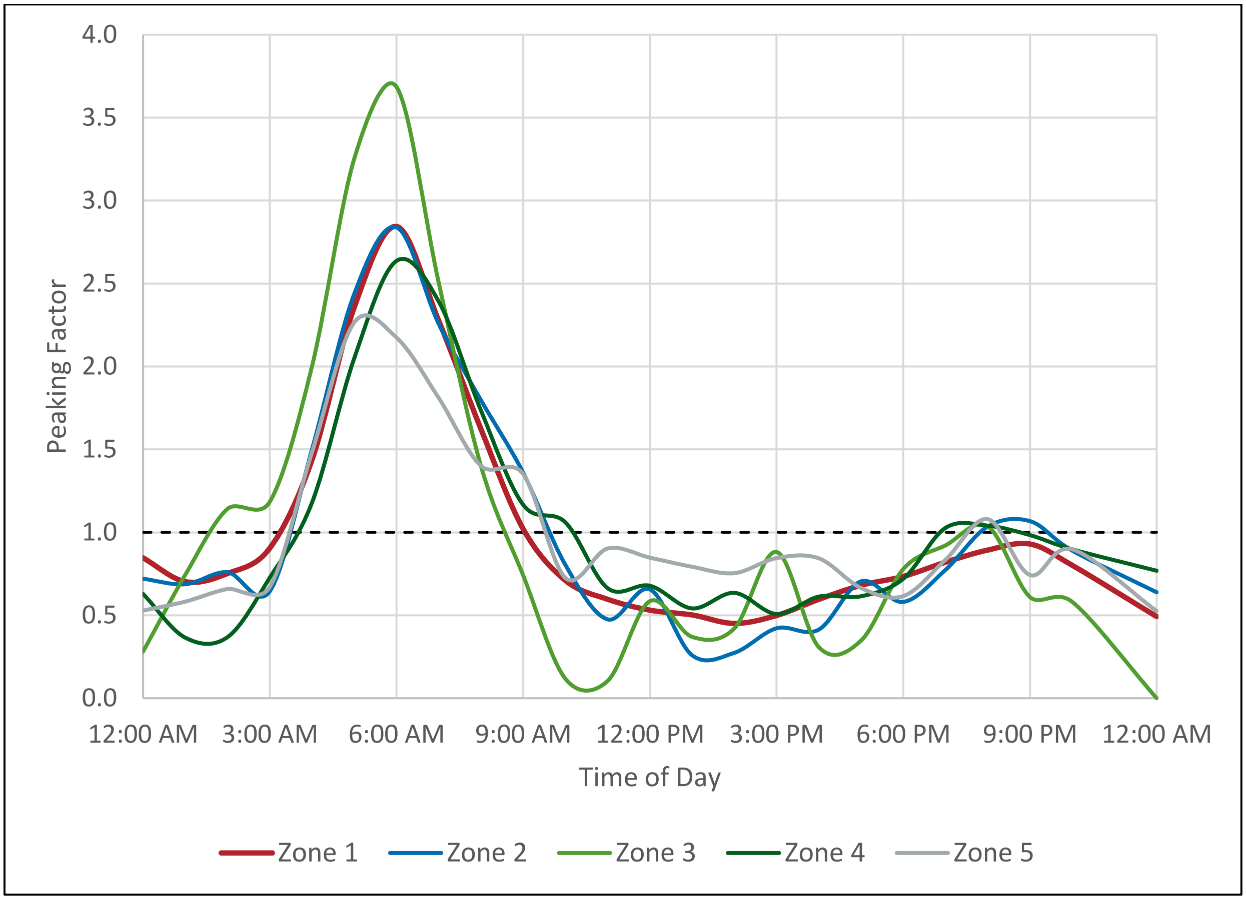


Figure 3-1. Maximum Day Diurnal Patterns

3.3 EXISTING AND FUTURE LAND USE AND GROWTH PROJECTIONS

The following sections discuss the existing and projected future land use for the Study Area.

3.3.1 Existing Land Use

Table 3-7 summarizes the existing land uses within the Study Area, based on existing zoning within the Medford city limit as shown on Figure 3-2. The calculations in Table 3-7 do not include areas with an existing zoning designation that are slated for future redevelopment. The Study Area is predominantly single family residential land uses.

Table 3-7. Existing Southeast Medford Land Uses

Land Use	Area within Study Area, acres[a]						Total within Study Area, %
	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Total	
Single Family Residential (0 to 10 DU/acre)	1,220.1	302.9	219.2	295.5	83.5	2,121.2	95
Multi-Family Residential (10 to 30 DU/acre)	38.7	1.3	0	0	0	40.0	2
Commercial	63.6	0	0	0.1	0	63.7	3
Public Parks	7.4	5.9	0	0	0	13.3	<1
Total	**1,329.8**	**310.1**	**219.2**	**295.6**	**83.5**	**2,238.2**	**100%**

(a) Land uses totals are based on the City of Medford zoning feature class received March 1, 2022. It should be noted that areas with an existing zoning district that is different than the planned future land use are not included in this table.

3.3.2 Projected Future Land Use

Future growth and land uses are defined by the General Land Use Plan Element of the City of Medford's Comprehensive Plan, which summarizes anticipated development within the City's UGB. The City's current planning estimate for timing of buildout of the UGB is 2040. In addition to the UGB, the City has several urban reserve areas within the Study Area which are the first priority supply of land when the City considers expanding its UGB.[2] The urban reserve areas are meant to provide a 50-year land supply for the City, therefore, for the purposes of this plan, buildout of the Urban Reserve is assumed to be 2070. Assumptions for development of the Urban Reserve areas are based on recent City development in planning units or adopted urbanization plans, where available.

West Yost compared the General Land Use Plan areas to existing zoning and development within the Study Area to identify the most likely areas for future growth. This primarily included vacant land and land identified to change to a different land use (i.e., low density residential to commercial). Conversely, some areas are identified to change to a different land use but appear to be relatively new developments. It was assumed that these are not areas where significant future growth will occur. Figure 3-3 shows the projected growth areas and anticipated land use types within the Study Area, and the corresponding acreage is presented in Table 3-8.

[2] City of Medford

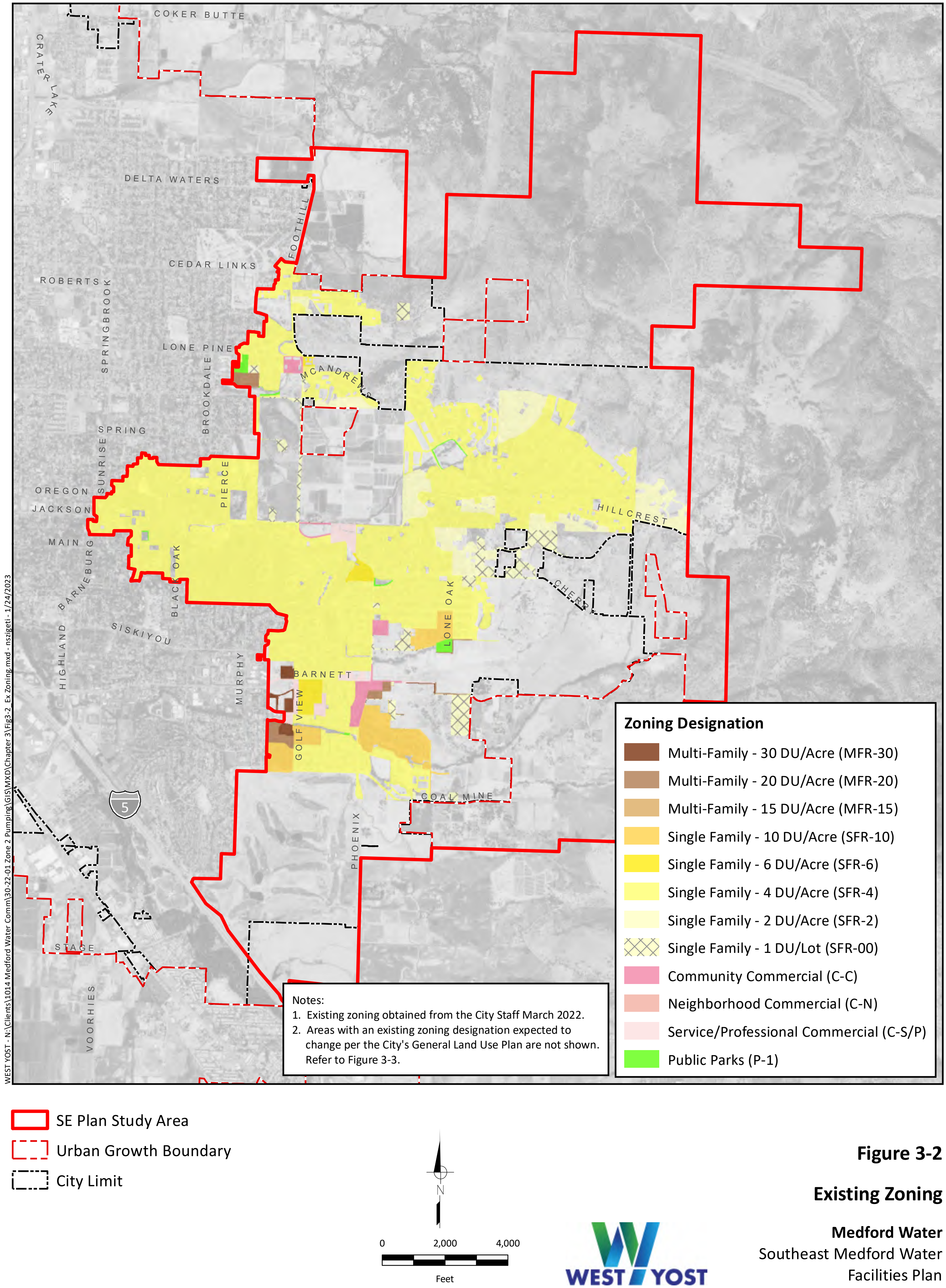


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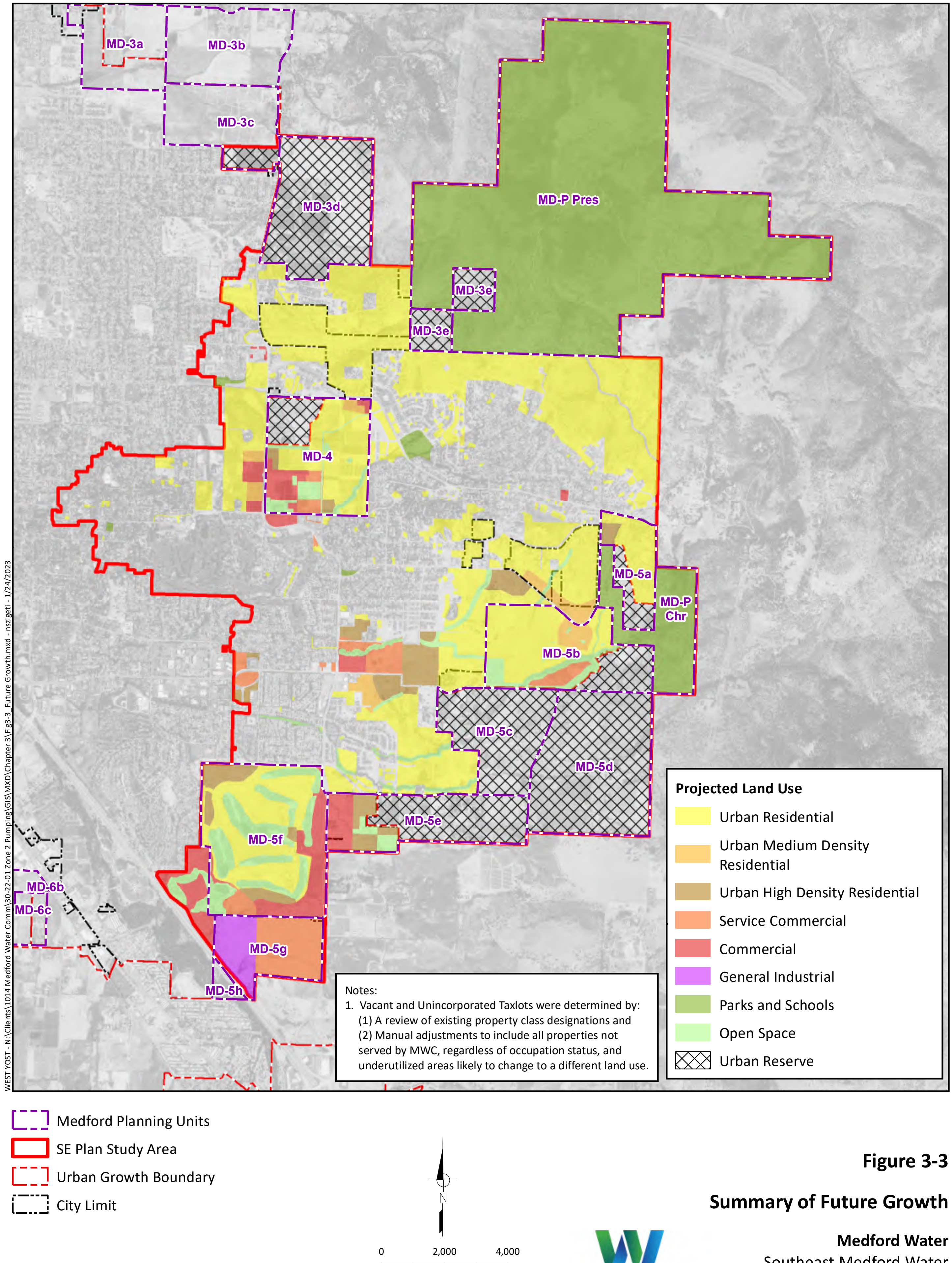
Figure 3-2

Existing Zoning

Medford Water
Southeast Medford Water
Facilities Plan



Notes:

1. Vacant and Unincorporated Taxlots were determined by:
   (1) A review of existing property class designations and
   (2) Manual adjustments to include all properties not served by MWC, regardless of occupation status, and underutilized areas likely to change to a different land use.

Figure 3-3

Summary of Future Growth

Medford Water
Southeast Medford Water
Facilities Plan

Table 3-8. Summary of Projected Land Use								
	Area, acres[a]							
Land Use Designation	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Total
Growth within Medford UGB - 2040								
Urban Residential	462	425	291	217	177	123	76	**1,771**
Urban Medium Density Residential	27	5	39	3	0	0	0	**73**
Urban High Density Residential	100	48	17	8	0	0	0	**173**
Service Commercial	159	8	11	0	0	0	0	**178**
Commercial	206	3	0	2	0	0	0	**211**
General Industrial	58	0	0	0	0	0	0	**58**
Parks and Schools / Open Space	217	68	52	117	105	1,620	11	**2,190**
Total Within Medford UGB	**1,228**	**556**	**410**	**347**	**282**	**1,742**	**87**	**4,653**
Growth outside Medford UGB - 2070								
Planning Unit MD-3c/3d	145	130	43	7	0	0	0	**324**
Planning Unit MD-3e	0	0	1	28	14	19	19	**81**
Planning Unit MD-4	39	12	0	0	0	0	0	**51**
Planning Unit MD-5	28	317	223	192	19	0	0	**780**
Total Outside Medford UGB	**211**	**459**	**267**	**227**	**33**	**19**	**19**	**1,235**
Total Within Study Area	**1,440**	**1,015**	**677**	**574**	**315**	**1,762**	**106**	**5,888**

(a) Acreage totals were calculated using GIS information provided by City of Medford staff and MWC staff.

A high-end and low-end projection of dwelling units(DU) was also developed by multiplying the projected residential growth areas by the planned number of DU per acre. The high-end estimate assumes development will occur at the full planned density for each residential land use. Much of the planned residential development extends into the hills on the eastern portion of the Study Area, and the actual developed densities in much of this area may be reduced due to steep slopes. The low-end estimate assumes a reduced density in Zones 3 and above equal to 75 percent of the planned density. Table 3-9 presents the projected low-end and high-end number of DU by pressure zone.

For additional detail on the number of projected DU in the SE Area, refer to Appendix A.

Table 3-9. Summary of Projected Dwelling Units

Growth Area	Dwelling Units							
	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Total
Low-End Projection								
Growth within Medford UGB	4,422	2,775	1,563	746	467	336	201	10,511
Growth outside Medford UGB	656	1,700	760	646	93	55	54	3,965
Total Low-End Projection	**5,079**	**4,475**	**2,324**	**1,392**	**561**	**390**	**256**	**14,476**
High-End Projection								
Growth within Medford UGB	4,422	2,775	2,084	994	623	448	269	11,616
Growth outside Medford UGB	656	1,700	1,014	862	124	73	72	4,501
Total High-End Projection	**5,079**	**4,475**	**3,098**	**1,856**	**747**	**520**	**341**	**16,117**

(a) Dwelling units are calculated by dividing the acreage by the number of dwelling units per acre. Densities were obtained from existing zoning designations (if available), and input from MWC staff.

3.4 UNIT WATER USE FACTORS

To develop land use-based water demand projections, water use factors are applied to the projected land uses (refer to Section 3.5 Future Water Demand Projections). Water use factors are typically classified as residential, presented in gallons per day per dwelling units (gpd/DU), and non-residential, presented in gallons per day per acre (gpd/acre). The following subsections provide additional details on how unit water use factors were developed for residential and non-residential land use designations.

3.4.1 Residential Water Use Factors

Residential water use factors were estimated in the 2017 WDSFP on a per-capita basis based on 2015 water use. Single family residential water use was estimated at 187 gallons per capita per day (gpcd) while multi-family residential was estimated at 97 gpcd. When these factors are multiplied by the average number of people per household (estimated to be 2.5 persons[3]), the resulting water use factors are approximately 468 gpd/DU for single family residential and 243 gpd/DU for multi-family residential. It should be noted that this water use factor for single family residential is high compared to similar water

[3] City of Medford 2010 Comprehensive Plan Housing Element, Table 4.

utilities. For example, the City of Grants Pass' water use factor for single family residential was estimated to be 322 gpd/DU in 2016.[4]

As previously discussed, single family residential land uses account for a vast majority (95 percent) of projected growth in the Study Area. West Yost performed a review of spatially located 2020 water consumption data specific to the Study Area to compare to the citywide single family residential water use factor reported in the 2017 WDSFP. Initial single family residential water use factors presented in Table 3-10 were calculated by dividing the total single family residential water consumption in each pressure zone divided by the total number of active 3/4-inch water meters.[5] The average water use factor for the Study Area weighted by consumption is approximately 486 gpd/DU.

Discussions with MW staff indicate that existing residential water use in the Study Area is likely significantly higher than what can be reasonably assumed for future homes. Zone 1 is the largest pressure zone and is generally comprised of older, more water-inefficient homes. Furthermore, the upper zones (Zones 2 through 5) currently consist of affluent, heavily irrigated homes on large lots that likely does not represent long-term development in those areas. Table 3-10 also calculates single family water use factors for residential accounts beginning after 2017 to capture water use for homes built to more water efficient standards. This criterion decreased the weighted average water use factor to 395 gpd/DU. To remain consistent in projecting water use, a single water use factor of 395 gpd/DU is recommended for pressure zones in the Study Area. A low-end demand projection for single family residential water use was also estimated at 356 gpd/DU which assumes a 10 percent reduction to account for continued water conservation efforts.

Table 3-10. Summary of Single Family Residential Water Use Factors

Pressure Zone	Unit Water Use Factor, gpd/DU	
	All SFR Accounts	2017 and Newer
1	435	369
2	529	378
3	538	485
4	507	452
5	775	661
Consumption-Weighted Average	**486**	**395**

[4] City of Grants Pass 2016 Water Distribution System Master Plan.

[5] 3/4-inch is the standard size for single family residential in MWC's service area. Water meters with zero consumption in 2020 were excluded from this calculation.

3.4.2 Non-Residential Water Use Factors

West Yost calculated updated non-residential water use factors within MW's service area as part of a separate water demand study. The results were presented in a TM dated September 2023, attached as Appendix B, and are summarized below. Commercial and industrial water use factors were found to vary significantly, and non-residential water use factors were separated into two categories:

- **Commercial and Light Industrial:**
  - Generally represented by land uses that do not use water specifically for manufacturing purposes (e.g., warehouses, distribution, retail, restaurants, etc.).
  - Range of water use factors bracketed by 45 gpd/acre to 400 gpd/acre.
- **Heavy Industrial:**
  - Generally represented by land uses that use water specifically for manufacturing purposes (e.g., timber industries, bottling plants, etc.) or are otherwise expected to have significant water use in relation to property area.
  - Single water use factor equal to 3,750 gpd/acre. There is no heavy industrial water use planned in the SE Area.

For additional detail regarding the development of non-residential water use factors, see Appendix B.

3.5 FUTURE WATER DEMAND PROJECTIONS

In order to build a level of flexibility into future demand projections, a range of water demands were projected for buildout of the UGB (2040) and buildout of the Urban Reserve (2070). Residential densities and water use factors were selected as parameters for bracketing water demands between a low-end projection and high-end projection. Table 3-11 documents the low-end and high-end assumptions for each parameter.

Table 3-11. Future Water Use Projection Assumptions

Projection	Assumptions
Low-End Demand Projection	• Residential density in Zones 3 and above is equal to 75 percent of the planned density • Future residential water use assumed a 10 percent reduction from existing water demand trends to account for continued water conservation efforts — Single Family Residential WUF = 356 gpd/DU — Multi-Family Residential WUF = 219 gpd/DU • Non-residential water use at low-end of range (see Section 3.4.2) — Commercial and Light Industrial WUF = 45 gpd/acre
High-End Demand Projection	• Residential density in Zones 3 and above is equal to 100 percent of the planned density • Future residential water use assumed to follow existing water demand trends (see Section 3.4.1) — Single Family Residential WUF = 395 gpd/DU — Multi-Family Residential WUF = 243 gpd/DU • Non-residential water use at high-end of range (see Section 3.4.2) — Commercial and Light Industrial WUF = 400 gpd/acre

WUF = Water Use Factor

Water demands were projected for buildout of the UGB (2040) and buildout of the urban reserve (2070) using the recommended water use factors applied to future proposed development. Future water supply requirements were then estimated by adding the future water demand projections and future NRW to the existing baseline supply (Section 3.1.1). The specific steps used in the development of this projection method and the results are discussed below.

For additional detail on future water demand in the SE Area, refer to Appendix A.

3.5.1 Additional Water Demand for Planned Future Development

Based on the projected future growth (Tables 3-8 and 3-9) and the updated water use factors (Section 3.4), water demands for buildout of the UGB (2040) and urban reserve (2070) were estimated. Table 3-12 summarizes the additional projected average day water demand from planned future development for the 2040 and 2070 timeframes.

Table 3-12. Future Additional Water Demands[(a)]

Pressure Zone	Additional Demand at buildout of the UGB, mgd	Additional Demand at Buildout of the Urban Reserve, mgd[(b)]
Low-End Projection		
1	1.21	1.44
2	0.83	1.43
3	0.46	0.73
4	0.24	0.47
5	0.17	0.20
6	0.12	0.14
7	0.07	0.09
Total Low-End Projection	**3.09**	**4.50**
High-End Projection		
1	1.49	1.76
2	0.93	1.60
3	0.68	1.08
4	0.36	0.70
5	0.25	0.30
6	0.18	0.21
7	0.11	0.13
Total High-End Projection	**3.98**	**5.77**

(a) Projections are for average day demand and do not include NRW.
(b) The additional demand at buildout of the Urban Reserve includes the additional demands from UGB.

3.5.2 Water Supply Required for Buildout within the Urban Growth Boundary

Table 3-13 summarizes the projected supply requirements within the Study Area for buildout within the UGB. The projected 2040 supply requirement includes the existing baseline supply, the additional 2040 water demand at average day demand and future non-revenue water.

By 2040, the water supply requirement is projected to increase by approximately 105 to 135 percent for the entire Study Area.

Table 3-13. Projected Water Supply Requirement for Urban Growth Boundary Buildout

Parameter	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Total
Low-End Projection								
Existing Baseline Supply (Refer to Table 3-1)	1.92	0.52	0.30	0.42	0.11	0.00	0.00	3.27
Additional 2040 Demand (Refer to Table 3-12)	1.21	0.83	0.46	0.24	0.17	0.12	0.07	3.09
Future NRW (10 percent)	0.13	0.09	0.05	0.03	0.02	0.01	0.01	0.34
Total Supply Requirement	**3.26**	**1.44**	**0.81**	**0.69**	**0.29**	**0.13**	**0.08**	**6.71**
Increase from Existing Supply, percent	**70%**	**177%**	**169%**	**64%**	**168%**	**-**	**-**	**105%**
High-End Projection								
Existing Baseline Supply (Refer to Table 3-1)	1.92	0.52	0.30	0.42	0.11	0.00	0.00	3.27
Additional 2040 Demand (Refer to Table 3-12)	1.49	0.93	0.68	0.36	0.25	0.18	0.11	3.98
Future NRW (10 percent)	0.17	0.10	0.08	0.04	0.03	0.02	0.01	0.44
Total Supply Requirement	**3.58**	**1.55**	**1.05**	**0.82**	**0.38**	**0.20**	**0.12**	**7.70**
Increase from Existing Supply, percent	**86%**	**198%**	**251%**	**95%**	**249%**	**-**	**-**	**135%**

3.5.3 Water Supply Required for Buildout within the Urban Reserve Boundary

Table 3-14 summarizes the projected supply requirements within the Study Area for buildout within the Urban Reserve Boundary. The projected 2070 supply requirement includes the existing baseline supply, the additional 2070 water demand at average day demand and future non-revenue water.

By 2070, the water supply requirement is projected to increase by approximately 153 to 196 percent for the entire Study Area.

Table 3-14. Projected Water Supply Requirement for Urban Reserve Buildout								
Parameter	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Total
Low-End Projection								
Existing Baseline Supply (Refer to Table 3-1)	1.92	0.52	0.30	0.42	0.11	0.00	0.00	3.27
Additional 2040 Demand (Refer to Table 3-11)	1.44	1.43	0.73	0.47	0.20	0.14	0.09	4.50
Future NRW (10 percent)	0.16	0.16	0.08	0.05	0.02	0.02	0.01	0.50
Total Supply Requirement	**3.52**	**2.11**	**1.11**	**0.94**	**0.33**	**0.15**	**0.10**	**8.27**
Increase from Existing Supply, percent	**83%**	**307%**	**269%**	**125%**	**201%**	**-**	**-**	**153%**
High-End Projection								
Existing Baseline Supply (Refer to Table 3-1)	1.92	0.52	0.30	0.42	0.11	0.00	0.00	3.27
Additional 2040 Demand (Refer to Table 3-11)	1.76	1.60	1.08	0.70	0.30	0.21	0.13	5.77
Future NRW (10 percent)	0.20	0.18	0.12	0.08	0.03	0.02	0.01	0.64
Total Supply Requirement	**3.87**	**2.30**	**1.50**	**1.20**	**0.44**	**0.23**	**0.15**	**9.69**
Increase from Existing Supply, percent	**102%**	**342%**	**400%**	**185%**	**298%**	**-**	**-**	**196%**

3.6 COMPARISON TO POPULATION-BASED GROWTH PROJECTIONS

This section compares the growth projections developed for this plan to population growth projections prepared by the Portland State University Population Research Center (PRC). The PRC produces annual certified 50-year population estimates for Oregon using U.S. Census data, an estimated natural increase (using State registration of births and deaths), and an estimated net migration (using data on school enrollment, employment, labor force, income tax exemptions, issued drivers licenses, voter registration, and Medicare enrollees). Population estimates for each city are developed using data on housing stock changes provided by City officials. PRC population projections were most recently published for Medford in June 2022[6]. PRC growth estimates were converted to DU by dividing by the average number of persons per DU (2.5 persons per DU).

Figure 3-4 compares the PRC population-based growth projections for the entire City to the land use-based growth projections for the Study Area from this plan, in DU. As shown, the City's current land use plan for the Study Area alone is projected to add between approximately 14,500 and 16,150 DU to the City by 2070, while the population growth projected for the entire City of Medford equates to an additional 28,810 DU over the same period. This indicates that about half (50 to 56 percent) of the future growth in the City will occur within the Study Area. Additionally, the City's current land use planning is

[6] Coordinated Population Forecast for Jackson County, its Urban Growth Boundaries (UGB), and Area Outside UGBs 2022-2072. Population Research Center, Portland State University. 2022. Obtained online at: https://www.pdx.edu/population-research/population-forecasts

more aggressive in the near-term and projects most of the City's near-term development will occur in the Study Area. Because of this difference in the timing of growth between the two projections, MW should plan infrastructure for growth as it occurs to properly size facilities as demands are realized. A one (1) percent average annual growth rate based on the City's 2020 population is also shown for reference. The land use-based projections and PRC projection exceed the 1 percent average annual growth rate between 2020 and 2040. The land use-based projections show a decrease in growth between 2040 and 2070 and are less than the 1 percent average annual growth rate in this time period.

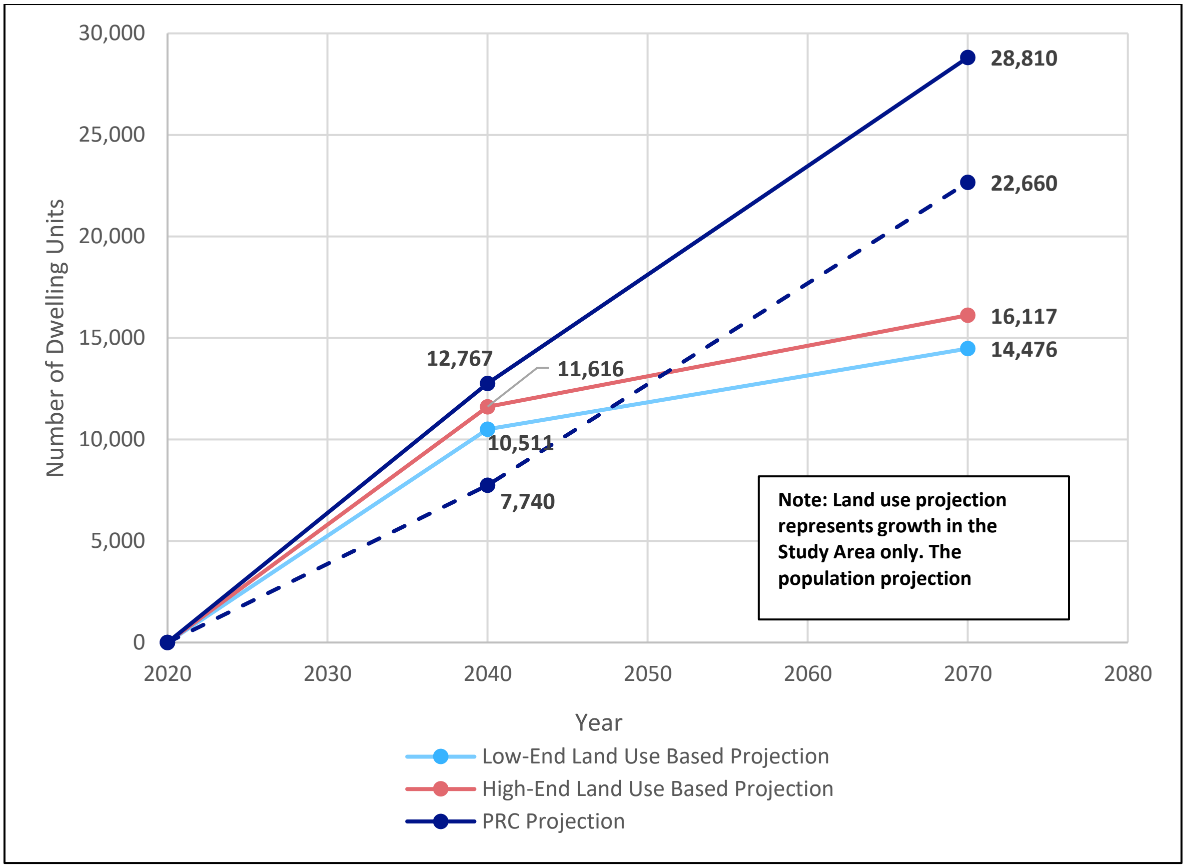


Figure 3-4. Comparison of Population-Based and Land Use-Based Growth Projections

CHAPTER 4
System Performance and Operational Criteria

The purpose of this chapter is to define the recommended performance and operational criteria for MW's water distribution system. For the potable water system, these criteria include the recommendations for the required fire flow and flow duration, definition of emergency events, system pumping capacity, system storage capacity (equalization, fire flow, and emergency components), minimum and maximum system pressures, and maximum pipeline velocity and head loss. Some areas in the existing water system may not currently meet the updated criteria developed in this plan. These criteria are for planning of future water system improvements.

The following sections of this chapter present the recommended performance and operational criteria for sizing proposed water system infrastructure:

- Summary of Water System Performance and Operations Criteria
- General Water System Reliability
- Fire Flow Requirements
- Water System Performance
- Facilities Sizing

A summary of the recommended potable water system performance and operational criteria is presented in Table 4-1 and reflect typical water system industry standards.

4.1 GENERAL WATER SYSTEM RELIABILITY

Attention to enhancing the reliability of MW's water system under all conditions is an important part of maintaining high quality water service. Water system reliability is achieved through a number of system features including: (1) appropriately sized storage facilities; (2) redundant or "firm" pumping capacity, transmission, and treatment facilities where required; and (3) alternate power supplies. Reliability and water quality are also improved by designing looped water distribution pipelines and avoiding dead-end distribution mains whenever possible. Looping pipeline configurations reduce the potential for stagnant water and the associated problems of poor taste and low chlorine residuals. In addition, proper valve placement is also necessary to maintain reliable and flexible system operation under normal and abnormal operating conditions.

Table 4-1. Summary of Water System Performance and Operations Criteria		
Component	**Criteria**	**Remarks / Issues**
Fire Flow Requirements		
Low-Density Residential	1500 gpm for 2 hours	Up to 10 DU/acre
Medium-Density Residential	2,000 gpm for 2 hours	10-20 DU/acre
Commercial, High Density Residential	3,000 gpm for 3 hours	Greater than 20 DU/acre
General Industrial, Schools	4,000 gpm for 4 hours	
Water System Performance		
Peak Supply Capacity		
Maximum Day Demand and Peak Hour Demand	MDD met by firm capacity of supply sources; PHD/fire flow met by storage volume	
System Pressure		
Maximum Pressure (psi)	150	Oregon plumbing code requires individual pressure reducing valves for service pressures over 80 psi
Minimum Pressure (psi)		
Average Day Demand	40	
Maximum Day Demand	40	
Maximum Day Demand plus Fire Flow	20	
Pumping Facility Capacity		
Pumping Capacity - Zones with Gravity Storage	Provide firm capacity greater than or equal to MDD for the Zone and all supporting Zones	Firm capacity is defined as the capacity with the largest single pump out of service
Pumping Capacity - Zones without Gravity Storage	Provide firm capacity greater than or equal to the maximum of (1) MDD plus fire flow for the Zone, or (2) the PHD for the Zone	
Maximum Pump Station Run Time	18 hours per day	Equates to 1.33 times the maximum day demand
Power Supply	Two primary power feeds, or one primary feed with an emergency power feed; Secondary power feed should be sized to provide ADD	Primary power feed is the normally operating power feed. Secondary power feed is backup power, e.g., backup generator
Backup Power		
Critical Pump Station	The largest or only pumping facility that provides water to a pressure zone	
Back-up Power	Critical pump stations will have on-site backup power; Non-critical pump stations will be equipped with plug-in adapters and transfer switches	Less critical facilities may be equipped with a plug-in adapter and transfer switch for a portable generator
Backup Power Fuel Storage	Stations with on-site backup power only. Minimum fuel storage equal to one average day pumping requirement for the pump station.	
Water Storage Capacity		
Equalization Storage	25% of the maximum day demand	Based on Zones 1-5 diurnals
Emergency Storage	100% of the average day demand	
Fire Storage	Fire flow times duration for the largest fire event in a pressure zone	Based on land use; see Table 4-2
Total Water Storage Capacity	Sum of equalizing, emergency, and fire storage	
Pipeline Sizing		
Diameter - Transmission	16-inches or larger	
Diameter - Distribution	Less than 16-inches	
Maximum Pipeline Velocity (fps)		
Transmission Pipelines	5	Under MDD conditions
Distribution Pipelines	12	Under PHD conditions
Hazen Williams "C" Factor	130	Assumed, for consistency in hydraulic modeling

4.2 FIRE FLOW REQUIREMENTS

Fire flow requirements were developed with input from MW to be generally consistent with the 2019 Oregon Fire Code, Tables B105.1 and B105.2, which establish minimum fire flows and durations for individual structures based on the structure's construction type and fire flow calculation area. The recommended planning fire flow requirements for MW based on various existing and planned land use designations within the Study Area are presented in Table 4-2. These fire flow requirements have not been developed for specific structures and are intended only for general planning purposes.

For planning purposes, the minimum fire flows identified in Table 4-2 are to be met concurrently with maximum day demand conditions while maintaining a minimum residual system pressure of 20 psi at customer service locations throughout the water system. Additionally, as discussed in subsequent sections of this chapter, minimum fire flows presented in Table 4-2 and their expected duration will also be used to establish MW's storage capacity requirements.

Table 4-2. Fire Flow Requirements

Land Use Designation	Fire Flow, gpm	Duration, hours	Recommended Storage, MG
Low-Density Residential[a]	1,500	2	0.18
Medium-Density Residential[b]	2,000	2	0.24
Commercial, Light Industrial High Density Residential[c]	3,000	3	0.54
General Industrial, Heavy Industrial, Schools	4,000	4	0.96

(a) Low-Density Residential includes the planned Urban Residential land use from the 2007 Medford Comprehensive Plan, and all Single Family zoning designations (up to 10 DUs/acre).

(b) Medium Density Residential includes the planned Urban Medium Residential use from the 2007 Medford Comprehensive Plan, and Multi-Family zoning designations up to 20 DUs/acre.

(c) Includes all commercial land uses within the Study Area and Multi-Family zoning designations above 20 DUs/acre.

MG = Million Gallons

4.3 WATER SYSTEM PERFORMANCE

Water system performance and facility sizing is evaluated based on various demand conditions. These demand conditions are described in more detail below.

4.3.1 Water System Capacity During High Demand Conditions

Maximum day demand plus fire flow and peak hour demand conditions are used to assess the adequacy of MW's potable water system during high demand periods. Updated peaking factors for maximum day and peak hour demands are discussed in Chapter 3 Water Demands. The following criteria are used to evaluate each pressure zone.

4.3.1.1 Maximum Day Demand plus Fire Flow

In accordance with typical industry standards, MW's water system should have the capability to meet a system demand condition equal to maximum day demand concurrent with a fire flow event while meeting the recommended system performance criteria (e.g., minimum and maximum system pressures) discussed later under Section 4.4.4 Pipeline Sizing.

Maximum day demand plus fire flow should be met from a combination of supply sources (e.g., pump stations) and treated water storage reservoirs. In general, supply sources should provide the maximum day demand with firm capacity while fire flow volume is provided from water storage reservoirs. The analysis of fire flow evaluations will be conducted assuming the largest pump at each pump station is offline (i.e., firm capacity).

These conservative assumptions ensure the reliability and flexibility of the system to provide sufficient flow during emergency fire flow conditions.

4.3.1.2 Peak Hour Demand

Peak hour demand should be met from a combination of supply sources and treated water storage reservoirs. In general, supply sources should provide maximum day demand with firm capacity while the additional peak hour volume is provided from water storage reservoirs. Assumptions regarding firm pumping capacity will also apply during a peak hour demand condition. During a peak hour demand condition, MW's water system should be able to meet the recommended system performance criteria (e.g., minimum and maximum system pressures) discussed later under Section 4.4.4 Pipeline Sizing.

4.3.2 Water System Pressures

Adequate system pressure is a basic indicator of acceptable water system performance.

4.3.2.1 Maximum Pressure

Water systems are generally planned around maintaining a minimum acceptable pressure for high elevation customers, which is more critical than avoiding high pressures at lower elevation customers. High pressures at customer service locations are managed by installing individual pressure reducing valves (PRVs). The Oregon Plumbing Code requires a PRV at any service where pressures in the mainline exceed 80 psi. Pipelines are typically designed to manage pressures exceeding 150 psi, however, excessively high pressures in the mainlines are not desirable due to increased chances for leaks. The purpose of the maximum pressure criteria is to avoid damage to pipelines and reduce the likelihood of leaks.

4.3.2.2 Minimum Pressure

In the past, the MW water system was designed for lower minimum pressures. MW's 2017 WDSFP established the minimum pressure criterion as 35 psi. Based on input from MW staff during a workshop on May 29, 2021, Operations staff noted the desire to increase this criterion to 40 psi. Many locations in the existing water system do not meet the revised minimum pressure criterion. To avoid future customer issues, the minimum pressure criterion is being raised as part of this plan for future planning areas.

4.3.2.3 Recommended Pressure Criteria

The recommended planning criteria for system pressures are:

- Service pressures should be maintained between a maximum of 150 psi and a minimum of 40 psi under all demand conditions. Customers with service pressure greater than 80 psi require an individual pressure reducing valve.
- The minimum allowable residual pressure during a fire flow event should be 20 psi at any customer service location.

4.4 FACILITY SIZING

The following sections describe the recommended criteria governing the size of water facilities (i.e., pump stations, storage reservoirs, and pipelines) within MW's service area.

4.4.1 Pump Station Capacity

As discussed in Section 4.3.1, the maximum day demand is assumed to be supplied by pump stations and supply sources, while peak demands and fire flows are supplied by storage tanks. If no storage exists (or is planned) within a pressure zone, then the pump station(s) supplying the pressure zone must be sized differently. The recommended criteria for pump station capacity are as follows:

- **For pressure zones with storage,** provide firm pumping capacity greater than or equal to the maximum day demand for the pressure zone and all higher pressure zones.
- **For pressure zones without storage,** provide firm pumping capacity greater than or equal to both (1) maximum day demand concurrent with a maximum fire flow event for the pressure zone, and (2) the peak hour demand for the pressure zone.

It is worth noting that MW does not currently have pressure zones without storage (i.e., hydropneumatic zones), however, it may opt for this configuration in the future if storage is not feasible.

All pump stations, regardless of storage, should be adequately sized to provide the required capacity with a maximum run time of 18 hours per day. This criterion increases the firm capacity requirement by a factor of 1.33 to match operations of the pump stations, prolong the useful life of individual pumps and provide flexibility as growth occurs. Firm capacity assumes a reduction in total pumping capacity to account for pumps that may be out of service at any given time due to mechanical breakdowns, maintenance, water quality, or other operational issues. Fire pumps are exempt from this sizing criterion as they are rarely operated under normal conditions.

Pump stations are recommended to have two primary power feeds, or one primary feed with an emergency power feed. Secondary power feed should be sized to provide average day demand.

4.4.2 Backup Power

Backup power is critical for maintaining system pressures and meeting customer needs in a power outage. It is not always feasible or necessary to maintain on-site power generators at each pump station. Therefore, the backup power criteria are based on pump station criticality. Critical pump stations are defined as the largest or only pump station supplying a pressure zone.

All critical pumping facilities should be equipped with an on-site, back-up power generator that can provide backup power for at least 1 average day demand. At less critical facilities, a plug-in adapter and transfer switch should be provided to allow interconnection to a portable generator, which would be brought to the site by MW staff during a prolonged power outage. At a minimum, portable generator connections should be provided at all booster pump station locations.

Facilities with on-site backup power should include sufficient fuel storage to provide a minimum of one average day demand pumping requirement for the pump station. AWWA has the following input on the topic of emergency operations. Power is often a key limiting factor in the immediate aftermath of many disasters. The 2008 edition of the National Electric Code (NEC) Article 708 establishes a minimum benchmark of 72 hours for backup power for critical operations and assets. This three-day window is the expected time it may take for services to be restored and/ or emergency power generators to be deployed. The greater the in-house capacity to be power-independent following an event increases a utility's resilience and minimizes the burden for like services that may be needed by other entities.

Three days of fuel can be difficult for a utility to maintain with regard to fuel management. The following factors should be considered to determine the amount of recommended fuel storage at each facility:

1. Criticality of pump station
2. Strength of contracts in place for delivery of fuel (are they exclusive and prioritized)
3. Ability to manage fuel age
4. Maturity in implementing curtailment plans to minimize water demand during outages
5. Reliability of power grid and redundant feeds from separate substations to pump station
6. Are overhead power lines from substations to pump station hardened, underground (local reliability)
7. Different fuel tank size for booster vs. closed end systems
8. Defining of “Critical Operations”

4.4.3 Water Storage Capacity

The total treated water storage capacity required is based on the following three storage components:

- Equalization Storage
- Fire Storage
- Emergency Storage

A discussion of these three storage components follows. Also described are potential operational strategies for MW’s storage facilities based on seasonal water demand patterns (i.e., winter vs. summer) and proposed service areas within the Study Area to help optimize system operations by facilitating tank turnover to minimize water quality issues (e.g., stale water, loss of residual).

4.4.3.1 Equalization Storage

Over any 24-hour period, water demands will vary. Typically, higher water demands will occur during the early morning hours when people are irrigating landscape and getting ready to go to work or school. Water demands will then decline to some nominal baseline level (depending on the proximity to water use patterns of adjacent commercial/industrial areas) and will then begin to increase again depending on outside water needs (and corresponding temperature), until it reaches a higher water demand in the early evening hours as people return home from work or school. Throughout the year, the peaks of this cycle will vary according to customer needs; thereby, creating maximum day and peak hour demands that vary seasonally.

Typically, water treatment plants supplying the system or pump stations supplying a pressure zone are assumed to operate at a constant rate over a 24-hour period (baseline) and are augmented by additional flow from storage tanks during daily high demand periods, as needed. Storage tanks are normally refilled when demands drop below the baseline water supply flow rate. The storage volume used to meet these peak demand periods is called equalization storage.

For a typical system, the volume of water recommended to be held in reserve for equalization flow should be at least equal to 25 percent of the total volume of water used on the maximum day. A review of MW's diurnal patterns within the study area performed by Jacobs (see *Chapter 3 Water Demands*) confirmed that 25 percent of the volume of water used on the maximum day demand is required for all pressure zones in the Study Area.

4.4.3.2 Fire Storage

Fire storage is the volume of storage reserved for fire flows. The fire storage volume is determined by multiplying the required maximum fire flow rate by the required duration. It is assumed that no more than one fire flow event would occur in any pressure zone at one time. Table 4-2 presents the recommended fire flow criteria and associated required fire flow storage.

4.4.3.3 Emergency Storage

A reserve of stored water is also required to meet demands during an emergency. An emergency is defined as an unforeseen or unplanned event that may degrade the quality or quantity of potable water supplies available to serve customers. Water utilities typically prepare for three types of emergency events:

- **Minor Emergency**. A fairly routine, normal, or localized event that affects a few customers, such as a pipeline break, malfunctioning valve, hydrant break, or a brief power loss. These types of emergencies typically last a few hours to half of a day. Utilities plan for minor emergencies and typically have staff and materials available to address them.
- **Major Emergency**. A disaster that affects an entire, and/or large, portion of a water system, lowers the quantity and quality of the water, or places the health and safety of the community at risk. Examples include water treatment plant failures, raw water contamination or major power grid outages. These types of emergencies typically last one to three days. Water utilities infrequently experience major emergencies.
- **Natural Disaster**. A disaster caused by natural forces or events that create water utility emergencies. Examples include earthquakes, wildfires, hurricanes, tornados or high winds, floods, and other severe weather conditions such as freezing or drought that damage or cause water system facilities to not be able to operate for extended periods of time.

Determination of the required volume of emergency storage is a policy decision based on the assessment of the risk of failures and the desired degree of system reliability. The amount of required emergency storage is a function of several factors including the diversity of the supply sources, redundancy and reliability of the production facilities, seasonal demands, and the anticipated length of the emergency outage.

The American Water Works Association (AWWA) states that no formula exists for determining the amount of emergency storage required, and that the decision will be made by the utility based on a judgment about the perceived vulnerability of the system. The 2017 WDSFP assumed an emergency storage requirement of 33 percent of the maximum day demand. MW staff agreed to increase this criterion to improve the ability of the water system to respond to emergencies, particularly considering the impacts of the 2020 Alameda Wildfire. Therefore, the emergency storage volume criterion is one average day demand. This correlates to meeting supply needs during a one-day major emergency, but not a natural disaster which would require extensive investment in storage infrastructure and could compromise water quality. MW is working towards a long-term resilient water system that can meet critical water needs following a natural disaster. This criterion also reflects that MW has two reliable water supply sources to meet customer needs in an emergency event.

4.4.3.4 Total Recommended Storage Capacity

MW's recommended total water storage capacity is the sum of the following components:

- **Equalization**: Volume of water necessary to meet diurnal peaks observed throughout the day, assumed to be equivalent to at least 25 percent of the maximum day demand; plus
- **Fire Flow**: Volume of water necessary to supply a fire flow event, where the fire flow event is contingent upon the land use designation; plus
- **Emergency**: Volume of water necessary to provide an emergency supply of 100 percent of the average day demand.

The amount of total system storage required to meet these criteria will change over time as water demands within the Study Area change.

4.4.4 Pipeline Sizing

The following criteria will be used as guidelines for sizing new transmission and distribution pipelines. However, MW's existing system will be evaluated on a case–by-case basis. For example, if an existing pipeline experiences velocities in excess of the criteria described below during a maximum day plus fire flow event, this condition, by itself, does not necessarily indicate a problem as long as the minimum system pressure criterion is satisfied.

Consequently, MW's existing system will be evaluated using pressure as the primary criterion; and secondary criteria, such as velocity, will be used as indicators to locate where water system improvements may be needed.

New transmission and distribution pipelines to serve MW's future planning areas should be located within designated utility corridors wherever possible. These designated utility corridors should be within public rights-of-way to minimize or eliminate the need for utility easements within private property.

4.4.4.1 Water Transmission System

MW transmission pipelines are defined as pipelines 16 inches in diameter or larger. However, for the purpose of this plan the existing transmission network within the Study Area is more represented by pipelines 12 inches in diameter and larger. Transmission pipelines should be designed based on the pressure criteria discussed in Section 4.3.2, and a maximum allowable velocity of 5 ft/s for average day, maximum day, and peak hour demand conditions.

4.4.4.2 Water Distribution System

Distribution pipelines are defined as pipelines less than 16 inches in diameter. However, the existing distribution network within the Study Area is more represented by pipelines less than 12 inches in diameter. Distribution pipelines should be sized based on the pressure criteria discussed in Section 4.3.2, and a maximum allowable velocity of 12 ft/s for average day, maximum day plus fire flow, and peak hour demand conditions.

CHAPTER 5
System Evaluation

This chapter presents the evaluation of MW's existing and future water system within the Study Area, as described in Chapter 2, and its ability to meet the recommended performance and operational criteria, described in Chapter 4, under future water demand conditions. This evaluation is comprised of two main components. First, a facilities capacity evaluation was performed to determine the size of future storage and pumping facilities to support future demands and develop alternatives. Second, a performance evaluation was conducted to evaluate the proposed distribution system's ability to meet recommended operational and design criteria (i.e., required pressures, velocities, or fire flows) under maximum day demand, peak hour demand, and maximum day demand plus fire flow scenarios.

The following sections present the evaluation methodology and results from the water system evaluation:

- Future Water Demands
- Future Water System Facilities Capacity Evaluation
- Summary of Proposed Future Infrastructure
- Future Water System Performance Evaluation

5.1 FUTURE WATER DEMANDS

As discussed in Chapter 3, the future water demand projections were bracketed between high-end and low-end estimates by varying water use and/or land use assumptions. The average of these two estimates was used for the water system facilities capacity evaluation and performance evaluation. Projected future demands were added to the existing baseline demands to develop projected future water demands for two future timeframes: buildout of the UBG (2040) and buildout of the Urban Reserve (2070) areas within the Study Area. Future water demands were spatially located in the hydraulic model based on the future development and land use areas presented in Chapter 3.

Future water demands for buildout of the UGB and Urban Reserve for the Study Area are summarized in Table 5-1 and Table 5-2, respectively.[1] As indicated in Table 5-1, average day demand of the Study Area at buildout of the UGB is expected to be 7.20 mgd, which corresponds to a 120 percent increase from existing conditions. Maximum day demands are estimated based on the 2021 average day to maximum day peaking factor in each pressure zone. Similarly, future peak hour demands are based on the average peak hour demand peaking factor of 2.8 times the maximum day demand.

[1] MW has determined that the portion of Planning Units MD-3d and MD-3e located within the Study Area will be supplied by a new River Zone storage tank located in the vicinity, and not by SE Plan infrastructure. Demands associated with this area (approximately 0.51 mgd) are discussed in Chapter 3 and are not included in this evaluation.

Table 5-1. Projected Future Water System Demands at Buildout of the UGB			
Pressure Zone	Average Day Demand mgd	Maximum Day Demand[(a)] mgd	Peak Hour Demand[(b)] mgd
1	3.42	5.81	16.28
2	1.50	2.99	8.38
3	0.93	1.02	2.86
4	0.75	1.51	4.22
5	0.34	0.64	1.80
6	0.16	0.33	0.92
7	0.10	0.20	0.55
Total	**7.20**	**12.51**	**35.02**

(a) Maximum day demands estimated by multiplying future average day demand for each pressure zone by their corresponding zone average day to maximum day peaking factor. Refer to Chapter 3 for more details.
(b) Peak hour demands estimated by multiplying the maximum day demand by 2.8.

As indicated in Table 5-2, the average day demands at buildout of the Urban Reserve (2070) are expected to be 8.47 mgd, or a 159 percent increase from existing baseline demands. This represents an 18 percent increase from water demands at buildout of the UGB (2040). Most of this additional growth is concentrated within Zones 2, 3, and 4. As discussed in the subsequent sections, additional pumping and storage facilities will be needed from Zones 1 through 4 in order to accommodate this additional growth.

Table 5-2. Projected Future Water System Demands at Buildout of the Urban Reserve			
Pressure Zone	Average Day Demand mgd	Maximum Day Demand[(a)] mgd	Peak Hour Demand[(b)] mgd
1	3.46	5.89	16.49
2	2.00	4.00	11.19
3	1.24	1.37	3.83
4	1.06	2.12	5.94
5	0.38	0.73	2.05
6	0.19	0.38	1.07
7	0.13	0.25	0.70
Total	**8.47**	**14.74**	**41.27**

(a) Maximum day demands estimated by multiplying future average day demand for each pressure zone by their corresponding zone average day to maximum day peaking factor. Refer to Chapter 3 for more details.
(b) Peak hour demands estimated by multiplying the maximum day demand by 2.8.

5.2 FUTURE WATER SYSTEM FACILITIES CAPACITY EVALUATION

Facilities capacity evaluations were performed to size the additional pump and storage facilities needed to be able to support future growth and associated water demands associated with buildout of the UGB (2040) and Urban Reserve (2070).

Per MW's request, facility capacity was also evaluated for a near-term planning horizon (2030) to aid in prioritizing more immediate infrastructure improvements. The facility capacity evaluations for the near-term planning horizon are shown in Appendix H. The required storage and pumping capacity for 2030 was assumed to be the average of the 2020 and 2040 required capacities. Appendix H also separates each pressure zone's storage and pumping capacity evaluation by North and South tributary area. Refer to Appendix H for more details.

Pipe and transmission capacity is evaluated as part of Section 5.4. The following evaluations were conducted:

- Pumping Capacity Evaluation
- Storage Capacity Evaluation

Evaluation findings and recommendations are discussed in the subsequent sections.

5.2.1 Pumping Capacity Evaluation

Pumping capacity was evaluated to assess the ability of MW to deliver reliable firm pumping capacity to the Study Area. At each booster pump station, firm pumping capacity was defined as the total booster pump station capacity with the largest pump out of service. Table 2-6, in Chapter 2, summarizes the total and firm pumping capacity of each pump station in the Study Area. The pumping capacity criterion for MW, described previously in Chapter 4, requires MW's water system to provide sufficient firm pumping capacity to meet demands during normal operating conditions. Normal operating conditions are defined as follows:

- For pump stations that serve a pressure zone with adequate storage – Provide firm pumping capacity equal to maximum day demand, assuming this volume can be pumped within an 18 hour period, for its associated pressure zone and all supported (higher) pressure zones.
- For pump stations that serve a pressure zone with inadequate storage – Provide firm pumping capacity equal to the greater of: (1) peak hour demand; or (2) maximum day demand plus fire flow, assuming this volume can be pumped within an 18 hour period.

Table 5-3 presents the existing firm capacity of each pump station, the combined existing firm capacity for each pressure zone, and compares it to the required demands for the zone for existing conditions, UGB Buildout, and Urban Reserve Buildout. The required pumping capacity for each zone is increased to reflect the pumping requirement within 18 out of 24 hours each day. As shown on Table 5-3, there is an existing pumping capacity deficit only in Zone 2. These findings are consistent with MW's operations staff experience, specifically at the Stanford PS, where staff notes that the pumping facility often times pumps 24 hours of the day.

Table 5-3 also indicates that additional pumping capacity is required to meet the future pumping capacity requirement in any pressure zone in the Study Area at both buildout of: (1) the UGB; and, (2) the Urban Reserve. MW will need to provide a total additional capacity of 25.8 mgd, across all zones in the Study area, prior to buildout of the UGB with the total increasing to 34.7 mgd (or 8.9 mgd more) prior to buildout of the Urban Reserve. It is recommended that new pump stations be sized initially for buildout of the UGB, but that site and layouts of these new pump station reserve space for additional pumps (and other associated improvements) to accommodate additional growth beyond the UGB. For additional detail on the pumping capacity evaluation, refer to Appendix C. Specific recommendations to improve firm pumping capacity are provided in Section 5.3 below.

Table 5-3. Comparison of Available versus Required Pumping Capacity

Pressure Zone	Pump Station	Firm Capacity, mgd[a]	Total Pressure Zone Firm Capacity, mgd	Existing, mgd		At Buildout of the UGB, mgd		At Buildout of the Urban Reserve, mgd	
				Required Pumping Capacity[b,c]	Surplus (Deficit)	Required Pumping Capacity[b,c]	Surplus (Deficit)	Required Pumping Capacity[b,c]	Surplus (Deficit)
1	Lone Pine	3.6	7.86	7.61	0.25	16.67	(8.81)	19.65	(11.79)
	Brookdale	3.25							
	Pierce Heights	1.01							
2	Stanford	2.65	2.65	3.25	(0.60)	8.92	(6.27)	11.80	(9.15)
3	Hillcrest	2.15	2.15	1.84	0.31	4.93	(2.78)	6.47	(4.32)
4	Angelcrest	1.73	1.73	1.39	0.34	3.57	(1.84)	4.65	(2.92)
5	Stardust	0.5	0.5	0.27	0.23	1.56	(1.06)	1.82	(1.32)
6	Undeveloped		0	n/a	n/a	2.60	(2.60)	2.67	(2.67)
7	Undeveloped		0	n/a	n/a	2.42	(2.42)	2.49	(2.49)

(a) Refer to Table 2-3.

(b) Required pumping capacity for zones with gravity storage (Zones 1-5) is equal to the MDD of the Zone plus all supported (higher) Zones. Required pumping capacity for zones without gravity storage (Zones 6 and 7 are planned as hydropneumatic zones) is equal to the MDD of the Zone plus the maximum fire flow for the Zone. The maximum fire flow planned in Zones 6 and 7 is 1,500 gpm (Single Family Residential). It is assumed that this volume is pumped within an 18-hour period.

(c) Refer to Tables 5-1 and 5-2 for projected MDD at buildout of the UGB and Urban Reserve, respectively.

5.2.2 Storage Capacity Evaluation

Water storage in a water distribution system has a pivotal role as it provides operational storage to balance differences in demands and supplies, emergency storage in case of a supply failure, and water to fight fires. MW's available storage reservoirs must be sufficient to meet the operational, emergency, and fire flow storage criteria. As presented in Chapter 4, MW's water storage capacity requirement for each pressure zone is as follows:

- Operational storage equal to 25 percent of a maximum day demand
- Fire flow storage equal to the largest fire flow rate multiplied by its duration
- Emergency storage equal to one average day demand

MW's water storage facilities were evaluated to determine the amount of additional storage capacity that is required to provide the recommended operational, emergency, and fire flow storage to support future demands following the storage criteria established in Chapter 4. Table 5-4 summarizes the results of comparing current storage tanks to the new storage criteria for each pressure zone under current day conditions. As shown on Table 5-4, Zone 2 has a storage deficit of 0.19 MG, and Zone 4 has a storage deficit of 0.13 MG under existing conditions using the new storage criteria.

Table 5-4. Comparison of Available versus Required Storage Capacity under Existing Conditions

Pressure Zone	Storage Facility	Capacity, MG	Total Available Storage	Total Required Storage, MG	Storage Surplus (Deficit)
1	Stanford	1.50	3.50	3.28	0.22
	Barnett	2.00			
2	Hillcrest #2	0.14	1.14	1.33	(0.19)
	Lone Pine #2	1.00			
3	Hillcrest #3	0.10	1.10	0.57	0.54
	Lone Pine #3	1.00			
4	Stardust	0.18	0.68	0.81	(0.13)
	Cherry Lane #4	0.50			
5	Highlands	0.50	0.50	0.34	0.16

Table 5-5 summarizes the results of the storage capacity evaluation by pressure zone at buildout of the UGB. For the purposes of this plan MW will not construct storage in Zones 6 and 7; as such the storage required to serve these zones is included in the Zone 5 storage requirement. The storage capacity evaluation indicates that additional storage is required in all pressure zones to meet storage criteria and adequately support demands anticipated at buildout of the UGB, except Zone 5. A total of 6.0 MG of additional storage is required to adequately serve the Study Area by 2040; the majority (approximately 4.0 MG) of the storage is needed in Zones 1 and 2, which are also the most likely areas for growth in the near-term. For additional detail on the storage capacity evaluation, refer to Appendix D. Specific recommendations to improve storage capacity are provided in Section 5.3 below.

Table 5-6 summarizes the results of the storage capacity evaluation zone by pressure zone at buildout of the Urban Reserve. The storage deficit at buildout of the Urban Reserve grows to a total of 7.8 MG (i.e., 1.8 MG more than the storage deficit at buildout of the UGB). For additional detail on the storage capacity evaluation, refer to Appendix D. Specific recommendations to improve storage capacity are provided in Section 5.3 below.

Fire flow storage is typically held in each pressure zone to limit reliance on pumping during a fire. However, constructing and reserving this volume in zones with low water demands can result in water quality and operational challenges due to the lower exchange rates (even if the reservoir is operated with a reduced volume) and the fact that these facilities are hydraulically distant from the supply source. To address this concern, fire flow requirement (equal to 0.18 MG for Single Family Residential) was omitted from the storage capacity evaluation presented in Tables 5-4 through 5-6 for Zone 5 to reduce the size of reservoirs in this zone. Fire flow volume is still assumed to be provided by emergency storage in these pressure zones but is recovered after a fire by pumping from fire storage sited in lower pressure zones. This also assumes that a fire is only likely to occur in one pressure zone at a time.

MW may consider an alternative storage scheme in the future to further reduce storage in the upper zones, in which emergency storage for the entire Study Area is sited in Zones 1 and 2. This assumes emergency storage can be conveyed by pump stations with reliable on-site backup power. The storage capacity evaluation presented below includes emergency storage in each pressure zone, and the alternative storage capacity evaluation is presented in Appendix D.

Table 5-5. Comparison of Available versus Required Storage Capacity at Buildout of the UGB[a]

Pressure Zone	Storage Facility	Capacity, MG	Total Available Storage	Total Required Storage, MG	Storage Surplus (Deficit)
1	Stanford	1.50	3.50	5.83	(2.33)
	Barnett	2.00			
2	Hillcrest #2	0.14	1.14	2.78	(1.64)
	Lone Pine #2	1.00			
3	Hillcrest #3	0.10	1.10	1.73	(0.63)
	Lone Pine #3	1.00			
4	Stardust	0.18	0.68	1.67	(0.99)
	Cherry Lane #4	0.50			
5	Highlands	0.50	0.50	0.89[b]	(0.39)

(a) Refer to Appendix D for an alternative storage capacity evaluation where emergency storage for all pressure zones is consolidated in Zones 1 and 2.
(b) Total required storage for Zone 5 includes storage required for growth in Zones 6 and 7.

Pressure Zone	Storage Facility	Capacity, MG	Total Available Storage	Total Required Storage, MG	Storage Surplus (Deficit)
1	Stanford	1.50	3.50	5.90	(2.40)
	Barnett	2.00			
2	Hillcrest #2	0.14	1.14	3.54	(2.40)
	Lone Pine #2	1.00			
3	Hillcrest #3	0.10	1.10	2.12	(1.02)
	Lone Pine #3	1.00			
4	Stardust	0.18	0.68	2.13	(1.45)
	Cherry Lane #4	0.50			
5	Highlands	0.50	0.50	1.04[b]	(0.54)

Table 5-6. Comparison of Available versus Required Storage Capacity at Buildout of the Urban Reserve[a]

(a) Refer to Appendix D for an alternative storage capacity evaluation where emergency storage for all pressure zones is consolidated in Zones 1 and 2.

(b) Total required storage for Zone 5 includes storage required for growth in Zones 6 and 7.

It is recommended that new storage reservoirs be sized and sited initially for buildout of the UGB to avoid constructing storage capacity before future demand is realized. It is recommended, however, that future storage sites have space reserved for additional storage reservoirs to provide MW flexibility to provide additional storage as needed, particularly when growth in the Urban Reserve is realized.

5.3 SUMMARY OF PROPOSED PUMP STATION & RESERVOIRS

As discussed in the Section 5.2, pumping and storage improvements are required to adequately support existing and future demands in the Study Area. The storage and pumping capacity deficits estimated in the previous sections identified the total needed by the UGB buildout timeframe or the Urban Reserve buildout timeframe. The configuration and location/siting of required additional facility capacity was further evaluated to improve or simplify service to the Study Area, leverage existing MW property, and to size/locate pumping or storage capacity adjacent to growth to minimize construction of new transmission pipelines. Once the desired configuration was achieved, specific recommendations (i.e., size and location of improvements) were developed. This methodology, along with specific recommendations, is further described in the sections below.

5.3.1 Configuration Alternatives

As growth and development proceeds in the Study Area, due to the topography of the area, the distribution system will extend further to the north and south, thereby creating long and “skinny” pressure zones. This can present operational challenges and require additional transmission infrastructure to minimize bottlenecks and increase the hydraulic connectivity between pump stations and storage reservoirs. To avoid triggering larger transmissions mains and to balance the size and location future pumping and storage facilities, storage and pumping deficits identified in Section 5.2 were subdivided into tributary areas. This framework also forces redundancy in facilities planning, since it inherently avoids fewer larger facilities, and instead results in facilities appropriately sized for the immediate areas they are serving.

Initially, deficits were split into three tributary areas (North, Central, and South) to align with three ridgelines separating the Study Area. This allowed distinct pumping lanes to be established and associated storage reservoirs in each tributary area to be sized to serve the growth in those areas. Then, two initial alternative infrastructure concepts were developed. These concepts were developed based on the distribution of pumping and storage capacity deficits within pressure zones, topography, prior recommendations from the 2017 WDSFP, and discussion with MW. Input from MW included the location of existing MW properties, and operational goals (e.g., discontinuing use of the problematic Hillcrest Reservoirs). The following two concept infrastructure alternatives were developed:

- **Alternative 1 – Pump to Tank.** In this alternative, each tributary within each pressure zone would have sufficient pump station and storage capacity to meet future needs. Storage tanks would be sited at the correct base elevation and adjacent to these tanks would be pump stations that would pump to the next pressure zone.
- **Alternative 2 – Cascade Supply.** In this alternative, high-lift pump stations located in lower pressure zones pumping to larger storage reservoirs in the upper zones via a dedicated transmission main. This approach would utilize pressure reducing stations located along the transmission main to serve the intermediate pressure zones without storage.

After a review of Alternatives 1 and 2 with MW during a workshop, with input from MW engineering and operations teams, it was decided that elements from both alternatives were preferred, thereby creating a hybrid alternative. As a result of the feedback provided by MW, the Study Area was subdivided into two tributary areas, rather than three, approximately divided by Hillcrest Road. Future growth and total water demand for the SE Area, previously presented in Chapter 3, was recalculated between the north and south tributary areas and is included in detail in Appendix A. The following revised infrastructure alternative was developed:

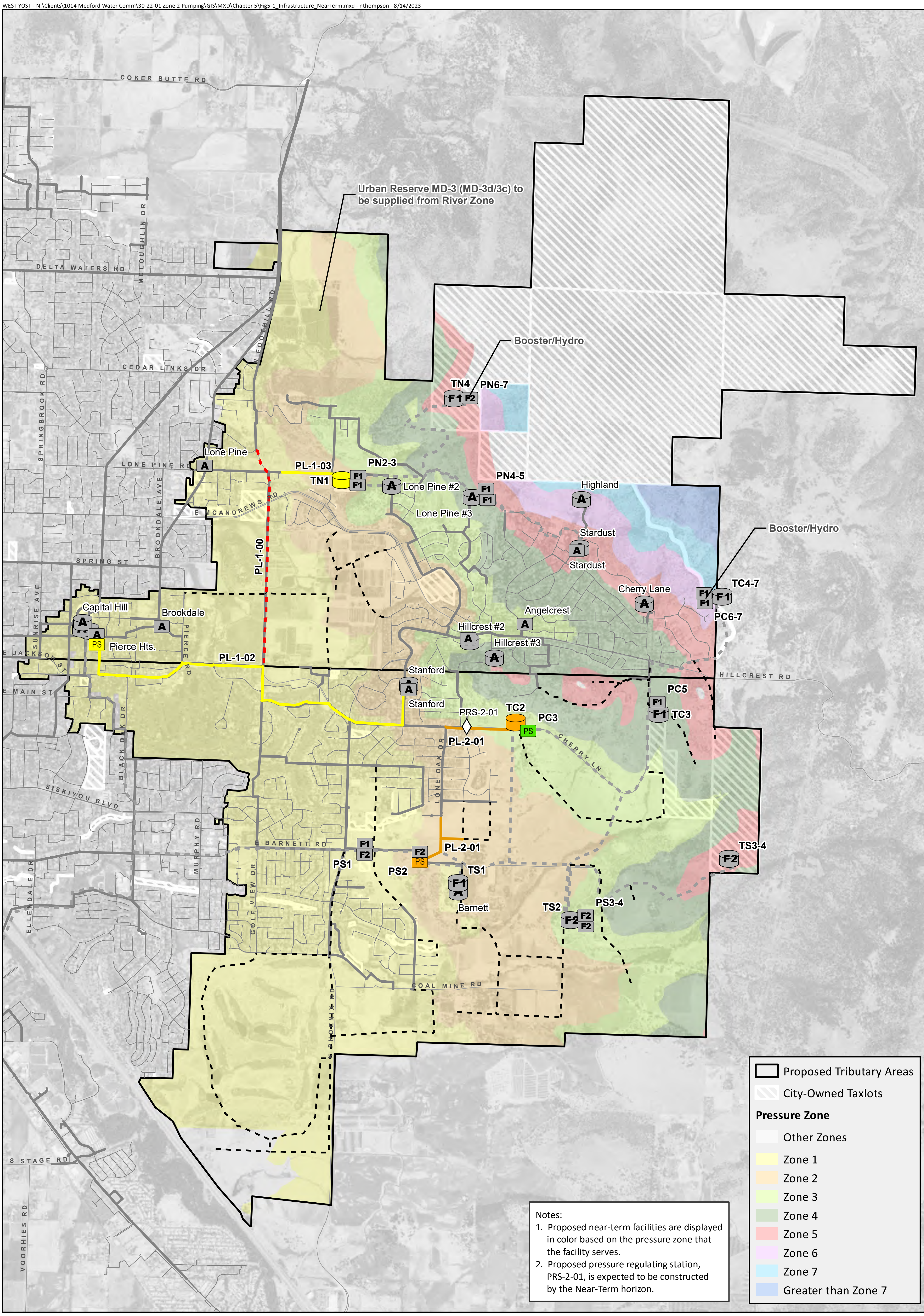
- **Alternative 3 – Hybrid.** In this alternative, infrastructure was developed based on the two tributary areas approach. For areas in the northern tributary, a traditional pump to tank approach was selected for infrastructure sizing and location. The southern tributary would have a mixture of cascade supply and pump to tank configurations, in an effort to consolidate the number of facilities (i.e., dual zone pump stations).

Alternative 3 was finalized in the same workshop and selected as the infrastructure configuration for the Study Area to use in developing specific infrastructure recommendations and subsequent use in the hydraulic model. The following section describes the recommended infrastructure.

5.3.2 Recommended Pump Stations & Reservoirs

Proposed infrastructure for the Near-Term, UGB, and Urban Reserve Buildout is presented in Figure 5-1, 5-2, and 5-3, respectively. A schematic view of the proposed infrastructure is shown in Figure 5-4. These figures show the infrastructure necessary to meet the pumping and storage capacity requirements at each planning horizon. New facilities were given individual IDs with three parts to describe the facility (ID: XY###):

- X designates the facility as either a tank or pump station (T = Tank, P = Pump Station)
- Y designates the approximate location within the study area (N = North, C = Central, S = South)
- ### designates the zone(s) served by the facility (e.g., 2 = Zone 2, 4-7 = Zones 4 through 7, etc.); some facilities such as dual zone pump stations serve multiple zones



A Active/Existing PS
F1 Proposed PS 2040
F2 Proposed PS 2070
A Active/Existing Tank
F1 Proposed Tank 2040
F2 Proposed Tank 2070

Proposed PRV/Flow Control Station

Recommended Transmission Pipelines for Near-Term Horizon (10-Year)
- Zone 1
- Zone 2
- Zone 3
- Zone 4
- Zone 5

On-Going Transmission Pipeline Projects

Assumed Developer In-Tract Pipelines

Existing Pipelines
- < 12" Diameter
- ≥ 12" Diameter

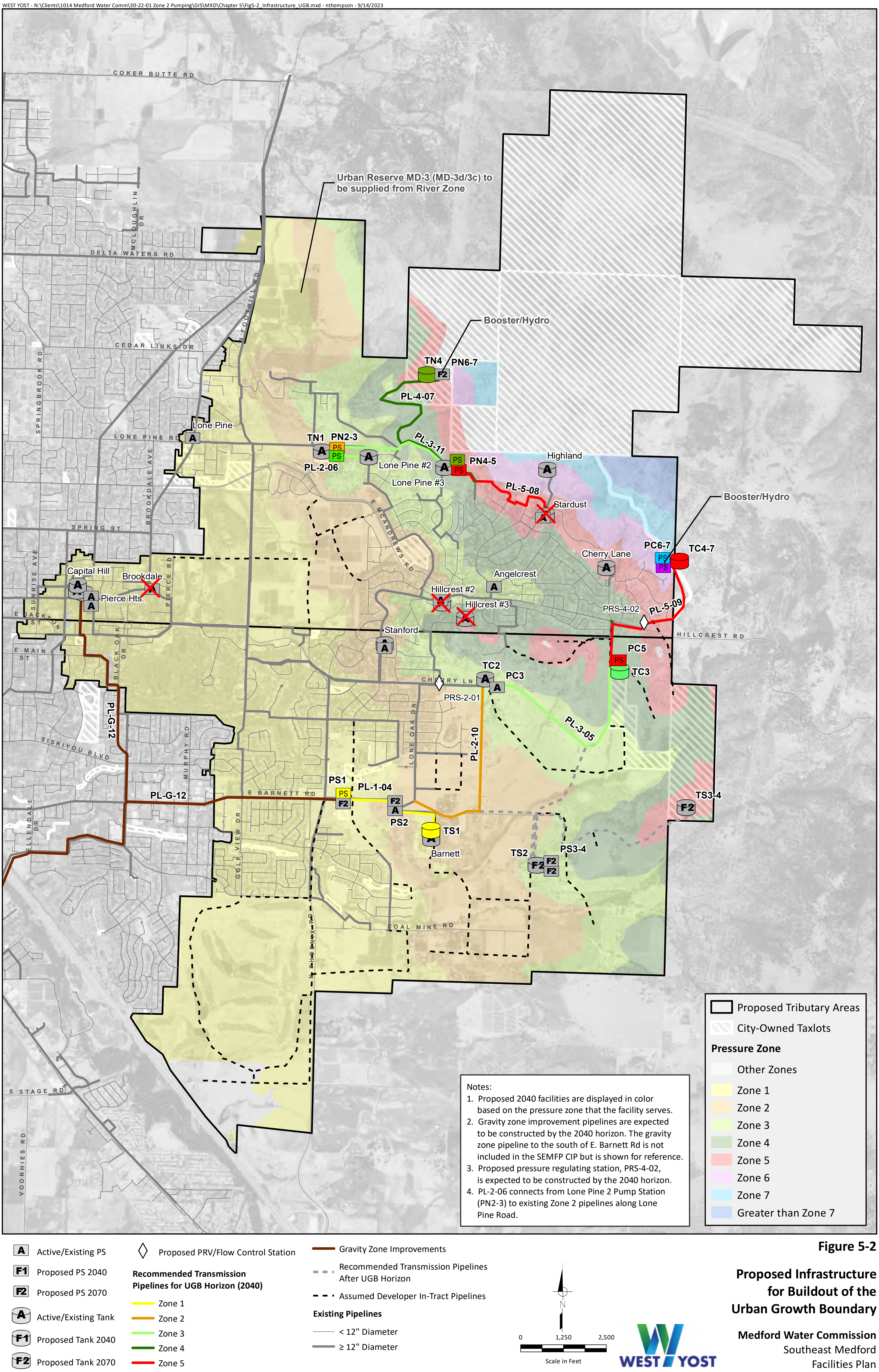
0 1,250 2,500
Scale in Feet

WEST YOST

Figure 5-1

Proposed Infrastructure for Near-Term Horizon (10-Year)

Medford Water Commission
Southeast Medford
Facilities Plan



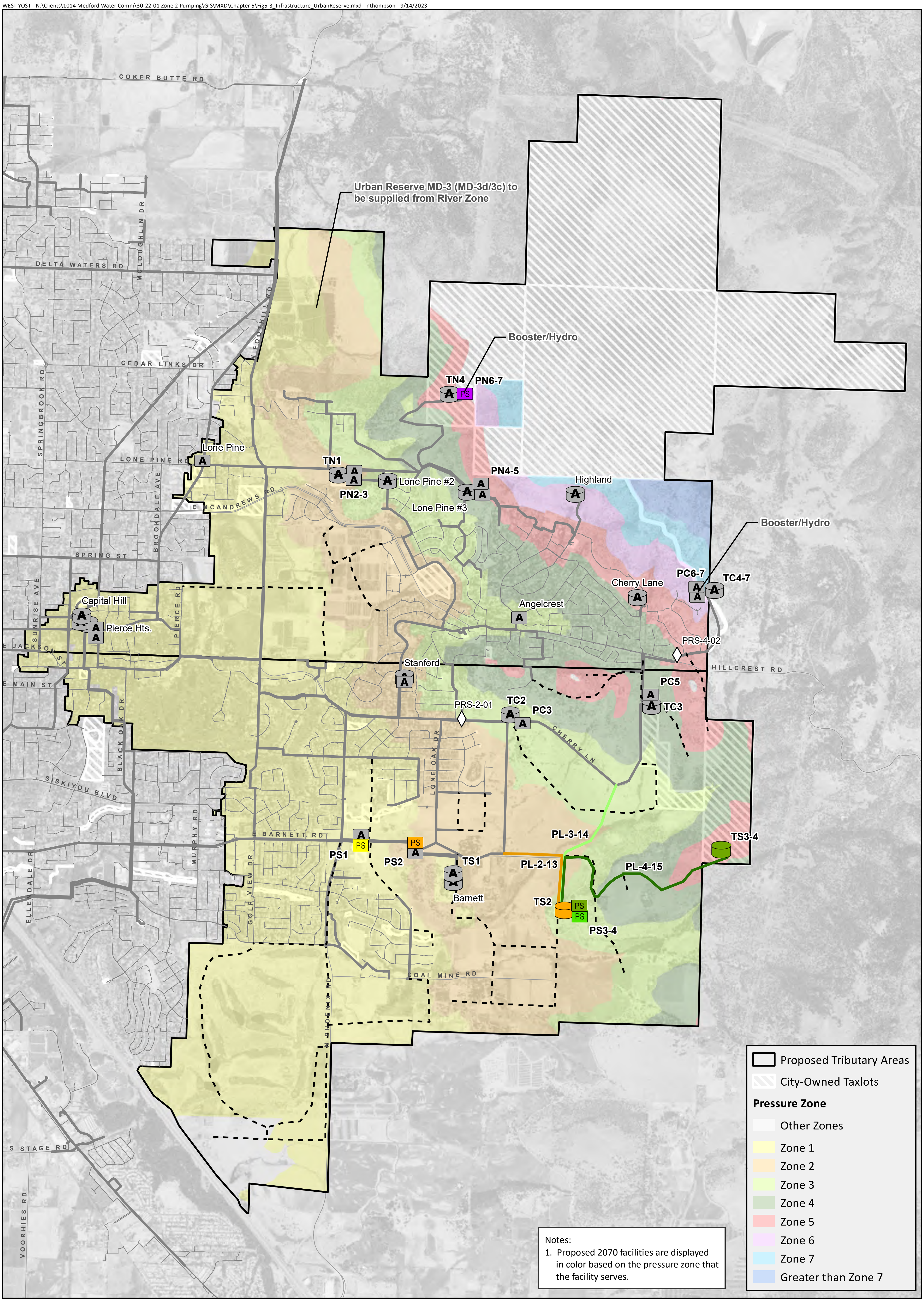
Notes:

1. Proposed 2040 facilities are displayed in color based on the pressure zone that the facility serves.
2. Gravity zone improvement pipelines are expected to be constructed by the 2040 horizon. The gravity zone pipeline to the south of E. Barnett Rd is not included in the SEMFP CIP but is shown for reference.
3. Proposed pressure regulating station, PRS-4-02, is expected to be constructed by the 2040 horizon.
4. PL-2-06 connects from Lone Pine 2 Pump Station (PN2-3) to existing Zone 2 pipelines along Lone Pine Road.

Figure 5-2

Proposed Infrastructure for Buildout of the Urban Growth Boundary

Medford Water Commission
Southeast Medford
Facilities Plan



Proposed Tributary Areas

City-Owned Taxlots

Pressure Zone

- Other Zones
- Zone 1
- Zone 2
- Zone 3
- Zone 4
- Zone 5
- Zone 6
- Zone 7
- Greater than Zone 7

Notes:

1. Proposed 2070 facilities are displayed in color based on the pressure zone that the facility serves.

- A Active/Existing PS
- F1 Proposed PS 2040
- F2 Proposed PS 2070
- A Active/Existing Tank
- F1 Proposed Tank 2040
- F2 Proposed Tank 2070

Proposed PRV/Flow Control Station

Recommended Transmission Pipelines for Urban Reserve Boundary (2070)

- Zone 1
- Zone 2
- Zone 3
- Zone 4
- Zone 5

Assumed Developer In-Tract Pipelines

Existing Pipelines

- < 12" Diameter
- ≥ 12" Diameter

N

0 1,250 2,500
Scale in Feet

WEST YOST

Figure 5-3

Proposed Infrastructure for Buildout of the Urban Reserve Boundary

Medford Water Commission
Southeast Medford Facilities Plan

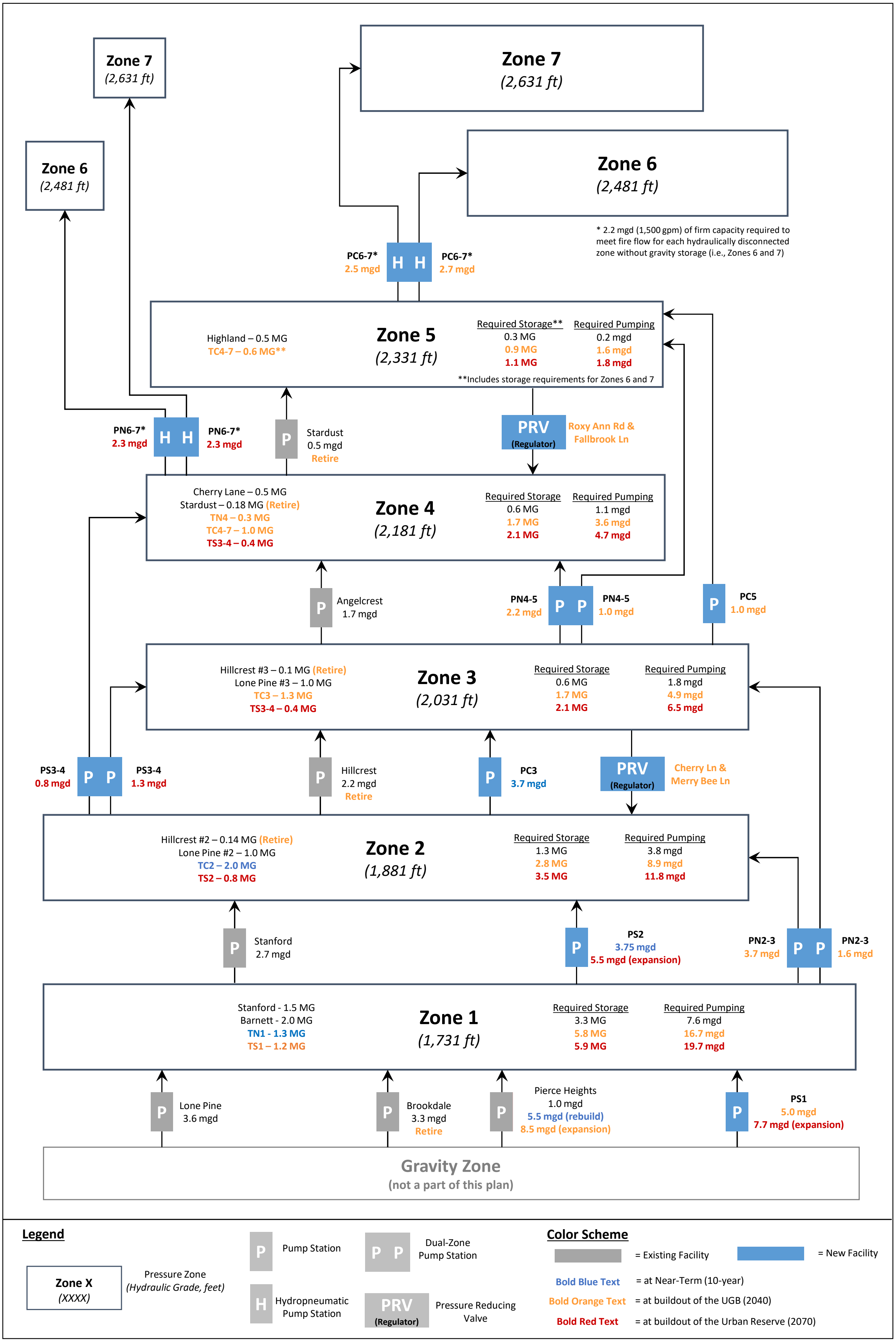


Figure 5-4. Schematic of Recommended Infrastructure

Medford Water

Southeast Medford Facilities Plan

MWs existing system in the SE Area does not have defined pumping lanes as much of the system was constructed to serve individual developments. The proposed layout creates three main pumping lanes by connecting key facilities: (1) from Lone Pine PS east along Lone Pine Road terminating at Highland Reservoir; (2) from Capital Hill Reservoirs, due east along Hillcrest Road and Cherry Lane and terminating at TC4-7; and (3) from a future Gravity Zone Reservoir (identified as TSG in the lower portion of Figure 5-1) east along Barnett and terminating at TS2 at buildout of the UGB and TS3-4 at buildout of the urban reserve.[2] Additional transmission improvements between these main pumping lanes are recommended to improve North-South bottlenecks within zones (e.g., between PC3 and Lone Pine #3) , facilitate balanced storage (i.e., reservoirs in a zone fill and empty together), and provide redundancy and resilience through looping.

These pumping lanes allows MW to retire Hillcrest #2, Hillcrest #3, and Stardust Reservoirs, which are currently undersized to adequately serve existing and future development and have operational challenges. The central pumping lane includes storage at TC2 and TC3 to replace Hillcrest #2 and Hillcrest #3, and TC4-7 is sized to support storage in Zone 4 though a PRV once Stardust is retired.

Governing land uses for fire flow storage requirements are largely in the South tributary area. Because the South area does not have existing storage tanks above Zone 1, fire storage for new development was allocated to new reservoirs in the South, primarily TS1, TC2, and TC3. As development occurs, adequate hydraulic capacity between the North and South should be verified and/or constructed.

Table 5-7 and Table 5-8 summarize the proposed pumping facilities and the proposed storage facilities, respectively. In general, storage and pump station capacity was rounded up to the nearest nominal capacity size, or 0.1 MG and 0.1 mgd, respectively. Furthermore, some UGB facilities were sized to include Urban Reserve demands if the additional capacity required was minimal (i.e., did not justify a separate future improvement).

For additional detail on the required pumping and storage in each tributary area, refer to Appendix C and Appendix D, respectively. A summary of the recommendations for each zone is provided in Appendix H.

To serve development in the Study Area at buildout of the UGB, the following improvements are recommended:

- Construct six new storage reservoirs with a total capacity of 7.7 MG
- Construct five new pump stations with a total firm capacity of 22.0 mgd
- Construct one new hydropneumatic pump station with a total firm capacity of 5.2 mgd (0.8 mgd to serve maximum day demands plus 2.2 mgd (1,500 gpm) of firm capacity to serve fire flows in both Zone 6 and Zone 7)
- Rebuild Pierce Heights PS with a firm capacity of 8.5 mgd (1.0 mgd of existing capacity plus 7.5 mgd of required additional capacity)
- Retire three pump stations with a total firm capacity of 6.0 mgd (at the end of their useful life)

[2] Sizing of infrastructure in the Gravity Zone was not included in the scope of this report.

- Retire three storage reservoirs with a total capacity of 0.42 MG (at the end of their useful life)
- Construct two new PRV/Flow Control Stations

Note that the above improvements also include improvements for the near-term planning horizon. Recommended improvements for the near-term planning horizon are detailed in Appendix H. Recommended near-term improvements were prioritized based on input from MW, existing pumping and storage capacity deficits, and the location of planned near-term growth.

It should also be noted that Zones 4 through 7 have storage and pumping deficits in the near-term based on the assumption that required storage and pumping capacity for 2030 was equal to the average of the 2020 and 2040 required capacities. Based on discussions with MW, construction of storage and pumping improvements for Zones 4 through 7 are assumed to remain as 2040 improvements to prioritize more immediate growth within the lower pressure zones of the Southeast area. MW should consider the timing of development in Zones 4 through 7 and the prioritization of other critical projects to determine the timing of Zones 4 through 7 improvements. Refer to Appendix H for details on the near-term facilities capacity evaluation.

To serve development in the Study Area at buildout of the Urban Reserve, the following improvements are recommended in addition to the improvements listed above:

- Construct two new storage reservoirs with a total capacity of 1.6 MG
- Construct one new dual-zone pump station with a total firm capacity of 2.1 mgd
- Construct one new dual-zone hydropneumatic pump station with a total firm capacity of 4.6 mgd (0.2 mgd to serve maximum day demands plus 2.2 mgd (1,500 gpm) of firm capacity to serve fire flows in both Zone 6 and Zone 7)
- Increase the firm capacity of PS1 and PS2 by a total of 4.45 mgd to meet increased demands

Table 5-7. Proposed Pumping Summary

Facility Name	Facility Type	Discharge Zone	Timing	Firm Capacity, mgd
New/Rebuilt Facilities				
Pierce Heights[a]	Single Zone	1	Near-Term	4.5
		1	UGB	3.0
PS1	Single Zone	1	UGB	5.0
		1	Urban Reserve	2.7
PN2-3	Dual Zone	2	UGB	3.7
		3	UGB	1.6
PS2	Single Zone	2	Near-Term	3.75
		2	Urban Reserve	1.75
PC3	Single Zone	3	Near-Term	3.7
PS3-4	Dual Zone	3	Urban Reserve	1.3
		4	Urban Reserve	0.8
PN4-5	Dual Zone	4	UGB	2.2
		5	UGB	1.0
PC5	Single Zone	5	UGB	1.0
PC6-7	Dual Zone; Hydropneumatic[b]	6	UGB	2.7
		7	UGB	2.5
PN6-7	Dual Zone; Hydropneumatic[b]	6	Urban Reserve	2.3
		7	Urban Reserve	2.3
Retired Facilities				
Brookdale	Single Zone	1	End of useful life	3.3
Hillcrest	Single Zone	3	End of useful life	2.2
Stardust	Single Zone	5	End of useful life	0.5

(a) The firm capacity at Pierce Heights shown is capacity needed in addition to the existing 1.0 mgd of firm capacity. The total firm capacity at Pierce Heights is equal to 5.5 mgd in the near-term and 8.5 mgd by UGB Buildout.

(b) Hydropneumatic pump stations include 1,500 gpm (2.16 mgd) of additional firm capacity for each zone served to meet fire flow.

Table 5-8. Proposed Storage Summary[a]					
Facility Name	Facility Type[a,b]	Zone(s) Served by Gravity	Zone(s) Served by On-Site Pumping	Timing	Capacity, MG
New Facilities					
TN1	Pump to Tank	1	2,3	Near-Term	1.3
TS1	Pump to Tank	1	2	UGB	1.2
TC2	Pump to Tank	2	3	Near-Term	2.0
TC3	Pump to Tank	3	5	UGB	1.3
TN4	Pump to Tank	4	6,7	UGB	0.3
TC4-7	Nested[C]	4,5	6,7	UGB	1.6
TS2	Pump to Tank	2	3,4	Urban Reserve	0.8
TS3-4	Nested[c]	3,4	-	Urban Reserve	0.8
Retired Facilities					
Hillcrest #2	Pump to Tank	2	3	End of useful life	0.14
Hillcrest #3	Pump to Tank	3	-	End of useful life	0.10
Stardust	Pump to Tank	4	5	End of useful life	0.18

(a) For alternative storage sizing, with emergency storage for all zones sited in Zones 1 and 2, refer to Appendix D.
(b) "Pump to Tank" is defined as a storage facility generally intended to serve a single pressure zone by gravity.
(c) "Nested" is defined as a storage facility generally intended to serve multiple pressure zones by gravity, through the use of pressure reducing valves.

5.4 FUTURE WATER SYSTEM PERFORMANCE EVALUATION

The water distribution system performance evaluation identifies necessary distribution system pipeline improvements to support water demands at buildout of the UGB and Urban Reserve while meeting MW's recommended water system planning and design criteria, presented in Chapter 4, as well as operational goals such as maintaining adequate cycling in each tank. The water distribution system is expected to deliver maximum day with peak hour demand flows and maximum day demand plus fire flow under future demand conditions, within the acceptable pressure and velocity ranges as identified in the water system performance and operational criteria.

MW's water system hydraulic model was used to evaluate the water system's performance with the proposed infrastructure alternatives. Proposed storage and pumping facilities noted above were included in the hydraulic model. Transmission pipelines were also added to the hydraulic model, based on known circulation plans or assumed alignments, to: (1) interconnect the new facilities and (2) distribute future demands. Transmission pipelines were sized to meet pressure and velocity criteria as described in Section 4.4.4. To evaluate the future distribution system performance, the following evaluations were conducted:

- **Normal Operations – Maximum Day with Peak Hour.** This evaluation is an extended period simulation (EPS) (seven days) and assesses system pressures and velocities during maximum day and peak hour demand conditions.

- **Emergency Operations – Maximum Day plus Fire Flow.** This evaluation assesses fire flow on the maximum day and confirms that required fire flows can be supplied at all locations while maintaining pressure and velocity criteria.

It should be noted that hydraulic modeling was not performed for the near-term planning horizon improvements.

5.4.1 Normal Operations – Maximum Day Demand with Peak Hour

The normal operations scenario evaluates MW's water distribution system under a maximum day with peak hour demand condition (i.e., non-fire).

5.4.1.1 Evaluation Overview

An EPS was conducted using the hydraulic model to evaluate system performance under a maximum day with peak hour demand conditions for the two development timeframes, under buildout of the UGB and buildout of the Urban Reserve. Diurnal patterns previously presented in Chapter 3 were incorporated into the hydraulic model for both demand conditions and evaluated for seven consecutive days; however, only results from the last three days of the simulation were used, as these results are usually not impacted by initial condition assumptions.

As specified in Chapter 4, during both a maximum day demand scenario and a peak hour demand scenario, pressures must be between a minimum pressure of 40 psi and a maximum pressure of 150 psi at service connections throughout the entire system. Although up to 150 psi is acceptable at service connections, based on the pressure criteria, customer service locations that experience pressure greater than 80 psi must be equipped with an individual pressure reducing valve. In addition, per criteria established in Chapter 4, the maximum velocity should not exceed 5 fps for pipelines greater than 16-inch in diameter. The future system analyses assume the maximum day would be provided by pump stations operating at firm capacity for 18 hours per day, and peak hour demand would be met by a combination of storage reservoirs and pump stations operating at firm capacity.

5.4.1.2 UGB Buildout Results

Hydraulic simulation results for the buildout of the Urban Growth Boundary are shown in figures in Appendix E. Figures are provided that summarize minimum pressure, maximum water velocity in the piping network, and maximum pressure during the maximum day demand simulation.

As summarized in the Figures, with the proposed pipelines all new areas of growth and development meet the minimum and maximum pressure requirements. Some areas in the existing system are below the minimum target pressure of 40 psi but are above 30 psi. These locations are currently developed properties at the highest elevations of the pressure zone. These areas will need to be rezoned over time to meet Medford Water's new pressure criteria. Isolated areas of pressure less than 20 psi are in areas where facilities are identified to be decommissioned and the existing piping to the decommissioned facilities is still simulated as being in service. The 16-inch discharge piping from Lone Pine pump station to the proposed Lone Pine 1 Reservoir exhibits water velocity just over 5.1 ft/sec for short durations of time when the tank fills. Tank hydraulic grade line performance data grouped by pressure zone is shown in Appendix F.

5.4.1.3 Urban Reserve Buildout Results

The results of the system performance evaluation for the Urban Reserve Boundary areas are also shown in Appendix E. Similar to the results for the Urban Growth Boundary above, some areas of the existing system experience minimum pressure that is less than 40 psi. To alleviate this minimum pressure, these areas could be isolated from their existing pressure zone and served by a PRV from the adjacent higher pressure zone. Tank level performance data grouped by pressure zone for the Urban Reserve Boundary Buildout is also included in Appendix F.

5.4.2 Emergency Operations – Maximum Day Demand Plus Fire Flow

The maximum day demand plus fire flow scenario evaluates the fire flow availability in MW's water distribution system under a maximum day demand condition.

5.4.2.1 Evaluation Overview

To evaluate the water system fire flow availability, InfoWater's fire flow module was used to determine the available fire flow at junctions that represent hydrant locations throughout the system, while maintaining a minimum residual system pressure of 20 psi at all customer service locations. The analysis assumed that water storage facility booster pump stations are operating at their firm pumping capacity. Maximum velocity is only considered on pipelines within new developments to confirm sizing of new infrastructure. Pipelines in existing areas are evaluated without a maximum velocity constraint because these pipelines were sized to meet standards at the time of their construction.

As discussed in Chapter 4, the recommended fire flow criteria presented in Table 4-2 are established for future development and do not apply to existing system conditions.

5.4.2.2 UGB Buildout Results

A figure displaying the available fire flow in the MW system for the buildout of the Urban Growth Boundary is included in Appendix E. With a network of 12-inch and 16-inch piping for the future growth areas, the available fire flow throughout the future growth areas is above 2,500 gpm and meets the fire flow criteria summarized in Table 4-2. The majority of residential areas within the existing system extents have available fire flow above 1,500 gpm and many locations in the existing system are above 3,000 gpm. Areas with less available fire flow are areas of smaller diameter piping within the existing system, which will be replaced in the future as part of MW's on-going rehabilitation and replacement efforts.

5.4.2.3 Urban Reserve Buildout Results

Results of the fire flow evaluation for buildout of the Urban Reserve Boundary are also included in Appendix E. Available fire flow results for the buildout of the Urban Reserve Boundary are similar to those described for the buildout of the Urban Growth Boundary, and fire flow requirements are also met for this condition.

5.4.3 Summary of Findings and Recommendations

The storage and pump station improvements sized to meet the future water demands of the Study Area were connected with a piping network and hydraulic modeling was performed to assess the performance of the proposed network. The proposed network of pipelines and facilities met the performance requirements for the MW system and was developed with a strategy to create a looped approach to serve upper zones in the Study Area. This looped approach provides an efficient method for serving the long, narrow pressure zones in the Study Area and creates the opportunity to retire facilities like the undersized Hillcrest Reservoirs.

With the increase of minimum pressure to 40 psi, areas of the existing system that did not meet the 40 psi minimum requirement but maintained pressure above 30 psi were identified. These areas are at the highest elevation areas within a pressure zone and the low pressures can be alleviated with some realignment of pressure zone boundaries. As improvement projects are executed to improve system performance and meet development needs, the system hydraulics should be assessed again to confirm the phasing and operational changes to integrate new facilities into the system.

CHAPTER 6
Findings and Recommendations

This chapter summarizes the recommended improvements discussed in Chapter 5 and provides capital improvement cost estimates associated with the recommended improvements, including both our opinion of probable construction costs and capital costs. In addition, the chapter presents an equivalent residential unit (ERU) analysis to provide MW with cost per ERU, so that MW can subsequently use this to estimate connection fees.

The recommended Capital Improvement Program (CIP) only identifies improvements at a master plan level and does not necessarily include all required on-site infrastructure or provide design of improvements. Subsequent detailed design is required to determine the exact sizes and locations of these proposed improvements. The following sections of this chapter summarize the cost estimating methodology and present the recommended capital improvement program to improve the existing system and support future system demands:

- Cost Estimating Assumptions
- Summary of Recommended CIP
- Analysis of Future Cost per ERU

6.1 COST ESTIMATING ASSUMPTIONS

Cost estimates prepared for this SE Master Plan are in accordance with the guidelines of the Association for the Advancement of Cost Engineering (AACE) International for a Class 5 Estimates. AACE International defines a Class 5 Estimate in the following manner:

> ***Class 5 Estimate:*** *This estimate is prepared based on limited information, where little more than proposed facility type, its location, and the capacity are known. Examples of estimating methods used would include cost/capacity curves and factors, scale up factors, and parametric and modeling techniques. Typically, little time is expended in the development of this estimate. The expected accuracy ranges for this class estimate are – 20 to –50 percent on the low side and +30 to +100 percent on the high side.*

Construction costs are presented in December 2022 dollars based on an Engineering News Record (ENR) Construction Cost Index (CCI) of 15,115 (Seattle, WA). Construction costs were developed based on a combination of data supplied by manufacturers, published industry standard cost data and curves, construction costs for similar facilities built by MW and/or other public agencies, and construction costs previously estimated by West Yost for similar facilities with similar construction cost indexes. Total CIP costs include markups equal to 64 percent of base construction costs, which are listed below:

- Construction Contingency: 20 percent
- Market Factor: 5 percent
- Project Cost Allowances: 30 percent
  - Engineering: 10 percent
  - Construction Management: 10 percent
  - Implementation: 10 percent

Construction cost estimates do not include costs for annual operations and maintenance (O&M) or property acquisition. A complete description of the assumptions used in developing the estimates of probable construction cost is provided in Appendix G.

6.2 SUMMARY OF RECOMMENDED CAPITAL IMPROVEMENTS PLAN

This section presents a summary of the recommended improvements needed to meet MW's water system performance criteria under future water demand conditions. Recommended improvements for the Near-Term, UGB, and Urban Reserve Buildout are presented in Figure 6-1, 6-2, and 6-3, respectively. Table 6-1 summarizes the estimated capital costs for each recommended improvement.

MW staff and the West Yost team held several meetings and workshops to optimize the proposed infrastructure to balance meeting the hydraulic needs of the water system, meeting emergency operations criteria, and keeping costs down. Recommended near-term improvements were prioritized based on input from MW, existing pumping and storage capacity deficits (refer to Chapter 5), and the location of planned near-term growth.

As shown in Table 6-1, the total estimated capital cost to implement recommended projects is approximately $119.5M. The total near-term (10-year) capital cost is approximately $37M, and an additional $61.4M and $21M in improvements is required to adequately serve growth at buildout of the UGB and Urban Reserve, respectively. Only transmission pipelines have been identified in this Study and additional in-tract pipelines will be required. In-tract pipelines, however, should be constructed and paid for by project proponents and are not included in Table 6-1.

As discussed in Chapter 5 and Appendix H, construction of infrastructure for Zones 4 through 7 are assumed to remain as UGB Buildout projects to prioritize more immediate growth within the lower pressure zones of the Southeast area. However, the timing of development in Zones 4 through 7 may accelerate the need for these improvements before 2040 and lead to greater CIP costs in the near-term.

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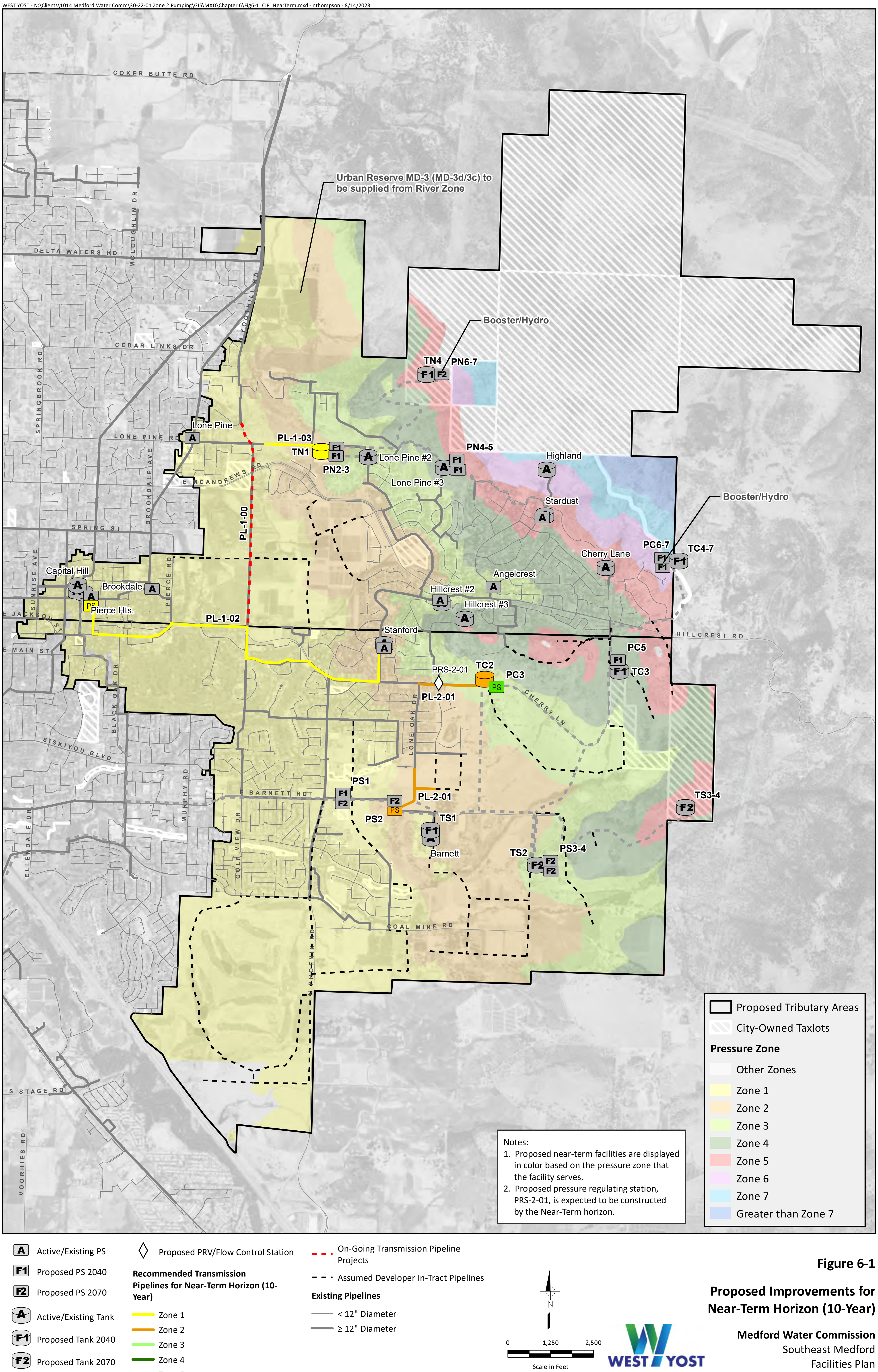

Figure 6-1

Proposed Improvements for Near-Term Horizon (10-Year)

Medford Water Commission
Southeast Medford
Facilities Plan

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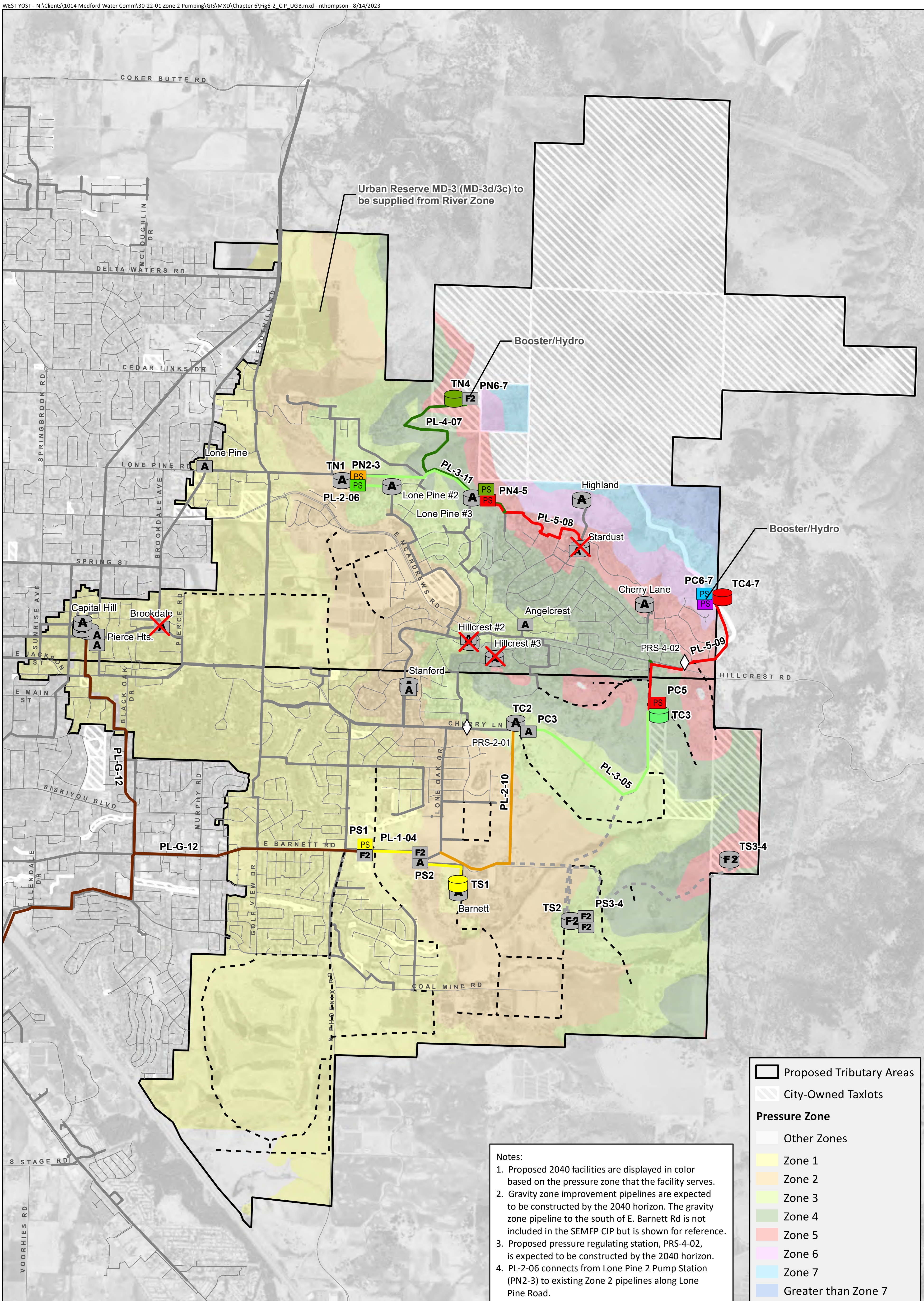


A Active/Existing PS
F1 Proposed PS 2040
F2 Proposed PS 2070
A Active/Existing Tank
F1 Proposed Tank 2040
F2 Proposed Tank 2070

Proposed PRV/Flow Control Station

Recommended Transmission Pipelines for UGB Horizon (2040)

- Zone 1
- Zone 2
- Zone 3
- Zone 4
- Zone 5

Gravity Zone Improvements

Recommended Transmission Pipelines After UGB Horizon

Assumed Developer In-Tract Pipelines

Existing Pipelines

- < 12" Diameter
- ≥ 12" Diameter

N

0 1,250 2,500

Scale in Feet

WEST YOST

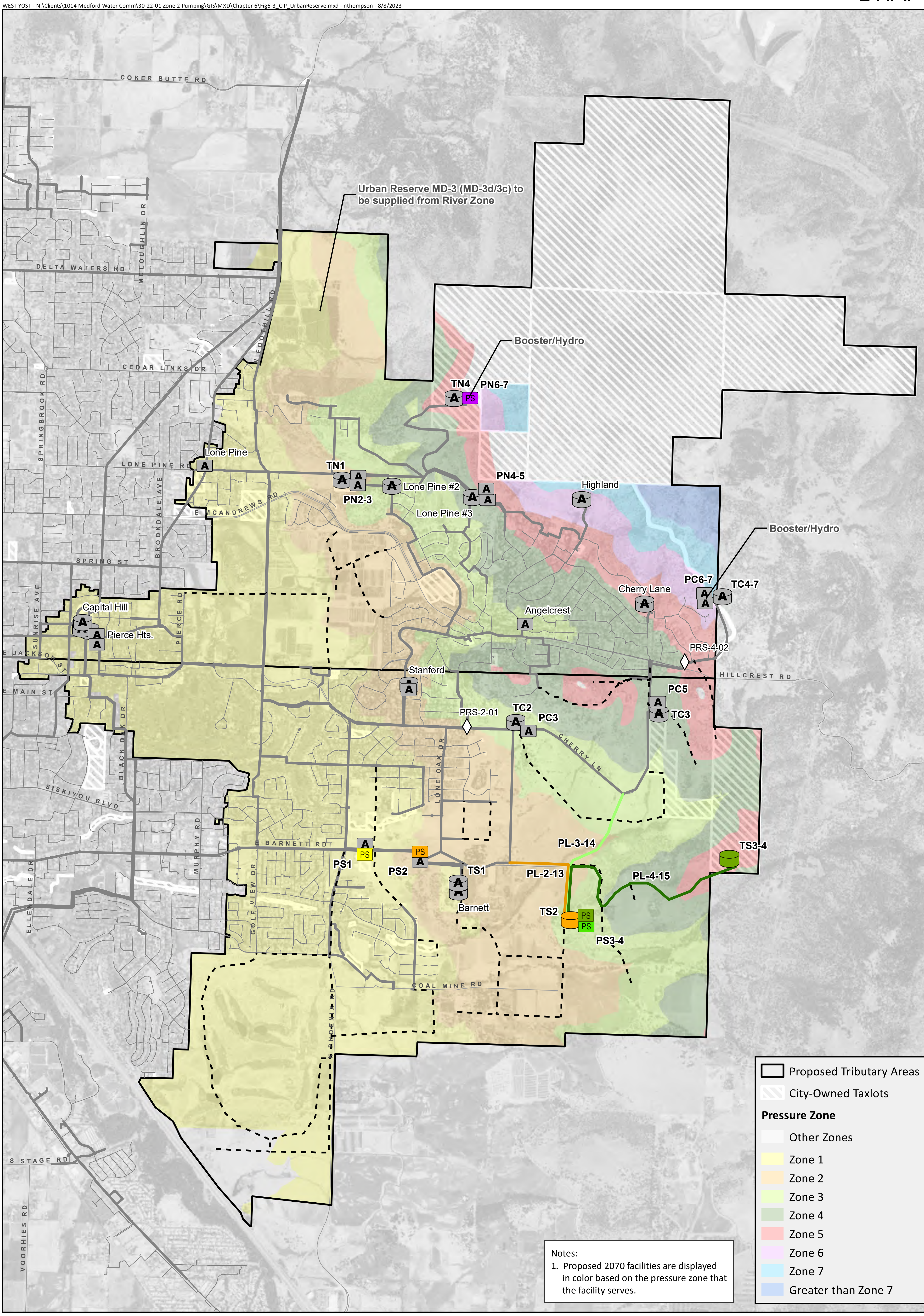
Figure 6-2

Proposed Improvements for Buildout of the Urban Growth Boundary

Medford Water Commission
Southeast Medford
Facilities Plan

DRAFT

WEST YOST - N:\Clients\1014 Medford Water Comm\30-22-01 Zone 2 Pumping\GIS\MXD\Chapter 6\Fig6-3_CIP_UrbanReserve.mxd - nthompson - 8/8/2023



A Active/Existing PS
F1 Proposed PS 2040
F2 Proposed PS 2070
A Active/Existing Tank
F1 Proposed Tank 2040
F2 Proposed Tank 2070

Proposed PRV/Flow Control Station

Recommended Transmission Pipelines for Urban Reserve Boundary (2070)

- Zone 1
- Zone 2
- Zone 3
- Zone 4
- Zone 5

Assumed Developer In-Tract Pipelines

Existing Pipelines

- < 12" Diameter
- ≥ 12" Diameter

N

0 1,250 2,500
Scale in Feet

WEST YOST

Figure 6-3

Proposed Improvements for Buildout of the Urban Reserve Boundary

Medford Water Commission
Southeast Medford
Facilities Plan

Table 6-1. Summary of Recommended Capital Improvements for the SE Medford Area[a]					
Project ID	Improvement Type	Improvement Description	Quantity and Unit	Construction Cost[b]	Capital Cost[c]
Near-Term (10-Year)					
TC2	Storage Reservoir	New Zone 2 storage tank along Cherry Ln. This tank would replace Hillcrest #2 and supplement Lone Pine #2 by providing more local storage in the South.	2 MG	$ 5,670,000	$ 7,371,000
TN1	Storage Reservoir	New Zone 1 storage tank along Lone Pine Rd to serve local growth in the North. Site would include space for a new pump station PN2-3.	1.3 MG	$ 4,700,000	$ 6,110,000
PS2	Booster Pump Station	New Zone 2 pump station along Barnett Rd. This PS should be constructed with space for additional firm capacity as growth occurs (see EXP-2070-02)	3.75 mgd	$ 2,583,000	$ 3,358,000
Pierce Heights	Booster Pump Station	Rebuild Pierce Heights PS with a total firm capacity of 5.5 mgd (4.5 mgd new plus 1.0 mgd existing).	5.5 mgd	$ 3,024,000	$ 3,932,000
PC3	Booster Pump Station	New Zone 3 pump station at proposed TC2 site. This PS is intended to replace Hillcrest PS and improve reservoir operations in the zone.	3.7 mgd	$ 2,571,000	$ 3,343,000
PL-1-00	Pipeline	New 12-inch and 24-inch Zone 1 pipelines in Foothill Rd from Eucalyptus Dr to Hillcrest Rd. This project is currently in progress.	6,200 LF	$ 2,501,000	$ 3,252,000
PL-2-01	Pipeline	New 24-inch and 16-inch Zone 2 pipeline to connect PS2 to existing Zone 2 pipelines in Lone Oak Dr, and a new 16-inch Zone 2 pipeline in Cherry Ln to increase transmission capacity between PS2 and TC2.	4,150 LF	$ 1,291,000	$ 1,679,000
PL-1-02	Pipeline	New 24-inch, 16-inch, and 12-inch Zone 1 pipelines to improve transmission capacity from Pierce Heights PS to Stanford Reservoir. Pipeline alignment from west to east is generally along Hillcrest Rd., S. Foothill Rd., Caperna Dr., Old Cherry Ln., and Stanford Ave.	12,050 LF	$ 5,176,000	$ 6,729,000
PL-1-03	Pipeline	New 16-inch Zone 1 pipeline in Lone Pine Rd to supply TN1 via Lone Pine PS.	1,850 LF	$ 635,000	$ 826,000
PRS-2-01	Pressure Reducing Station	New PRV On Cherry Ln to supply Zone 2 from Zone 3 during emergency conditions, e.g., fire flow.	1 EA	$ 315,000	$ 410,000
			Near-Term (10-year) Improvements Subtotal	**$ 28,466,000**	**$ 37,010,000**
Urban Growth Boundary Buildout (2040)					
TS1	Storage Reservoir	New Zone 1 storage tank sited at Barnett Reservoir to serve local growth in the South.	1.2 MG	$ 4,562,000	$ 5,931,000
TC3	Storage Reservoir	New Zone 3 storage tank along Cherry Ln. This tank would replace Hillcrest #3 and supplement Lone Pine #3 by providing more local storage in the South.	1.3 MG	$ 4,700,000	$ 6,110,000
TN4	Storage Reservoir	New Zone 4 storage tank sited North of planning unit MD-3e. This tank would provide some local storage to Zone 4 growth, and provide suction for a future hydropneumatic pump station if MD-3e is developed in Zones 6 and 7 (see PN6-7).	0.3 MG	$ 3,314,000	$ 4,309,000
TC4-7	Storage Reservoir	New storage tank along Roxy Ann Rd. This tank would serve Zones 4 and 5 by gravity and Zones 6 and 7 via an on-site dual-zone hydropneumatic pump station (see PC6-7).	1.6 MG	$ 5,116,000	$ 6,651,000
PS1	Booster Pump Station	New Zone 1 south pump station. This PS should be constructed with space for additional firm capacity as growth occurs (see EXP-2070-01).	5 mgd	$ 2,898,000	$ 3,768,000
PC5	Booster Pump Station	New Zone 5 pump station at proposed TC3 site. This PS would "skip" Zone 4 to fill Tank TC4-7 via a dedicated transmission pipeline (see PL-5-09).	1.0 mgd	$ 1,638,000	$ 2,130,000
PN2-3	Dual-Zone Pump Station[d]	New dual-zone pump station at proposed TN1 site to serve Zones 2 and 3. This PS is part of the northern pumping lane.	5.3 mgd	$ 2,974,000	$ 3,867,000
PN4-5	Dual-Zone Pump Station[d]	New dual zone pump station at Lone Pine #3 to serve Zones 4 and 5. This PS is part of the northern pumping lane.	3.2 mgd	$ 2,445,000	$ 3,179,000
PC6-7	Dual-Zone Pump Station[d]	New dual-zone hydropneumatic pump station at proposed TC4-7 to serve growth in Zones 6 and 7. This PS includes 1,500 gpm of firm capacity for both zones to provide fire flows.	5.2 mgd	$ 1,638,000	$ 2,130,000
EXP-2040-PH	Pump Station Expansion	Additional firm capacity at Pierce Heights pump station for a total of 8.5 mgd.	3.0 mgd	$ 630,000	$ 819,000
PL-1-04	Pipeline	New 24-inch Zone 1 pipeline in Barnett Rd to supply Barnett Reservoir 1 and 2 and provide suction to PS2.	3,650 LF	$ 1,224,000	$ 1,592,000

Table 6-1. Summary of Recommended Capital Improvements for the SE Medford Area[a]								
Project ID	Improvement Type	Improvement Description	Quantity and Unit		Construction Cost[b]		Capital Cost[c]	
PL-3-05	Pipeline	New 16-inch Zone 3 pipelines in Cherry Ln to supply TC3 via PC3.	6,400	LF	$	2,190,000	$	2,847,000
PL-2-06	Pipeline	New 16-inch Zone 2 pipeline from PN2-3 to connect to existing Zone 2 pipelines.	350	LF	$	120,000	$	156,000
PL-4-07	Pipeline	New 12-inch Zone 4 pipeline to supply TN4 via PN4-5. Pipeline alignment is generally along undeveloped access roads.	7,450	LF	$	1,471,000	$	1,913,000
PL-5-08	Pipeline	New 12-inch Zone 5 pipeline to supply Highland via PN4-5 and improve Zone 5 transmission capacity. Pipeline alignment is generally along Devonshire Pl. and Pinnacle Dr.	4,150	LF	$	998,000	$	1,298,000
PL-5-09	Pipeline	New 12-inch Zone 5 pipelines to supply TC4-7 via PC5 and provide redundant supply connection into Zone 4 via PRS-4-02. Pipeline alignment is generally along Cherry Ln., Hillcrest Rd., and Roxy Ann Rd.	4,950	LF	$	1,131,000	$	1,471,000
PL-2-10	Pipeline	New 16-inch Zone 2 pipeline to supply TC2 via PS2 from Barnett Reservoir. Pipeline alignment is south to north in an undeveloped area between E. Barnett Rd. and Cherry Ln.	5,950	LF	$	1,560,000	$	2,028,000
PL-3-11	Pipeline	New 12-inch Zone 3 pipeline to supply Lone Pine #3 Reservoir from Lone Pine #2 Reservoir via PN2-3. Pipeline alignment is generally east to west along undeveloped land.	5,450	LF	$	1,072,000	$	1,394,000
PL-G-12	Pipeline	New 36-inch and 24-inch Gravity Zone pipeline from Capital Hill Reservoirs to supply the proposed Zone 1 South Pump Station (PS1) and provide transmission capacity for the Gravity Zone. This pipeline is needed to avoid low pressures to customers in the Gravity Zone when operating PS1.	13,700	LF	$	7,235,000	$	9,406,000
PRS-4-02	Pressure Reducing Station	New PRV located along transmission pipeline PL-5-09 to serve Zone 4. This station provides redundancy to the portion of Zone 4 south of the ridgeline.	1	EA	$	315,000	$	410,000
				Buildout of the UGB (2040) Improvements Subtotal	**$**	**47,231,000**	**$**	**61,409,000**
Buildout of the Urban Reserve (2070)								
TS2	Storage Reservoir	New Zone 2 storage tank. This tank would serve future growth outside the UGB in the South.	0.8	MG	$	4,007,000	$	5,210,000
TS3-4	Storage Reservoir	New storage tank. This tank would serve future growth outside the UGB in Zones 3 and 4 by gravity.	0.8	MG	$	4,007,000	$	5,210,000
EXP-2070-01	Pump Station Expansion	Additional firm capacity at PS1 to serve future growth outside the UGB in upstream pressure zones for a total of 7.7 mgd.	2.7	mgd	$	630,000	$	819,000
EXP-2070-02	Pump Station Expansion	Additional firm capacity at PS2 to serve future growth outside the UGB in Zones 2 and above for a total of 5.5 mgd.	1.75	mgd	$	630,000	$	819,000
PS3-4	Dual-Zone Pump Station[d]	New dual-zone pump station at proposed TS2 site. This PS is part of the southern pumping lane.	2.1	mgd	$	2,168,000	$	2,819,000
PN6-7	Dual-Zone Pump Station[d]	New dual-zone hydropneumatic pump station at proposed TN4 to serve growth in Zones 6 and 7. This PS includes 1,500 gpm of firm capacity for both zones to provide fire flows.	4.6	mgd	$	1,638,000	$	2,130,000
PL-2-13	Pipeline	New 16-inch Zone 2 pipeline to supply TS2 via PS2. Pipeline alignment is generally along E. Barnett Rd.	3,150	LF	$	833,000	$	1,083,000
PL-3-14	Pipeline	New 12-inch Zone 3 pipeline to supply TC3 via PS3-4 and connect growth in the south to storage at TC3. Pipeline alignment is generally south to north along undeveloped land between E. Barnett Rd. and Cherry Ln.	4,100	LF	$	806,000	$	1,048,000
PL-4-15	Pipeline	New 12-inch Zone 4 pipeline to supply TS3-4 via PS3-4. Pipeline alignment is generally along E. Barnett Rd. and undeveloped land.	7,550	LF	$	1,485,000	$	1,931,000
				Buildout of the Urban Reserve (2070) Improvements Subtotal	**$**	**16,204,000**	**$**	**21,069,000**
				Total Capital Improvements Plan	**$**	**91,901,000**	**$**	**119,488,000**

(a) Costs are rounded to the nearest thousand dollars. Improvements in this table are considered 'backbone' improvements. Smaller, in-tract, improvements are not included and are assumed to be constructed by future development proponents.
(b) Construction cost is equal to the base construction cost with a 20 percent contingency and a 5 percent market factor (total 25 percent markup). Refer to Appendix E for details.
(c) Capital cost is equal to the construction cost with a 30 percent markup for engineering, construction management, and program implementation. Refer to Appendix E for details.
(d) Dual-zone pump station costs are based on the combined firm capacity of the pump station, regardless of assocaited pressure zone. For firm capacity details of these pump stations by pressure zone, refer to Table 5-8.
(e) Facility sizing does not consider serving TAP partners from Zone 1. This would increase pumping capacity needs and discharge pipeline diameters, and would need to be evaluated.

6.3 ERU ANALYSIS

An ERU analysis was prepared to quantify how many equivalent residential units are being planned and so that a cost per ERU can be estimated to cover the cost for improvements recommended in each pressure zone. ERUs are a standardized unit of measure used by water utilities to equate non-residential or multi-family residential properties to a specific number of single-family residences. One ERU is equal to the average water demand of one single family residential (SFR) customer, or dwelling unit. ERU factors are presented in Table 6-3 for the City's Comprehensive Plan land use classifications used in this Study. The ERU factors presented in Table 6-3 are intended to assist MW when assessing a project, to determine how many ERUs are being proposed and therefore determine the appropriate proportionate costs for different developments.

6.3.1 Unit ERU Factors

The first step with developing ERUs is to identify Unit ERU Factors for each land use type. The Unit ERU factors are used to convert the number of residential dwelling units and/or commercial and industrial acreage into a quantity of ERUs. As shown in Table 6-2, residential water use factors are established in gpd per dwelling unit. For the different residential land uses, the unit ERU factor is calculated by dividing the unit water use factor by the urban residential SFR water use factor (established as 356 gpd per SFR dwelling unit) to get the Unit ERU factor, expressed in ERUs per dwelling unit. Similarly, for non-residential land uses, the non-residential water use factor is divided by the urban residential SFR water use factor to get the unit ERU factor, expressed in ERUs per acre.

As discussed in Chapter 3, low-end and high-end demand projections were prepared to establish a future demand range. As discussed in Chapter 5, the average of the two projections was used for the purposes of facilities sizing and the hydraulic performance evaluation. Accordingly, it is recommended that average ERU factors, which are the average of the low and high projections, be used to establish ERUs. For example, based on the average values presented in Table 6-3, a development of 100 Urban High Density Residential dwelling units would be approximately equivalent to the water demand of 62 SFR homes, or 62 ERUs. Commercial and industrial water use can vary more than residential water use, so it is recommended to estimate individual commercial and industrial development water demands when possible.

Using the average ERU water use of 376 gpd/ERU, the number of ERUs can be expressed as a demand. An example is shown below for how to convert a new development into ERUs, and then into an estimated water demand.

Table 6-2. Equivalent Residential Unit Example				
	Units	Dwelling Units/Acres	Unit ERU Factor	ERUs
Single Family Residential	Dwelling Units	100	1.00	100
Multi-Family Residential	Dwelling Units	300	0.62	300 x 0.62 = 186
Commercial	Acres	4	0.57	4 x 0.57 = 2
			Total ERUs	**288**
			Water Use Per ERU	**376**
			Total Demand, gpd	**108,288**

6.3.2 ERU Capacity Evaluation

ERUs are also helpful for comparing the capacity of infrastructure to existing and future customers. The capacity of each pump station, reservoir, and transmission pipeline can be expressed in numbers of ERUs and compared to the number of required ERUs as growth occurs. New developments can be quickly checked if their plans come close to or exceed the ERU capacity of facility or pressure zone, thereby triggering the need for new infrastructure.

Appendix H shows the number of ERUs required for each planning period as well as the number of ERUs provided by pump stations, reservoirs, and pipelines.

6.3.3 ERUs for System Development Charges

Table 6-4 shows the estimated connection cost per ERU for near-term (10-year) and buildout of the UGB (2040) future development. Connection costs were estimated using the additional water demand by 2040 at average day demand and the ERU factors shown in Table 6-3. The average connection cost was found to be $10,540 per ERU.

Table 6-5 shows the estimated connection cost per ERU for future development for buildout of the Urban Reserve (2070). Similarly, connection costs were estimated using the additional water demand by 2070 at average day demand and the ERU factors shown in Table 6-3. The average connection cost to fund development through buildout of the Urban Reserve is $8,810 per ERU which indicates a decrease in connection costs when the full CIP timeframe is considered. The cost per ERU decreases for buildout of the Urban Reserve since costs are divided among a larger number of customers.

It is recommended that MW consider assessing the higher connection cost (i.e., the higher cost per ERU through 2040 instead of the lower cost per ERU through 2070), so sufficient funding can be provided to construct facilities through 2040. As mentioned in Section 6.2, the timing of development in Zones 4 through 7 may accelerate the need for these improvements before 2040 and lead to greater CIP costs in the near-term.

The connection costs presented in Table 6-4 and Table 6-5 assume that all capital improvements listed in Table 6-1 are financed fully through future development and not through existing customers, which is appropriate because these improvements are required to meet future growth.

Table 6-3. Equivalent Residential Unit Factors

Land Use	Unit Water Use Factor	Unit Water Use Factor Units	Unit ERU Factor[a,b,c]	Unit ERU Factor Units
Low-End Projection				
Urban Residential	356	gpd/du	1.00	ERU/dwelling unit
Urban Medium Density Residential	219	gpd/du	0.62	ERU/dwelling unit
Urban High Density Residential	219	gpd/du	0.62	ERU/dwelling unit
Service Commercial	45	gpd/acre	0.13	ERU/acre
Commercial	45	gpd/acre	0.13	ERU/acre
General Industrial	45	gpd/acre	0.13	ERU/acre
High-End Projection				
Urban Residential	395	gpd/du	1.00	ERU/dwelling unit
Urban Medium Density Residential	243	gpd/du	0.62	ERU/dwelling unit
Urban High Density Residential	243	gpd/du	0.62	ERU/dwelling unit
Service Commercial	400	gpd/acre	1.01	ERU/acre
Commercial	400	gpd/acre	1.01	ERU/acre
General Industrial	400	gpd/acre	1.01	ERU/acre
Average[d]				
Urban Residential	-	-	**1.00**	ERU/dwelling unit
Urban Medium Density Residential	-	-	**0.62**	ERU/dwelling unit
Urban High Density Residential	-	-	**0.62**	ERU/dwelling unit
Service Commercial	-	-	**0.57**	ERU/acre
Commercial	-	-	**0.57**	ERU/acre
General Industrial	-	-	**0.57**	ERU/acre

(a) One ERU represents the average water use by one single family residential home, or one Urban Residential dwelling unit.
(b) Residential water use factors are given in gpd/du. The unit ERU factor is calculated by dividing the respective water use factor (in gpd/du) by the Urban Residential water use factor (in gpd/ERU).
(c) Non-residential water use factors are given in gpd/acre. The unit ERU factor is calculated by dividing the respective water use factor (in gpd/acre) by the Urban Residential water use factor (in gpd/ERU).
(d) Average Unit ERU Factor is calculated by taking the average of the Low-End Projection and the High-End Projection.
ERU = equivalent residential unit; gpd= gallons per day
du= dwelling unit

Table 6-4. Estimated Connection Costs per Equivalent Residential Unit for Recommended Capital Improvements at UGB Buildout

Pressure Zone	Additional Demand at UGB Buildout, mgd	Equivalent Number of New ERUs at UGB Buildout
Low-End Projection[a]		
1	1.21	3,400
2	0.83	2,335
3	0.46	1,281
4	0.24	681
5	0.17	467
6	0.12	336
7	0.07	201
Total Low-End Projection	**3.09**	**8,700**
High-End Projection[b]		
1	1.49	3,775
2	0.93	2,344
3	0.68	1,717
4	0.36	909
5	0.25	623
6	0.18	448
7	0.11	269
Total High-End Projection	**3.98**	**10,085**
Near-Term (10-year) and UGB Buildout (2040) CIP Capital Cost[c]		$98,419,000
Low-End Projection Connection Cost per ERU ($/ERU)		**$11,320**
High-End Projection Connection Cost per ERU ($/ERU)		**$9,760**
Average Connection Cost per ERU[d,e] ($/ERU)		***$10,540***

(a) Low-End Projection uses a Single Family Residential water use factor of 356 gpd/DU per Table 3-11.
(b) High-End Projection uses a Single Family Residential water use factor of 395 gpd/DU per Table 3-11.
(c) See Table 6-1. Summary of Recommended Capital Improvements for the SE Medford Area for further detail.
(d) Connection costs in this table assume that all Capital Improvements listed in Table 6-1 are financed through future development and not existing customers.
(e) Average Connection Cost per ERU is calculated by taking the average of the Low-End Projection Connection Cost per ERU and High-End Projection Connection Cost per ERU.

ERU = equivalent residential unit
mgd =million gallons per day
UGB = Urban Growth Boundary.

Table 6-5. Estimated Connection Costs per Equivalent Residential Unit for Recommended Capital Improvements at Buildout of the Urban Reserve

Pressure Zone	Additional Demand at Buildout of the Urban Reserve, mgd	Equivalent Number of New ERUs at Buildout of the Urban Reserve
Low-End Projection[(a)]		
1	1.44	4,058
2	1.43	4,036
3	0.73	2,042
4	0.47	1,327
5	0.20	561
6	0.14	390
7	0.09	256
Total Low-End Projection	**4.50**	**12,669**
High-End Projection[(b)]		
1	1.76	4,446
2	1.60	4,057
3	1.08	2,735
4	0.70	1,772
5	0.30	747
6	0.21	520
7	0.13	341
Total High-End Projection	**5.77**	**14,619**
Total CIP Capital Cost[(c)]		$119,488,000
Low-End Projection Connection Cost per ERU ($/ERU)		**$9,440**
High-End Projection Connection Cost per ERU ($/ERU)		**$8,180**
Average Connection Cost per ERU[(d,e)] ($/ERU)		***$8,810***

(a) Low-End Projection uses a Single Family Residential water use factor of 356 gpd/DU per Table 3-11.
(b) High-End Projection uses a Single Family Residential water use factor of 395 gpd/DU per Table 3-11.
(c) See Table 6-1. Summary of Recommended Capital Improvements for the SE Medford Area for further detail. Total CIP capital cost includes costs for 10-year, buildout of the UGB (2040), and buildout of the Urban Reserve (2070) improvements.
(d) Connection costs in this table assume that all Capital Improvements listed in Table 6-1 are financed through future development and not existing customers.
(e) Average Connection Cost per ERU is calculated by taking the average of the Low-End Projection Connection Cost per ERU and High-End Projection Connection Cost per ERU.

ERU = equivalent residential unit
mgd =million gallons per day

Appendix A

Southeast Medford Growth and Future Water Demand Projections

Table A-1. Southeast Medford Vacant and Unincorporated Area Growth Projections

Land Use	Water Use Factor[a]	Units	Pressure Zone														Total	
			1		2		3		4		5		6		7			
			Dwelling Units / Acreage[b]	ADD, mgd	Dwelling Units / Acreage[b]	ADD, mgd	Dwelling Units / Acreage[b]	ADD, mgd	Dwelling Units / Acreage[b]	ADD, mgd	Dwelling Units / Acreage[b]	ADD, mgd	Dwelling Units / Acreage[b]	ADD, mgd	Dwelling Units / Acreage[b]	ADD, mgd	Dwelling Units / Acreage[b]	ADD, mgd
Low-End Projection[c]																		
Growth within Medford UGB (2040)																		
Urban Residential	356	gpd/du	1,626	0.58	1,627	0.58	825	0.29	576	0.20	467	0.17	336	0.12	201	0.07	5,658	2.01
Urban Medium Density Residential	219	gpd/du	401	0.09	76	0.02	434	0.09	28	0.01	0	0.00	0	0.00	0	0.00	939	0.21
Urban High Density Residential	219	gpd/du	2,396	0.52	1,073	0.23	304	0.07	142	0.03	0	0.00	0	0.00	0	0.00	3,914	0.86
Service Commercial	45	gpd/acre	159	0.01	8	0.00	11	0.00	0	0.00	0	0.00	0	0.00	0	0.00	178	0.01
Commercial	45	gpd/acre	206	0.01	3	0.00	0	0.00	2	0.00	0	0.00	0	0.00	0	0.00	211	0.01
General Industrial	45	gpd/acre	58	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	58	0.00
Parks and Schools / Open Space	0	gpd/acre	217	0.00	68	0.00	52	0.00	117	0.00	105	0.00	1,620	0.00	11	0.00	2,190	0.00
Non-Revenue Water for Future Growth[d]				**0.13**		**0.09**		**0.05**		**0.03**		**0.02**		**0.01**		**0.01**		**0.34**
Totals Within UGB			**4,422**	**1.34**	**2,775**	**0.92**	**1,563**	**0.51**	**746**	**0.27**	**467**	**0.18**	**336**	**0.13**	**201**	**0.08**	**10,511**	**3.44**
Growth outside Medford UGB (2070)																		
Planning Unit MD-3c/3d	356	gpd/du	549	0.20	494	0.175	121	0.04	20	0.01	0	0.00	0	0.00	0	0.00	1,185	0.42
	45	gpd/acre	14	0.00	13	0.00	4	0.00	1	0.00	0	0.00	0	0.00	0	0.00	32	0.00
Planning Unit MD-3e	356	gpd/du	0	0.00	0	0.00	3	0.00	79	0.03	39	0.01	55	0.02	54	0.02	230	0.08
Planning Unit MD-4	0	gpd/acre	39	0.00	12	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	51	0.00
Planning Unit MD-5	356	gpd/du	107	0.04	1,206	0.43	636	0.23	547	0.19	54	0.02	0	0.00	0	0.00	2,551	0.91
Non-Revenue Water for Future Growth[d]				**0.03**		**0.07**		**0.03**		**0.03**		**0.00**		**0.00**		**0.00**		**0.16**
Totals Outside Medford UGB			**656**	**0.26**	**1,700**	**0.67**	**760**	**0.30**	**646**	**0.26**	**93**	**0.04**	**55**	**0.02**	**54**	**0.02**	**3,965**	**1.57**
Totals Low-End Projection			**5,079**	**1.60**	**4,475**	**1.59**	**2,324**	**0.81**	**1,392**	**0.52**	**561**	**0.22**	**390**	**0.15**	**256**	**0.10**	**14,476**	**5.00**

Table A-1. Southeast Medford Vacant and Unincorporated Area Growth Projections

Land Use	Water Use Factor[a]	Units	Pressure Zone 1 Dwelling Units / Acreage[b]	Zone 1 ADD, mgd	Zone 2 Dwelling Units / Acreage[b]	Zone 2 ADD, mgd	Zone 3 Dwelling Units / Acreage[b]	Zone 3 ADD, mgd	Zone 4 Dwelling Units / Acreage[b]	Zone 4 ADD, mgd	Zone 5 Dwelling Units / Acreage[b]	Zone 5 ADD, mgd	Zone 6 Dwelling Units / Acreage[b]	Zone 6 ADD, mgd	Zone 7 Dwelling Units / Acreage[b]	Zone 7 ADD, mgd	Total Dwelling Units / Acreage[b]	Total ADD, mgd
High-End Projection[e]																		
Growth within Medford UGB (2040)																		
Urban Residential	395	gpd/du	1,626	0.64	1,627	0.64	1,100	0.43	768	0.30	623	0.25	448	0.18	269	0.11	6,460	2.55
Urban Medium Density Residential	243	gpd/du	401	0.10	76	0.02	579	0.14	37	0.01	0	0.00	0	0.00	0	0.00	1,093	0.27
Urban High Density Residential	243	gpd/du	2,396	0.58	1,073	0.26	406	0.10	189	0.05	0	0.00	0	0.00	0	0.00	4,063	0.99
Service Commercial	400	gpd/acre	159	0.06	8	0.00	11	0.00	0	0.00	0	0.00	0	0.00	0	0.00	178	0.07
Commercial	400	gpd/acre	206	0.08	3	0.00	0	0.00	2	0.00	0	0.00	0	0.00	0	0.00	211	0.08
General Industrial	400	gpd/acre	58	0.02	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	58	0.02
Parks and Schools / Open Space	0	gpd/acre	217	0.00	68	0.00	52	0.00	117	0.00	105	0.00	1,620	0.00	11	0.00	2,190	0.00
Non-Revenue Water for Future Growth[d]				**0.17**		**0.10**		**0.08**		**0.04**		**0.03**		**0.02**		**0.01**		**0.44**
Totals Within UGB			**4,422**	**1.66**	**2,775**	**1.03**	**2,084**	**0.75**	**994**	**0.40**	**623**	**0.27**	**448**	**0.20**	**269**	**0.12**	**11,616**	**4.43**
Growth outside Medford UGB (2070)																		
Planning Unit MD-3c/3d	395	gpd/du	549	0.22	494	0.19	162	0.06	27	0.01	0	0.00	0	0.00	0	0.00	1,232	0.49
	400	gpd/acre	14	0.01	13	0.01	4	0.00	1	0.00	0	0.00	0	0.00	0	0.00	32	0.01
Planning Unit MD-3e	395	gpd/du	0	0.00	0	0.00	4	0.00	105	0.04	52	0.02	73	0.03	72	0.03	306	0.12
Planning Unit MD-4	0	gpd/acre	39	0.00	12	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	51	0.00
Planning Unit MD-5	395	gpd/du	107	0.04	1,206	0.48	849	0.34	729	0.29	72	0.03	0	0.00	0	0.00	2,963	1.17
Non-Revenue Water for Future Growth[d]				**0.03**		**0.08**		**0.04**		**0.04**		**0.01**		**0.00**		**0.00**		**0.20**
Totals Outside Medford UGB			**656**	**0.29**	**1,700**	**0.75**	**1,014**	**0.45**	**862**	**0.38**	**124**	**0.05**	**73**	**0.03**	**72**	**0.03**	**4,501**	**1.99**
Totals High-End Projection			**5,079**	**1.95**	**4,475**	**1.78**	**3,098**	**1.20**	**1,856**	**0.78**	**747**	**0.33**	**520**	**0.23**	**341**	**0.15**	**16,117**	**6.42**

(a) Water use factors are based on 2020 metered water use. Refer to Chapter 3.

(b) Acreage totals were calculated using GIS information provided by City of Medford staff and MWC staff. Dwelling units were calculated based on the area-weighted average density of land uses within the SE Area.

(c) Low-end projections are based on the following assumptions:
- Residential growth in Zones 3 and above will develop at 75 percent of the planned density.
- Residential water use factors are reduced by 10 percent due to future water conservation.
- The commercial and light industrial water use factor is equal to the low-end estimate, or 45 gpd/acre.

(d) Non-revenue water for future growth is assumed to be 10 percent.

(e) High-end projections are based on the following assumptions:
- Residential growth in Zones 3 and above will develop at the planned density.
- Residential water use factors are not reduced due to future water conservation.
- The commercial and light industrial water use factor is equal to the high-end estimate, or 400 gpd/acre.

mgd = million gallons per day
gpd = gallons per day
ADD = average day demand
du = dwelling unit

Table A-2. Total Projected Southeast Medford Water Production, mgd[(a)]

Demand Component	Zone 1		Zone 2		Zone 3		Zone 4		Zone 5		Zone 6		Zone 7		Total	
	ADD	MDD[(b)]	ADD	MDD[(b)]	ADD	MDD[(b)]	ADD	MDD[(b)]	ADD	MDD[(b)]	ADD	MDD[(b)]	ADD	MDD[(b)]	ADD	MDD[(b)]
Existing[(c)]	1.92	3.26	0.52	1.06	0.30	0.34	0.42	0.84	0.11	0.20	0.00	0.00	0.00	0.00	**3.27**	**5.70**
Low-End Projection																
Projected UGB	1.34	2.28	0.92	1.84	0.51	0.56	0.27	0.54	0.18	0.35	0.13	0.27	0.08	0.16	**3.44**	**6.00**
Projected Urban Reserve	0.26	0.44	0.67	1.34	0.30	0.33	0.26	0.51	0.04	0.07	0.02	0.04	0.02	0.04	**1.57**	**2.78**
Total at Buildout of the UGB	**3.26**	**5.55**	**1.44**	**2.90**	**0.81**	**0.90**	**0.69**	**1.38**	**0.29**	**0.55**	**0.13**	**0.27**	**0.08**	**0.16**	**6.71**	**11.70**
Total at Buildout of the Urban Reserve	**3.52**	**5.99**	**2.11**	**4.25**	**1.11**	**1.23**	**0.94**	**1.89**	**0.33**	**0.62**	**0.15**	**0.31**	**0.10**	**0.20**	**8.27**	**14.48**
High-End Projection																
Projected UGB	1.66	2.82	1.03	2.06	0.75	0.83	0.40	0.80	0.27	0.52	0.20	0.39	0.12	0.24	**4.43**	**7.65**
Projected Urban Reserve	0.29	0.50	0.75	1.50	0.45	0.49	0.38	0.76	0.05	0.10	0.03	0.06	0.03	0.06	**1.99**	**3.48**
Total at Buildout of the UGB	**3.58**	**6.08**	**1.55**	**3.12**	**1.05**	**1.17**	**0.82**	**1.64**	**0.38**	**0.72**	**0.20**	**0.39**	**0.12**	**0.24**	**7.70**	**13.35**
Total at Buildout of the Urban Reserve	**3.87**	**6.58**	**2.30**	**4.62**	**1.50**	**1.66**	**1.20**	**2.40**	**0.44**	**0.82**	**0.23**	**0.46**	**0.15**	**0.30**	**9.69**	**16.84**

(a) Includes non-revenue water. Non-revenue water for future water demand is assumed to be 10 percent.

(b) Maximum day demand peaking factors for Zones 1-5 are based on 2021 SCADA data and vary by zone: (Zone 1 = 1.7; Zone 2 = 2.0; Zone 3 = 1.1; Zone 4 = 2.0; Zone 5 = 1.9). Peaking factors for future pressure zones was assumed to be 2.0.

(c) Existing water demand is based on 2020 metered water use. Refer to Chapter 3.

mgd = million gallons per day

ADD = average day demand

MDD = maximum day demand

Table A-3. Southeast Medford Vacant and Unincorporated Area Growth Projections - North Tributary Area

Land Use	Water Use Factor[a]	Units	Pressure Zone 1		Pressure Zone 2		Pressure Zone 3		Pressure Zone 4		Pressure Zone 5		Pressure Zone 6		Pressure Zone 7		Total	
			Dwelling Units / Acreage[b]	ADD, mgd	Dwelling Units / Acreage[b]	ADD, mgd	Dwelling Units / Acreage[b]	ADD, mgd	Dwelling Units / Acreage[b]	ADD, mgd	Dwelling Units / Acreage[b]	ADD, mgd	Dwelling Units / Acreage[b]	ADD, mgd	Dwelling Units / Acreage[b]	ADD, mgd	Dwelling Units / Acreage[b]	ADD, mgd
Low-End Projection[c]																		
Growth within Medford UGB (2040)																		
Urban Residential	356	gpd/du	727	0.26	669	0.24	427	0.15	268	0.10	255	0.09	331	0.12	201	0.07	2,879	0.95
Urban Medium Density Residential	219	gpd/du	183	0.04	76	0.02	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	259	0.06
Urban High Density Residential	219	gpd/du	183	0.04	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	183	0.04
Service Commercial	45	gpd/acre	11	0.00	1	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	12	0.00
Commercial	45	gpd/acre	41	0.00	3	0.00	0	0.00	2	0.00	0	0.00	0	0.00	0	0.00	46	0.00
General Industrial	45	gpd/acre	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Parks and Schools / Open Space	0	gpd/acre	34	0.00	21	0.00	0	0.00	23	0.00	58	0.00	1,620	0.00	11	0.00	1,767	0.00
Non-Revenue Water for Future Growth[d]				**0.04**		**0.03**		**0.02**		**0.01**		**0.01**		**0.01**		**0.01**		**0.12**
Totals Within UGB			**1,093**	**0.38**	**745**	**0.28**	**427**	**0.17**	**268**	**0.11**	**255**	**0.10**	**331**	**0.13**	**201**	**0.08**	**3,321**	**1.17**
Growth outside Medford UGB (2070)																		
Planning Unit MD-3c/3d[f]	0	gpd/du	549	0.00	494	0.000	121	0.00	20	0.00	0	0.00	0	0.00	0	0.00	1,185	0.00
	0	gpd/acre	145	0.00	130	0.00	43	0.00	7	0.00	0	0.00	0	0.00	0	0.00	324	0.00
Planning Unit MD-3e	356	gpd/du	0	0.00	0	0.00	3	0.00	79	0.03	39	0.01	55	0.02	54	0.02	230	0.06
Planning Unit MD-4	0	gpd/acre	39	0.00	12	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	51	0.00
Planning Unit MD-5	356	gpd/du	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Non-Revenue Water for Future Growth[d]				**0.00**		**0.00**		**0.00**		**0.00**		**0.00**		**0.00**		**0.00**		**0.01**
Totals Outside Medford UGB			**549**	**0.00**	**494**	**0.00**	**124**	**0.00**	**99**	**0.03**	**39**	**0.02**	**55**	**0.02**	**54**	**0.02**	**1,414**	**0.07**
Totals Low-End Projection			**1,642**	**0.38**	**1,239**	**0.28**	**551**	**0.17**	**368**	**0.14**	**295**	**0.12**	**385**	**0.15**	**256**	**0.10**	**4,735**	**1.24**

Table A-3. Southeast Medford Vacant and Unincorporated Area Growth Projections - North Tributary Area

Land Use	Water Use Factor[a]	Units	Pressure Zone														Total	
			1		2		3		4		5		6		7			
			Dwelling Units / Acreage[b]	ADD, mgd	Dwelling Units / Acreage[b]	ADD, mgd	Dwelling Units / Acreage[b]	ADD, mgd	Dwelling Units / Acreage[b]	ADD, mgd	Dwelling Units / Acreage[b]	ADD, mgd	Dwelling Units / Acreage[b]	ADD, mgd	Dwelling Units / Acreage[b]	ADD, mgd	Dwelling Units / Acreage[b]	ADD, mgd
High-End Projection[e]																		
Growth within Medford UGB (2040)																		
Urban Residential	395	gpd/du	727	0.29	669	0.26	570	0.23	358	0.14	340	0.13	441	0.17	269	0.11	3,374	1.23
Urban Medium Density Residential	243	gpd/du	183	0.04	76	0.02	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	259	0.06
Urban High Density Residential	243	gpd/du	183	0.04	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	183	0.04
Service Commercial	400	gpd/acre	11	0.00	1	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	12	0.00
Commercial	400	gpd/acre	41	0.02	3	0.00	0	0.00	2	0.00	0	0.00	0	0.00	0	0.00	46	0.02
General Industrial	400	gpd/acre	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Parks and Schools / Open Space	0	gpd/acre	34	0.00	21	0.00	0	0.00	23	0.00	58	0.00	1,620	0.00	11	0.00	1,767	0.00
Non-Revenue Water for Future Growth[d]				**0.04**		**0.03**		**0.03**		**0.02**		**0.01**		**0.02**		**0.01**		**0.15**
Totals Within UGB			**1,093**	**0.44**	**745**	**0.32**	**570**	**0.25**	**358**	**0.16**	**340**	**0.15**	**441**	**0.19**	**269**	**0.12**	**3,816**	**1.51**
Growth outside Medford UGB (2070)																		
Planning Unit MD-3c/3d[f]	0	gpd/du	549	0.00	494	0.00	162	0.00	27	0.00	0	0.00	0	0.00	0	0.00	1,232	0.00
	0	gpd/acre	145	0.00	130	0.00	43	0.00	7	0.00	0	0.00	0	0.00	0	0.00	324	0.00
Planning Unit MD-3e	395	gpd/du	0	0.00	0	0.00	4	0.00	105	0.04	52	0.02	73	0.03	72	0.03	306	0.09
Planning Unit MD-4	0	gpd/acre	39	0.00	12	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	51	0.00
Planning Unit MD-5	395	gpd/du	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Non-Revenue Water for Future Growth[d]				**0.00**		**0.00**		**0.00**		**0.00**		**0.00**		**0.00**		**0.00**		**0.01**
Totals Outside Medford UGB			**549**	**0.00**	**494**	**0.00**	**165**	**0.00**	**133**	**0.05**	**52**	**0.02**	**73**	**0.03**	**72**	**0.03**	**1,538**	**0.10**
Totals High-End Projection			**1,642**	**0.44**	**1,239**	**0.32**	**735**	**0.25**	**490**	**0.20**	**393**	**0.17**	**514**	**0.23**	**341**	**0.15**	**5,354**	**1.61**

(a) Water use factors are based on 2020 metered water use. Refer to Chapter 3.
(b) Acreage totals were calculated using GIS information provided by City of Medford staff and MWC staff. Dwelling units were calculated based on the area-weighted average density of land uses within the SE Area.
(c) Low-end projections are based on the following assumptions:
- Residential growth in Zones 3 and above will develop at 75 percent of the planned density.
- Residential water use factors are reduced by 10 percent due to future water conservation.
- The commercial and light industrial water use factor is equal to the low-end estimate, or 45 gpd/acre.

(d) Non-revenue water for future growth is assumed to be 10 percent.
(e) High-end projections are based on the following assumptions:
- Residential growth in Zones 3 and above will develop at the planned density.
- Residential water use factors are not reduced due to future water conservation.
- '- The commercial and light industrial water use factor is equal to the high-end estimate, or 400 gpd/acre.

(f) Medford Water determined that growth in Planning Units MD-3c and MD-3d would not be served by the proposed infrastructure in the SE Plan. These areas will be served by separate infrastructure supplied by the River Zone.
mgd = million gallons per day
gpd = gallons per day
ADD = average day demand
du = dwelling unit

Table A-4. Southeast Medford Vacant and Unincorporated Area Growth Projections - South Tributary Area

Land Use	Water Use Factor[a]	Units	Pressure Zone 1		Pressure Zone 2		Pressure Zone 3		Pressure Zone 4		Pressure Zone 5		Pressure Zone 6		Pressure Zone 7		Total	
			Dwelling Units / Acreage[b]	ADD, mgd	Dwelling Units / Acreage[b]	ADD, mgd	Dwelling Units / Acreage[b]	ADD, mgd	Dwelling Units / Acreage[b]	ADD, mgd	Dwelling Units / Acreage[b]	ADD, mgd	Dwelling Units / Acreage[b]	ADD, mgd	Dwelling Units / Acreage[b]	ADD, mgd	Dwelling Units / Acreage[b]	ADD, mgd
Low-End Projection[c]																		
Growth within Medford UGB (2040)																		
Urban Residential	356	gpd/du	899	0.32	958	0.34	398	0.14	308	0.11	212	0.08	5	0.00	0	0.00	2,779	0.99
Urban Medium Density Residential	219	gpd/du	217	0.05	0	0.00	434	0.09	28	0.01	0	0.00	0	0.00	0	0.00	680	0.15
Urban High Density Residential	219	gpd/du	2,213	0.48	1,073	0.23	304	0.07	142	0.03	0	0.00	0	0.00	0	0.00	3,731	0.82
Service Commercial	45	gpd/acre	148	0.01	7	0.00	11	0.00	0	0.00	0	0.00	0	0.00	0	0.00	166	0.01
Commercial	45	gpd/acre	165	0.01	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	165	0.01
General Industrial	45	gpd/acre	58	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	58	0.00
Parks and Schools / Open Space	0	gpd/acre	182	0.00	47	0.00	52	0.00	94	0.00	47	0.00	0	0.00	0	0.00	422	0.00
Non-Revenue Water for Future Growth[d]				**0.10**		**0.06**		**0.03**		**0.02**		**0.01**		**0.00**		**0.00**		**0.22**
Totals Within UGB			**3,329**	**0.96**	**2,030**	**0.64**	**1,136**	**0.34**	**478**	**0.16**	**212**	**0.08**	**5**	**0.00**	**0**	**0.00**	**7,190**	**2.19**
Growth outside Medford UGB (2070)																		
Planning Unit MD-3c/3d[f]	0	gpd/du	0	0.00	0	0.000	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
	0	gpd/acre	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Planning Unit MD-3e	356	gpd/du	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Planning Unit MD-4	0	gpd/acre	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Planning Unit MD-5	356	gpd/du	107	0.04	1,206	0.43	636	0.23	547	0.19	54	0.02	0	0.00	0	0.00	2,551	0.91
Non-Revenue Water for Future Growth[d]				**0.00**		**0.05**		**0.03**		**0.02**		**0.00**		**0.00**		**0.00**		**0.10**
Totals Outside Medford UGB			**107**	**0.04**	**1,206**	**0.48**	**636**	**0.25**	**547**	**0.22**	**54**	**0.02**	**0**	**0.00**	**0**	**0.00**	**2,551**	**1.01**
Totals Low-End Projection			**3,436**	**1.01**	**3,237**	**1.12**	**1,772**	**0.59**	**1,024**	**0.38**	**266**	**0.11**	**5**	**0.00**	**0**	**0.00**	**9,741**	**3.20**

Table A-4. Southeast Medford Vacant and Unincorporated Area Growth Projections - South Tributary Area

Land Use	Water Use Factor[a]	Units	Pressure Zone														Total	
			1		2		3		4		5		6		7			
			Dwelling Units / Acreage[b]	ADD, mgd	Dwelling Units / Acreage[b]	ADD, mgd	Dwelling Units / Acreage[b]	ADD, mgd	Dwelling Units / Acreage[b]	ADD, mgd	Dwelling Units / Acreage[b]	ADD, mgd	Dwelling Units / Acreage[b]	ADD, mgd	Dwelling Units / Acreage[b]	ADD, mgd	Dwelling Units / Acreage[b]	ADD, mgd
High-End Projection[e]																		
Growth within Medford UGB (2040)																		
Urban Residential	395	gpd/du	899	0.36	958	0.38	530	0.21	411	0.16	283	0.11	7	0.00	0	0.00	3,087	1.22
Urban Medium Density Residential	243	gpd/du	217	0.05	0	0.00	579	0.14	37	0.01	0	0.00	0	0.00	0	0.00	834	0.20
Urban High Density Residential	243	gpd/du	2,213	0.54	1,073	0.26	406	0.10	189	0.05	0	0.00	0	0.00	0	0.00	3,880	0.94
Service Commercial	400	gpd/acre	148	0.06	7	0.00	11	0.00	0	0.00	0	0.00	0	0.00	0	0.00	166	0.07
Commercial	400	gpd/acre	165	0.07	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	165	0.07
General Industrial	400	gpd/acre	58	0.02	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	58	0.02
Parks and Schools / Open Space	0	gpd/acre	182	0.00	47	0.00	52	0.00	94	0.00	47	0.00	0	0.00	0	0.00	422	0.00
Non-Revenue Water for Future Growth[d]				**0.12**		**0.07**		**0.05**		**0.02**		**0.01**		**0.00**		**0.00**		**0.28**
Totals Within UGB			**3,329**	**1.22**	**2,030**	**0.71**	**1,515**	**0.50**	**637**	**0.24**	**283**	**0.12**	**7**	**0.00**	**0**	**0.00**	**7,800**	**2.80**
Growth outside Medford UGB (2070)																		
Planning Unit MD-3c/3d[f]	0	gpd/du	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
	0	gpd/acre	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Planning Unit MD-3e	395	gpd/du	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Planning Unit MD-4	0	gpd/acre	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Planning Unit MD-5	395	gpd/du	107	0.04	1,206	0.48	849	0.34	729	0.29	72	0.03	0	0.00	0	0.00	2,963	1.17
Non-Revenue Water for Future Growth[d]				**0.00**		**0.05**		**0.04**		**0.03**		**0.00**		**0.00**		**0.00**		**0.13**
Totals Outside Medford UGB			**107**	**0.05**	**1,206**	**0.53**	**849**	**0.37**	**729**	**0.32**	**72**	**0.03**	**0**	**0.00**	**0**	**0.00**	**2,963**	**1.30**
Totals High-End Projection			**3,436**	**1.26**	**3,237**	**1.24**	**2,363**	**0.88**	**1,366**	**0.56**	**355**	**0.16**	**7**	**0.00**	**0**	**0.00**	**10,763**	**4.10**

(a) Water use factors are based on 2020 metered water use. Refer to Chapter 3.
(b) Acreage totals were calculated using GIS information provided by City of Medford staff and MWC staff. Dwelling units were calculated based on the area-weighted average density of land uses within the SE Area.
(c) Low-end projections are based on the following assumptions:
- Residential growth in Zones 3 and above will develop at 75 percent of the planned density.
- Residential water use factors are reduced by 10 percent due to future water conservation.
- The commercial and light industrial water use factor is equal to the low-end estimate, or 45 gpd/acre.

(d) Non-revenue water for future growth is assumed to be 10 percent.
(e) High-end projections are based on the following assumptions:
- Residential growth in Zones 3 and above will develop at the planned density.
- Residential water use factors are not reduced due to future water conservation.
- The commercial and light industrial water use factor is equal to the high-end estimate, or 400 gpd/acre.

(f) Medford Water determined that growth in Planning Units MD-3c and MD-3d would not be served by the proposed infrastructure in the SE Plan. These areas will be served by separate infrastructure supplied by the River Zone.
mgd = million gallons per day
gpd = gallons per day
ADD = average day demand
du = dwelling unit

Table A-5. Total Projected Southeast Medford Water Production - North Tributary Area, mgd[(a)]								
	Average Day Demand							
Demand Component	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Total
Existing[(b)]	0.45	0.23	0.25	0.41	0.11	0.00	0.00	**1.45**
Low-End Projection								
Projected UGB	0.38	0.28	0.17	0.11	0.10	0.13	0.08	**1.25**
Projected Urban Reserve	0.00	0.00	0.00	0.03	0.02	0.02	0.02	**0.09**
Total at Buildout of the UGB	**0.83**	**0.51**	**0.42**	**0.52**	**0.21**	**0.13**	**0.08**	**2.70**
Total at Buildout of the Urban Reserve	**0.83**	**0.51**	**0.42**	**0.55**	**0.23**	**0.15**	**0.10**	**2.79**
High-End Projection								
Projected UGB	0.44	0.32	0.25	0.16	0.15	0.19	0.12	**1.63**
Projected Urban Reserve	0.00	0.00	0.00	0.05	0.02	0.03	0.03	**0.13**
Total at Buildout of the UGB	**0.89**	**0.55**	**0.50**	**0.57**	**0.26**	**0.19**	**0.12**	**3.08**
Total at Buildout of the Urban Reserve	**0.89**	**0.55**	**0.50**	**0.62**	**0.28**	**0.23**	**0.15**	**3.21**

(a) Includes non-revenue water. Non-revenue water for future water demand is assumed to be 10 percent.

(b) Existing water demand is based on 2020 metered water use. Refer to Chapter 3.

mgd = million gallons per day

Table A-6. Total Projected Southeast Medford Water Production - South Tributary Area, mgd[(a)]								
	Average Day Demand							
Demand Component	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Total
Existing[(b)]	1.47	0.29	0.05	0.01	0.00	0.00	0.00	**1.82**
Low-End Projection								
Projected UGB	0.96	0.64	0.34	0.16	0.08	0.00	0.00	**2.19**
Projected Urban Reserve	0.04	0.48	0.25	0.22	0.02	0.00	0.00	**1.01**
Total at Buildout of the UGB	**2.43**	**0.93**	**0.38**	**0.17**	**0.08**	**0.00**	**0.00**	**4.00**
Total at Buildout of the Urban Reserve	**2.48**	**1.41**	**0.64**	**0.39**	**0.11**	**0.00**	**0.00**	**5.01**
High-End Projection								
Projected UGB	1.22	0.71	0.50	0.24	0.12	0.00	0.00	**2.80**
Projected Urban Reserve	0.05	0.53	0.37	0.32	0.03	0.00	0.00	**1.30**
Total at Buildout of the UGB	**2.69**	**1.00**	**0.55**	**0.25**	**0.12**	**0.00**	**0.00**	**4.62**
Total at Buildout of the Urban Reserve	**2.73**	**1.53**	**0.92**	**0.57**	**0.16**	**0.00**	**0.00**	**5.92**

(a) Includes non-revenue water. Non-revenue water for future water demand is assumed to be 10 percent.

(b) Existing water demand is based on 2020 metered water use. Refer to Chapter 3.

mgd = million gallons per day

Appendix B

System-Wide Growth and Future Water Demand Projections Technical Memorandum

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TECHNICAL MEMORANDUM

DATE: October 30, 2023

Project No.: 1014-30-22-01
SENT VIA: EMAIL

REGISTERED PROFESSIONAL ENGINEER 95681PE OREGON JAN. 14, 2020 ROBERTO DAMIAN VERA
EXPIRES : 6/30/2024

TO: Andy Huffman, PE, Medford Water Commission

FROM: Roberto Vera, PE, RCE #95681

REVIEWED BY: Polly Boissevain, PE, RCE #76795

SUBJECT: Medford Water System-Wide Demand Analysis

This technical memorandum (TM) documents and summarizes West Yost's analysis of Medford Water's (MW) system-wide demand analysis. This analysis was performed using information from the Southeast Medford Facilities Plan (SEMFP). It extends the methodology established as part of the SEMFP effort and applies to the rest of MW's water system outside of the SEMFP study area. (refer to *Chapter 3 Water Demands* of the SE Plan). As a result, this analysis develops updated water demand estimates for the entire water service area (retail and wholesale), enabling MW to proceed with on-going planning efforts with a consistent demand projection methodology as that used in the SEMFP. This technical memorandum is organized as follows:

- Background
- Existing Water Use
- Existing and Future Land Use and Growth Projections
- Unit Water Use Factors
- Future Water Demand Projections
- Equivalent Residential Unit Analysis

BACKGROUND

As part of the SEMFP, West Yost analyzed MW's historical, current, and projected near-term and future water demands for the SEMFP Study Area. Projected near-term and future demands are based on updated water use factors and planned future development from the City of Medford's (City's) 2007 Comprehensive Plan along with other, more recent City planning assumptions. During the SEMFP effort, MW noted that there were on-going efforts to re-configure portions of its pressure zones, thereby causing the water demand projections from the 2017 Water Distribution Facilities Plan (WDFP) to be out of date. Therefore, MW decided to proceed with an update to water demand projections for its entire service area, using the same land-used based approach as developed for the SEMFP to maintain consistency in its ongoing planning efforts.

This TM summarizes the results of this system-wide demand projection effort, building on the projections prepared in the SEMFP.

EXISTING WATER USE

The following sections summarize the existing water consumption and non-revenue water for MW's service area, wholesale water use and MW's existing water production.

Existing Water Consumption

Water consumption is calculated from existing customer meter records. As of March 2022, MW has approximately 31,600 metered water use accounts that serve various customer types within the Study Area. Table 1 summarizes the number of customers by meter type. As shown in Table 1, the predominant customer type is Single-Family residential, which accounts for approximately 81 percent of the total number of water meters. Multi-family residential accounts make up approximately 8 percent of the total metered accounts and non-residential metered accounts make up approximately 10 percent of the total metered accounts. As shown in the table, the number of existing customers within the SEMFP study area represents about 15 percent of the total customer accounts.

Table 1. Summary of Customer Types within the Service Area as of March 2022

Customer Type	Number of Meters			Percent of System-Wide Accounts
	SEMFP	Outside of SE Plan	System-Wide	
Residential				
Single Family	4,623[(a)]	21,062	25,685	81
Multi-Family	90	2,515	2,605	8
Residential Subtotal	***4,713***	***23,577***	***28,290***	***89***
Non-Residential				
Commercial	128	2,986	3,114	10
Industrial	0	155	155	1
MW Facilities	11	10	21	<1
Wholesale	0	14	14	<1
Non-Residential Subtotal	***139***	***3,165***	***3,304***	***11***
Total	**4,852 (15%)**	**26,742 (85%)**	**31,594**	**100%**

Source: Water meter shapefile "Meters.shp" provided by Medford Water staff August 2022.

(a) The value reported in this table is includes 21 extra meters, that were not accounted for during the SEMFP. These additional meters do not appreciably change the findings in the SEMFP.

Table 2 summarizes 2020 retail water consumption by customer type. Residential customers account for 65 percent of the total consumption, while they make up approximately 90 percent of the total metered accounts as shown in Table 1. Non-residential customers account for about 35 percent of the total consumption, while they make up only 10 percent of the total metered accounts.

Table 2. Existing Retail Consumption by Customer Type

Customer Type	Consumption, MG			Customer Type as percent of Total Consumption
	SE Plan	Outside of SE Plan	System-Wide	
Residential				
Single Family	848[(a)]	2,719	3,567	49
Multi-Family	46	1,065	1,111	16
Residential Subtotal	**894**	**3,784**	**4,678**	**65%**
Non-Residential				
Commercial	95	1,479	1,574	22
Industrial	0	891	891	12
MW Facilities	2	100	102	1
Non-Residential Subtotal	97	2,470	2,567	35
Total	**992**	**6,253**	**7,245**	**100%**

Source: Water meter shapefile "Meters.shp" provided by Medford Water staff August 2022. Consumption data is based on 2020 water use.

(a) The value reported in this table is includes an additional 5 MG (associated with the 21 extra meters), that were not accounted for during the SEMFP. These additional meters do not appreciably change the findings in the SEMFP, as the increase in demand is less than 0.5 percent of the SEMFP demand.

Non-Revenue Water

Non-Revenue Water (NRW) is the difference between the quantity of water produced and the quantity of water consumed/metered. Customer water use rarely equals the total water production due to unmeasured system losses. While water utilities strive to minimize the amount of NRW, it is difficult to eliminate entirely. There are various reasons why the total customer water use is less than the total amount of water produced by MW. The most common reasons for NRW are system losses such as leakage, errors in measurement, and unmetered usage (such as water used at production facilities, or water discharged through distribution system hydrants).

An estimate of NRW is required for water system planning to establish future water production needs, as a system will always have some amount of water loss. NRW is calculated by taking the difference between water production and water consumption, and then subsequently calculating expressing NRW as a percentage of production. A NRW ranging from 5 to 10 percent is typical and desirable for water utilities. Based on previous studies and evaluations performed by MW, NRW system-wide has been estimated at 14 percent, which includes areas outside of City limits (i.e., wholesale deliveries). NRW estimates for the SE Area were estimated in Chapter 3 of the SEMFP and assumed that future NRW factor for the SE area would be 10 percent, as a result of recommended improvements planned for the area.

Table 3 compares production and consumption data for the SE Plan area and the rest of the MW system and shows that NRW is approximately 6 percent, while the NRW factor for the SE area is 17 percent, which is higher than desirable. For planning purposes, 6 percent NRW was assumed for future water demand associated with growth outside of the SE Area. Production for the SE Plan area was estimated using SCADA information provided as part of the SEMFP Report and specific details are included in Chapter 3. NRW percentages within the SEMFP area are known by MW and are being systematically addressed.

Table 3. 2020 Retail Non-Revenue Water within MW Service Area

Planning Area	Production, MG	Consumption, MG	NRW, MG	NRW as a Percent of Production
SE Plan[(a)]	1,194	987	206	17.3
Outside SE Plan[(b)]	6,638	6,253	384	5.8
Total[(c)]	**7,832**	**7,240**	**590**	**7.5**

(a) Refer to Chapter 3, Tables 3-4 of the SE Plan.
(b) Outside SE Plan consumption is based on metered water use; production is based on the total retail water production for 2020 from the 2022 WCMP minus the SE Plan estimated production.
(c) Total production and consumption for 2020 were obtained from the 2022 WCMP.

Wholesale Water Use

MW also provides wholesale water to customers outside of the City. These customers include the nearby cities of Ashland, Central Point, Eagle Point, Jacksonville, Phoenix and Talent. Historical average annual deliveries are presented in Table 4 below. The cities of Talent, Ashland, and Phoenix are part of the regional system also known as the TAP System. MW meters supply to the TAP system as well as subsequently meters water delivered to each of the systems (i.e., for Phoenix).

Table 4. Summary of Historical Wholesale Water Deliveries Average Day, mgd

Year	Ashland [(a)]	Central Point	Eagle Point	Jacksonville	Phoenix	TAP Meter
2016	0.00	2.72	1.59	0.68	0.25	1.23
2017	0.00	2.72	1.57	0.69	0.29	1.23
2018	0.00	2.72	1.59	0.69	0.26	1.41
2019	0.00	2.59	1.56	0.70	0.24	1.31
2020	0.00	2.83	1.56	0.73	0.25	1.49
2021	0.00	2.88	1.60	0.66	0.24	1.54
Average (2016 – 2021)	**0.00**	**2.74**	**1.58**	**0.69**	**0.26**	**1.37**

(a) Ashland currently is metered under the TAP meter.

Existing Water Production

Table 5 summarizes water production for the MW service area from calendar year 2020. This information uses MW's consumption information from 2020 (i.e., metered demands, discussed further in the following section) and adds non-revenue water (NRW).

Table 5. Existing Water Production

Pressure Zone	2020 Water Production, mgd
SE Plan – Retail[(a)]	
1	1.92
2	0.52
3	0.30
4	0.42
5	0.11
SE Plan Subtotal	**3.27**
Outside SE Plan Area - Retail	
Barneburg	0.22
Gravity	11.33
River	5.95
Southwest	0.23
BBS Customers	0.42
Outside SE Plan Subtotal	**18.14**
Medford Water Retail Total	**21.40**
Wholesale[(b)]	
Central Point	2.83
Eagle Point	1.56
Jacksonville	0.73
Phoenix[(c)]	0.25
TAP[(c)(d)]	1.49
Medford Water Wholesale Total	**6.86**
Medford Water System-Wide Total	**28.25**

Source: 2020 water use data provided by Medford Water to Jacobs on 03/17/2022.

(a) Refer to Chapter 3, Table 3-1 of the SE Plan.

(b) Wholesale production is equal to the metered water consumption. Non-revenue water associated with wholesale systems occurs downstream of MW's water meter.

(c) The City of Phoenix receives water both from a meter directly from MW, and via MW water supplied to TAP. Exact TAP allocations to Talent, Ashland, and Phoenix are unknown.

(d) TAP refers to the shared infrastructure associated with serving the Cities of Talent, Ashland, and Phoenix.

EXISTING AND FUTURE LAND USE AND GROWTH PROJECTIONS

The following sections discuss the existing and projected future land use for the MW service area.

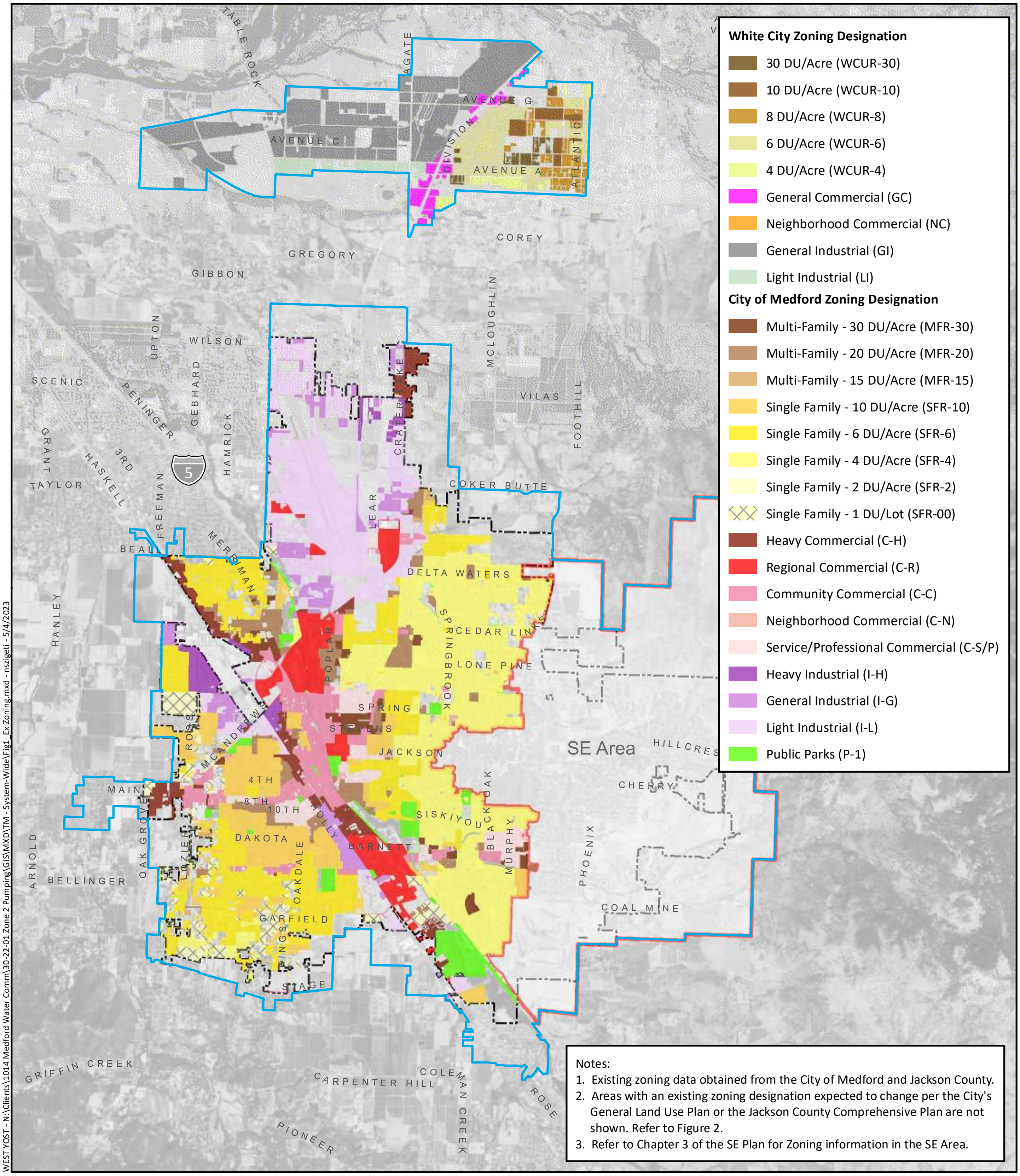
Existing Land Use

The existing MW retail service area includes areas within the Medford City limit and the unincorporated White City area, to the north of Medford. Table 6 summarizes the existing land uses within the MW service area, based on existing zoning within the Medford city limit and the White City unincorporated area, as shown on Figure 1. Land uses in the MW service area outside the SE Area are predominantly Single Family Residential, Commercial, and Industrial.

Table 6. Existing Land Uses

Land Use	Area, acres[a]						Total within Service Area, %
	SE Plan[b]	Gravity	River[c]	SW	Barnebur g	Total	
Single Family Residential (0 to 10 DU/acre)	2,121.2	4,822.9	1,196.3	187.3	222.6	8,550.3	56
Multi-Family Residential (10 to 30 DU/acre)	40.0	441.8	274.7	2.3	15.7	774.6	5
Commercial	63.7	1,449.5	623.9	0.0	0.0	2,137.1	14
Industrial	0.0	406.9	2,958.3	0.0	0.0	3,365.2	22
Public Parks	13.3	316.2	25.9	0.0	0.0	355.5	2
Total	**2,238.2**	**7,437.4**	**5,079.2**	**189.6**	**238.3**	**15,182.7**	**100%**

(a) Land uses totals are based on the City of Medford zoning feature class received March 1, 2022. Areas with an existing zoning district that is different than the planned future land use are not included in this table.
(b) SE Plan land uses are summarized by pressure zone in Chapter 3, Table 3-7 of the SE Plan.
(c) River Zone acreage totals include zoning for White City, which are based on Jackson County zoning information.



WEST YOST - N:\Clients\1014 Medford Water Comm\30-22-01 Zone 2 Pumping\GIS\MXD\TM - System-Wide\Fig1_Ex Zoning.mxd - nszigeti - 5/4/2023

MW Buildout Service Area

SE Plan Study Area

City Limit

N

0 4,000 8,000

Feet

WEST YOST

Figure 1

Existing Zoning

Medford Water

System-Wide

Growth Projections TM

Projected Future Land Use

MW's anticipated future retail service area spans beyond the City of Medford Sphere of Influence (SOI) and includes: portions of unincorporated Jackson County adjacent to the Medford SOI, and the White City unincorporated community. Different planning documents were used for areas inside and outside the Medford SOI. Growth within the City's SOI is broken into two categories: growth within the defined urban growth boundary (UGB), and growth within the defined Urban Reserve areas.

West Yost compared the future planning areas to existing zoning and development within the MW service area to identify future growth areas. This primarily included a review of vacant tax lots and tax lots identified to change to a different land use (i.e., low density residential to commercial). Conversely, some areas were identified with a different future land use but appear to be relatively new developments and were therefore omitted from the evaluation. Growth within each distinct area is described in the following subsections.

For wholesale customers, land uses were not available, so a population-based projection was used to develop demand projections (refer to Future Water Demand Projection section below).

Growth within the Medford SOI

Growth within the Medford SOI is categorized as: 1) within the UGB or,2) within the Urban Reserve. As described in Chapter 3 of the SEMFP, the City's current planning estimates for timing of full development of the City's UGB and Urban Reserve are 2040 and 2070, respectively. Growth associated with each of these areas is discussed in more detail below.

Growth within the Medford UGB at Buildout

Future growth within the Medford SOI is defined by the General Land Use Plan Element of the City of Medford's Comprehensive Plan, which summarizes anticipated development within the City's UGB. In addition to the UGB, the City has several urban reserve areas within the MW service area which are the first priority when the City considers expanding its UGB.

Growth within Medford Urban Reserve at Buildout

Development assumptions within Urban Reserve areas are based on recent City estimates of Planning Units or adopted urbanization plans, where available. Table 7 details the growth assumptions for each Planning Unit within each Urban Reserve area. Generally, growth within the Urban Reserve was assumed to follow similar trends to adjacent existing or planned land uses. For example, Urban Reserve Area MD-1 borders areas where the planned land use is industrial, and the area east of OR-62 is planned as heavy industrial. Therefore, planning Units MD-1a, MD-1b, and MD-1c were thus all assumed to develop as industrial, and MD-1c (east of OR-62) to develop as heavy industrial.

The number of dwelling units presented in Table 7 are presented as range from low-end to high-end projection. As discussed in Chapter 3 of the SE Plan, dwelling units in the upper pressure zones were projected using a range of densities based on potential slope limitations. No slope limitations are assumed for growth outside the SE Area, therefore, all dwelling unit projections are the same for the low-end and high-end projections.

Table 7. Summary of Growth Within Urban Reserve Areas

Urban Reserve Area	Summary	Planning Unit	Pressure Zone(s)	Assumed Land Use	Distribution Assumptions	Gross Area, acres	Representative Area, acres	Number of DUs	
								Low-End Projection	High-End Projection
MD-1	• Based on surrounding comprehensive plan land uses within the UGB. • The MD-1a and MD-1b areas are assumed to be industrial.	1a, 1b	River	Commercial/Light Industrial	• 100% of gross area	385.2	385.2	-	-
	• Based on surrounding comprehensive plan land uses within the UGB. • The MD-1c area is assumed to be Heavy Industrial.	1-c	River	Heavy Industrial	• 100% of gross area	173.6	173.6	-	-
					MD-1 Subtotal:	**558.9**	-	**0**	**0**
MD-2	• Based on surrounding general plan land uses within the UGB. • The portion of MD-2 within Planning Unit MD-2a is assumed to be 50% Commercial and 50% Industrial • The portion of MD-2 within planning unit MD-2b is assumed to be 100% residential.	2a	River	Commercial/Light Industrial	• 100% of area within planning unit(s)	678.6	658.7	-	-
		2b	Gravity	Residential	• 100% of area within planning unit(s) • Density = 4.0 DU/acre		19.9		80
					MD-2 Subtotal:	**678.6**	-	**0**	**80**
MD-3	• The portion of MD-3 within Planning Units MD-3a and MD-3b are based on adopted Urbanization Plans (2b, 3a, 3c) for the adjacent land within the UGB: • The average dwelling unit density based on gross area (including residential and non-residential land uses) is 4 DU/acre. • To account for non-residential uses, 10 percent of the gross area is assumed to be commercial land uses. • The portion of MD-3 within Planning Units MD-3c and MD-3d fall within the SE Plan boundary and are assumed to develop similar to MD-3a/3b above, but with a variable density: • The average dwelling unit density based on gross area is 3.8 DU/acre, and reduced by 75 percent in Zones 3 and above. • To account for non-residential land uses, 10 percent of the gross area is assumed to be commercial land uses. • The portion of MD-3 within Planning Unit MD-3e falls within the SE Plan boundary and is assumed to be 100% residential, and develop at a reduced density due to the steep topography	3a, 3b	Gravity	Residential	• Number of DUs calculated based on total area within planning unit(s) • Density = 4.0 DU/acre	689.2	284.4	1,138	1,138
		3a, 3b	Gravity	Commercial/Light Industrial	• 10% of total area within planning unit(s)		28.4	-	-
		3c, 3d	SE Plan/ River[x]	Residential	• 100% of gross area • Density = varies by pressure zone • SE Area water use factors		324.2	1,185	1,232
		3c, 3d	SE Plan/ River[x]	Commercial/Light Industrial	• 10% of total area within planning unit(s)		32.4	-	-
		3e	SE Plan	Residential	• Number of DUs calculated based on area within planning unit • Density = 2.9 DU/acre • SE Area water use factors		80.6	230	306
					MD-3 Subtotal:	**689.2**	-	**2,552**	**2,676**
MD-4	Based on the adopted Urbanization Plan for MD-4, the majority of this area will be reserved for open space when it is brought into the City's UGB. No growth in water demand is assumed for this area.	4	SE Plan	Open Space	• 100% of gross area • No growth in water demand	50.7	50.7	-	-
					MD-4 Subtotal:	**50.7**	-	**0**	**0**
MD-5	Based on surrounding comprehensive plan land uses within the UGB. The entire MD-5 area is assumed to be residential.	5a, 5b, 5c, 5d, 5e	SE Plan	Residential	• 100% of gross area; • Density = varies by pressure zone • SE Area water use factors	779.7	779.7	2,551	2,963
					MD-5 Subtotal:	**779.7**	-	**2,551**	**2,963**
MD-6	Based on surrounding comprehensive plan land uses within the UGB. The entire MD-6 area is assumed to be industrial.	6a, 6b, 6c	Gravity	Commercial/Light Industrial	• 100% of gross area	89.0	89.0	-	-
					MD-6 Subtotal:	**89.0**	-	**0**	**0**
					Totals:	**2,846**	**-**	**5,103**	**5,718**

Growth outside the Medford SOI

Future growth outside the Medford SOI and within unincorporated Jackson County is defined by the Jackson County Comprehensive Plan. This growth is assumed to occur within the same time-frame as the City of Medford's UGB (i.e., 2040). The majority of growth classified as outside the Medford SOI occurs within the White City unincorporated area approximately 3 miles north of the current Medford city limit, though there are some small areas contiguous with the City's SOI and within MW's planned service area.

Summary of System-Wide Projected Future Growth

Table 8 summarizes the projected growth within the City's SOI and outside of the City's SOI. As shown on Table 8, there are a total of approximately 8,350 acres of land (or about 17,500 dwelling units) are anticipated to be developed within MW service area by 2070. Approximately 5,500 acres (or about 13,300 dwelling units) are projected to develop within the 2040 timeframe, indicating that 66 percent of the planned development acreage (or 76 percent of dwelling units) is anticipated to be developed during this timeframe. Also, with respect to planned development during the 2040 timeframe, approximately 77 percent of the planned development acreage is within the City's SOI (or 88 percent of the planned dwelling units). The SE Area represents approximately 17 percent of the planned development acreage (or 29 percent of the planned dwelling units) by 2070.

These land use estimates were subsequently used with assumed water use factors, described in the subsequent sections, to develop future projected demands for the retail service area. As noted previously, land use information for wholesale customer areas is limited, so projections were developed assuming historical population growth rates will continue unchanged in the future. This methodology used for future water demands is described in the Future Water Demand Projection Section.

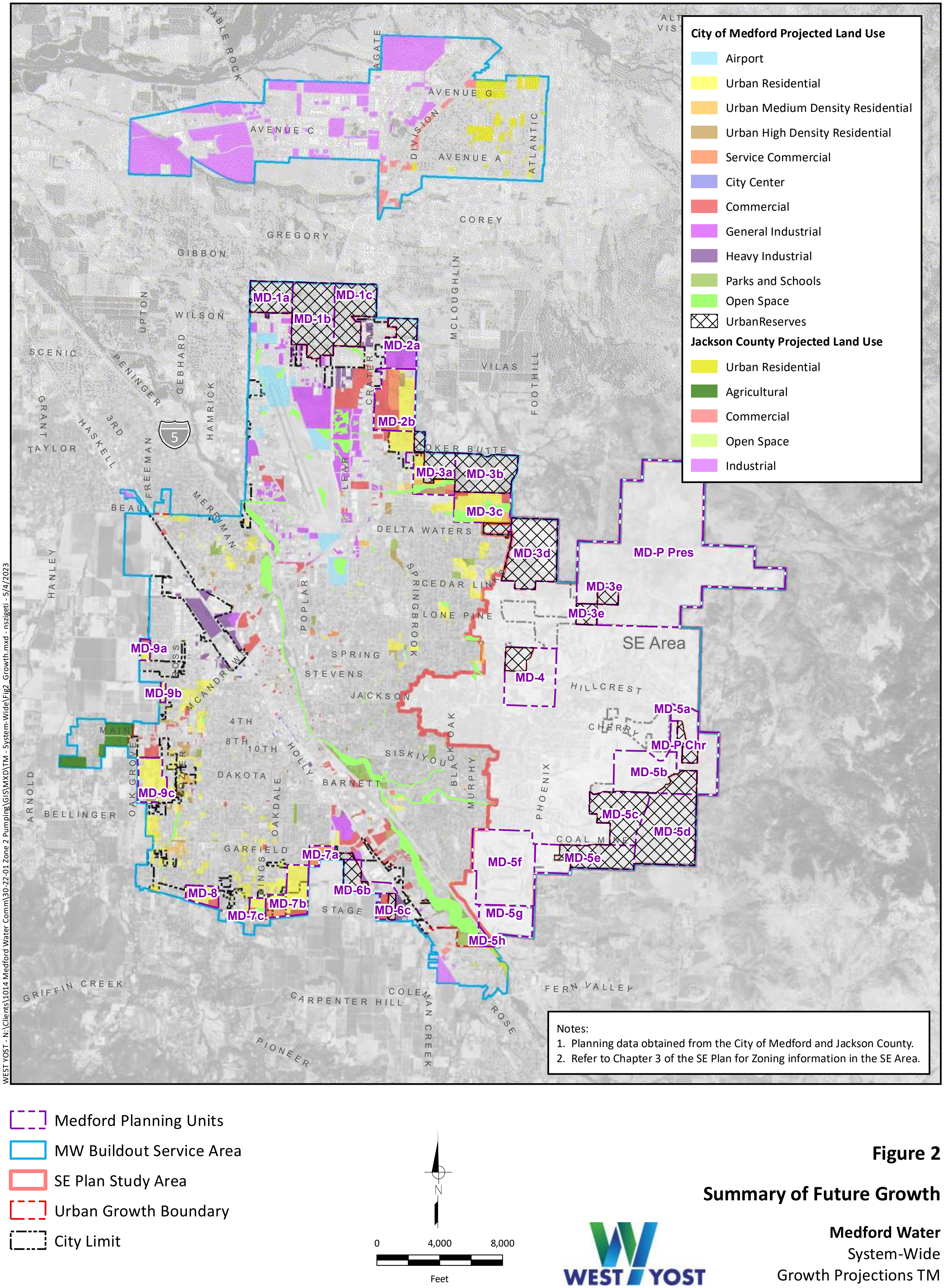


Figure 2

Summary of Future Growth

Medford Water
System-Wide
Growth Projections TM

Table 8. Summary of Projected Land Use and Future Growth													
Land Use Plan	Land Use	SE Plan		Gravity		River		Southwest		Barneburg		Total	
		Area, Acres	Dwelling Units	Area, Acres	Dwelling Units	Area, Acres	Dwelling Units	Area, Acres	Dwelling Units	Area, Acres	Dwelling Units	Area, Acres	Dwelling Units
Inside City of Medford SOI													
Within Medford UGB (2040)													
Medford Comprehensive Plan	Urban Residential	1,770.5	6,059	787.7	3,527	102.8	596	73.0	265	0.5	2	2,734.5	10,449
	Urban Medium Density Residential	72.9	1,016	26.5	280	5.9	88	16.0	140	0.0	0	121.3	1,524
	Urban High Density Residential	172.9	3,988	91.0	1,199	26.6	586	0.0	0	0.0	0	290.5	5,774
	Service Commercial	178.0	-	63.1	-	45.6	-	0.0	-	0.0	-	286.7	0
	Commercial	210.8	-	276.1	-	189.7	-	8.5	-	0.0	-	685.1	0
	City Center	0.0	-	5.1	-	0.0	-	0.0	-	0.0	-	5.1	0
	General Industrial	58.2	-	45.0	-	426.0	-	0.0	-	0.0	-	529.2	0
	Heavy Industrial	0.0	-	57.3	-	118.1	-	0.0	-	0.0	-	175.4	0
	Airport	0.0	-	0.0	-	220.5	-	0.0	-	0.0	-	220.5	0
	Parks and Schools / Open Space	2,189.5	-	133.7	-	19.7	-	0.0	-	0.0	-	2,342.9	0
	Inside Medford UGB Subtotal	**1,485.4**	**5,006**	**1,485.4**	**5,006**	**1,155.0**	**1,270**	**97.5**	**405**	**0.5**	**2**	**4,223.9**	**11,689**
Medford Urban Reserve (2070)													
Assumed	Varies - Refer to Table 6	1,235.2	3,025	393.3	1,178	1,217.6	0	0.0	0	0.0	0	2,846.1	4,202
	Medford Urban Reserve Subtotal	**1,235.2**	**3,025**	**393.3**	**1,178**	**1,217.6**	**0**	**0.0**	**0**	**0.0**	**0**	**2,846.1**	**4,202**
Outside City of Medford SOI (2040)													
Contiguous with Medford SOI													
Jackson County Comprehensive Plan	Urban Residential Land	-	-	12.0	123	0.2	0	0.0	0	0.0	0	12.2	123
	Commercial Land	-	-	5.6	-	0.0	-	0.0	-	0.0	-	5.6	0
	Industrial Land	-	-	29.9	-	5.6	-	0.0	-	0.0	-	35.5	0
	Agricultural Land	-	-	86.4	-	0.0	-	0.0	-	0.0	-	86.4	0
	Contiguous with Medford SOI Subtotal	**-**	**-**	**133.9**	**123**	**5.8**	**0**	**0.0**	**0**	**0.0**	**0**	**139.7**	**123**
White City Unincorporated Area													
Jackson County Comprehensive Plan	Urban Residential Land	-	-	0.0	0	157.0	1,490	0.0	0	0.0	0	157.0	1,490
	Commercial Land	-	-	0.0	-	62.9	-	0.0	-	0.0	-	62.9	0
	Industrial Land	-	-	0.0	-	912.5	-	0.0	-	0.0	-	912.5	0
	White City Unincorporated Area Subtotal	**-**	**-**	**0.0**	**0**	**1,132**	**1,490**	**0.0**	**0**	**0.0**	**0**	**1,132.3**	**1,490**
	Medford Water Total	**2,720.6**	**8,031**	**2,012.6**	**6,307**	**3,510.6**	**2,760**	**97.5**	**405**	**0.5**	**2**	**8,341.9**	**17,505**

UNIT WATER USE FACTORS

To develop land use-based water demand projections, water use factors (WUFs) developed from historical data and were then applied to the projected land uses. Water use factors were classified as residential, presented in gallons per day per dwelling units (gpd/DU), and non-residential, presented in gallons per day per acre (gpd/acre). The following subsections provide additional details on how unit water use factors were developed for residential and non-residential land use designations.

Residential Water Use Factors

To develop residential water use factors, West Yost reviewed meter consumption records for meters outside of the SE area that currently serve residential land uses. Only metered consumption for meters with an install date of 2017 and later were used, since future land uses are assumed to have similar construction standards as recently completed developments. WUFs developed for Single Family and Multi-family land use categories are described below.

The WUFs developed differ from those that were used in the SEMFP. This is based on input from MW. It is anticipated that residential water use within the SE Area will be larger due to the type of homes planned within this area (i.e., larger square footage with larger yards) compared to the more traditionally sized homes planned within the remainder of the MW's plan area.

Single Family Residential

For single family residential connections, the average water use was found to be 295 gallons per day per dwelling unit (gpd/du) (based on a total of 714 meters). Therefore, for this analysis and for the purposes of developing high end and low-end water demand projections, the following were used:

- High-end Projection: 295 gpd/du, based on the findings discussed above
- Low-end Projection: 266 gpd/du, which reduces the high-end projection 10 percent to account for potential future conservation efforts

Multi-Family Residential

The average water use for a multi-family residential connection was calculated as 1,591 gpd/du, based on 50-meter records with install dates since 2017. The resulting WUF from this recent data was found not to be representative of multi-family uses due to the few number of records available. Therefore the entire data set (i.e. all meters designated multi-family, irrespective of install date) was used instead. The average water use using the entire dataset was found to be 223 gpd/du. Therefore, for this analysis and for the purposes of developing high end and low-end water demand projections, the following estimates were used:

- High-end Projection: 225 gpd/du, based on the entire multi-family dataset
- Low-end Projection: 203 gpd/du, which reduces the high-end projection by 10 percent to account for potential future conservation efforts

Non-Residential Water Use Factors

To develop non-residential water use factors, West Yost reviewed meter consumption records for customer services outside of the SE area that are designated non-residential land uses. Due to the number of metered records available for these land uses, the entire dataset was utilized. WUFs developed for typical commercial/industrial and heavy industrial land uses are described below.

Typical Commercial/Industrial

Upon reviewing data, WUFs for commercial and industrial land uses were found to vary widely. Specifically, there were a few services with industrial land use designations that were found to have a very high unit water use (i.e., gpd per acre), resulting in a skewed average that would not be appropriate for use for projecting water demand system wide. The remainder of the data were found to not vary as significantly. Therefore, intensive water use industrial services were omitted from the evaluation and instead were used to define a Heavy Industrial land use factor, discussed in more detail below. For high end and low end water demand projections, the following were used:

- High-end Projection: 400 gpd/acre, based on the 75th percentile of values of the combined commercial and industrial customer meter consumption record information
- Low-end Projection: 45 gpd/acre, based on the 25th percentile of values of the combined commercial and industrial customer meter consumption record information

Heavy Industrial

As noted in the section above, there were a few commercial or industrial metered services that have a very high unit water use. These were used to define a Heavy Industrial water use, subsequently used to develop water demand projections for planned land uses that are designated as Heavy Industrial. To develop this factor, the 85th and 95th percentiles of the combined dataset were averaged, resulting in a water use factor of 3,750 gpd/acre. This factor was used for both low end and high end projections.

FUTURE WATER DEMAND PROJECTION

Water demands were projected for buildout of the Urban Growth Boundary (UGB) and the Urban Reserve Boundary (UR) using the factors described above and applying them to the future land uses. These demands established the basis for Future Water Production Requirements, which were estimated by adding the future water demand projections and future non-revenue water to the existing baseline water production. The following sections describe the future water demand / water production requirements in more detail.

Water Production Associated with Urban Growth Boundary at Buildout

Table 9 summarizes water production requirements for full development of the UGB. As summarized on Table 9, planned growth within the UGB is estimated to have a water production requirement ranging from 3.0 to 4.1 mgd for the areas outside the SEMFP area

Water Production Associated for Urban Reserve Boundary at Buildout

Table 10 summarizes water production requirements associated with planned growth for full development of the UR area. As summarized on Table 10, planned growth within the UR is estimated to have a water production requirement ranging from 2.6 mgd to 3.5 mgd. Note that this growth includes some areas that were previously included as part of the SEMFP area (i.e., Planning Units 3C, 3D, 4, and 5A-5E). If these Planning Units are omitted, since they are included within the SEMFP Area, the net increase in demand is estimated to range from 1.1 to 1.6 mgd. MW is considering serving Planning Units 3C and 3D from the River Zone. For the purposes of this study, it was assumed to continue to be served by the SEMFP area.

Table 9. Summary of Water Production Reqiured for Growth within the Urban Growth Boundary [(a)]

Land Use Group	Land Use Code	Water Use Factor	Units	Pressure Zone: Gravity Dwelling Units / Acreage	Gravity ADD, mgd	River Dwelling Units / Acreage	River ADD, mgd	Southwest Dwelling Units / Acreage	Southwest ADD, mgd	Barneburg Dwelling Units / Acreage	Barneburg ADD, mgd	Total Dwelling Units / Acreage	Total ADD, mgd
Low-End Projection													
Single Family Residential	SFR	266	gpd/du	3,527	0.94	2,086	0.55	265	0.07	2	0.00	5,880	1.56
Multi-Family Residential	MFR	203	gpd/du	1,479	0.30	674	0.14	140	0.03	0	0.00	2,294	0.46
Commercial/Industrial	C/I	45	gpd/acre	511	0.02	1,863	0.08	9	0.00	0	0.00	2,383	0.11
Heavy Industrial	HI	3,750	gpd/acre	57	0.21	118	0.44	0	0.00	0	0.00	175	0.66
Parks/Open Space	PS	0	gpd/acre	134	0.00	20	0.00	0	0.00	0	0.00	153	0.00
Non-Revenue Water for Future Growth (6 percent)					**0.09**		**0.08**		**0.01**		**0.00**	0	**0.18**
Total Low-End Projection				**5,006**	**1.57**	**2,760**	**1.29**	**405**	**0.11**	**2**	**0.00**	**8,174**	**2.97**
High-End Projection													
Single Family Residential	SFR	295	gpd/du	3,527	1.04	2,086	0.62	265	0.08	2	0.00	5,880	1.73
Multi-Family Residential	MFR	225	gpd/du	1,479	0.33	674	0.15	140	0.03	0	0.00	2,294	0.52
Commercial/Industrial	C/I	400	gpd/acre	511	0.20	1,863	0.75	9	0.00	0	0.00	2,383	0.95
Heavy Industrial	HI	3,750	gpd/acre	57	0.21	118	0.44	0	0.00	0	0.00	175	0.66
Parks/Open Space	PS	0	gpd/acre	134	0.00	20	0.00	0	0.00	0	0.00	153	0.00
Non-Revenue Water for Future Growth (6 Percent)					**0.11**		**0.12**		**0.01**		**0.00**		**0.25**
Total High-End Projection				**5,006**	**1.91**	**2,760**	**2.08**	**405**	**0.12**	**2**	**0.00**	**8,174**	**4.11**

(a) Growth within the southeast Medford Area is summarized in Chapter 3 of the SEMFP Report.

Table 10. Summary of Water Production Reqiured for Growth within the Urban Growth Boundary

Urban Reserve Area	Summary	Planning Unit	Land Use	Assumptions	Gross Area, acres	Representative Area for Calculating Water Use, acres	Number of DUs		Water Use Factor		Units	Projected Average Day Demand (includes 10% water loss), mgd	
MD-1	• Based on surrounding comprehensive plan land uses within the UGB. • The MD-1a and MD-1b areas are assumed to be industrial.	1a, 1b	Commercial/Light Industrial	• 100% of gross area	385.2	385.2	-	-	45	400	gpd/acre	0.02	0.16
	• Based on surrounding comprehensive plan land uses within the UGB. • The MD-1c area is assumed to be Heavy Industrial.	1-c	Heavy Industrial	• 100% of gross area	173.6	173.6	-	-	3,750	3,750	gpd/acre	0.69	0.69
				MD-1 Subtotal:	**558.9**	-	**0.0**	**0.0**	-	-	-	**0.71**	**0.86**
MD-2	• Based on surrounding general plan land uses within the UGB. • The portion of MD-2 within Planning Unit MD-2a is assumed to be 50% Commercial and 50% Industrial • The portion of MD-2 within planning unit MD-2b is assumed to be 100% residential.	2a	Commercial/Light Industrial	• 100% of area within planning unit(s)	678.6	658.7	-	-	45	400	gpd/acre	0.03	0.28
		2b	Residential	• 100% of area within planning unit(s) • Density = 4.0 DU/acre		19.9		80	266	295	gpd/DU	0.00	0.02
				MD-2 Subtotal:	**678.6**	-	**0.0**	**79.5**	-	-	-	**0.03**	**0.31**
MD-3	• The portion of MD-3 within Planning Units MD-3a and MD-3b are based on adopted Urbanization Plans (2b, 3a, 3c) for the adjacent land within the UGB: • The average dwelling unit density based on gross area (including residential and non-residential land uses) is 4 DU/acre. • To account for non-residential uses, 10 percent of the gross area is assumed to be commercial land uses. • The portion of MD-3 within Planning Units MD-3c and MD-3d fall within the SE Plan boundary and are assumed to develop similar to MD-3a/3b above, but with a variable density: • The average dwelling unit density based on gross area is 3.8 DU/acre, and reduced by 75 percent in Zones 3 and above. • To account for non-residential land uses, 10 percent of the gross area is assumed to be commercial land uses. • The portion of MD-3 within Planning Unit MD-3e falls within the SE Plan boundary and is assumed to be 100% residential, and develop at a reduced density due to the steep topography	3a, 3b	Residential	• Number of DUs calculated based on total area within planning unit(s) • Density = 4.0 DU/acre	689.2	284.4	1,138	1,138	266	295	gpd/DU	0.32	0.36
		3a, 3b	Commercial/Light Industrial	• 10% of total area within planning unit(s)		28.4	-	-	45	400	gpd/acre	0.00	0.01
		3c, 3d	Residential	• 100% of gross area • Density = varies by pressure zone • SE Area water use factors		324.2	1,185	1,232	356	395	gpd/DU	0.45	0.52
		3c, 3d	Commercial/Light Industrial	• 10% of total area within planning unit(s)		32.4	-	-	45	400	gpd/acre	0.00	0.01
		3e	Residential	• Number of DUs calculated based on area within planning unit • Density = 2.9 DU/acre • SE Area water use factors		80.6	230	306	356	395	gpd/DU	0.09	0.13
				MD-3 Subtotal:	**689.2**	-	**2551.9**	**2675.7**	-	-	-	**0.86**	**1.03**
MD-4	Based on the adopted Urbanization Plan for MD-4, the majority of this area will be reserved for open space when it is brought into the City's UGB. No growth in water demand is assumed for this area.	4	Open Space	• 100% of gross area • No growth in water demand	50.7	50.7	-	-	0	0	gpd/acre	0.00	0.00
				MD-4 Subtotal:	**50.7**	-	**0.0**	**0.0**	-	-	-	**0.00**	**0.00**
MD-5	Based on surrounding comprehensive plan land uses within the UGB. The entire MD-5 area is assumed to be residential.	5a, 5b, 5c, 5d, 5e	Residential	• 100% of gross area; • Density = varies by pressure zone • SE Area water use factors	779.7	779.7	2,551	2,963	356	395	gpd/DU	0.96	1.25
				MD-5 Subtotal:	**779.7**	-	**2550.8**	**2963.2**	-	-	-	**0.96**	**1.25**
MD-6	Based on surrounding comprehensive plan land uses within the UGB. The entire MD-6 area is assumed to be industrial.	6a, 6b, 6c	Commercial/Light Industrial	• 100% of gross area	89.0	89.0	-	-	45	400	gpd/acre	0.00	0.04
				MD-6 Subtotal:	**89.0**	-	**0.0**	**0.0**	-	-	-	**0.00**	**0.04**
				Totals:	**2,846**	**-**	**5,103**	**5,718**	**-**	**-**	**-**	**2.57**	**3.47**

Water Production Associated with Wholesale Areas

There is limited growth information available for the wholesale customer areas. Therefore, future water production requirements were based on the average per capita water use, based on 2016 through 2021 information, multiplied by the projected population for each respective wholesale customer. Population projections are based on the information published by the Portland State University Population Research Center. Table 11 below summarizes the existing average production and projected growth by 2040 and 2070. As shown on Table 11, Wholesale demands are estimated to increase 24 percent by 2040 and 54 percent by 2070.

Table 11. Summary of Wholesale Existing and Future Water Production Requirements

Wholesale Customer	Existing Average Water Production Requirement (Average form 2016 – 2021)	Population Growth Rate assumed through 2040 / after 2040 to 2070	2040 Projected Wholesale Water Production Requirement	2070 Projected Wholesale Water Production Requirement
Ashland	Refer to TAP Meter			
Central Point	2.74	0.6% / 0.5%	3.48	4.16
Eagle Point	1.58	0.8% / 0.6%	2.00	2.54
Jacksonville	0.69	0.3% / 0.5%	0.77	0.88
Phoenix Meter	0.26	0.9% / 0.2%	0.31	0.41
TAP Meter	1.37	1.0% / 0.8%	1.67	2.27
Total (Incremental Increase from Existing)	**6.64**	**--**	**8.23 (+1.59)**	**10.25 (+3.62)**

Future Water Production Requirement

Table 12 below summarizes the overall future retail water production requirement system wide, including demands associated with the SEMFP Area. Details associated with growth within the SEMFP area are included in Chapter 3 of the SEMFP Report. As shown on Table 12, existing retail average day demand is approximately 21 mgd. By buildout of the UGB this is expected to increase to a range from 27.4 mgd to 29.6 mgd (representing a 30 to 41 percent increase), and by buildout of the UR this is expected to range from 29.6 mgd to 32.5 mgd (representing a 41 to 55 percent increase, or an 11 to 14 percent increase from growth associated with the UGB.

Table 12. Summary of Future Retail Water Demands

Demand Component	Average Day Demand by Pressure Zone, mgd					Study Area (Total)
	Gravity	River	Southwest	Barneburg	SEMFP Area	
Existing	11.33	5.95	0.23	0.22	3.27	20.99
Low-End Projection						
Projected UGB	1.60	1.29	0.11	0.00	3.44	6.44
Projected Urban Reserve	0.33	0.74	0.00	0.00	1.10	2.17
Total at Buildout of the UGB	**12.93**	**7.24**	**0.33**	**0.22**	**6.71**	**27.43**
Total at Buildout of the Urban Reserve	**13.25**	**7.99**	**0.33**	**0.22**	**7.81**	**29.60**
High-End Projection						
Projected UGB	1.95	2.08	0.12	0.00	4.43	8.58
Projected Urban Reserve	0.43	1.14	0.00	0.00	1.43	3.00
Total at Buildout of the UGB	**13.27**	**8.03**	**0.35**	**0.22**	**7.70**	**29.57**
Total at Buildout of the Urban Reserve	**13.70**	**9.17**	**0.35**	**0.22**	**9.13**	**32.56**

Table 13 summarizes the total overall future water production requirement, for both retail and wholesale customers. As shown on Table 13, the projected growth by 2040 results in an estimated water production requirement ranging from 36.3 mgd to 38.5 mgd (or about a 28 to 36 percent increase from existing conditions). The projected growth by 2040 results in an estimated water production requirement ranging from 40.5 mgd to 43.5 mgd (or about a 43 to 54 percent increase from existing conditions).

Table 13. Summary of Overall Future Water Production Requirement (Retail and Wholesale)

Demand Component	Total Average Day Demand, mgd	Notes
Existing Retail Demand	21.4	Refer to Table 5, note that 0.42 mgd is associated with BBS Customers, which are outside of Medford City Limits
Existing Wholesale Demand	6.9	Refer to Table 5
Subtotal Existing Demand	*28.3 mgd*	
Future Demands Associate with Buildout of UGB	6.4 to 8.6	Assumed to develop by 2040, Low – High Range. Refer to Table 12
Future Demands Associate with Buildout of UR	2.2 – 3.0	Assumed to Develop by 2070, Low and High Range. Refer to Table 12
Future Wholesale Demand	1.6 by 2040; 3.6 by 2070	Values Represent incremental growth beyond existing demand. Refer to Table 11
Total Future Average Day Demand by 2040	**36.3 to 38.5**	**Low – High Range**
Total Future Average Demand by 2070	**40.5 to 43.5**	**Low – High Range**

Demands presented in Table 13 are expressed in average day demands. Previous analyses have estimated that the overall system wide peaking factor from average day demand to maximum day demand is approximately 2.11 (including both retail and wholesale demands). Therefore, the projected water production requirement on the maximum day by 2040 is estimated to range from 76.6 mgd to 81.2 mgd. By 2070 the projected water production requirement on the maximum day by 2070 is estimated to range 85.5 mgd to 91.8 mgd. Medford Water should reassess these peaking factors and the timing associated with water supply expansions at the Duff Water Treatment Plant.

EQUIVALENT RESIDENTIAL UNIT ANALYSIS

Table 14 below summarizes the estimated additional equivalent residential units (ERUs) associated with the growth demand associated with Medford Water's retail demand. The purpose of this analysis is to equate the amount of growth in projected demand for Medford Water's retail service area to the equivalent number of residential units. Note that this analysis excludes future wholesale demand.

Medford Water can use these estimates to assess how many ERUs are expected to be built in the future and to determine associated development impact fees. However, it is recommended that Medford Water expand this analysis further to include an analysis of existing available supply, storage and pumping to determine how many ERUs existing infrastructure can accommodate and to establish triggers for when additional supply, storage or pumping is required. Note that a detailed ERU analysis was prepared for the SEMFP area and is included in Appendix H of the SEMFP area Report.

Table 14. Summary of Estimated ERUs (excluding Wholesale Customers)

Timeframe	Incremental Increase in Average Day Demand	ERUs
Buildout of UGB (2040)	8.0 to 10.2	30,132 to 34,576
Buildout of UR (2070)	8.6 to 11.6	32,392 to 39,322

Appendix C

Pumping Capacity Evaluation

Table C-1. Comparison of Available versus Required Pumping Capacity - North Tributary Area								
				Required Pumping, mgd[c][d]		Pumping Surplus (Deficit)	
Zone	Pump Station(s)[a]	Firm Capacity, mgd[b]	Total Firm Capacity, mgd	UGB (2040)	Urban Reserve (2070)	UGB (2040)	Urban Reserve (2070)
1	Lone Pine	3.60	7.86	6.78	7.08	1.08	0.78
	Brookdale	3.25					
	Pierce Heights	1.01					
2	-	0.00	0.00	4.83	5.13	(4.83)	(5.13)
3	Hillcrest	2.15	2.15	3.42	3.72	(1.27)	(1.57)
4	Angelcrest	1.73	1.73	2.74	3.04	(1.01)	(1.31)
5	Stardust	0.50	0.50	1.29	1.48	(0.79)	(0.98)
6	-	0.00	0.00	0.43	0.50	(0.43)	(0.50)
7	-	0.00	0.00	0.26	0.33	(0.26)	(0.33)

(a) Pump stations are allocated to a tributary area based on the physical location of the pump station.

(b) Refer to Table 2-3

(c) Required pumping capacity shown in this table is equal to the MDD of the Zone plus all supported zones for Zones 1-5 (zones with gravity storage), and equal to the MDD of the Zone for Zones 6-7 (hydropneumatic zones). The fire flow requirement has been omitted from this table for Zones 6 and 7, however, pump stations to serve these zones must be sized to include 1,500 gpm of firm capacity in addition to the deficit shown (refer to Chapter 5, Table 5-7). It is assumed that this volume is pumped within an 18-hour period.

(d) Required pumping capacity is based on the average of the low-end and high-end projected demands presented in Appendix A, Table A-5.

mgd - million gallons per day

UGB = Urban Growth Boundary

MDD = maximum day demand

Table C-2. Comparison of Available versus Required Pumping Capacity - South Tributary Area							
				Required Pumping, mgd[c]		Pumping Surplus (Deficit)	
Zone	Pump Station(s)[a]	Firm Capacity, mgd[b]	Total Firm Capacity	UGB (2040)	Urban Reserve (2070)	UGB (2040)	Urban Reserve (2070)
1	-	0.00	0.00	9.89	12.58	(9.89)	(12.58)
2	Stanford	2.65	2.65	4.09	6.67	(1.44)	(4.02)
3	-	0.00	0.00	1.51	2.75	(1.51)	(2.75)
4	-	0.00	0.00	0.83	1.61	(0.83)	(1.61)
5	-	0.00	0.00	0.27	0.34	(0.27)	(0.34)
6	-	0.00	0.00	0.01	0.01	(0.01)	(0.01)
7	-	0.00	0.00	0.00	0.00	0.00	0.00

(a) Pump stations are allocated to a tributary area based on the physical location of the pump station.

(b) Refer to Table 2-3

(c) Required pumping capacity is based on the average of the low-end and high-end projected demands presented in Appendix A, Table A-6.

mgd - million gallons per day

UGB = Urban Growth Boundary

Appendix D

Storage Capacity Evaluation

Table D-1. Comparison of Available versus Required Storage Capacity - North Tributary Area, MG												
				Equalization[b]		Emergency[c]			Total Required Storage		Surplus (Deficit)	
Zone	Tank(s)[a]	Capacity	Total Capacity	UGB (2040)	Urban Reserve (2070)	UGB (2040)	Urban Reserve (2070)	Fire[d]	UGB (2040)	Urban Reserve (2070)	UGB (2040)	Urban Reserve (2070)
1	-	0.00	0.00	0.37	0.37	0.86	0.86	-	1.23	1.23	(1.23)	(1.23)
2	Lone Pine #2	1.00	1.14	0.26	0.26	0.53	0.53	-	0.79	0.79	0.35	0.35
	Hillcrest #2	0.14										
3	Hillcrest #3	0.10	1.1	0.13	0.13	0.46	0.46	-	0.59	0.59	0.51	0.51
	Lone Pine #3	1.00										
4	Stardust	0.18	0.68	0.27	0.29	0.54	0.58	-	0.82	0.87	(0.14)	(0.19)
	Cherry Lane #4	0.50										
5[e]	Highlands	0.50	0.50	0.24	0.28	0.50	0.57	-	0.74	0.85	(0.24)	(0.35)

(a) Reservoirs are allocated to a tributary area based on the physical location of the Reservoir.

(b) Equalization storage required is equal to 25 percent of the maximum day demand (refer to Chapter 4).

(c) Emergency storage required is equal to 100 percent of the average day demand of the pressure zone (refer to Chapter 4). Refer to Table D-3 for an alternative storage capacity evaluation in which all emergency storage is consolidated in Zones 1 and 2.

(d) Fire storage required is equal to the largest fire flow event in the pressure zone times its duration (refer to Chapter 4). No fire storage requirement is included in the North evaluation as land uses with the largest fire flow requirement in each pressure zone are located in the South tributary area. This assumes storage volume would be provided by local storage and recovered by storage in the South.

(e) Total required storage for Zone 5 includes storage required for growth in Zones 6 and 7.

UGB = Urban Growth Boundary

MG = million gallons

Table D-2. Comparison of Available versus Required Storage Capacity - South Tributary Area, MG												
				Equalization[b]		Emergency[c]			Total Required Storage		Surplus (Deficit)	
Zone	Tank(s)[a]	Capacity	Total Capacity	UGB (2040)	Urban Reserve (2070)	UGB (2040)	Urban Reserve (2070)	Fire[d]	UGB (2040)	Urban Reserve (2070)	UGB (2040)	Urban Reserve (2070)
1	Barnett	2.00	3.5	1.09	1.11	2.56	2.60	0.96	4.61	4.67	(1.11)	(1.17)
	Stanford	1.50										
2	-	0.00	0	0.48	0.73	0.97	1.47	0.54	1.99	2.74	(1.99)	(2.74)
3	-	0.00	0	0.13	0.21	0.47	0.78	0.54	1.14	1.53	(1.14)	(1.53)
4	-	0.00	0	0.10	0.24	0.21	0.48	0.54	0.85	1.26	(0.85)	(1.26)
5	-	0.00	0.00	0.05	0.06	0.10	0.13	0.00	0.15	0.19	(0.15)	(0.19)

(a) Reservoirs are allocated to a tributary area based on the physical location of the Reservoir.

(b) Equalization storage required is equal to 25 percent of the maximum day demand (refer to Chapter 4).

(c) Emergency storage required is equal to 100 percent of the average day demand of the pressure zone (refer to Chapter 4). Refer to Table D-3 for an alternative storage capacity evaluation in which all emergency storage is consolidated in Zones 1 and 2.

(d) Fire storage required is equal to the largest fire flow event in the pressure zone times its duration (refer to Chapter 4). MW opted to exclude fire storage in Zone 5 and rely on pumping with on-site back-up power, to minimize reservoir size.

UGB = Urban Growth Boundary

MG = million gallons

Table D-3. Alternative Comparison of Available versus Required Storage Capacity - North Tributary Area, MG

Zone	Tank(s)[a]	Capacity	Total Capacity	Equalization[b] UGB (2040)	Equalization[b] Urban Reserve (2070)	Emergency[c] UGB (2040)	Emergency[c] Urban Reserve (2070)	Fire[d]	Total Required Storage UGB (2040)	Total Required Storage Urban Reserve (2070)	Surplus (Deficit) UGB (2040)	Surplus (Deficit) Urban Reserve (2070)
1	-	0.00	0.00	0.37	0.37	0.86	0.86	-	1.98	2.03	(1.98)	(2.03)
2	Lone Pine #2	1.00	1.14	0.26	0.26	0.53	0.53	-	1.54	1.60	(0.40)	(0.46)
	Hillcrest #2	0.14										
3	Hillcrest #3	0.10	1.1	0.13	0.13	0.46	0.46	-	0.13	0.13	0.97	0.97
	Lone Pine #3	1.00										
4	Stardust	0.18	0.68	0.27	0.29	0.54	0.58	-	0.27	0.29	0.41	0.39
	Cherry Lane #4	0.50										
5	Highlands	0.50	0.50	0.24	0.28	0.50	0.57	-	0.24	0.28	0.26	0.22

(a) Reservoirs are allocated to a tributary area based on the physical location of the Reservoir.

(b) Equalization storage required is equal to 25 percent of the maximum day demand (refer to Chapter 4).

(c) Emergency storage required is equal to 100 percent of the average day demand of the pressure zone (refer to Chapter 4). This table consolidates the emergency storage for all pressure zones and distributes it equally between Zones 1 and 2.

(d) Fire storage required is equal to the largest fire flow event in the pressure zone times its duration (refer to Chapter 4). No fire storage requirement is included in the North evaluation as land uses with the largest fire flow requirement in each pressure zone are located in the South tributary area. This assumes storage volume would be provided by local storage and recovered by storage in the South.

UGB = Urban Growth Boundary

MG = million gallons

Table D-4. Alternative Comparison of Available versus Required Storage Capacity - South Tributary Area, MG

Zone	Tank(s)[a]	Capacity	Total Capacity	Equalization[b] UGB (2040)	Equalization[b] Urban Reserve (2070)	Emergency[c] UGB (2040)	Emergency[c] Urban Reserve (2070)	Fire[d]	Total Required Storage UGB (2040)	Total Required Storage Urban Reserve (2070)	Surplus (Deficit) UGB (2040)	Surplus (Deficit) Urban Reserve (2070)
1	Barnett	2.00	3.5	1.09	1.11	2.56	2.60	0.96	5.00	5.37	(1.50)	(1.87)
	Stanford	1.50										
2	-	0.00	0	0.48	0.73	0.97	1.47	0.54	2.38	3.44	(2.38)	(3.44)
3	-	0.00	0	0.13	0.21	0.47	0.78	0.54	0.67	0.75	(0.67)	(0.75)
4	-	0.00	0	0.10	0.24	0.21	0.48	0.54	0.64	0.78	(0.64)	(0.78)
5	-	0.00	0.00	0.05	0.06	0.10	0.13	0.00	0.05	0.06	(0.05)	(0.06)

(a) Reservoirs are allocated to a tributary area based on the physical location of the Reservoir.

(b) Equalization storage required is equal to 25 percent of the maximum day demand (refer to Chapter 4).

(c) Emergency storage required is equal to 100 percent of the average day demand of the pressure zone (refer to Chapter 4). This table consolidates the emergency storage for all pressure zones and distributes it equally between Zones 1 and 2.

(d) Fire storage required is equal to the largest fire flow event in the pressure zone times its duration (refer to Chapter 4). MW opted to exclude fire storage in Zone 5 and rely on pumping with on-site back-up power, to minimize reservoir size.

UGB = Urban Growth Boundary

MG = million gallons

Table D-4. Proposed Storage Summary

Facility Name	Facility Type[a][b]	Zone(s) Served by Gravity	Zone(s) Served by On-Site Pumping	Timing	Capacity, MG		Change in Capacity, MG
					Emergency Storage in Each Zone	Emergency Storage Consolidated in Zones 1 and 2	
New Facilities							
TN1	Pump to Tank	1	2,3	UGB	1.3	2.5	1.20
TS1	Pump to Tank	1	2	UGB	1.2	1.9	0.70
TC2	Pump to Tank	2	3	UGB	2.0	2.4	0.40
TC3	Pump to Tank	3	5	UGB	1.3	0.8	(0.50)
TN4	Pump to Tank	4	6,7	UGB	0.3	0.3	0.00
TC4-7	Nested	4,5	6,7	UGB	1.6	0.8	(0.80)
TS2	Pump to Tank	2	3,4	Urban Reserve	0.8	1.1	0.30
TS3-4	Nested	3,4	-	Urban Reserve	0.9	0.3	(0.60)
Retired Facilities							
Hillcrest #2	Pump to Tank	2	3	End of useful life	0.14	N/A	N/A
Hillcrest #3	Pump to Tank	3	-	End of useful life	0.10	N/A	N/A
Stardust	Pump to Tank	4	5	End of useful life	0.18	N/A	N/A

(a) Pump to Tank is defined as a storage facility generally intended to serve a single pressure zone by gravity.

(b) Nested is defined as a storage facility generally intended to serve multiple pressure zones by gravity, through the use of pressure reducing valves.

UGB = Urban Growth Boundary

MG = million gallons

Table D-5. Proposed Storage Summary							
Facility Name	Facility Type[(a)(b)]	Zone(s) Served by Gravity	Zone(s) Served by On-Site Pumping	Timing	Capacity, MG: Emergency Storage in Each Zone	Capacity, MG: Emergency Storage Consolidated in Zones 1 and 2	Change in Capacity, MG
New Facilities							
TN1	Pump to Tank	1	2,3	UGB	1.3	2.5	1.20
TS1	Pump to Tank	1	2	UGB	1.2	1.9	0.70
TC2	Pump to Tank	2	3	UGB	2.0	2.4	0.40
TC3	Pump to Tank	3	5	UGB	1.3	0.8	(0.50)
TN4	Pump to Tank	4	6,7	UGB	0.3	0.3	0.00
TC4-7	Nested	4,5	6,7	UGB	1.6	0.8	(0.80)
TS2	Pump to Tank	2	3,4	Urban Reserve	0.8	1.1	0.30
TS3-4	Nested	3,4	-	Urban Reserve	0.9	0.3	(0.60)
Retired Facilities							
Hillcrest #2	Pump to Tank	2	3	End of useful life	0.14	N/A	N/A
Hillcrest #3	Pump to Tank	3	-	End of useful life	0.10	N/A	N/A
Stardust	Pump to Tank	4	5	End of useful life	0.18	N/A	N/A

(a) Pump to Tank is defined as a storage facility generally intended to serve a single pressure zone by gravity.

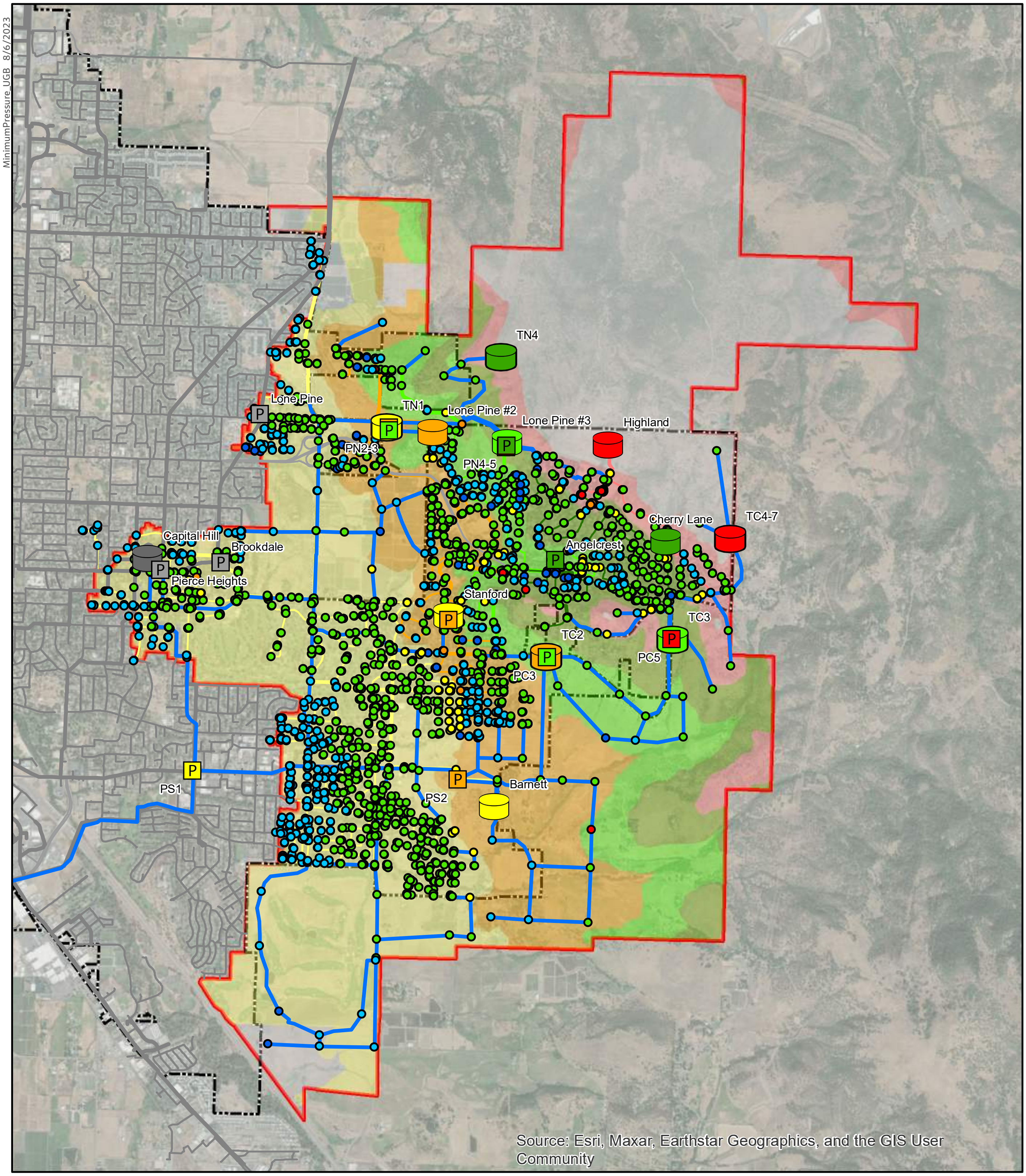
(b) Nested is defined as a storage facility generally intended to serve multiple pressure zones by gravity, through the use of pressure reducing valves.

UGB = Urban Growth Boundary

MG = million gallons

Appendix E

Hydraulic Model Results – System Pressure and Fire Flow



SE Plan Study Area

City Limit

Pump Station

Reservoir

Pipelines

Diameter <12"

Diameter ≥ 12"

Pressure (psi)

< 20

20 - 30

30 - 40

40 - 80

80 - 100

100 - 150

>150

Pressure Zone

Other Zones

Zone 1

Zone 2

Zone 3

Zone 4

Zone 5

N

0 2,000 4,000

Feet

FIGURE E-1

Minimum Pressure
Buildout of the Urban Growth Boundary

Medford Water
Southeast Medford Water Facilities Plan

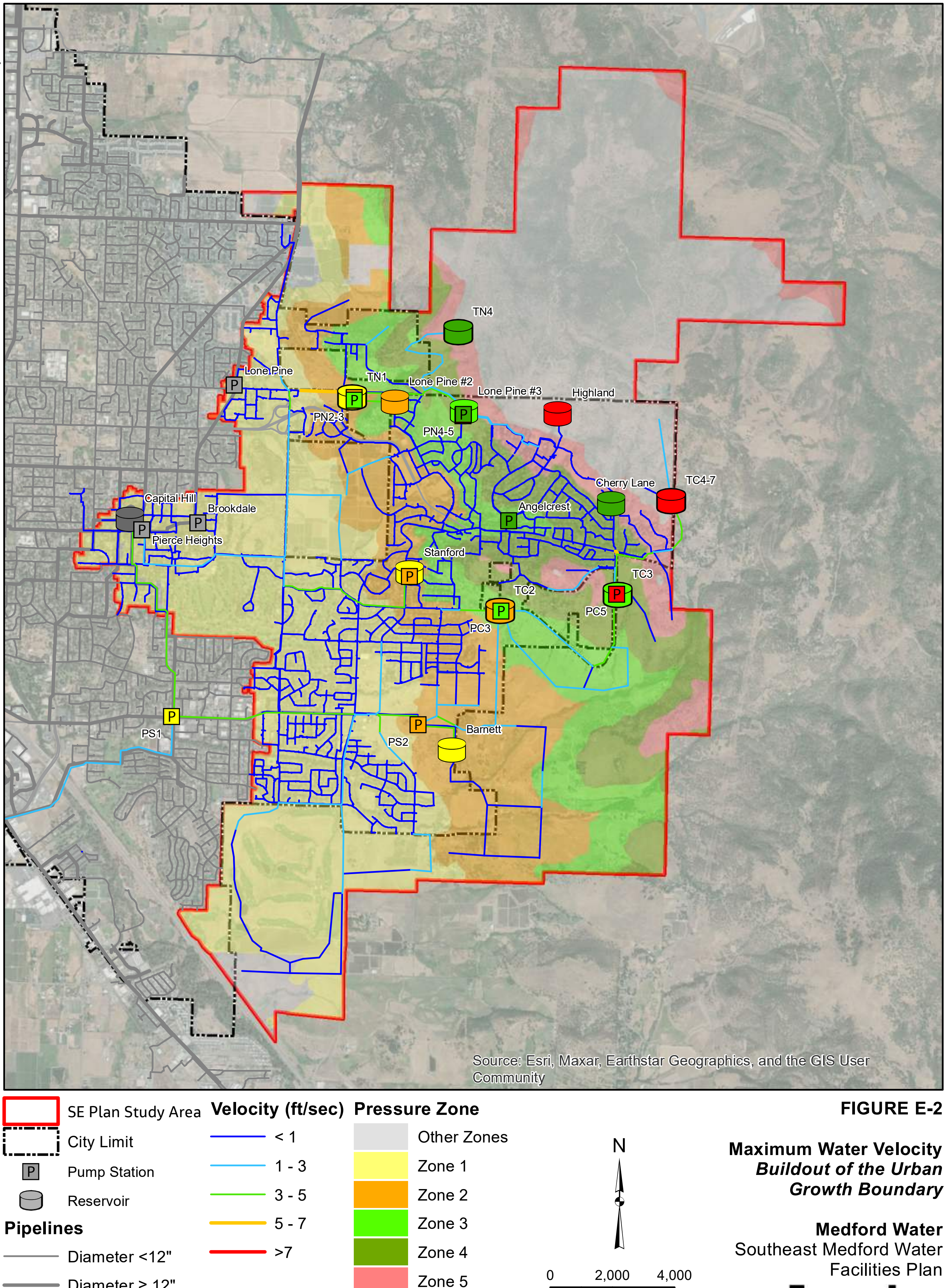
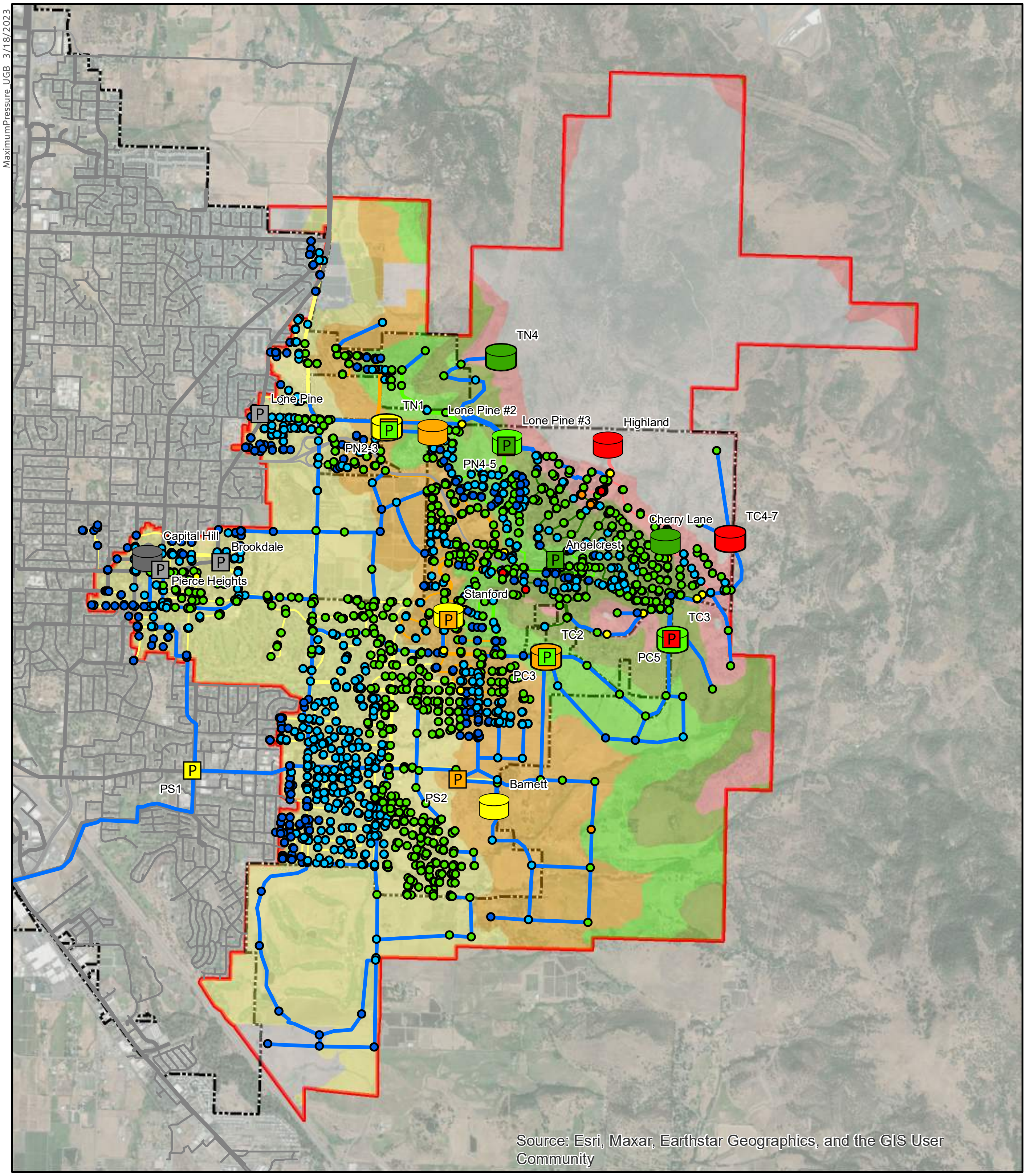


FIGURE E-2

Maximum Water Velocity
Buildout of the Urban Growth Boundary

Medford Water
Southeast Medford Water Facilities Plan

Jacobs



SE Plan Study Area

City Limit

Pump Station

Reservoir

Pipelines

Diameter <12"

Diameter ≥ 12"

Pressure (psi)

- < 20
- 20 - 30
- 30 - 40
- 40 - 80
- 80 - 100
- 100 - 150
- >150

Pressure Zone

- Other Zones
- Zone 1
- Zone 2
- Zone 3
- Zone 4
- Zone 5

N

0 2,000 4,000

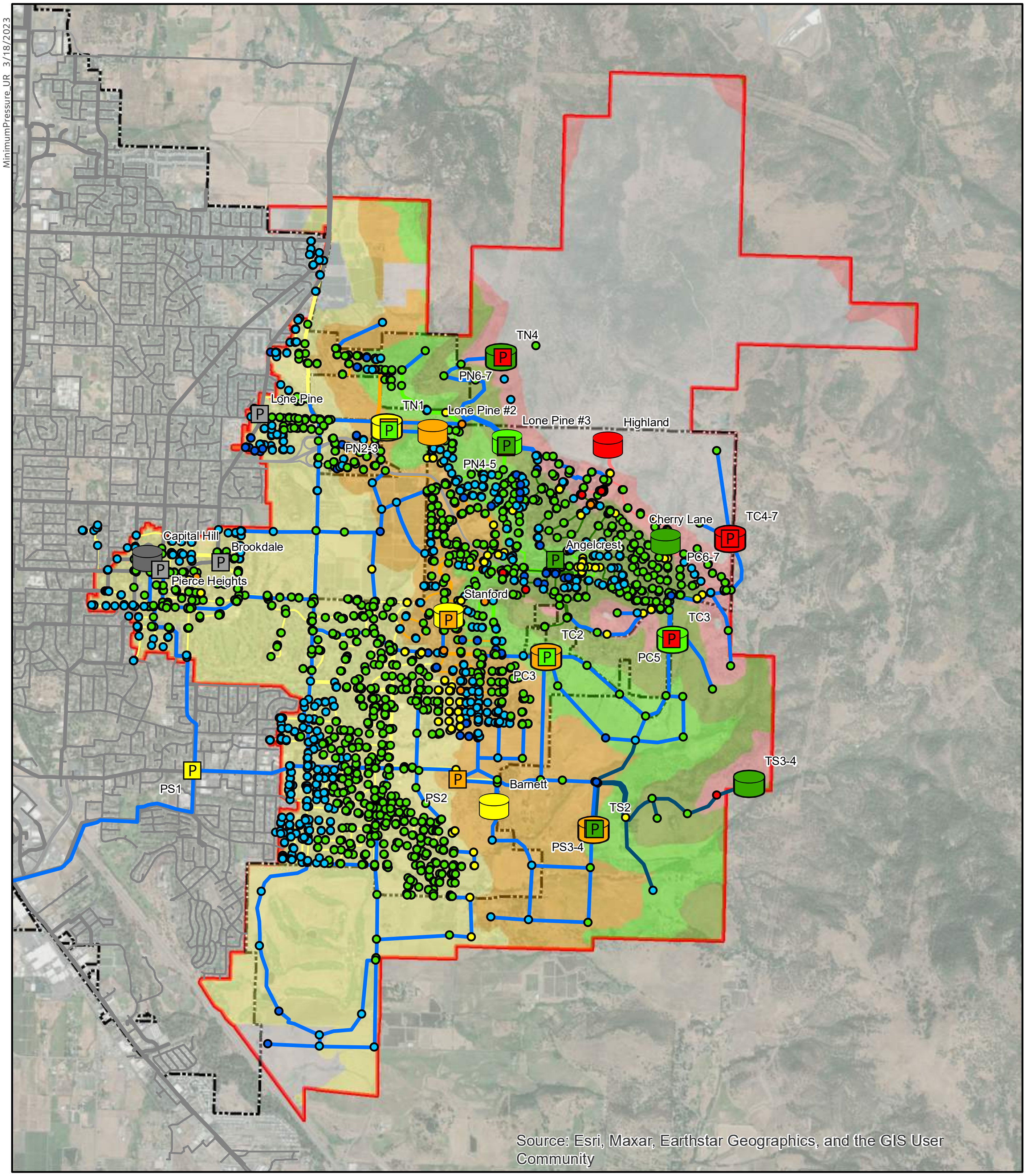
Feet

FIGURE E-3

Maximum Pressure Buildout of the Urban Growth Boundary

Medford Water
Southeast Medford Water Facilities Plan

Jacobs



SE Plan Study Area

City Limit

Pump Station

Reservoir

Pipelines

Diameter <12"

Diameter ≥ 12"

Pressure (psi)

- < 20
- 20 - 30
- 30 - 40
- 40 - 80
- 80 - 100
- 100 - 150
- >150

Pressure Zone

- Other Zones
- Zone 1
- Zone 2
- Zone 3
- Zone 4
- Zone 5

N

0 2,000 4,000

Feet

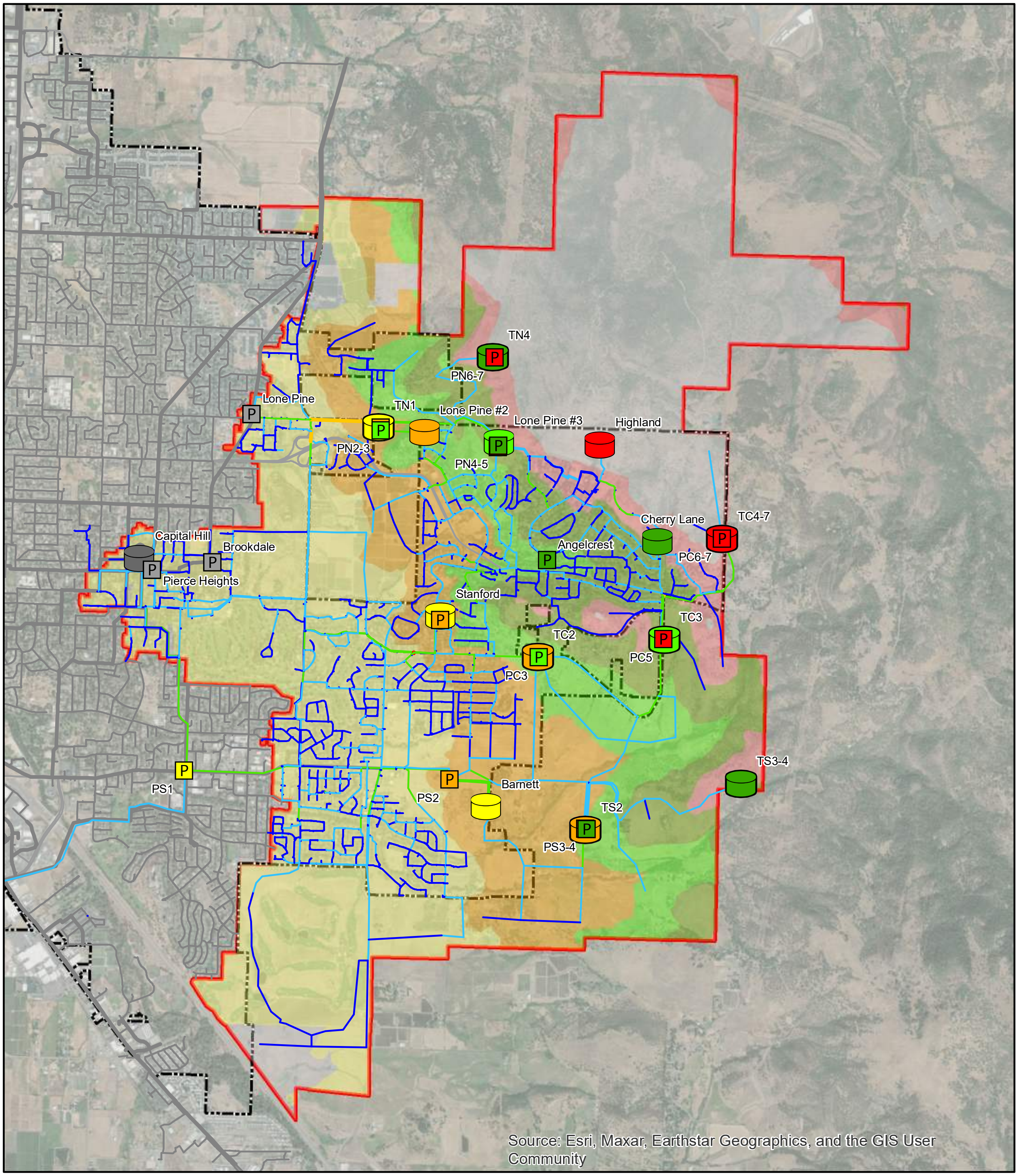
FIGURE E-4

Minimum Pressure Buildout of the Urban Reserve Boundary

Medford Water

Southeast Medford Water Facilities Plan

Jacobs



SE Plan Study Area
City Limit
Pump Station
Reservoir

Pipelines
Diameter <12"
Diameter ≥ 12"

Velocity (ft/sec)
< 1
1 - 3
3 - 5
5 - 7
>7

Pressure Zone
Other Zones
Zone 1
Zone 2
Zone 3
Zone 4
Zone 5

N

0 2,000 4,000
Feet

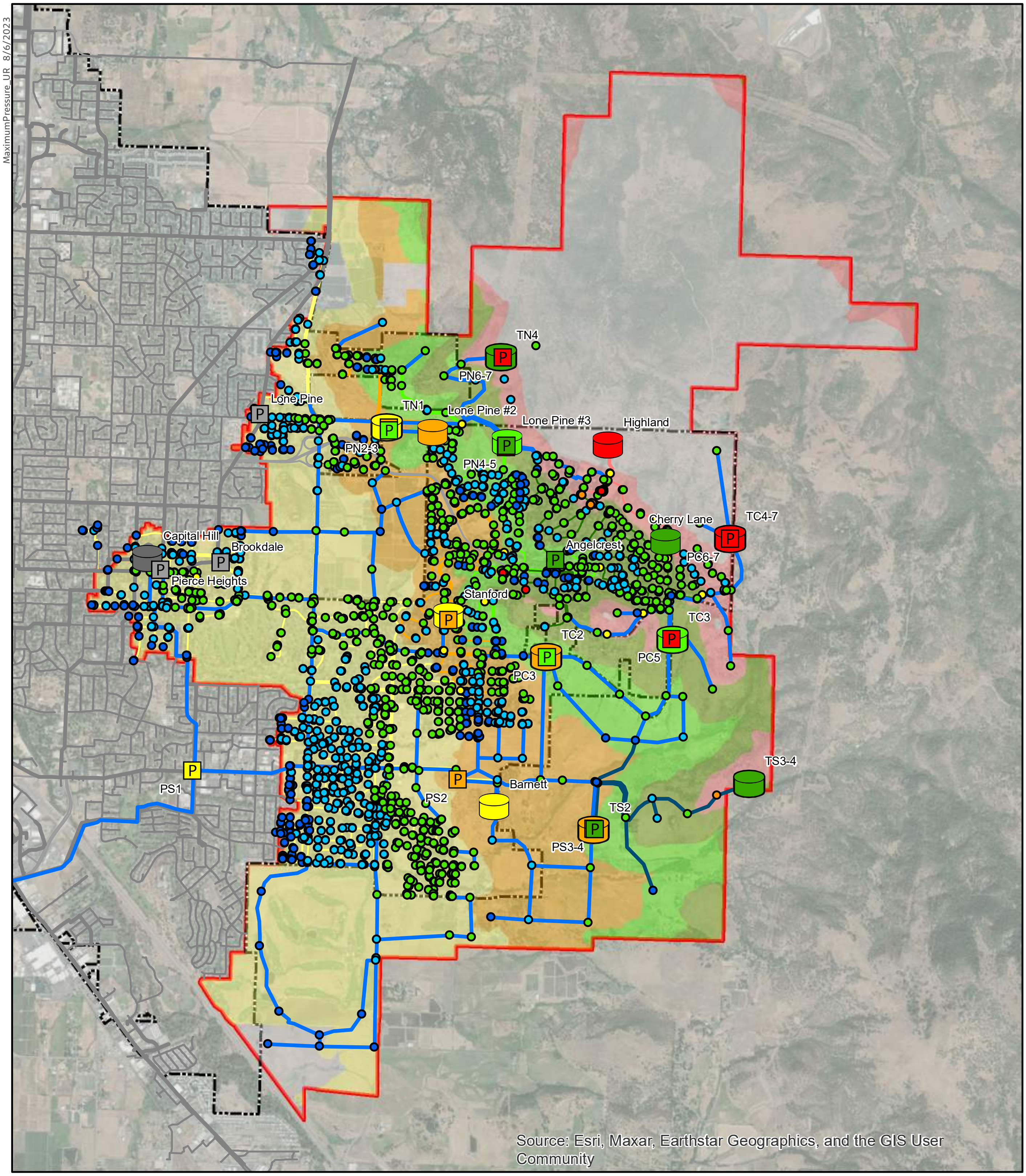
FIGURE E-2

Maximum Water Velocity
Buildout of the Urban Reserve Boundary

Medford Water
Southeast Medford Water Facilities Plan

Jacobs

MaximumPressure_UR 8/6/2023



SE Plan Study Area

City Limit

P Pump Station

Reservoir

Pipelines

Diameter <12"

Diameter ≥ 12"

Pressure (psi)

- < 20
- 20 - 30
- 30 - 40
- 40 - 80
- 80 - 100
- 100 - 150
- >150

Pressure Zone

- Other Zones
- Zone 1
- Zone 2
- Zone 3
- Zone 4
- Zone 5

N

0 2,000 4,000
Feet

FIGURE E-6

Maximum Pressure
Buildout of the Urban Reserve Boundary

Medford Water
Southeast Medford Water Facilities Plan

Jacobs

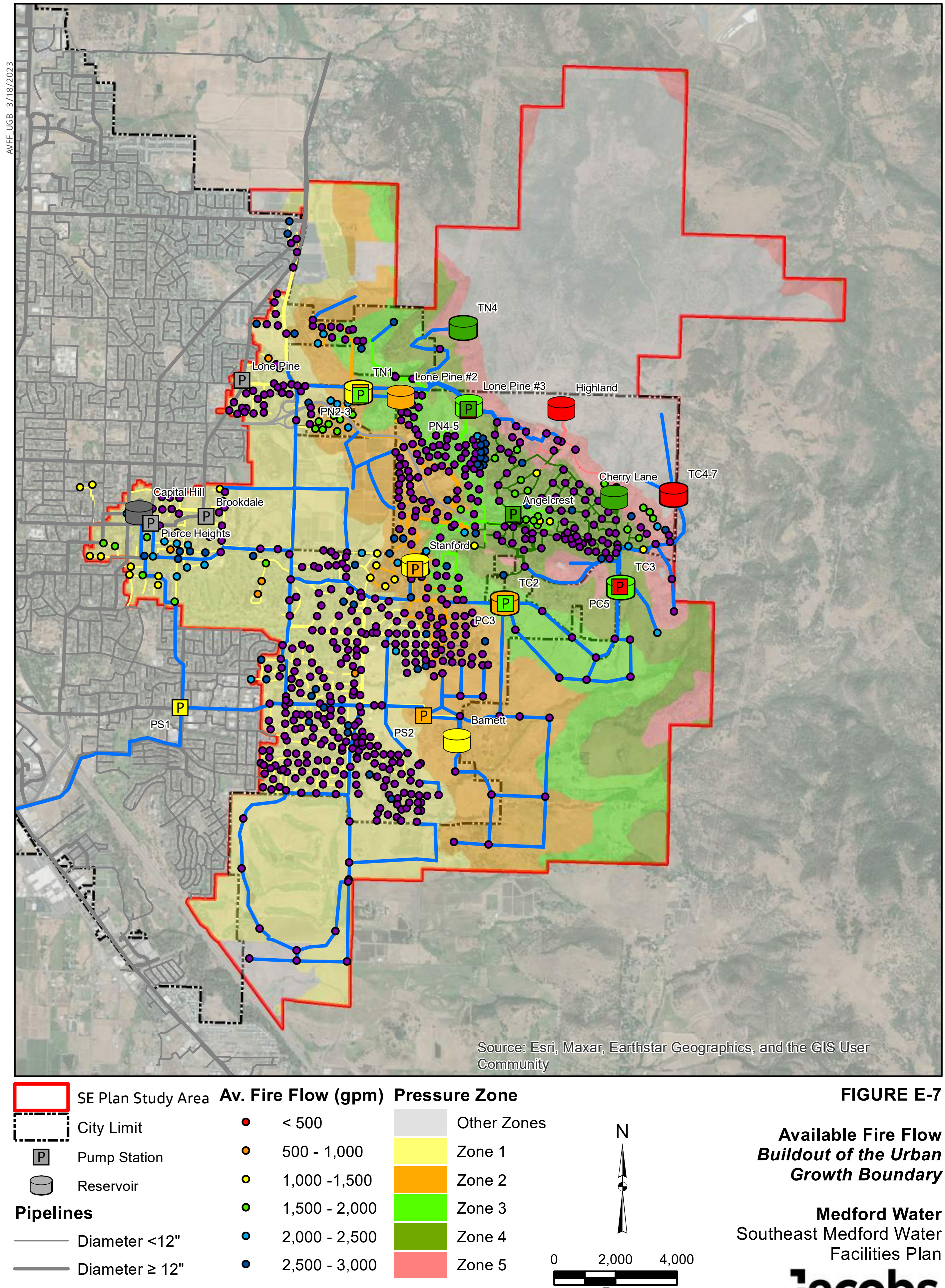


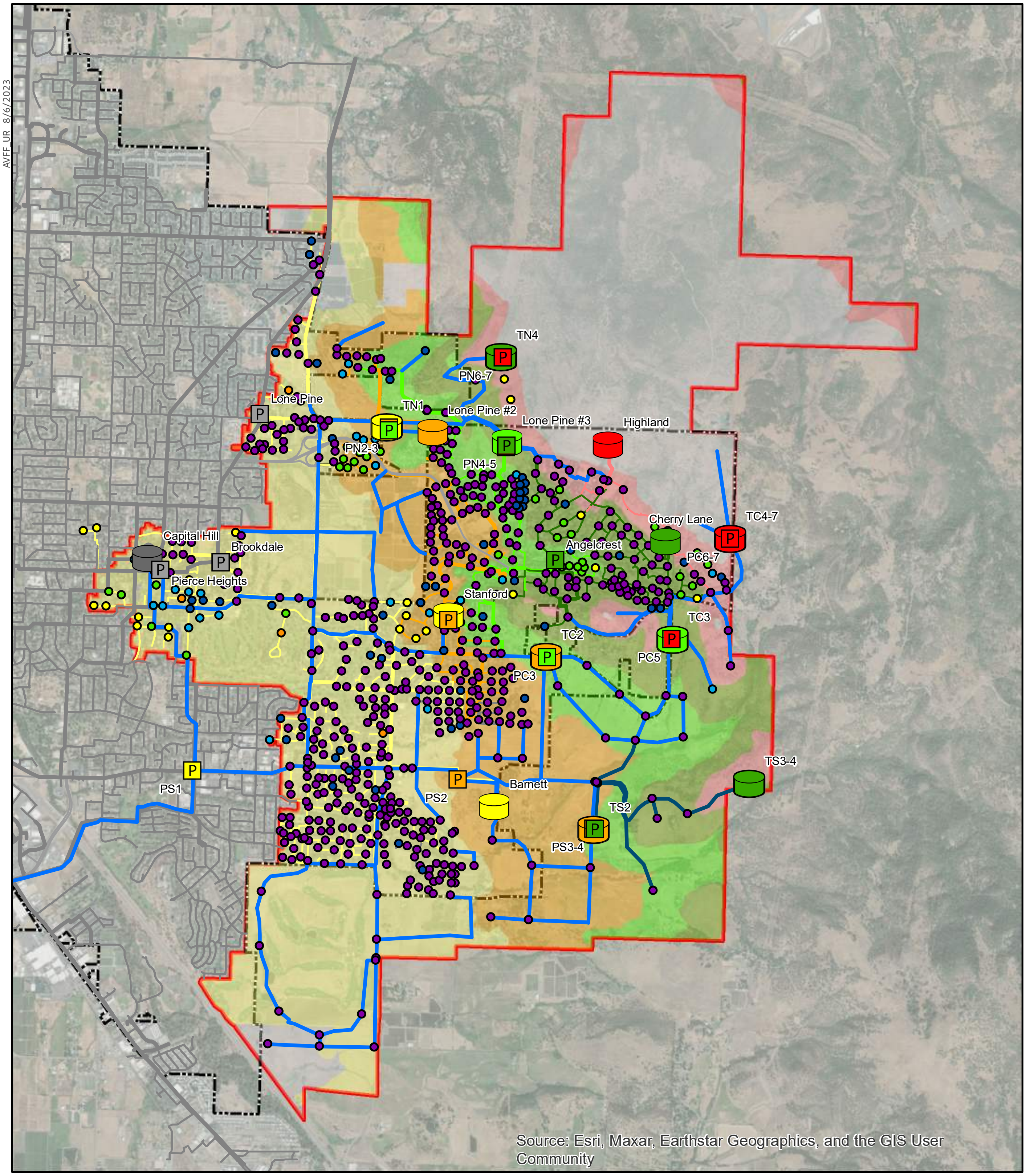
FIGURE E-7

Available Fire Flow Buildout of the Urban Growth Boundary

Medford Water
Southeast Medford Water Facilities Plan

Jacobs

AVFF_UR 8/6/2023



SE Plan Study Area

City Limit

Pump Station

Reservoir

Pipelines

Diameter <12"

Diameter ≥ 12"

Av. Fire Flow (gpm)

- < 500
- 500 - 1,000
- 1,000 -1,500
- 1,500 - 2,000
- 2,000 - 2,500
- 2,500 - 3,000
- > 3,000

Pressure Zone

- Other Zones
- Zone 1
- Zone 2
- Zone 3
- Zone 4
- Zone 5

N

0 2,000 4,000

Feet

FIGURE E-8

Available Fire Flow
Buildout of the Urban
Reserve Boundary

Medford Water
Southeast Medford Water
Facilities Plan

Jacobs

Appendix F

Hydraulic Model Results – Tank Hydraulic Grade Lines

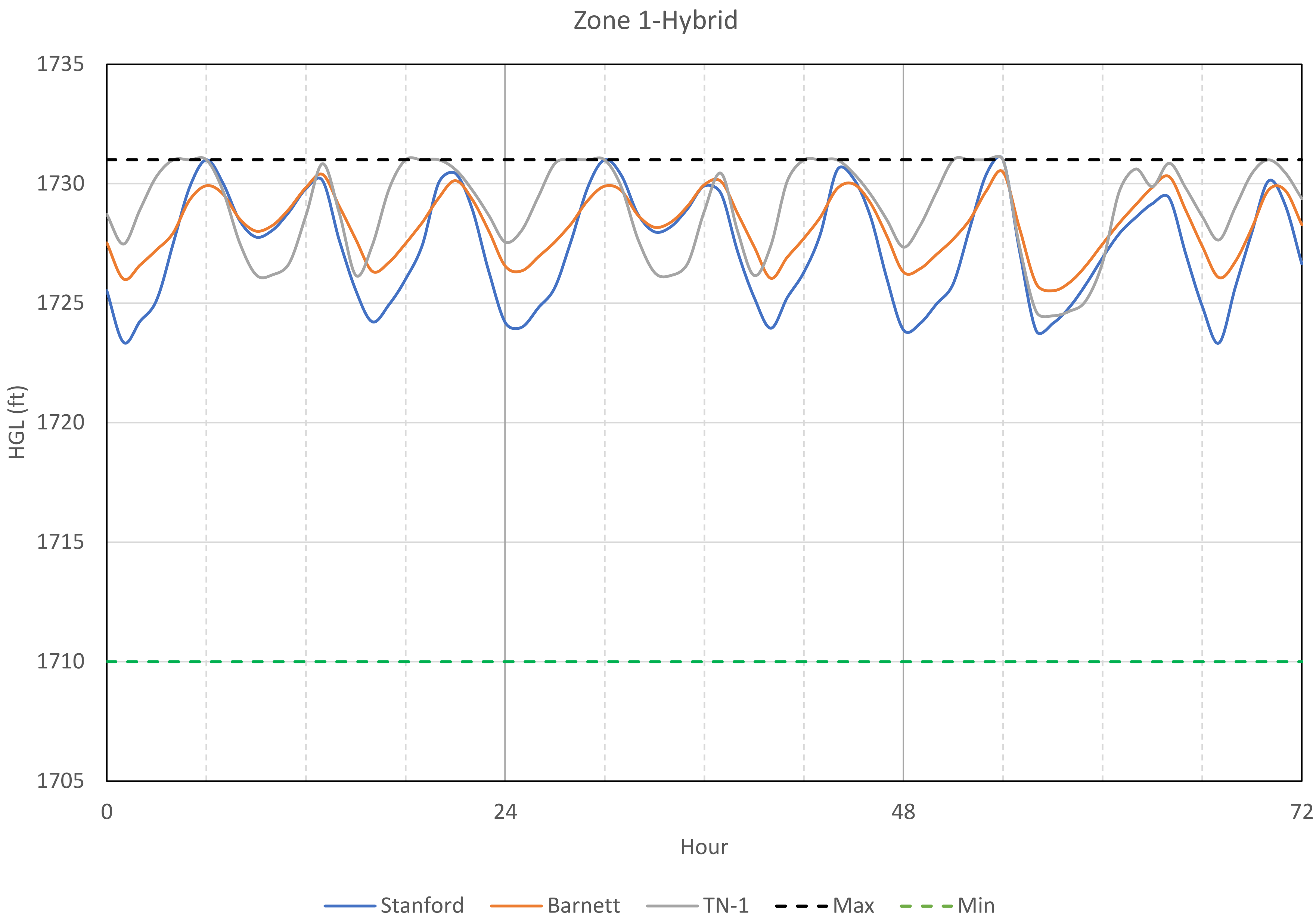


Figure F-1 Zone 1 Reservoir Level Variation

Buildout of Urban Growth Boundary

Medford Water

Southeast Medford Water Facilities Plan

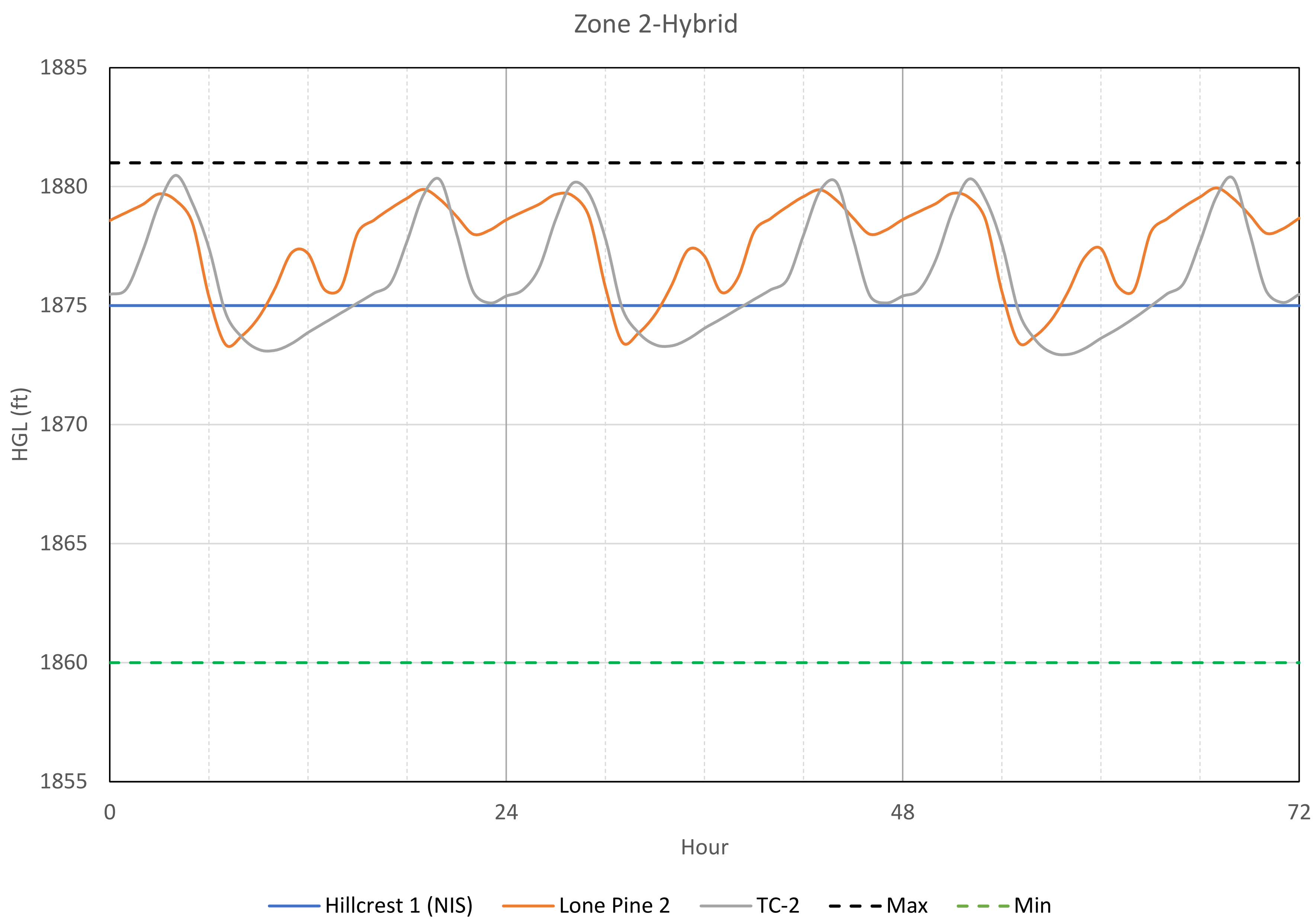


Figure F-2 Zone 2 Reservoir Level Variation

Buildout of Urban Growth Boundary

Medford Water

Southeast Medford Water Facilities Plan

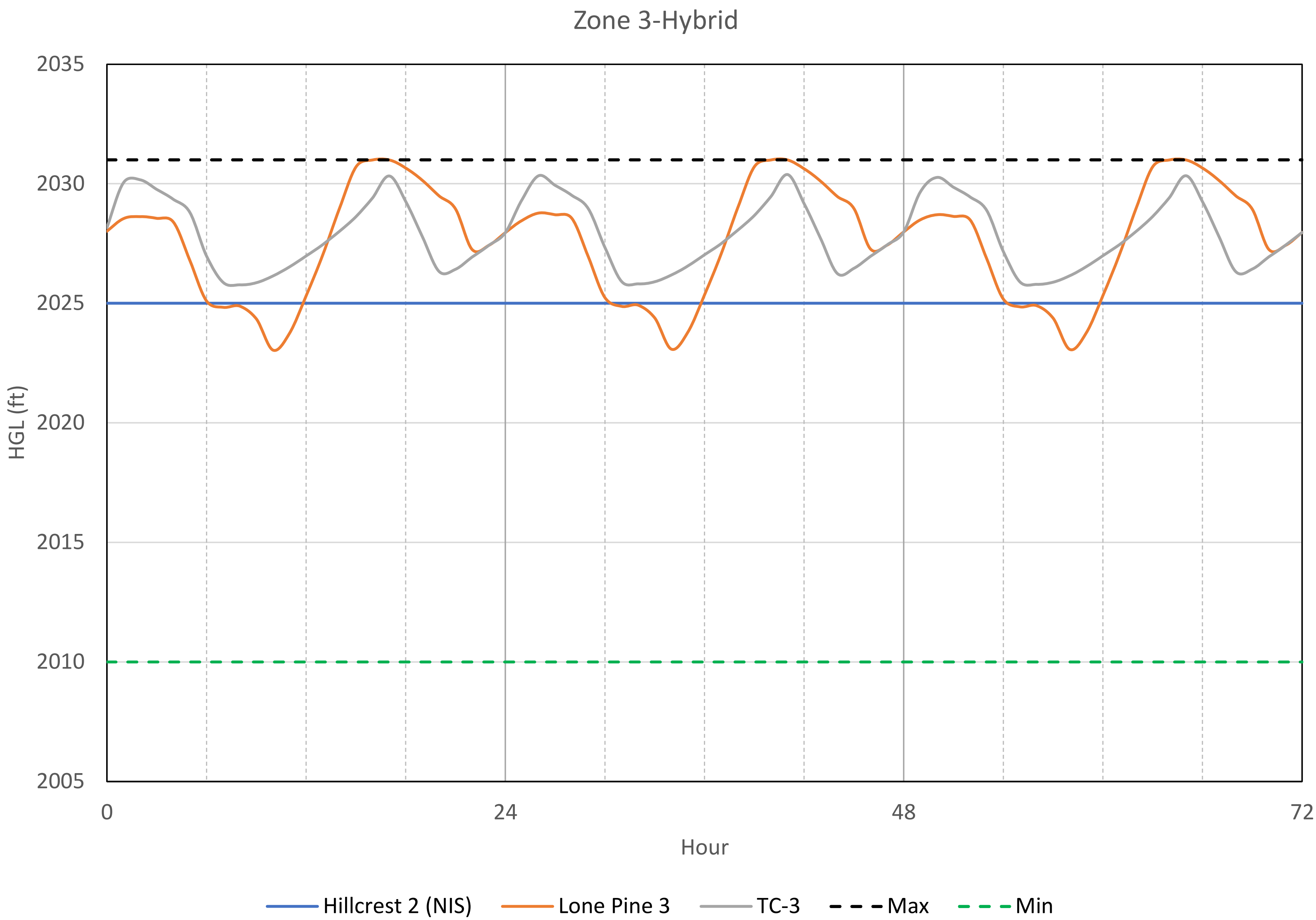


Figure F-3 Zone 3 Reservoir Level Variation

Buildout of Urban Growth Boundary

Medford Water

Southeast Medford Water Facilities Plan

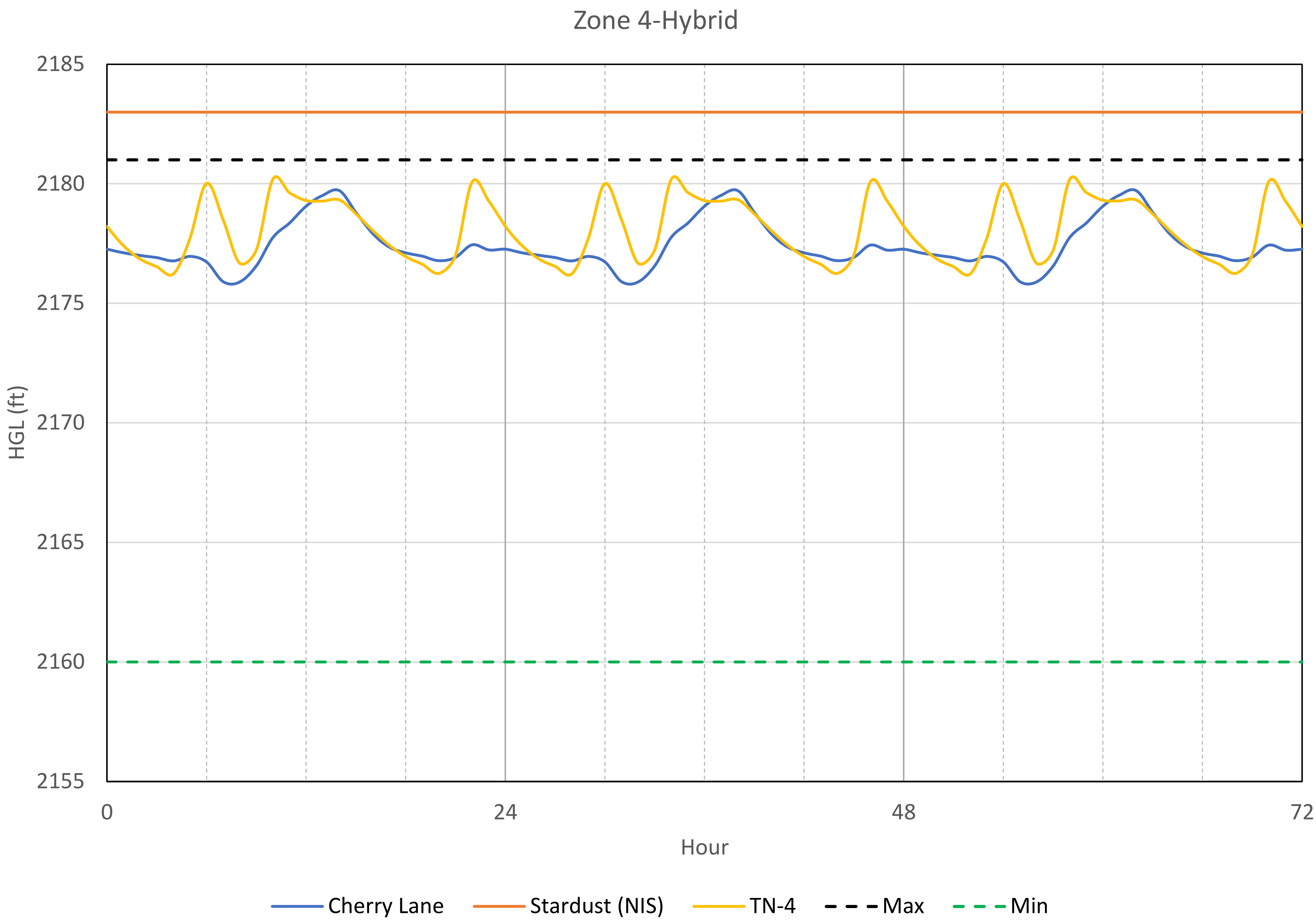


Figure F-4 Zone 4 Reservoir Level Variation

Buildout of Urban Growth Boundary

Medford Water

Southeast Medford Water Facilities Plan

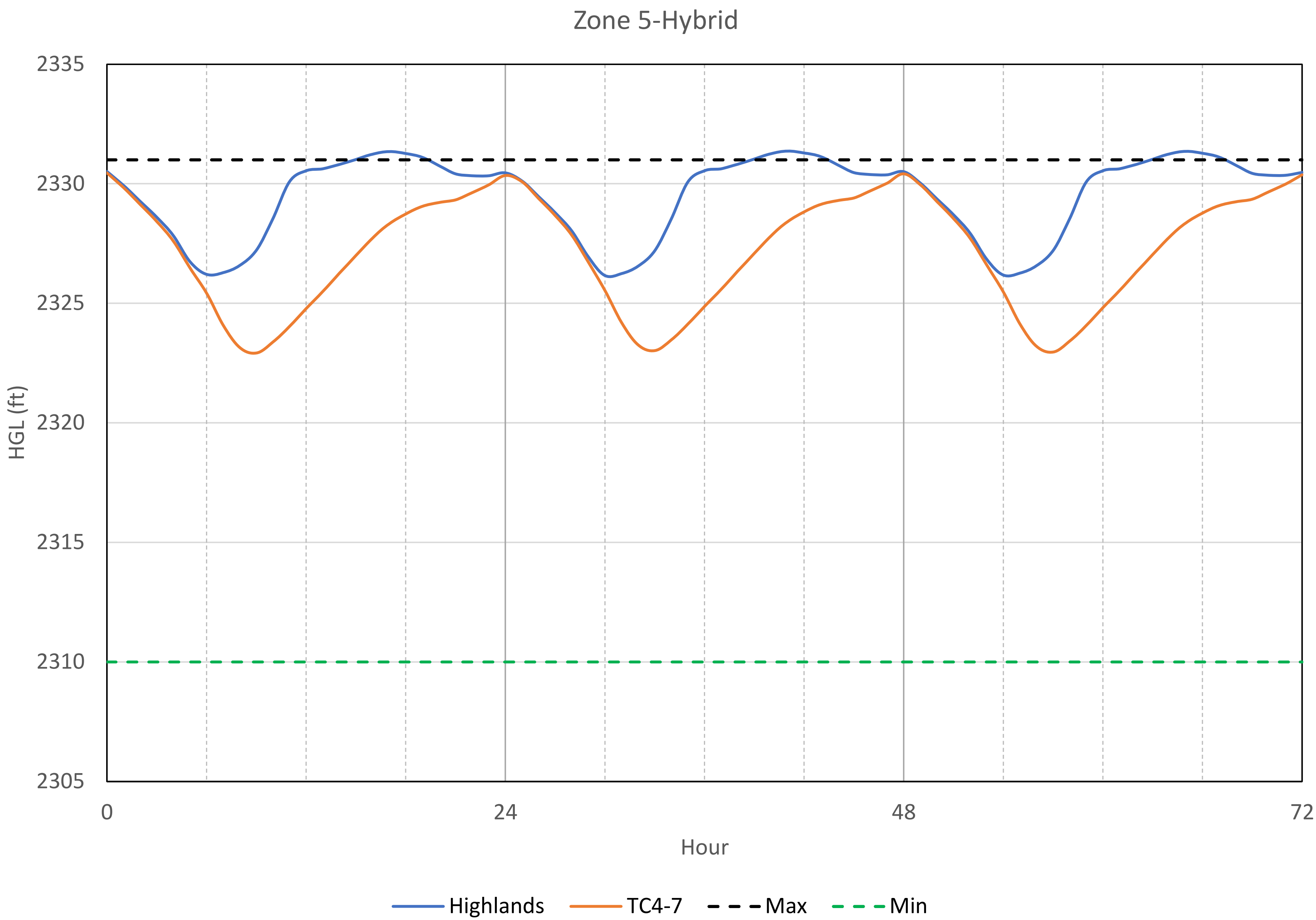


Figure F-5 Zone 5 Reservoir Level Variation

Buildout of Urban Growth Boundary

Medford Water

Southeast Medford Water Facilities Plan

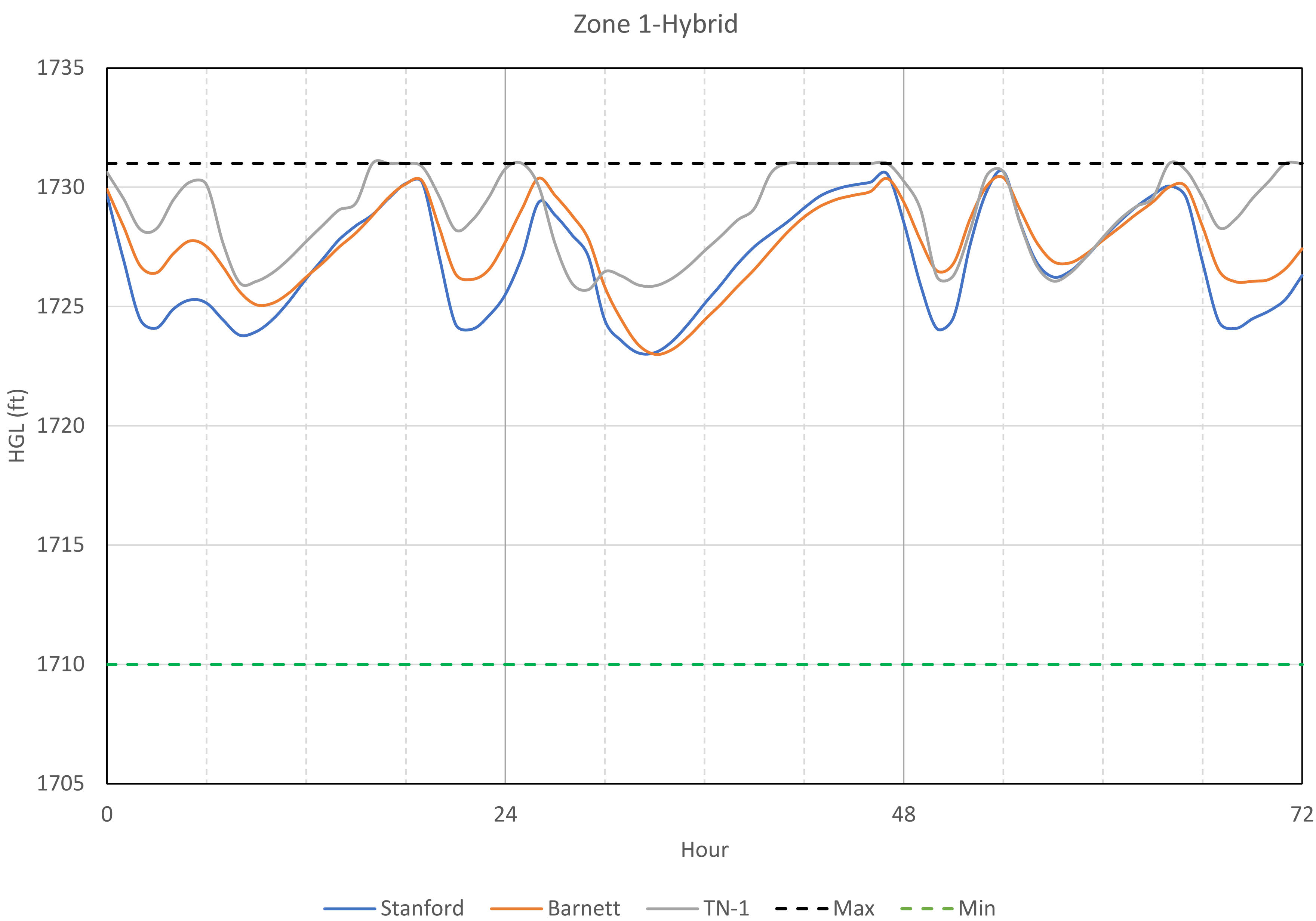


Figure F-6 Zone 1 Reservoir Level Variation

Buildout of Urban Reserve Boundary

Medford Water

Southeast Medford Water Facilities Plan

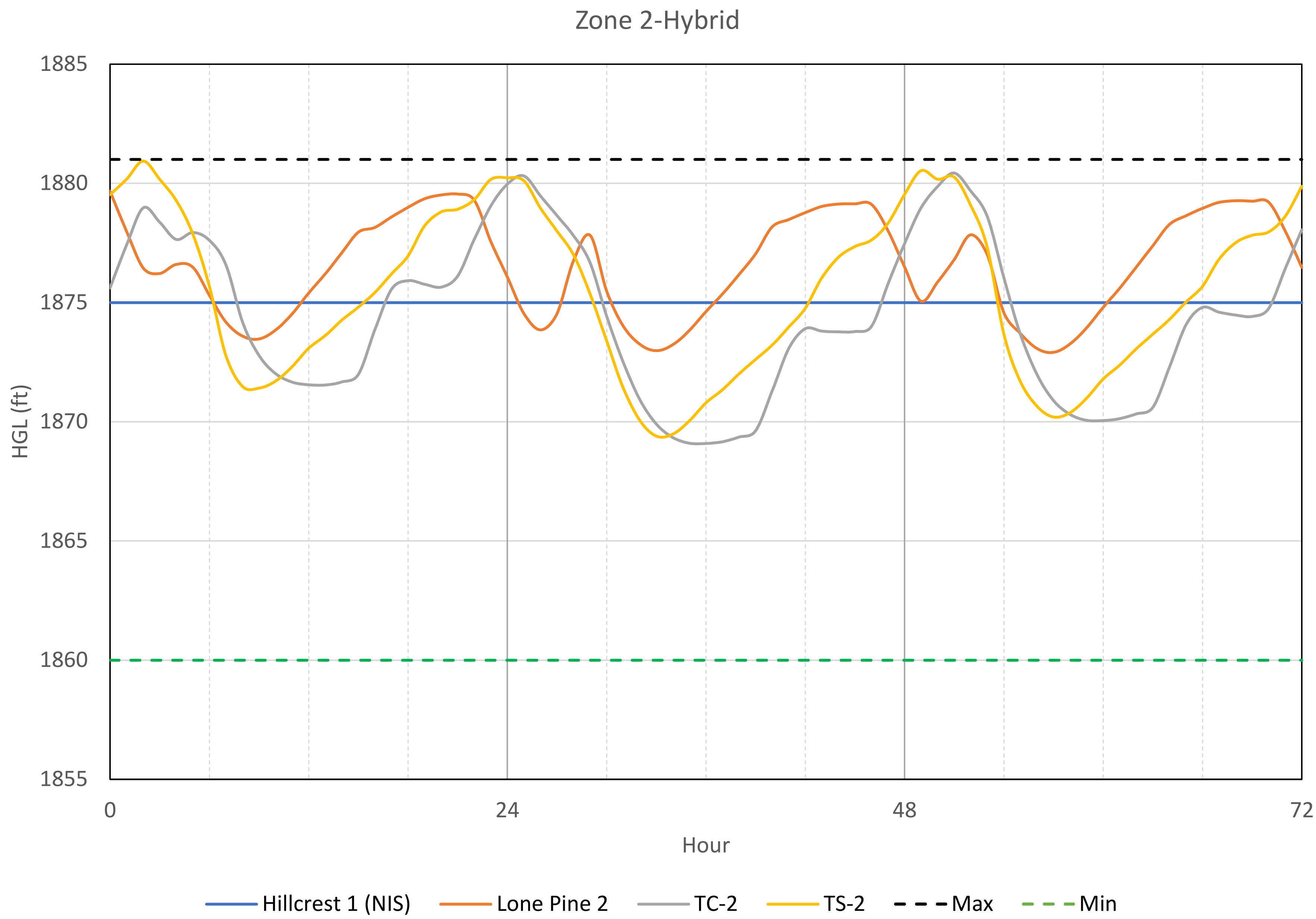


Figure F-7 Zone 2 Reservoir Level Variation

Buildout of Urban Reserve Boundary

Medford Water

Southeast Medford Water Facilities Plan

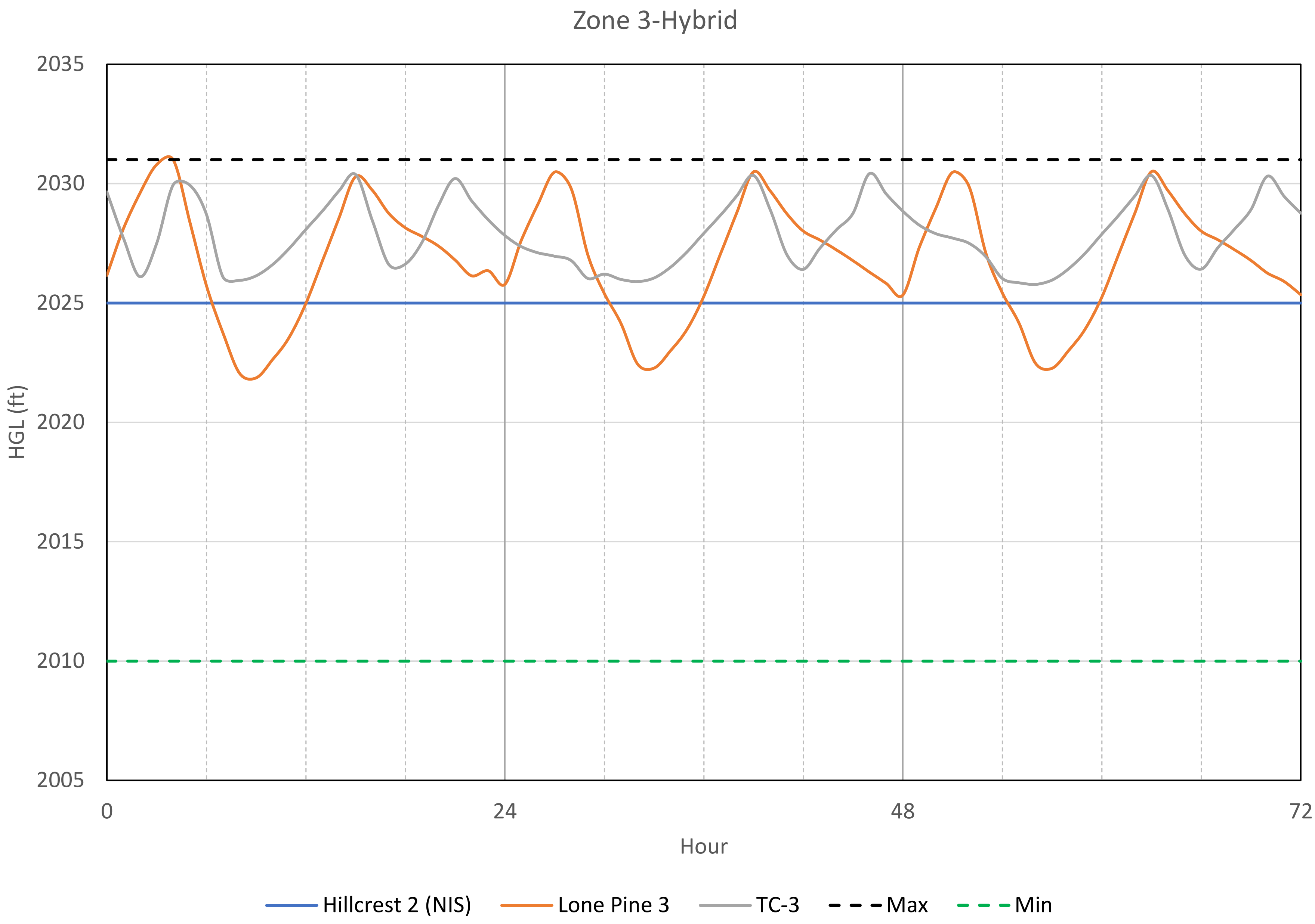


Figure F-8 Zone 3 Reservoir Level Variation

Buildout of Urban Reserve Boundary

Medford Water

Southeast Medford Water Facilities Plan

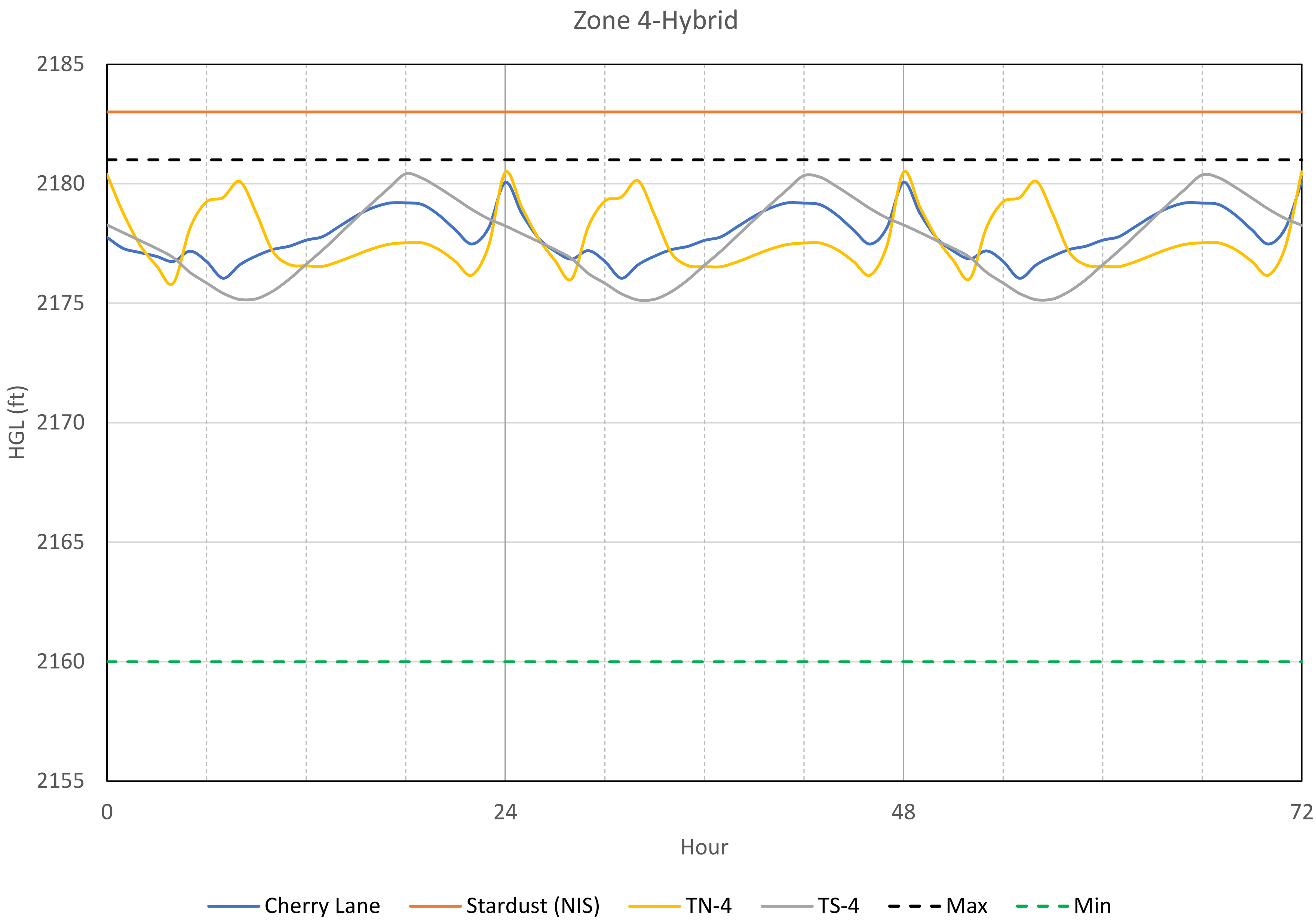


Figure F-9 Zone 4 Reservoir Level Variation

Buildout of Urban Reserve Boundary

Medford Water

Southeast Medford Water Facilities Plan

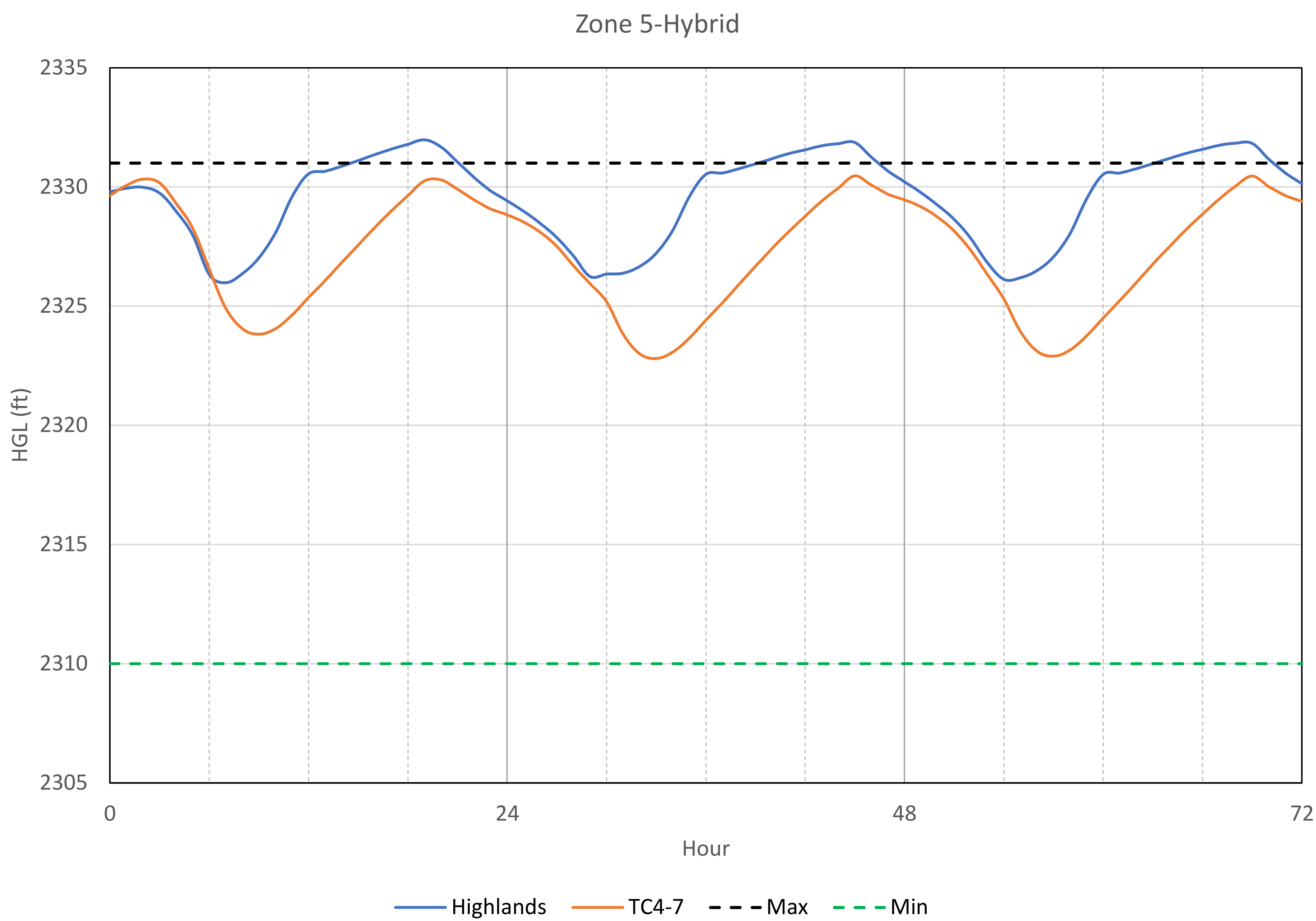


Figure F-10 Zone 5 Reservoir Level Variation

Buildout of Urban Reserve Boundary

Medford Water

Southeast Medford Water Facilities Plan

Appendix G

Cost Estimating Assumptions

This appendix details West Yost's assumptions for estimating probable construction costs for the recommended water system facilities. The costs presented in this appendix are in accordance with the guidelines of the Association for the Advancement of Cost Engineering (AACE) International for a Class 5 estimate. AACE International defines a Class 5 Estimate as follows:

> ***Class 5 Estimate****: This estimate is prepared based on limited information, where little more than proposed plant type, its location, and the capacity are known. Strategic planning purposes include, but are not limited to, market studies, assessment of viability, evaluation of alternate schemes, project screening, location and evaluation of resource needs and budgeting, and long-range capital planning. Examples of estimating methods would include cost/capacity curves and factors, scale-up factors, and parametric and modeling techniques. Typically, little time is expended in the development of this estimate. The expected accuracy ranges for this class estimate are -20 to -50 percent of the low side and +30 to +100 percent on the high side.*

Unit construction costs were developed based on a combination of data supplied by manufacturers, published industry standard cost data and curves, construction costs for similar facilities built by other public agencies, and construction costs previously estimated by West Yost for similar facilities with similar construction cost indexes.

The costs presented in this sections below are base construction costs and do not include estimating or construction uncertainties (e.g., variations in final quantities) or cost estimates for engineering, legal services, environmental review, inspections, and/or contract administration. Some of these items are referred to as contingency costs and are addressed in the last section of this appendix. It should also be noted that the construction costs presented in this appendix represent infrastructure costs and do not include costs for purchase of additional surface water supplies, supply reliability, or operation and maintenance.

Construction costs have been adjusted to reflect December 2022 dollars for the Engineering News Record (ENR) construction cost index for Seattle, WA. These costs should be used for conceptual cost estimates (e.g., Class 5 estimates per AACE) and should be updated regularly. Construction costs presented in this appendix are not intended to represent the lowest prices in the industry for each type of construction; rather they are representative of average or typical construction costs. These planning-level construction cost estimates have been prepared for guidance in evaluating various facility improvement options and are intended only establishing a budgetary basis within the context of this planning effort.

The following sections of this appendix describe the assumptions used to estimate the probable construction costs for the planning and design of recommended water system facilities for the City's water system:

- Current Market Volatility
- Water System Construction Costs
- Contingency Costs

G.1 CURRENT MARKET VOLATILITY

Global and local materials markets are currently experiencing significant surges in pricing of raw and recycled materials which is impacting municipal utilities. For example, an index of shredded scrap pricing has seen an approximate 20 percent rise from February 2022 to March 2022, causing an increase in the cost of ductile iron pipe (DIP). It is expected that these inflated costs are a response to current supply chain constraints and are thus not anticipated to be experienced in the long term. Using such costs, and increasing the unit construction costs presented in subsequent sections, as the basis for long-range planning would result in unreasonably high capital costs that would not be representative of likely capital costs over the long term. Therefore, the construction costs presented in this appendix assume that the current market volatility is a short-term issue which will soften over the planning period of the SEMFP. However, an optional market factor is included and assumed contingencies discussed in Section E.3 to provide flexibility capital cost estimates. A modest five percent factor is currently assumed and should be reevaluated in future planning efforts.

G.2 WATER SYSTEM CONSTRUCTION COSTS

The following sections present the unit construction cost estimates used to estimate probable construction costs for recommended water system facilities in the City's water system and are categorized by type of improvement, including:

- Potable Water Pipelines
- Treated Water Storage Reservoirs
- Booster Pump Stations
- Pressure or Flow Regulating Stations and Check Valves

G.2.1 Potable Water Pipelines

Unit construction costs for potable water pipelines 8 through 36 inches in diameter are provided in Table 1. These unit costs are categorized by typical pipeline construction either in developed areas (e.g., in urban or suburban roads) or undeveloped areas (e.g., across open fields or in rural roads) and are representative of pipeline construction under common or normal conditions. Special or difficult conditions would increase costs significantly.

The unit construction costs presented below include pipeline materials, trenching, placing and jointing pipe, valves, fittings, hydrants, service connections, placing imported pipe bedding, native backfill material, and partial asphalt pavement replacement, if required. However, the costs presented in Table do not include jacking and boring pipe or constructing boring and receiving pits. Jack and bore costs are shown in Table 2 and should be added where required.

Table 1. Unit Construction Costs for Pipelines[a]		
Pipeline Size	Unit Construction Cost, dollars/linear foot[b]	
	Developed Areas	Undeveloped Areas
8-inch diameter	176	120
10-inch diameter	220	150
12-inch diameter	204	156
14-inch diameter	238	182
16-inch diameter	272	208
18-inch diameter	306	234
20-inch diameter	340	260
24-inch diameter	336	264
30-inch diameter	420	330
36-inch diameter	504	396

(a) Based on May 2022 ENR CCI for Seattle, WA (15115.33).
(b) Estimated construction costs do not reflect an adjustment to account for the current economic bidding climate.

Table 2. Unit Construction Costs for Jack and Bore[a]	
Pipeline Size	Unit Construction Cost, dollars/linear foot[b]
12-inch diameter (24-inch diameter casing)	700
16-inch diameter (30-inch diameter casing)	880
18-inch diameter (32-inch diameter casing)	940
24-inch diameter (36-inch diameter casing)	1,055

(a) Based on May 2022 ENR CCI for Seattle, WA (15115.33).
(b) Estimated construction costs do not reflect an adjustment to account for the current economic bidding climate.

G.2.2 Treated Water Storage Reservoirs

Table 3 summarizes the estimated construction costs for both above-ground concrete or steel treated water storage reservoirs between the size range of 1.0 to 3.0 MG. These costs generally include the installation of the storage reservoirs, site piping, earthwork, paving, instrumentation, and related sitework. These costs are representative of construction under normal excavation and foundation conditions and would be significantly higher for special or difficult foundation requirements.

For the purposes of the capital costs estimates prepared in Chapter 6, it was assumed that all recommended treated water storage reservoirs would be concrete, matching the existing material of all storage tanks in the MW system.

Table 3. Construction Costs for Treated Water Storage Reservoirs[a]		
Capacity, MG	Estimated Construction Cost, million dollars[b]	
	Above-ground Concrete	Above-ground Steel
1.0	3.4	2.7
2.0	4.5	3.8
3.0	5.6	4.6

(a) Based on May 2022 ENR CCI for Seattle, WA (15115.33).
(b) Estimated construction costs do not reflect an adjustment to account for the current economic bidding climate.

G.2.3 Booster Pump Stations

G.2.3.1 New Booster Pump Stations

Pump stations will be required at ground level and below grade reservoirs to lift water to the hydraulic grade of the City's water distribution system. Estimated construction costs for reservoir pump stations, as shown in Table 4, are based on enclosed stations with architectural and landscaping treatment suitable for residential areas. Pump station costs can vary considerably, depending on architectural design, pumping head, and pumping capacity. Therefore, these costs presented below are representative of construction under common or normal conditions and would be significantly higher for special or difficult conditions.

Pump station cost estimates include the installation of the pumps, site piping, earthwork, paving, on site backup/standby power generator, SCADA, and related sitework.

Table 4. Construction Costs for Booster Pump Stations[a]	
Firm Capacity, mgd[b]	Estimated Construction Cost, million dollars[c]
0.5	1.3
1	1.3
2	1.7
3	1.9
5	2.3
6	2.5
9	2.9

(a) Based on May 2022 ENR CCI for Seattle, WA (15115.33).
(b) Equal to the total pumping capacity with the largest pump out of service or on standby.
(c) Estimated construction costs do not reflect an adjustment to account for the current economic bidding climate.

G.2.3.2 Booster Pump Station Expansions

Existing pump stations may also be expanded to serve development. The unit construction cost for a pump station expansion is assumed to be $500,000. This includes the cost to acquire and furnish up to three new pumps and procure and install the necessary mechanical, electrical, instrumentation and control elements associated with new pumps. The construction cost also assumes no major improvements to the pump station structure are required (i.e., adequate room is available for new pumps).

G.2.3 Pressure or Flow Regulating Stations and Check Valves

Interconnections (i.e., pressure regulating stations or check valves) are recommended to provide flexibility and redundancy to move water between pressure zones during peak demands and/or emergency conditions (i.e., fire flow conditions). The construction cost for a new pressure regulating station or an existing pressure regulating station upgrade under normal conditions is estimated to be approximately $250,000. The construction cost for a new pressure regulating station or an existing pressure regulating station upgrade under special or difficult conditions (e.g., construction in high traffic areas) is estimated to be approximately $300,000. The construction cost for a new check valve connection is estimated to be approximately $5,000.

Construction cost estimates for a pressure regulating station include the installation of control valve(s), a concrete utility vault, access hatches, site piping, earthwork, paving, SCADA, and related sitework.

G.3 CONTINGENCIES AND OTHER PROJECT COSTS

Contingency costs must be reviewed on a case-by-case basis because they will vary considerably with each project. However, to establish capital budgeting for these future project, contingency markups have been included, as percentages of the estimated base construction cost using for the following:

- **Construction Contingency Costs**: 20 percent of base construction cost
  The construction costs presented above are representative of the construction of water system facilities under normal construction conditions and schedules; consequently, it is appropriate to allow for estimating and construction uncertainties unavoidably associated with the conceptual planning of projects. Factors such as unexpected construction conditions, the need for unforeseen mechanical items, and variations in final quantities are only a few of the items that can increase project costs. An allowance of 20 percent of the base construction cost will be included to cover such project related construction contingencies. This is also assumed to include contractor overhead and profit.

- **Market Factor**: 5 percent of base construction cost and contingency subtotal
  An allowance of 5 percent of the base construction cost will be included to adjust costs to reflect the current bidding and supply chain constraints. This factor is dynamic and should be updated, as market conditions change.

- **Other Project Cost Allowances:** 30 percent of base construction cost, contingency and mark up subtotal
  Other project costs have been divided into three (3) subcategories, totaling 30 percent (10 percent engineering, 10 percent construction management, and 10 percent program implementation)

  - Engineering costs associated with new facilities include preliminary investigations and reports, right-of-way acquisition, foundation explorations, preparation of drawings and specifications during construction, surveying and staking, sampling of testing material, and start-up services. For this study, engineering costs are assumed to be 10 percent of the base construction cost estimate.
  - Construction management covers such items as contract management and inspection during construction. The cost of these items can also vary, but for the purpose of this study, it is assumed that construction management charges will equal approximately 10 percent of the base construction cost estimate.
  - Program implementation costs cover items such as legal fees, environmental compliance requirements, financing expenses, administrative costs, and interest during construction. The cost of these items can also vary, but for the purpose of this study, it is assumed that program implementation costs will equal approximately 10 percent of the base construction cost estimate.

An example application of how these allowances are applied to a project with an assumed base construction cost of $1.0 million is shown in Table 5. As shown, the total cost of all project construction contingencies (construction, design, construction management, and administration costs) these factors result in an overall multiplier of 64 percent of the base construction cost. Without considering the current market volatility, the total cost of all project construction contingencies decreases to approximately 58 percent of the base construction cost.

Table 5. Example Application of Contingency Costs		
Cost Component	Percent	Cost, dollars
Estimated Base Construction Cost before Mark-ups[a]	--	1,000,000
Construction Contingency Costs	20	200,000
Estimated Construction Cost with Contingency		**$1,200,000**
Market Factor (optional)	5	60,000
Subtotal Construction Costs		**$1,260,000**
Other Project Costs		
Engineering	10	126,000
Construction Management	10	126,000
Program Implementation	10	126,000
Total Project Cost Allowances		**$378,000**
Estimated Total Project Cost		**$1,638,000**
(a) Assumed cost of an example project.		

Appendix H

Time-Phased and Zone ERU Analysis

INTRODUCTION

This appendix summarizes the recommendations from Chapters 5 and 6 for each pressure zone. Section 5.3.2 provides the nomenclature methodology for CIP project numbers.

ERU Capacity Method

The method for estimating ERUs for storage, pump stations, and transmission pipelines are described below.

Storage Facilities

A storage facility's ERU capacity is calculated as total volume minus the fire flow volume, divided by the ratio of equalizing and emergency storage to MDD (0.25+0.5=0.75), divided by the MDD:ADD factor for the zone, divided by the water use per ERU (376 gpd/ERU).

For example, the Stanford Reservoir in Zone 1 has a capacity of 1.5 MG. It shares 0.96 MG of fire storage with Barnett Reservoir, so it is assumed to have 0.48 MG of fire capacity. The remaining 1.02 MG of storage is for equalizing and emergency storage. Dividing this value by 0.75 indicates the maximum day demand that the tank can serve using the storage criteria (1.02/0.75=1.36 mgd). Since Zone 1 has an MDD:ADD factor of 1.7, 1.36 is divided by this value indicating how much average day demand can be served (1.36/1.7=0.80 mgd). Dividing this by 376 gpd/ERU results in 2,128 ERUs (800,000 gpd/376 = 2,128 ERUs).

Pump Stations

A pump station's ERU capacity is calculated as the firm capacity (expressed in gallons per day using only 18 hours of pumping) divided by the MDD:ADD factor for the zone, divided by the established water use per ERU (376 gpd/ERU).

For example, in Zone 1 with a MDD:ADD factor of 2.0, a 1,500-gpm pump station has the capacity to supply approximately 2,156 ERUs (1,500 gpm x 60 min/hr x 18 hr/day divided by 1.7 divided by 376 gpd/ERU = 2,534 ERUs).

Zone 1 Summary

Growth Projections

Zone 1 has the largest expected growth of all the pressure zones, with the majority occurring within the UGB Buildout area. As shown in the tables below, demand and ERUs are anticipated to double in both the north and south areas of the zone. Maximum day demand (MDD) is expected to increase from 3.3 mgd in 2020 to 5.9 mgd by Urban Reserve Buildout.

Zone 1 ERU Projections					
Zone & Tributary Area	Current ERUs	UGB Buildout		Urban Reserve Buildout	
		New ERUs	Total ERUs	New ERUs	Total ERUs
Zone 1 – North	1,196	1,090	2,286	-	2,286
Zone 1 – South	3,910	2,899	6,809	119	6,928
Zone 1 - Total	**5,106**	**3,989**	**9,095**	**119**	**9,214**

Zone 1 Demand Projections						
Zone & Tributary Area	Current		UGB Buildout		Urban Reserve Buildout	
	ADD, mgd	MDD, mgd	ADD, mgd	MDD, mgd	ADD, mgd	MDD, mgd
Zone 1 – North	0.45	0.76	0.86	1.46	0.86	1.46
Zone 1 – South	1.47	2.50	2.56	4.35	2.60	4.43
Zone 1 - Total	**1.92**	**3.26**	**3.42**	**5.81**	**3.46**	**5.89**

Storage Recommendations

Current Zone 1 storage is comprised of the 1.5-MG Stanford Reservoir and 2.0-MG Barnett Reservoir. The reservoirs generally operate well together, with Stanford Reservoir cycling deeper than Barnett Reservoir due to the Stanford Pump Station drawing water from the Stanford Reservoir to supply Zone 2.

Lone Pine 1 Reservoir (TN1)

The storage analysis (Table D-1) identified a 1.23 MG storage requirement by buildout of the UGB in the north tributary area. (This deficiency does not increase for the Urban Reserve Buildout but could be larger if growth in Urban Reserve MD-3d/3c does not get served by pumping from the River Zone.) It is recommended to construct a 1.3-MG tank on the property owned by Medford Water for Lone Pine 1 Reservoir. The reservoir is anticipated to be constructed in the near-term horizon.

Barnett Reservoir 2 (TS1)

In the south tributary area, the storage analysis (Table D-2) identified a deficiency of 1.11 MG by buildout of the UGB, increasing to 1.2 MG by buildout of the Urban Reserves. It is recommended to construct a 1.2-MG tank adjacent to the existing Barnett Reservoir (on the property owned by Medford Water). The timing of this reservoir depends on growth but is anticipated to be needed by UGB Buildout.

Storage Summary

The tables below present the storage analysis considering volume and ERUs with the recommended improvements. Appendix F shows that the existing and new reservoirs, combined with the recommended piping and pump stations, will cycle well together at Buildout of the UGB and Urban Reserves.

Zone 1 Storage Capacity Projections – Volume

Reservoirs	Volume, MG			
	2020 Conditions	10-Year Projections	UGB Buildout	Urban Reserve Buildout
North				
Future Lone Pine 1 Reservoir (TN1)	-	*1.30*	*1.30*	*1.30*
Total North Available Capacity	**-**	**1.30**	**1.30**	**1.30**
Required Capacity	0.64	0.93	1.23	1.23
Excess/(Deficiency)	(0.64)	0.37	0.07	0.07
South				
Stanford Reservoir	1.50	1.50	1.50	1.50
Barnett Reservoir	2.00	2.00	2.00	2.00
Future Barnett Reservoir 2 (TS1)	-	-	*1.20*	*1.20*
Total South Available Capacity	**3.50**	**3.50**	**4.70**	**4.70**
Required Capacity	2.64	3.62	4.61	4.67
Excess/(Deficiency)	0.86	(0.12)	0.09	0.03
Zone 1				
Total Zone 1 Available Capacity	**3.50**	**4.80**	**6.00**	**6.00**
Required Capacity	3.28	4.55	5.83	5.90
Excess/(Deficiency)	0.22	0.25	0.17	0.10

Zone 1 Storage Capacity Projections - ERUs				
	ERUs			
Reservoirs	2020 Conditions	10-Year Projections	UGB Buildout	Urban Reserve Buildout
North				
Future Lone Pine 1 Reservoir (TN1)	-	*2,712*	*2,712*	*2,712*
Total North Available Capacity	-	2,712	2,712	2,712
Required Capacity	1,196	1,741	2,286	2,286
Excess/(Deficiency)	(1,196)	970	425	425
South				
Stanford Reservoir	2,566	2,566	2,128	2,128
Barnett Reservoir	3,609	3,609	3,171	3,171
Future Barnett Reservoir 2 (TS1)	-	-	*2,503*	*2,503*
Total South Available Capacity	**6,174**	**6,174**	**7,801**	**7,801**
Required Capacity	3,910	5,360	6,809	6,928
Excess/(Deficiency)	2,264	815	992	874
Zone 1				
Total Zone 1 Available Capacity	**6,174**	**8,886**	**10,513**	**10,513**
Required Capacity	5,106	7,101	9,095	9,214
Excess/(Deficiency)	1,068	1,785	1,418	1,299

Pumping Recommendations

Zone 1 is currently supplied by the Lone Pine, Brookedale, and Pierce Heights Pump Stations, which are located central and north of the pressure zone. The Lone Pine and Brookedale Pump Stations operate most frequently. On peak demand days, the Pierce Heights pumps are unable to meet the discharge head when Lone Pine and Brookedale are operating at their highest capacities. Operators have noted that on peak demand days, the pump stations must operate continuously to keep Zone 1 tank levels from dropping significantly.

Under existing conditions, the pumping capacity analysis (Table 5-3) indicates a small amount (0.25 mgd) of excess pumping capacity to Zone 1 using the new pumping criteria. This small excess indicates additional pumping in Zone 1 is needed soon. However, the new 24-inch diameter Foothill Road transmission pipeline being installed in 2023 is anticipated to improve pumping through Lone Pine Pump Station.

For future conditions, Table 5-3 indicates an overall pumping deficiency of 8.8 mgd by UGB Buildout and 11.8 mgd by Urban Reserve Buildout. Table C-1 differentiates the pumping requirements by north and south tributaries and identified excess pumping capacity of 5.3 mgd in the north tributary area, but a 4.9 mgd deficiency in the south tributary area by UGB Buildout. Additionally, Medford Water sees the benefit in consolidating the Brookedale and Pierce Heights Pump Stations since they are so close together. Rebuilding the Pierce Heights Pump Station adjacent to the Capital Hill Reservoirs is preferred.

Pierce Heights Pump Station Replacement (Pierce Heights)

Rebuilding the Pierce Heights Pump Station to provide 5.5 mgd (4.5 mgd new plus 1.0 mgd existing) for the 10-year period is recommended. The Pierce Heights Pump Station is recommended for an ultimate capacity of 8.5 mgd for UGB and Urban Reserve Buildout conditions. The Brookdale Pump Station is planned to be decommissioned by UGB Buildout after the Pierce Heights Pump Station expansion.

Zone 1 South Pump Station (PS1)

With continued growth in the south of the system, a new Zone 1 Pump Station (PS1) with capacity of 5.0 mgd (expansion to 7.7 mgd at Urban Reserve Buildout) is also recommended. This pump station will require construction concurrent with a dedicated supply line in the Gravity Zone providing adequate suction pressure to avoid impacting customers on the suction side of the pump station (see Gravity Zone and Zone 1 South Pump Station Supply Pipeline below).

Pumping Summary

The tables below present the pumping analysis considering volume and ERUs with the recommended improvements. It is assumed that the Pierce Heights Pump Station will supply both the north and south areas of the zone, thus, the south area deficiencies in the tables below are not considered problematic since the overall zone requirements are met. The ERU capacity analysis for the pump stations includes ERUs for Zone 1 and all zones above it.

Zone 1 Pumping Capacity Projections - Flow Capacity

Pump Stations	Flow Capacity, mgd			
	2020 Conditions	10-Year Projections	UGB Buildout	Urban Reserve Buildout
North				
Lone Pine 1 PS	3.60	3.60	3.60	3.60
Brookedale PS	3.25	3.25	-	-
Pierce Heights PS	1.01	5.50	8.50	8.50
Total North Available Capacity	**7.86**	**12.35**	**12.10**	**12.10**
Required Capacity	3.38	5.08	6.78	7.08
Excess/(Deficiency)	4.48	7.27	5.32	5.02
South				
Future Zone 1 PS (PS1)	-	-	5.00	7.70
Total South Available Capacity	**-**	**-**	**5.00**	**7.70**
Required Capacity	4.20	7.05	9.89	12.58
Excess/(Deficiency)	(4.20)	(7.05)	(4.89)	(4.88)
Zone 1				
Total Zone 1 Available Capacity	**7.86**	**12.35**	**17.10**	**19.80**
Required Capacity	7.61	12.13	16.67	19.65
Excess/(Deficiency)	0.25	0.22	0.43	0.15

Zone 1 Pumping Capacity Projections - ERUs				
Pump Stations	ERUs			
	2020 Conditions	10-Year Projections	UGB Buildout	Urban Reserve Buildout
North				
Lone Pine 1 PS	4,224	4,224	4,224	4,224
Brookedale PS	3,813	3,813	-	
Pierce Heights PS	1,185	5,867	9,973	9,973
Total North Available Capacity	9,222	13,904	14,197	14,197
Required Capacity	3,869	5,779	7,690	7,989
Excess/(Deficiency)	5,354	8,125	6,508	6,208
South				
Future Zone 1 PS (PS1)	-	-	5,867	9,035
Total South Available Capacity	-	-	5,867	9,035
Required Capacity	4,828	8,145	11,463	14,532
Excess/(Deficiency)	(4,828)	(8,145)	(5,596)	(5,497)
Zone 1				
Total Zone 1 Available Capacity	**9,222**	**13,904**	**20,064**	**23,232**
Required Capacity	8,697	13,925	19,152	22,521
Excess/(Deficiency)	526	(21)	912	711

Note that there is a minor pumping capacity deficit projected in the 10-year when considering ERUs. Due to the small deficit and that there is no pumping deficit when considering flow capacity, it is assumed that this deficit is negligible.

Pipeline Recommendations

North Foothill Road Transmission Line (PL-1-00)

A new 24-inch and 12-inch transmission main in North Foothill Road from Lone Pine Road to Hillcrest Road is under construction in 2023. This transmission line will significantly improve the ability of water to move through Zone 1 in the northern end and will allow the Lone Pine Pump Station to pump at a lower head, thereby increasing flow.

Zone 1 Transmission Pipeline (PL-1-02)

A large diameter (varies between 30-inch, 16-inch, and 12-inch) transmission main is recommended in Zone 1 to deliver water from the expanded Pierce Heights Pump Station to customers further south, to supply the Stanford and Barnett Pump Stations, and to support balance between the Zone 1 Reservoirs.

Lone Pine Reservoir Supply Pipeline (PL-1-03)

When the new Lone Pine 1 Reservoir (TN1) is constructed, a 16-inch diameter pipeline in Lone Pine Road is recommended to connect to existing Zone 1 piping in Lone Pine Road and Foothill Road.

Barnett Pump Station Supply Pipeline (PL-1-04)

An additional 24-inch pipeline parallel to the existing 16-inch pipe in Barnett Road is recommended to supply the proposed Barnett Zone 2 Pump Station (PS2) and fill Barnett Reservoir 1 and 2. The pipeline would connect from the proposed Gravity Zone Pipeline (PL-G-12) east of the proposed Zone 1 South Pump Station (PS1). If Medford Water plans to abandon the existing parallel 16-inch pipe in Barnett Road, it is recommended to upsize the planned 24-inch pipe to 30-inch diameter.

Gravity Zone and Zone 1 South Pump Station Supply Pipeline (PL-G-12)

A new 36-inch and 24-inch pipeline is recommended to connect Capitol Hill Reservoirs to Gravity Zone connections and the Zone 1 South Pump Station Supply Pipeline (PL-1-04). This pipeline is needed to avoid low pressures to customers in the Gravity Zone when operating the proposed Zone 1 South Pump Station (PS1).

North Phoenix Road Pipeline

A transmission pipeline in North Phoenix Road is required to supply development south of Coal Mine Road and to supply water to a potential future connection to the City of Phoenix for Talent-Ashland-Phoenix (TAP) water supply. Medford Water is currently evaluating the size and extent of this pipeline. It is assumed that development will pay for installing this pipe and Medford Water will contribute funds to oversize the pipe.

Zone 1 Pipeline Recommendations

	Pipe ID				
	PL-1-00	PL-1-02	PL-1-03	PL-1-04	North Phoenix Road Pipeline
Diameter, inches	Varies	Varies	16	24	TBD[a]
Length, feet	6,200	12,050	1,850	3,650	TBD[a]
Street	N. Foothill Road	Lone Oak Dr, Cherry Ln	Lone Pine Road	Barnett Road	N. Phoenix Road
From	Lone Pine Road	Pierce Heights PS	Existing Piping	PL-G-12	PL-G-12
To	Hillcrest Road	Stanford Reservoir	Lone Pine 1 Reservoir (TN1)	Barnett Pump Station (PS2), Barnett Reservoirs	N. Phoenix Road
Timing/Purpose/ Trigger	Under Construction. Provides Zone 1 transmission capacity	Concurrent with re-build of Pierce Heights PS	Concurrent with TN1 construction	Concurrent with PS1 and TS1 construction	Supply development south of Coal Mine Road

(a) Medford Water has not finalized the size and extent of this pipeline

Summary of Zone 1 Recommendations					
Project ID	Description	Size	Purpose	Trigger	Capital Cost Estimate, dollars
10-Year					
TN1	Lone Pine 1 Reservoir	1.3 MG	Support growth in Zone 1 north area	Zone 1 ERUs > 6,174 or Industrial development occurs	6,110,000
Pierce Heights	Pierce Heights Pump Station Rebuild	5.5 mgd	Support additional SE area growth	Zone 1 and above ERUs > 9,222	3,932,000
PL-1-00	Foothill Road Transmission Line	Varies	Increased capacity in north Zone 1; improves Lone Pine Pump Station operations	Already under Construction	3,252,000
PL-1-02	Zone 1 Transmission Main	Varies	Improve transmission capacity from Pierce Heights PS to Stanford Reservoir	Concurrent with re-build of Pierce Heights PS	6,729,000
PL-1-03	Lone Pine 1 Reservoir Supply Pipeline	16-inch	Supply Lone Pine 1 Reservoir	Concurrent with TN1 Construction	826,000
UGB Buildout					
TS1	Barnett Reservoir 2	1.2 MG	Support local growth in the South	Zone 1 ERUs > 8,886	5,931,000
PS1	Zone 1 South Pump Station	5.0 mgd	Support growth for SE Development	Zone 1 ERUs and above >13,904	3,768,000
EXP-2040-PH	Expand Pierce Heights PS Capacity to 8.5 mgd (3.0 mgd expansion)	3.0 mgd	Abandon Brookedale Pump Station	Zone 1 ERUs and above >13,904	819,000
PL-G-12	Gravity Zone and Zone 1 South Pump Station Supply Pipeline	Varies	Supply Zone 1 South Pump Station	Concurrent with PS1 construction	9,406,000
PL-1-04	Barnett Pump Station Supply Pipeline	24-inch	Support higher pumping out of Barnett Reservoir	Concurrent with TS1 Construction	1,592,000
Urban Reserves Buildout					
EXP-2070-01	Expand Zone 1 South PS Capacity to 7.7 mgd (2.7 mgd expansion)	2.7 mgd	Meet additional growth in SE Urban Reserve Areas	Zone 1 and above ERUs > 20,064	819,000

Zone 2 Summary

Growth Projections

Zone 2 has significant growth potential, with most growth in residential development. As shown in the tables below, demand and ERUs are anticipated to quadruple in both the north and south areas of the zone. Maximum day demand (MDD) is expected to increase from 1.0 mgd in 2020 to 4.0 mgd by Urban Reserve Buildout.

Zone 2 ERU Projections

Zone & Tributary Area	Current ERUs	UGB Buildout		Urban Reserve Buildout	
		New ERUS	Total ERUs	New ERUs	Total ERUs
Zone 2 – North	611	797	1,407	-	1,407
Zone 2 – South	772	1,798	2,570	1,338	3,908
Zone 2 - Total	**1,383**	**2,595**	**3,978**	**1,338**	**5,315**

Zone 2 Demand Summary

Zone & Tributary Area	Current		UGB Buildout		Urban Reserve Buildout	
	ADD	MDD	ADD	MDD	ADD	MDD
Zone 2 – North	0.23	0.46	0.53	1.06	0.53	1.06
Zone 2 – South	0.29	0.58	0.97	1.93	1.47	2.94
Zone 2 - Total	**0.52**	**1.04**	**1.50**	**2.99**	**2.00**	**4.00**

Storage Recommendations

Current Zone 2 storage is comprised of the 1.0-MG Lone Pine 2 and 0.14-MG Hillcrest Reservoirs. These two reservoirs do not operate well together due to limited transmission capacity between them. The Stanford Pump Station looks to the nearby Hillcrest Reservoir to call pumps on/off. Due to its small size, the reservoir cycles quickly which prevents the Lone Pine 2 Reservoir from providing equalizing storage for diurnal demands. This results in the Stanford Pump Station pumping to meet peak hour demands rather than maximum day demands and on peak days, the pump station is barely able to maintain adequate water levels in the zone. Medford Water would like to abandon the undersized Hillcrest Reservoir and improve pumping and storage in Zone 2.

Zone 2 Cherry Lane Reservoir (TC2)

The storage analysis (Table D-1) identified excess storage capacity of 0.35 MG by buildout of the UGB in the north tributary area. (This deficiency does not increase for the Urban Reserve Buildout but could be larger if growth in Urban Reserve MD-3d/3c does not get served by pumping from the River Zone.)

In the south tributary area, the storage analysis (Table D-2) identified a deficiency of 1.99 MG by buildout of the UGB, increasing to 2.74 MG by buildout of the Urban Reserves. The recommendation is to construct a 2.0-MG tank on Cherry Lane. This reservoir is recommended in the next 10-years to address current growth in Zone 2 and allow abandonment of the Hillcrest 2 Reservoir. The tank is sized to meet storage requirements for the South Tributary area up to UGB Buildout.

Zone 2 South Reservoir (TS2)

A second 0.8-MG Zone 2 Reservoir is recommended to meet demands from buildout of the Urban Reserves.

Hillcrest Reservoir 2 Abandonment

To abandon Hillcrest Reservoir 2, the following projects are needed:

- Zone 2 Cherry Lane Reservoir (TC2)
- Abandon Hillcrest 3 Pump Station
  - Lone Pine 2 PS (PN2-3)
  - Keep track of Angelcrest pump demand and possibly construct Cherry Lane facilities to supplement Zone 4 through PRV

STORAGE SUMMARY

The tables below present the storage analysis considering volume and ERUs with the recommended improvements. With the addition of the Zone 2 Cherry Lane Reservoir (and abandonment of Hillcrest 2 Reservoir), the zone will have sufficient storage capacity through UGB Buildout. Appendix F shows that the new reservoirs, combined with the recommended piping and pump stations, will cycle well together at Buildout of the UGB and Urban Reserves.

Zone 2 Storage Capacity Projections - Volume

Reservoirs	Volume, MG			
	2020 Conditions	10-Year Projections	UGB Buildout	Urban Reserve Buildout
North				
Hillcrest 2 Reservoir	0.14	0.14	-	-
Lone Pine 2 Reservoir	1.00	1.00	1.00	1.00
Total North Available Capacity	**1.14**	**1.14**	**1.00**	**1.00**
Required Capacity	0.34	0.57	0.79	0.79
Excess/(Deficiency)	0.80	0.57	0.21	0.21
South				
Future Zone 2 Cherry Lane Res (TC2)	-	2.00	2.00	2.00
Future Zone 2 South Reservoir (TS2)	-	-	-	0.80
Total South Available Capacity	**-**	**2.00**	**2.00**	**2.80**
Required Capacity	0.98	1.48	1.99	2.74
Excess/(Deficiency)	(0.98)	0.52	0.01	0.06

Zone 2 Storage Capacity Projections - Volume				
Reservoirs	Volume, MG			
	2020 Conditions	10-Year Projections	UGB Buildout	Urban Reserve Buildout
Zone 2				
Total Zone 2 Available Capacity	**1.14**	**3.14**	**3.00**	**3.80**
Required Capacity	1.33	2.05	2.78	3.54
Excess/(Deficiency)	(0.19)	1.09	0.22	0.26

Zone 2 Storage Capacity Projections - ERUS				
Reservoirs	ERU			
	2020 Conditions	10-Year Projections	UGB Buildout	Urban Reserve Buildout
North				
Hillcrest 2 Reservoir	248	248	-	-
Lone Pine 2 Reservoir	816	1,773	1,773	1,773
Total North Available Capacity	**1,064**	**2,021**	**1,773**	**1,773**
Required Capacity	611	1,009	1,407	1,407
Excess/(Deficiency)	453	1,012	366	366
South				
Future Zone 2 Cherry Lane Res (TC2)	-	3,067	3,067	3,067
Future Zone 2 South Reservoir (TS2)	-	-	-	940
Total South Available Capacity	**-**	**3,067**	**3,067**	**4,007**
Required Capacity	772	1,671	2,570	3,908
Excess/(Deficiency)	(772)	1,396	497	99
Zone 2				
Total Zone 2 Available Capacity	**1,064**	**5,089**	**4,840**	**5,780**
Required Capacity	1,383	2,680	3,978	5,315
Excess/(Deficiency)	(319)	2,408	863	465
Note: Available capacity in Lone Pine 2 increases due to sharing fire storage among new reservoirs.				

Pumping Recommendations

Zone 2 and the zones above are currently supplied solely by the Stanford Pump Station. As noted in the storage analysis, the Zone 2 storage and transmission capacity limitations require the Stanford Pump Station to supply peak hour demands, causing the pump station to reach its capacity limit under current conditions.

Barnett Pump Station (PS2)

For existing conditions, the pumping capacity analysis (Table 5-3) indicates a 0.6-mgd deficit in pumping capacity to Zone 2 using the new pumping criteria. This deficit has been noticed by operations staff and is the main driver for constructing a new Barnett Pump Station pumping from Zone 1 to Zone 2. For future conditions, Table 5-3 indicates an overall pumping deficiency of 6.3 mgd by UGB Buildout and 9.2 mgd by Urban Reserve Buildout.

Table C-1 breaks this up by north and south tributaries and assigns the Stanford Pump Station to the south tributary area. In the south tributary area, Table C-1 indicates a deficiency of 1.4 mgd growing to 4.0 mgd by Urban Reserve Buildout.

In the south area, West Yost recommends the new Barnett Pump Station with capacity of 3.75 mgd for the UGB capacity. The pump station should be expanded to 5.5 mgd for the Urban Reserve Buildout. A near term capacity was not calculated but will be reviewed as part of the preliminary design phase. The near-term capacity of the pump station will need to carefully selected to work with head loss associated with existing infrastructure. The Barnett Pump Station will be designed and constructed by 2025. Medford Water is securing land for locating this pump station.

Lone Pine 2/3 Pump Station (PN2-3)

Table C-1 indicates a pumping capacity deficiency of 4.8 mgd in the north tributary area by the UGB build out, and 5.1 mgd by Urban Reserve Buildout. In the north area, West Yost recommends a new Lone Pine 2/3 Pump Station that supplies the north tributary area of Zone 2 with a capacity of 3.7 mgd (for a total firm capacity of 5.3 mgd including Zone 3 pumping). The Lone Pine 2/3 Pump Station should be constructed on the same site as a new Lone Pine 1 Reservoir. The Lone Pine 2/3 Pump Station should be constructed by UGB Buildout so that the combination of all three pump stations can support the Zone 2 pumping.

PRS-2-01

West Yost recommends a PRV in Cherry Lane to supply Zone 2 with Zone 3 water. This PRV is necessary for operational flexibility but is not assumed to operate every day. The PRV setting should be set low enough to support low pressure conditions, such as from fire flow conditions. The PRV is recommended to be constructed concurrent with the Zone 3 Cherry Lane Pump Station (PC3).

Pumping Summary

The tables below present the pumping analysis considering volume and ERUs with the recommended improvements. The tables below indicate even with a pump station of this size, the north area still requires additional pumping capacity; however, the Stanford Pump Station is centrally located and is able to supply both the north and south areas of the zone, so this is not considered an issue. The modeling confirms the proposed balance of pumping works well for operations of the zone.

The ERU capacity analysis for the pump stations includes ERUs for Zone 2 and all zones above it. The ERUs appear deficient, but it is not considered an issue. The ERU deficiency is due to a high MDD to ADD peaking factor for this zone (2.0), which reduces the ERUs the pump station can support. It is recommended that Medford Water work towards reducing the peak demands of Zone 2 and above to maximize the number of ERUs the pump stations can support.

Zone 2 Pumping Capacity Projections - Flow Capacity

Pump Stations	Flow Capacity, mgd			
	2020 Conditions	10-Year Projections	UGB Buildout	Urban Reserve Buildout
North				
Future Lone Pine 2/3 PS (PN2-3)	-	-	3.70	3.70
Total North Available Capacity	**-**	**-**	**3.70**	**3.70**
Required Capacity	1.77	3.30	4.83	5.13
Excess/Surplus	(1.77)	(3.30)	(1.13)	(1.43)
South				
Stanford Pump Station	2.65	2.65	2.65	2.65
Future Barnett Pump Station (PS2)	-	3.75	3.75	5.50
Total South Available Capacity	**2.65**	**6.40**	**6.40**	**8.15**
Required Capacity	2.03	3.06	4.09	6.67
Excess/(Deficiency)	0.62	3.34	2.31	1.48
Zone 2				
Total Zone 2 Available Capacity	**2.65**	**6.40**	**10.10**	**11.85**
Required Capacity	3.80	6.36	8.92	11.80
Excess/(Deficiency)	(1.15)	0.04	1.18	0.05

Zone 2 Pumping Capacity Projections - ERUs				
Pump Stations	ERUs			
	2020 Conditions	10-Year Projections	UGB Buildout	Urban Reserve Buildout
North				
Future Lone Pine 2/3 PS (PN2-3)	-	-	3,690	3,690
Total North Available Capacity	**-**	**-**	**3,690**	**3,690**
Required Capacity	2,672	4,038	5,403	5,703
Excess/Surplus	(2,672)	(4,038)	(1,713)	(2,013)
South				
Stanford Pump Station	2,643	2,643	2,643	2,643
Future Barnett Pump Station (PS2)	-	3,740	3,740	5,485
Total South Available Capacity	**2,643**	**6,383**	**6,383**	**8,128**
Required Capacity	918	2,786	4,654	7,604
Excess/(Deficiency)	1,725	3,597	1,729	524
Zone 2				
Total Zone 1 Available Capacity	**2,643**	**6,383**	**10,073**	**11,818**
Required Capacity	3,590	6,824	10,057	13,307
Excess/(Deficiency)	(947)	(441)	16	(1,488)

Note that there is a pumping capacity deficit projected in the 10-year and Urban Reserve Buildout when considering ERUs. Deficient ERUs can be attributed to the zone's high Maximum Day Demand peaking factor. As there is no pumping deficit when considering flow capacity, it is assumed that this deficit is negligible.

Pipeline Recommendations

Barnett Pump Station Discharge Pipeline (PL-2-01)

A new 24-inch and 16-inch pipeline is recommended to connect the new Barnett Pump Station (PS2) to supply the existing Zone 2 pipe network. The 24-inch pipeline is anticipated to extend east from the new Barnett Pump Station to the proposed roundabout. From the roundabout, a new 16-inch pipeline will head north and connect to a proposed waterline at the end of Lone Oak Drive. This pipeline has been designed by a local developer who intends to extend Lone Oak Drive south to Barnett Road. Depending on the timing, the developer may install this pipeline or Medford Water will pay to install this pipeline. The pipeline is required to be constructed concurrent with PS2.

Lone Pine 2 Pipeline (PL-2-06)

A 16-inch pipeline is recommended to connect the new Lone Pine 3 Pump Station (PN2-3) to existing Zone 2 pipelines along Lone Pine Road. This pipeline is recommended by UGB Buildout and concurrent with PN2-3.

TC2 Supply Pipeline (PL-2-10)

A new 16-inch Zone 2 pipeline is recommended to supply TC2 via PS2 from Barnett Reservoir. Pipeline alignment is south to north in an undeveloped area between E. Barnett Road and Cherry Lane. This pipeline is recommended to be constructed by UGB Buildout to meet growth in Zone 2 and upper zones.

Zone 2 South Reservoir Pipeline (PL-2-13)

A new 16-inch pipeline extending from the Barnett Pump Station (PS2) east in Barnett Road is recommended to supply the future Zone 2 South Reservoir (TS2) and Zone 3 & 4 South Pump Station (PS3-4). This pipeline can be constructed incrementally as development occurs along Barnett Road but should extend to the reservoir when constructed.

Zone 2 Pipeline Recommendations

	Pipe ID			
	PL-2-01	PL-2-06	PL-2-10	PL-2-13
Diameter, inches	24 and 16	16	16	16
Length, feet	4,150	350	5,950	3,150
Street	Lone Oak Drive	Lone Pine Road	Future	Barnett Road
From	Barnett PS (PS2)	PN2-3	Barnet PS (PS2)	Barnet PS (PS2)
To	End of Lone Oak Drive	Existing Zone 2 pipeline	Zone 2 Cherry Lane Reservoir (TC2)	Zone 2 South Reservoir (TS2)
Timing/Purpose/Trigger	Barnett Pump Station Discharge Pipe; concurrent with PS2 construction	Complete concurrent with PN2-3 construction	Concurrent with construction of PL-1-04	Concurrent with TS2 construction and PS2 expansion (EXP-2070-02)

Summary of Zone 2 Recommendations					
Project ID	Description	Size	Purpose	Trigger	Capital Cost Estimate, dollars
10-Year					
TC2	Zone 2 Cherry Lane Reservoir	2.0 MG	Replace Hillcrest 2 Reservoir that is undersized and meet growth of new customers to south	Needed as soon as possible; existing storage deficiency	7,371,000
PS2	Barnett Pump Station	3.75 mgd	Address Zone 2 pumping deficiency, provide redundancy to Stanford Pump Station	Needed as soon as possible; existing pumping deficiency.	3,358,000
PL-2-01	Barnett Pump Station Discharge Pipeline	Varies	Connect Barnett Pump Station (PS2) to existing piping	Concurrent with PS2 (or developer to install)	1,679,000
PRS-2-01	Pressure Reducing Station	N/A	Supply Zone 2 with Zone 3 water for operational flexibility	Concurrent with construction of PC3	410,000
UGB Buildout					
PN2-3	Lone Pine 2/3 Pump Station	3.7 mgd	Support growth in north area of zone	Zone 2 and above ERUs > 6,383	3,867,000
PL-2-06	Lone Pine 2 Pipeline	16-inch	Connect Lone Pine 2 Pump Station (PN2-3) to existing Zone 2 pipelines	Concurrent PS2-3 construction	156,000
PL-2-10	TC2 Supply Pipeline	16-inch	Supply Zone 2 Cherry Lane Reservoir (TC2) via Barnett Pump Station (PS2)	Concurrent with PL-1-04 construction	2,028,000
Urban Reserves Buildout					
TS2	South Zone 2 Reservoir	0.8 MG	Serve future growth in south Urban Reserves	Zone 2 ERUs > 4,840	5,210,000
EXP-2070-02	Barnett Pump Station Expansion (PS2)	5.5 mgd	Supply growth in Urban Reserves	Zone 2 and above ERUs > 10,073	819,000
PL-2-13	South Zone 2 Reservoir Pipeline	16-inch	Connect Barnett Pump Station (PS2) to South Zone 2 Reservoir (TS2)	Concurrent with TS2 construction and PS2 expansion (EXP-2070-02)	1,083,000

Zone 3 Summary

Growth Projections

Zone 3 is also expecting significant growth, with ERUs more than doubling in the north and multiplying by 16 in the south from 2020 to Urban Reserve Buildout. Maximum day demand (MDD) is anticipated to increase from 0.3 mgd to 1.0 mgd by UGB Buildout, and 1.4 mgd by Urban Reserve Buildout.

Zone 3 ERU Projections

Zone & Tributary Area	2020 ERUs	UGB Buildout		Urban Reserve Buildout	
		New ERUS	Total ERUs	New ERUs	Total ERUs
Zone 3 – North	672	557	1,229	3	1,233
Zone 3 – South	125	1,118	1,243	830	2,073
Zone 3 - Total	**798**	**1,675**	**2,473**	**833**	**3,306**

Zone 3 Demand Projections

Zone & Tributary Area	2020		UGB Buildout		Urban Reserve Buildout	
	ADD	MDD	ADD	MDD	ADD	MDD
Zone 3 – North	0.25	0.28	0.46	0.51	0.46	0.51
Zone 3 – South	0.05	0.05	0.47	0.51	0.78	0.86
Zone 3 - Total	**0.30**	**0.33**	**0.93**	**1.02**	**1.24**	**1.37**

Storage Recommendations

Zone 3 storage is comprised of the 1.0-MG Lone Pine 3 Reservoir in the north and the 0.1-MG Hillcrest 3 Reservoir in the central area. Hillcrest 3 Reservoir is far undersized to be useful for the growth of the zone and Medford Water intends to abandon it when other storage is constructed for the zone. In the north area, the storage analysis (Table D-1) identified excess storage capacity of 0.5 MG by buildout of the UGB in the north tributary area. (This surplus does not change for the Urban Reserves). However, in the south tributary area, the storage analysis (Table D-2) identified a deficiency of 1.1 MG by buildout of the UGB, increasing to 1.5 MG by buildout of the Urban Reserves.

Zone 3 Cherry Lane Reservoir (TC3)

To address the storage deficiency in the south area of Zone 3, West Yost recommends a 1.3-MG reservoir on property owned by Medford Water on Cherry Lane. This reservoir meets the UGB deficiency and also allows abandonment of the existing Hillcrest 3 Reservoir. This reservoir is recommended at UGB Buildout to address growth in Zone 3.

Zone 3 and 4 South Reservoir (TS3-4)

A second 0.8-MG reservoir is recommended to meet the remaining storage requirements for both Zones 3 and 4 in the southeast area at Urban Reserve Buildout. Of the 0.8 MG, 0.4 MG is needed for Zone 3.

Hillcrest Reservoir 3 Abandonment

To abandon Hillcrest Reservoir 3, the following projects are needed:

- Zone 3 Cherry Lane Reservoir (TC3)
- Zone 3 Cherry Lane Pump Station (PC3)
- Zone 5 East Pump Station (PC5)
- PL-5-09 (southern portion from PC5 to PRS-04-02)
- PRS-4-02 (to offset Angelcrest Pumping)

Storage Summary

The tables below present the storage analysis considering volume and ERUs with the recommended improvements. With the addition of the Zone 3 Cherry Lane Reservoir (and abandonment of Hillcrest 3 Reservoir), the zone will have excess storage capacity through UGB Buildout. Appendix F shows the anticipated cycling of the Lone Pine 3 and Zone 3 Cherry Lane Reservoirs combined with the recommended piping and pump stations. While the modeling indicates deeper cycling of the Lone Pine 3 Reservoir than the Cherry Lane Reservoir, this is considered acceptable as the north and south areas of Zone 3 will be supplied from different pump stations and can operate somewhat distinctly.

Zone 3 Storage Capacity Projections - Volume

Reservoirs	Volume, MG			
	2020 Conditions	10-Year Projections	UGB Buildout	Urban Reserve Buildout
North				
Hillcrest 3 Reservoir	0.10	0.10	-	-
Lone Pine 3 Reservoir	1.00	1.00	1.00	1.00
Total North Available Capacity	**1.10**	**1.10**	**1.00**	**1.00**
Required Capacity	0.32	0.46	0.59	0.59
Excess/(Deficiency)	0.78	0.64	0.41	0.41
South				
Future Zone 3 Cherry Lane Res (TC3)	-	-	*1.30*	*1.30*
Future Zone 3/4 South Reservoir (TS3-4)	-	-	-	*0.40*
Total South Available Capacity	**-**	**-**	**1.30**	**1.70**
Required Capacity	0.24	0.69	1.14	1.53
Excess/(Deficiency)	(0.24)	(0.69)	0.16	0.17
Zone 3				
Total Zone 3 Available Capacity	**1.10**	**1.10**	**2.30**	**2.70**
Required Capacity	0.57	1.14	1.73	2.12
Excess/(Deficiency)	0.54	(0.04)	0.57	0.58

Zone 3 Storage Capacity Projections - ERUs				
Reservoir	ERUs			
	2020 Conditions	10-Year Projections	UGB Buildout	Urban Reserve Buildout
North				
Hillcrest 3 Reservoir	322	322	-	-
Lone Pine 3 Reservoir	2,643	2,643	2,353	2,353
Total North Available Capacity	**2,966**	**2,966**	**2,353**	**2,353**
Required Capacity	672	951	1,229	1,233
Excess/(Deficiency)	2,293	2,015	1,124	1,120
South				
Future Zone 3 Cherry Lane Res (TC3)	-	-	*3,320*	*3,320*
Future Zone 3/4 South Reservoir (TS3-4)	-	-	-	*1,289*
Total South Available Capacity	**-**	**-**	**3,320**	**4,610**
Required Capacity	125	684	1,243	2,073
Excess/(Deficiency)	(125)	(684)	2,077	2,537
Zone 3				
Total Zone 3 Available Capacity	**2,966**	**2,966**	**5,674**	**6,963**
Required Capacity	798	1,635	2,473	3,306
Excess/(Deficiency)	2,168	1,331	3,201	3,658

Note that there is a minor storage capacity deficit projected in the 10-year when considering ERUs. Due to the small deficit and that there is no storage deficit when considering ERUs, it is assumed that this deficit is negligible.

Pumping Recommendations

Zone 3 is currently supplied only by the Hillcrest Pump Station with a capacity of 2.2 mgd. The pump station boosts water from Hillcrest 2 Reservoir to Hillcrest 3 and Lone Pine 3 Reservoirs. Hillcrest Pump Station is located very central to the Zone. The recommendations below consider the ability to abandon Hillcrest Pump Station when it reaches the end of its useful life and rely on other pumping facilities to the north and south to supply Zone 3 and higher zones.

Lone Pine 2/3 Pump Station (PN2-3)

In the north area of Zone 3, Table C-1 identifies a pumping capacity deficiency of 1.3 mgd at UGB Buildout growing to 1.6 mgd by Urban Reserve Buildout. To address this deficiency, West Yost recommends a new Lone Pine 2/3 Pump Station that supplies the north tributary area of Zone 3 with a capacity of 1.6-mgd (for a total firm capacity of 5.3 mgd including Zone 2 pumping). The pump station would be located adjacent to the existing Lone Pine 2 Reservoir and is recommended to be constructed by UGB Buildout.

Zone 3 Cherry Lane Pump Station (PC3)

In the south area of Zone 3, Table C-2 identifies a pumping capacity deficiency of 1.5 mgd at UGB Buildout growing to 2.75 mgd by Urban Reserve Buildout. To address this deficiency, West Yost recommends two new pump stations. A 3.7-mgd pump station is recommended adjacent to the new Zone 2 Cherry Lane Reservoir to supply surrounding areas of Zone 3 and supply upper zones via Cherry Lane to the east. The pump station is recommended to be constructed by the near-term horizon to meet projected near-term demands.

Zones 3 & 4 South Pump Station (PS3-4)

To meet the ultimate capacity needs at Urban Reserve Buildout, West Yost recommends a dual-zone pump station to supply Zones 3 and 4. The capacity supplying Zone 3 is recommended at 1.3 mgd. The Zone 3 portion of the pump station would discharge into Zone 3 piping through the proposed Zone 3 South Transmission Pipeline (PL-3-14).

Hillcrest 3 Pump Station Abandonment

To abandon Hillcrest 3 Pump Station, the following projects are needed:

- Zone 3 Cherry Lane Pump Station (PC3)
- Lone Pine 2/3 Pump Station (PN2-3)
- Zone 5 East Pump Station (PC5)
- Zones 4-7 Reservoir Supply Pipeline (PL-5-09)
- PRS-4-02

Pumping Summary

The tables below present the pumping analysis considering volume and ERUs with the recommended improvements.

The tables below indicate even with a pump station of this size, the north area still requires additional pumping capacity; however, the Zone 3 Cherry Lane Pump Station also supplies the eastern side of north area, so this is not considered an issue. Pumping capacity for the south area was strategically placed to avoid an excess of pumping capacity towards Lone Pine 3 reservoir. The modeling confirms the proposed balance of pumping works well for operations of the zone.

The ERU capacity analysis for the pump stations includes ERUs for Zone 3 and all zones above it.

Zone 3 Pumping Capacity Projections - Flow Capacity				
Pump Stations	Flow Capacity, mgd			
	2020 Conditions	10-Year Projections	UGB Buildout	Urban Reserve Buildout
North				
Hillcrest PS	2.15	2.15	-	-
Future Lone Pine 2/3 PS (PN2-3)	-	-	*1.60*	*1.60*
Total North Available Capacity	**2.15**	**2.15**	**1.60**	**1.60**
Required Capacity	1.31	2.37	3.42	3.72
Excess/(Deficiency)	0.84	(0.22)	(1.82)	(2.12)
South				
Future Zone 3 Cherry Lane PS (PC3)	-	*3.70*	*3.70*	*3.70*
Future Zone 3/4 South PS (PS3-4)	-	-	-	*1.30*
Total South Available Capacity	**-**	**-**	**3.70**	**5.00**
Required Capacity	0.07	0.79	1.51	2.75
Excess/(Deficiency)	(0.07)	2.91	2.19	2.25
Zone 3				
Total Zone 3 Available Capacity	**2.15**	**5.85**	**5.30**	**6.60**
Required Capacity	1.38	3.16	4.93	6.47
Excess/(Deficiency)	0.77	2.69	0.37	0.13

Zone 3 Pumping Capacity Projections - ERUs				
Pump Stations	ERUs			
	2020 Conditions	10-Year Projections	UGB Buildout	Urban Reserve Buildout
North				
Hillcrest PS	2,383	2,383	-	-
Future Lone Pine 2/3 PS (PN3)	-	-	*1,773*	*1,773*
Total North Available Capacity	**2,383**	**2,383**	**1,773**	**1,773**
Required Capacity	2,062	3,029	3,996	4,296
Excess/(Deficiency)	321	(647)	(2,223)	(2,522)
South				
Future Zone 3 Cherry Lane PS (PC3)	-	*4,100*	*4,100*	*4,100*
Future Zone 3/4 South PS (PS3-4)	-	-	-	*1,441*
Total South Available Capacity	**-**	**4,100**	**4,100**	**5,541**
Required Capacity	145	1,114	2,083	3,696
Excess/(Deficiency)	(145)	2,986	2,017	1,845

Zone 3 Pumping Capacity Projections - ERUs				
Pump Stations	ERUs			
	2020 Conditions	10-Year Projections	UGB Buildout	Urban Reserve Buildout
Zone 3				
Total Zone 3 Available Capacity	**2,383**	**6,483**	**5,873**	**7,314**
Required Capacity	2,207	4,143	6,079	7,992
Excess/(Deficiency)	175	2,339	(206)	(678)

Note that there is a pumping capacity deficit projected in the UGB Buildout and Urban Reserve Buildout when considering ERUs. As there is no pumping deficit when considering flow capacity, it is assumed that this deficit is negligible.

PIPELINE RECOMMENDATIONS

Zone 3 Cherry Lane Transmission Pipeline (PL-3-05)

A 16-inch pipeline is recommended to supply the future Zone 3 Cherry Lane Reservoir (TC3) from the future Zone 3 Cherry Lane Pump Station (PC3). This pipeline may be installed incrementally as development occurs along Cherry Lane but should extend to the reservoir when constructed.

Lone Pine 3 Reservoir Pipeline (PL-3-11)

A 12-inch pipeline is recommended to connect the new Lone Pine 3 Pump Station (PN2-3) to the existing Lone Pine 3 Reservoir. This pipeline is recommended by UGB Buildout and concurrent with PN2-3.

Zone 3 South Transmission Pipeline (PL-3-14)

As development continues to grow south of Cherry Lane at Urban Reserve Buildout, West Yost recommends a 12-inch pipeline extending from the future Zone 3 & 4 South Pump Station (PS3-4) to the Zone 3 Cherry Lane Transmission Pipeline (PL-3-05). The pipeline should align with future road rights-of-way, following City transportation planning.

Zone 3 Pipeline Recommendations			
	Pipe ID		
	PL-3-05	PL-3-11	PL-3-14
Diameter, inches	16	12	12
Length, feet	6,400	5,450	4,100
Street	Cherry Lane	Undeveloped	Future
From	PC3	PN2-3	PS3-4
To	TC3	Lone Pine 3 Reservoir	TC3
Timing/Purpose/Trigger	Complete concurrent with TC3	Complete concurrent with PN2-3 construction	Complete concurrent with TS2 and PS3-4 construction

Summary of Zone 3 Recommendations					
Project ID	Description	Size	Purpose	Trigger	Capital Cost Estimate, dollars
10-Year					
PC3	Zone 3 Cherry Lane Pump Station	3.7 mgd	Support Zone 3 growth south of Hillcrest Rd; allow Hillcrest 3 PS to be abandoned	Zone 3 and above ERUs > 2,383	3,343,000
UGB Buildout					
TC3	Zone 3 Cherry Lane Reservoir	1.3 MG	Meet storage deficiency in the south area of Zone 3; allow Hillcrest 3 Reservoir to be abandoned	Zone 3 ERUs > 2,966; prior to abandoning Hillcrest 3 Reservoir	6,110,000
PN2-3	Lone Pine 2/3 Pump Station	1.6 mgd	Support Zone 3 growth in north area	Zone 3 and above ERUs > 6,079; prior to abandoning Hillcrest 3 PS	3,867,000
PL-3-05	Zone 3 Cherry Lane Reservoir Pipeline	16-inch	Support development; connect to Zone 3 Cherry Lane Reservoir (TC3)	Concurrent with TC3 construction	2,847,000
PL-3-11	Lone Pine 3 Reservoir Pipeline	12-inch	Supply Lone Pine 3 Reservoir	Concurrent with PN2-3 construction	1,394,000
Urban Reserves Buildout					
TS3-4	Zones 3 & 4 South Reservoir	0.8 MG	Support growth in Urban Reserves to South	Zone 3 ERUs > 5,674	5,210,000
PS3-4	Zone 3/4 South Pump Station	1.3 mgd	Support growth in Urban Reserves to South	After PN2-3 construction and Hillcrest 3 PS abandonment; Zone 3 and above ERUs > 6,079	2,819,000
PL-3-14	Zone 2 South Connector Pipeline	12-inch	Supply Zone 3 Cherry Lane Reservoir (TC3) via Zones 3 & 4 South Pump Station (PS3-4)	Concurrent with TS2 and PS3-4 construction	1,048,000

Zone 4 Summary

Growth Projections

Zone 4 is expecting growth, with ERUs increasing by 50 percent in the north and multiplying by 16 in the south from 2020 to Urban Reserve Buildout. Maximum day demand (MDD) is anticipated to increase from 0.8 mgd to 1.5 mgd by UGB Buildout, and 2.1 mgd by Urban Reserve Buildout.

Zone 4 ERU Projections

Zone & Tributary Area	2020 ERUs	UGB Buildout		Urban Reserve Buildout	
		New ERUS	Total ERUs	New ERUs	Total ERUs
Zone 4 – North	1,097	351	1,448	103	1,551
Zone 4 – South	20	537	557	713	1,270
Zone 4 - Total	**1,117**	**888**	**2,005**	**816**	**2,821**

Zone 4 Demand Projections

Zone & Tributary Area	2020		UGB Buildout		Urban Reserve Buildout	
	ADD	MDD	ADD	MDD	ADD	MDD
Zone 4 – North	0.41	0.82	0.54	1.09	0.58	1.17
Zone 4 – South	0.01	0.02	0.21	0.42	0.48	0.96
Zone 4 - Total	**0.42**	**0.84**	**0.75**	**1.51**	**1.06**	**2.12**

Storage Recommendations

The current storage in Zone 4 is comprised of the 0.18-MG Stardust Reservoir and 0.5-MG Cherry Lane 4 Reservoir. The Stardust Reservoir was constructed to serve a small development and Medford Water would like to abandon the reservoir due to its small size.

Table 5-4 identified a current storage deficiency in Zone 4 of 0.13 MG, growing to 0.99 MG at UGB Buildout, and 1.45 MG at Urban Reserve Buildout. The deficiency only increases with the removal of Stardust Reservoir.

Zones 4-7 East Reservoir (TC4-7)

The storage analysis for the upper east side zones resulted in the recommendation for a combined 1.6-MG Zone 4, 5, 6, & 7 storage tank located east and central of Zone 4. This reservoir is planned to provide equalizing, emergency, and fire flow volume for all four zones (only one fire flow volume shared between zones). Of the 1.6 MG, 1.0 MG is needed for Zone 4, including a 0.54-MG fire flow volume. The reservoir should be sited high enough to provide gravity storage to Zone 5. Supply to Zone 4 would be provided through a PRV (PRS-4-02) located at Roxyanne Road and Fallbrook Lane. Supplies for Zones 6 & 7 would be pumped out of the reservoir.

Zone 4 North Reservoir (TN4)

West Yost recommends a new 0.3-MG reservoir in the far north of Zone 4 to support additional growth in the north end of the zone. The reservoir is recommended for construction by UGB Buildout to meet growing demands. Once it is constructed, the Stardust Reservoir can be abandoned while Cherry Lane 4 and the new reservoir meet storage requirements for the zone.

Zones 3 & 4 South Reservoir (TS3-4)

A second 0.8-MG reservoir is recommended to meet the remaining storage requirements for both Zones 3 and 4 in the southeast area at Urban Reserve Buildout. Of the 0.8 MG, 0.4 MG is needed for Zone 4.

STORAGE SUMMARY

The tables below present the storage analysis considering volume and ERUs with the recommended improvements. A storage deficit is predicted in the 10-year time frame; Medford Water will need to consider the prioritization of other critical projects and timing of development when considering when to construct future zone 4 storage.

Zone 4 Storage Capacity Projections - Volume

Reservoirs	Volume. MG			
	2020 Conditions	10-Year Projections	UGB Buildout	Urban Reserve Buildout
North				
Stardust Reservoir	0.18	0.18	-	-
Cherry Lane 4 Reservoir	0.50	0.50	0.50	0.50
Future Zone 4 North Reservoir (TN4)	-	-	*0.30*	*0.30*
Total North Available Capacity	**0.68**	**0.68**	**0.80**	**0.80**
Required Capacity	0.62	0.72	0.82	0.87
Excess/(Deficiency)	0.06	(0.04)	(0.02)	(0.07)
South				
Future Zone 4-7 East Reservoir (TC4-7)	-	-	*1.00*	*1.00*
Future Zone 3/4 South Reservoir (TS3-4)	-	-	-	*0.40*
Total South Available Capacity	**-**	**-**	**1.00**	**1.40**
Required Capacity	-	0.43	0.85	1.26
Excess/(Deficiency)	-	(0.43)	0.15	0.14
Zone 4				
Total Zone 4 Available Capacity	**0.68**	**0.68**	**1.80**	**2.20**
Required Capacity	0.62	1.14	1.67	2.13
Excess/(Deficiency)	0.06	(0.46)	0.13	0.07

Zone 4 Storage Capacity Projections - ERUs				
Reservoirs	ERUs			
	2020 Conditions	10-Year Projections	UGB Buildout	Urban Reserve Buildout
North				
Stardust Reservoir	319	319	-	-
Cherry Lane 4 Reservoir	887	887	887	887
Zone 4 North Reservoir (TN4)	-	-	532	532
Total North Available Capacity	**1,206**	**1,206**	**1,418**	**1,418**
Required Capacity	1,097	1,272	1,448	1,551
Excess/(Deficiency)	109	(67)	(29)	(132)
South				
Future Zone 4-7 East Reservoir (TC4-7)	-	-	*816*	*816*
Future Zone 3/4 South Reservoir (TS3-4)	-	-	-	*1,289*
Total South Available Capacity	**-**	**-**	**816**	**2,105**
Required Capacity	20	289	557	1,270
Excess/(Deficiency)	(20)	(289)	258	835
Zone 4				
Total Zone 4 Available Capacity	**1,206**	**1,206**	**2,234**	**3,524**
Required Capacity	1,117	1,561	2,005	2,821
Excess/(Deficiency)	89	(355)	229	702

Pumping Recommendations

Zone 4 is currently supplied entirely by the 1.7-mgd Angelcrest Pump Station. The Master Plan recommends retaining this pump station for the future. Table 5-3 shows a pumping deficit of 1.8 mgd beginning at UGB Buildout growing to 2.9 mgd by Urban Reserve Buildout.

Zones 4 and 5 North Pump Station (PN4-5)

To resolve the pumping deficiency anticipated at UGB Buildout, a dual zone pump station is recommended at the Lone Pine 3 Reservoir site to pump to both Zones 4 & 5. The recommended capacity for Zone 4 is 2.2 mgd, which supports the pumping needs for the north area, and allows the Angelcrest Pump Station capacity to be available for the south area. Additionally, a PRV located between Zones 5 & 4 near Roxyanne Road is anticipated to meet the Zone 4 needs to the south.

Zones 3 and 4 South Pump Station (PS3-4)

To meet the pumping needs in the southern area of Zone 4, a dual pump station is recommended for supplying both Zones 3 & 4 at Urban Reserve Buildout. The Zone 4 recommended capacity is 0.8 mgd.

PRS-4-02

A PRV to supply Zone 4 at the top of Hillcrest Road is recommended. The PRV is necessary under normal operating conditions to serve Zone 4 customers with supplies from the upper zones, e.g., Zones 4-7 East Reservoir (TC4-7). The PRV will also reduce demand on the Angelcrest Pump Station.

Pumping Summary

The tables below present the pumping analysis considering volume and ERUs with the recommended improvements. A pumping deficit is predicted in the 10-year time frame; Medford Water will need to consider the prioritization of other critical projects and timing of development when considering when to construct the Zone 4/5 North Pump Station.

The tables below indicate even with a pump station of this size, the south area still requires additional pumping capacity; however, the Angelcrest Pump Station also supplies the southern area, so this is not considered an issue. The modeling confirms the proposed balance of pumping works well for operations of the zone.

The ERU capacity analysis for the pump stations includes ERUs for Zone 4 and all zones above it.

Zone 4 Pumping Capacity Projections - Flow Capacity

Pump Stations	Flow Capacity, mgd			
	2020 Conditions	10-Year Projections	UGB Buildout	Urban Reserve Buildout
North				
Angelcrest PS	1.73	1.73	1.73	1.73
Future Zone 4/5 North PS (PN4-5)	-	-	*2.20*	*2.20*
Total North Available Capacity	**1.73**	**1.73**	**3.93**	**3.93**
Required Capacity	1.03	1.89	2.74	3.04
Excess/(Deficiency)	0.70	(0.16)	1.19	0.89
South				
Future Zone 3/4 South PS (PS3-4)	-	-	-	*0.80*
Total South Available Capacity	**-**	**-**	**-**	**0.80**
Required Capacity	0.02	0.42	0.83	1.61
Excess/(Deficiency)	(0.02)	(0.42)	(0.83)	(0.81)
Zone 4				
Total Zone 4 Available Capacity	**1.73**	**1.73**	**3.93**	**4.73**
Required Capacity	1.05	2.31	3.57	4.65
Excess/(Deficiency)	0.68	(0.58)	0.36	0.08

Zone 4 Pumping Capacity Projections - ERUs				
Pump Stations	ERUs			
	2020 Conditions	10-Year Projections	UGB Buildout	Urban Reserve Buildout
North				
Angelcrest PS	1,725	1,725	1,725	1,725
Future Zone 4/5 North PS (PN4-5)	-	-	*2,194*	*2,194*
Total North Available Capacity	**1,725**	**1,725**	**3,920**	**3,920**
Required Capacity	1,390	2,078	2,767	3,063
Excess/(Deficiency)	336	(353)	1,153	857
South				
Future Zone 3/4 South PS (PS3-4)	-	-	-	*798*
Total South Available Capacity	**-**	**-**	**-**	**798**
Required Capacity	20	430	840	1,624
Excess/(Deficiency)	(20)	(430)	(840)	(826)
Zone 4				
Total Zone 4 Available Capacity	**1,725**	**1,725**	**3,920**	**4,717**
Required Capacity	1,410	2,508	3,607	4,686
Excess/(Deficiency)	316	(783)	313	31

Pipeline Recommendations

Zone 4 North Reservoir Supply Pipeline (PL-4-07)

A 12-inch pipeline is needed to supply the Zone 4 North Reservoir (TN4) from the Zone 4/5 North Pump Station (PN4-5) when constructed.

Zone 3/4 South Reservoir Supply Pipeline (PL-4-15)

A 12-inch pipeline is needed to supply the Zone 3/4 South Reservoir (TS3-4) from the Zone 3/4 South Pump Station (PS3-4) when constructed.

Zone 4 Pipeline Recommendations		
	Pipe ID	
	PL-4-07	PL-4-15
Diameter, inches	12	12
Length, feet	7,450	7,550
Street	Undeveloped access roads	East Barnett Road
From	PN4-5	PS3-4
To	TN4	TS3-4
Timing/Purpose/Trigger	Supply TN4; complete concurrent with TN4	Supply TS3-4; complete concurrent with TS3-4

Summary of Zone 4 Recommendations					
Project ID	Description	Size	Purpose	Trigger	Capital Cost Estimate, dollars
UGB Buildout					
TC4-7	Zones 4-7 East Reservoir	1.6 MG	Support storage needs for Zones 4 through 7; includes 0.54 MG fire flow volume	Zone 4 ERUs > 1,206; concurrent with PL-5-09 and PC5	6,651,000
TN4	Zone 4 North Reservoir	0.3 MG	Support storage needs in north area	Concurrent with PN4-5 and PL-4-07	4,309,000
PN4-5	Zones 4/5 North Pump Station	2.2 MG	Supplement Angelcrest Pump Station to meet demands	Zone 4 and above ERUs > 1,725	3,179,000
PRS-4-02	Pressure Reducing Station	N/A	Supply Zone 4 with Zone 5 water and reduce demand on the Angelcrest PS	Concurrent with PL-5-09	410,000
PL-4-07	Zone 4 North Reservoir Pipeline	12-inch	Supply line to TN4	Concurrent with TN4	1,913,000
Urban Reserves Buildout					
TS3-4	Zone 3/4 South Reservoir	0.4 MG	Support storage needs in south area of Urban Reserves	Zone 4 ERUs > 2,234	5,210,000
PS3-4	Zones 3 & 4 South Pump Station	0.8 mgd	Support pumping needs in south area of Urban Reserves	Concurrent with TS2	2,819,000
PL-4-15	Zone 3/4 South Reservoir Pipeline	12-inch	Supply line to TS3-4 or as development occurs	Concurrent with TS3-4	1,931,000

Zone 5 Summary

Growth Projections

Zone 5 is expecting growth, with ERUs increasing by more than doubling from 2020 to Urban Reserve Buildout. Maximum day demand (MDD) is anticipated to increase from 0.2 mgd to 0.6 mgd by UGB Buildout, and 0.7 mgd by Urban Reserve Buildout.

Zone 5 ERU Projections

Zone & Tributary Area	2020 ERUs	UGB Buildout		Urban Reserve Buildout	
		New ERUS	Total ERUs	New ERUs	Total ERUs
Zone 5 – North	293	333	625	51	676
Zone 5 – South	-	276	276	70	347
Zone 5 - Total	**293**	**609**	**902**	**122**	**1,023**

Zone 5 Demand Projections

Zone & Tributary Area	2020		UGB Buildout		Urban Reserve Buildout	
	ADD	MDD	ADD	MDD	ADD	MDD
Zone 5 – North	0.11	0.21	0.24	0.45	0.25	0.48
Zone 5 – South	-	-	0.10	0.20	0.13	0.25
Zone 5 - Total	**0.11**	**0.21**	**0.34**	**0.64**	**0.38**	**0.73**

Storage Recommendations

Current storage for Zone 5 is provided by the 0.5-MG Highland Reservoir, which provides adequate storage volume to the north end of the zone through Urban Reserve Buildout. However, development south of the reservoir is expected to continue to grow and a deficit of 0.2 MG is anticipated by Urban Reserve Buildout.

Zones 4-7 East Reservoir (TC4-7)

As noted in the Zone 4 summary, the storage analysis for the upper east side zones resulted in the recommendation for a combined 1.6-MG Zone 4, 5, 6, & 7 storage tank located up Roxyanne Road. This reservoir is planned to provide equalizing, emergency, and fire flow volume for all four zones (only one fire flow volume shared between zones). Of the 1.6 MG, 0.15 MG is needed for Zone 5. The reservoir should be sited high enough to provide gravity storage to Zone 5. The reservoir will be connected to Zone 5 through a pipeline down Roxyanne Road (PL-5-09).

Storage Summary

The tables below present the storage analysis considering volume and ERUs with the recommended improvements.

Zone 5 Storage Capacity Projections - Volume				
	Volume, MG			
Reservoirs	2020 Conditions	10-Year Projections	UGB Buildout	Urban Reserve Buildout
North				
Highland Reservoir	0.50	0.50	0.50	0.50
Total North Available Capacity	**0.50**	**0.50**	**0.50**	**0.50**
Required Capacity	0.16	0.25	0.35	0.38
Excess/(Deficiency)	0.34	0.25	0.15	0.12
South				
Future Zone 4-7 East Reservoir (TC4-7)	-	-	*0.15*	*0.15*
Total South Available Capacity	**-**	**-**	**0.15**	**0.15**
Required Capacity	-	0.08	0.15	0.19
Excess/(Deficiency)	-	(0.08)	(0.00)	(0.04)
Zone 5				
Total Zone 5 Available Capacity	**0.50**	**0.50**	**0.65**	**0.65**
Required Capacity	0.16	0.33	0.50	0.57
Excess/(Deficiency)	0.34	0.17	0.15	0.08

Zone 5 Storage Capacity Projections - ERUs				
	ERUs			
Reservoirs	2020 Conditions	10-Year Projections	UGB Buildout	Urban Reserve Buildout
North				
Highland Reservoir	933	933	933	933
Total North Available Capacity	**933**	**933**	**933**	**933**
Required Capacity	293	459	625	676
Excess/(Deficiency)	641	474	308	257
South				
Future Zone 4-7 East Reservoir (TC4-7)	-	-	*280*	*280*
Total South Available Capacity	**-**	**-**	**280**	**280**
Required Capacity	-	131	263	333
Excess/(Deficiency)	-	(131)	17	(53)

Zone 5 Storage Capacity Projections - ERUs				
	ERUs			
Reservoirs	2020 Conditions	10-Year Projections	UGB Buildout	Urban Reserve Buildout
Zone 5				
Total zone 5 Available Capacity	**933**	**933**	**1,213**	**1,213**
Required Capacity	293	590	888	1,010
Excess/(Deficiency)	641	343	325	204

Pumping Recommendations

Current pumping to Zone 5 is provided through the 0.5 mgd Stardust Pump Station. This pump station is not built to modern day pump station standards and is recommended for replacement with other pump stations to the zone.

Zones 4 and 5 North Pump Station (PN4-5)

To resolve the pumping deficiency anticipated at UGB Buildout, a dual zone pump station is recommended at the Lone Pine 3 Reservoir site to pump to both Zones 4 & 5. The recommended capacity for Zone 5 is 1.0 mgd, which is approximately half of the pumping needs for Zone 5 and allows removal of the Stardust Pump Station. This is recommended by UGB Buildout or as development in the north occurs.

Zone 5 East Pump Station (PC5)

A 1.0-mgd pump station is recommended at the Zone 3 East Reservoir (TC3) site. This pump station would pump to the Zone 4-7 East Reservoir (TC4-7) located in Zone 5 through the recommended Zone 5 pipeline (PL-5-09). A PRV (PRS-4-02) in Roxyanne Road would allow boosted water to supply Zone 4 as needed. Other Zone 5 piping could also connect to the discharge of this new pump station. This is recommended by UGB Buildout or as development occurs.

Stardust Pump Station Abandonment

To abandon the Stardust Pump Station, the following projects need to be completed:

- Zone 4/5 North PS (PN4-5)
- Zone 5 North Connector Pipeline (PL-5-08)

Pumping Summary

The tables below present the pumping analysis considering volume and ERUs with the recommended improvements. A pumping deficit is predicted in the 10-year time frame; Medford Water will need to consider the prioritization of other critical projects and timing of development when considering when to construct the Zone 4/5 North Pump Station or Zone 5 East Pump Station.

The tables indicate an excess pumping capacity by Urban Reserve Buildout. The additional capacity is assumed to be available for supplying Zone 4 through PRS-4-02.

The tables show more deficiency in the north area than the south area. However, the Zone 5 East PS (PC5) is able to supply both the north and south areas of the zone, so this is not considered an issue. The modeling confirms the proposed balance of pumping works well for operations of the zone.

The ERU capacity analysis for the pump stations includes ERUs for Zone 5 and all zones above it.

Zone 5 Pumping Capacity Projections - Flow Capacity

Pump Stations	Flow Capacity, mgd			
	2020 Conditions	10-Year Projections	UGB Buildout	Urban Reserve Buildout
North				
Stardust Pump Station	0.50	0.50	-	-
Future Zone 4/5 North PS (PN4-5)	-	-	*1.00*	*1.00*
Total North Available Capacity	**0.50**	**0.50**	**1.00**	**1.00**
Required Capacity	0.21	0.75	1.29	1.48
Excess/(Deficiency)	0.29	(0.25)	(0.29)	(0.48)
South				
Future Zone 5 East PS (PC5)	-	-	*1.00*	*1.00*
Total South Available Capacity	**-**	**-**	**1.00**	**1.00**
Required Capacity	-	0.13	0.27	0.34
Excess/(Deficiency)	-	(0.13)	0.73	0.66
Zone 5				
Total Zone 5 Available Capacity	**0.50**	**0.50**	**2.00**	**2.00**
Required Capacity	0.21	0.88	1.56	1.82
Excess/(Deficiency)	0.29	(0.38)	0.44	0.18

Zone 5 Pumping Capacity Projections - ERUs

Pump Stations	ERUs			
	2020 Conditions	10-Year Projections	UGB Buildout	Urban Reserve Buildout
North				
Stardust Pump Station	525	525	-	-
Future Zone 4/5 North PS (PN4-5)	-	-	*1,050*	*1,050*
Total North Available Capacity	**525**	**525**	**1,050**	**1,050**
Required Capacity	293	806	1,319	1,512
Excess/(Deficiency)	232	(281)	(269)	(462)

Zone 5 Pumping Capacity Projections - ERUs				
Pump Stations	ERUs			
	2020 Conditions	10-Year Projections	UGB Buildout	Urban Reserve Buildout
South				
Future Zone 5 East PS (PC5)	-	-	*1,050*	*1,050*
Total South Available Capacity	**-**	**-**	**1,050**	**1,050**
Required Capacity	-	141	283	353
Excess/(Deficiency)	-	(141)	767	697
Zone 5				
Total Zone 5 Available Capacity	**525**	**525**	**2,100**	**2,100**
Required Capacity	293	947	1,602	1,865
Excess/(Deficiency)	232	(422)	498	235

Pipeline Recommendations

Zone 5 North Connector Pipeline (PL-5-08)

With the removal of Stardust Pump Station, Zone 5 will require a new 12-inch pipeline connecting PN4-5 to existing Zone 5 piping and serving the Highland Reservoir. This pipeline can be constructed as part of serving new development in Zone 5. It is recommended to use a new pipeline alignment through future streets due to narrow easements and developed streets within the existing Zone 5 pipeline alignment.

Zones 4-7 Reservoir Supply Pipeline (PL-5-09)

A 12-inch pipeline is needed to supply the Zones 4-7 Reservoir (TC4-7) from the Zone 4 South Pump Station (PC5) when constructed. This pipeline is a Zone 5 pipeline but is assumed to have a PRV to supply Zone 4 near Hillcrest Road.

Zone 5 Pipeline Recommendations		
	Pipe ID	
	PL-5-08	PL-5-09
Diameter, inches	12	12
Length, feet	4,150	4,950
Street	Devonshire Place, Pinnacle Drive	Cherry Lane, Hillcrest Road, Roxyanne Road
From	PN4-5	PC5
To	Existing Zone 5 pipeline on Stardust Way	TC4-7
Timing/Purpose/Trigger	Supply Highland Reservoir; construct prior to removal of Stardust Pump Station	Supply TC4-7; concurrently with construction of PC5 Pump Station and TC4-7

Summary of Zone 5 Recommendations					
Project ID	Description	Size	Purpose	Trigger	Capital Cost Estimate, dollars
UGB Buildout					
TC4-7	Zones 4-7 East Reservoir	0.15 MG	Provide gravity storage to Zone 5 including equalizing, emergency, and fire flow volume	Zone 5 ERUS > 933; concurrently with construction of PC5 Pump Station and PL-5-09	6,651,000
PN4-5	Zones 4 & 5 North Pump Station	1.0 mgd	Increase pumping capacity for Zones 4 and 5; allow removal of Stardust PS	Zone 5 and above ERUs > 525; construct prior to removal of Stardust PS	3,179,000
PC5	Zone 5 East Pump Station	1.0 mgd	Pump to TC4-7 and Zone 5 piping	Zone 5 and above ERUs > 525; concurrently with construction of TC4-7 and PL-5-09	2,130,000
PL-5-08	Zone 5 North Connector Pipeline	12-inch	Supply Highland Reservoir	Construct prior to removal of Stardust PS	1,298,000
PL-5-09	Zones 4-7 Reservoir Supply Pipeline	12-inch	Supply TC4-7	Concurrently with construction of PC5 Pump Station and TC4-7	1,471,000

Zone 6 Summary

Growth Projections

Zone 6 has no existing customers but is expected to increase to over 500 ERUs by Urban Reserve Buildout. Maximum day demand (MDD) is anticipated to be 0.33 mgd by UGB Buildout, and 0.4 mgd by Urban Reserve Buildout.

Zone 6 ERU Projections

Zone & Tributary Area	2020 ERUs	UGB Buildout		Urban Reserve Buildout	
		New ERUS	Total ERUs	New ERUs	Total ERUs
Zone 6 – North	-	431	431	71	502
Zone 6 – South	-	7	7	-	7
Zone 6 - Total	**-**	**438**	**438**	**71**	**509**

Zone 6 Demand Projections

Zone & Tributary Area	2020		UGB Buildout		Urban Reserve Buildout	
	ADD	MDD	ADD	MDD	ADD	MDD
Zone 6 – North	-	-	0.16	0.32	0.19	0.38
Zone 6 – South	-	-	0.00	0.00	0.00	0.00
Zone 6 - Total	**-**	**-**	**0.16**	**0.33**	**0.19**	**0.38**

Storage Recommendations

Zone 6 does not currently have water demand or storage needs. However, development is expected to increase storage needs to 0.24 MG by UGB Buildout and 0.28 MG by Urban Reserve Buildout.

Zones 4-7 East Reservoir (TC4-7)

As noted in the Zone 4 summary, the storage analysis for the upper east side zones resulted in the recommendation for a combined 1.6-MG Zone 4, 5, 6, & 7 storage tank located up Roxyanne Road. This reservoir is planned to provide equalizing, emergency, and fire flow volume for all four zones (only one fire flow volume shared between zones). Of the 1.6 MG, 0.28 MG is needed for Zone 6.

Storage Summary

The tables below present the storage analysis considering volume and ERUs with the recommended improvements. A storage deficit is predicted in the 10-year time frame based on assumed development timing; Medford Water will need to consider the prioritization of other critical projects and timing of development when considering when to construct the Zone 4-7 East Reservoir.

Zone 6 Storage Capacity Projections - Volume				
	Volume, MG			
Reservoirs	2020 Conditions	10-Year Projections	UGB Buildout	Urban Reserve Buildout
Total Zone 6				
Future Zone 4-7 East Reservoir (TC4-7)	-	-	*0.28*	*0.28*
Required Capacity	-	0.12	0.24	0.28
Excess/(Deficiency)	-	(0.12)	0.04	-

Zone 6 Storage Capacity Projections – ERUs				
	ERUs			
Reservoirs	2020 Conditions	10-Year Projections	UGB Buildout	Urban Reserve Buildout
Total Zone 6				
Total Available Capacity	-	-	502	502
Required Capacity	-	219	438	509
Excess/(Deficiency)	-	(219)	65	(7)

Pumping Recommendations

Zone 6 does not currently have water demand or pumping needs. However, development is expected to increase pumping needs to 0.44 mgd by UGB Buildout and 0.51 mgd by Urban Reserve Buildout.

Zone 6-7 Central Pump Station (PC6-7)

A dual zone hydropneumatic pump station is recommended at the proposed Zone 4-7 East Reservoir (TC4-7) site to serve growth in Zones 6 and 7. The total recommended pumping capacity of PC6-7 is 5.2 mgd. This capacity includes 1,500 gpm (or 2.16 mgd) of firm capacity for both zones to provide fire flows, as well as 0.50 mgd for Zone 6 demands. PC6-7 is recommended by UGB Buildout or as development occurs.

Zone 6-7 North Pump Station (PN6-7)

A dual zone hydropneumatic pump station is recommended at the proposed Zone 4 North Reservoir (TN4) site to serve growth in Zones 6 and 7. The total recommended pumping capacity of PN6-7 is 4.6 mgd. This capacity includes 1,500 gpm (or 2.16 mgd) of firm capacity for both zones to provide fire flows, as well as 0.10 mgd for Zone 6 demands. PN6-7 is recommended by UGB Buildout or as development occurs.

Pumping Summary

The tables below present the pumping analysis considering volume and ERUs with the recommended improvements. A pumping deficit is predicted in the 10-year time frame based on assumed development timing; Medford Water will need to consider the prioritization of other critical projects and timing of development when considering when to construct the Zone 6-7 Central PS.

The ERU capacity analysis for the pump stations includes ERUs for Zone 6 and all zones above it.

Zone 6 Pumping Capacity Projections - Flow Capacity				
	Flow Capacity, mgd			
Pump Stations	2020 Conditions	10-Year Projections	UGB Buildout	Urban Reserve Buildout
Zone 6				
Zone 6-7 Central PS (PC6-7)	-	-	0.50	0.50
Zone 6-7 North PS (PN6-7)	-	-	-	0.10
Total Zone 6 Available Capacity	**-**	**-**	**0.50**	**0.60**
Required Capacity	-	0.22	0.44	0.51
Excess/(Deficiency)	-	(0.22)	0.06	0.09

Zone 6 Pumping Capacity Projections – ERUs				
	ERUs			
Pump Stations	2020 Conditions	10-Year Projections	UGB Buildout	Urban Reserve Buildout
Zone 6				
Zone 6-7 Central PS (PC6-7)	-	-	499	499
Zone 6-7 North PS (PN6-7)	-	-	-	100
Total Zone 6 Available Capacity	**-**	**-**	**499**	**598**
Required Capacity	-	421	842	842
Excess/(Deficiency)	-	(421)	(343)	(243)

Pipeline Recommendations

No pipeline projects are identified for Zone 6.

Summary of Zone 6 Recommendations

Project ID	Description	Size	Purpose	Trigger	Capital Cost Estimate, dollars
UGB Buildout					
TC4-7	Zones 4-7 East Reservoir	0.28 MG	Providing equalizing, emergency, and fire flow volume	No existing Zone 6 storage; concurrently with Zone 6 development and construction of PC5 and PL-5-09	6,651,000
PC6-7	Zone 6-7 Central Pump Station	0.50 mgd	Provide pumping capacity for growth in Zone 6 and 7	No existing Zone 6 pumping; concurrently with Zone 6 development	2,130,000
Urban Reserves Buildout					
PN6-7	Zone 6-7 North Pump Station	0.10 mgd	Provide additional pumping capacity for growth in Zone 6 and 7	Zone 6 and above ERUs > 499	2,130,000

Zone 7 Summary

Growth Projections

Zone 7 ERU Projections

Zone & Tributary Area	2020 ERUs	UGB Buildout		Urban Reserve Buildout	
		New ERUS	Total ERUs	New ERUs	Total ERUs
Zone 7 – North	-	263	263	70	333
Zone 7 – South	-	-	-	-	-
Zone 7 - Total	**-**	**263**	**263**	**70**	**333**

Zone 7 Demand Projections

Zone & Tributary Area	2020		UGB Buildout		Urban Reserve Buildout	
	ADD, mgd	MDD, mgd	ADD, mgd	MDD, mgd	ADD, mgd	MDD, mgd
Zone 7 – North	-	-	0.10	0.20	0.13	0.25
Zone 7 – South	-	-	-	-	-	-
Zone 7 - Total	**-**	**-**	**0.10**	**0.20**	**0.13**	**0.25**

Storage Recommendations

Zone 7 does not currently have water demand or storage needs. However, development is expected to increase storage needs to 0.15 MG by UGB Buildout and 0.19 MG by Urban Reserve Buildout.

Zones 4-7 East Reservoir (TC4-7)

As noted in the Zone 4 summary, the storage analysis for the upper east side zones resulted in the recommendation for a combined 1.6-MG Zone 4, 5, 6, & 7 storage tank located up Roxyanne Road. This reservoir is planned to provide equalizing, emergency, and fire flow volume for all four zones (only one fire flow volume shared between zones). Of the 1.6 MG, 0.19 MG is needed for Zone 7.

Storage Summary

The tables below present the storage analysis considering volume and ERUs with the recommended improvements. A storage deficit is predicted in the 10-year time frame based on assumed development timing; Medford Water will need to consider the prioritization of other critical projects and timing of development when considering when to construct the Zone 4-7 East Reservoir.

Zone 7 Storage Capacity Projections - Volume				
Reservoirs	Volume, MG			
	2020 Conditions	10-Year Projections	UGB Buildout	Urban Reserve Buildout
Total Zone 7				
Future Zone 4-7 East Reservoir (TC4-7)	-	-	*0.19*	*0.19*
Required Capacity	-	0.07	0.15	0.19
Excess/(Deficiency)	-	(0.07)	0.04	-

Zone 7 Storage Capacity Projections – ERUs				
Reservoirs	ERUs			
	2020 Conditions	10-Year Projections	UGB Buildout	Urban Reserve Buildout
Total Zone 7				
Total Zone 7 Available Capacity	**-**	**-**	**333**	**333**
Required Capacity	-	131	263	333
Excess/(Deficiency)	-	(131)	70	-

Pumping Recommendations

Zone 7 does not currently have water demand or pumping needs. However, development is expected to increase pumping needs to 0.26 mgd by UGB Buildout and 0.33 mgd by Urban Reserve Buildout.

Zone 6-7 Central Pump Station (PC6-7)

As noted in the Zone 6 summary, a dual zone hydropneumatic pump station is recommended at the proposed Zone 4-7 East Reservoir (TC4-7) site to serve growth in Zones 6 and 7. The total recommended pumping capacity of PC6-7 is 5.2 mgd. This capacity includes 1,500 gpm (or 2.16 mgd) of firm capacity for both zones to provide fire flows, as well as 0.30 mgd for Zone 7 demands. PC6-7 is recommended by UGB Buildout or as development occurs.

Zone 6-7 North Pump Station (PN6-7)

As noted in the Zone 6 summary, a dual zone hydropneumatic pump station is recommended at the proposed Zone 4 North Reservoir (TN4) site to serve growth in Zones 6 and 7. The total recommended pumping capacity of PN6-7 is 4.6 mgd. This capacity includes 1,500 gpm (or 2.16 mgd) of firm capacity for both zones to provide fire flows, as well as 0.10 mgd for Zone 7 demands. PN6-7 is recommended by UGB Buildout or as development occurs.

Pumping Summary

The tables below present the pumping analysis considering volume and ERUs with the recommended improvements. A pumping deficit is predicted in the 10-year time frame based on assumed development timing; Medford Water will need to consider the prioritization of other critical projects and timing of development when considering when to construct the Zone 6-7 Central PS.

The ERU capacity analysis for the pump stations includes ERUs for Zone 7.

Zone 7 Pumping Capacity Projections - Flow Capacity

Pump Stations	Flow Capacity, mgd			
	2020 Conditions	10-Year Projections	UGB Buildout	Urban Reserve Buildout
Total Zone 6				
Zone 6-7 Central PS (PC6-7)	-	-	0.30	0.30
Zone 6-7 North PS (PN6-7)	-	-	-	0.10
Total Zone 6 Available Capacity	**-**	**-**	**0.30**	**0.40**
Required Capacity	-	0.13	0.26	0.33
Excess/(Deficiency)	-	(0.13)	0.04	0.07

Zone 7 Pumping Capacity Projections – ERUs

Pump Stations	ERUs			
	2020 Conditions	10-Year Projections	UGB Buildout	Urban Reserve Buildout
Total Zone 6				
Zone 6-7 Central PS (PC6-7)	-	-	214	214
Zone 6-7 North PS (PN6-7)	-	-	-	71
Total Zone 6 Available Capacity	**-**	**-**	**214**	**285**
Required Capacity	-	131	263	333
Excess/(Deficiency)	-	(131)	(49)	(48)

PIPELINE RECOMMENDATIONS

No pipeline projects are identified for Zone 7.

Summary of Zone 7 Recommendations

Project ID	Description	Size	Purpose	Trigger	Capital Cost Estimate, dollars
UGB Buildout					
TC4-7	Zones 4-7 East Reservoir	0.19 MG	Providing equalizing, emergency, and fire flow volume	No existing Zone 7 storage; concurrently with Zone 7 development and construction of PC5 and PL-5-09	6,651,000
PC6-7	Zone 6-7 Central Pump Station	0.30 mgd	Provide pumping capacity for growth in Zone 6 and 7	No existing Zone 7 pumping; concurrently with Zone 7 development	2,130,000
Urban Reserves Buildout					
PN6-7	Zone 6-7 North Pump Station	0.10 mgd	Provide additional pumping capacity for growth in Zone 6 and 7	Zone 7 ERUs > 214	2,130,000

Table 6-3. Equivalent Residential Unit Factors

Land Use	Unit Water Use Factor	Unit Water Use Factor Units	Unit ERU Factor(a,b,c)	Unit ERU Factor Units
Low-End Projection				
Urban Residential	356	gpd/du	1.00	ERU/dwelling unit
Urban Medium Density Residential	219	gpd/du	0.62	ERU/dwelling unit
Urban High Density Residential	219	gpd/du	0.62	ERU/dwelling unit
Service Commercial	45	gpd/acre	0.13	ERU/acre
Commercial	45	gpd/acre	0.13	ERU/acre
General Industrial	45	gpd/acre	0.13	ERU/acre
High-End Projection				
Urban Residential	395	gpd/du	1.00	ERU/dwelling unit
Urban Medium Density Residential	243	gpd/du	0.62	ERU/dwelling unit
Urban High Density Residential	243	gpd/du	0.62	ERU/dwelling unit
Service Commercial	400	gpd/acre	1.01	ERU/acre
Commercial	400	gpd/acre	1.01	ERU/acre
General Industrial	400	gpd/acre	1.01	ERU/acre
Average(d)				
Urban Residential	-	-	1.00	ERU/dwelling unit
Urban Medium Density Residential	-	-	0.62	ERU/dwelling unit
Urban High Density Residential	-	-	0.62	ERU/dwelling unit
Service Commercial	-	-	0.57	ERU/acre
Commercial	-	-	0.57	ERU/acre
General Industrial	-	-	0.57	ERU/acre

(a) One ERU represents the average water use by one single family residential home, or one Urban Residential dwelling unit.
(b) Residential water use factors are given in gpd/du. The unit ERU factor is calculated by dividing the respective water use factor (in gpd/du) by the Urban Residential water use factor (in gpd/ERU).
(c) Non-residential water use factors are given in gpd/acre. The unit ERU factor is calculated by dividing the respective water use factor (in gpd/acre) by the Urban Residential water use factor (in gpd/ERU).
(d) Average Unit ERU Factor is calculated by taking the average of the Low-End Projection and the High-End Projection.
ERU = equivalent residential unit; gpd= gallons per day
du= dwelling unit