PLANNING COMMISSION AGENDA
City Commission Chambers - City Hall
625 Center Street, Oregon City, Oregon 97045
October 10, 2011 at 7:00 p.m.

The Planning Commission agendas, including staff reports, memorandums, and minutes are available from the Oregon City Web site home page under meetings.(www.orcity.org)

1. CALL TO ORDER

2. PUBLIC COMMENT ON ITEMS NOT LISTED ON AGENDA

3. PLANNING COMMISSION HEARING

   a. L 10-02: Water Master Plan Update

4. COMMUNICATIONS

   a. Update on Street Tree and Sidewalk Public Outreach

5. ADJOURN

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Agenda Item No.
Meeting Date: 10 Oct 2011

COMMISSION REPORT: CITY OF OREGON CITY

TO:	Planning Commission
FROM:	Pete Walter, Planner
PRESENTER:	Pete Walter, Planner
SUBJECT:	L 10-02: Water Master Plan Update
Agenda Heading: Public Hearing	
Approved by:	

RECOMMENDED ACTION (Motion):

Staff recommends that the Planning Commission listen to the Applicant's presentation, take testimony from anyone present who wishes to speak or provide comment on this item, ask any questions that they would like, and then make a motion to continue the Public Hearing for L 10-02 to the date certain of October 24, 2011.

Staff will not be making a recommendation for approval of the Water Master Plan on October 10.

BACKGROUND:

The Oregon City Water Master Plan is an adopted ancillary document to the Comprehensive Plan. The current plan was adopted in 2004. The Water Master Plan update is necessary to maintain compliance with Statewide Planning Goal 11, Public Facilities. Goal 11 requires that public facilities and services be provided in a timely, orderly and efficient manner. The goal's central concept is that local governments should plan public services in accordance with the community's needs as a whole rather than be forced to respond to individual developments as they occur. This includes water distribution and storage.

The applicant, Oregon City Public Works Department, will present the Water Master Plan on October 10, 2011. Planning will present their Staff Report and make a recommendation at the October 24, 2011, Public Hearing.

BUDGET IMPACT:

FY(s):
Funding Source:

ATTACHMENTS:

Water Master Plan
Comments Received to Date

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EXECUTIVE SUMMARY

INTRODUCTION

This Water Distribution System Master Plan (WMP) is for the City of Oregon City's (City) distribution facilities and existing and projected future water demands. In order to evaluate the Oregon City water system, West Yost Associates (West Yost) updated a hydraulic model of the water system that was originally created for the 2004 WMP.

The following are the three major work products that resulted from this master planning effort:

- A Diurnal Curve Development Technical Memorandum,
- A recommended Capital Improvement Program (CIP) for the City's existing and future water system including renewal and replacement pipeline projects; and
- A financing plan that addresses implementation of the recommended CIP. The 1996 City Charter requires rates to be rolled back to pro-bond levels once the bonds are paid which will occur in Fiscal Year 2014-15. The City must address this requirement before any long term water fund planning can realistically be established.

The associated analyses and assessments related to these work products are briefly summarized below. Complete descriptions of the analyses and assessments are provided in the chapters and appendices of this Water Master Plan.

OVERVIEW OF THE OREGON CITY SERVICE AREA AND SOURCE

A detailed description of the City's existing service area and water distribution system is provided in Chapter 2. The following subsections present a brief overview of the service area.

Service Area

The City of Oregon City currently provides potable water service to most of the City's residents. The City is located in the Portland Metropolitan Area east of Interstate 205, southeast of the Willamette River. As shown on Figure ES-1, the City's service area is approximately 4,134 acres. Areas within the City limits not served by City are served by the Clackamas River Water District (CRW). There are also portions of the City that are adjacent to undeveloped, unincorporated county land that has the potential for development and annexation into the City's service area.

Source of Supply

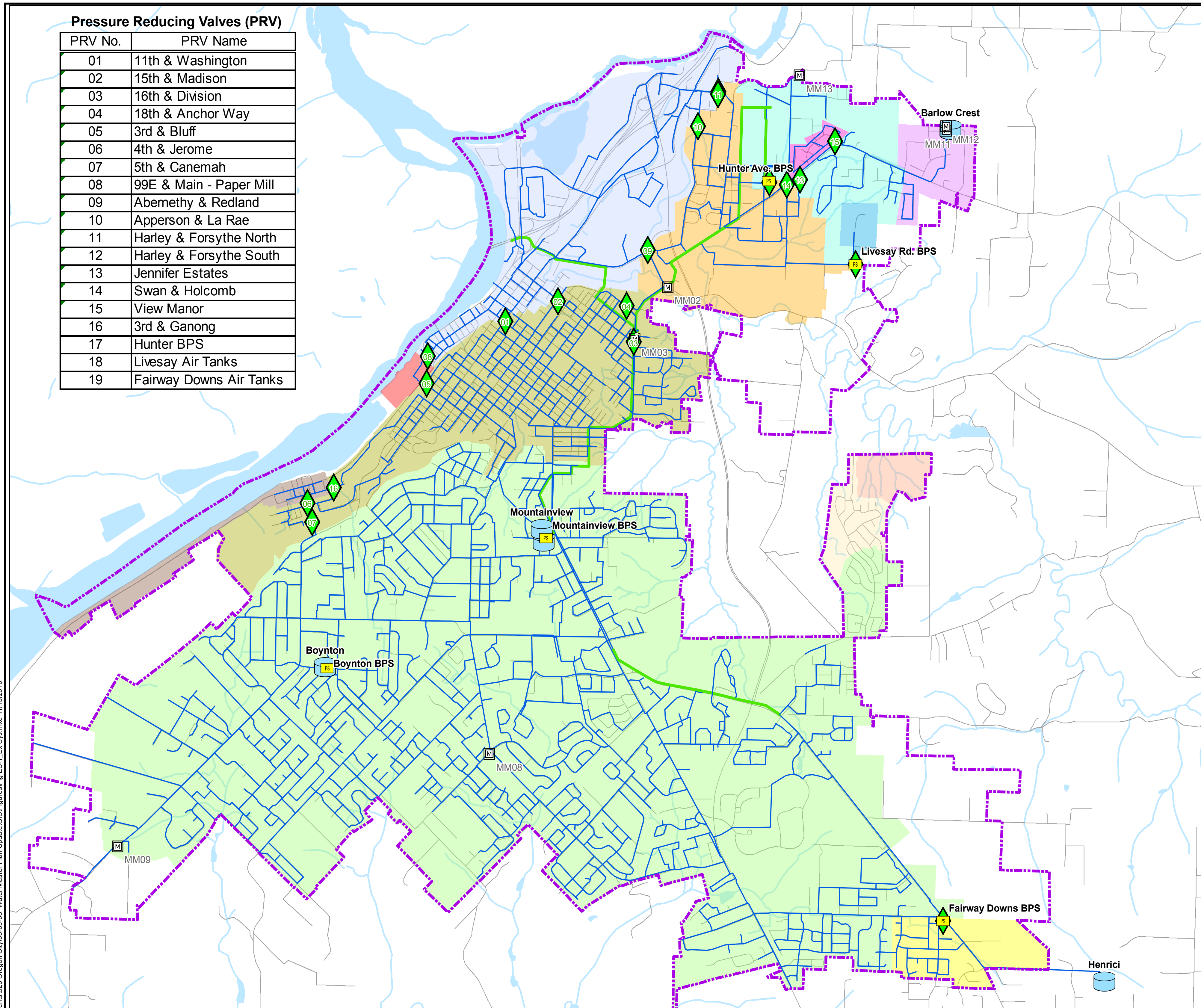
The source of supply for the City is surface water from the lower Clackamas River which is supplied by the South Fork Water Board (SFWB). The SFWB is a wholesale water supplier that is equally owned by the Cities of Oregon City and West Linn. The SFWB operates an intake and pumping station just to the north of the Oregon City city limits which delivers raw water to the SFWB water treatment plant located in the City's Park Place area. The Oregon City water distribution system is supplied by the SFWB at five different locations.

FIGURE ES-1

CITY OF OREGON CITY
EXISTING WATER SYSTEM

Pressure Reducing Valves (PRV)

PRV No.	PRV Name
01	11th & Washington
02	15th & Madison
03	16th & Division
04	18th & Anchor Way
05	3rd & Bluff
06	4th & Jerome
07	5th & Canemah
08	99E & Main - Paper Mill
09	Abernethy & Redland
10	Apperson & La Rae
11	Harley & Forsythe North
12	Harley & Forsythe South
13	Jennifer Estates
14	Swan & Holcomb
15	View Manor
16	3rd & Ganong
17	Hunter BPS
18	Livesay Air Tanks
19	Fairway Downs Air Tanks



EXISTING AND FUTURE WATER DEMANDS

A detailed description of the City's existing and projected future water demands is provided in Chapter 3. The following subsections present a brief overview of existing and future water demands.

Existing Water Demands

Existing water demands for the City were determined based on historical water production at the SFWB, historical Master Meter Data for the Cities of West Linn and Oregon City, and historical consumption data for the City of Oregon City. Water use by customer class is shown in Table ES-1. Peaking factors for maximum day and peak hour demand were developed based on historical production records.

Table ES-1. Water Use by Customer Class, 2002-2008[(a)]

Year	Demand, mgd[(b)]				
	Single Family	Institutional	Multi-Family	Industrial/ Commercial	Total
2002	2.16	0.33	0.63	0.65	3.78
2003	2.42	0.29	0.65	0.68	4.04
2004	2.36	0.34	0.63	0.70	4.04
2005[(c)]	2.22	0.32	0.64	0.77	3.95
2006	2.42	0.42	0.62	0.72	4.17
2007	2.32	0.28	0.58	0.71	3.89
2008	2.22	0.30	0.55	0.66	3.74
Historical annual average demand	2.32	0.33	0.61	0.69	3.94
Percent of total annual average demand	59%	8%	16%	17%	100%

(a) Water use includes unaccounted for water
(b) Data provided by Utility Billing (Oregon City Water Consumption 2002-2009 (Account Type).xls)
(c) Utility Billing software upgraded data is not complete and is not used for determining Historical Annual Average Demand

Future Water Demands

Water demands were projected through buildout of the City's Urban Growth Boundary (UGB) using a unit demand methodology based on land uses in the City's Comprehensive Plan. Individual water use (by meter) was linked to individual parcels using addresses. The unit demand factor for each land use designation was then calculated by dividing the total water use by the total parcel area for which it was linked. The same peaking factors used for existing water demands were used for future projections. Buildout water demand projections are shown by customer class in Table ES-2.

Table ES-2. Summary of Buildout Water Demand Projections[(a)]

Customer Use Category	Average Day Demand, mgd	Maximum Day Demand[(b)], mgd	Peak Hour Demand[(c)], mgd
Single Family Residential	3.94	9.07	17.75
Institutional	0.37	0.85	1.66
Multi-Family Residential	0.80	1.85	3.62
Commercial/Industrial	1.90	4.38	8.57
Total	7.01	16.15	31.60

(a) Includes unaccounted for water.
(b) The City's maximum day demand is 2.3 times the average day demand.
(c) The City's peak hour demand is 4.5 times the average day demand.

WATER DISTRIBUTION SYSTEM SERVICE STANDARDS

The City of Oregon City maintains benchmarks for service quality that are used to measure performance of the water utility. These benchmarks include service standards for water quality, quantity, and pressure, as well as the minimum supply levels for fire protection. For example, the Oregon City water distribution system was analyzed to ensure that service pressures are maintained above 40 psi during normal demand scenarios and fire flows are available without dropping system pressures below 20 psi. The service standards set forth in this master plan are derived from regulations, rules, and recommendations established by a variety of sources including the Oregon State Department of Human Services (DHS), the Environmental Protection Agency (EPA), the American Water Works Association (AWWA), the Insurance Services Office (ISO), and the Uniform Fire Code (UFC). A summary of these standards is presented in Table ES-3. A detailed description of the City’s service standards is provided in Chapter 4.

HYDRAULIC MODEL

A hydraulic model of the City’s water system was developed for the 2004 WMP and was updated for this WMP using a series of steps that included the following:

- Model Update
- Roughness Factors Assigned for New Areas in InfoWater
- Water Demands Allocated in H_2OMAP.
- Elevations Allocated for New Areas in H_2OMAP.
- Naming Scheme Applied in InfoWater.

A detailed description of the City’s hydraulic model update is provided in Chapter 5.

Table ES-3. City of Oregon City Planning and Design Criteria

Component	Criteria	Remarks / Issues
PERFORMANCE CRITERIA FOR PLANNING & DESIGN		
Fire Flow Requirements (flow [gpm] @ duration [hours])		
Single-Family Residential	1,500 gpm @ 2 hrs	Fire flows based on new development requirements. Existing development will be evaluated on a case by case basis, because of the historical varying standard.
Multi-Family Residential	1,500 gpm @ 3 hrs	
Institutional (schools, hospitals, etc.)	2,000 gpm @ 4 hrs (with approved automatic sprinkler system)	
Commercial/Industrial	3,000 gpm @ 4 hrs (with approved automatic sprinkler system)	
Water Supply Capacity		
Maximum Day Demand Plus Fire Flow	Provide capacity equal to maximum day demand plus fire flow	
Peak Hour Demand	Provide capacity equal to peak hour demand	
Pumping Facility Capacity		
Booster Pump Capacity	Equal to the maximum day demand for the pressure zone.	Design for maximum day plus fire flow or peak hour (whichever is larger), only if no gravity storage is available within the pressure zone and/or service area.
Backup Power	Equal to the firm capacity of the pumping facility.	On-site generator for critical stations.[a] Plug in portable generator for less critical stations.
Water Storage and System Peaking Capacity		
Equalization	25 percent of maximum day demand	
Fire	Varies (see requirements listed in remarks column)	Varies depending on required fire flow duration. Highest fire flow demand in any particular area controls size of required storage. See Table 4-2. 1,500 gpm @ 2 hrs = 0.18 MG 1,500 gpm @ 3 hrs = 0.27 MG 2,500 gpm @ 4 hrs = 0.60 MG
Emergency	Maximum day demand	Based on DHS recommendations.
Total Water Storage Capacity	Equalization + Fire + Emergency	
Water Transmission Line Sizing		
Diameter	18-inches in diameter or larger	Criteria based on requirements for new development, existing transmission mains will be evaluated on case-by-case basis. Evaluation will include age, material type, velocity, head loss, and pressure.
Average Day Demand Condition		
Minimum Pressure [psi]	40 psi	
Maximum Pressure [psi]	100 psi	
Maximum Velocity [ft/sec]	3 fps	
Maximum Day Demand Condition		
Minimum Pressure [psi]	40 psi	
Maximum Head loss [ft/1000 ft]	3 ft/kft	
Maximum Velocity [ft/sec]	5 fps	
Peak Hour Demand Condition		
Minimum Pressure [psi]	40 psi	
Maximum Head loss [ft/1000 ft]	3 ft/kft	
Maximum Velocity [ft/sec]	5 fps	
Hazen Williams "C" Factor	140	For consistency in hydraulic modeling.
Pipeline Material	Ductile Iron	
Water Distribution Line Sizing		
Diameter	Less than 18-inches in diameter	Must verify pipeline size with max day and fire flow analysis.
Average Day Demand Condition		Criteria based on requirements for new development, existing distribution mains will be evaluated on case-by-case basis. Evaluation will include age, material type, velocity, head loss, and pressure.
Minimum Pressure [psi]	40 psi	
Maximum Pressure [psi]	100 psi	
Maximum Velocity [ft/sec]	3 - 5 fps	
Maximum Day w/ Fire Flow Demand Condition		
Minimum Pressure [psi] (at fire node)	20 psi	
Maximum Head loss [ft/1000 ft]	10 ft/kft	
Maximum Velocity [ft/sec]	10 fps	
Peak Hour Demand Condition		
Minimum Pressure [psi]	40 psi	
Maximum Head loss [ft/1000 ft]	10 ft/kft	
Maximum Velocity [ft/sec]	7 fps	
Hazen Williams "C" Factor	140	For consistency in hydraulic modeling.
Pipeline Material	Ductile Iron	
Maximum Valve Spacing		
Supply Pipeline	1 mile	
Transmission Pipeline	2,000 feet (minimum)	1,300 feet (preferred)
Residential Distribution Pipeline	800 feet	
Commercial Distribution Pipeline	500 feet	
Uniform Fire Code Hydrant Distribution Requirements		
Residential	500	
Commercial, Industrial, and Other High Value District	200-500	
OTHER CRITERIA		
Maximum Number of residential lots that can be served by a non-looped water pipeline	25 lots	If a non-looped water line goes out-of-service, all associated residences lose water service.

[a] A pumping facility is defined as critical if it provides service to pressure zones and/or service areas without sufficient emergency storage and that meet the following criterion:

- The largest facility that provides water to a particular pressure zone and/or service area;
- A facility that provides the sole source of water to single or multiple pressure zones and/or service areas; and
- A facility that provides water from a supply turnout into pressure zones and/or service areas.

EXISTING WATER SYSTEM

The existing water system is expected to deliver peak hour flows and maximum day demand plus fire flow within the acceptable pressure, velocity and head loss ranges as identified in the performance criteria presented in Chapter 4. However, the system was evaluated using pressure as the primary criterion. Recommended improvements needed to comply with the performance criteria will be added to the existing water system to fix any deficiencies found.

Overall the City of Oregon City has a storage surplus of 4.99 million gallons (MG) in the existing water system.

Mountainview and Hunter Avenue pump stations both have surplus pumping capacities for meeting existing flow requirements. Livesay Road and Fairway Downs Pump Stations both have significant deficits.

A detailed description of the evaluation of the existing water system is provided in Chapter 6 and the existing water system is shown here in Figure ES-1.

Several pipeline improvements are identified in Chapter 6 that address fire flow deficiencies in the pipeline network. These improvements are included in the CIP.

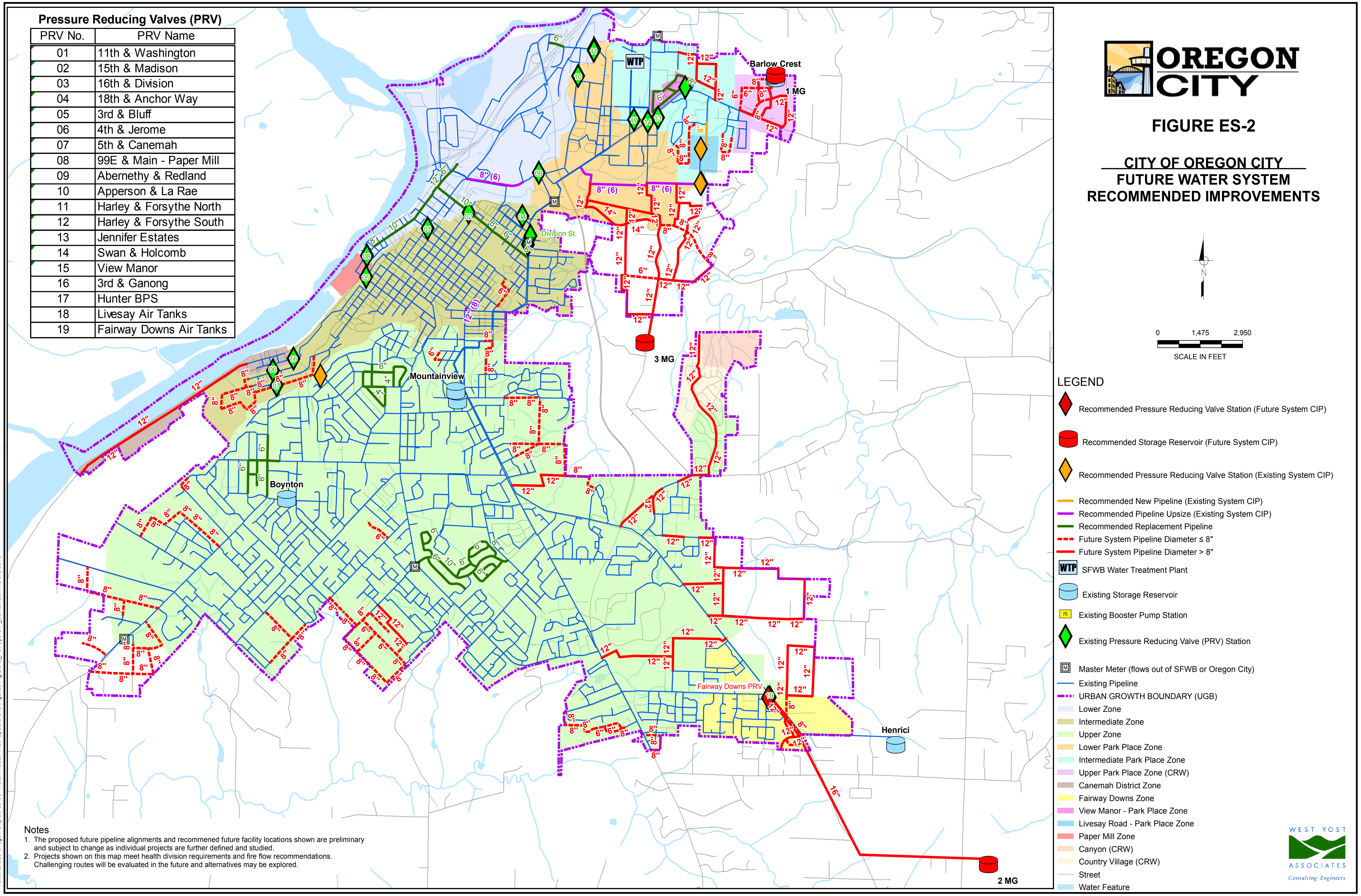
FUTURE WATER SYSTEM EVALUATION

The City of Oregon City has a projected water storage capacity deficit of 4.84 MG in the future water system. A new ground level storage reservoir is planned to be constructed just beyond the Henrici Reservoir at the 620 elevation contour. This tank will serve a new pressure zone created to encompass the Fariway Downs pressure zone. Another new tank is proposed to make up the remaining storage deficit near Holly Lane. These new storage reservoirs will alleviate the water storage capacity deficit in the future water system.

The City of Oregon City has a projected pumping deficit at the Fairway Downs Pump Station of 711 gpm and the Barlow Crest Pump Station of 874 gpm. With the new 620 elevation storage reservoir, however, the Fairway Downs area will be gravity fed and its pumping deficit becomes obsolete. The Barlow Crest Pump Station is only a concern when the City assumes responsibility for those customers from Clackamas River Water (CRW).

Maximum day demand plus fire flow simulation results indicate that there are numerous areas where the available fire flow, evaluated using the maximum day demand plus fire flow performance criteria, was less than the minimum required fire flow for the area. At most of these locations, the existing pipelines are undersized and would need to be replaced by larger diameter pipelines to supply a minimum fire flow required while meeting the maximum day demand plus fire flow performance criteria.

A detailed description of the evaluation of the future water system is provided in Chapter 7. Figure ES-2 shows the recommended future water system improvements.



Pressure Reducing Valves (PRV)

PRV No.	PRV Name
01	11th & Washington
02	15th & Madison
03	16th & Division
04	18th & Anchor Way
05	3rd & Bluff
06	4th & Jerome
07	5th & Canemah
08	99E & Main - Paper Mill
09	Abernethy & Redland
10	Apperson & La Rae
11	Harley & Forsythe North
12	Harley & Forsythe South
13	Jennifer Estates
14	Swan & Holcomb
15	View Manor
16	3rd & Ganong
17	Hunter BPS
18	Livesay Air Tanks
19	Fairway Downs Air Tanks

Notes
1. The proposed future pipeline alignments and recommened future facility locations shown are preliminary and subject to change as individual projects are further defined and studied.
2. Projects shown on this map meet health division requirements and fire flow recommendations. Challenging routes will be evaluated in the future and alternatives may be explored.

RECOMMENDED CAPITAL IMPROVEMENT PROGRAM

A detailed description of the City's CIP is provided in Chapter 8.

Recommended Capital Improvements

Recommended capital improvements are organized into three CIP tables: Existing Improvements, Future Improvements, and Renewal and Replacement Improvements. Recommendations for improvements to the existing water system are described in Chapter 6 and are generally recommended to improve fire flows for existing customers. Chapter 7 describes the recommendations for improvements to the future water system which are for improvements related to growth of the system. Renewal and replacement improvements are recommended for areas where pipes are old, leaking or have significant maintenance needs. A summary of the recommended capital improvements is listed below.

Existing System Improvements

- PRV Stations
  - Construct a 6-inch PRV station from Upper Pressure Zone at Telford Road to address fire flow deficiencies at Center Street and Sunset Street in the Intermediate Pressure Zone.
- Pipeline Improvements
  - Install approximately 8,900 linear feet of pipelines ranging from 6 inches to 16 inches in diameter.

The locations of the recommended existing system CIP projects are shown on Figure ES-2.

Future System Improvements

- Storage Facility[1]
  - Construct a 2 MG storage reservoir at the 620 foot elevation contour to serve the Fairway Downs pressure zone and the Upper pressure zone.
  - Construct a 3 MG storage reservoir along Holly Lane to serve the Lower Park Place Pressure Zone.
  - 1 MG storage reservoir at the existing Barlow Crest storage reservoir site (the remainder of the buildout emergency storage requirement will be met from Mountainview Reservoir No. 2). This reservoir is shown on Figure ES-2, but not currently included in the CIP. This additional storage will only be required when CRW facilities are incorporated into the City.

[1] Projects that include the integration of CRW facilities into the Oregon City water system are not included in the CIP.

- PRV Stations
  - Construct two 6-inch PRV stations near Livesay Road pump station to increase fire flow supply availability in the Livesay Road pressure zone (one PRV will supply flow from Intermediate Park Place pressure zone and the other PRV can supply flow into the Lower Park Place pressure zone if needed).
- Pump Station[2,3]
  - Increase the firm pumping capacity at the Barlow Crest Pump Station by adding two additional 500 gpm booster pumps (in the event that the current Barlow Crest customers come to be served by Oregon City).
- Pipelines
  - Install approximately 78,000 linear feet of proposed pipelines ranging from 6 inches to 16 inches in diameter.

The locations of the recommended future system CIP projects are shown on Figure ES-2.

Renewal and Replacement Improvements

- PRV Stations
  - Station #2 Replacement
  - Station # 15 Replacement
- Pipelines
  - Install approximately 40,000 linear feet of proposed pipelines ranging from 4 inches to 10 inches in diameter.

The locations of the recommended future system CIP projects are shown on Figure ES-2.

Recommended Cost and Timing of Capital Improvements

Costs are presented in October 2009 dollars based on an Engineering News Record Construction Cost Index (ENR CCI) of 8596 (20 Cities Average). Total CIP costs include the following construction contingency and project cost allowances:

- Construction Contingency: 20 percent
- Project Cost Allowances:
  - Design: 10 percent
  - Construction Management: 10 percent
  - Administration: 8 percent

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[2] Projects that include the integration of CRW facilities into the Oregon City water system were not included in the CIP.

[3] Cost estimate was based on the additional firm capacity required.

A summary of the costs for the recommended CIP by project type is provided in Table ES-4. As shown in Table ES-4, the total estimated recommended CIP cost for the City of Oregon City water system is estimated to be $53 million. Additional details of the probable construction costs of each individual project are provided in Chapter 8.

The construction of the improvements for the future system should be coordinated with the proposed schedules of future development to ensure that the required infrastructure will be in place to serve future customers. However, if the future system improvements are based on addressing deficiency in fire flow pumping or storage, emergency storage, or reliability issues, they should be a higher priority.

Table ES-4. Estimated Cost of Recommended CIP by Project Type

CIP Project Type	Existing System CIP, million dollars	Future System CIP[a,b,c], million dollars	Renewal and Replacement CIP, million dollars	Total CIP Cost[a], million dollars
Storage Facility	-	14.46	0.56	15.02
Pump Station	-	-	-	-
Pipeline Improvement	1.50	20.42	8.96	30.88
PRV Station	0.33	0.58	-	0.91
Operations Facility	6.05	-	-	6.05
Total[d]	7.88	35.46	9.52	$52.86

(a) Timing of future system improvements will be triggered by specific developments and increase in system demands.
(b) Future system CIP costs are in current dollars and have not been escalated by the CPI.
(c) Cost based on a ground level, pre-stressed concrete storage tank.
(d) Total cost based on the October 2009 ENR index of 8596 and includes construction contingency and project cost allowances.

CHAPTER 1. INTRODUCTION

MASTER PLAN PURPOSE

Since the previous Water Master Plan (WMP) was developed, the City of Oregon City has aggressively pursued that plan's Capital Improvement Plan (CIP) and made significant improvements to the water system. Due in part to the age of that plan and to the aggressive nature of improvements being constructed within the system, the previous plan is in need of an update. The intent of this WMP is to update the aging plan, identify existing system deficiencies and required system improvements, based on updated demand estimates and system evaluations, and to formulate a comprehensive CIP which meets the needs of existing and future customers.

MASTER PLAN OBJECTIVES

The objectives of this WMP are to:

- Develop operational and design criteria under which the existing system will be analyzed and future facilities will be formulated;
- Evaluate existing water demands and project future water demands;
- Analyze the existing capacity and operation of pump stations, and water storage facilities to meet existing and 2030 water demands;
- Identify potential new water storage facilities;
- Evaluate water service to new development areas;

AUTHORIZATION

West Yost Associates (West Yost) was authorized to prepare this WMP by the City of Oregon City on March 3, 2009.

REPORT ORGANIZATION

This WMP is organized into the following chapters:

- Chapter 2: Existing Water Distribution System
- Chapter 3: Water Demand Analysis
- Chapter 4: Water Distribution System Service Standards
- Chapter 5: Hydraulic Model Update
- Chapter 6: Existing Water Distribution System Evaluation
- Chapter 7: Future Water Distribution System Evaluation
- Chapter 8: Recommended Capital Improvement Program
- Chapter 9: Water Distribution System Financing Plan

The following appendices to this WMP contain additional technical information and assumptions:

- APPENDIX A: Diurnal Curve Development Technical Memorandum
- APPENDIX B: Water System Seismic Vulnerability Assessment
- APPENDIX C: Cost Estimating Assumptions
- APPENDIX D: Project Sheets

ACRONYMS AND ABBREVIATIONS

The following acronyms and abbreviations have been used throughout this WMP to improve document clarity and readability.

AC	Asbestos Cement
ADD	Average Day Demand
af	Acre-Feet
af/service/yr	Acre-Feet Per Service Per Year
af/yr	Acre-Feet Per Year
AWWA	American Water Works Association
BPS	Booster Pump Station
bgs	below ground surface
BMPs	Best Management Practices
ccf	Hundred Cubic Feet
CCI	Construction Cost Index
cfs	Cubic Feet per Second
CFD	Clackamas Fire District
CI	Cast Iron
CIP	Capital Improvement Program
City	City of Oregon City
CL&C	Concrete Pressure Pipe
COP	Copper
CPI	Consumer Price Index
CRW	Clackamas River Water
DBPR	Disinfection By-Products Rule
DHS	Department of Human Services
DI	Ductile Iron
DOC	Dissolved Organic Compounds
EC or COND	Electrical Conductivity
ENR	Engineering News Record
EPA	Environmental Protection Agency
EPS	Extended Period Simulation
ESFU	Equivalent Single Family Unit
fps	Feet Per Second
ft	Feet

ft/kft	Feet Per Thousand Feet
ft/yr	Feet Per Year
GALV	Galvanized Pipe
GIS	Geographical Information System
gpcd	Gallons Per Capita Per Day
gpm	Gallons Per Minute
GPS	Global Positioning System
GSE	Ground Surface Elevation
HD	High Density
HGL	Hydraulic Grade Line
HPR	Hydrant Pressure Recorders
IDSE	Initial Distribution System Evaluation
ISO	Insurance Service Office
LD	Low Density
MCL	Maximum Contaminant Levels
MDD	Maximum Day Demand
MG	Million Gallons
mg/L	Milligrams Per Liter
mgd	Million Gallons Per Day
MHD	Medium High Density
MLD	Medium Low Density
MOU	Memorandum of Understanding
msl	Mean Sea Level
my	Million Years
NFPA	National Fire Protection Association
NO_3	Nitrate
O&M	Operations and Maintenance
OFC	Oregon Fire Code
PHD	Peak Hour Demand
PRV	Pressure Reducing Valve
PS	Pump Station
psi	Pounds Per Square Inch
PVC	polyvinyl chloride
R&R	Replacement and Renewal
RMS	Root Mean Square
SC	Specific Conductance
SCADA	Supervisory Control and Data Acquisition
SDC	System Development Charge
SFWB	South Fork Water Board
SID	Solano Irrigation District
SMCL	Secondary Maximum Contaminant Level
SS	Stainless Steel
STD STL	Standard Steel
TDS	Total Dissolved Solids
THM	Total Trihalomethane
total Cr	Total Chromium

TRANS	Transite
UAFW	Unaccounted-for Water
UCI	Unlined Cast Iron
UFC	Uniform Fire Code
UGB	Urban Growth Boundary
USBR	United States Bureau of Reclamation
USGS	U.S. Geological Survey
VLD	Very Low Density
VOC	Volatile Organic Chemical
WI	Steel Lined
WMP	Water Master Plan
WSS	Water Sampling Station
WWTP	Waste Water Treatment Plant
West Yost	West Yost Associates

ACKNOWLEDGEMENTS

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

- Nancy Kraushaar, Public Works Director and City Engineer
- John Burrell, Project Manager
- Eli Deberry, Operations Supervisor
- Chris Dunlop, GIS Analyst
- Jason Frazier, Engineering Technician II
- Kevin Hanks, Utility Maintenance Team Leader
- Gail Johnson, Water Quality Coordinator

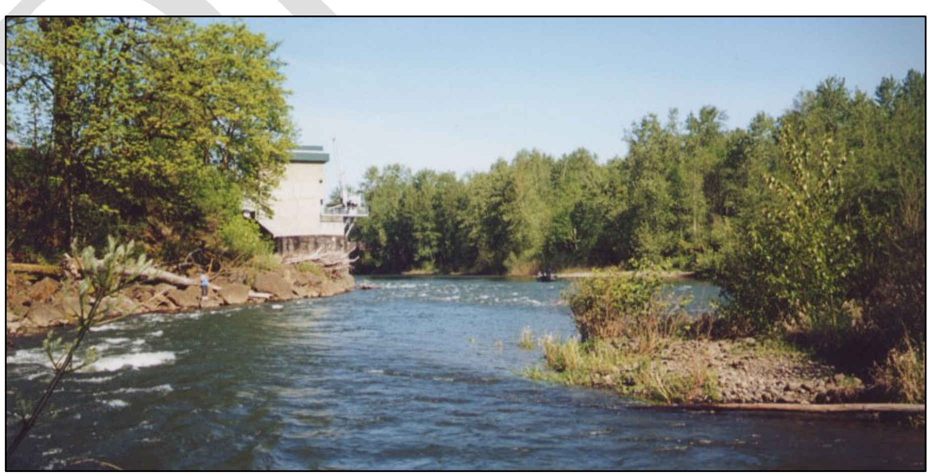
CHAPTER 2. EXISTING WATER DISTRIBUTION SYSTEM

The Oregon City water distribution system currently serves more than 4,000 acres of developed property within the City limits. The existing system is composed of an extensive pipeline network, five booster pumping stations, five reservoirs, nineteen pressure reducing valve (PRV) stations, two altitude valves, and ten interties with other water systems. This chapter provides background information on the various elements of the existing system as well as an overview of system operations.

SOURCE OF SUPPLY

The source of supply for the City of Oregon City is surface water from the lower Clackamas River (Figure 2-1) which is supplied by the South Fork Water Board (SFWB). Figure 2-2 is a map of the Clackamas River and surrounding river systems. The SFWB is a wholesale water supplier that is equally owned by the Cities of Oregon City and West Linn. The SFWB operates an intake and pumping station just to the north of the Oregon City city limits which delivers raw water to the SFWB water treatment plant located in the City's Park Place area. The treatment plant was originally constructed in 1958 and has undergone several renovations over the years. The most recent plant expansion was completed in 1986, bringing the plant's rated production capacity to 20 million gallons per day (mgd). The historical maximum day treated water production rate is 22 mgd. The most recent site expansion was completed in 2009 and added a 2 million gallon (MG) storage reservoir adjacent to the plant. The treatment process includes flocculation and sedimentation of suspended solids, filtration of the remaining particles, and chlorination for disinfection prior to pumping into the SFWB transmission system.

Figure 2-1. South Fork Water Board Raw Water Intake



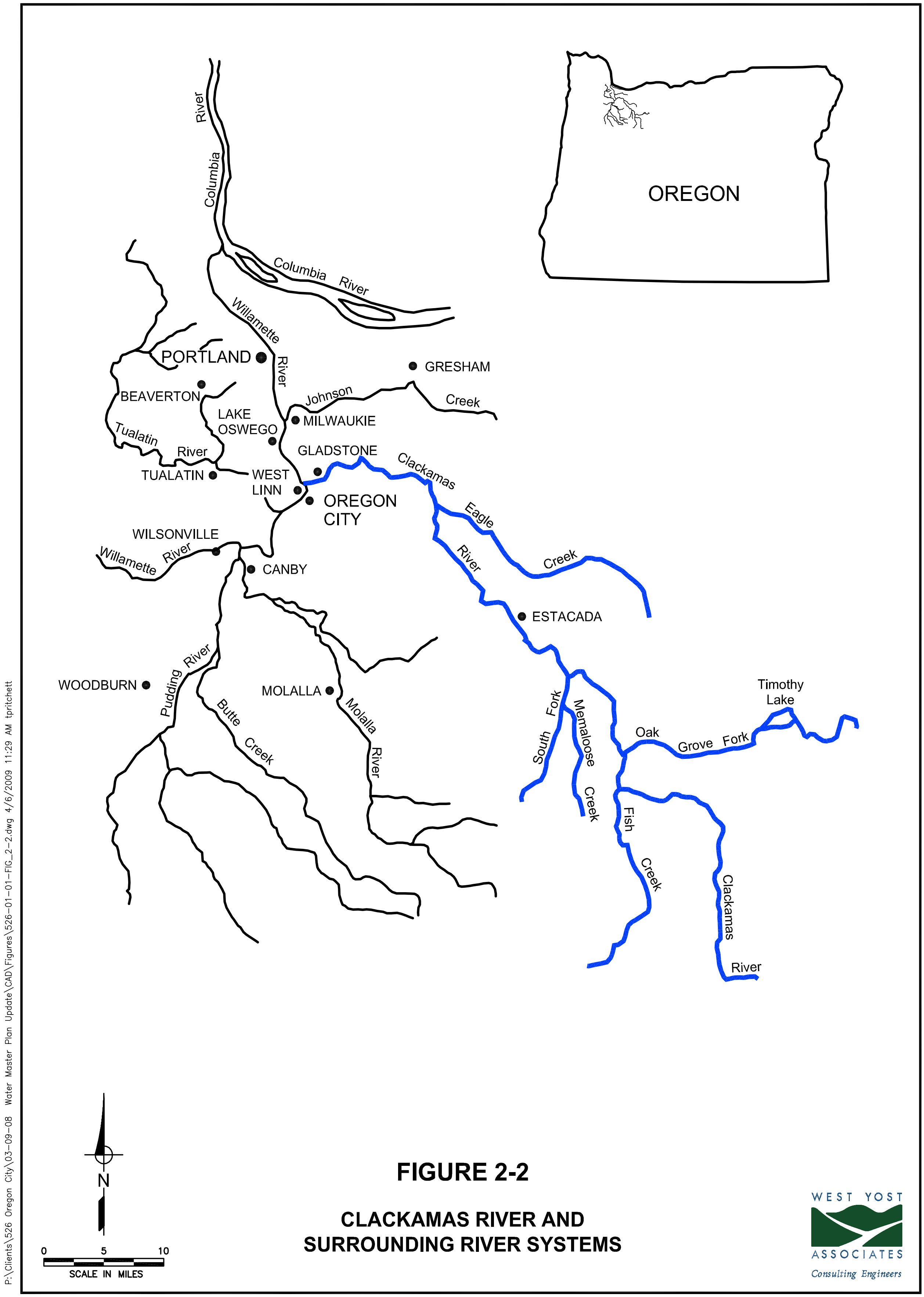


FIGURE 2-2

CLACKAMAS RIVER AND SURROUNDING RIVER SYSTEMS

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WATER SUPPLY RIGHTS

The SFWB holds four water rights on the Clackamas River and its tributaries which total 116 cubic feet per second (cfs) or nearly 75 mgd. However, the allowed maximum withdrawal rate for these water rights is based on available flow during summertime periods of low stream flow. As a result, it is estimated that the actual maximum withdrawal rate is 80 cfs or nearly 52 mgd. Since some of the water rights pertain to upstream locations on the South Fork of the Clackamas River and Memaloose Creek, the SFWB has taken legal steps in recent years to ensure access to these water rights at the existing water supply intake on the Lower Clackamas River. Currently, the SFWB has 46.9 cfs or 30.3 mgd of undeveloped rights at their intake structure.

REGIONAL MASTER METERING SYSTEM

The regional water supply master metering system measures the volumes of water delivered by the SFWB to its customers. The SFWB's three primary customers include the City of Oregon City, the City of West Linn, and Clackamas River Water District (CRW). CRW is a domestic water supply district that serves the unincorporated rural areas surrounding Oregon City and areas North of the Clackamas River East of the City of Milwaukie. The Oregon City water distribution system is supplied by the SFWB at five different locations, the City of West Linn is supplied at one location, and CRW is supplied at six locations. The City of Oregon City and the City of West Linn are directly supplied from the SFWB's transmission pipelines. One of the CRW connections is directly supplied by the SFWB and the other five connections are supplied through the Oregon City water distribution system. CRW also has two emergency interties with Oregon City's water distribution system. There is a master metering vault at each of these supply locations that is monitored on a monthly basis to determine delivered water volumes for billing purposes. Figure 2-3 illustrates a typical master metering station configuration. Table 2-1 summarizes important information about each of the twelve primary master metering stations.

Figure 2-3. Barlow Crest Master Meter Vault Plan

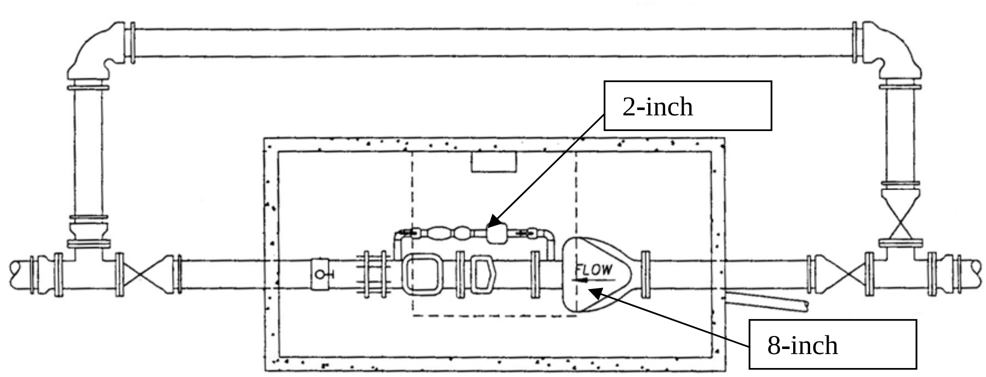


Table 2-1. Regional Master Meter Sites

Master Meter Station No.	Location	Meter Diameter and Type	Agency Served	Owner
1	Cleveland Street & Hiram Avenue	10-inch turbine	City of Oregon City	SFWB
2	Redland Road & Anchor Way	8-inch compound	Clackamas River Water	SFWB
3	17th & Division Street	16-inch magnetic	City of West Linn	SFWB
4	16th & Division Street	8-inch magnetic	City of Oregon City	SFWB
6	Mountainview Pump Station Pump Numbers 1, 2, & 3	16-inch turbine	City of Oregon City	SFWB
7	Mountainview Street	10-inch turbine	City of Oregon City	SFWB
8	Leland & Meyers Roads	6-inch compound	Clackamas River Water	Oregon City
9	South End Road & Impala Lane	6-inch, 2-inch turbine, piston	Clackamas River Water	Oregon City
10	Hunter Avenue Pump Station	10-inch turbine	City of Oregon City	SFWB
11	Barlow Crest Pump Station	6-inch turbine	Clackamas River Water	Oregon City
12	Barlow Crest Reservoir	8-inch, 2-inch turbine, piston	Clackamas River Water	Oregon City
13	Swan Avenue & Forsythe Road	6-inch, 2-inch turbine, piston	Clackamas River Water	Oregon City
Secondary	Old River Road & Highway 43	12-inch magnetic	City of Lake Oswego	West Linn
Secondary	SFWB Treatment Plant	24-inch magnetic	North Clackamas County Water Commission	SFWB

There are also two secondary water supply interties in the regional water system. The SFWB occasionally provides water to the City of Lake Oswego through an intertie with the City of West Linn's water distribution system and is also able to provide water to the North Clackamas County Water Commission system through an intertie at the SFWB treatment plant. The Lake Oswego meter is monitored and maintained by The City of West Linn staff whenever the intertie is active. The City of Lake Oswego can also pump into City of West Linn system at this location if the SFWB supply to West Linn is disrupted. The North Clackamas County Water Commission intertie, which is monitored and maintained by SFWB staff, is typically active when that agency is experiencing problems treating highly turbid water during winter flood events. Since neither of these interties is regularly in operation, the meters are not included in the monthly monitoring program. Instead, the City of West Linn and SFWB report metered water volumes to master meter billing staff as necessary. Table 2-1 also includes information on these two secondary master metering stations.

Figure 2-4 is a schematic that depicts the configuration of the master metering system, showing the primary master meters used for revenue calculations as well as the secondary flow meters that are used for operational or emergency purposes. Figure 2-5 is a map of the regional system that shows the location of each master metering station.

In addition to the formal master metered boundaries between agencies, there are also joint usage agreements between the City of Oregon City and CRW that govern special situations within the Oregon City distribution system. Under these agreements, CRW can serve customers directly from Oregon City pipelines that are upstream of their master meter. These joint usage areas, such as those along South End Road, typically occur where land that has been annexed into the Oregon City city limits but remain intermixed with unincorporated properties that are still served by CRW. CRW then reimburses Oregon City for the water supplied to joint usage areas based on individual customer meter summaries that are prepared each month.

DISTRIBUTION AND STORAGE SYSTEM

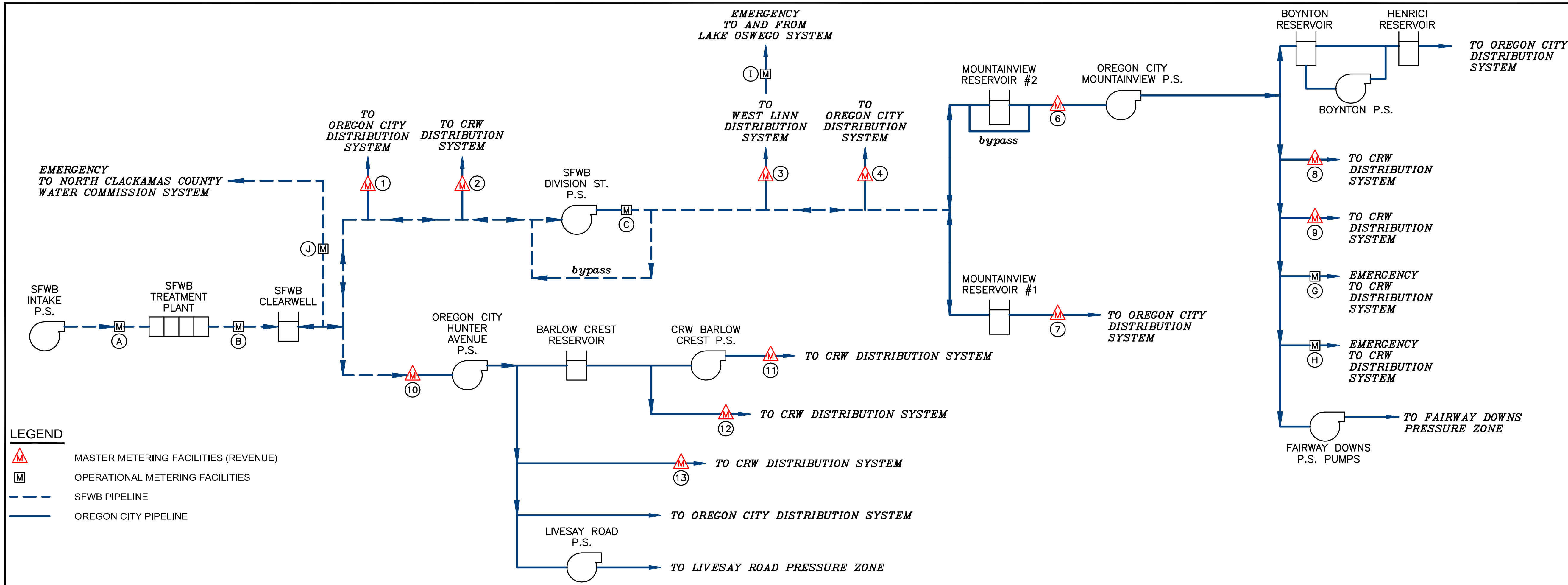
The following sections provide background information on each component of the water distribution and storage system. Figure 2-6 provides an overview of the Oregon City water distribution system, depicting the location of major facilities and all water distribution piping ten inches in diameter and larger. In addition, the figure shows facilities and transmission piping within Oregon City that are operated by the SFWB, City of West Linn, and CRW. Figure 2-6 also illustrates the existing city limits and urban growth boundary (UGB). The city limits mark the boundary of the existing service area and the UGB marks the boundary of the future service area. The City is nearing approval for three UGB expansion areas which will also be included in the future service area.

Pipeline Configuration

The City's water distribution pipeline configuration consists of approximately 150 miles of pipeline. Table 2-2 summarizes the water distribution system according to pipeline length and diameter. These pipeline material types are primarily cast iron or ductile iron and range in age up to approximately 100 years. However, there is some asbestos cement in the Park Place area.

Table 2-2. Water Distribution System Pipeline Network

Pipeline Diameter, inches	Length, miles	Percent of Water System
2	4.6	3.0
3	0.3	0.2
4	7.3	4.7
6	39.9	25.8
8	62.4	40.4
10	8.8	5.7
12	17.1	11.1
14	0.4	0.2
16	11.2	7.2
20	2.4	1.6
24	0.02	< 0.1
30	0.01	< 0.1
Total	154.4	100.0



MASTER METER KEY

1 Owner: SFWB
Location: Cleveland Street and Hiram Avenue
Purpose: Revenue
Agency Served: City of Oregon City
Diameter: 10-inch
Units: 500 cubic feet
Type: Sensus Turbo

2 Owner: SFWB
Location: Redland Road and Anchor Way
Purpose: Revenue
Agency Served: Clackamas River Water
Diameter: 8-inch, 4-inch, & 4-inch
Units: 100 cubic feet, 100 cubic feet, & cubic feet
Type: Hersey Compound

3 Owner: SFWB
Location: 17th and Division Street
Purpose: Revenue
Agency Served: City of West Linn
Diameter: 16-inch
Units: 1,000 gallons
Type: Magnetic

4 Owner: SFWB
Location: 16th and Division Street
Purpose: Revenue
Agency Served: City of Oregon City
Diameter: 8-inch, 4-inch, & 4-inch
Units: 100 cubic feet, 100 cubic feet, & cubic feet
Type: Hersey Compound

6 Owner: SFWB
Location: Mountainview Pump Station Pumps No. 1, 2, & 3
Purpose: Revenue
Agency Served: City of Oregon City
Diameter 16-inch
Units: 10,000 cubic feet
Type: Sensus Turbo

7 Owner: SFWB
Location: Mountainview Street
Purpose: Revenue
Agency Served: City of Oregon City
Diameter 10-inch
Units: 1,000 cubic feet
Type: Sensus Turbo

8 Owner: City of Oregon City
Location: Leland and Meyers Roads
Purpose: Revenue
Agency Served: Clackamas River Water
Diameter: 6-inch, 6-inch, & 6-inch
Units: 100 cubic feet, 100 cubic feet, & 100 cubic feet
Type: Hersey Compound

9 Owner: City of Oregon City
Location: South End Road and Impala Lane
Purpose: Revenue
Agency Served: Clackamas River Water
Diameter: 6-inch & 2-inch
Units: 500 cubic feet & 100 cubic feet
Type: Sensus Turbo

10 Owner: SFWB
Location: Hunter Avenue Pump Station
Purpose: Revenue
Agency Served: City of Oregon City
Diameter: 10-inch
Units: 100 cubic feet
Type: Sensus Turbo

11 Owner: City of Oregon City
Location: Barlow Crest Pump Station
Purpose: Revenue
Agency Served: Clackamas River Water
Diameter: 6-inch
Units: 10 gallons
Type: Sensus Turbo

12 Owner: City of Oregon City
Location: Barlow Crest Reservoir
Purpose: Revenue
Agency Served: Clackamas River Water
Diameter: 8-inch & 2-inch
Units: 500 cubic feet & 100 cubic feet
Type: Sensus Turbo

13 Owner: City of Oregon City
Location: Swan Avenue and Forsythe Road
Purpose: Revenue
Agency Served: Clackamas River Water
Diameter: 6-inch & 2-inch
Units: 500 cubic feet & 100 cubic feet
Type: Sensus Turbo

OPERATIONAL METER KEY

A Owner: SFWB
Location: Water Treatment Plant
Purpose: Operational - Raw Water Measurement
Diameter: 20-inch
Type: Propeller

B Owner: SFWB
Location: Water Treatment Plant
Purpose: Operational - Finished Water Measurement
Diameter: 20-inch
Type: Propeller

C Owner: SFWB
Location: Division Street Pump Station
Purpose: Operational - Pumping Rate Measurement
Diameter: 24-inch
Type: Sonic

G Owner: Clackamas River Water
Location: Beavercreek Road and Highway 213
Purpose: Emergency Intertie to CRW

H Owner: Clackamas River Water
Location: Beavercreek and Glen Oak Roads
Purpose: Emergency Intertie to CRW

I Owner: City of West Linn
Location: Old River Rd and Hwy 43
Purpose: Emergency Intertie to Lake Oswego
Diameter: 12-inch
Type: Magnetic Bi-Directional

J Owner: SFWB
Location: SFWB Treatment Plant
Purpose: Emergency Intertie to NCCWC
Diameter: 24-inch
Type: Magnetic

FIGURE 2-4

CITY OF OREGON CITY

MASTER METERING SYSTEM SCHEMATIC

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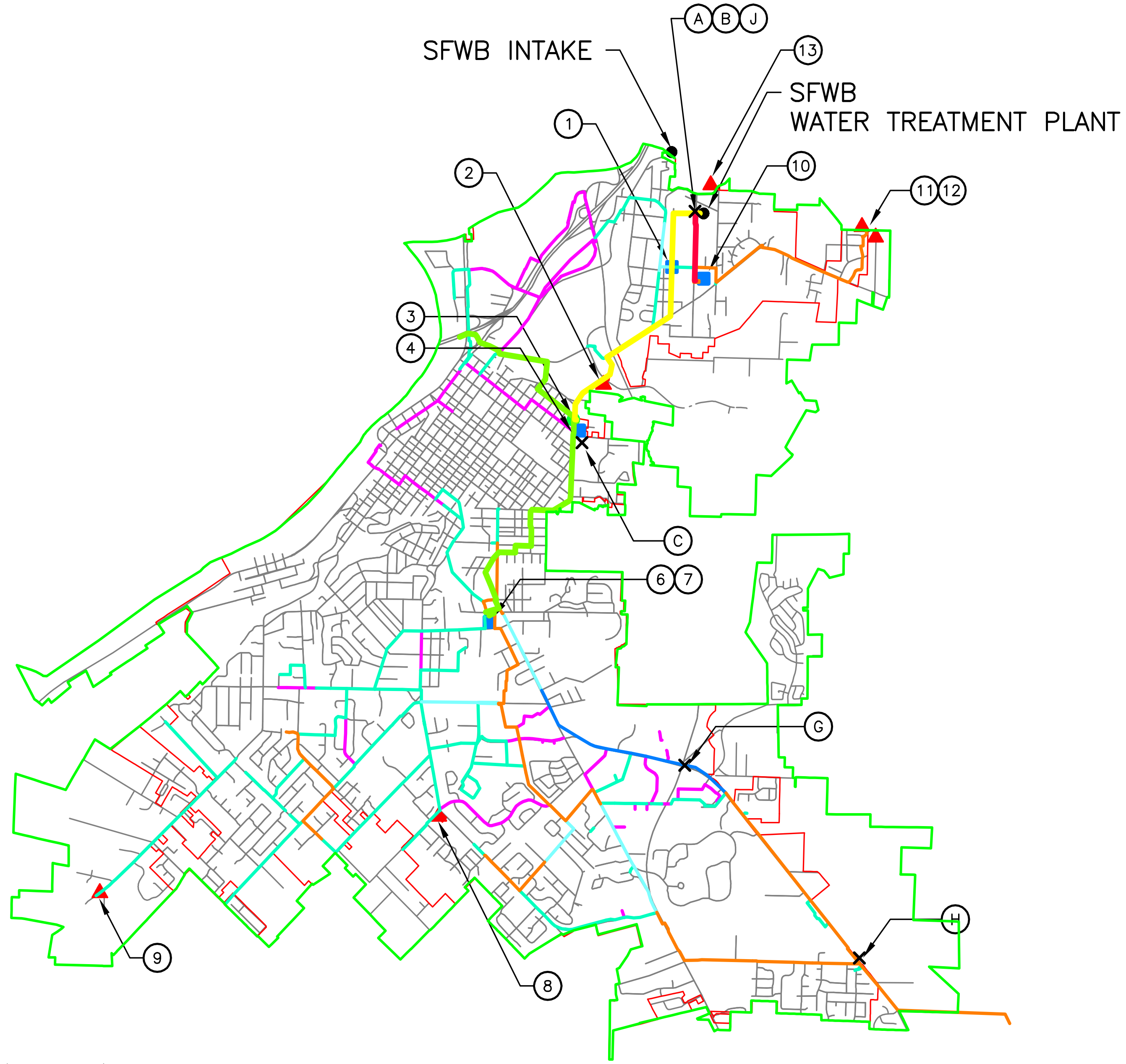
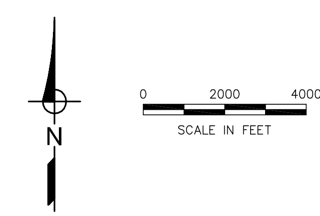
FIGURE 2-5

METER LOCATIONS

MASTER METERS

1. SERVES CITY OF OREGON CITY CLEVELAND STREET AND HIRAM AVENUE
2. SERVES CLACKAMAS RIVER WATER REDLAND ROAD AND ANCHOR WAY
3. SERVES CITY OF WEST LINN 17th AND DIVISION STREET
4. SERVES CITY OF OREGON CITY 16th AND DIVISION STREET
6. SERVES CITY OF OREGON CITY MOUNTAINVIEW PUMP STATION
7. SERVES CITY OF OREGON CITY MOUNTAINVIEW STREET
8. SERVES CLACKAMAS RIVER WATER LELAND AND MEYERS ROADS
9. SERVES CLACKAMAS RIVER WATER SOUTH END AND IMPALA ROADS
10. SERVES CITY OF OREGON CITY HUNTER AVENUE PUMP STATION
11. SERVES CLACKAMAS RIVER WATER BARLOW CREST PUMP STATION
12. SERVES CLACKAMAS RIVER WATER BARLOW CREST RESERVOIR
13. SERVES CLACKAMAS RIVER WATER SWAN AVENUE AND FORSYTHE ROADS





OPERATIONAL METERS

- A. RAW WATER SUPPLY SFWB TREATMENT PLANT
- B. FINISHED WATER DELIVERED SFWB TREATMENT PLANT
- C. PUMP STATION FLOW DIVISION STREET PUMP STATION
- G. EMERGENCY INTERTIE TO CRW BEAVERCREEK ROAD AND HIGHWAY 213
- H. EMERGENCY INTERTIE TO CRW BEAVERCREEK AND GLEN OAK ROADS
- I. EMERGENCY INTERTIE TO LAKE OSWEGO OLD RIVER ROAD AND HIGHWAY 43, WEST LINN (NOT SHOWN)
- J. EMERGENCY INTERTIE TO NORTH CLACKAMAS WATER CO – SFWB TREATMENT PLANT

LEGEND:

- URBAN GROWTH BOUNDARY (UGB)
- CITY LIMITS
- 10" }
- 12" }
- 14" } OREGON CITY PIPELINES
- 16" }
- 20" }
- 24" }
- 30" } SFWB PIPELINES
- 42" }
- MASTER METER TO WEST LINN
- MASTER METER TO CRW
- MASTER METER TO OREGON CITY
- × OPERATIONAL METER

WEST YOST ASSOCIATES
Consulting Engineers

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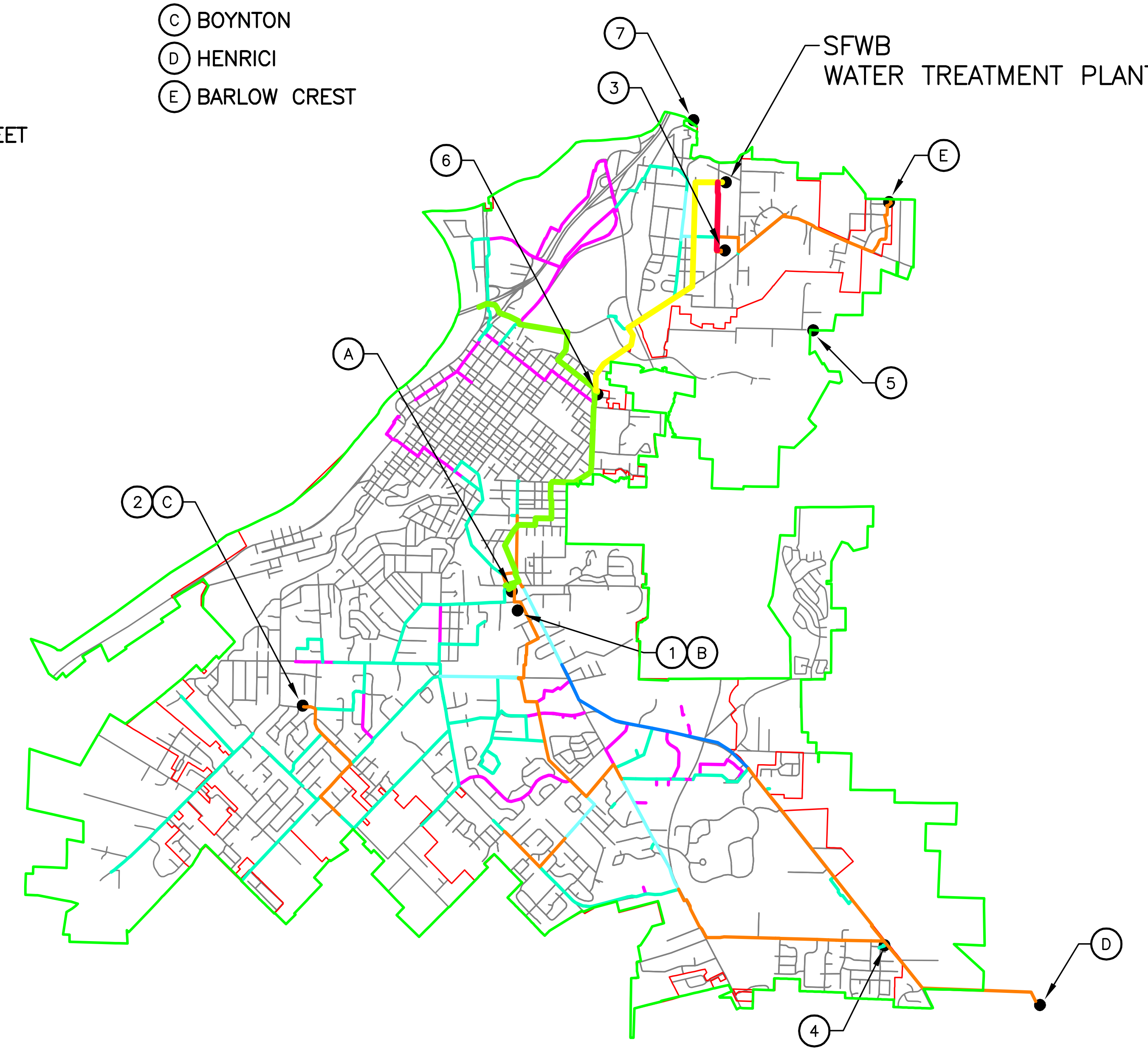
PUMP STATIONS

1. MOUNTAINVIEW
2. BOYNTON
3. HUNTER AVENUE
4. FAIRWAY DOWNS
5. LIVESAY ROAD
6. SFWB DIVISION STREET
7. SFWB INTAKE

RESERVOIRS

A. MOUNTAINVIEW #1
B. MOUNTAINVIEW #2
C. BOYNTON
D. HENRICI
E. BARLOW CREST



OREGON CITY

FIGURE 2-6

CITY OF OREGON CITY
WATER DISTRIBUTION SYSTEM

LEGEND:

- URBAN GROWTH BOUNDARY (UGB)
- CITY LIMITS
- 10" } OREGON CITY PIPELINES
- 12"
- 14"
- 16"
- 20"
- 24" } SFWB PIPELINES
- 30"
- 42"
- WATER SYSTEM FACILITIES

WEST YOST ASSOCIATES
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Booster Pumping Stations

Oregon City's water distribution system includes five booster pumping stations that either transfer water to the higher pressure zones or boost system pressure during emergency conditions. Two of the transfer pump stations, Mountainview and Hunter Avenue (Figure 2-7), are designed to fill reservoirs that serve the higher pressure zones. The other two transfer pump stations, Fairway Downs and Livesay Road, operate to maintain a minimum system pressure in areas that are not served by reservoirs. The emergency pump station located at Boynton Reservoir (Figure 2-8) is designed to increase local pressures during emergency conditions. Table 2-3 details the design data for each of the system's pumping stations and the location of each facility is shown on Figure 2-6.

Figure 2-7. Hunter Avenue Pump Station

Figure 2-8. Boynton Pump Station

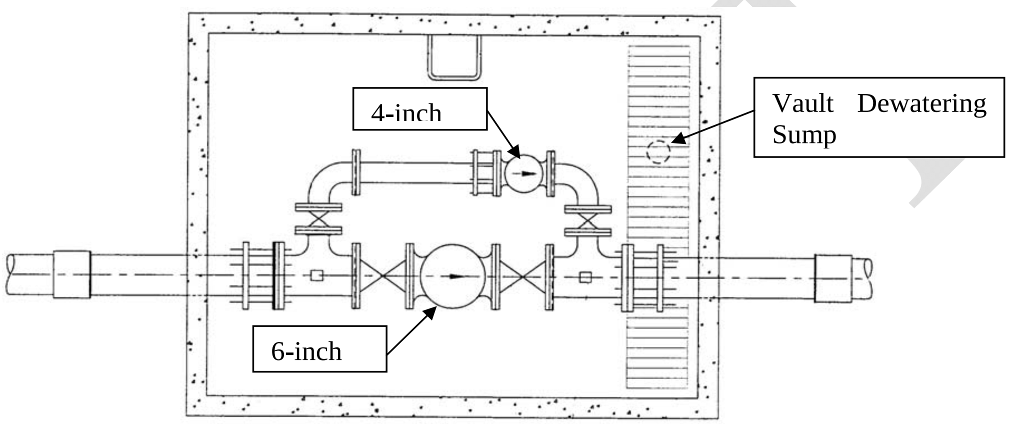
Table 2-3. Design Data for Existing Booster Pumping Stations

Pump Station Name	Pressure Zone Served	Reservoirs Served	Number of Pumps	Pump Motor Size and Speed, hp/rpm	Capacity of Each Pump, gpm	Ground Elevation, feet	Rated Discharge Head, feet
Mountainview	Upper, Fairway Downs	Boynton, Henrici	3	200/1780 200/1780 200/1780	4,000 4,000 4,000	465.5	150 150 150
Boynton	Upper, Fairway Downs	--	2	75/1750 75/1750	2,300 2,300	482	105 105
Hunter Avenue	Intermediate Park Place	Barlow Crest	3, 1 future	75/1700 75/1700 75/1700	900 900 900	198	250 250 250
Fairway Downs	Fairway Downs	--	4	3/3500 15/1750 15/1750 15/1750	50 500 500 500	494	81 60 60 60
Livesay Road	Livesay Road Park Place	--	1	7.5/3600	30	222	210

Pressure Reducing Valve Stations

The Oregon City water distribution system relies on seventeen pressure reducing valve (PRV) stations to supply water from higher pressure zones into the lower pressure zones and two pressure reducing valves at constant pumping stations for a total of nineteen. Table 2-4 lists the location of each PRV station along with its size and outlet pressure. The stations typically consist of a small PRV to supply the relatively low flows associated with normal demand conditions and a large PRV to supply the high water demand associated with a fire flow event (Figure 2-9). The location of the pressure reducing stations is shown in Figure 2-10.

Figure 2-9. Typical Pressure Reducing Valve Station Configuration (View Manor)



Reservoirs

There are five treated water storage reservoirs within the Oregon City water distribution system. Design information for the existing reservoirs is detailed in Table 2-5 and locations are shown on Figure 2-6, presented earlier. The operating reservoirs provide a total of 18.25 MG of treated water storage.

Mountainview Reservoir No. 2 (Figure 2-11) is the City's oldest operating and largest reservoir. The reservoir, constructed in 1916 with a capacity of 5 MG, originally served as the terminal point for the Mountain Line water supply system that brought water to Oregon City from Memaloose Creek, approximately eleven miles southeast of Estacada. The reservoir was expanded in 1952 to the current capacity of 10.5 MG through the addition of a vertical perimeter wall to the existing concrete basin. A roof system, consisting of laminated wood beams, plywood sheathing, and built-up roofing material supported on galvanized steel pipe columns, was installed in 1978. In 2007 this roof was replaced and seismic improvements were made to the vertical perimeter wall of the tank. The reservoir now meets current seismic standards.

Table 2-4. Pressure Reducing Valve (PRV) Stations

No.	Location	Pressure Zone Served	Elevation, feet	Size, inches	Outlet Pressure, psi
1	11th & Washington	Lower Zone	125	3 10	68 60
2	15th & Madison	Lower Zone	132	1.25 6	67 63
3	16th & Division	Intermediate Zone	260	1.25 10	90 100
4	18th & Anchor Way	Park Place Lower Zone	194	4 8 4 (relief)	53 50 63
5	3rd & Bluff	Lower Zone	175	3 10	55 50
6	4th & Jerome	Canemah Zone	180	2 6	55 50
7	5th & Canemah	Canemah Zone	270	1.25 4	83 80
8	99E & Main	Lower Zone (bi-directional)	58	3 10	80 75
9	Abernethy & Redland	Lower Zone	40	4 8 4 (relief) 4 (relief)	108 103 113 140
10	Apperson & La Rae	Lower Zone	78	2 4 6	80 79 76
11	Harley & Forsythe (north)	Lower Zone	115	12 4 (relief) 4 (relief)	79 95 95
12	Harley & Forsythe (south)	Lower Zone	115	1.5 6	Off 78
13	Wayne Drive & Holcomb	Jennifer Estates	240	4 8	140 57
14	Swan & Holcomb	Park Place Lower Zone	220	4 8	62 67
15	View Manor	View Manor Zone	323	4 8	100 23
16	3rd & Ganong	Canemah	119	2 6	80 80
17	Hunter Pump Station	Park Place Lower Zone	195	3 6	45 51

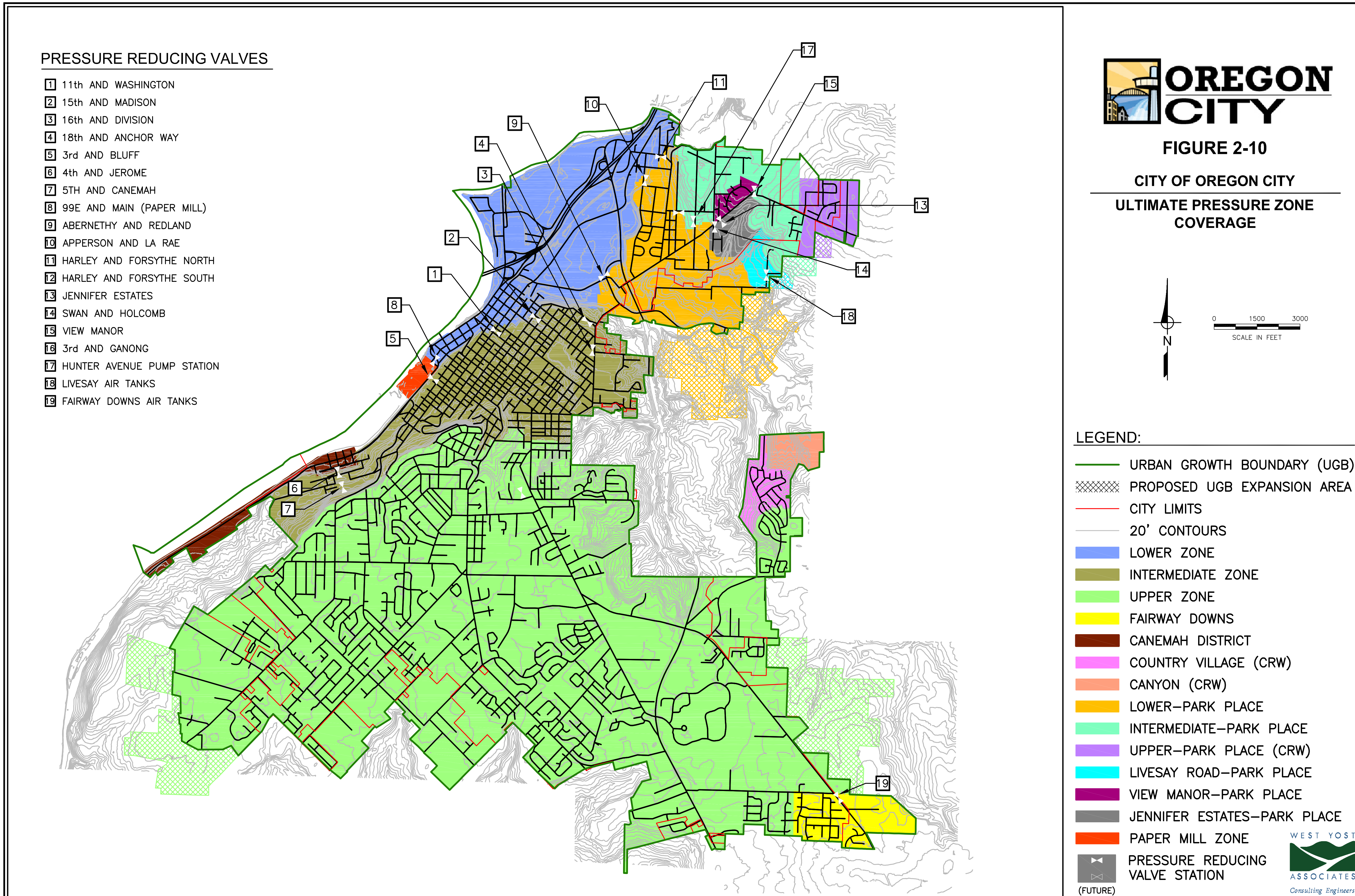


FIGURE 2-10

CITY OF OREGON CITY

ULTIMATE PRESSURE ZONE COVERAGE

Figure 2-11. Mountainview Reservoir No. 2

Table 2-5. Design Data for the Existing Reservoirs

Reservoir Name	Primary Pressure Zone Served	Year Built	Construction Materials	Capacity, MG	Bottom Elevation, feet	Overflow Elevation, feet
Barlow Crest	Intermediate Park Place and Lower Park Place	1999	Steel	1.75	518	549
Boynton	Upper	1984	Steel Standpipe	2.0	484	592
Henrici	Upper	1994	Steel	2.0	573.5	592
Mountainview Number 1	Intermediate	2007	Concrete	2.0	463.75	490
Mountainview Number 2	Intermediate	1916 expanded 1952 seismic retrofit in 2007	Concrete	10.5	463.75	490

In 2007 Mountainview Reservoir No. 1 (Figure 2-12) was constructed on a nearly adjacent site to the Mountainview Reservoir No. 2 site. The two reservoirs are hydraulically connected and operate in parallel. Jointly the Mountainview Reservoirs provide water to the Intermediate and Lower Pressure Zones and are currently supplied by the SFWB's Division Street Pump Station. The Division Street Pump Station also supplies the City of West Linn through a 24-inch transmission main. Due to a higher hydraulic grade line in the Oregon City water distribution system relative to West Linn, water can backfeed from the Mountainview Reservoirs into the West Linn system when the Division Street Pump Station is not operating. Also, the Division Street Pump Station is equipped with a transfer valve between the discharge and suction piping which allows for filling of the SFWB clearwell from the Mountainview Reservoirs when the pump station is not operating. This controlled bypassing of the Division Street Pump Station has been necessary in the past since portions of Oregon City's Park Place district and portions of the CRW service area rely on supply from the clearwell even when the SFWB treatment plant is not operating. However, SFWB just completed construction of a new 2 MG clear well reservoir at the treatment plant site that should make this practice less regular.

Figure 2-12. Mountainview Reservoir No. 1

Boynton Reservoir (Figure 2-13) is a steel standpipe with a total capacity of 2.0 MG that serves the Upper Pressure Zone. Approximately 0.5 MG is available by gravity and the remainder can be boosted for fire flows and emergency flows by the manually controlled pump station located at the reservoir site. Water levels in Boynton Reservoir can be used to control pump operation at the Mountainview Pump Station.

Figure 2-13. Boynton Reservoir

Henrici Reservoir (Figure 2-14) is located just outside of the southeast boundary of the Oregon City UGB. This reservoir provides a second gravity supply source for the Upper Pressure Zone, allowing either Henrici or Boynton to be taken out of service for maintenance or repair while minimizing operational issues in the system. The location of Henrici at the southern extremity of the service area has greatly improved fire flow and peak demand condition pressures in that portion of the system. Henrici Reservoir tends to fill slowly relative to Boynton Reservoir when the Mountainview Pump Station is operating; however, this situation is expected to diminish in the future as pipeline improvements and network expansions take place in the vicinity of Henrici. As with Boynton Reservoir, water levels in Henrici Reservoir can also be used to control pump operation at the Mountainview Pump Station.

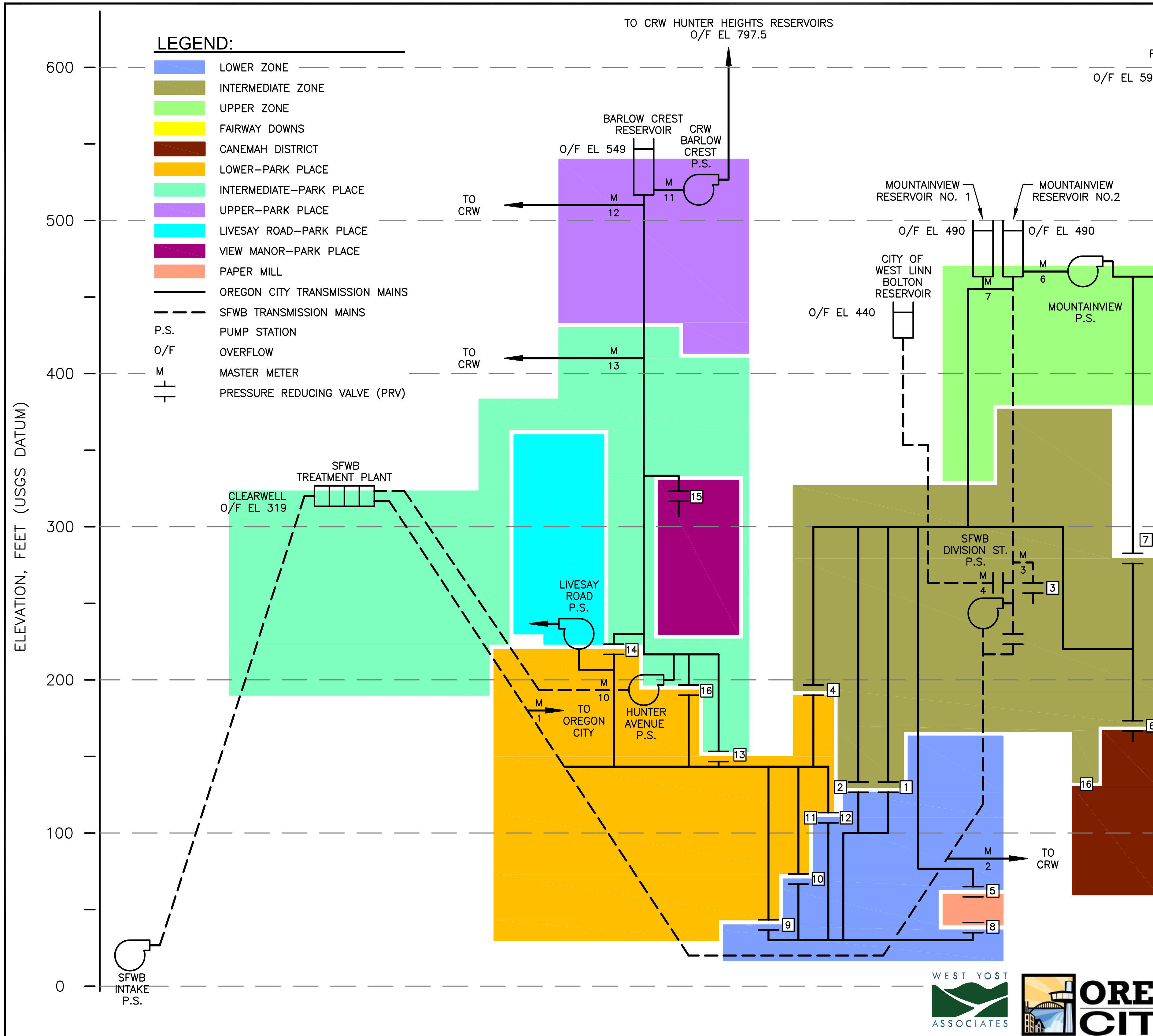
Figure 2-14. Henrici Reservoir

Barlow Crest (Figure 2-15) reservoir is located in the northeast corner of the Oregon City UGB and serves the Intermediate Zone of the Park Place District. The reservoir is filled by the Hunter Avenue Pump Station which is controlled by SCADA system monitoring of Barlow Crest reservoir water levels. CRW operates a pump station immediately adjacent to the reservoir. This pump station boosts water to CRW's Stoltz Reservoir which serves the Park Place Upper Zone.

Figure 2-15. Barlow Crest Reservoir

SERVICE PRESSURES

The urban growth boundary (UGB) for the City of Oregon City encompasses a wide range of elevations. Also, the City has annexed neighboring water distribution systems that contained independent water service pressure zones. As a result, the existing water distribution system is made up of eleven separate service pressure zones. Table 2-6 summarizes the service elevations and static pressure range for each pressure zone. The lower end of the pressure range is based on reservoirs at 80 percent full and the upper end is based on full reservoirs. Figure 2-16 illustrates the hydraulic profile of the Oregon City system including the SFWB facilities and Figure 2-10 illustrates the ultimate extent of each pressure zone within the Oregon City UGB. Only those areas within the present city limits are served by the existing Oregon City water distribution system with the exception of the Livesay Road area that is currently part of Clackamas County and an area near Winston, North of Holcomb Boulevard. CRW is currently serving the developed areas of these pressure zones outside of the city limits as well as all of the Upper Park Place Zone.



PRESSURE REDUCING VALVES

1. 11th AND WASHINGTON
2. 15th AND MADISON
3. 16th AND DIVISION
4. 18th AND ANCHOR WAY
5. 3rd AND BLUFF
6. 4th AND JEROME
7. 5TH AND CANEMAH
8. 99E AND MAIN (PAPER MILL)
9. ABERNETHY AND REDLAND
10. APPERSON AND LA RAE
11. HARLEY AND FORSYTHE (N)
12. HARLEY AND FORSYTHE (S)
13. JENNIFER ESTATES
14. SWAN AND HOLCOMB
15. VIEW MANOR
16. 3rd AND GANONG
17. HUNTER AVE. P.S.
18. LIVESAY AIR TANKS
19. FAIRWAY AIR TANKS

MASTER METERS

1. SERVES CITY OF OREGON CITY CLEVELAND STREET AND HIRAM AVE.
2. SERVES CLACKAMAS RIVER WATER REDLAND ROAD AND ANCHOR WAY
3. SERVES CITY OF WEST LINN 17th AND DIVISION STREET
4. SERVES CITY OF OREGON CITY 16th AND DIVISION STREET
5. SERVES CITY OF OREGON CITY MOUNTAINVIEW PUMP STATION
6. SERVES CITY OF OREGON CITY MOUNTAINVIEW STREET
7. SERVES CLACKAMAS RIVER WATER LELAND AND MEYERS ROADS
8. SERVES CLACKAMAS RIVER WATER SOUTH END ROAD AND IMPALA LANE
9. SERVES CITY OF OREGON CITY HUNTER AVENUE PUMP STATION
10. SERVES CLACKAMAS RIVER WATER BARLOW CREST PUMP STATION
11. SERVES CLACKAMAS RIVER WATER BARLOW CREST RESERVOIR
12. SERVES CLACKAMAS RIVER WATER SWAN AVENUE AND FORSYTHE ROAD

WEST YOST ASSOCIATES Consulting Engineers

OREGON CITY

FIGURE 2-16

CITY OF OREGON CITY

DISTRIBUTION SYSTEM HYDRAULIC PROFILE

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Table 2-6. Pressure Zone Ranges

Zone	Lower Elevation, feet	Upper Elevation, feet	Pressure Range, psi
Lower Zone	10	116	68 - 114
Intermediate Zone	98	378	40 – 161
Upper Zone	292	500	34 – 141
Canemah Zone	74	140	54 –83
Fairway Downs Zone	470	518	55 –80
Lower Park Place Zone	44	218	43 – 118
Intermediate Park Place Zone	222	434	47 –142
Upper Park Place Zone – CRW	434	522	203 –233
View Manor Park Place Zone	324	326	35 –36
Livesay Road Park Place Zone	222	272	70-100
Paper Mill Zone	54	54	102

SYSTEM OPERATION

The general procedures for operation of the Oregon City water distribution system are discussed in the following sections.

South Fork Water Board Water Treatment Plant

The SFWB operates their water treatment plant (Figure 2-17) to fill the Oregon City and West Linn reservoirs. Therefore, the operating schedule varies with seasonal variations in water demand. During the low demand periods, the plant generally operates only during the evenings and night to take advantage of off-peak electrical power rates. Operational hours are extended during the high demand summer months, when the plant must operate nearly all day in order to keep the storage reservoirs full.

Figure 2-17. SFWB Water Treatment Plant

Booster Pumping Stations Serving Pressure Zones With Reservoirs

Those booster pumping stations that fill storage reservoirs (Mountainview and Hunter Avenue pump stations) are automatically controlled to maintain preset water levels. When sensors show that the water level in a reservoir has fallen below a preset threshold, the lead pump will activate and begin filling the reservoir to a high water level. If water demand on the reservoir is such that a single pump cannot maintain the water level, a lag pump (or pumps) will activate as necessary until the reservoir fills to a high water level. Although Boynton Pump Station serves a pressure zone with reservoirs, it is for emergency fire flow use only and is manually operated.

Booster Pumping Stations Serving Pressure Zones Without Reservoirs

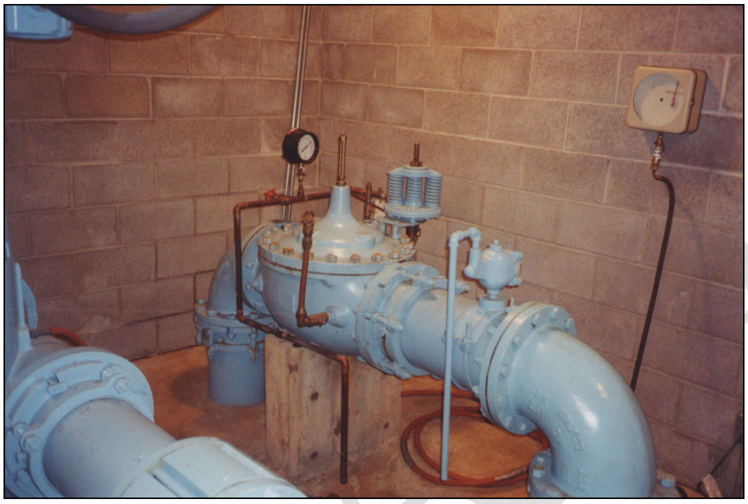
Those booster pumping stations that serve areas without storage reservoirs (Fairway Downs and Livesay Road pump stations) are automatically controlled to maintain a minimum discharge pressure at the pumping stations. For the Livesay Pump Station, when pressure sensors show that the discharge pressure has fallen below a preset threshold, the lead pump activates and pumps until the discharge pressure exceeds a high pressure level. At the Fairway Downs Pump Station, when water demand in the pump station's service area is such that a single pump cannot maintain the pressure level, a lag pump (or pumps) will activate as necessary until the system pressure is restored.

Reservoir Operation

The reservoirs in the water distribution system are generally maintained between 70 and 90 percent full, although levels may be lowered during low demand periods to improve turnover and ensure adequate chlorine residual levels. The fluctuating water volume represents the operating and equalization storage caused by pump station control strategies and non-uniform demand in the system. The remaining storage is allocated to providing fire flow requirements and emergency reserves.

Altitude valves (Figure 2-18) are in place to control the flow into and out of Boynton and Henrici reservoirs. These valves are designed to close when the reservoir is full and open when the system pressure drops. At Henrici Reservoir, the altitude valve is currently not in operation since the SCADA system is used to prevent overfilling. The other reservoirs in the distribution system float on the system.

Figure 2-18. Altitude Valve at Boynton Reservoir



Pressure Reducing Valve Operation

The pressure reducing valve (PRV) stations control the flow of water from upper pressure zones to lower pressure zones. Each station contains at least two PRVs, one large and one small. The small PRV provides service during normal operating conditions and the large PRV provides higher flows during a fire flow condition.

Supervisory Control and Data Acquisition (SCADA) System

The City recently upgraded the water distribution SCADA system to allow for improved monitoring and control of water operations. The new central computer system for the graphical user interface (GUI) is located at the Oregon City public works operations building at 122 South Center Street. Remote monitoring is also possible through the use of a laptop computer. The new SCADA system provides status information for each pump station, reservoir, and PRV station including the following:

1) Pump Stations:
    a) Run status
    b) Total elapsed run time
    c) All possible faults
    d) Suction and discharge pressure (Mountainview Pump Station)

   e) Pump station flow
   f) Intrusion
2) Reservoirs:
   a) Water level
   b) Hatch/Door intrusion
3) PRVs:
   a) Upstream pressure
   b) Downstream pressure
   c) Intrusion
   d) Power fail

Water operations staff control set points for pump operation at the Mountainview and Hunter Avenue pump stations. The system also monitors pump operation at Barlow Crest (a Clackamas River Water pump station) but does not control set points.

WATER QUALITY MONITORING

The City conducts regular water quality monitoring in the distribution system to ensure the provision of safe drinking water to customers. The City's regular activities focus on ensuring compliance with federal and state regulations, monitoring the flow of water through pump stations and reservoirs, and addressing any issues of concern to water customers. Table 2-7 shows the City's current monitoring sites.

Specific water quality sampling activities include the following:

- A minimum of 30 bacteriological samples are collected each month from locations that are representative of the entire distribution system.
- Compliance samples for Stage 1 Disinfectant By-Products Rule (DBPR) are collected from four designated sites on a quarterly basis. Results are reported to DHS quarterly.
- Sampling for Stage 2 DBPR compliance will begin in November 2013 at four designated sites. See Oregon City's Stage 2 DBPR Compliance Monitoring Plan for more information.
- In the limited areas where asbestos-cement pipe is still in service, asbestos sampling is required every three years.
- Lead and Copper Rule requirements are met via an Oregon DHS-approved Joint Monitoring Plan for Oregon City and West Linn.

As a community water system, the City delivers an annual water quality report to all water customers. The City also uses these reports to update the community on improvements to the water distribution system and to answer frequently asked questions.

Additional programs that optimize water quality in the distribution system include a program for controlling and eliminating cross connections and an annual (or as-needed) dead-end line flushing program.

Table 2-7. Water Sampling Stations (WSS)

Station Number	Location	Sample Type
WSS03	19225 Central Point Road	R
WSS04	304 5th Avenue	R
WSS05	14901 Glen Oak Road	R
WSS06	1810 Red Soils Court	R
WSS07	16298 Oak Tree Terrace	R
WSS08	816 Harrison Street	R
WSS09	19413 Cokeron Drive	R
WSS11	Gaffney/Meyers	R
WSS12	19445 Silverfox Parkway	R
WSS13	1826 Davis Road	R
WSS14	15057 Spy Glass Lane	R
WSS15	14168 Livesay Road	R + Asbestos
WSS16	11519 Parrish Road	R
WSS17	Hiram/Cleveland	R
WSS18	15815 Pope Lane	WQM
WSS19	224 Center Street	R
	19077 Dallas Street	R
	Traveler Road	WQM
	Toman Road	WQM
	1900 Clackamette Drive	R
	Whitehorse Court	WQM
	Pasture Way	WQM
	Scarlet Oak Street	WQM
	275 Amanda Court	R
	14212 Fir Street	R
	1220 Main Street	R
	Creed Street and Promontory Avenue	R
	13665 Holcomb Boulevard	R
	20079 Chanticleer Place	R
	Shore Pine Place	R
	Peter Skene	R
	Henrici Reservoir	R
	437 Mountainview Street – E	R
	437 Mountainview Street – W	WQM
	Sassafras Way	WQM

R = Routine sample site listed in Coliform Sampling Plan
WQM = Currently used for water quality monitoring only

CHAPTER 3. WATER DEMAND ANALYSIS

This chapter presents historic data on water deliveries to the City from the South Fork Water Board (SFWB) as well as customer demand data from the City's billing records. These historical data define the unique patterns that characterize water use in the City and provide a framework for projecting future water demand in the community. Analysis of the data also relates the various measures of water demand (maximum monthly demand, maximum daily demand, and peak hour demand) to the average annual demand through the use of peaking factors.

The projection of future water demand is based on unit demand factors that are indexed to land use categories and population levels. These future demand projections provide the basis for assessing the adequacy of the existing water distribution system and planning for future improvements.

EXISTING WATER USE

There are several measures of water use that are important to analyze during the development of the water master plan. Following is a description of the critical water demand factors that will guide planning decisions with respect to the City's water distribution system:

- Annual average demand – A measure of the average amount of water used by the community on an annual basis. The annual average demand can be compared to annual billing records to assess the unaccounted-for water rate.
- Monthly average demand – A measure of the amount of water used by the community in a given month. Review of monthly average water demand illustrates seasonal variations in demand due to such factors as climate, irrigation, industrial production, and domestic use patterns.
- Maximum day demand – A measure of the maximum amount of water used by the community in a single day. The maximum daily water demand is used to size booster pumping stations that serve areas with storage reservoirs. This measure of demand is also used in conjunction with fire demands and emergency supplies to size storage reservoirs.
- Peak hour demand – A measure of the maximum amount of water used by the community in a single hour. The peak hour water demand is used to size pipelines and booster pumping stations that serve pressure zones without reservoirs.

Analysis of the water demand factors described above allows for the development of peaking factors, expressed as a ratio of each factor to the annual average demand. Historical peaking factors are useful for comparing the system-wide water use patterns in the City to other communities and for projecting future water use patterns.

Historical Water Production and Consumption

Water production is the portion of SFWB's treated water that is delivered to the City while water consumption is the quantity of water actually consumed or used by its customers. As will be discussed later, the difference between production and consumption is unaccounted-for water.

The City regularly monitors master metering stations that record the volume of water delivered by the SFWB. The City reads the meters on a monthly basis for the purpose of calculating payments to the SFWB. Table 3-1, Monthly Historical Water Use, presents historical delivered water data for the past five years, from 2004 to 2008. Figure 3-1, Historical Water Production, presents this same information in a graphical form and compares total historical water production and historical average annual rainfall. As shown in Figure 3-1, the City's water demands increased at a relatively stable growth rate over the past 12 years, with a low demand period in 1995, followed by a sharp decrease in 2007. The low demand periods (including the sharp decrease in 2007) appear to be the result of above average rainfall (1994) and water conservation efforts, of which, the City has participated. A major component of the City's water conservation effort has been an aggressive approach to decrease the amount of unaccounted-for water. This is being accomplished through the installation of meters on City owned property and replacement and repair of leaky pipelines. Based on this program and the above average rainfall in 2006, the large increase in annual production in 2006 appears to be an anomaly. The City should consider investigating the causes of this spike and whether this was an anomaly or whether it should be removed from the average annual production estimates. Based on the data presented in Table 3-1, it is also possible to identify a peaking factor between the average annual demand and the maximum monthly demand. Table 3-2 summarizes the peaking factor analysis for maximum monthly demand.

From 2002 to 2008, master metering data indicated that the average annual demand ranged from 3.73 mgd to 4.16 mgd. The highest monthly average water demand was 7.80 mgd in August of 2005. Analysis of these historical data indicates that the average peaking factor for the maximum monthly demand is 1.77.

Figure 3-1. Historical Water Production

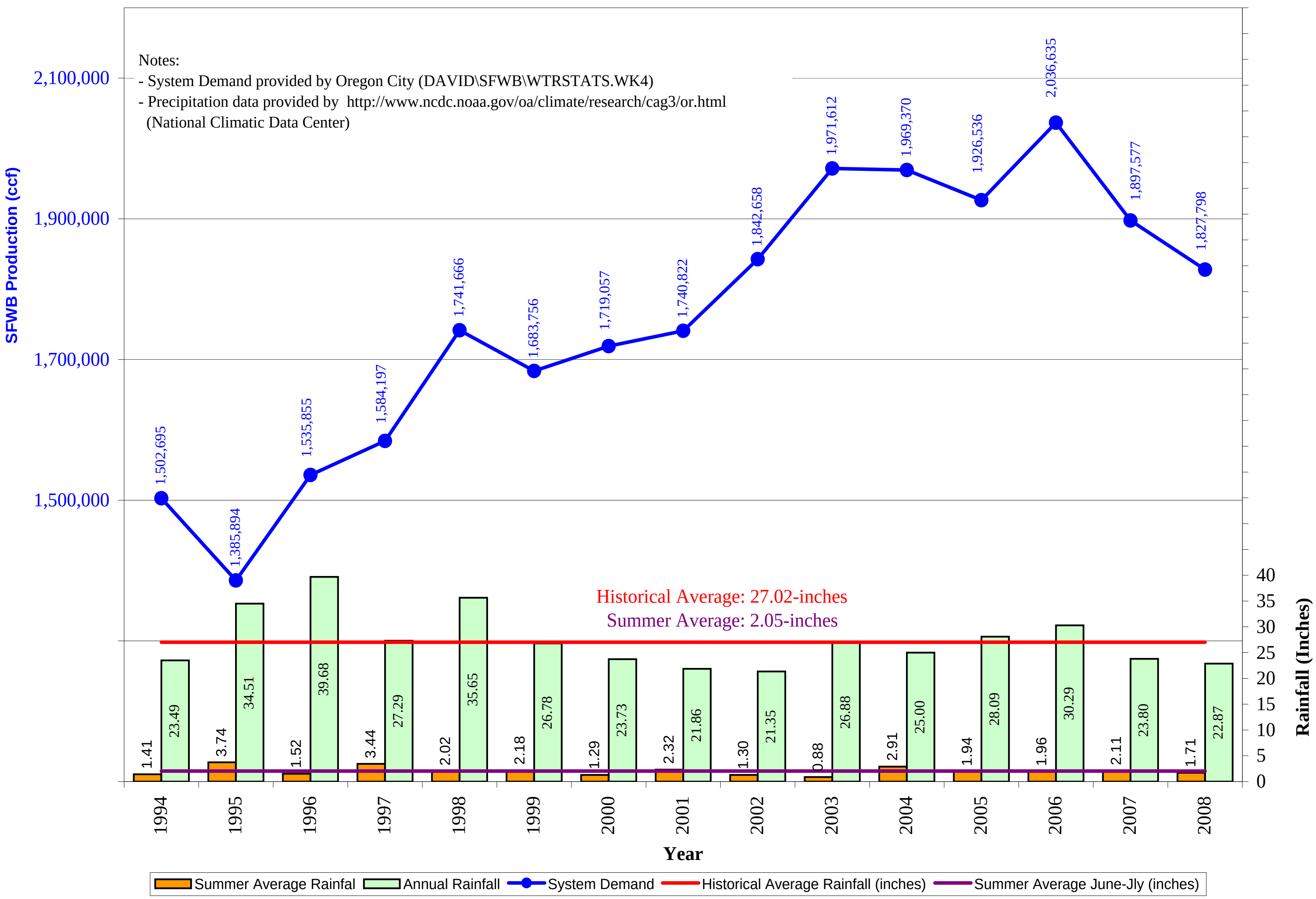


Table 3-1. Monthly Historical Water Use[a]

Month	Monthly Average Demand, mgd[b]				
	2004	2005	2006	2007	2008
January	2.93	3.33	3.23	3.36	2.52
February	2.82	2.71	2.67	2.63	2.65
March	2.92	3.10	2.72	2.70	2.67
April	3.62	2.95	2.77	2.98	2.82
May	4.13	3.44	4.53	3.89	3.29
June	4.94	3.65	4.80	5.14	4.66
July	6.89	5.40	7.45	6.62	6.46
August	6.43	7.80	6.97	5.24	5.60
September	3.94	5.78	5.48	5.67	5.24
October	3.59	2.95	3.28	2.74	3.18
November	3.01	3.12	3.15	2.78	2.94
December	2.98	3.12	2.82	2.80	2.75
Average Annual Demand	4.02	3.93	4.16	3.88	3.73
Maximum Month Demand	6.89	7.80	7.45	6.62	6.46
Monthly Peaking Factor	1.71	1.98	1.79	1.71	1.73
Average Annual Rainfall (inches)	25.00	28.09	30.29	23.80	22.87

[a] Data provided by Oregon City (DAVID\SFWB\WTRSTATS.WK4).
[b] mgd: million gallons per day.

Table 3-2. Maximum Monthly Demand Peaking Factor[a]

Year	Average Annual Demand, mgd	Maximum Monthly Demand, mgd	Maximum Month Peaking Factor
2002	3.76	6.43	1.71
2003	4.03	7.14	1.77
2004	4.02	6.89	1.71
2005	3.93	7.80	1.98
2006	4.16	7.45	1.79
2007	3.88	6.62	1.71
2008	3.73	6.46	1.73
Average	-	-	1.77

[a] Data provided by Oregon City (DAVID\SFWB\WTRSTATS.WK4).

Maximum Daily Water Demand

Since the City's master meters are read on a monthly basis, historical data on the daily delivered water volumes to the City are not available. However, the SFWB does maintain daily records of their overall water production volume. Since variations in the treatment plant's daily production typically correspond to the daily variations in demand within the served water systems, the peaking factor for the SFWB's daily production should roughly conform to the peaking factor for daily demand in the City's water distribution system. Table 3-3 presents the average annual, maximum month, and maximum daily production rates for the SFWB treatment plant from 2002 to 2008. Also, shown in the table are the resulting peaking factors for the maximum monthly and maximum daily flows.

Table 3-3. SFWB Water Production Data and Peaking Factors[(a)]

Year	Average Annual Production, mgd	Maximum Monthly Average, mgd	Maximum Daily Average, mgd	Maximum Month Peaking Factor	Maximum Daily Peaking Factor
2002	8.58	15.72	N/A	1.83	N/A
2003	9.50	17.10	19.70	1.80	2.07
2004	9.00	16.20	19.70	1.80	2.19
2005	8.80	16.40	19.60	1.86	2.23
2006	9.30	17.10	22.10	1.84	2.38
2007	8.70	15.20	20.00	1.75	2.30
2008	8.40	15.40	19.90	1.83	2.37
Average	-	-	-	1.81	2.26

(a) Data provided by Oregon City (DAVID\SFWB\WTRSTATS.WK4 and Plant Production data.pdf).

The maximum month peaking factor for the SFWB treatment plant of 1.81 corresponds well to the maximum month peaking factor of 1.77 that was independently determined for the City's water distribution system in the preceding section. It is reasonable to expect that the SFWB plant's maximum daily peaking factor of 2.26 will also correspond well to the maximum daily demand in the City.

Peak Hour Demand

The peak hour demand on a water distribution system in Western Oregon typically occurs during mid-summer when customers are heavily irrigating landscaped yards and parks. For the City of Oregon City, the peak hour demand would be expected to happen in the month of July or August during the peak day demand. An estimate of the peak hour demand is typically developed based on an analysis of hourly water production data from each of the reservoirs in the distribution system during the summertime peak demand period. In combination with hourly data on the SFWB delivered water rate for that period, it is then possible to identify the peak hour demand. Since this level of detail on system operations is currently not available from the City's SCADA system records, it was not possible to develop a precise estimate of peak hour demand for the City. However, a review of the peaking factors reported by other Western Oregon communities with similar variation in seasonal demand indicates that the system-wide peak hour demand for the City is likely to be 4.5 times the average annual demand. Since this is a system-wide peaking factor, local peaking factors may be higher for small areas or areas with exclusively single-family residences.

Summary of Existing Water Demand and Peaking Factors

Table 3-4 summarizes the system-wide water demand and peaking factors for the City based on analysis of data from the past five to seven years. The maximum day demand is estimated using a peaking factor from the SFWB treatment plant, and the peak hour demand is estimated using a general Western Oregon peaking factor. All of the identified peaking factor values are fairly typical for a Western Oregon community. The system-wide peaking factors for the City provide a basis for projecting future water demand patterns for the community.

Table 3-4. Existing Oregon City Demand and System-Wide Peaking Factor Summary(a,b)

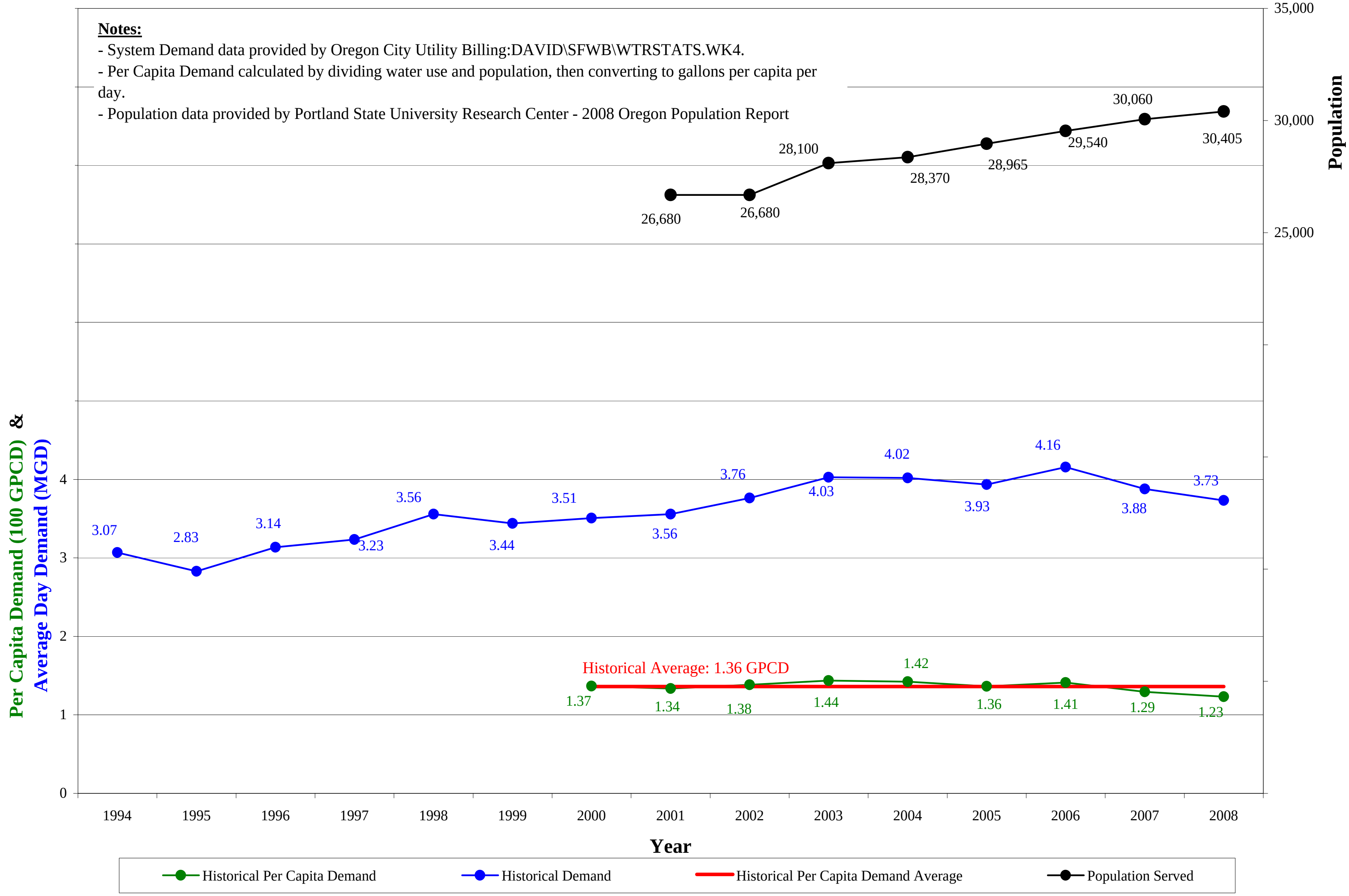
Description	Current Demand, mgd	Peaking Factor
Average annual demand	3.73	1.0
Maximum month demand	6.46	1.8
Maximum day demand	8.74	2.3
Peak hour demand	16.79	4.5

(a) Data provided by Oregon City (DAVID\SFWB\WTRSTATS.WK4 and PSU Population Report 2002-2008).
(b) The average demand multiplied by the peaking factor yields the respective demand.

Per Capita Water Demand

Per capita water demand is also a useful demand measure that is derived from the preceding historical data. Table 3-5 presents the population for the City along with the average annual demand during the past seven years which allows for calculation of the average demand in gallons per capita per day (gpcd). Ranging from 123 gpcd to 143 gpcd, the average daily water demand is 136 gpcd. Note that this unit demand factor is based on water production and includes all uses: residential, commercial, industrial, institutional, and unaccounted-for or lost water. Variation in per capita demand from year to year is expected due to irregular water use patterns caused by unsteady weather and end user demand characteristics; however there appears to be a decreasing trend in the data for years 2007 and 2008. These years show noticeable drop in per capita demand that corresponds to a drop in production at the SFWB Treatment Plant. These drops could be due to the loss of a significant customer, the repair of significant leaks or conservation, for example. This information is presented graphically on Figure 3-2.

Figure 3-2. Comparison of Historical Per Capita Demand, System Demand & Population



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Last Revised: 08-23-10

City of Oregon City
Water Distribution System Master Plan

Table 3-5. Per Capita Water Demand for 2002 – 2008[a,b]

Year	Population	Average Demand, mgd	Average Demand, gpcd[c]
2002	27,270	3.76	138
2003	28,100	4.03	143
2004	28,370	4.02	142
2005	28,965	3.93	136
2006	29,540	4.16	141
2007	30,060	3.88	129
2008	30,405	3.73	123
Average	-	-	136

(a) Demand includes all uses (residential, commercial, industrial, institutional, and unaccounted).
(b) Data provided by Oregon City (DAVID\SFWB\WTRSTATS.WK4 and PSU Population Report 2002-2008).
(c) gpcd: gallons per capita per day.

High Consumption Water Customers

The City serves a number of high consumption water customers. In order to ensure that the high demand associated with these customers are accounted for in the planning process, the largest customers are identified by location to ensure an accurate allocation of large demands in the hydraulic model. Table 3-6 identifies the Top 25 customers with a water demand greater than 0.3 million gallons per month (0.011 million gallons per day), in addition to their location and user category.

Table 3-6. High Consumption Water Customers in Oregon City[a]

Facility	Address	User Category	Average Water Demand, mgd
Blue Heron Paper Mill	401 Main St	Industrial/Commercial	0.13
Clackamas Community College	19600 S. Molalla Ave	Institutional	0.083
Clackamas County Complex	2106 Kaen Road	Institutional	0.069
Providence Willamette Falls Medical Center	1500 Division St	Institutional	0.052
Pioneer Ridge Apartments	13826 S. Meyers Rd	Multi-Family	0.052
Chapin Park	Warner Parrott Road	City Account	0.051
King's Berry Heights Apartments	14290 Marjorie Ln	Multi-Family	0.050
Clackamas County Housing Authority	13930 Gain St	Institutional	0.041
Mountainview Cemetery	500 Hilda St	City Account	0.039
Clairmont Mobile Home Park	13531 Clairmont Way	Single-Family	0.033
OC Shopping Center	1900 McLoughlin Blvd	Commercial	0.021
Hidden Creek Apartments	19839 S Hwy 213	Multi-Family	0.020
South Ridge Shopping Center	1630 Beavercreek Rd	Commercial	0.018
Oregon City Health Care Center	148 Hood St	Institutional	0.018
Oregon City High School	19761 Beavercreek Rd	Institutional	0.017
Public Works/Sewer Pump Station [b]	Wild Bill Ct	City Account	0.017
Barclay Hills Apartments	775 Cascade St	Multi-Family	0.017
Sierra Vista Nursing home	1680 Molalla Ave	Institutional	0.017
Del Mesa Farms	2500 Beavercreek Rd	Industrial/Commercial	0.017
The Home Depot	2002 Washington St	Commercial	0.016
Mt Pleasant Mobile Home Park	18780 Central Point	Single-Family	0.016
Browning/Ferris Industries	2001 Washington St	Industrial/Commercial	0.013
Sandvik Medical Solutions	13963 Fir St	Industrial/Commercial	0.011
Fred Meyer Shopping Center	1839 Molalla Ave	Commercial	0.011
Gilman Park	2205 Gilman Dr	Multi-Family	0.011

(a) Data provided by Oregon City (DAVID\SFWB\WTRSTATS.WK4).
(b) Public works has located the source of this high water using pump station and reduced the use.

Unaccounted-for Water

All water distribution systems experience losses of water during distribution to the end user. These losses, known as unaccounted-for water, result from many situations including unmetered customers, transmission system leaks, reservoir leaks, main breaks, faulty meters, over-filling reservoirs, fire fighting activities, system flushing, and other miscellaneous hydrant uses. Thus, the total volume of water metered for all end users in the City is expected to be less than the volume of water delivered by the SFWB.

Table 3-7 shows the estimated volume of unaccounted-for water in millions of gallons (MG) and also as a percentage of total delivered water during the past seven years. Although the schedules for reading the master meters are quite different than the schedules for reading customer meters, the average unaccounted-for water rate over a full one-year period will provide a reasonable estimate. The seven year average number will be even more accurate. In this case, there appears to be an outlier in the year 2005 that is abnormally high as compared to adjacent years. As such, this number is discarded for the seven year average.

A distribution system in good condition typically shows a water loss rate of 10 to 15 percent. Therefore, the calculated unaccounted-for water rate of 16.8 percent indicates that the volume of under-reported water use in the City is fairly significant and warrants further attention. The drop off seen in 2008 could be the result of leak repairs by the City and may be the start of a lower average in years to come. Since the City has made significant efforts in recent years to install meters for all customers including City owned parks and facilities, unmetered customers are not expected to be a major source of unaccounted-for water. Since 2000, the City is also averaging 450 old meter change outs per year, as well as more than 10,000 feet of pipeline replacement per year. Ongoing refinement of master metering and record keeping practices is anticipated to further reduce the volume of unaccounted-for water in the coming years. The City may wish to consider implementing other programs that will reduce the unaccounted-for water rates such as continued replacement of old customer meters, metering of construction site water use, and improved monitoring of hydrant use for system flushing and fire fighting. The leak detection efforts made in recent years by the City should continue and should focus on the older, higher pressure areas of the distribution system where leaks are most to occur and are most likely to be significant.

Table 3-7. Unaccounted-for Water, 2002-2008[a]

Year	Delivered Water, MG	Metered Water, MG	Unaccounted-for Water, MG	Percent of Total Delivered Water
2002	1,378	1,177	201	14.6
2003	1,475	1,231	244	16.5
2004	1,473	1,196	278	18.9
2005	1,441	1,057	384	26.6[b]
2006	1,523	1,249	275	18.0
2007	1,273	1,185	235	18.5
2008	1,332	1,171	196	14.7
Average	-	-	-	16.8%

(a) Data provided by Oregon City (DAVID\SFWB\WTRSTATS.WK4).
(b) Discarded from average as an outlier.

Unit Demand Factors by Land Use

The development of water demand factors related to land use patterns provides another important perspective on water demand in the community. Based on historical billing data provided by the City's Finance Department for the period between 2002 and 2008, Table 3-8 summarizes the

Table 3-8. Historical Services by Revenue Class[a]

Year	Residential	Institutional	Commercial	Industrial	Multiple Units	Seniors Citizens	Residential Out	Comm/Ind Out	Total Services
2002	7,351	84	458	4	403	113	25	1	8,439
2003	7,587	86	456	4	402	122	22	1	8,680
2004	7,770	87	456	5	403	121	24	1	8,867
2005	8,056	83	464	2	404	123	23	1	9,156
2006	8,316	83	484	2	401	117	23	1	9,427
2007	8,564	84	494	2	404	110	23	1	9,682
2008	8,671	85	497	2	409	113	23	1	9,801
Historical Average	8,118	85	476	3	404	117	23	1	9,164
7-Year Average[b]	8,045	85	473	3	404	117	23	1	9,150
5 Year Average[c]	8,275	84	479	3	404	117	23	1	9,387
Average Annual % Growth	2.79%	0.19%	1.16%	-5.00%	0.18%	0.09%	-1.01%	0.00%	1.38%

(a) Data provided by Oregon City Water Consumption 2002-2009(Account Type).xls
(b) 7-Year Average: 2002-2008
(c) 5-Year Average: 2003-2007

total number of services by revenue class. Some revenue classes were combined with others to create four general customer class categories: single family residential, multi-family residential, institutional, and industrial/commercial. The "Senior Citizens" revenue class was combined with multi-family, "Residential Comm/Ind Out" was combined with industrial/commercial, and "Residential Out" was combined with single-family residential. Table 3-9 summarizes annual average water demand within these customer classes. As indicated in the percentage summary of annual average demand by customer class category, the single family residential classification accounts for almost two-thirds of the water used in the City.

Table 3-9. Water Use by Customer Class, 2002-2008[(a)]

	Demand, mgd[(b)]				
Year	Single Family	Institutional	Multi-Family	Industrial/ Commercial	Total
2002	2.16	0.33	0.63	0.65	3.78
2003	2.42	0.29	0.65	0.68	4.04
2004	2.36	0.34	0.63	0.70	4.04
2005[(c)]	2.22	0.32	0.64	0.77	3.95
2006	2.42	0.42	0.62	0.72	4.17
2007	2.32	0.28	0.58	0.71	3.89
2008	2.22	0.30	0.55	0.66	3.74
Historical annual average demand	2.32	0.33	0.61	0.69	3.94
Percent of total annual average demand	59%	8%	16%	17%	100%

(a) Water use includes unaccounted-for water
(b) Data provided by Utility Billing (Oregon City Water Consumption 2002-2009 (Account Type).xls)
(c) Utility Billing software upgraded data is not complete and is not used for determining Historical Annual Average Demand

To develop a unit demand factor for the four different customer use types, the water use data presented in Table 3-9 is combined with estimated areas for each of the customer use categories. Figure 3-3 shows the land use designations within the Urban Growth Boundary (UGB). Each land use classification was associated with one of the four major customer use types: single family residential, multi-family residential, institutional, and industrial/commercial. Table 3-10 summarizes the assignment of each land use classification to a customer use category.

Table 3-11 summarizes the existing land use acreages by customer use category for all areas within the City limits. The quotient of water demand and existing land use acreage yields a unit demand factor for each customer use category in gallons per acre per day (gpad), as summarized in Table 3-12. Based on these calculated unit demand factors, Table 3-12 also includes recommended unit demand factors for future planning. These planning level demand factors allow for more intensive water consumption patterns in the future, especially for the City's industrial/commercial land use, which currently exhibits relatively low levels of water demand.

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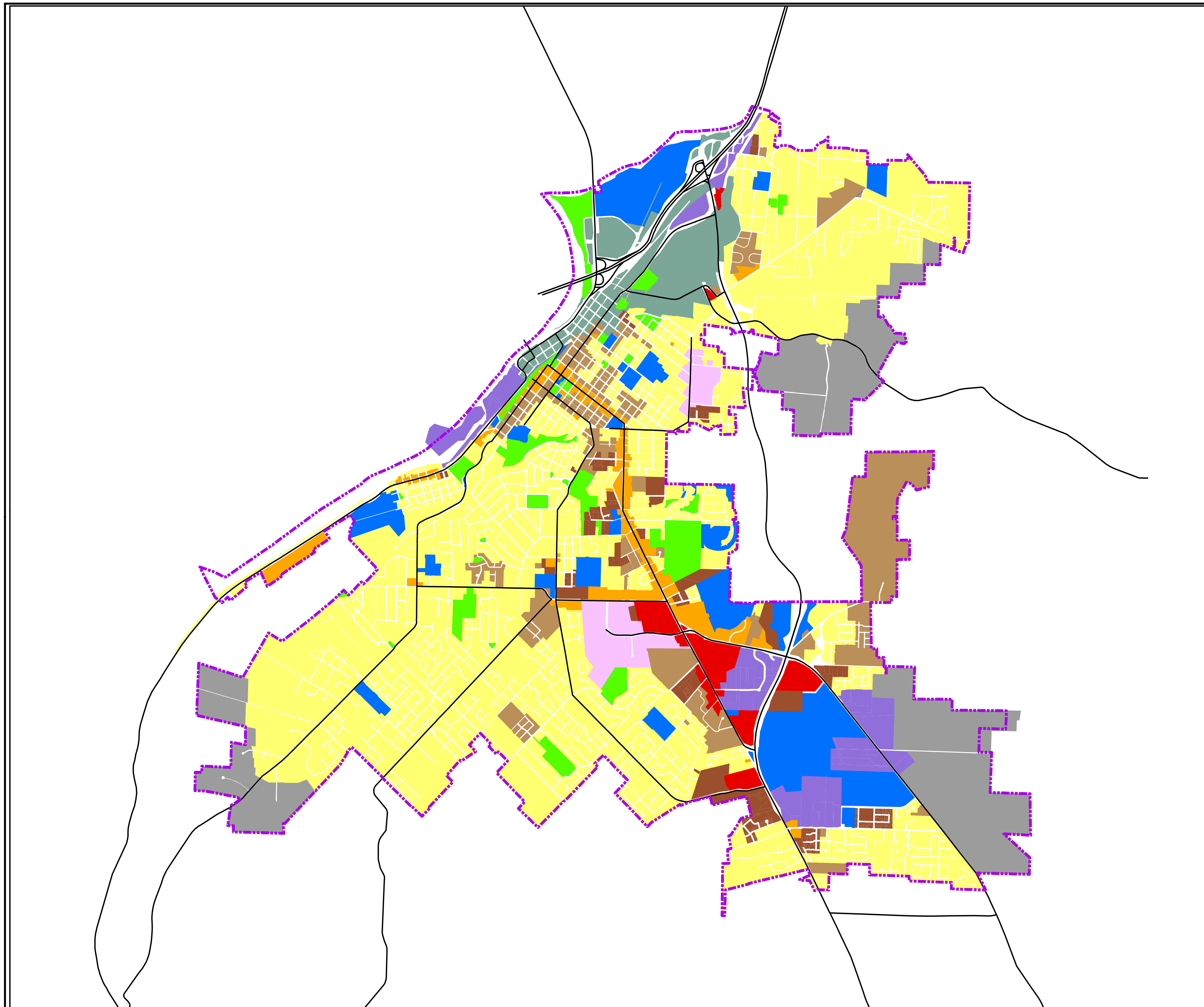


OREGON CITY

FIGURE 3-3

CITY OF OREGON CITY
LAND USE DESIGNATIONS

N

0 1,000 2,000
Scale in Feet

Legend:

- URBAN GROWTH BOUNDARY (UGB)
- c - Commercial
- fu - Future Urban
- hr - High Density Residential
- i - Industrial
- lr - Low Density Residential
- mr - Medium Density Residential
- muc - Mixed Use Corridor
- mud - Mixed Use Downtown
- mue - Mixed Use Employment
- p - Parks
- qp - Public and Quasi-Public

WEST YOST ASSOCIATES
Consulting Engineers

Table 3-10. Land Use Classification by Customer Use Category

	Customer Use Category			
	Single Family	Multi-Family	Institutional	Industrial/Commercial
Zoning Classifications	Low Density Residential	High Density Residential	Parks	Commercial
	Medium Density Residential		Public and Quasi-Public	Mixed Use Corridor
				Mixed Use Downtown
				Mixed Use Employment
				Industrial
				Future Urban

Table 3-11. Land Use in Acres

Customer Use Category	2001 Served Area[a], acres	Percentage	2008 Served Area[b], acres	Percentage
Single Family Residential			2,396	58
Institutional[c]	2,932	71	800	19
Multi-Family Residential	302	7	171	4
Commercial/Industrial	933	22	767	19
Total	4,167	100%	4,134	100%

(a) Area based on Table 3-10 in the 2004 WMP.
(b) Area based on taxlots data within the City Limits minus vacant area data without existing water use.
(c) Institutional water use category was combined with the Single Family Residential water use in the 2004 WMP.

Table 3-12. Summary of Recommended Unit Water Demand Factors[a]

Customer Use Category	2008 Water Use[b], mgd	2008 Served Area, acres	Calculated Unit Demand Factor, gpad	Normalized Unit Demand Factor[c], gpad
Single-Family Residential	2.22	2,396	930	1,050
Institutional	0.30	800	380	450
Multi-Family Residential	0.55	171	3,230	3,600
Commercial/Industrial	0.66	767	870	1,000
Total	3.74	4,134	--	--

(a) Data provided by Utility Billing (Oregon City Water Consumption 2002-2009 (Account Type).xls)
(b) Includes unaccounted-for water.
(c) Equal to the calculated unit demand factor multiplied by the normalization factor of 1.11
(based on 2006 annual production).

FUTURE WATER DEMAND

Projections of future water demand for the City's water distribution system are based on the unit demand factors developed in the preceding section. The following analysis presents estimates of the City's water demand for both the 20-year planning horizon (year 2030) and for build-out of the existing UGB.

Year 2030 Water Demand Projection

The year 2030 water demand projection is based on the anticipated rate of population growth in the City over the next 20 years. Since water demand patterns in the City are not anticipated to change significantly during the planning period, the projected future population provides a sound basis for estimating future water demand for the system. The most recent population projections by Metro (20 and 50 year Regional Population and Employment Range Forecasts, April 2009 draft) anticipate that the region will grow at an annual average rate of 1.14 to 1.3 percent. However, review of historical data indicates that the annual average growth rate in the City was six percent during the 1990s. Since the rate of growth will determine the necessary timing of certain improvement projects, it is recommended that the City consider the possibility of faster growth rates during development of the capital improvement plan and financing plan. To allow for consideration of potentially higher rates of growth than the Metro projections, all analysis of future conditions will consider both 1.5 percent and 3.0 percent annual growth rates (half that of the growth rate seen in the 1990s). At a growth rate of 1.5 percent, the City's existing population of 30,405 will grow to 41,565 by the year 2030. At a growth rate of 3.0 percent, the population will grow to 56,562 during the same period.

The future population can be translated into a future water demand using the per capita water demand factor of 136 gpcd developed earlier. Using this figure, the year 2030 average annual water demand will be 5.7 mgd at the 1.5 percent growth rate and 7.7 mgd at the 3.0 percent growth rate. Based on these estimates of the year 2030 average annual demand, the corresponding estimates of maximum day, and peak hour demand can be estimated using the historical peaking factors. Table 3-13 summarizes the water demand projections for the year 2030 condition.

Table 3-13. Year 2030 Water Demand Projection Summary[(a)]

Description	Current Water Demand, mgd	Year 2030 Water Demand at 1.5% Growth	Year 2030 Water Demand at 3% Growth
Average Annual	3.73	5.66	7.76
Maximum Day	8.74	13.26	18.17
Peak Hour	16.79	25.47	34.91

(a) Data provided by Oregon City (DAVID\SFWB\WTRSTATS.WK4).

UGB Build-Out Water Demand Projection

The projection of water demand in the City at build-out of the urban growth boundary is based on the land use demand factors developed earlier in conjunction with an estimate of the City's ultimate urban area. Assuming a future customer use profile similar to the existing community, Table 3-14 summarizes the acreage of properties within the UGB by customer use category. Using these acreages and the unit demand factors developed for these customer use categories, the projected average annual water demand at the City's UGB build-out condition is 7.0 mgd. Since this demand projection falls very close to the year 2030 estimate at a growth rate of 3.0 percent, it appears that the City could achieve build-out of the existing UGB within 20 years.

Table 3-14. UGB Buildout Water Demand Projections[(a)]

Customer Use Category	UGB Area[(b)], acres	Normalized Unit Demand Factor, gpad	Average Annual Demand[(c)], mgd
Single Family Residential	3,756	1,050	3.94
Institutional	821	450	0.37
Multi-Family Residential	223	3,600	0.80
Commercial/Industrial	1,904	1,000	1.90
Total	6,704	--	7.01

(a) Data provided by Oregon City (DAVID\SFWB\WTRSTATS.WK4).
(b) Area based on taxlots data within the UGB.
(c) Includes unaccounted-for water.

Based on this estimate of the build-out average annual demand, the corresponding estimates of maximum day, and peak hour demand can be estimated using the historical peaking factors. Table 3-15 summarizes the water demand projections for the UGB build-out condition.

Table 3-15. Summary of Buildout Water Demand Projections[(a)]

Customer Use Category	Average Day Demand, mgd	Maximum Day Demand[(b)], mgd	Peak Hour Demand[(c)], mgd
Single Family Residential	3.94	9.07	17.75
Institutional	0.37	0.85	1.66
Multi-Family Residential	0.80	1.85	3.62
Commercial/Industrial	1.90	4.38	8.57
Total	7.01	16.15	31.60

(a) Includes unaccounted-for water.
(b) The City's maximum day demand is 2.3 times the average day demand.
(c) The City's peak hour demand is 4.5 times the average day demand.

Master Meters

The City conveys SFWB water through its distribution system for delivery to Clackamas River Water District (CRW) and the City of West Linn at seven different locations. Since this practice will continue for the foreseeable future, it is necessary to plan for providing adequate system capacity for these water wheeling services in addition to serving the City's own customers. Table 3-16 summarizes the most recent annual average water deliveries to CRW and West Linn at each of the seven delivery locations. An estimate of the maximum day demand is also provided based on a peaking factor of 3.0. A maximum day peaking factor greater than the City's peaking factor is warranted due to the higher percentage of residential development within the CRW and West Linn service areas.

Table 3-16. Water Wheeled to CRW in 2008[(a)]

Location	Average Annual Demand, mgd	Maximum Daily Demand, mgd
Redland Rd & Anchor Way (MM2)	0.92	2.77
Meyers and Leland Roads (MM8)	0.07	0.20
South End Rd & Impala Ln (MM9)	0.04	0.10
Barlow Crest Pump Station (MM11)	0.24	0.73
Barlow Crest Reservoir (MM12)	0.01	0.02
Forsythe Rd & Swan Ave (MM13)	0.01	0.03
17th and Division (MM3)	2.97	2.77
Total	4.26	12.77

(a) Data provided by Oregon City (MasterMeterRecord2008.xls).

Future demand for the areas served by CRW through the City delivery locations is uncertain. Portions of the CRW service areas will be incorporated into the City's system as the city limits expand toward the UGB while CRW continues to add customers outside of the UGB. Metro projections for these unincorporated areas are not available, but CRW staff feel that two percent annual growth is a reasonable estimate. Therefore, for the purpose of the master planning process, it is assumed that the CRW demands on the City's future water system will grow at an average annual rate of two percent. Based on this growth rate, Table 3-17 summarizes CRW demands in the year 2030. Table 3-18 the total usage summary of Oregon City's water by sales category.

Table 3-17. Projection of Future Water Wheeled to CRW in 2030[a]

Location	Average Annual Demand, mgd	Maximum Daily Demand, mgd
Redland Rd & Anchor Way (MM2)	1.43	4.28
Meyers and Leland Roads (MM8)	0.10	0.31
South End Rd & Impala Ln (MM9)	0.05	0.16
Barlow Crest Pump Station (MM11)	0.37	1.12
Barlow Crest Reservoir (MM12)	0.01	0.03
Forsythe Rd & Swan Ave (MM13)	0.02	0.06
17th and Division (MM3)	4.60	13.79
Total	6.58	19.75

[a] Data provided by Oregon City (MasterMeterRecord2008.xls) and expanded using a 2% growth rate.

Table 3-18. Projection of Future Water Use by Use Category Year in 2030

Use Category	Average Annual Demand, mgd	Maximum Daily Demand, mgd	Peak Hour Demand, mgd
Retail Water Use	7.01	16.15	31.60
Wholesale Water Use	6.58	19.75	19.75
Total Water Use	13.59	35.90	51.35

CHAPTER 4. WATER DISTRIBUTION SYSTEM SERVICE STANDARDS

The purpose of this chapter is to define the water distribution service standards for analyzing the performance of the City's potable water distribution system. The service standards recommended in this chapter provide a basis for evaluating the City's existing water distribution system and guide the planning and design of those improvements to the water system that are necessary to meet future demands. These standards include the desired fire flow and flow duration, definition of "emergency events", pumping capacity, storage capacity components (including operational, fire flow and emergency), minimum and maximum system pressures, and maximum pipeline velocity and head loss. The water distribution system service standards used for this WMP are summarized in the following sections:

- Water Service Quality Standards
- Fire Flow Requirements
- Water Supply Capacity During High Demand Periods
- Pumping Facility Capacity
- Critical Pumping Facilities
- Water Storage Capacity
- Water Transmission and Distribution System

These service standards, summarized in Table 4-1, reflect typical water system industry standards, including the Oregon State Department of Human Services (DHS), the Environmental Protection Agency (EPA), the American Water Works Association (AWWA), the Insurance Services Office, Inc. (ISO), and the Oregon Fire Code (OFC).

WATER SERVICE QUALITY STANDARDS

Water service quality standards largely pertain to protecting public health and consistently delivering a satisfactory product to the customer. Most of the water quality considerations are related to supply and treatment issues and are not the subject of this chapter. In the water distribution network, a major water quality concern is maintaining compliance with the Oregon State DHS residual disinfectant requirements. The DHS requires that there is a measurable chlorine residual level throughout the system in at least 95 percent of all monthly samples and a chlorine residual of at least 0.2 mg/l where water enters the distribution system.

Stage 2 Disinfectants and Disinfection Byproducts Rule

To reduce disease incidence associated with the disinfection byproducts that form when public water supply systems add disinfectants, the Environmental Protection Agency (EPA) proposed the Stage 2 Disinfectants and Disinfection Byproducts Rule (Stage 2 DBPR). The Stage 2 DBPR supplements existing regulations by requiring water systems to meet disinfection byproduct

Table 4-1. City of Oregon City Planning and Design Criteria

Component	Criteria	Remarks / Issues
PERFORMANCE CRITERIA FOR PLANNING & DESIGN		
Fire Flow Requirements (flow [gpm] @ duration [hours])		
Single-Family Residential	1,500 gpm @ 2 hrs	Fire flows based on new development requirements. Existing development will be evaluated on a case by case basis, because of the historical varying standard.
Multi-Family Residential	1,500 gpm @ 3 hrs	
Institutional (schools, hospitals, etc.)	2,000 gpm @ 4 hrs (with approved automatic sprinkler system)	
Commercial/Industrial	3,000 gpm @ 4 hrs (with approved automatic sprinkler system)	
Water Supply Capacity		
Maximum Day Demand Plus Fire Flow	Provide capacity equal to maximum day demand plus fire flow	
Peak Hour Demand	Provide capacity equal to peak hour demand	
Pumping Facility Capacity		
Booster Pump Capacity	Equal to the maximum day demand for the pressure zone.	Design for maximum day plus fire flow or peak hour (whichever is larger), only if no gravity storage is available within the pressure zone and/or service area.
Backup Power	Equal to the firm capacity of the pumping facility.	On-site generator for critical stations.[a] Plug in portable generator for less critical stations.
Water Storage and System Peaking Capacity		
Equalization	25 percent of maximum day demand	
Fire	Varies (see requirements listed in remarks column)	Varies depending on required fire flow duration. Highest fire flow demand in any particular area controls size of required storage. See Table 4-2. 1,500 gpm @ 2 hrs = 0.18 MG 1,500 gpm @ 3 hrs = 0.27 MG 2,500 gpm @ 4 hrs = 0.60 MG
Emergency	Maximum day demand	Based on DHS recommendations.
Total Water Storage Capacity	Equalization + Fire + Emergency	
Water Transmission Line Sizing		
Diameter	18-inches in diameter or larger	Criteria based on requirements for new development, existing transmission mains will be evaluated on case-by-case basis. Evaluation will include age, material type, velocity, head loss, and pressure.
Average Day Demand Condition		
Minimum Pressure [psi]	40 psi	
Maximum Pressure [psi]	100 psi	
Maximum Velocity [ft/sec]	3 fps	
Maximum Day Demand Condition		
Minimum Pressure [psi]	40 psi	
Maximum Head loss [ft/1000 ft]	3 ft/kft	
Maximum Velocity [ft/sec]	5 fps	
Peak Hour Demand Condition		
Minimum Pressure [psi]	40 psi	
Maximum Head loss [ft/1000 ft]	3 ft/kft	
Maximum Velocity [ft/sec]	5 fps	
Hazen Williams "C" Factor	140	For consistency in hydraulic modeling.
Pipeline Material	Ductile Iron	
Water Distribution Line Sizing		
Diameter	Less than 18-inches in diameter	Must verify pipeline size with max day and fire flow analysis.
Average Day Demand Condition		Criteria based on requirements for new development, existing distribution mains will be evaluated on case-by-case basis. Evaluation will include age, material type, velocity, head loss, and pressure.
Minimum Pressure [psi]	40 psi	
Maximum Pressure [psi]	100 psi	
Maximum Velocity [ft/sec]	3 - 5 fps	
Maximum Day w/ Fire Flow Demand Condition		
Minimum Pressure [psi] (at fire node)	20 psi	
Maximum Head loss [ft/1000 ft]	10 ft/kft	
Maximum Velocity [ft/sec]	10 fps	
Peak Hour Demand Condition		
Minimum Pressure [psi]	40 psi	
Maximum Head loss [ft/1000 ft]	10 ft/kft	
Maximum Velocity [ft/sec]	7 fps	
Hazen Williams "C" Factor	140	For consistency in hydraulic modeling.
Pipeline Material	Ductile Iron	
Maximum Valve Spacing		
Supply Pipeline	1 mile	
Transmission Pipeline	2,000 feet (minimum)	1,300 feet (preferred)
Residential Distribution Pipeline	800 feet	
Commercial Distribution Pipeline	500 feet	
Uniform Fire Code Hydrant Distribution Requirements		
Residential	500	
Commercial, Industrial, and Other High Value District	200-500	
OTHER CRITERIA		
Maximum Number of residential lots that can be served by a non-looped water pipeline	25 lots	If a non-looped water line goes out-of-service, all associated residences lose water service.

[a] A pumping facility is defined as critical if it provides service to pressure zones and/or service areas without sufficient emergency storage and that meet the following criterion:

- The largest facility that provides water to a particular pressure zone and/or service area;
- A facility that provides the sole source of water to single or multiple pressure zones and/or service areas; and
- A facility that provides water from a supply turnout into pressure zones and/or service areas.

maximum contaminant levels (MCLs) at each monitoring site in the distribution system. The proposal also contains a risk-targeting approach to better identify monitoring sites where customers are exposed to high levels of disinfection byproducts (DBPs). The goal of this regulation is to reduce DBP exposure to provide more equitable health protection, and will result in lower cancer, reproductive and developmental risks.

The Stage 2 measure of DBP compliance is called a locational running annual average (LRAA). The LRAA differs from the Stage 1 DBPR compliance strategy which is based upon a system-wide running annual average. Under the Stage 2 Rule the LRAA at each monitoring location must be below the present regulatory DBP MCLs of 80 µg/L for total trihalomethanes (THM), and 60 µg/L for the 5 major haloacetic acids (HAA5). However, if a supplier exceeds a threshold, referred to as a significant excursion at any location, during any sampling event, there are additional requirements that will need to be performed.

Under the Stage 2 DBPR, systems will conduct an evaluation of their distribution system (Initial Distribution System Evaluation or IDSE), to identify monitoring locations that are most likely to have high levels of DBPs. These locations will then be used as the sampling sites for DBP compliance monitoring. The EPA provides guidance to assist suppliers in finding locations to include in the IDSE. The EPA has also designed a boilerplate study, called a Standard Monitoring Plan (SMP), to determine how newly identified locations compare to ones used for compliance with Stage 1 Rule. EPA will allow suppliers to demonstrate that new monitoring locations meet the intent of the IDSE though the use of specific alternatives means, referred to as a system specific study, or SSS. Following the IDSE, suppliers and their primacy agencies will determine which location will be used for Stage 2 LRAA compliance.

System Reliability

Attention to enhancing the reliability of the system under all conditions is another important part of maintaining high quality water service. Reliability is achieved through a number of system features including appropriately sized storage; redundant pumping, transmission, and rechlorination where required; and 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 reduces the potential for stagnant water and the associated problems of poor taste and low chlorine residuals and increased DBPs. Proper valve placement is also necessary to maintain reliable system operation under normal and abnormal operating conditions.

FIRE FLOW REQUIREMENTS

While the City is the purveyor of water, the Clackamas Fire District #1 (CFD) is also concerned with the availability of adequate water supply. The City is responsible for supply and distribution of water; whereas, CFD establishes minimum water flows required for fire fighting purposes.

CFD uses the 2007 OFC Table B105.1 *Minimum Required Fire-Flow and Flow Duration for Buildings* to assist them in establishing minimum fire flows and durations for individual structures.

The City's minimum design standards for fire flow are 1,500 gallons per minute (gpm) at a domestic residence 3,000 gpm for a commercial building, and 5,000 gpm for buildings in heavy commercial areas. However, actual fire flow requirements are determined by CFD and ISO on a case-by-case basis. Specific fire flow requirements are based on the size of building (in square feet) and type of construction (wood frame, metal, masonry, installation of sprinklers, etc.). Once the fire flow requirement is established, it is multiplied by the required duration to determine the total volume needed for fire flow storage. Table 4-2 represents the general fire flow requirements that have been established for planning the City's water system.

WATER SUPPLY CAPACITY DURING HIGH DEMAND PERIODS

In accordance with typical industry standards, the City's water supply system should have the capability to meet a system demand condition equal to the occurrence of a maximum day demand condition concurrent with a fire flow event. For planning purposes, it is assumed that the maximum day plus fire flow demand condition will consist of a single fire flow event.

Water Supply and Treatment Capacity

Since the City shares its source of supply with two other water purveyors, evaluations of the water supply and treatment capacity must account for overall demand on the South Fork Water Board (SFWB) facility.

<u>Source Supply</u>. The reliable yield of all sources of supply should exceed the projected maximum day demand on the system. The definition of reliable yield of water supplies is that which can be delivered to the City during the worst drought. The worst drought conditions are estimated from historical stream flow records. The reliable yield from the SFWB's water rights is nearly 52 mgd, well in excess of the historical overall maximum day demand of 22.1 mgd.

<u>Treatment Capacity</u>. Total potable water production and supply delivery capacity should be equal to or greater than the maximum day demand. It is recommended that the total maximum production capacity be at least ten percent greater than the maximum day demand to allow for concurrent fire flow demands, meeting drinking water quality standards with difficult water, or when repairing equipment. Since the overall historical maximum day demand on the system is above the 20 mgd treatment capacity of the SFWB plant, the SFWB's 1997 master plan called for expansion of the treatment plant and distribution facilities in the near future. SFWB is currently undergoing a Master Plan Update to determine the required improvements.

System Pressure Requirements

Under normal operating conditions, water pressure in the distribution system should range between 40 and 100 psi. The lower end of this pressure range is intended to ensure that adequate pressure is available for the highest fixture at a service connection during maximum demand

Table 4-2. Recommended Fire Flow Requirements[a,b]

Designation	Non-Sprinklered			Sprinklered[c,d]		
	Fire Flow, gpm	Duration, hours	Recommended Storage, MG	Fire Flow, gpm	Duration, hours	Recommended Storage, MG[e]
Single-Family Residential[f]	1,500	2	0.18	--	--	--
Multi-Family Residential[g]	1,500	3	0.27	--	--	--
Institutional[h]	3,000	4	0.72	2,000[i]	4	0.36
Industrial/Commercial[j]	5,000	4	1.20	3,000[i]	4	0.60

[a] Construction type and fire area are not generally known during the development of a master plan; consequently, fire flow requirements set forth in this table are based on previous estimates for these land use types and similar communities.

[b] Unique projects or projects with alternate materials may require higher fire flows and will be reviewed by the Fire Marshal on a case-by-case basis (e.g., proposed commercial/industrial areas and schools).

[c] The Fire Marshal normally allows up to a 50 percent reduction in fire flows if a building is sprinklered. However, the Fire Code also requires that no fire flow be less than 1,000 gpm for single family residential or 1,500 gpm for all other building types. For a more conservative fire flow estimate, Single Family and Multiple Family buildings were considered non-sprinklered for this Water Master Plan Update.

[d] Specific fire flows were determined from Table B105.1 of the 2007 OFC, and depend on construction type and fire area. These fire flow requirements are based on buildings being fully sprinklered.

[e] Recommended storage volumes do not include volume associated with 500 gpm sprinkler flow.

[f] Single Family includes Low Density Residential and Medium Density Residential land use.

[g] Multiple Family includes High Density Residential land uses.

[h] Institutional includes Parks & Recreation and Public and Quasi-Public land uses.

[i] Fire flow includes a 500 gpm demand for on-site sprinkler flow.

[j] Industrial/Commercial includes Commercial, Mixed Use Corridor, Mixed Use Downtown, Mixed Use Employment, Industrial and Future Urban land uses.

conditions. The higher end of this pressure range is intended to minimize system repairs, lower the potential for surge damage, minimize water leakage rates, and lower the expense of pipelines.

Under fire flow conditions, lower pressures in the distribution system are allowable. In accordance with DHS rules, the minimum system pressure under fire flow conditions shall be 20 psi as measured at the property line.

PUMPING FACILITY CAPACITY

Sufficient water system pumping capacity should be provided to meet the greater of these two demand conditions:

1. A maximum day demand concurrent with a maximum fire flow event with the largest pump at each booster pump station in standby mode.
2. A peak hour demand with the largest pump at each booster pump station in standby mode.

Consequently, the maximum demand requirement sets the pumping capacity requirement.

CRITICAL PUMPING FACILITIES

Critical pumping facilities are defined as those facilities that provide service to service area(s) without sufficient emergency storage (see emergency storage section) and that meet the following criteria:

- The largest pumping facility that provides water;
- A pumping facility that provides the sole source of water to a single or multiple pressure zone(s); and
- A pumping facility that provides water from a supply turnout.

All critical pumping facilities should be equipped with an on-site, back-up power generator. At less critical facilities, a plug-in adapter will be used to allow interconnection to a portable generator, which will be brought to the site by City staff during a prolonged power outage.

If unavailable by gravity storage, the fire flow should be supplied with a National Fire Protection Association (NFPA) rated fire pump. If an NFPA rated fire pump is not used, then a pump(s) and motor(s) combination with a backup power source of sufficient capacity to meet the required maximum fire flow and minimum residual pressure requirements, as determined by the CFD's Fire Marshal, will be required. The pump stations serving pressure zones without storage shall also be equipped with a hydropneumatic tank to limit pump cycling.

WATER STORAGE CAPACITY

Standards have been developed for determining treated water storage capacity needs within the individual pressure zones of a distribution system to meet diurnal operational peaks and emergency conditions. Storage requirements can generally be categorized into the following four components:

- Operational Storage
- Equalization Storage
- Fire Flow Storage
- Emergency Storage

The following discussion presents design guidelines for each of these four components.

Operational Storage

The operational storage component allows for the continued supply of water to the system from reservoirs during temporary shutdowns of the water treatment plant or booster pump stations. The necessary volume of operational storage is determined based on the anticipated timing and duration of temporary shutdowns during the maximum demand period. Since the necessary operational storage for treatment plant shutdowns is the responsibility of the SFWB, the City's operational storage needs are solely related to the operation of its booster pumping stations. Because the City's booster pumping stations are capable of operating as long as necessary during the maximum demand period, there is not a need for dedicated operational storage within the City's distribution system.

Equalization Storage

Over any 24-hour period, water demand on the distribution system will vary. Typically, water demand will be high in the morning when people are getting ready for the day, then will decline to a nominal baseline level that is dominated by the water use patterns of commercial and industrial areas. Demand will then begin to increase again in late afternoon, reaching a higher level in the early evening as people return home from work. During periods when the rate of demand exceeds the treatment plant's production rate, the excess demand is provided from equalization storage. During periods when the rate of demand is less than the treatment plant's production rate, the equalization storage is recharged. When a typical diurnal demand pattern is compared to the average daily demand, the necessary supply from equalization storage is typically equal to 25 percent of daily demand. Therefore, to ensure the availability of adequate equalization storage during a maximum day demand event, equalization storage requirements should be 25 percent of the maximum day demand.

Fire Storage

The highest fire flow requirement in a given pressure zone determines the necessary fire flow storage that must be provided by the reservoir(s) that serve that pressure zone. Since the lowest pressure zones in Oregon City are served through PRVs from the upper pressure zones, the fire flow reserves for these interconnected pressure zones are shared in common, allowing the pressure zones to be analyzed as a set.

Fire flows will be provided by storage unless a specific exception is approved by the City. Pumped fire flows can be allowed for small areas under the condition that the pump station provides an adequate firm capacity, sufficient pressure, and reliable operation. These areas would be small, isolated zones where construction of a gravity storage facility is not practical.

Emergency Storage

A reserve of treated water is also required to meet demands during emergency outage periods, when normal supply is interrupted. 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. There are three types of emergency events that a water utility typically prepares for:

- Minor emergency. A fairly routine, normal, or localized event that affects few customers, such as a pipeline break, malfunctioning valve, hydrant break, or a brief power loss. Utilities plan for minor emergencies and typically have staff and materials available to correct them.
- Major emergency. A disaster that affects an entire, and/or large, portion of a water system, lowers the quality and quantity of the water, or places the health and safety of a community at risk. Examples include water treatment plant failures, raw water contamination, or major power grid outages. Water utilities infrequently experience major emergencies.
- Natural disaster. A disaster caused by natural forces or events that create water utility emergencies. Examples include earthquakes, forest or brush fires, hurricanes, tornados or high winds, floods, and other severe weather conditions such as freezing or drought.

Since the risk of an emergency situation varies from city to city, the amount of reservoir volume allocated to emergency storage also varies from city to city. The required emergency storage volume is a function of several factors including the diversity of the sources of supply, redundancy and reliability of the production facilities, and the anticipated length of the emergency outage. Review of other water system planning criteria for communities with a surface water supply shows that emergency storage volumes vary from 25 percent of maximum day demand to 150 percent of maximum day demand.

The Clackamas River is the sole source of supply for the City's water system. Although the reliability and quality of the City's water supply has been excellent, it is vulnerable to temporary contamination by chemical spills into the Clackamas River. Consideration of such a scenario is useful for preparing the City to manage emergency storage supplies during an emergency event. The following scenario allows for the determination of a reasonable volume of emergency storage:

- If the Clackamas River became contaminated, it is estimated that it would take up to three days to allow the contamination to pass by the water treatment plant or to modify the process to treat the contaminated water.
- Immediately following the water treatment plant shutdown, the public would be notified and advised to adopt water rationing measures to prolong the availability of emergency storage supplies.
- If the shutdown were to occur during a period of maximum demand, it would take up to 12 hours for water rationing measures to be adopted, after which the demand might drop to one-half the annual average day demand for the remainder of the shutdown period.
- It is important to note that the response to an emergency depends on the ability of the City to reach its citizens with the necessary information. An extensive emergency curtailment plan is essential to effectively reduce water demand during an emergency.

Given this scenario, the required emergency storage would be approximately 100 percent of maximum day demand. Therefore, one maximum day demand is the recommended emergency storage requirement for the City's water system.

Total Water Storage

The minimum treated water storage capacity in the system available to each pressure zone shall equal the sum of the following:

- Equalization. The storage allocated for meeting diurnal demand peaks should be equivalent to 25 percent of the maximum day demand. This storage volume should be located within the pressure zone.
- Fire Flow. The storage allocated to provide fire flows should be equivalent to the maximum fire flow in the pressure zone times the duration the flow rate must be maintained.
- Emergency. The minimum emergency storage volume allocated for providing water during periods when normal supply is interrupted should be equivalent to 100 percent of the City's maximum day demand.

A table comparing the existing storage volume in the system and the recommended storage volume is provided in Chapter 6, "Existing Water Distribution System Evaluation."

Reservoirs

Reservoir facilities shall be sized in accordance with the preceding discussion of system storage requirements. Reservoir inlet and outlet piping shall be designed to facilitate adequate turnover of stored water at the facility and avoid water quality problems. Reservoir management techniques such as lowering reservoir levels during periods of low demand will also ensure the freshness of the water supply and eliminate the need for rechlorination.

To ensure adequate service pressures, new reservoirs shall be placed so that the overflow elevation is 100 feet above the normal upper service elevation of the pressure zone it is serving. This arrangement will allow for fluctuations in reservoir level while maintaining system pressures within the desired range. In addition, it is recommended that the City consider equipping reservoirs with a remote controlled shut-off valve or seismic valve to prevent drainage after a significant earthquake.

WATER TRANSMISSION AND DISTRIBUTION SYSTEM

The following criteria are to be used as guidelines for new transmission and distribution pipeline sizing. However, the City's existing system will be evaluated on a case–by-case basis. For example, if an existing pipeline experiences head loss 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 pressure criterion is satisfied.

Although these criteria and guidelines have been established, and will be used to size new pipelines, the City's existing system will be evaluated using pressure as the primary criterion; and secondary criteria, such as velocity, head loss, age, and material type, will be used as indicators for where water system improvements may be needed.

Pipeline Networks

The pipelines and transmission mains in the City's distribution system will generally be sized based on the criteria described below for average, maximum day and peak hour demand conditions.

<u>Water Transmission System</u>

Transmission pipelines are generally 18 inches in diameter or larger, and should be designed based on the criteria described below for average day, maximum day and peak hour demand scenarios. The criteria reflect industry standards and West Yost's experience working in other Cities and Water Districts.

Average Day Demand

- Pressures should be maintained between a maximum of 100 psi and a minimum of 40 psi.
- Maximum velocity within transmission pipelines should be 3 feet per second (fps).

Maximum Day Demand

- The minimum allowable service pressure should be 40 psi.
- The maximum velocity within the transmission system pipelines should be 5 fps.
- Head losses within the transmission system pipelines should be limited to 3 ft/kft of pipeline.

Peak Hour Demand

- The minimum allowable service pressure should be 40 psi.
- The maximum velocity within the transmission system pipelines should be 5 fps.
- Head losses within the transmission system pipelines should be limited to 3 ft/kft of pipeline.

<u>Water Distribution System</u>

Distribution pipelines are generally less than 18 inches in diameter, and should be sized based on the criteria described below for average day, maximum day plus fire flow, and peak hour demand scenarios. The criteria reflect industry standards and West Yost's experience working in other Cities and Water Districts.

Average Day Demand

- Pressures should be maintained between a maximum of 100 psi and a minimum of 40 psi.
- The maximum velocity within the distribution system pipelines should be 3 to 5 fps.

Maximum Day Demand plus Fire Flow

- The minimum allowable residual pressure should be 20 psi at the flowing fire hydrant.
- The maximum velocity within the distribution system pipelines should be 10 fps.
- Head losses within the distribution system pipelines should be limited to 10 ft/kft of pipeline.

Peak Hour Demand

- The minimum allowable service pressure should be 40 psi.
- The maximum velocity within the distribution system pipelines should be 7 fps.
- Head losses within the distribution system pipelines should be limited to 10 ft/kft of pipeline.

The minimum distribution pipeline inside diameter shall be eight inches. The distribution system shall be looped at all possible locations to maintain adequate circulation and water quality. Long dead end pipelines shall be avoided whenever possible to prevent water quality problems. When unavoidable, a fire hydrant or blow-off hydrant shall be installed at the end of the line to facilitate periodic system flushing. A maximum development size of 25 lots will be allowed on a dead end line.

Valves

Valve location and spacing are important considerations in the design of a water distribution system. Pipelines must include an adequate number of properly located valves to allow for isolation of pipeline sections in the event of maintenance operations or new construction. ISO has developed standards for valve spacing on pipelines according to their function. These standards have been modified by the City as identified in Table 4-3. The supply pipelines that deliver water to the City's system are owned and operated by the SFWB. Transmission pipelines are the high capacity mains that form the framework for moving water around the system. The distribution pipelines provide the network grid from which most customer connections are served. A general guideline for locating valves in the distribution system is that smaller branch mains should be equipped with a valve so that any service problems on the branch pipeline does not require a shut-off of the major transmission line. Within the distribution grid, placement of a valve on all legs of tees and crosses will minimize the extent of a service disruption during system work. For the same reason of localizing service disruptions, system design should avoid direct service taps into transmission pipelines whenever possible.

Table 4-3. Maximum Valve Spacing Standards

Pipeline Function	Maximum Spacing
Supply pipeline	1 mile
Transmission pipeline	2,000 feet (minimum) 1,300 feet (preferred)
Residential distribution pipeline	800 feet
Commercial distribution pipeline	500 feet

Hydrants

Fire hydrants are dispersed throughout the distribution system to provide the emergency flows required for fire protection. The requirements for spacing fire hydrants are defined in the Uniform Fire Code and have been modified by the City's development codes as shown in Table 4-4. In applying the fire code, the CFD shall determine the required fire hydrant distribution based on their judgment. In addition to the maximum spacing requirements, any building must be within 250 feet of a fire hydrant. Distances are measured along the route that the CFD will use to deploy the fire hose.

Table 4-4. Uniform Fire Code Hydrant Distribution Requirements

Land Use Category	Maximum Hydrant Spacing, feet
Residential	500
Commercial, Industrial, and Other High Value Districts	200 – 500

No hydrant shall be installed on a water main with less than an 8 inch inside diameter and the hydrant shall have a minimum 6 inch inside diameter. Hydrants shall be located as close to the distribution main as possible and shall be no more than 40 feet away. To comply with this requirement, hydrants will generally be located on the same side of the street as the distribution main. In areas where required fire flows exceed 1,500 gallons per minute, the water supply must be provided by more than one hydrant.

CHAPTER 5. HYDRAULIC MODEL UPDATE

This chapter presents an overview of the methodology used to refine/update the hydraulic network model of the City's existing potable water distribution system. West Yost developed a hydraulic model of the City's water distribution system for the October 2004 Water Master Plan Update to allow for computer simulations of various existing and future demand conditions using the City's water distribution facilities. To refine and update the City's existing hydraulic network model, West Yost completed the following steps:

- Used the City's existing water distribution system maps (exported from the City's geographical information system (GIS)) to update the current hydraulic model.
- Incorporated new facilities that were constructed and operating as of January 2009.
- Verified that the current hydraulic model system configuration (pipeline sizes, alignments, connections, and other facility sizes and locations) was representative of the City's existing water system.
- Allocated water demands by using the City's meter data and West Linn and CRW's master meter data to properly distribute demands within the hydraulic model.

To accomplish these tasks, West Yost worked closely with City staff to obtain and review information regarding new transmission and distribution mains, reservoirs and other water facilities. The following sections summarize the refinement of the City's existing hydraulic network model.

REFINEMENT OF THE HYDRAULIC MODEL

West Yost updated the existing hydraulic model of the City's water system using a series of steps that included the following:

- Model Update
- Roughness Factors Assigned for New Areas in InfoWater
- Water Demands Allocated in H_2OMAP
- Elevations Allocated for New Areas in H_2OMAP
- Naming Scheme Applied in InfoWater

Each of these steps is discussed in more detail below.

MODEL UPDATE

The City's computerized hydraulic model was originally developed in H_2OMAP. For the October 2004 Water Master Plan Update Project, West Yost updated and calibrated the City's computerized hydraulic model (2004 Model). Since the completion of the 2004 Model, new facilities and service areas have continued to be constructed and developed within the City's service area. With the number of new facilities and significant changes to the service area, an updated model was required.

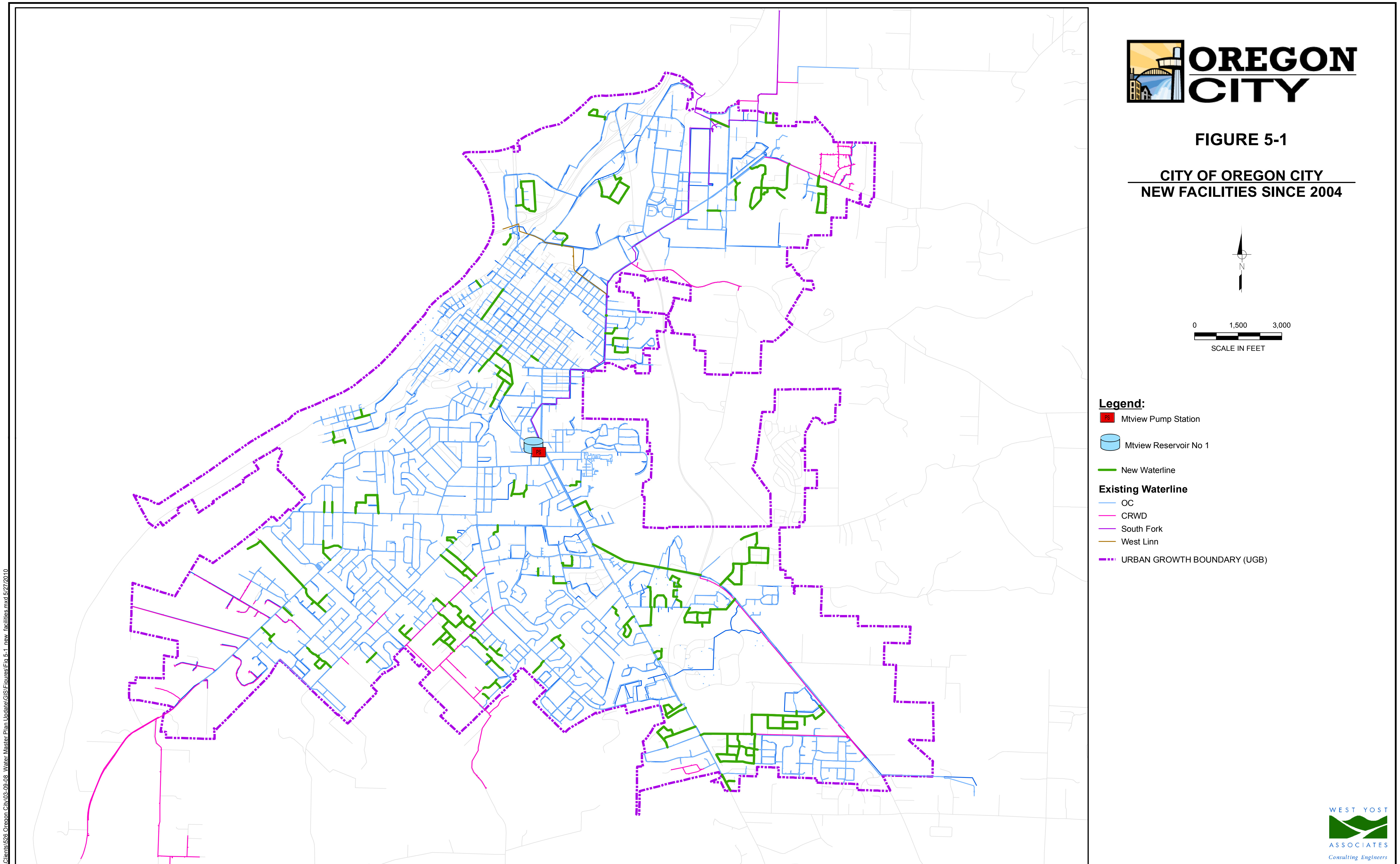
West Yost compared the 2004 Model with the GIS geodatabase file provided by City staff. Figure 5-1 illustrates the new facilities and service areas which were not included in the 2004 Model. These new facilities and service areas were consequently added into the 2004 Model. West Yost also verified and updated some pipeline configurations of the existing 2004 Model to be consistent with the City's GIS geodatabase file.

ROUGHNESS FACTORS ASSIGNED FOR NEW AREAS IN INFOWATER

Pipelines in the City's water system date from the 1920's and range in size from 2 to 30 inches in diameter. Pipeline materials in the City's water system include cast iron, steel, cement lined and coated steel, asbestos cement, and mortar-lined ductile iron. Roughness factors (C-factors) can range from a low of around 40 for old unlined cast iron pipes in poor condition to a high of 140 for newly installed, cement-lined ductile iron pipe. Each newly added pipeline was assigned a C-factor based on pipeline age. Table 5-1 summarizes the C-factors that were used in the model update. These coefficients were assigned to each pipe in the distribution system based on age.

Table 5-1. Pipeline Age-Based C-Factor Summary

Decade of Pipeline Construction	Hazen Williams C-Factor
Pre-1920s	40
1920s	60
1930s	70
1940s	80
1950s	90
1960s	100
1970s	110
1980s	120
1990s	130
2000s	140


OREGON CITY
FIGURE 5-1
CITY OF OREGON CITY
NEW FACILITIES SINCE 2004
N
0
1,500
3,000
SCALE IN FEET
Legend:
Mtview Pump Station
Mtview Reservoir No 1
New Waterline
Existing Waterline
OC
CRWD
South Fork
West Linn
URBAN GROWTH BOUNDARY (UGB)
WEST YOST
ASSOCIATES
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WATER DEMANDS ALLOCATED IN H_2OMAP

The focus of the re-allocation of water demands was to confirm the location and quantity of the existing water demands within the City's water system. Existing water demands were re-allocated in the hydraulic model based on meter location. The methodology for calculating and allocating existing water demands into the hydraulic model is summarized below:

1. Allocate the City's existing water demands using geocoded water meter data provided by City staff.
2. Allocate existing master meter water demands (West Linn and CRW) using 2008 monthly SFWB invoice totals and the known spatial location of master meters.

These steps are discussed in more detail below.

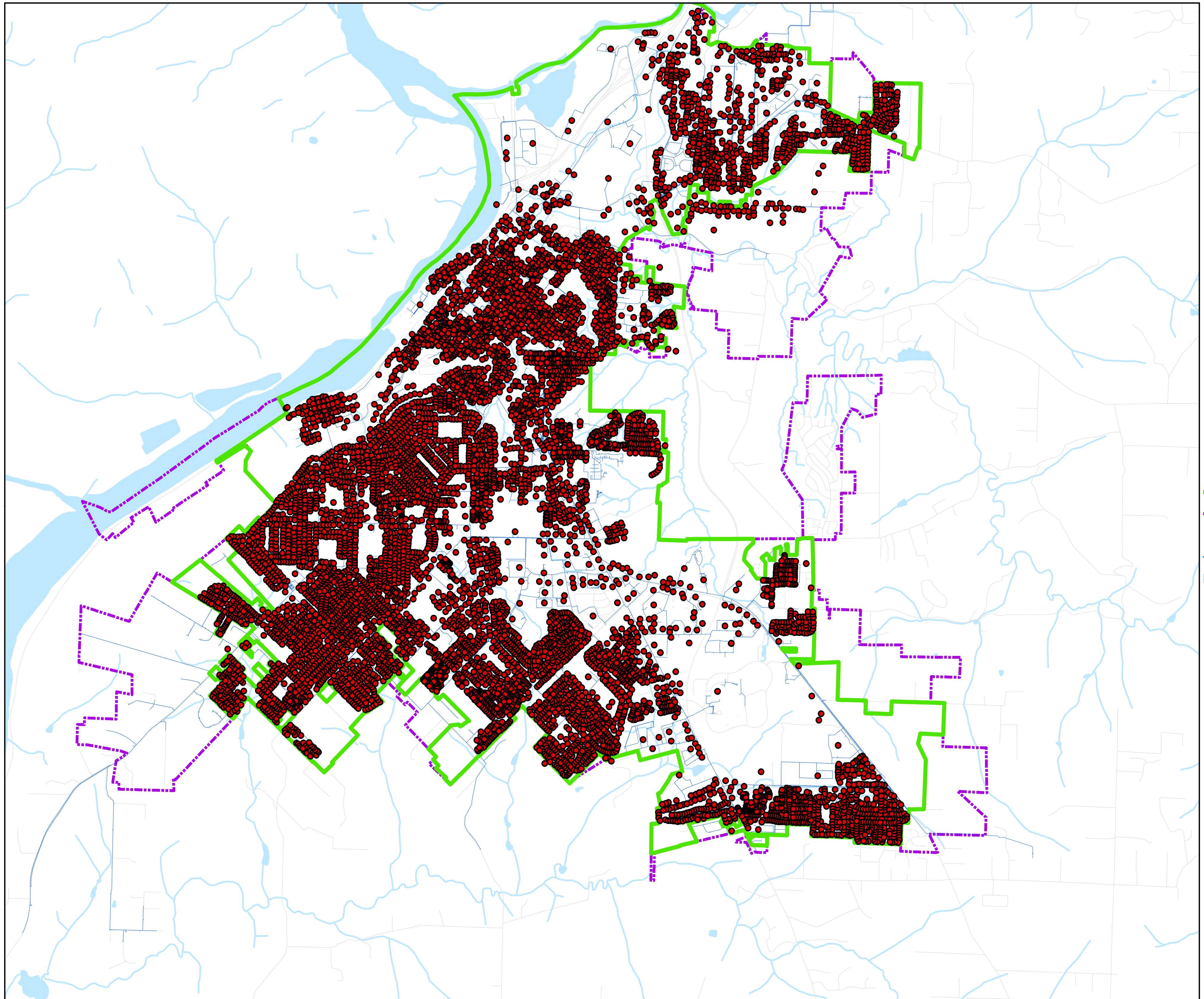
Existing Water Meter Demands (City)

A GIS shapefile (UB Account Locations.shp) containing the City's water meter records from July 2008 was provided to West Yost by City staff in May 2009. The City's total geocoded water meter demand in July 2008 was equal to 5.62 mgd. Figure 5-2 illustrates the locations of the City's geocoded water meters with available records in July 2008.

Consequently, the City's existing water demands were allocated into the hydraulic model using the geocoded meter data discussed above and the Demand Allocation/Pro module of H_2OMAP[1] (Allocation Module). The Allocation Module automatically assigned the geocoded meter to the closest pipeline to its position in the water system. The City's water demands in the existing model were then scaled to represent an average day demand using the City's 2008 production data.

Additionally, West Yost was able to refine the City's future system demand allocations within the hydraulic model with land use designations, providing the City with additional flexibility in the future system model. Table 5-2 below presents the demand column assigned to each land use category within the hydraulic model.

[1] MWH Soft's H_2OMAP program was used to allocate water demands. Consequently, this information was then imported into the City's InfoWater model.



OREGON CITY

FIGURE 5-2

CITY OF OREGON CITY
SPATIALLY LOCATED ACCOUNTS

N

0 1,325 2,650
SCALE IN FEET

LEGEND

- City Limits
- URBAN GROWTH BOUNDARY (UGB)
- UB Account Locations
- Existing Pipeline
- Water Feature

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Table 5-2. Land Use Category Assignment

Land Use Category	Demand Column in Model[a]
Single Family Residential	1
Multi-Family Residential	2
Commercial/Industrial	3
Institutional	4
Master Meters	5
Future Use	6
Future Use	7
Future Use	8
Future Use	9
Future Use	10

[a] Column number corresponds to Demand # Column in the Junction database of the InfoWater model.

Existing Master Meter Demands (West Linn and CRW)

2008 monthly master meter invoice data from SFWB was provided to West Yost by City staff in April 2009. The 2008 average day demands from West Linn and CRW master meters were calculated based on these monthly SFWB invoices and then allocated manually into the hydraulic model using the master meter locations shown previously on Figure 2-5.

The combination of meter data from the City's water meters and the West Linn and CRW's master meters (now allocated in the hydraulic model) provides a realistic representation of actual water demands in the existing water system. In addition, this demand allocation methodology captures water demands from large users as they are already present in the City's geocoded water meter data.

ELEVATIONS ALLOCATED IN H_2OMAP

Digital topology information for the City was extracted as a GIS shapefile using the software program TopoDepot®. TopoDepot® provides elevation contours generated from the USGS National Elevation Database Digital Elevation Model (NED DEM). NED DEM consists of a grid of elevation values posted approximately every 30 meters. TopoDepot® runs this grid of elevations through a Surface Contouring Program to generate elevation contours; the resulting shapefile was imported into the hydraulic model and service elevations assigned to new nodes, within new service areas, in the updated model using H_2OMAP's[2] Elevation Interpolation feature.

[2] MWH Soft's H_2OMAP program was used to allocate elevations. Consequently, this information was then imported into the City's InfoWater model.

NAMING SCHEME APPLIED IN INFOWATER

After the major facilities were updated in the model, a naming scheme was applied to each model element added. The naming scheme helps identify the element's location and allows the modeler to easily locate specific elements or more readily identify potential problems during the calibration and verification process.

Consequently, each node and pipeline link in the system has a unique identification number. The identification number series corresponds to the Pressure Zone in which the node or pipe is located. For example, all identification numbers in the 1000 series are located in the Lower Pressure Zone, all identification numbers in the 2000 series are located in the Intermediate Pressure Zone, etc. Table 5-3 provides the index between pressure zones and identification number series.

Table 5-3. Model Element Naming Scheme

Pressure Zone	Identification Number Series
Lower Zone	1000
Intermediate Zone	2000
Upper Zone	3000
Lower Park Place Zone	4000
Intermediate Park Place Zone	5000
Upper Park Place Zone	6000
Canemah Zone	7000
Fairway Downs Zone	8000
View Manor Zone	9000
Swan Zone	10000
Livesay Road Zone	11000
Paper Mill Zone	12000
SFWB Transmission System	13000
CRW System	20000

MODEL VALIDATION

The City's model went through a full calibration effort in the development of the 2004 Model. However, for this update, the City was interested in developing an extended period simulation model, which would require the development of a diurnal curve and additional validation to evaluate how the City's facilities (i.e. pump stations and tanks) were trending over time. Overall, the results from the diurnal curve development task were inconclusive due to lack of sufficient hourly data to produce accurate demands in the system and chart the flow of water (see Appendix A). Due to the quantity of assumptions that were required to generate an hourly diurnal curve and the resulting inconsistencies with the hydraulic model, an extended period validation of the model was not undertaken at this time.

CONCLUSION

With the updates described in the preceding sections, the City’s hydraulic model is representative of the City’s January 2009 system configuration and 2008 average day demand condition. It is West Yost’s opinion that the City’s updated 2009 Model is ready for use in simulating existing and buildout hydraulic system conditions. However, West Yost does recommend that the City budget for additional calibration of the hydraulic model within the next two years. This would include continuing to update/verify pipeline system configurations in the model as new facilities are constructed and to collect additional data to support a more accurate approach to developing an hourly diurnal curve.

CHAPTER 6. EXISTING WATER DISTRIBUTION SYSTEM EVALUATION

This chapter presents an overview evaluation of the City's existing water distribution system (see Figure 6-1) and its ability to meet the recommended performance and planning criteria under existing demand conditions. Performance standards used to evaluate the water system are defined in Chapter 4.

The existing water system evaluation includes an analysis of water storage capacity, pumping capacity, and the existing distribution system's ability to meet recommended operational and design criteria under maximum day demand plus fire flow and peak hour demand conditions. The existing system evaluation is based on current water production data presented in Chapter 3 and the results of hydraulic analyses conducted using the updated hydraulic model.

Evaluations, findings, and recommendations to address the identified deficiencies in the existing water distribution system are included and summarized at the end of this chapter. The identified recommendations and estimated timings were then used to develop a CIP, including an estimate of probable construction costs. The recommended CIP is described further in Chapter 8.

EXISTING WATER DEMANDS

The existing water demands for the City's water system were spatially located using meter data provided by City staff for the month of July 2008. These existing water demands were then scaled using 2008 production data to represent an average day demand, maximum day demand, and peak hour demand. Additional discussion regarding meter data and its allocation into the hydraulic model is provided in Chapter 5. Table 6-1 summarizes the existing water demands for the City by pressure zone. Water demands from master meters serving CRW and West Linn have also been allocated in the City's hydraulic model and are included in Table 6-1.

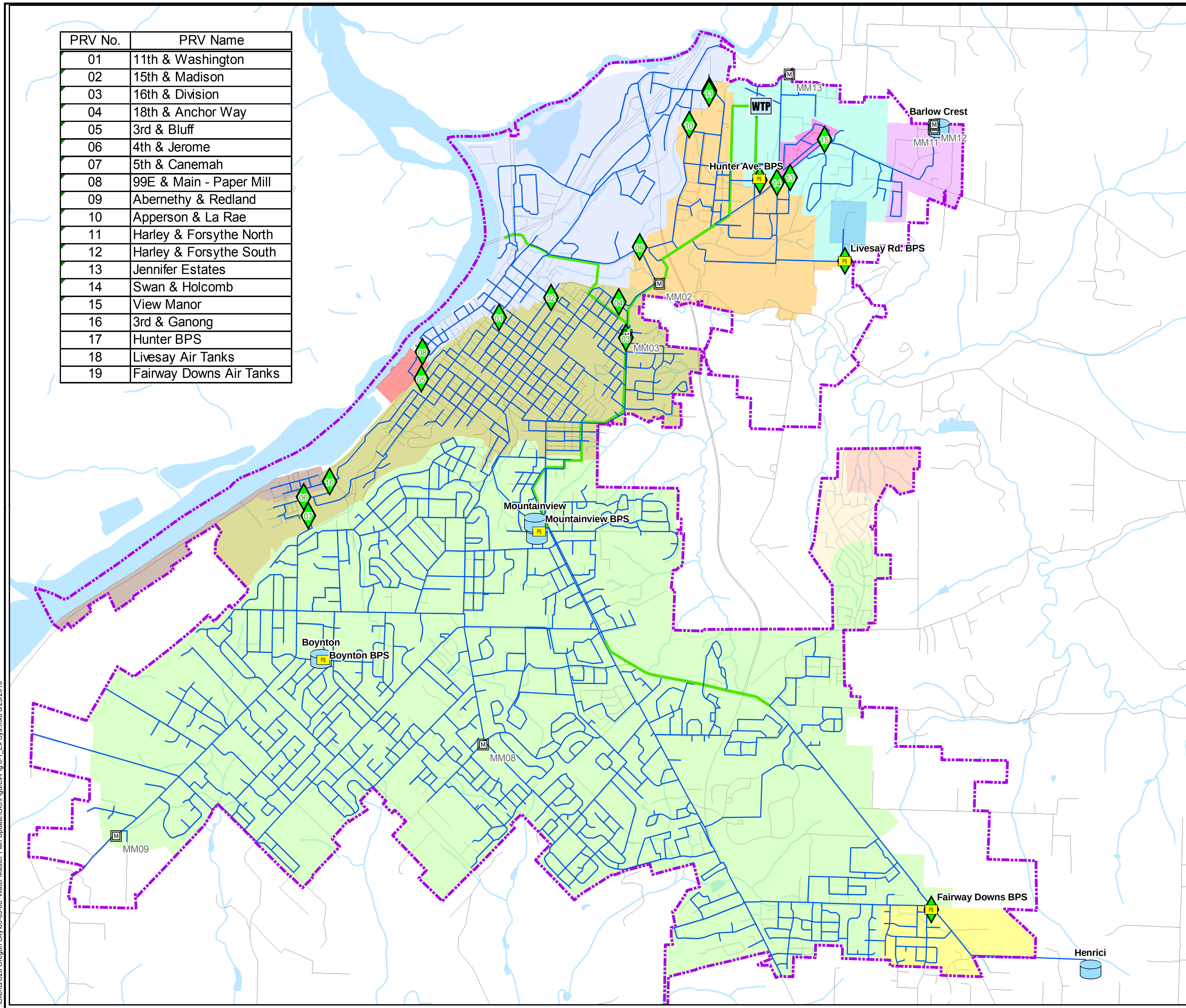
EXISTING WATER SYSTEM FACILITY EVALUATION

To evaluate the existing water system, the following system facilities analyses were conducted:

- Water Storage Capacity,
- Pumping Capacity, and
- Critical Supply Facilities.

The results of the existing water system facility analyses are discussed below.

PRV No.	PRV Name
01	11th & Washington
02	15th & Madison
03	16th & Division
04	18th & Anchor Way
05	3rd & Bluff
06	4th & Jerome
07	5th & Canemah
08	99E & Main - Paper Mill
09	Abernethy & Redland
10	Apperson & La Rae
11	Harley & Forsythe North
12	Harley & Forsythe South
13	Jennifer Estates
14	Swan & Holcomb
15	View Manor
16	3rd & Ganong
17	Hunter BPS
18	Livesay Air Tanks
19	Fairway Downs Air Tanks



OREGON CITY

FIGURE 6-1

CITY OF OREGON CITY EXISTING WATER SYSTEM

N

0 1,325 2,650
SCALE IN FEET

LEGEND

- SFWB WTP
- Existing Storage Reservoir
- Existing Booster Pump Station
- Existing PRV Station
- Master Meter (flows out of SFWB or Oregon City)
- Existing Pipeline Diameter < 18-inches
- Existing Pipeline Diameter ≥ 18-inches
- URBAN GROWTH BOUNDARY (UGB)
- Lower Zone
- Intermediate Zone
- Upper Zone
- Lower Park Place Zone
- Intermediate Park Place Zone
- Upper Park Place Zone (CRW)
- Canemah District Zone
- Fairway Downs Zone
- View Manor - Park Place Zone
- Livesay Road - Park Place Zone
- Paper Mill Zone
- Canyon (CRW)
- Country Village (CRW)
- Street
- Water Feature

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Table 6-1. Water Demands for the Existing Water System

Pressure Zone	Average Day Demand[a]		Maximum Day Demand[b]		Peak Hour Demand[c]	
	gpm	mgd	gpm	mgd	gpm	mgd
Lower	200.7	0.29	461.7	0.67	903.3	1.30
Intermediate	295.7	0.43	679.9	0.98	1,330.1	1.91
Upper	1,858.5	2.68	4,274.2	6.15	8,362.5	12.04
Lower Park Place	91.5	0.13	210.4	0.30	411.7	0.59
Intermediate Park Place	71.4	0.10	164.4	0.24	321.5	0.46
Canemah	8.8	0.01	20.3	0.03	39.6	0.06
Fairway Downs	47.8	0.07	110.1	0.16	215.4	0.31
View Manor	14.8	0.02	34.0	0.05	66.6	0.10
Livesay Road	0.8	0.001	1.8	0.003	3.5	0.005
Paper Mill	0.4	0.001	0.8	0.001	1.7	0.002
City of Oregon City's Subtotal	*2,590.4*	*3.73*	*5,957.6*	*8.58*	*11,655.9*	*16.78*
Master Meter No. 2[d]	641.3	0.92	1,923.9	2.77	1,923.9	2.77
Master Meter No. 3[d]	2,064.7	2.97	6,194.1	8.92	6,194.1	8.92
Master Meter No. 8[e]	45.8	0.07	137.5	0.20	137.5	0.20
Master Meter No. 9[e]	23.4	0.04	70.3	0.10	70.3	0.10
Master Meter No. 11[e]	168.2	0.24	504.5	0.73	504.5	0.73
Master Meter No. 12[e]	5.1	0.01	15.2	0.02	15.2	0.02
Master Meter No. 13[e]	8.3	0.01	25.0	0.03	25.0	0.03
Master Meters Subtotal	*2,956.8*	*4.26*	*8,870.5*	*12.77*	*8,870.5*	*12.77*
Water System Total	**5,547.2**	**7.99**	**14,828.1**	**21.35**	**20,526.4**	**29.55**

(a) The City's average day demands are based on 2008 production data. Average day demand for master meters is based on data from 2008 monthly SFWB invoices.
(b) The City's maximum day demand is 2.3 times the average day demand. Maximum day demand for master meters is based on 3.0 times the average day master meter demand.
(c) The City's peak hour demand is 4.5 times the average day demand. Peak hour demand for master meters is based on 3.0 times the average day master meter demand.
(d) Master meter is served directly from the SFWB transmission main.
(e) Master meter is served by the City's water system.

Water Storage Capacity

The principal advantages that storage provides for the water system are the ability to equalize demands on supply sources, production facilities, and transmission mains; to provide emergency storage in case of supply failure; and to provide water to fight fires. The City's existing water system includes five water storage facilities serving ten pressure zones.

Together, these water storage facilities must be sufficient to meet the City's storage criteria for the existing water system. The volume required for each storage component is detailed below:

- Equalization Storage: 25 percent of maximum day demand,
- Emergency Storage: 100 percent of maximum day demand, and
- Fire Flow Storage: Determined using the largest fire flow requirement times the fire flow duration period as required by the Clackamas Fire District #1.

Typically the required storage volume for these three system storage components is determined individually within each pressure zone and then combined to identify the total amount of storage volume required for the overall system. However, since the lower pressure zones in the City are served through PRVs from the upper pressure zones, the fire flow storage for these interconnected pressure zones are shared in common, allowing the pressure zones to be analyzed as a set for fire flow storage. Consequently, the required fire flow storage for the existing water system will be based on the following maximum fire flow demands in the pressure zones served by each reservoir or group of reservoirs:

- A 3,000 gpm fire flow for the duration of 4 hours for the pressure zones served by Boynton, Henrici, and Mountainview No. 2 Reservoirs.
- A 5,000 gpm fire flow for the duration of 4 hours for the pressure zones served by Mountainview No. 1 Reservoir.
- A 3,000 gpm fire flow for the duration of 4 hours for the pressure zones served by Barlow Crest Reservoir.

The existing storage facilities were evaluated to determine whether the City's existing water system has sufficient capacity to provide the required system storage. Table 6-2 summarizes the evaluation of water storage capacity in the existing water system. The existing system contains an overall water storage capacity of 18.25 MG, which is sufficient to meet the current storage requirements. The City's existing water storage is primarily located in Mountainview Reservoir No. 2, which accounts for approximately 58 percent of the total available storage capacity. The other reservoirs have sufficient storage to meet the equalization and fire flow storage requirements for their pressures zones, but must rely on Mountainview Reservoir No. 2 for much of their emergency storage.

Seismic Vulnerability of Reservoirs

During the 2004 Master Plan a study was conducted to evaluate the City's storage reservoirs for seismic vulnerability (see full report in Appendix B). The seismic vulnerability assessment recommended the following improvements at the City's reservoirs:

- Dismantle the elevated tank at Mountainview Street (completed since 2004)
- Provide seismic reinforcement of the perimeter walls at Mountainview Reservoir No. 2 (completed since 2004)
- Provide seismic anchorage improvements at Boynton Reservoir.

Table 6-2. Summary of Existing Water Storage Evaluation

Reservoir Set (Volume)	Pressure Zones Served	[A] Total Available Storage, MG	[B] Required Storage Capacity, MG: Equalization [a]	[C] Required Storage Capacity, MG: Emergency [b]	[D] Required Storage Capacity, MG: Fire Flow [c]	[E] = [B]+[C]+[D] Total Required Storage, MG	[F] = [A]-[E] Storage Surplus (Deficit), MG
Boynton (2.0 MG) Henrici (2.0 MG) Mountainview No.2 (10.5 MG)	Upper	14.50	1.54	6.15	0.72	8.61	5.89
	Fairway Downs		0.04	0.16			
Mountainview No.1 (2.0 MG)	Intermediate	2.00	0.24	0.98	1.10	2.97	(0.97)
	Lower [d]		0.08	0.33			
	Lower Park Place [d]		0.04	0.15			
	Canemah		0.01	0.03			
	Paper Mill		0.00	0.00			
	Livesay Road [d]		0.00	0.00			
Barlow Crest (1.75 MG)	Intermediate Park Place	1.75	0.06	0.24	0.72	1.68	0.07
	Lower [d]		0.08	0.33			
	Lower Park Place [d]		0.04	0.15			
	View Manor		0.01	0.05			
	Livesay Road [d]		0.00	0.00			
Total		**18.25**	**2.14**	**8.58**	**2.54**	**13.26**	**4.99**

[a] Based on 25 percent of a maximum day demand (see Table 6-1).

[b] Based on a maximum day demand (see Table 6-1).

[c] Fire flow storage for Boynton, Henrici, and Mountainview No. 2 reservoir set based on a 3,000 gpm fire flow for the duration of 4 hours. Fire flow storage for Mountainview No. 1 reservoir based on a 5,000 gpm fire flow for the duration of 4 hours; however, the required storage was reduced by 0.10 MG to account for the fire storage tank at the Paper Mill. Fire flow storage for Barlow Crest reservoir based on a 3,000 gpm fire flow for the duration of 4 hours.

[d] Required storage capacity for this zone was split between Mountainview No.1 and Barlow Crest reservoirs.

Boynton Reservoir Circulation

Boynton Reservoir is fed by a single pipe that terminates at the bottom of the reservoir and serves as both the reservoir's inlet and outlet. This arrangement does not ensure that there is good circulation of water in this standpipe style reservoir. Although the City's regular water quality monitoring has not indicted problems during regular reservoir operation, it is possible that old water in the upper portions of the reservoir could be pumped into the system in the event of an emergency requiring operation of the Boynton Pump Station. Due to this situation, it is recommended that the City plan to make piping improvements at the reservoir that will enhance regular turnover of the reservoir. These improvements would involve dedicating the existing feed pipe to serve as the outlet only by adding a check valve and adding a new dedicated inlet pipe (with check valve) that extends into the upper portion of the reservoir. With water entering at the top of the reservoir and exiting from the bottom, the water in the reservoir will regularly turn over.

Pumping Capacity

The pumping capacity within the City's existing water system was evaluated to assess its ability to deliver a reliable firm capacity to the existing service area. Firm capacity assumes a reduction in total pumping capacity to account for pumps that are out of service at any given time due to mechanical breakdowns, maintenance, water quality, or other operational issues. For each booster pump station, the firm pumping capacity was defined as the total pump station capacity with the largest pump out of service.

There are five booster pump stations in the City's water distribution system. The Boynton pump station provides local emergency and fire flow service and is adequately sized to serve this function. The other four pump stations perform transfer pumping service, moving water from one pressure zone to another. The performance criteria for a transfer booster pumping facility serving a pressure zone(s) with storage requires that the pump station have adequate firm capacity to supply the maximum day demand within all dependent pressure zone(s) over a 24-hour period. For pressure zone(s) without storage, the planning criteria requires that the pump station have adequate firm capacity to supply peak hour demand plus fire flow requirements within the pressure zone(s).

Table 6-3 summarizes the evaluation of the pumping capacity in the existing water system. The pumping capacity analysis indicates that the existing capacity of the Hunter Avenue pump station, which serves pressure zones with storage, is adequate for meeting maximum day demand. The Mountainview pump station has surplus pumping and is therefore also adequate for meeting maximum day demand.

Both of the pump stations serving pressure zones without storage have capacity issues. The Fairway Downs pump station does not have adequate capacity for serving the required 1,500 gpm fire flow demand, and the normal service pump's capacity of 50 gpm appears to be low relative to an estimated peak hour demand of more than 200 gpm. However, the Fairway Downs pressure zone is also served by the Upper pressure zone through a few check valves, which may be able to eliminate the peak hour pumping capacity deficit within this pressure zone, but are not likely adequate to overcome the fire flow deficit for the long term. This pump station will be addressed further in the future system analysis as presented in Chapter 7. With respect to the

Table 6-3. Summary of Existing Pumping Capacity Evaluation

Pump Station	Pressure Zone/Master Meter Served	Pump 1, gpm	Pump 2, gpm	Pump 3, gpm	Pump 4, gpm	Total Capacity, gpm	Firm Capacity [a], gpm	Existing Maximum Day Demand, gpm	Existing Peak Hour plus Fire Flow Demand [b], gpm	Pumping Capacity Surplus (Deficit), gpm
Mountainview	Upper									
	Fairway Downs									
	CRW Master Meter No. 8									
	CRW Master Meter No. 9	4,000	4,000	4,000	--	12,000	8,000	4,592	--	3,408
Hunter Avenue	Intermediate Park Place									
	View Manor									
	Livesay Road									
	CRW Master Meter No. 11									
	CRW Master Meter No. 12									
	CRW Master Meter No. 13	900	900	900	--	2,700	1,800	745	--	1,055
Fairway Downs	Fairway Downs	50	500	500	500	1,550	1,050	--	1,715	(665)
Livesay Road	Livesay Road	30	--	--	--	30	0	--	1,504	(1,504)

[a] Firm capacity is defined as the total booster pumping capacity with the largest pump out of service.

[b] Fire flow demand is defined as 1,500 gpm (residential land use).

Livesay Road pump station, it is adequately sized for serving normal peak hour demands, but lacks fire flow pumping capability. Since the Livesay Road pressure zone can be incorporated into the Intermediate Park Place pressure zone through a future system extension, it is recommended that the City plan to retire the Livesay Road pump station rather than upgrading the pump station to provide fire flow capacity.

Critical Supply Facilities

All critical supply facilities should be equipped with an on-site, backup power generator to provide pumping capacity during a power outage. Critical pumping facilities are defined as those facilities that provide service to pressure zone(s) without sufficient emergency storage and that meet the following criteria:

- The largest facility that provides water to a particular pressure zone(s);
- A facility that provides the sole source of water to a single or multiple pressure zones.

The following list summarizes the current available backup power facilities at each pump station.

- The Boynton pump station does not have backup power. As a result, this pump station cannot provide service during emergencies that involve a power outage.
- The Mountainview pump station has a diesel engine generator capable of operating the pump station at firm capacity.
- The Hunter Avenue pump station has a diesel engine generator capable of operating the pump station at firm capacity.
- The Fairway Downs pump station has a natural gas engine generator capable of operating the pump station at firm capacity.
- The Livesay Road pump station has no backup power source, but improvements are not necessary since this pump station will ultimately be decommissioned.

Based on the critical pumping facilities criteria and the available backup power facilities, the City's water system should be able to provide a reliable source of supply to the existing water system during a power outage.

WATER SYSTEM PERFORMANCE EVALUATION

This section discusses the performance criteria for, and results of, the existing water distribution system evaluation.

Existing Water System Performance Criteria

Steady state hydraulic analyses using the updated hydraulic model were conducted to identify areas of the existing water system that do not meet the recommended system performance criteria as presented previously in Chapter 4. The results of the evaluation of the existing water system are presented below for the following demand scenarios:

- Peak Hour Demand—A peak hour flow condition was simulated for the existing distribution facilities to evaluate their capability to meet a peak hour demand scenario. Peak hour demands are met by the combined flows from SFWB and storage reservoirs.
- Maximum Day Demand plus Fire Flow—To evaluate the existing water system under a maximum day demand plus fire flow scenario, InfoWater's "*Available Fire Flow Analysis*" tool was used to determine the available fire flow while meeting the maximum day demand plus fire flow performance criteria within the existing water system. Maximum day plus fire flow demands are met by the combined flows from SFWB and storage reservoirs.

These demand scenarios were selected to simulate critical conditions that are the most demanding of pipeline network performance capabilities.

Peak Hour Demand Scenario

As shown in Table 6-1, the peak hour demand for the City's existing water system was calculated to be 11,656 gpm (16.8 mgd). This peak hour demand represents a peaking factor of 4.5 times the average day demand. In addition, approximately 8,870 gpm (12.8 mgd) is delivered to CRW and West Linn through the master meter connections for a total peak hour system demand of 20,526 gpm (29.6 mgd).

During a peak hour demand scenario, a minimum pressure of 40 psi must be maintained throughout the water system. In addition, maximum head loss per thousand feet of distribution main should not exceed 10 ft/kft and maximum velocities should not exceed 7 fps. Details of the system pressures as simulated in the model under the peak hour demand scenario are discussed below.

Maximum Day Demand plus Fire Flow Scenario

As shown in Table 6-1, the maximum day demand for the City's existing water system was calculated to be 5,958 gpm (8.6 mgd). This maximum day demand represents a peaking factor of 2.3 times the average day demand. In addition, approximately 8,870 gpm (12.8 mgd) is delivered to CRW and West Linn through the master meter connections for a total maximum day system demand of 14,828 gpm (21.4 mgd).

This scenario was simulated in the hydraulic model to verify the availability of minimum fire flows for residential land use areas (1,500 gpm), as well as commercial, multi-family, and public facility land uses. InfoWater's "*Available Fire Flow Analysis*" tool was used to determine the available fire flow in the existing water system while meeting the minimum residual pressure criterion of 20 psi. The results from this evaluation will help City staff identify areas within the existing system where they may want to improve fire flow as future pipeline replacement projects are developed.

Recommended Improvements Criteria

The existing water system is expected to deliver peak hour flows and maximum day demand plus fire flow within the acceptable pressure, velocity and head loss ranges as identified in the performance criteria presented in Chapter 4. However, the system was evaluated using pressure as the primary criterion. Recommended improvements needed to comply with the performance criteria will be added to the existing water system to fix any deficiencies found and will also be described below.

Existing Water System Evaluation Results

This section addresses the results of the peak hour demand and maximum day demand plus fire flow analyses.

Peak Hour Demand Scenario

During a peak hour demand scenario, results indicate that the existing water system could not adequately deliver peak hour demands to meet the City's minimum pressure criterion of 40 psi as illustrated on Figure 6-2. Under this scenario, system pressures ranged from 35 to 164 psi.

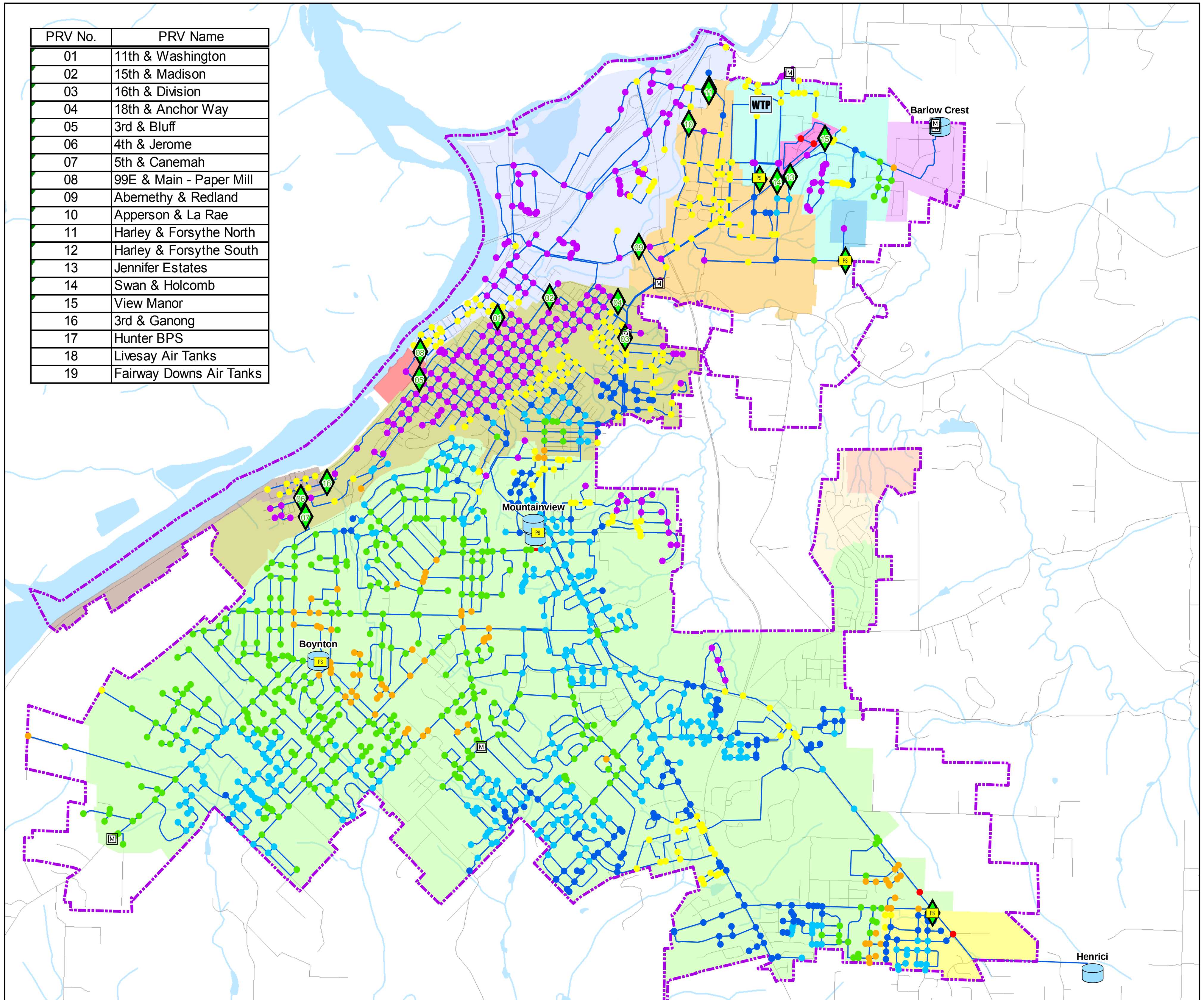
As shown on Figure 6-2, a small area of low pressures (35-37 psi) was simulated in the Upper pressure zone downstream of Henrici Reservoir. Based on the location of this area of low pressures, it appears that the low pressures are caused by higher elevations. This result is comparable to the established pressure range for the Upper pressure zone, which is between 34-141 psi. Based on this information, no mitigation is recommended at this time.

As shown on Figure 6-2, a few junctions in the View Manor pressure zone also had simulated pressures slightly below 40 psi. This result is also comparable to the established pressure range for the View Manor pressure zone, which is between 35-36 psi. Currently, the View Manor PRV station has a control setting of 40 psi which City staff set to prevent pipe bursting. There have been numerous pipe breaks with the old cast iron pipe in the View Manor pressure zone.

As noted in Chapter 2, there are areas in the City's water system where high pressures are inherent to the existing pressure zone system. In particular, the Intermediate and Intermediate Park Place pressure zones span such a great range of elevations that pressures at the bottom of the pressure zone significantly exceed 100 psi in order to keep pressures at the top of the pressure zone above 40 psi. Figure 6-2 shows the location of the high pressure nodes in the City's water system. High pressure areas in the older parts of the water system would be prime targets for leak detection activities.

In general, the recommended corrective action for existing high pressure areas is the installation of individual pressure reducing valves on service connections. If leakage problems in the very high pressure areas (upwards of 120 psi) prove to be extensive, this situation may warrant the consideration of reconfiguring pressure zone boundaries. Reconfigured pressure zone boundaries would be achieved through modifications in pipeline configuration and the addition of new PRV stations. These reconfigurations would be harder in some areas of the system than others. For example, in the Intermediate pressure zone, modifying pressure zone boundaries would be a challenge since it is a heavily interconnected pipeline network.

PRV No.	PRV Name
01	11th & Washington
02	15th & Madison
03	16th & Division
04	18th & Anchor Way
05	3rd & Bluff
06	4th & Jerome
07	5th & Canemah
08	99E & Main - Paper Mill
09	Abernethy & Redland
10	Apperson & La Rae
11	Harley & Forsythe North
12	Harley & Forsythe South
13	Jennifer Estates
14	Swan & Holcomb
15	View Manor
16	3rd & Ganong
17	Hunter BPS
18	Livesay Air Tanks
19	Fairway Downs Air Tanks



OREGON CITY

FIGURE 6-2

CITY OF OREGON CITY
EXISTING SYSTEM PEAK HOUR DEMAND ANALYSIS

N

0 1,325 2,650
SCALE IN FEET

LEGEND
- Pressure < 40 psi
- 40 psi ≤ Pressure ≤ 50 psi
- 50 psi < Pressure ≤ 60 psi
- 60 psi < Pressure ≤ 70 psi
- 70 psi < Pressure ≤ 80 psi
- 80 psi < Pressure ≤ 100 psi
- Pressure > 100 psi
- Pipeline Velocity ≤ 7 fps
- Pipeline Velocity > 7 fps
- SFWB WTP
- Existing Storage Reservoir
- Existing Booster Pump Station
- Existing PRV Station
- Master Meter (flows out of SFWB or Oregon City)
- URBAN GROWTH BOUNDARY (UGB)
- Lower Zone
- Intermediate Zone
- Upper Zone
- Lower Park Place Zone
- Intermediate Park Place Zone
- Upper Park Place Zone (CRW)
- Canemah District Zone
- Fairway Downs Zone
- View Manor - Park Place Zone
- Livesay Road - Park Place Zone
- Paper Mill Zone
- Canyon (CRW)
- Country Village (CRW)
- Street
- Water Feature

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As illustrated on Figure 6-2, most of the pipelines in the existing water system meet the maximum velocity criterion during a peak hour demand scenario. Almost all of the pipelines exceeding the maximum pipeline velocity requirement of 7 fps are downstream of either a pump station or PRV station, which typically experience high velocities due to the large volumes of water being conveyed. It should also be noted that some of the 30-inch diameter transmission mains from the SFWB have velocities in the range of 5.8-7.6 fps, which exceeds the recommended transmission pipeline velocity of 5 fps. City staff may want to consider adding additional transmission pipeline capacity to the City's water system as water demands increase to reduce transmission pipeline velocities and to prevent excessive pressure loss.

However, since pipeline velocity is a secondary criterion, no improvements for pipelines that exceed the velocity criterion in the existing water system are recommended unless the primary criterion (pressure) is not met. Based on results of the peak hour simulation, none of the above pipelines are in the vicinity of the low pressure areas. Therefore, no mitigation is recommended at this time.

Maximum Day Demand plus Fire Flow Scenario

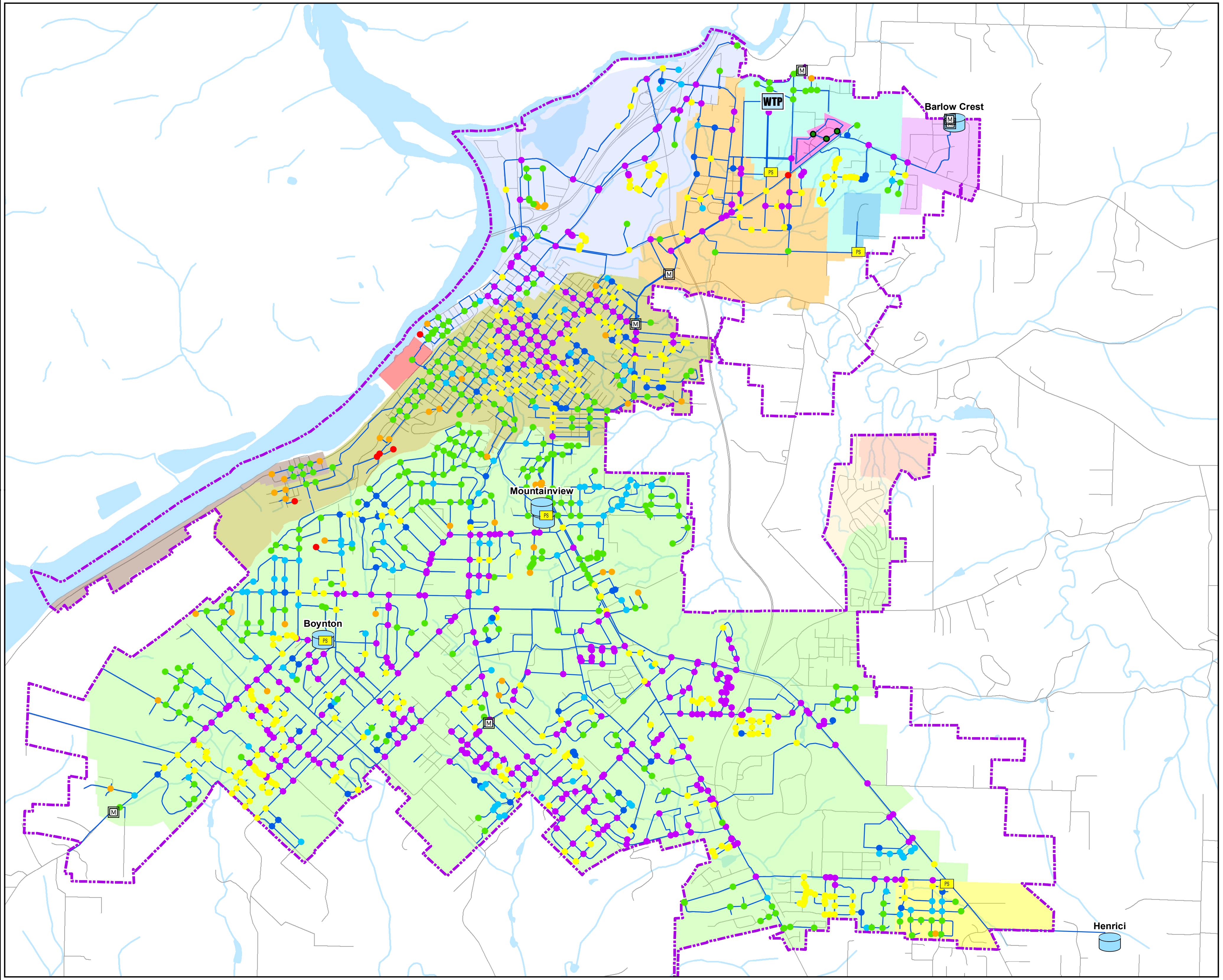
InfoWater's "*Available Fire Flow Analysis*" tool was used to determine the available fire flow at each junction within the existing water system under a maximum day demand scenario. Figure 6-3 illustrates the available fire flow at a residual pressure of 20 psi for each junction within the existing water system. In general, fire flow availability is very good in the City's existing system, but a review of Figure 6-3 indicates that there are a few areas in the system with extensive lengths of 6-inch or smaller diameter pipelines where the model simulated clusters of junctions that do not meet minimum fire flow requirements. However, most of these junctions have been identified previously for fire flow deficiencies as discussed below.

As an update to the 2004 WMP, West Yost reviewed the fire flow deficiencies identified previously to provide a current status on the City's previously identified fire flow deficiencies. Table 6-4 identifies the fire flow location, updated available fire flow estimate, required fire flow demand, and updated recommended corrective action for each of the previously deficient areas. The updated recommended corrective actions identified in Table 6-4 provide the basis for the development of the recommended CIP for fire flow deficiencies in the existing water system.

It is important to note that much of the existing CRW network within the City's UGB, such as those service areas along South End Road, are small diameter systems with inadequate fire flow availability. These pipelines will require upsizing when annexed into the City's water system in the future.

Table 6-4. Review of Maximum Day Demand plus Fire Flow Deficiencies Identified in 2004 WMP

Location and Model Junction ID	Pressure Zone	Updated Available Fire Flow, gpm	Required Fire Flow, gpm	Previously Recommended Corrective Action	Updated Recommended Corrective Action
Residential Land Use Areas					
Highway 99 1025	Lower	2000	1,500	Upsize 4-inch pipeline serving hydrant.	**Previously recommended corrective action has been completed.**
Blanchard-Canemah 2069, 2071	Intermediate	920	1,500	Cluster: Upsize 4-inch pipeline serving hydrants.	Same as 2004 WMP.
Center St. and Sunset 2283, 2471, 2127, 2281	Intermediate	600	1,500	Cluster: Upsize local 6-inch pipelines or add PRV feed from Upper Zone at Telford.	Add PRV feed from Upper pressure zone at Telford.
Third and East 2259, 2263	Intermediate	1400	1,500	Cluster: Upsize local 6-inch pipelines.	**Previously recommended corrective action has been completed.**
Caufield 3712	Upper	1,900	1,500	Upsize and loop 4-inch pipeline serving hydrant.	**Previously recommended corrective action has been completed.**
Woodfield 3300	Upper	1000	1,500	Close to required flow. No piping modification necessary if Boynton pump station on.	Same as 2004 WMP.
Forest Ridge Ln, Beutel Rd, CRW pipelines	Upper	180-750	1,500	CRW pipelines off South End Road require upsizing if annexed.	Same as 2004 WMP.
Livesay Road 4115, 4119	Lower Park Place	690	1,500	Upsize 6-inch pipeline and add feed through PRV station from Intermediate Park Place Zone.	Same as 2004 WMP.
Commercial and Multi-Family Land Use Areas					
7th and Polk 2433	Intermediate	5,200	4,500	Low priority. Upsize local 6-inch pipelines as opportunity arises.	**Previously recommended corrective action has been completed.**
Industrial, Institutions, and Public Land Use Areas					
5th and Main – Mill 12101	Paper Mill	2,450	5,000	Supplementary fire protection systems available. **No action recommended.**	Same as 2004 WMP.
Abernethy Road - County Shops, 1095	Lower	5,200	3,000	Low priority. Upsize 6-inch pipeline as opportunity arises.	**Previously recommended corrective action has been completed.**
King Street – School 3870	Upper	5,500	5,000	Upsize 8-inch pipeline.	**Previously recommended corrective action has been completed.**



OREGON CITY

FIGURE 6-3

CITY OF OREGON CITY
EXISTING SYSTEM AVAILABLE
FIRE FLOW (Residual Pressure ≥ 20psi)

N

0 1,325 2,650
SCALE IN FEET

LEGEND

- Available Fire Flow < 1,000 gpm for 4 hour duration
- 1,000 gpm ≤ Available Fire Flow ≤ 1,500 gpm for 4 hour duration
- 1,500 gpm < Available Fire Flow ≤ 3,500 gpm for 4 hour duration
- 3,500 gpm < Available Fire Flow ≤ 4,500 gpm for 4 hour duration
- 4,500 gpm < Available Fire Flow ≤ 5,000 gpm for 4 hour duration
- 5,000 gpm < Available Fire Flow ≤ 7,000 gpm for 4 hour duration
- Available Fire Flow > 7,000 gpm for 4 hour duration
- WTP SFWB WTP
- Existing Storage Reservoir
- PS Existing Booster Pump Station
- M Master Meter (flows out of SFWB or Oregon City)
- Existing Pipeline
- URBAN GROWTH BOUNDARY (UGB)
- Lower Zone
- Intermediate Zone
- Upper Zone
- Lower Park Place Zone
- Intermediate Park Place Zone
- Upper Park Place Zone (CRW)
- Canemah District Zone
- Fairway Downs Zone
- View Manor - Park Place Zone
- Livesay Road - Park Place Zone
- Paper Mill Zone
- Canyon (CRW)
- Country Village (CRW)
- Street
- Water Feature

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SUMMARY OF RECOMMENDED IMPROVEMENTS FOR EXISTING WATER SYSTEM

The recommended improvements needed to eliminate deficiencies identified in the evaluation of the existing water distribution system are summarized below and shown on Figure 6-4. These recommendations only identify improvements at a master plan level and do not constitute a design of such improvements. Subsequent detailed design is required to determine the exact sizes and/or locations of these proposed improvements. The estimated costs and timing for these recommended improvements are discussed in Chapter 8.

PRV Stations

- Construct a 6-inch PRV station from Upper pressure zone at Telford Road to address fire flow deficiencies at Center Street and Sunset Street in the Intermediate pressure zone.

Pipelines

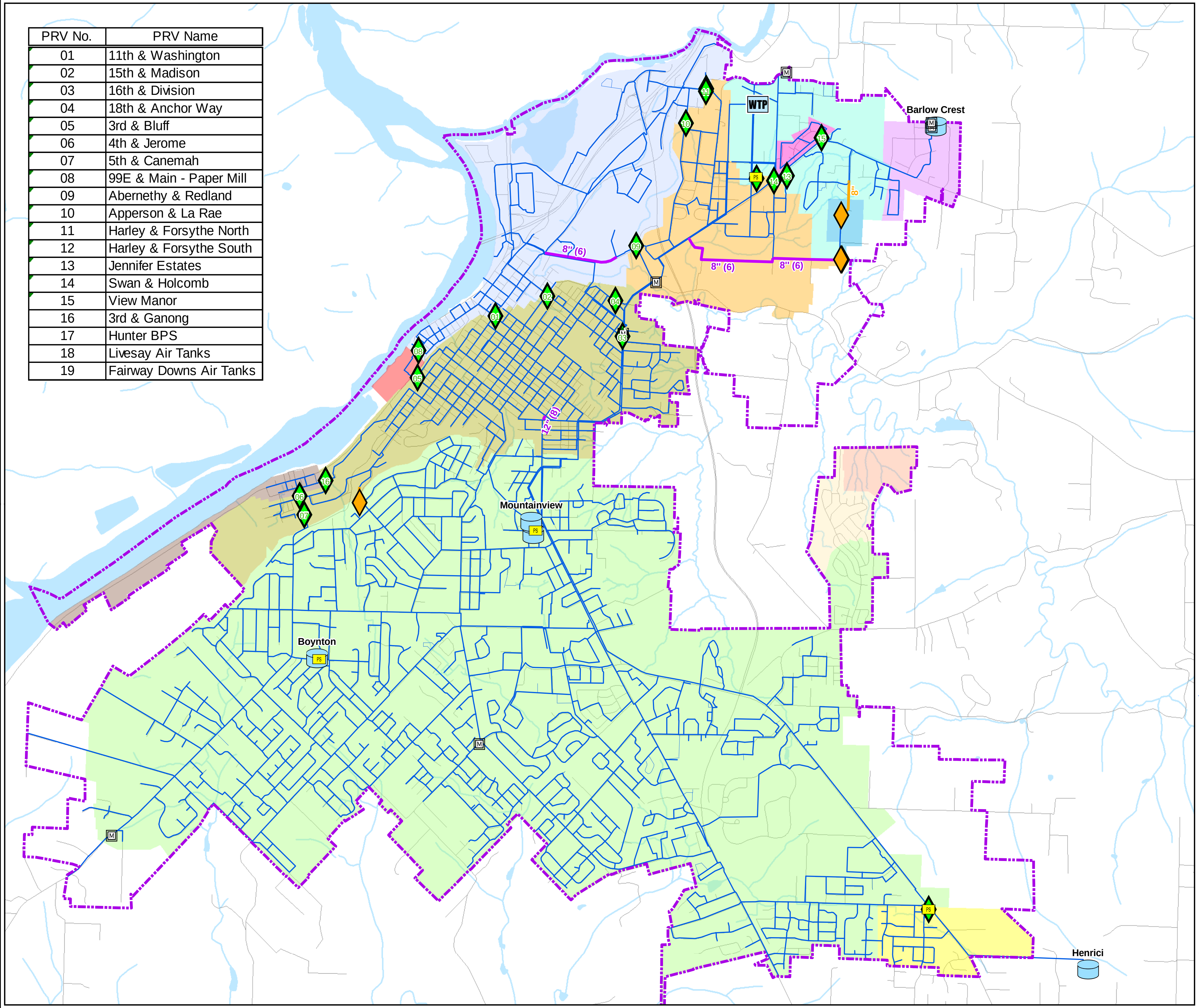
- Construct pipeline improvements identified in Table 6-4 to address fire flow deficiencies.

OREGON CITY

FIGURE 6-4

CITY OF OREGON CITY
EXISTING WATER SYSTEM
RECOMMENDED IMPROVEMENTS

PRV No.	PRV Name
01	11th & Washington
02	15th & Madison
03	16th & Division
04	18th & Anchor Way
05	3rd & Bluff
06	4th & Jerome
07	5th & Canemah
08	99E & Main - Paper Mill
09	Abernethy & Redland
10	Apperson & La Rae
11	Harley & Forsythe North
12	Harley & Forsythe South
13	Jennifer Estates
14	Swan & Holcomb
15	View Manor
16	3rd & Ganong
17	Hunter BPS
18	Livesay Air Tanks
19	Fairway Downs Air Tanks



0 1,325 2,650
SCALE IN FEET

LEGEND

- Recommended PRV Station
- Recommended New Pipeline
- Recommended Pipeline Upsize
- SFWB WTP
- Existing Storage Reservoir
- Existing Booster Pump Station
- Existing PRV Station
- Master Meter (flows out of SFWB or Oregon City)
- Existing Pipeline
- URBAN GROWTH BOUNDARY (UGB)
- Lower Zone
- Intermediate Zone
- Upper Zone
- Lower Park Place Zone
- Intermediate Park Place Zone
- Upper Park Place Zone (CRW)
- Canemah District Zone
- Fairway Downs Zone
- View Manor - Park Place Zone
- Livesay Road - Park Place Zone
- Paper Mill Zone
- Canyon (CRW)
- Country Village (CRW)
- Street
- Water Feature

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CHAPTER 7. FUTURE WATER DISTRIBUTION SYSTEM EVALUATION

This chapter presents an overview evaluation of the City's future water distribution system and its ability to meet the recommended performance and planning criteria under buildout demand conditions. Performance standards used to evaluate the water system are defined in Chapter 4.

This chapter identifies the improvements to existing water system infrastructure that will be required to expand service to new areas and support the projected buildout water demands. The evaluation includes an analysis of water storage capacity, pumping capacity and the future system's ability to meet recommended operational and design criteria under buildout maximum day demand plus fire flow and peak hour demand scenarios.

West Yost conducted this evaluation using an updated hydraulic model that incorporated improvements needed to eliminate deficiencies identified in the existing water system evaluation (see Chapter 6), as well as distribution pipelines required to serve projected buildout demands[1]. These facilities are shown on Figure 7-1. Evaluations, findings, and recommendations for addressing the identified future water distribution system deficiencies are included and summarized at the end of this chapter. The identified recommendations and estimated timings were then used to develop a CIP, including an estimate of probable construction costs. The recommended CIP is described further in Chapter 8.

BUILDOUT WATER DEMANDS

The buildout water demands for the City were developed based on UGB buildout land use information provided by City staff as shown on Figure 7-2, and the adopted water duty factors as described in Chapter 3. These projected buildout water demands were then allocated into the future system hydraulic model. Table 7-1 summarizes the buildout water demands for the City by pressure zone. Projected buildout water demands from master meters serving CRW and West Linn have also been allocated in the City's hydraulic model and are included in Table 7-1.

FUTURE WATER SYSTEM FACILITY EVALUATION

To evaluate the future water system, the following system facilities analyses were conducted:

- Water Storage Capacity,
- Pumping Capacity, and
- Critical Supply Facilities.

The results of the future water system facility analyses are discussed below.

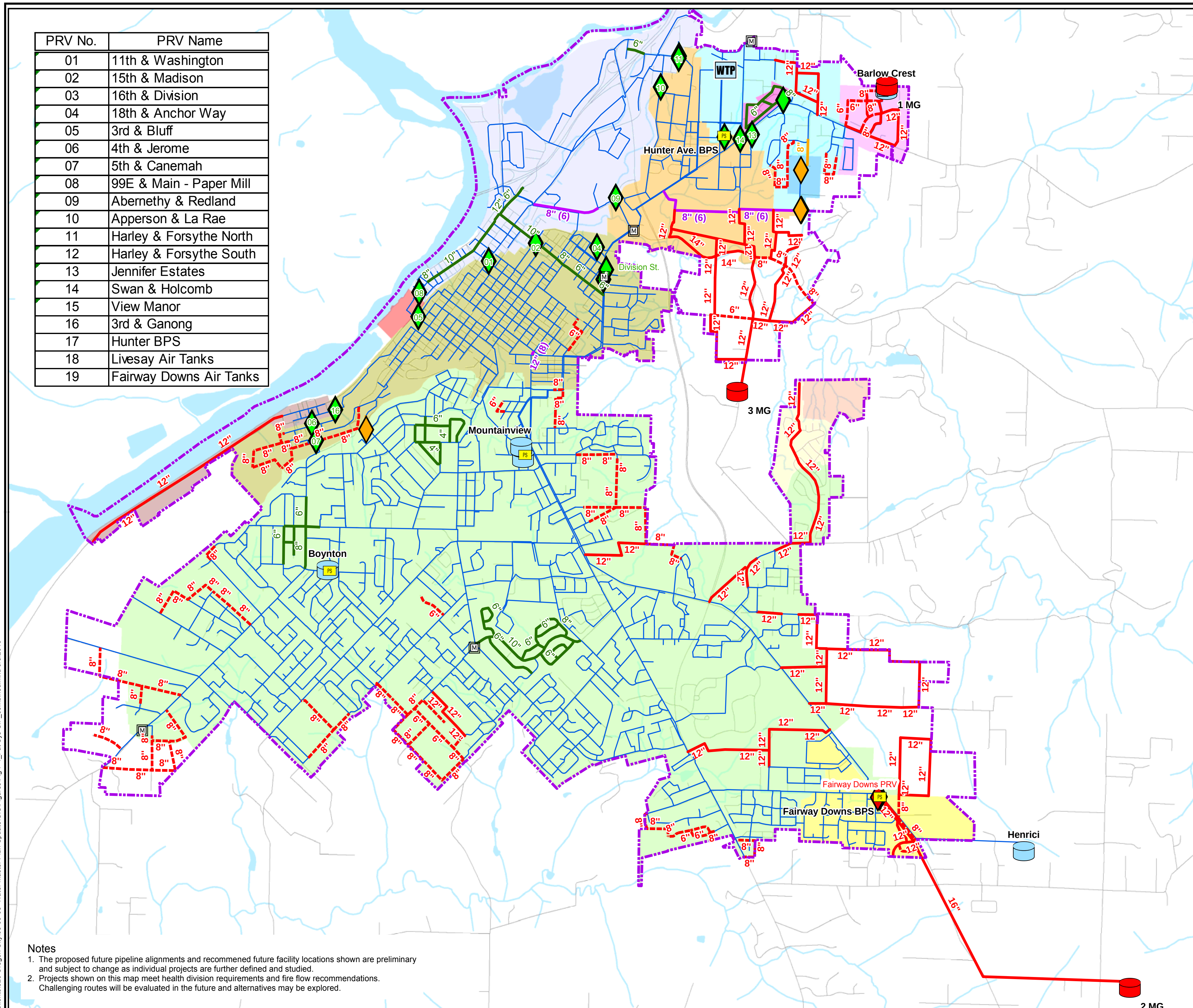
[1] Some future UGB service areas are currently served by CRW, and it is unclear how these areas will be incorporated into the City's future water system (i.e., new pipelines or existing CRW pipelines). Consequently, it was assumed that some existing CRW pipelines would be added into the future system to serve these expanded areas.

![OREGON CITY]

FIGURE 7-1

CITY OF OREGON CITY
FUTURE WATER SYSTEM
RECOMMENDED IMPROVEMENTS

PRV No.	PRV Name
01	11th & Washington
02	15th & Madison
03	16th & Division
04	18th & Anchor Way
05	3rd & Bluff
06	4th & Jerome
07	5th & Canemah
08	99E & Main - Paper Mill
09	Abernethy & Redland
10	Apperson & La Rae
11	Harley & Forsythe North
12	Harley & Forsythe South
13	Jennifer Estates
14	Swan & Holcomb
15	View Manor
16	3rd & Ganong
17	Hunter BPS
18	Livesay Air Tanks
19	Fairway Downs Air Tanks



Notes
1. The proposed future pipeline alignments and recommened future facility locations shown are preliminary and subject to change as individual projects are further defined and studied.
2. Projects shown on this map meet health division requirements and fire flow recommendations. Challenging routes will be evaluated in the future and alternatives may be explored.

N

0 1,475 2,950
SCALE IN FEET

LEGEND

- Recommended PRV Station (Future System CIP)
- Recommended Storage Reservoir (Future System CIP)
- Recommended PRV Station (Existing System CIP)
- Recommended New Pipeline (Existing System CIP)
- Recommended Pipeline Upsize (Existing System CIP)
- Recommended Replacement Pipeline
- Future System Pipeline Diameter ≤ 8"
- Future System Pipeline Diameter > 8"
- SFWB WTP
- Existing Storage Reservoir
- Existing Booster Pump Station
- Existing PRV Station
- Master Meter (flows out of SFWB or Oregon City)
- Existing Pipeline
- URBAN GROWTH BOUNDARY (UGB)
- Lower Zone
- Intermediate Zone
- Upper Zone
- Lower Park Place Zone
- Intermediate Park Place Zone
- Upper Park Place Zone (CRW)
- Canemah District Zone
- Fairway Downs Zone
- View Manor - Park Place Zone
- Livesay Road - Park Place Zone
- Paper Mill Zone
- Canyon (CRW)
- Country Village (CRW)
- Street
- Water Feature

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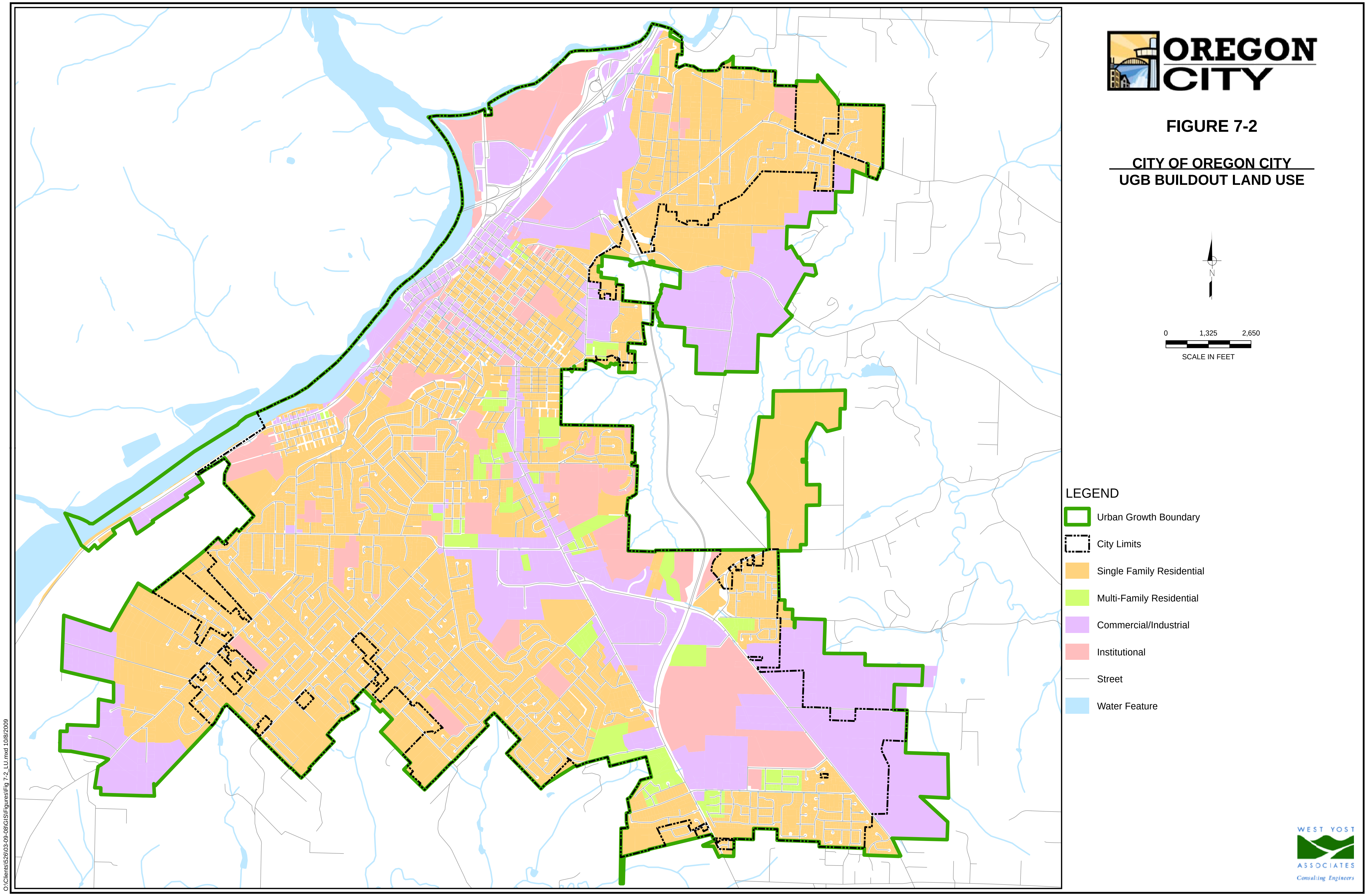
OREGON CITY
FIGURE 7-2
CITY OF OREGON CITY
UGB BUILDOUT LAND USE
N
0
1,325
2,650
SCALE IN FEET
LEGEND
Urban Growth Boundary
City Limits
Single Family Residential
Multi-Family Residential
Commercial/Industrial
Institutional
Street
Water Feature
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Table 7-1. Water Demands for the Buildout Water System

Pressure Zone	Average Day Demand[a]		Maximum Day Demand[b]		Peak Hour Demand[c]	
	gpm	mgd	Gpm	mgd	gpm	mgd
Lower	296.8	0.43	682.7	0.98	1,335.6	1.92
Intermediate	387.1	0.56	890.2	1.28	1,741.7	2.51
Upper	3,235.9	4.66	7,442.6	10.72	14,561.7	20.97
Lower Park Place	426.7	0.61	981.6	1.41	1,920.4	2.77
Intermediate Park Place	198.9	0.29	457.6	0.66	895.2	1.29
Upper Park Place	72.1	0.10	165.8	0.24	324.4	0.47
Canemah	35.5	0.05	81.6	0.12	159.7	0.23
Fairway Downs	169.0	0.24	388.8	0.56	760.6	1.09
View Manor	16.4	0.02	37.8	0.054	73.9	0.11
Livesay Road	21.1	0.03	48.5	0.07	95.0	0.14
Paper Mill	16.2	0.02	37.2	0.054	72.9	0.10
City of Oregon City's Subtotal	*4,875.7*	*7.01*	*11,214.4*	*16.15*	*21,941.1*	*31.60*
Master Meter No. 2[d]	991.4	1.43	2,974.2	4.28	2,974.2	4.28
Master Meter No. 3[d]	3,192.0	4.60	9,576.0	13.79	9,576.0	13.79
Master Meter No. 8[e]	70.8	0.10	212.5	0.31	212.5	0.31
Master Meter No. 9[e]	36.2	0.05	108.7	0.16	108.7	0.16
Master Meter No. 11[e]	260.0	0.37	779.9	1.12	779.9	1.12
Master Meter No. 12[e]	7.9	0.01	23.6	0.03	23.6	0.03
Master Meter No. 13[e]	12.9	0.02	38.7	0.06	38.7	0.06
Master Meters Subtotal	*4,571.2*	*6.58*	*13,713.6*	*19.75*	*13,713.6*	*19.75*
Water System Total	**9,446.9**	**13.59**	**24,928.0**	**35.90**	**35,654.7**	**51.35**

(a) The City's average day demands were projected using the City's land use data within the UGB and the recommended water duty factors developed in Chapter 3. Average day demand for master meters was projected based on 2008 water use data plus a two percent annual growth up to 2030.
(b) The City's maximum day demand is 2.3 times the average day demand. Maximum day demand for master meters is based on 3.0 times the average day master meter demand.
(c) The City's peak hour demand is 4.5 times the average day demand. Peak hour demand for master meters is based on 3.0 times the average day master meter demand.
(d) Master meter is served directly from the SFWB transmission main.
(e) Master meter is served by the City's water system.

Water Storage Capacity

The principle advantages that storage provides for the water system are the ability to equalize demands on supply sources, production facilities, and transmission mains; to provide emergency storage in case of supply failure; and to provide water to fight fires. The City's existing water system includes five water storage facilities serving ten pressure zones.

Together, these water storage facilities must be sufficient to meet the City's storage criteria for the future water system. The volume required for each storage component is detailed below:

- Equalization Storage: 25 percent of maximum day demand,
- Emergency Storage: 100 percent of maximum day demand, and
- Fire Flow Storage: Determined using the largest fire flow requirement times the fire flow duration period as required by the Clackamas County Fire District.

Typically the required storage volume for these three system storage components is determined individually within each pressure zone and then combined to identify the total amount of storage volume required for the overall system. However, since the lower pressure zones in the City are served through PRVs from the upper pressure zones, the fire flow storage for these interconnected pressure zones are shared in common, allowing the pressure zones to be analyzed as a set for fire flow storage. Consequently, the required fire flow storage for the future water system will be based on the following maximum fire flow demands in the pressure zones served by each reservoir or group of reservoirs:

- A 3,000 gpm fire flow for the duration of 4 hours for the pressure zones served by Boynton, Henrici, and Mountainview No. 2 Reservoirs.
- A 5,000 gpm fire flow for the duration of 4 hours for the pressure zones served by Mountainview No. 1 Reservoir.
- A 3,000 gpm fire flow for the duration of 4 hours for the pressure zones served by Barlow Crest Reservoir.

The existing storage facilities were evaluated to determine whether the City's existing storage facilities have sufficient capacity to provide the required system storage for projected buildout water demands. Table 7-2 summarizes the evaluation of water storage capacity in the future water system. The future system contains an overall water storage capacity of 18.25 MG, which is not sufficient to meet the projected storage requirement of 24.17 MG. As summarized in Table 7-2, the City is projected to have a water storage capacity deficit of approximately 6 MG.

Consequently, the following storage facilities are recommended to increase the storage capacity in the future water system to meet projected storage requirements:

- 2 MG storage reservoir at the 620 foot contour elevation to serve the expanded Fairway Downs pressure zone and portions of the Upper pressure zone through pressure reducing valve stations.
- 3 MG storage reservoir along Holly Lane to serve the Lower Park Place pressure zone.
- 1 MG storage reservoir at the existing Barlow Crest storage reservoir site (the remainder of the buildout emergency storage requirement will be met from Mountainview Reservoir No. 2).

Table 7-2. Summary of Buildout Water Storage Evaluation

Reservoir Set (Volume)	Pressure Zones Served	Total Available Storage, MG	Required Storage Capacity, MG: Equalization [a]	Emergency [b]	Fire Flow [c]	Total Required Storage, MG	Storage Surplus (Deficit), MG
		[A]	[B]	[C]	[D]	[E] = [B]+[C]+[D]	[F] = [A]-[E]
Boynton (2.0 MG) Henrici (2.0 MG) Mountainview No.2 (10.5 MG)	Upper	14.50	2.68	10.72	0.72	14.12	0.38
Mountainview No.1 (2.0 MG)	Intermediate	2.00	0.32	1.28	1.10	4.41	(2.41)
	Lower [d]		0.12	0.49			
	Lower Park Place [d]		0.18	0.71			
	Canemah		0.03	0.12			
	Paper Mill		0.01	0.05			
Fairway Downs	Fairway Downs		0.14	0.56	0.36	1.06	(1.06)
Barlow Crest (1.75 MG)	Intermediate Park Place	1.75	0.16	0.66	0.72	3.50	(1.75)
	Upper Park Place		0.06	0.24			
	Lower [d]		0.12	0.49			
	Lower Park Place [d]		0.18	0.71			
	View Manor		0.01	0.05			
	Livesay Road		0.02	0.07			
Total		**18.25**	**4.04**	**16.15**	**2.90**	**23.09**	**(4.84)**

[a] Based on 25 percent of a maximum day demand (see Table 7-1).

[b] Based on a maximum day demand (see Table 7-1).

[c] Fire flow storage for Boynton, Henrici, and Mountainview No. 2 reservoir set based on a 3,000 gpm fire flow for the duration of 4 hours. Fire flow storage for Mountainview No. 1 reservoir based on a 5,000 gpm fire flow for the duration of 4 hours; however, the required storage was reduced by 0.10 MG to account for the fire storage tank at the Paper Mill. Fire flow storage for Barlow Crest reservoir based on a 5,000 gpm fire flow for the duration of 4 hours. Fire flow storage for Fairway Downs reservoir based on a 1,500 gpm fire flow for the duration of 4 hours.

[d] Required storage capacity for this zone was split between Mountainview No.1 and Barlow Crest reservoirs.

Pumping Capacity

The pumping capacity within the City's future water system was evaluated to assess its ability to deliver a reliable firm capacity to the buildout service area. Firm capacity assumes a reduction in total pumping capacity to account for pumps that are out of service at any given time due to mechanical breakdowns, maintenance, water quality, or other operational issues. For each booster pump station, the firm pumping capacity was defined as the total pump station capacity with the largest pump out of service.

There are five booster pump stations in the City's future water distribution system. The Boynton pump station provides local emergency and fire flow service and is adequately sized to serve this function. The other four pump stations perform transfer pumping service, moving water from one pressure zone to another. The performance criteria for a transfer booster pumping facility serving a pressure zone(s) with storage requires that the pump station have adequate firm capacity to supply the maximum day demand within all dependent pressure zone(s) over a 24-hour period. For pressure zone(s) without storage, the planning criteria requires that the pump station have adequate firm capacity to supply peak hour demand plus fire flow requirements within the pressure zone(s).

Table 7-3 summarizes the evaluation of the pumping capacity in the future water system. The pumping capacity analysis indicates that the existing capacity of the Hunter Avenue pump station, which serves pressure zones with storage, is adequate for meeting a buildout maximum day demand condition. However, the Mountainview pump station has a slight capacity deficit of approximately 150 gpm during a buildout maximum day demand condition. City personnel also report that the pumps at the Mountainview pump station can not pump their full firm capacity because the existing configuration constricts the flow and causes the pump station to pump at a higher pressure. Consequently, in the short term, Boynton and Henrici Reservoirs would be required to supply water to the Upper pressure zone during a maximum day demand. It is recommended that the City make improvement to the pipeline configuration in the immediate vicinity of the pump station to allow the pump station to use it full firm capacity without causing other system damage.

In addition, the Barlow Crest pump station has a capacity deficit of approximately 1,300 gpm under a buildout maximum day demand condition. While this station is currently owned and operated by CRW, should the time come that Oregon City serve the customers in the Upper Park Place pressure zone it would be recommended that the City install two additional pumps (700 gpm each) at the Barlow Crest pump station to increase the station's firm capacity to meet buildout maximum day demands.

The Fairway Downs pump station does not have adequate capacity for serving the required 1,500 gpm fire flow demand, and the existing normal service pump's capacity of 50 gpm is insufficient to meet projected peak hour demands of approximately 760 gpm. However, when the new Fairway Downs reservoir is constructed, this pump station will no longer be the source of supply for the Fairway Downs pressure zone. This station will change in function from a constant run station booster station to one that fills the new Fairway Downs reservoir. Preliminary modeling shows that the current pumps are adequate for this future purpose, however, this should be further refined and evaluated once the City has developed an extended period simulation model.

Table 7-3. Summary of Buildout Pumping Capacity Evaluation

Pump Station	Pressure Zone/Master Meter Served	Pump 1, gpm	Pump 2, gpm	Pump 3, gpm	Pump 4, gpm	Total Capacity, gpm	Firm Capacity [a], gpm	Buildout Maximum Day Demand, gpm	Buildout Peak Hour plus Fire Flow Demand [b], gpm	Pumping Capacity Surplus (Deficit), gpm
Mountainview	Upper									
	CRW Master Meter No. 8									
	CRW Master Meter No. 9	4,000	4,000	4,000	--	12,000	8,000	7,764	--	236
Hunter Avenue	Intermediate Park Place									
	Upper Park Place									
	View Manor									
	Livesay Road									
	CRW Master Meter No. 11									
	CRW Master Meter No. 12									
	CRW Master Meter No. 13	900	900	900	--	2,700	1,800	1,552	--	248
Barlow Crest [c]	Upper Park Place	450	450	--	--	900	450	--	1,324	(874)
Fairway Downs	Fairway Downs	50	500	500	500	1,550	1,050	--	1,761	(711)

[a] Firm capacity is defined as the total booster pumping capacity with the largest pump out of service.

[b] Fire flow demand is defined as 1,500 gpm (residential land use). However, if future development in these pressure zones include land uses other than single family residential, the capacity of these pump stations should be re-evaluated to accommodate additional fire flow demand.

[c] It was assumed that the Barlow Crest booster pump station (currently operated by CRW) will be incorporated into the City's future water system to serve projected water demands in the UGB from the Upper Park Place pressure zone.

Critical Supply Facilities

All critical supply facilities should be equipped with an on-site, backup power generator to provide pumping capacity during a power outage. Critical pumping facilities are defined as those facilities that provide service to pressure zone(s) without sufficient emergency storage and that meet the following criteria:

- The largest facility that provides water to a particular pressure zone(s);
- A facility that provides the sole source of water to a single or multiple pressure zones.

The following list summarizes the current available backup power facilities at each pump station.

- The Boynton pump station does not have backup power. As a result, this pump station cannot provide service during emergencies that involve a power outage.
- The Mountainview pump station has a diesel engine generator capable of operating the pump station at firm capacity.
- The Hunter Avenue pump station has a diesel engine generator capable of operating the pump station at firm capacity.
- The Fairway Downs pump station has a natural gas engine generator capable of operating the pump station at firm capacity.
- The Barlow Crest pump station has a generator capable of operating the pump station at firm capacity.

Based on the critical pumping facilities criteria and the available backup power facilities, the City's water system should be able to provide a reliable source of supply to the future water system during a power outage.

WATER SYSTEM PERFORMANCE EVALUATION

This section discusses the performance criteria for and results of the future water distribution system evaluation. The proposed future water system, which includes improvements recommended from the future water system facility evaluation, is illustrated on Figure 7-1.

Future Water System Performance Criteria

Steady state hydraulic analyses using the updated hydraulic model were conducted to identify areas of the future water system that do not meet the recommended system performance criteria as presented previously in Chapter 4. The results of the evaluation of the future water system are presented below for the following demand scenarios:

- Peak Hour Demand—A peak hour flow condition was simulated for the future distribution facilities to evaluate their capability to meet a peak hour demand scenario. Peak hour demands are met by the combined flows from SFWB and storage reservoirs.

- Maximum Day Demand plus Fire Flow—To evaluate the future water system under a maximum day demand plus fire flow scenario, InfoWater's "*Available Fire Flow Analysis*" tool was used to determine the available fire flow while meeting the maximum day demand plus fire flow performance criteria within the future water system. Maximum day plus fire flow demands are met by the combined flows from SFWB and storage reservoirs.

These demand scenarios were selected to simulate critical conditions that are the most demanding of pipeline network performance capabilities.

<u>Peak Hour Demand Scenario</u>

As shown in Table 7-1, the peak hour demand for the City's future water system was projected to be 21,941 gpm (31.6 mgd). This peak hour demand represents a peaking factor of 4.5 times the average day demand. In addition, approximately 13,714 gpm (19.8 mgd) is projected to be delivered to CRW and West Linn through the master meter connections for a total peak hour system demand of 35,655 gpm (51.4 mgd).

During a peak hour demand scenario, a minimum pressure of 40 psi must be maintained throughout the water system. In addition, maximum head loss per thousand feet of distribution main should not exceed 10 ft/kft and maximum velocities should not exceed 7 fps. Details of the system pressures as simulated in the model under the peak hour demand scenario are discussed below.

<u>Maximum Day Demand plus Fire Flow Scenario</u>

As shown in Table 7-1, the maximum day demand for the City's future water system was projected to be 11,214 gpm (16.15 mgd). This maximum day demand represents a peaking factor of 2.3 times the average day demand. In addition, approximately 13,714 gpm (19.75 mgd) is projected to be delivered to CRW and West Linn through the master meter connections for a total maximum day system demand of 24,928 gpm (35.9 mgd).

This scenario was simulated in the hydraulic model to verify the availability of minimum fire flows for residential land use areas (1,000 gpm), as well as commercial, multi-family, and public facility land uses. InfoWater's "*Available Fire Flow Analysis*" tool was used to determine the available fire flow in the future water system while meeting the minimum residual pressure criterion of 20 psi. The results from this evaluation will help City staff identify areas within the existing system where they may want to improve fire flow as future pipeline replacement projects are developed, as well as proposed areas where additional fire flow may be required.

<u>Recommended Improvements Criteria</u>

The future water system is expected to deliver peak hour flows and maximum day demand plus fire flow within the acceptable pressure, velocity and head loss ranges as identified in the performance criteria presented in Chapter 4. However, the system was evaluated using pressure as the primary criterion. Recommended improvements needed to comply with the performance criteria will be added to the future water system to fix any deficiencies found and will also be discussed in the following paragraphs.

The performance criteria described above was used to evaluate the future water system during peak hour demand and maximum day demand plus fire flow scenarios. The evaluation results are discussed below.

Future Water System Evaluation Results

This section addresses the results of the peak hour demand and maximum day demand plus fire flow analyses.

Peak Hour Demand Scenario

During a peak hour demand scenario, results indicate that the future water system could not adequately deliver peak hour demands to meet the City's minimum pressure criterion of 40 psi as illustrated on Figure 7-3. Under this scenario, system pressures ranged from 34 to 162 psi.

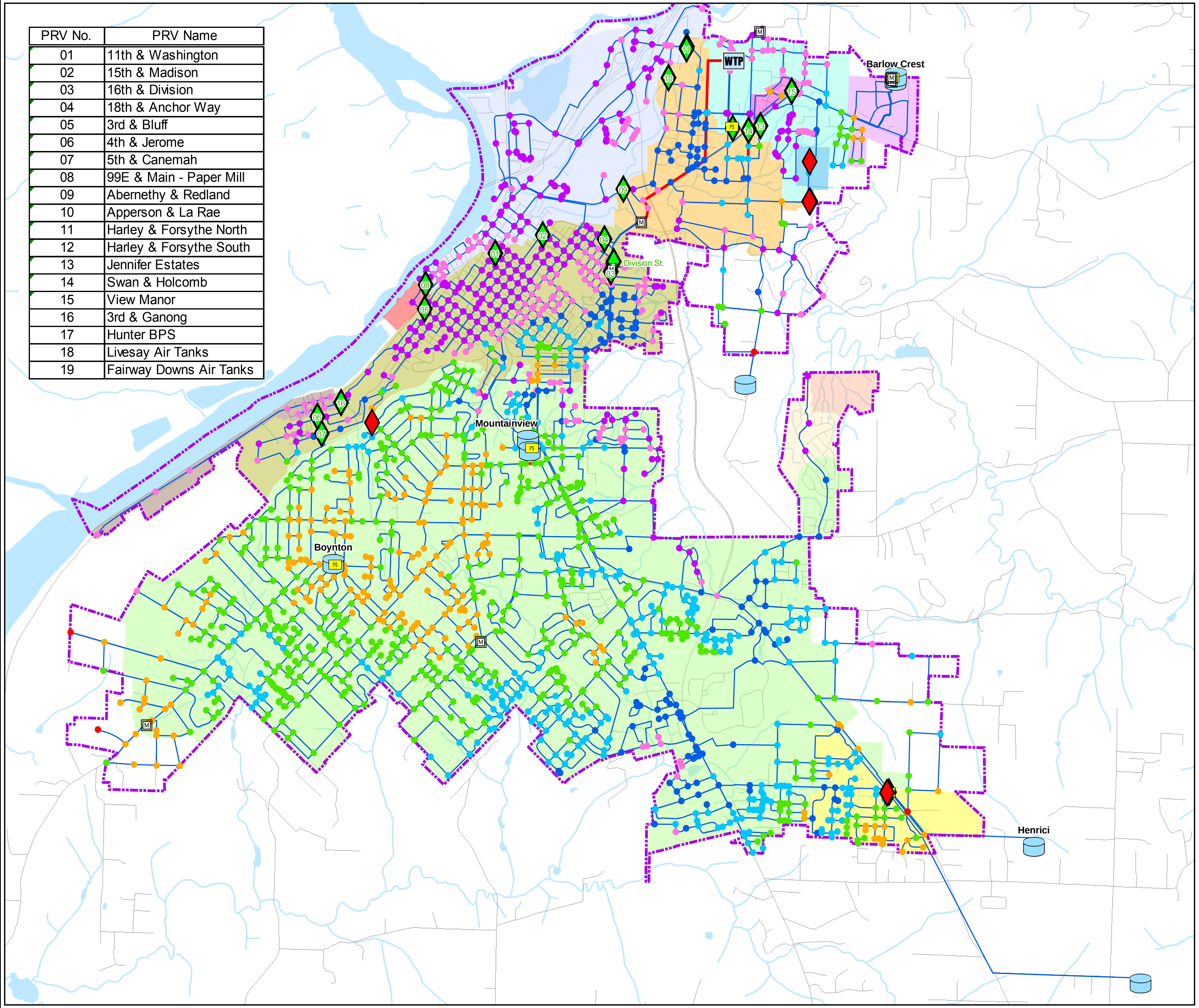
As shown on Figure 7-3, a small area of low pressures (34-39 psi) was simulated in the Upper pressure zone downstream of Henrici Reservoir and along the border of the Fairway Downs pressure zone. Based on the location of this area of low pressures, it appears that the low pressures are caused by higher elevations. This result is comparable to the established pressure range for the Upper pressure zone, which is between 34-141 psi. Based on this information, no mitigation is recommended at this time.

In addition, one junction in the Lower Park Place pressure zone also had a simulated pressure slightly below 40 psi. Based on the location of this area of low pressure, it appears that the low pressure is caused by the higher elevation. Consequently, it is recommended that the City consider the topographic constraints of this area while designing the recommended new storage reservoir along Holly Lane. Since the pressure is very close to the pressure requirement and future design of the Holly Lane storage reservoir can address this issue, no mitigation is recommended at this time.

As noted in Chapters 2 and 6, there are areas in the City's water system where high pressures are inherent to the existing pressure zone system. In particular, the Intermediate and Intermediate Park Place pressure zones span such a great range of elevations that pressures at the bottom of the pressure zone significantly exceed 100 psi in order to keep pressures at the top of the pressure zone above 40 psi. Figure 7-3 shows the location of the high pressure nodes in the City's water system. High pressure areas in the older parts of the water system would be prime targets for leak detection activities.

In general, the recommended corrective action for high pressure areas is the installation of individual pressure reducing valves on service connections. If leakage problems in the very high pressure areas (upwards of 120 psi) prove to be extensive, this situation may warrant the consideration of reconfiguring pressure zone boundaries. Reconfigured pressure zone boundaries would be achieved through modifications in pipeline configuration and the addition of new PRV stations. These reconfigurations would be more difficult in some areas of the system than others. For example, in the Intermediate pressure zone, modifying pressure zone boundaries would be a challenge since it is a heavily interconnected pipeline network.

PRV No.	PRV Name
01	11th & Washington
02	15th & Madison
03	16th & Division
04	18th & Anchor Way
05	3rd & Bluff
06	4th & Jerome
07	5th & Canemah
08	99E & Main - Paper Mill
09	Abernethy & Redland
10	Apperson & La Rae
11	Harley & Forsythe North
12	Harley & Forsythe South
13	Jennifer Estates
14	Swan & Holcomb
15	View Manor
16	3rd & Ganong
17	Hunter BPS
18	Livesay Air Tanks
19	Fairway Downs Air Tanks



OREGON CITY

FIGURE 7-3

CITY OF OREGON CITY FUTURE SYSTEM PEAK HOUR DEMAND ANALYSIS

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SCALE IN FEET

LEGEND

- Recommended PRV Station (Future System CIP)
- PRV Station
- Pressure < 40 psi
- 40 psi ≤ Pressure ≤ 50 psi
- 50 psi < Pressure ≤ 60 psi
- 60 psi < Pressure ≤ 70 psi
- 70 psi < Pressure ≤ 80 psi
- 80 psi < Pressure ≤ 100 psi
- Pressure > 100 psi
- Pipeline Velocity ≤ 7 fps
- Pipeline Velocity > 7 fps
- SFWB WTP
- Storage Reservoir
- Booster Pump Station
- Master Meter (flows out of SFWB or Oregon City)
- URBAN GROWTH BOUNDARY (UBG)
- Lower Zone
- Intermediate Zone
- Upper Zone
- Lower Park Place Zone
- Intermediate Park Place Zone
- Upper Park Place Zone (CRW)
- Canemah District Zone
- Fairway Downs Zone
- View Manor - Park Place Zone
- Livesay Road - Park Place Zone
- Paper Mill Zone
- Canyon (CRW)
- Country Village (CRW)
- Street
- Water Feature

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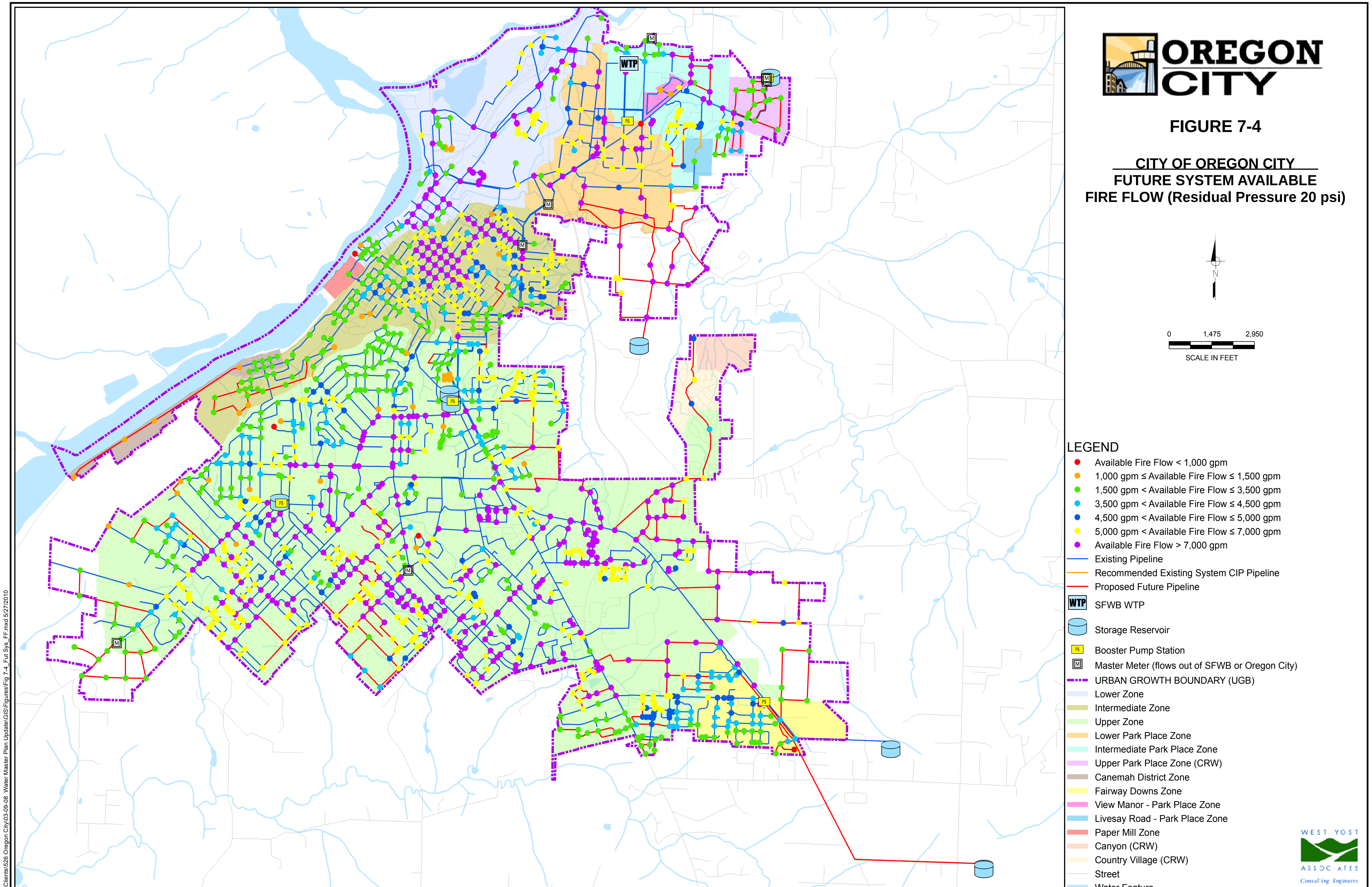
As illustrated on Figure 7-3, most of the pipelines in the future water system meet the maximum velocity criterion during a peak hour demand scenario. Almost all of the pipelines exceeding the maximum pipeline velocity requirement of 7 fps are downstream of either a pump station or PRV station (e.g., SFWB WTP, Mountainview pump station, PRV 14, etc.), which typically experience high velocities due to the large volumes of water being conveyed. It should also be noted that some of the 30-inch diameter transmission mains from the SFWB have velocities in the range of 6.1-8.8 fps, which exceeds the recommended transmission pipeline velocity of 5 fps. City staff will need to consider adding additional transmission pipeline capacity to the City's water system as water demands increase to reduce transmission pipeline velocities.

Since pipeline velocity is a secondary criterion, no improvements for pipelines that exceed the velocity criterion in the future water system are recommended unless the primary criterion (pressure) is not met. Based on results of the peak hour simulation, none of the above pipelines are in the vicinity of the low pressure areas. In addition, these pipelines discussed above are part of the existing water system; therefore, no mitigation is recommended at this time.

However, due to the high pipeline velocities (6.0-10.7 fps) simulated near the Mountainview pump station during a buildout peak hour demand scenario, it is recommended that the capacity of the existing pipelines be evaluated during the design of additional booster pumping capacity at this pump station.

Maximum Day Demand plus Fire Flow Scenario

InfoWater's "*Available Fire Flow Analysis*" tool was used to determine the available fire flow at each junction within the future water system under a buildout maximum day demand scenario. Figure 7-4 illustrates the available fire flow at a residual pressure of 20 psi for each junction within the future water system. In general, fire flow availability is very good in the City's future system, but a review of Figure 7-4 indicates that there are five junctions in the system where the model simulated fire flow results that do not meet minimum fire flow requirement of 1,500 gpm. Subsequent examination of these areas indicate that all of these junctions are located at either a 4-inch or 6-inch diameter dead-end main. Consequently, no mitigation is recommended at this time because additional fire flow can be supplied from hydrants available upstream of these dead-end mains.



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SUMMARY OF RECOMMENDED IMPROVEMENTS FOR FUTURE WATER SYSTEM

The recommended improvements needed to eliminate deficiencies identified in the evaluation of the future water distribution system are summarized below and shown previously on Figure 7-1. These recommendations only identify improvements at a master plan level and do not constitute a design of such improvements. Subsequent detailed design is required to determine the exact sizes and/or locations of these proposed improvements. The estimated costs and timing for these recommended improvements are discussed in Chapter 8.

Storage Reservoirs

To alleviate the future system water storage capacity deficit, the following storage reservoirs are recommended for the future water system:

- 2 MG storage reservoir along Wilson to serve the Fairway Downs and Upper pressure zones
- 3 MG storage reservoir along Holly Lane to serve the Lower Park Place pressure zone
- 1 MG storage reservoir at the existing Barlow Crest storage reservoir site

Pump Stations

To alleviate the future system pumping capacity deficit, the following booster pump modifications are recommended for the future water system:

- Fairway Downs pumps will convert from constant pumping for a closed zone to a booster station that pumps up to the new reservoir.

PRV Stations

- Construct two 6-inch PRV stations near Livesay Road pump station to increase fire flow supply availability in the Livesay Road pressure zone (one PRV will supply flow from Intermediate Park Place pressure zone and the other PRV can supply flow into the Lower Park Place pressure zone if needed).

Pipelines

- To serve future customers, construct/incorporate approximately 78,000 linear feet of proposed pipelines ranging in diameter from 6 to 16-inches as shown on Figure 7-1. (The specific alignments shown on Figure 7-1 are preliminary; the actual alignments will conform to future land use, development patterns, easement acquisition issues, and topographic considerations identified during the design phase of project implementation.)
- Due to the high pipeline velocities simulated during a buildout peak hour demand condition, evaluate the capacity of the existing pipelines at the Mountainview pump station to meet buildout demands.

CHAPTER 8. RECOMMENDED CAPITAL IMPROVEMENT PROGRAM

This chapter presents the recommended Capital Improvement Plan (CIP) for the City of Oregon City's existing and future water system. Recommendations for improvements to the existing and future water system were described previously in Chapters 6 and 7, respectively. This chapter provides a summary of all the recommended improvement projects, along with estimates of probable construction costs. It should be noted that the recommended CIP only identifies improvements at a master plan level and does not constitute a design of such improvements. Subsequent detailed design is required to determine the exact sizes and locations of these proposed improvements.

Costs are presented in October 2009 dollars based on an Engineering News Record Construction Cost Index (ENR CCI) of 8596 (20 Cities Average). Total CIP costs include the following construction contingency and project cost allowances:

- Construction Contingency: 20 percent
- Project Cost Allowances:
  - — Design: 10 percent
  - — Construction Management: 10 percent
  - — Administration: 8 percent

A complete description of the assumptions used in developing the estimates of probable construction cost is provided in Appendix C.

RECOMMENDED CAPITAL IMPROVEMENT PROGRAM

Existing Water System Improvements

Chapter 6 provided a summary of the evaluation of Oregon City's existing water system and its ability to meet the recommended operational and design criteria described in Chapter 4. Based on this evaluation, improvements to the existing water system were recommended to eliminate existing deficiencies, as listed in the following section.

The existing system improvements have been grouped into several recommended CIP projects, and include the following:

- PRV Stations
  - — Construct a 6-inch PRV station at the north end of the Livesay Pressure Zone to supply the Livesay Pressure Zone and potentially retire the Livesay Pump Station. Install 980 lf of 8-inch diameter pipeline and 410 lf of 6-inch diameter pipeline.
  - — Construct a 6-inch PRV station from Upper Pressure Zone at Telford Road to address fire flow deficiencies at Center Street and Sunset Street in the Intermediate Pressure Zone.

- Construct a 6-inch PRV station from the Livesay Pressure Zone to the Lower Park Place Pressure Zone to address fire flow deficiencies in the Lower Park Place Pressure Zone. Install 67 lf of 6-inch diameter pipeline.

- Pipeline Improvements
  - Install approximately 8,900 feet of pipeline to improve looping, pressures and fire flows. These projects are described in Table 8-1 and specific project sheets are included in Appendix D for the corresponding CIP identification number.
- Operational Improvements
  - Maintenance management system - Implementation of the maintenance management system is needed to automate and prioritize maintenance activities. Programs are available but will require staff resources to populate the data base which will make for more efficient system maintenance. Based on the industry standards or staff directed frequencies, work orders will be generated for routine maintenance activities.
  - Automated meter reading – A pilot program should be planned that would provide additional information on the feasibility of an automated meter reading program. Such a system would reduce the ongoing cost for meter reading and provide a more robust system for setting charges including demand charges. Since much of the system expansion depends on peak demands, billings that encourage lower demand and conservation could offset future system expansion.

The locations of the recommended existing system CIP projects are shown on Figure 8-1. Details of the recommended existing system CIP projects are provided in Chapter 6. Project sheets are presented in Appendix D.

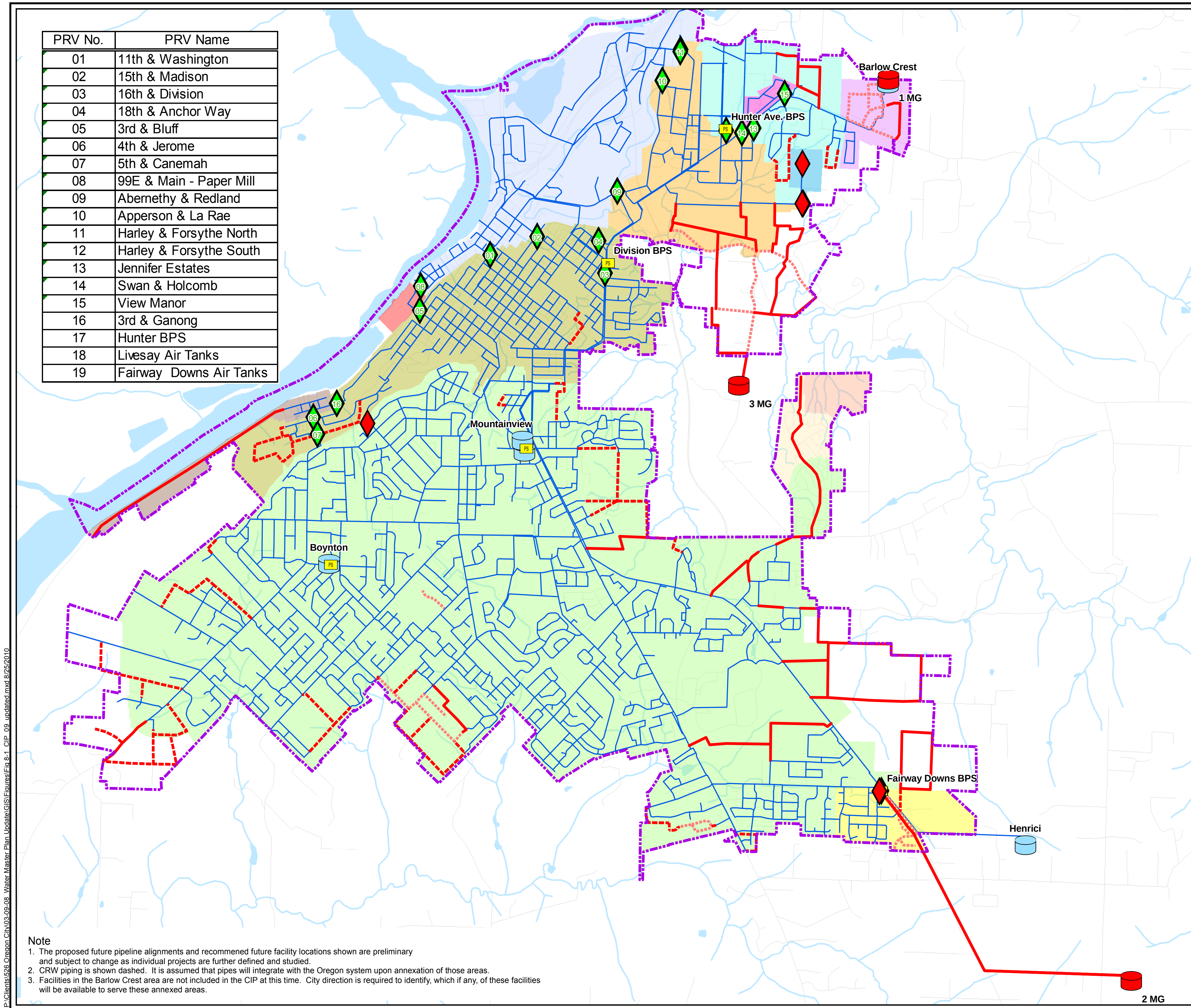
Future Water System Improvements

Chapter 7 provided a summary of the evaluation of Oregon City's future water system and its ability to meet the recommended operational and design criteria described in Chapter 4. Based on this evaluation, improvements to the future water system were recommended to meet projected demands. It should be noted that the timing of future system improvements will be triggered by specific developments and increase in system demands. Improvements have been grouped into several recommended CIP projects, and include the following:

- Storage Facility[1]
  - Construct a 2 MG storage reservoir at the 620 foot contour elevation to serve the Fairway Downs pressure zone and the Upper pressure zone.
  - Construct a 3 MG storage reservoir along Holly Lane to serve the Lower Park Place Pressure Zone.

[1] Projects that include the integration of CRW facilities into the Oregon City water system were not included in the CIP.

PRV No.	PRV Name
01	11th & Washington
02	15th & Madison
03	16th & Division
04	18th & Anchor Way
05	3rd & Bluff
06	4th & Jerome
07	5th & Canemah
08	99E & Main - Paper Mill
09	Abernethy & Redland
10	Apperson & La Rae
11	Harley & Forsythe North
12	Harley & Forsythe South
13	Jennifer Estates
14	Swan & Holcomb
15	View Manor
16	3rd & Ganong
17	Hunter BPS
18	Livesay Air Tanks
19	Fairway Downs Air Tanks



Note
1. The proposed future pipeline alignments and recommened future facility locations shown are preliminary and subject to change as individual projects are further defined and studied.
2. CRW piping is shown dashed. It is assumed that pipes will integrate with the Oregon system upon annexation of those areas.
3. Facilities in the Barlow Crest area are not included in the CIP at this time. City direction is required to identify, which if any, of these facilities will be available to serve these annexed areas.

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OREGON CITY

FIGURE 8-1

CITY OF OREGON CITY
WATER SYSTEM CIP
RECOMMENDED IMPROVEMENTS

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SCALE IN FEET

LEGEND
- Recommended Storage Reservoir
- Recommended PRV Station
- Recommended CIP Pipeline Diameter ≤ 8"
- Recommended CIP Pipeline Diameter > 8"
- Future System Pipeline (CRW)
- Existing Pipeline
- New_Existing_Pipes
- Existing Storage Reservoir
- Existing Booster Pump Station
- Existing PRV Location
- URBAN GROWTH BOUNDARY (UGB)
- Lower Zone
- Intermediate Zone
- Upper Zone
- Lower Park Place Zone
- Intermediate Park Place Zone
- Upper Park Place Zone (CRW)
- Canemah District Zone
- Fairway Downs Zone
- View Manor - Park Place Zone
- Livesay Road - Park Place Zone
- Paper Mill Zone
- Canyon (CRW)
- Country Village (CRW)
- Street
- Water Feature

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Table 8-1. Summary of Probable Construction Costs for Existing System CIP [a]

Improvement Type	Improvement Description	CIP ID	Quantity	2009-2015		2016 - 2020		2021 - 2025		2026 - 2030		2031-2035		Cost for Existing CIP by Project Type
				Estimated Construction Cost	CIP Cost[b] (including contingency and cost allowances)	Estimated Construction Cost	CIP Cost[b] (including contingency and cost allowances)	Estimated Construction Cost	CIP Cost[b] (including contingency and cost allowances)	Estimated Construction Cost	CIP Cost[b] (including contingency and cost allowances)	Estimated Construction Cost	CIP Cost[b] (including contingency and cost allowances)	
EXISTING CAPITAL IMPROVEMENTS														
New Pipeline & PRV	6-inch PRV station from Upper pressure zone at Telford Road and Center Street to address fire flow deficiencies in the Intermediate pressure zone (8-inch diameter, 315 lf & 6-inch diameter, 200 lf)	CIP-V- 102	515 lf	$ 136,100	$ 209,050									$ 327,890
New Pipeline & PRV	6-inch PRV station near Livesay pump station to increase FF capacities in the Lower Park Place pressure zone (6-inch diameter, 67 lf)	CIP-V- 103	67 lf	$ 77,370	$ 118,840									
Pipeline Improvement [c]	Livesay Road, 8-inch diameter	CIP-P-104	4,767 lf	$ 667,380	$ 1,025,096									$ 1,499,843
Pipeline Improvement [c]	Abernethy Road, 8-inch diameter	CIP-P-105	2,022 lf	$ 283,080	$ 434,811									
Pipeline Improvement [c]	Taylor Street, 12-inch diameter	CIP-P-108	130 lf	$ 26,000	$ 39,936									
		Total[b]		**$ 1,189,930**	**$ 1,828,000**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 1,828,000**
		Construction Contingency (20%)		$ 237,986		$ -		$ -		$ -		$ -		
		Total Construction Cost		**$ 1,427,916**		**$ -**		**$ -**		**$ -**		**$ -**		
		Engineering (10%)		$ 142,792		$ -		$ -		$ -		$ -		
		Construction Management (10%)		$ 142,792		$ -		$ -		$ -		$ -		
		Program Implementation (8%)		$ 114,233		$ -		$ -		$ -		$ -		
		Total Existing System CIP Cost[b,d]		**$ 1,828,000**		**$ -**		**$ -**		**$ -**		**$ -**		

[a] Costs shown are based on October 2009 dollars and an ENR CCI of 8596 (20 Cities Average).
[b] Total cost rounded to nearest $1,000.
[c] Projects motivated by fire flow deficiencies
[d] Cost is in current dollars and have not been escalated by the CPI of 3 to 5 percent.

- 1 MG storage reservoir at the existing Barlow Crest storage reservoir site (the remainder of the buildout emergency storage requirement will be met from Mountainview Reservoir No. 2). This reservoir is shown on Figure 8-1, but not currently included in the future CIP, Table 8-2. This additional storage will only be required when CRW facilities are incorporated into the City.

- Pump Station[2,3]
  - Increase the firm pumping capacity at the Barlow Crest Pump Station by adding two additional 500 gpm booster pumps (in the event that the current Barlow Crest customers come to be served by Oregon City).
- Pipelines
  - Install approximately 80,000 linear feet of proposed pipelines ranging from 6 inches to 16 inches in diameter.

The locations of the recommended future system CIP projects are shown on Figure 8-1 and the estimated costs are summarized in Table 8-2. Details of the recommended future system CIP projects are provided in Chapter 7. Project sheets are presented in Appendix D.

Pipeline Renewal and Replacement

Several high priority projects have been identified that replace existing pipelines. The locations of the replacement projects are shown on Figure 8-1 and the estimated costs are summarized in Table 8-3. Details of the replacement projects are provided in Chapter 7 and project sheets are presented in Appendix D.

In addition to the projects identified, there is a backlog of pipeline replacement projects that needs to be considered, especially if roadway improvements are planned. Table 8-4 shows these projects without any specific priorities.

SUMMARY

The recommended existing system CIP projects are presented in Table 8-1, along with their probable construction costs. The future system CIP projects are presented in Table 8-2 along with their probable construction costs. Renewal and replacement CIP projects are presented in Table 8-3 along with their probable construction costs. As shown, the existing system CIP cost is estimated to be approximately $1.83 million. The future system CIP cost is estimated to be approximately $35.46 million. The Renewal and replacement CIP cost is estimated to be approximately $9.5 million. Existing and future water system improvement costs should be appropriately allocated to existing and/or future users as shown in Tables 8-1 and 8-2. Renewal and replacement costs should be allocated to existing users as shown in Table 8-3.

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[2] Projects that include the integration of CRW facilities into the Oregon City water system were not included in the CIP.

[3] Cost estimate was based on the additional firm capacity required.

Table 8-2. Summary of Probable Construction Costs for Future System CIP [(a)]

Improvement Type	Improvement Description	CIP ID	Quantity	2009-2015		2016 - 2020		2021 - 2025		2026 - 2030		2031-2035		Cost for Future CIP by Project Type
				Estimated Construction Cost	CIP Cost[(b)] (including contingency and cost allowances)	Estimated Construction Cost	CIP Cost[(b)] (including contingency and cost allowances)	Estimated Construction Cost	CIP Cost[(b)] (including contingency and cost allowances)	Estimated Construction Cost	CIP Cost[(b)] (including contingency and cost allowances)	Estimated Construction Cost	CIP Cost[(b)] (including contingency and cost allowances)	
FUTURE CAPITAL IMPROVEMENTS														
Pipeline	Highway 99E/Mcloughlin Boulevard, 12 inch diameter	1	6,863 lf			$ 1,372,600	$ 2,108,314							
Pipeline	Joseph Way and Leland to Jessie, 8 inch diameter (161 lf) and 12 inch diameter (1839 lf)	8	2,964 lf			$ 390,340	$ 599,562							
Pipeline	Between Highway 213 and Beavercreek, 12 inch diameter	11	5,662 lf			$ 1,132,400	$ 1,739,366							
Pipeline	East side of Beavercreek near Fairway Downs Pump Station, 8 inch diameter (688 lf) and 12 inch diameter (5187 lf)	12	5,876 lf			$ 1,133,720	$ 1,741,394							
Pipeline	Loder Road, 12 inch diameter	13	7,303 lf			$ 1,460,600	$ 2,243,482							
Pipeline	East Side of Beavercreek from Loder to Maplelane, 12 inch diameter	14	8,690 lf					$ 1,738,000	$ 2,669,568					$ 20,421,366
Pipeline	Holly Lane to Greenfield, 12 inch diameter	15	6,311 lf					$ 1,262,200	$ 1,938,739					
Pipeline	Livesay Road south to New Holly Lane Reservoir (west side), 12 inch diameter (9580 lf) and 16 inch diameter (1070 lf)	20	10,620 lf					$ 2,183,500	$ 3,353,856					
Pipeline	Livesay Road south to New Holly Lane Reservoir (east side), 12 inch diameter	21	7,497 lf					$ 1,499,400	$ 2,303,078					
Pipeline	North of Holcomb, 12 inch diameter	24	4,140 lf			$ 828,000	$ 1,271,808							
Pipeline	North of Holcomb on the east side of the Barlow Crest Reservoir, 12 inch diameter	25	1,472 lf			$ 294,400	$ 452,198							
PRV	Fairway Downs Pressure Zone PRV	26	140 lf	$ 128,000	$ 196,608									
PRV	6-inch PRV station from Intermediate Park Place pressure zone at the north end of Livesay Road to increase fire flow capacity in the Livesay pressure zone, 8-inch diameter (980 lf) and 6-inch diameter (410 lf)	CIP-V- 101	1,390 lf	$ 252,300	$ 387,533									$ 584,141
Storage Reservoir	2 mg storage reservoir along Wilson Rd to serve Fairway Downs pressure zone, includes 16-inch diameter, 10,750 lf	CIP-TF-123	2.00 MG	$ 5,687,500	$ 8,736,000									$ 14,463,744
Storage Reservoir	3 mg storage reservoir along Holly Lane to serve Lower Park Place pressure zone, includes 12-inch diameter, 7,139 lf	CIP-TF-124	3.00 MG		$ -			$ 3,729,000	$ 5,727,744					
Total[(b)]				**$ 6,067,800**	**$ 9,320,000**	**$ 6,612,060**	**$ 10,156,000**	**$ 10,412,100**	**$ 15,993,000**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 35,469,000**
Construction Contingency (20%)				$ 1,213,560		$ 1,322,412		$ 2,082,420		$ -		$ -		
Total Construction Cost				**$ 7,281,360**		**$ 7,934,472**		**$ 12,494,520**		**$ -**		**$ -**		
Engineering (10%)				$ 728,136		$ 793,447		$ 1,249,452		$ -		$ -		
Construction Management (10%)				$ 728,136		$ 793,447		$ 1,249,452		$ -		$ -		
Program Implementation (8%)				$ 582,509		$ 634,758		$ 999,562		$ -		$ -		
Total Future System CIP Cost[(b,c)]				**$ 9,320,000**		**$ 10,156,000**		**$ 15,993,000**		**$ -**		**$ -**		

[(a)] Costs shown are based on October 2009 dollars and an ENR CCI of 8596 (20 Cities Average).
[(b)] Total cost rounded to nearest $1,000.
[(c)] Cost is in current dollars and have not been escalated by the CPI

Table 8-3. Summary of Probable Construction Costs for Renewal and Replacement CIP [(a)]

Improvement Type	Improvement Description	CIP ID	Quantity	2009-2015 Estimated Construction Cost	2009-2015 CIP Cost[(b)] (including contingency and cost allowances)	2016 - 2020 Estimated Construction Cost	2016 - 2020 CIP Cost[(b)] (including contingency and cost allowances)	2021 - 2025 Estimated Construction Cost	2021 - 2025 CIP Cost[(b)] (including contingency and cost allowances)	2026 - 2030 Estimated Construction Cost	2026 - 2030 CIP Cost[(b)] (including contingency and cost allowances)	2031-2035 Estimated Construction Cost	2031-2035 CIP Cost[(b)] (including contingency and cost allowances)	Cost for Future CIP by Project Type
FUTURE CAPITAL IMPROVEMENTS														
Pipeline	View Manor Pressure Zone, PRV#15, 4 inch diameter (150 lf) and 8 inch diameter (4397 lf)	50	4,547 lf	$ 700,580	$ 1,076,091									$ 8,960,118
Pipeline	Clairmont Area, 8 inch diameter (9513 lf) and 10 inch diameter (3920 lf)	51	13,433 lf	$ 1,959,020	$ 3,009,055									
Pipeline	Weleber St to Harding Blvd, 8 inch diameter	52	7,521 lf	$ 1,052,940	$ 1,617,316									
Pipeline	I-205 Crossing between Pope Lane and Park Place Ct, 8 inch diameter	53	555 lf	$ 77,700	$ 119,347									
Pipeline	15th St from Main St to Division St, PRV#2, 6 inch diameter (85 lf) , 8 inch diameter (1797 lf) and 10 inch diameter (2174 lf)	55	4,056 lf	$ 608,770	$ 935,071									
Pipeline	Main St from 5th St to 18th St, 8 inch diameter (1023 lf), 10 inch diameter (2558 lf) and 12 inch diameter (535 lf)	58	4,116 lf	$ 659,500	$ 1,012,992									
Pipeline	South End Rd and Warner Parrott Rd, 8 inch diameter	59	5,535 lf	$ 774,900	$ 1,190,246									
Storage Reservoir	Seismic and Mixing Improvements for Boynton Reservoir	60	1 ea	$ 365,000	$ 560,640									$ 560,640
	Total[(b)]			**$ 6,198,410**	**$ 9,521,000**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 9,521,000**
	Construction Contingency (20%)			$ 1,239,682		$ -		$ -		$ -		$ -		
	Total Construction Cost			**$ 7,438,092**		**$ -**		**$ -**		**$ -**		**$ -**		
	Engineering (10%)			$ 743,809		$ -		$ -		$ -		$ -		
	Construction Management (10%)			$ 743,809		$ -		$ -		$ -		$ -		
	Program Implementation (8%)			$ 595,047		$ -		$ -		$ -		$ -		
	Total Future System CIP Cost[(b,c)]			**$ 9,521,000**		**$ -**		**$ -**		**$ -**		**$ -**		

[(a)] Costs shown are based on October 2009 dollars and an ENR CCI of 8596 (20 Cities Average).
[(b)] Total cost rounded to nearest $1,000.
[(c)] Cost is in current dollars and have not been escalated by the CPI

Table 8-4. Unfunded Replacement Projects

S. Center St. between S. 2nd and 1st Street
Ogden Drive and Brighten Avenue between Telford Road and Jersey Avenue
Cherry Avenue between Holmes Avenue and Park Drive
South End Road between Barker Avenue and Barker Road
Barker Avenue between South End Road and Barker Road
Warner Perrot Road between S. End Road and Boynton
Belle and Glenwood between Holmes Lane and Linn Avenue
Valleyview Drive between Park Drive and McCarver Avenue
Canemah Court between Canemah Road and Telford Road
Randall Street between Canemah Road and Hartke Loop
Hartke Loop and Alderwood Place
Jersey Avenue between Charmon and Brighton Avenue
Center Street between 7th Street and 10th Street
Harrison Street between 7th Street and Division Street
Singer Creek Park from Mountain View Reservoir #1 to Linn Avenue
Division Street between Harrison Street and 13th/14th Street
All old main north of Division Street
Division Street between Anchor Way PRV Station and Davis Street

A summary of the costs for the recommended CIP by project type is provided in Table 8-5. This table also includes the amount that the Water Division is contributing to the new Operations Facility of $6,050,000. As shown in Table 8-5, the total estimated recommended CIP cost for the City of Oregon City water system, including the contribution to the Operations Facility, is estimated to be approximately $ 52.86 million.

Table 8-5. Estimated Cost of Recommended CIP by Project Type

CIP Project Type	Existing System CIP, million dollars	Future System CIP[a,b,c], million dollars	Renewal and Replacement CIP, million dollars	Total CIP Cost[a], million dollars
Storage Facility	-	14.46	0.56	15.02
Pump Station	-	-	-	-
Pipeline Improvement	1.50	20.42	8.96	30.88
PRV Station	0.33	0.58	-	0.91
Operations Facility	6.05	-	-	6.05
Total[d]	$7.88	$35.46	$9.52	$52.86

(a) Timing of future system improvements will be triggered by specific developments and increase in system demands.
(b) Future system CIP costs are in current dollars and have not been escalated by the CPI.
(c) Cost based on a ground level, pre-stressed concrete storage tank.
(d) Total cost based on the October 2009 ENR index of 8596 and includes construction contingency and project cost allowances.

CHAPTER 9. WATER DISTRIBUTION SYSTEM FINANCING PLAN

The development of a financing plan supports the planning for implementation of the recommended CIP. The following technical memorandum presents information that the City will need to make financing and implementation decisions. The recommended CIP projects are presented in three groups. The projects for the improvement of the existing system and for renewal and replacement need to be funded from other than system development charges (SDCs) while the projects shown for future system expansion should be funded from water SDCs or from the water fund. The next sections summarize data on the number of users as well as background information regarding historical revenues and expenses associated with the City's water fund and SDC fund. This historical data provides a basis for projecting future water system revenues and expenses for these funds. The availability and timing of funding from water rates and from SDCs is compared to the funding requirements and timing of CIP projects.

CIP PROJECT COST ALLOCATIONS AND SCHEDULE

Cities are required to use water rates for funding projects that improve the existing system but do not expand system capacity. Projects that increase water system capacity for future growth are eligible for funding from SDCs. For projects that both increase system capacity for growth and improve existing facilities, appropriate percentages of the project cost can be assigned to each category. Table 9-1 summarizes the costs for CIP projects between the water rate funding source and the SDC funding source for each phase of the improvement period.

Table 9-1. CIP Project Cost Summary by Source of Funds

Funding Source	Capital Cost, $
Water Fund – Existing System Improvements	2,215,000
Water Fund – Renewal and Replacement	8,629,000
SDC Fund – Future System Improvements	48,786,000

RATE PAYER BASE

The water customer profile in Oregon City is dominated by single family residential rate payers but also includes a mix of multi-family, commercial, institutional, and industrial customers. In order to evaluate water revenues from all customers and evaluate rate impacts, it is useful to consider the rate payer base in terms of equivalent single family units (ESFUs). Table 9-2 presents data for Fiscal Year 2008-09 that indicates the total number of existing ESFUs and the average rate of revenue per ESFU. This data indicates that each single family customer (ESFU) paid $373/year for water service or about $31/month. The average single family customer uses just under 936 cubic feet or 7,000 gallons of water per month.

Table 9-2. Rate Payer Base Equivalent Single Family Units (ESFUs)

Fiscal Year	Total Water Rate Billings, $/year	Single Family Water Rate Billings, $/year	Single Family Residential Units	Average Payment per Single Family Unit, $/SFU/year	Total System ESFUs
2008/09	4,976,931	3,222,967	8,650	372.60	13,357

It is expected that the number of ESFUs served by the water system will continue to grow with overall system water demand and revenues from water rates can be expected to increase comparably over time. As discussed in Chapter 3 – Water Demand Analysis of the City of Oregon City Water System Distribution Master Plan, water demand will most likely increase at an annual rate of three percent. For purposes of projecting future water system revenues, the ESFU growth is estimated at a conservative one percent annual rate of increase.

City Funding Sources

The City maintains two funds that can be used to finance capital improvement projects for the water distribution system. Each of these funding sources is described in the following sections and a baseline for revenue projections is identified for those funds.

Water Fund (501)

The water fund (identified by fund number 501) is the source of funding for ongoing water operations and improvements for the existing water system. Revenues for the water fund predominantly come from rates with smaller amounts derived from miscellaneous sources such as tapping fees, hydrant draw payments, and interest. Expenses for the water fund primarily include employee salaries and benefits, materials and contract services, capital outlays for new construction and equipment, and debt service on bonds. Table 9-3 summarizes historical revenues and expenses for the water fund during the last four fiscal years

The City currently pays debt service on one remaining bond through the water fund. The debt service schedule for these bonds is summarized in Table 9-4. This bond dates from 2002 and will be paid off in fiscal year 2014/15.

Table 9-3. Historical Water Fund Revenue and Expenses

	Actual 2006-2007	Actual 2007-2008	Budgeted 2008-2009	Actual 2008-2009	Budgeted 2009-2010
Equivalent Single Family Units (ESFUs)				13,357	13,197
Beginning Balance	3,746,830	2,021,140	2,536,651	2,536,651	3,118,009
Revenues					
Water Bills	4,840,566	4,766,367	4,917,272	4,976,931	5,064,790
Misc. Revenues[(a)]	371,926	318,231	176,150	155,418	110,000
SFWB SDC	488,301	220,087	275,500	103,255	100,000
Total Charges for Services	5,700,793	5,304,685	5,368,922	5,235,603	5,274,790
Interest - LGIP	119,462	95,484	120,000	52,810	70,000
Debt Service Interest Income	55,765	42,065	16,000	17,621	16,000
Total Water Fund Revenue	5,876,020	5,442,234	5,504,922	5,306,034	5,360,790
Revenue per Budget	6,285,520	5,449,026	8,041,573	7,842,685	8,478,799
Expenses					
Personal Services	925,119	996,216	1,150,413	1,113,624	1,239,178
Non-CIP Material and Services	2,930,463	2,618,700	3,044,032	2,507,882	3,102,613
Non-CIP Capital Outlays (new equipment)	5,500	0	43,000	0	50,250
CIP Material and Services	21,568	53,325	144,375	61,791	130,000
Debt Service Materials and Services	1,000	500	1,000	500	1,000
CIP Capital Outlays	3,641,517	960,243	1,649,500	1,095,509	1,838,000
Transfers to Fleet Reserve, Maintenance	60,000	61,000	70,000	70,000	55,000
Transfer to Rate Stabilization	20,000	0	0		0
Transfer to Building Reserve	0	0	0	45,000	700,000
Debt Service	406,045	200,245	199,345	199,345	198,051
Total Expenses	8,011,212	4,890,229	6,301,665	5,093,651	7,314,092
Debt Coverage			49,837	0	49,513
Debt Service Reserve			201,393	0	201,393
Contingency			1,488,678		913,801
Total Expenses with reserves and Cont.	8,011,212	4,890,229	8,041,573	5,093,651	8,478,799

(a) Pumping charge, hydrant draw payments, new taps, urban renewal, project management, and misc.

Table 9-4. Bond Debt Service Schedule

Fiscal Year	Debt Service Payment, $/year
2009/10	198,051
2010/11	196319
2011/12	199,138
2012/13	201,393
2013/14	198,179
2014/15	199,485

The historical/budget data and debt service schedule provide a basis for projecting future revenues and expenses for the water fund. Table 9-5 presents the anticipated water fund revenue and expenses for fiscal year 2009/10 that are used as a baseline for the financial projections.

Table 9-5. Fiscal Year 2009/10 Water Fund Baseline for Projections

	2009/10 Projected $	Basis
Beginning Balance	2,749,034	2009-10 Budget
Revenues		
Water Rate Revenues	5,064,790	2009-10 Budget
Miscellaneous Revenues	110,000	2009 -10 Budget
SFWB SDC	100,000	2009 -10 Budget
LGIP Interest	70,000	2009 -10 Budget
Bond Interest	16,000	2009 -10 Budget
Total Revenues	5,360,790	
Expenses		
Personnel Services	1,169,306	2008-09 actual plus 5%
Non-CIP Material & Services	2,579,766	2008-09 actual plus 3%
Non-CIP Capital Outlays	20,000	Historical amount
Other Materials & Services	66,000	Historical amount
Fleet Transfers, Maintenance	60,000	Historical amount
Building Reserve	700,000	Budgeted
Existing Debt Service	198,051	Per debt service schedule
CIP Capital Outlay	1,838,000	Budgeted
Total Expenses	6,631,123	
Net Revenues w/o CIP Outlays	1,267,667	

For the purpose of developing water fund financial projections, water rate and miscellaneous revenues are expected to increase over time at a rate of one percent per year. In addition, a three percent annual rate increase is included which is consistent with the Commissions rate ordinance that is set through Fiscal Year 2014.

Labor costs have historically grown more than the rate of inflation and are projected to increase at an annual rate of five percent. Material and services expenses are projected to increase at three percent per year. Future debt service on existing bonds is based on the debt service schedule. Interest income is expected to decline over time. A one time expense of $1,056,000 is included for the building reserve for Fiscal Year 2010/11. Based on these assumptions, the projected water fund revenues and expenses are projected in Table 9-6 for the next five years.

Table 9-6. Projected Revenue and Expenses

Description	Fiscal Year				
	2011-2012	2012-13	2013-14	2014-15	2015-16
Revenues					
Water Bills	5,478,000	5,697,000	5,925,000	6,162,000	6,408,000
Misc. Revenues	118,000	123,000	128,000	133,000	138,000
SFWB SDC					
Total Charges for Services	5,596,000	5,820,000	6,053,000	6,295,000	6,546,000
Interest - LGIP	70,000	70,000	70,000	70,000	70,000
Debt Service Interest Income	16,000	16,000	16,000	16,000	
Total Water Fund Revenue	5,682,000	5,906,000	6,139,000	6,381,000	6,616,000
Expenses					
Personal Services	1,289,000	1,353,000	1,421,000	1,492,000	1,567,000
Non-CIP Material and Services	2,631,000	2,710,000	2,791,000	2,875,000	2,961,000
Non-CIP Capital Outlays (new equipment)	20,000	20,000	20,000	20,000	20,000
CIP Material and Services	65,000	65,000	65,000	65,000	65,000
Debt Service Materials and Services	1,000	1,000	1,000	1,000	
CIP Capital Outlays					
Transfers to Fleet Reserve Maintenance	60,000	60,000	60,000	60,000	60,000
Transfer to Rate Stabilization					
Transfer to Building Reserve	850,000	850,000	850,000	500,000	500,000
Debt Service	199,000	201,393	198,179	199,485	0
Total Expenses	5,115,000	5,260,393	5,406,179	5,212,485	5,173,000
Operation surplus	567,000	645,607	732,821	1,168,515	1,443,000

System Development Charge Fund (511)

The SDC fund (identified by fund number 511) is the source of funding for the planning, design, and construction of water system expansion projects necessary to accommodate growth. Revenues for the SDC fund come from the SDCs paid by new connections to the water system and interest income. Expenses for the SDC fund primarily include new construction projects with additional funds spent on related planning and design work. Table 9-7 summarizes historical revenues and expenses for the SDC fund during fiscal years 2006/07, 2007/08, and 2008/09 as well as the budgeted amounts for 2009/10.

Table 9-7. SDC Fund Historical and Budget Data

	2006-07 Actual $	2007-08 Actual $	2008-09 [(a)] Actual $	2009-10 Budgeted $
Beginning Balance	2,017,448	888,422	867,425	972,384
Revenues				
Grant	273000			
SDC Revenues	1,051,610	491,219	232,949	300,000
Interest Income	72,675	36,009	18,433	20,000
Total Revenues	1,397,285	527,228	251,382	320,000
Expenses				
Material & Services	54,946	52,218	54,332	82,100
Capital Outlays	2471365	496,009	185,061	110,065
Total Expenses	2,526,311	548,227	239,393	192,165
Net Revenues	-1,129,026	-20,999	11,989	127,835
Ending Balance	888,422	867,423	879,414	1,100,219

(a) Final unaudited figures.

Historical and budget data provide a basis for projecting future revenues and expenses. The budgeted 2009/10 SDC fund revenue and expense amounts are used as a baseline for the financial projections.

The SDC charges were adopted by the City Commission in June 2004. These charges are adjusted annually based on cost indices and the current SDC for a single family dwelling is $3,132. The ordinance provides for an increase based on the increase in construction costs.

Water System Financial Projections

Water Fund Financial Projections. Table 9-8 summarizes the revenues, expenses, and anticipated balance for the water fund. The beginning water fund balance is derived from the current balance less net expenditures projected in the 2009/2010 budget. It is assumed in these projections that water rates will increase at 3 percent per year to keep pace with inflation and system growth.

Table 9-8. Water Fund Financial Projections

Fiscal Year	Total Revenue	Total Expenses	Operating Surplus	Cumulative Balance
				1,479,000
2010/11	5,467,000	5,180,000	287,000	1,766,000
2011/12	5,682,000	5,115,000	567,000	2,333,000
2012/13	5,906,000	5,261,000	645,000	2,978,000
2013/14	6,139,000[1]	5,406,000	733,000	3,711,000
2014/15	6,381,000[1]	5,213,000	1,168,000	4,879,000
2015/16	6,616,000[1]	5,173,000	1,443,000	6,322,000
2016/17	6,878,000[1]	5,340,000	1,538,000	7,860,000
2017/18	7,151,000[1]	5,514,000	1,637,000	9,497,000
2018/18	7,434,000[1]	5,695,000	1,739,000	11,236,000
2019/20	7,728,000	5,882,000	1,846,000	13,082,000

[1]Projected revenue shown requires modification of the City charter to prevent rollback of rates to pre-bond levels.

Based on these projections, a CIP plan is presented in Table 9-9 for the existing system improvements and for the renewal and replacement projects. This table incorporates a 2.5 percent rate of inflation for construction costs.

As noted in Table 9-8, no roll back of rates is assumed for the revenue projection. While it is not clear how the rate roll back would be interpreted and implemented, a roll back to pre-bond levels would not allow for continued operations, let alone financing of any improvements.

SDC Fund Financial Projections. Table 9-10 summarizes the revenues for the SDC fund for the next ten fiscal years. The beginning SDC fund balance is derived from the current balance less net expenditures projected in the 2009/2010 budget. The growth shown in this projection is based on a one percent increase in EDUs through 2012 and then an average growth of two percent. In addition, construction costs are projected to increase by 2.5 percent per year and the SDC charge will be adjusted annually to reflect this increase.

By Fiscal Year 2020, about 25 percent of the capital projects shown in Table 9-1 can be funded using SDC funds. At that time, about $3 million dollars will also be available in the water fund that could be transferred to system expansion.

Table 9-9. Capital Improvement Plan for the Water Fund

Capital Improvement Description	CIP Number	Capital Cost,$	Fiscal Year								
			2011-2012	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-2020
Existing System Improvements											
New Pipeline & PRV	CIP-V- 101	387,533	397,221								
New Pipeline & PRV	CIP-V- 102	209,050	214,276								
New Pipeline & PRV	CIP-V- 103	118,840	121,811								
Pipeline Improvement	CIP-P-104	1,025,096	1,050,723								
Pipeline Improvement	CIP-P-105	434,811	445,681								
Renewal and Replacement											
View Manor Pressure Zone, PRV#15, 4-inch diameter (150 lf) and 8-inch diameter (4397 lf)	50	968,571			1,043,045						
Clairmont Area, 8-inch diameter (9513 lf) and 10-inch diameter (3920 lf)	51	3,009,055									3,757,897
Weleber St to Harding Blvd, 8-inch diameter	52	1,617,316				1,785,214					
I-205 crossing between pope Lnae and Park Place Ct, 8-inch diameter	53	119,347					135,030				
15th St from Main St to Division St, PRV#2, 6-inch diameter (85 lf), 8-inch diameter (1797 lf) and 10-inch diameter (2174 lf)	55	935,071						1,084,396			
Main St fron 5th St to 18th St, 8-inch diameter (1023 lf), 10-inch diameter (2558 lf) and 12-inch diameter (535 lf)	58	1,012,992							1,204,129		
South End Rd and Warner Parrott Rd, 8-inch diameter	59	1,190,246								1,450,199	
Seismic and mixing improvements for Boynton Reservoir	60	560,640					634,313				
Total Capital Expenditures		11,588,567	2,229,713	0	1,043,045	1,785,214	769,343	1,084,396	1,204,129	1,450,199	3,757,897
Operating Surplus			567,000	645,607	732,821	1,168,515	1,443,000	1,538,000	1,637,000	1,740,000	1,846,000
Available Funds from Water Operations			2,333,000	748,894	1,481,715	1,607,185	1,264,971	2,033,629	2,586,233	3,122,104	3,517,904
Ending Water Fund Balance			103,287	748,894	438,670	-178,029	495,629	949,233	1,382,104	1,671,904	-239,993

Table 9-10. SDC Fund Projections

Fiscal Year	Revenue, $	Cumulative, $
2009/10	320,000	1,100,000
2010/11	417,000	1,517,000
2011/12	426,000	1,943,000
2012/13	882,000	2,825,000
2013/14	922,000	3,747,000
2014/15	964,000	4,711,000
2015/16	1,008,000	5,719,000
2016/17	1,054,000	6,773,000
2017/18	1,101,000	7,874,000
2018/18	1,152,000	9,026,000

Other Financing

The financial projections indicate that the City will be able to fund water system improvements on a pay-as-you-go basis except for extension of the system in the growth areas. An alternate source for funding would be required to fund all of the future projects identified in Chapter 7 – Future Water Distribution System Evaluation of the City of Oregon City Water System Distribution Master Plan. The sale of revenue bonds, which would be backed by the City's ability to collect service fees from system users, would generally be the recommended financing tool for meeting the projected funding shortfalls associated with implementation of the capital plan. To sell bonds, the City would be required to reserve one year of debt service and increase rates to cover the cost of the bonds. It is important to note that since 1996, the City charter requires approval of the sale of revenue bonds by a vote of the people. Furthermore, the charter requires that rates be reduced to pre-bond issue levels once the existing bond issue is fully retired. It is not known how this requirement will be met and the projections in this plan do not reflect any reduction in rates.

Given the current market for bonds, it would be difficult to market bonds until such time that the City alters its charter and establishes a higher level of certainty for potential purchasers of bonds. In addition, the City would also need to obtain voter approval for revenue bond financing. Prior to any revenue bond vote, it is critical that the City Commission, with the approval of the voters, move to eliminate the existing water user fee regression provision that is currently in the City Charter (Section 58). If left in place, this provision will obstruct the City's ability to obtain financing.

No new bonding is included in the projections provided in this section. Thus, decisions on priorities for system expansion will need to be made based on growth pressure that occurs when development is moving forward.

CHAPTER 9. WATER DISTRIBUTION SYSTEM FINANCING PLAN

The development of a financing plan supports the planning for implementation of the recommended capital improvement plan (CIP). The following section presents information that the City will need to make financing and implementation decisions. The recommended CIP projects are presented in three groups. The projects for the improvement of the existing system and for renewal and replacement generally need to be funded from rates. Projects shown for future system expansion should primarily be funded from water system development charges (SDCs). Data on the number of users as well as background information regarding historical revenues and expenses associated with the City's water fund are presented as background information. This historical data provides a basis for projecting future water system revenues and expenses.

Because the current City charter requires that rates be rolled back once the bonds are paid, several scenarios for future rates are evaluated. Scenarios include continuation of the existing level of services and costs, a rollback of rates, and rates that are required for maintaining the system at a sustainable level of system replacements.

CIP PROJECT COST SUMMARY

The existing water distribution system can generally provide the required level of service with the exception that several pipeline improvement projects are needed to increase the available fire flows. Because some of the Oregon City water distribution system is relatively old, there is a backlog of pipeline replacement projects that need to be addressed. The most critical projects are included in the current CIP. The estimated capital costs for both the existing system improvements and the replacement projects are shown in Table 9-1.

Table 9-1. CIP Project Cost Summary by Source of Funds

Funding Source	Capital Cost, $
Existing System Improvements	2,215,000
Renewal and Replacement	8,629,000
Future System Improvements	48,786,000

There are approximately 154 miles of pipelines in the City. Experience has shown that the useful life of water lines in the area is somewhere between 50 and 75 years. Assuming a service life of 75 years, the City should replace approximately two miles per year to maintain the existing system in good condition. This would require a capital investment of $2.3 million per year in today's dollars. As currently planned, capital expenditures will not allow the City to maintain the water infrastructure on a long term sustainable basis. The City needs to move deliberately towards a more sustainable level of capital expenditures. A revision of the existing charter will be required to support this level of investment.

Also shown in Table 9-1 are the projects that will be required to extend water service into the urban growth boundary area that will be served by the City. As the City grows and developers need water system extensions, the City should be prepared to construct the improvements necessary for the planned growth. Some projects could be funded by developers and they could be reimbursed based on the capacity provided to other users. System development charges can be used to finance such improvements.

RATE PAYER BASE

The water customer profile in Oregon City is dominated by single family residential rate payers but also includes a mix of multi-family, commercial, institutional, and industrial customers. In order to evaluate water revenues from all customers and evaluate rate impacts, it is useful to consider the rate payer base in terms of equivalent single family units (ESFUs). Table 9-2 presents data for Fiscal Years 2008-09 through 2010-11and shows the total number of existing ESFUs and the average rate of revenue per ESFU. This data indicates that each single family customer (ESFU) paid about $370/year for water service or about $31/month. The typical single family customer uses an average of about 7,000 gallons of water per month. During years with a wet summer, domestic water consumption and corresponding revenue can drop significantly.

Table 9-2. Rate Payer Base Equivalent Single Family Units (ESFUs)

Fiscal Year	Total Water Rate Billings, $/year	Single Family Water Rate Billings, $/year	Single Family Residential Units	Average Payment per Single Family Unit, $/SFU/year	Total System ESFUs
2008/09	4,976,931	3,222,967	8,650	372.60	13,357
2009/10	$4,978,738	$3,244,067	8,615	376.60	13,221
2010/11	$5,089,063	$3,154,080	8,718	361.80	14,066

The number of single family connections decreased in 2009-10 when the economy suffered a recession but the number of connections has recovered. It is expected that the number of ESFUs served by the water system will continue to grow, and overall system water demand and revenues from water rates can be expected to increase comparably over time. As discussed in Chapter 3 – Water Demand Analysis of the City of Oregon City Water System Distribution Master Plan, water demand will most likely increase at an annual rate of three percent. For purposes of projecting future water system revenues, the ESFU growth is estimated at a conservative one percent annual rate of increase.

CITY FUNDING SOURCES

The City maintains two funds that can be used to finance capital improvement projects for the water distribution system. Each of these funding sources is described in the following sections and a baseline for revenue projections is identified for those funds.

Water Fund (501)

The water fund (identified by fund number 501) is the source of funding for ongoing water operations and improvements for the existing water system. Revenues for the water fund predominantly come from rates with smaller amounts derived from miscellaneous sources such as tapping fees, hydrant draw payments, and interest. Expenses for the water fund primarily include employee salaries and benefits, materials and contract services, capital outlays for new construction and equipment, and debt service on bonds. Table 9-3 summarizes historical revenues and expenses for the water fund during the last five fiscal years and shows the current budget.

Table 9-3. Historical Water Fund Revenue

	Actual 2006-2007	Actual 2007-2008	Actual 2008-2009	Actual 2009-2010	Estimated 2010-2011	Budgeted 2011-2012
Equivalent Single Family Units (ESFUs)			13,357	12,611	12,339	11,668
Beginning Balance	$3,746,830	$2,021,140	$2,536,651	$2,792,322	$1,403,363	$1,029,456
Revenues						
Water Bills	$4,840,566	$4,766,367	$4,976,931	$4,978,738	$5,089,043	$4,963,711
Misc. Revenues*	$371,926	$318,231	$155,419	$210,062	$230,100	$130,000
SFWB SDC	$488,301	$220,087	$103,255	$198,050	$117,687	$150,000
Total Charges for Services	$5,700,793	$5,304,685	$5,235,605	$5,386,850	$5,436,830	$5,243,711
Interest - LGIP	$119,462	$95,484	$52,810	$15,383	$6,124	$10,000
Debt Service Interest Income	$55,765	$42,065	$17,621	$4,737	$1,342	$2,000
Total Water Fund Revenue	$5,876,020	$5,442,234	$5,306,036	$5,406,970	$5,444,296	$5,255,711
Revenue per budget	$6,285,520	$5,449,026	$7,842,687	$8,199,292	$6,847,659	$6,285,167
Expenses						
Personal Services	$925,119	$996,216	$1,113,627	$1,210,350	$1,277,426	$1,363,626
Non-CIP Material and Services	$2,930,463	$2,618,700	$2,507,885	$2,694,578	$2,767,792	$3,010,617
Non-CIP Capital Outlays (new equipment)	$5,500	$0	$0	$35,704	$15,960	$5,000
CIP Material and Services	$21,568	$53,325	$106,791	$116,608	$59,760	$65,000
Debt Service Materials and Services	$1,000	$500	$500	$500	$500	$1,000
CIP Capital Outlays	$3,641,517	$960,243	$1,095,509	$1,785,142	$498,553	$300,000
Transfers to Fleet Reserve, Maintenance	$60,000	$61,000	$70,000	$55,000	$52,500	$70,000
Transfer to Rate Stabilization	$20,000	$0				$0
Transfer to Building Reserve	$0	$0	$45,000	$700,000	$450,000	$400,000
Debt Service	$406,045	$200,245	$199,345	$198,051	$196,318	$199,138
Total Expenses	$8,011,212	$4,890,229	$5,138,657	$6,795,933	$5,318,809	$5,414,381
Debt Coverage			$0	$0	$0	$49,785
Debt Service Reserve			$0	$0	$0	$201,393
Contingency						$619,608
Total Expenses with reserves and Contingency	$8,011,212	$4,890,229	$5,138,657	$6,795,933	$5,318,809	$6,285,167

The City currently pays debt service on one remaining bond through the water fund. The debt service schedule for these bonds is summarized in Table 9-4. This bond dates from 2002 and will be paid off in fiscal year 2014/15.

Table 9-4. Bond Debt Service Schedule

Fiscal Year	Debt Service Payment, $/year
2009/10	198,051
2010/11	196319
2011/12	199,138
2012/13	201,393
2013/14	198,179
2014/15	199,485

The historical/budget data and debt service schedule provide a basis for projecting future revenues and expenses for the water fund. Since the revenue budgeted necessarily needs to be conservative, the revenue projected in the various scenarios is somewhat more than the Fiscal Year 2011-12 budget.

For the purpose of developing water fund financial projections, water rate and miscellaneous revenues are expected to increase over time at a rate of one percent per year but with no growth for the first two fiscal years. Labor costs have historically grown more than the rate of inflation and are projected to increase at an annual rate of five percent. Material and services expenses are projected to increase at three percent per year. Future debt service on existing bonds is based on the debt service schedule. Interest income is expected to decline over time.

For purposes of evaluating future rate requirements, the following three scenarios are presented below:

1. Projection Scenario 1- No rollback of rates and 3% annual rate increase
2. Projection Scenario 2 – Rate rollback in Fiscal Year 2015-16 and 3% rate increase
3. Projection Scenario 3 – Sustainable system investment

Projection Scenario 1

The City has for several years increased charges at a rate of 3-percent which is the maximum allowed by the City Charter. This has been sufficient to construct some capital improvements ranging from $300,000 in the current fiscal year to $3.7 million in Fiscal Year 2006-07. If the City Charter were changed to eliminate the rollback and the rates were to continue to increase at a rate of three percent per year, capital expenditures could be maintained starting at $700,000 per year and slowly increasing to $1.5 million by Fiscal Year 2021-2022. This represents the total of funds available and capital expenditures for water system improvements would be reduced by the transfers to the building reserve fund. This projection is shown in Table 9-5.

Projection Scenario 2

The City Charter requires rates to be rolled back to pre-bond issue levels with an annual maximum increase of three percent. The final debt service payment will be made in Fiscal Year 2014-15 so revenue for the following fiscal year will decrease as the rates are adjusted. It is not clear how the rollback of rates would be interpreted and the impact of the rollback could be quite variable.

Based on the estimates provided by the Finance Department, Fiscal Year 2015-16 revenues are reduced by approximately $1.3 million to reflect the rollback of rates. This rollback is based on the following assumptions:

- The rate increase adopted by the City in Fiscal Year 1993-94 would be rolled back to the previous rates.
- Rates would be increase by three percent per year as allowed by the charter.

Once this rollback is implemented, the water fund will have an annual deficit of approximately $300,000 plus whatever funds are needed for capital expenditures including the building reserves. Table 9-6 shows the projections based on the rollback of rates. If the assumption is that in those years when the City did not increase rates, no rate increase is computed, the rollback would cause an annual fund deficit of about 1.5 million dollars with no capital expenditures.

Projection Scenario 3

Utilities should invest in the replacement of their infrastructure based on the useful life of the facilities. While reservoirs and pump stations have a limited useful life, periodic rehabilitation can restore the useful life of these facilities. For example, the improvements to the Mountain

View Reservoir improved its structural capacity to resist earthquakes based on current code requirements. However, pipelines have a given useful life and need to be replaced and an annual investment of $2.3 million is recommended. A 10-percent rate increase in Fiscal Year 2015-16 followed by two years of a 5-percent increase will allow the City to increase its investment to reach $2.3 million at the end of the planning period. At this level of investment, barring unforeseen demands related to water treatment, the utility will be operating on a sustainable, pay-as-you-go basis for long term operation. This projection scenario is shown in Table 9-7.

System Development Charge Fund (511)

The SDC fund (identified by fund number 511) is the source of funding for the planning, design, and construction of water system expansion projects necessary to accommodate growth. Revenues for the SDC fund come from the SDCs paid by new connections to the water system and interest income. Expenses for the SDC fund primarily include new construction projects with additional funds spent on related planning and design work. Table 9-8 summarizes historical revenues and expenses for the SDC fund and shows that almost $1 million is available for eligible projects.

Table 9-8. SDC Fund Historical Data

	2007-08 Actual $	2008-09 Actual $	2009-10 Actual $	2010-11 Actual, $
Beginning Balance	888,422	867,425	879,413	909,238
Revenues				
Grant				
SDC Revenues	491,219	232,949	443,101	265,602
Interest Income	36,009	18,433	6,184	4,638
Total Revenues	527,228	251,382	449,285	270,240
Expenses				
Material & Services	52,218	54,332	65,447	53,758
Capital Outlays	496,009	185,061	354,012	161,342
Total Expenses	548,227	239,393	419,459	215,100
Net Revenues	-20,999	11,989	29,826	55,140
Ending Balance	867,425	879,413	909,238	964,378

The SDC charges were adopted by the City Commission in June 2004. These charges are adjusted annually based on cost indices and the current SDC for a single family dwelling is $3,123. The ordinance provides for an increase based on the increase in construction costs.

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Table 9-5. Projection Scenario 1 - No Rollback and 3% Rate Increases

Description	Fiscal Year										
	2011-2012	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-2020	2020-2021	2021-2022
Equivalent Single Family Units (ESFUs)	0	0	0	0	0	0	0	0	0	0	0
Beginning Balance	1,029,000	1,356,000	1,039,000	476,000	785,000	1,215,000	649,000	1,192,000	631,000	281,000	1,170,000
Revenues											
Water Bills	5,191,000	5,347,000	5,507,000	5,727,000	5,956,000	6,194,000	6,442,000	6,700,000	6,968,000	7,247,000	7,537,000
Misc. Revenues	130,000	134,000	138,000	144,000	150,000	156,000	162,000	168,000	175,000	182,000	189,000
SFWB SDC	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000
Total Charges for Services	5,471,000	5,631,000	5,795,000	6,021,000	6,256,000	6,500,000	6,754,000	7,018,000	7,293,000	7,579,000	7,876,000
Interest - LGIP	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000
Debt Service Interest Income	2,000	2,000	2,000	2,000							
Total Water Fund Revenue	5,483,000	5,643,000	5,807,000	6,033,000	6,266,000	6,510,000	6,764,000	7,028,000	7,303,000	7,589,000	7,886,000
Expenses											
Personal Services	1,364,000	1,432,000	1,504,000	1,579,000	1,658,000	1,741,000	1,828,000	1,919,000	2,015,000	2,116,000	2,222,000
Non-CIP Material and Services	3,011,000	3,101,000	3,194,000	3,290,000	3,389,000	3,491,000	3,596,000	3,704,000	3,815,000	3,929,000	4,047,000
Non-CIP Capital Outlays (new equipment)	5,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000
CIP Material and Services	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000
Debt Service Materials and Services	1,000	1,000	1,000	1,000							
CIP Capital Outlays	41,000	220,000	468,000	0	134,000	1,189,000	142,000	1,311,000	1,168,000	0	1,329,000
Transfers to Fleet Reserve, Maint.	70,000	70,000	70,000	70,000	70,000	70,000	70,000	70,000	70,000	70,000	70,000
Transfer to Rate Stabilization	0										
Transfer to Building Reserve	400,000	850,000	850,000	500,000	500,000	500,000	500,000	500,000	500,000	500,000	500,000
Debt Service	199,000	201,393	198,179	199,485	0	0	0		0	0	0
Total Expenses	5,156,000	5,960,393	6,370,179	5,724,485	5,836,000	7,076,000	6,221,000	7,589,000	7,653,000	6,700,000	8,253,000
Operation surplus	327,000	(317,393)	(563,179)	308,515	430,000	(566,000)	543,000	(561,000)	(350,000)	889,000	(367,000)
Ending Fund Balance	1,356,000	1,038,607	475,821	784,515	1,215,000	649,000	1,192,000	631,000	281,000	1,170,000	803,000

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Table 9-6. Projection Scenario 2 - Rate Rollback and 3% Rate Increase

Description	Fiscal Year										
	2011-2012	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-2020	2020-2021	2021-2022
Equivalent Single Family Units (ESFUs)	0	0	0	0	0	0	0	0	0	0	0
Beginning Balance	1,029,000	1,097,000	1,000,000	905,000	1,214,000	759,000	302,000	(156,000)	(615,000)	(1,074,000)	(1,533,000)
Revenues											
Water Bills	5,191,000	5,347,000	5,507,000	5,727,000	4,437,000	4,614,000	4,799,000	4,991,000	5,191,000	5,399,000	5,615,000
Misc. Revenues	130,000	134,000	138,000	144,000	150,000	156,000	162,000	168,000	175,000	182,000	189,000
SFWB SDC	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000
Total Charges for Services	5,471,000	5,631,000	5,795,000	6,021,000	4,737,000	4,920,000	5,111,000	5,309,000	5,516,000	5,731,000	5,954,000
Interest - LGIP	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000
Debt Service Interest Income	2,000	2,000	2,000	2,000							
Total Water Fund Revenue	5,483,000	5,643,000	5,807,000	6,033,000	4,747,000	4,930,000	5,121,000	5,319,000	5,526,000	5,741,000	5,964,000
Expenses											
Personal Services	1,364,000	1,432,000	1,504,000	1,579,000	1,658,000	1,741,000	1,828,000	1,919,000	2,015,000	2,116,000	2,222,000
Non-CIP Material and Services	3,011,000	3,101,000	3,194,000	3,290,000	3,389,000	3,491,000	3,596,000	3,704,000	3,815,000	3,929,000	4,047,000
Non-CIP Capital Outlays (new equipment)	5,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000
CIP Material and Services	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000
Debt Service Materials and Services	1,000	1,000	1,000	1,000							
CIP Capital Outlays	300,000										
Transfers to Fleet Reserve, Maint.	70,000	70,000	70,000	70,000	70,000	70,000	70,000	70,000	70,000	70,000	70,000
Transfer to Rate Stabilization	0										
Transfer to Building Reserve	400,000	850,000	850,000	500,000	0	0	0	0	0	0	0
Debt Service	199,000	201,393	198,179	199,485	0	0	0	0	0	0	0
Total Expenses	5,415,000	5,740,393	5,902,179	5,724,485	5,202,000	5,387,000	5,579,000	5,778,000	5,985,000	6,200,000	6,424,000
Operation surplus	68,000	(97,393)	(95,179)	308,515	(455,000)	(457,000)	(458,000)	(459,000)	(459,000)	(459,000)	(460,000)
Ending Fund Balance	1,097,000	999,607	904,821	1,213,515	759,000	302,000	(156,000)	(615,000)	(1,074,000)	(1,533,000)	(1,993,000)

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Table 9-7. Projection Scenario 3 - Sustainable System Investment

Description	Fiscal Year										
	2011-2012	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-2020	2020-2021	2021-2022
Equivalent Single Family Units (ESFUs)	0	0	0	0	0	0	0	0	0	0	0
Beginning Balance	1,029,000	1,356,000	1,039,000	476,000	654,000	459,000	378,000	583,000	851,000	1,148,000	601,000
Revenues											
Water Bills	5,191,000	5,347,000	5,507,000	5,727,000	6,357,000	6,738,000	7,142,000	7,428,000	7,725,000	8,034,000	8,355,000
Misc. Revenues	130,000	134,000	138,000	144,000	150,000	156,000	162,000	168,000	175,000	182,000	189,000
SFWB SDC	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000
Total Charges for Services	5,471,000	5,631,000	5,795,000	6,021,000	6,657,000	7,044,000	7,454,000	7,746,000	8,050,000	8,366,000	8,694,000
Interest - LGIP	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000
Debt Service Interest Income	2,000	2,000	2,000	2,000							
Total Water Fund Revenue	5,483,000	5,643,000	5,807,000	6,033,000	6,667,000	7,054,000	7,464,000	7,756,000	8,060,000	8,376,000	8,704,000
Expenses											
Personal Services	1,364,000	1,432,000	1,504,000	1,579,000	1,658,000	1,741,000	1,828,000	1,919,000	2,015,000	2,116,000	2,222,000
Non-CIP Material and Services	3,011,000	3,101,000	3,194,000	3,290,000	3,389,000	3,491,000	3,596,000	3,704,000	3,815,000	3,929,000	4,047,000
Non-CIP Capital Outlays (new equipment)	5,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000
CIP Material and Services	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000
Debt Service Materials and Services	1,000	1,000	1,000	1,000							
CIP Capital Outlays	41,000	220,000	468,000	131,000	1,160,000	1,248,000	1,180,000	1,210,000	1,278,000	2,223,000	1,963,000
Transfers to Fleet Reserve, Maint.	70,000	70,000	70,000	70,000	70,000	70,000	70,000	70,000	70,000	70,000	70,000
Transfer to Rate Stabilization	0										
Transfer to Building Reserve	400,000	850,000	850,000	500,000	500,000	500,000	500,000	500,000	500,000	500,000	500,000
Debt Service	199,000	201,393	198,179	199,485	0	0	0		0	0	0
Total Expenses	5,156,000	5,960,393	6,370,179	5,855,485	6,862,000	7,135,000	7,259,000	7,488,000	7,763,000	8,923,000	8,887,000
Operation Surplus	327,000	(317,393)	(563,179)	177,515	(195,000)	(81,000)	205,000	268,000	297,000	(547,000)	(183,000)
Ending Fund Balance	1,356,000	1,038,607	475,821	653,515	459,000	378,000	583,000	851,000	1,148,000	601,000	418,000
Rate Increase		3%	3%	3%	10%	5%	5%	3%	3%	3%	3%

Projects included in Table 8-2 are planned for serving the urban growth boundary and are fully eligible to be funded from SDC reserves. The timing for these projects will be driven by the timing of development.

WATER SYSTEM FINANCIAL PLAN

Table 9-9 summarizes the existing system improvements and for the renewal and replacement projects. In addition to these projects, Chapter 8 identifies numerous additional projects presented as unfunded replacement projects since the available capital is less than the scope of the existing demand for replacement.

Table 9-9. Capital Improvement Plan for the Water Fund

Capital Improvement Description	CIP Number	Capital Cost,$
Existing System Improvements		
New Pipeline & PRV	CIP-P- 108	39,936
New Pipeline & PRV	CIP-V- 102	209,050
New Pipeline & PRV	CIP-V- 103	118,840
Pipeline Improvement	CIP-P-104	1,025,096
Pipeline Improvement	CIP-P-105	434,811
Renewal and Replacement		
View Manor Pressure Zone, PRV#15, 4 inch diameter (150 lf) and 8 inch diameter (4397 lf)	50	1,076,091
Clairmont Area, 8 inch diameter (9513 lf) and 10 inch diameter (3920 lf)	51	3,009,055
Weleber St to Harding Blvd, 8 inch diameter	52	1,617,316
I-205 Crossing between Pope Lane and Park Place Court, 8 inch diameter	53	119,347
15th St from Main St to Division St, PRV#2, 6 inch diameter (85 lf) ,8 inch diameter (1797 lf) and 10 inch diameter (2174 lf)	55	935,071
Main St from 5th St to 18th St, 8 inch diameter (1023 lf), 10 inch diameter (2558 lf) and 12 inch diameter (535 lf)	58	1,012,992
South End Rd and Warner Parrott Rd, 8 inch diameter	59	1,190,246
Seismic and Mixing Improvements for Boynton Reservoir	60	560,640
Total Capital Expenditures		11,308,554

For Scenario 1, approximately half of the dollar value of the projects could be funded. As shown in Table 9-10, some capital expenditures are feasible but well below the level necessary for the identified projects or at a sustainable level of replacement. Table 9-10 is premised on a 2.5% rate of inflation for capital projects and an average of about $560,000 is available for capital improvements other than the building fund reserve.

For Scenario 2, no funds are available for financing improvements. Even with no capital improvements, the water fund will have an annual deficit of $0.5 million.

For Scenario 3, pay-as-you-go financing is available to fund the projects defined in the master plan. As shown in Table 9-11, most of the projects identified in the master plan can be funded. More important, the level of funding that is established by this approach provides for a level of capital investment that is sustainable.

Table 9-10. Scenario 1 Financial Plan

Capital Improvement Description	CIP Number	Capital Cost,$	Fiscal Year 2011-2012	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-2020	2020-21	2021-2022
Existing System Improvements													
Pipeline Improvement	CIP-P-108	39,936	40,934										
New Pipeline & PRV	CIP-V- 102	209,050		219,633									
New Pipeline & PRV	CIP-V- 103	118,840					134,457						
Pipeline Improvement	CIP-P-104	1,025,096						1,188,797					
Pipeline Improvement	CIP-P-105	434,811			468,244								
Renewal and Replacement													
View Manor Pressure Zone, PRV#15, 4 inch diameter (150 lf) and 8 inch diameter (4397 lf)	50	1,076,091								1,311,112			
Clairmont Area, 8 inch diameter (9513 lf) and 10 inch diameter (3920 lf)	51	3,009,055											
Welcber St to Harding Boulevard, 8 inch diameter	52	1,617,316											
I-205 Crossing between Pope Lane and Park Place Court, 8 inch diameter	53	119,347							141,866				
15th Street from Main Street to Division Street, PRV#2, 6 inch diameter (85 lf), 8 inch diameter (1797 lf) and 10 inch diameter (2174 lf)	55	935,071									1,167,776		
Main Street froM 5th Street to 18th Street, 8 inch diameter (1023 lf), 10 inch diameter (2558 lf) and 12 inch diameter (535 lf)	58	1,012,992											1,329,133
South End Road and Warner Parrott Road, 8 inch diameter	59	1,190,246											
Seismic and Mixing Improvements for Boynton Reservoir	60	560,640											
Total Capital Expenditures		11,348,490	40,934	219,633	468,244	0	134,457	1,188,797	141,866	1,311,112	1,167,776	0	1,329,133
Operating Surplus			327,000	(317,000)	(563,000)	309,000	430,000	(566,000)	543,000	(561,000)	(350,000)	889,000	(367,000)
Available Funds from Water Operations		1,029,000	1,356,000	1,039,000	476,000	785,000	1,215,000	649,000	1,192,000	631,000	281,000	1,170,000	803,000

RECOMMENDATIONS

Based on the assessment of existing financial conditions, Oregon City should take immediate action to improve the water utility financial conditions. The City has a valuable investment in the water distribution infrastructure and should take steps to ensure its long term viability.

Recommendation 1	**Begin a dialogue with the citizens to explain the current conditions with the goal to remove the Charter requirement for a rate rollback and to allow a one-time rate adjustment.** The City will soon have retired its debt for the water system and the prospect for maintaining the system debt free is excellent. A rate rollback will reverse the gains that have been made in the system and will prevent the operation of the water utility on a sustainable basis. A recent review of staffing for operation and maintenance of water distribution systems was completed for Milwaukie, Oregon City, Clackamas River Water and the Oak Lodge Water District. Oregon City has a staffing level that is comparable to these systems and significant staffing cuts are not viable.
Recommendation 2	**Implement rate increases to place the water distribution system on a pay-as-you-go financing program for replacement of old pipelines.** While rate increases are difficult, a proactive program to replace aged piping will save future expenditures. Experience in the industry has clearly shown that a proactive replacement program saves money. Once a significant percentage of a utility system exceeds its useful life, system breaks and leaks will increase and emergency response is more expensive and causes more public disruption. The deterioration of the system will continue to the degree where a pay-as-you-go financing program will no longer be viable because the backlog of required work will be overwhelming.
Recommendation 3	**Bill system users directly for water treatment costs that are adopted by the South Fork Water Board.** The costs for water production depend on the actions of the South Fork Water Board (SFWB) and are outside the direct control of the City Commission, except to the degree that the City participates on the board. When the South Fork Water Board adopts higher rates, the City would bill these rates as approved by the SFWB. Higher water treatment costs should not diminish the source of funding for the water distribution system. The SFWB needs to set rates which the City can bill and pass on the revenue to the SFWB based on the collected revenue corresponding to the approved SFWB rates.

DRAFT

Table 9-11. Scenario 3 Financial Plan

Capital Improvement Description	CIP Number	Capital Cost,$	Fiscal Year 2011-2012	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-2020	2020-21	2021-2022
Existing System Improvements													
Pipeline Improvement	CIP-P-108	39,936	40,934										
New Pipeline & PRV	CIP-V- 102	209,050		219,633									
New Pipeline & PRV	CIP-V- 103	118,840				131,177							
Pipeline Improvement	CIP-P-104	1,025,096					1,159,802						
Pipeline Improvement	CIP-P-105	434,811			468,244								
Renewal and Replacement													
View Manor Pressure Zone, PRV#15, 4 inch diameter (150 lf) and 8 inch diameter (4397 lf)	50	1,076,091						1,247,936					
Clairmont Area, 8 inch diameter (9513 lf) and 10 inch diameter (3920 lf)	51	3,009,055							1,180,351	1,209,860	1,277,685		
Weleber Street to Harding Boulevard, 8 inch diameter	52	1,617,316										2,070,301	
I-205 Crossing between Pope Lane and Park Place Court, 8 inch diameter	53	119,347										152,774	
15th Street from Main Street to Division Street, PRV#2, 6 inch diameter (85 lf), 8 inch diameter (1797 lf) and 10 inch diameter (2174 lf)	55	935,071											1,226,894
Main Street from 5th Street to 18th Street, 8 inch diameter (1023 lf), 10 inch diameter (2558 lf) and 12 inch diameter (535 lf)	58	1,012,992											
South End Road and Warner Parrott Road, 8 inch diameter	59	1,190,246											
Seismic and Mixing Improvements for Boynton Reservoir	60	560,640											735,608
Total Capital Expenditures		11,348,490	40,934	219,633	468,244	131,177	1,159,802	1,247,936	1,180,351	1,209,860	1,277,685	2,223,075	1,962,502
Operating Surplus			327,000	(317,000)	(563,000)	178,000	(195,000)	(81,000)	205,000	268,000	297,000	(547,000)	(183,000)
Ending Water Fund Balance		1,029,000	1,356,000	1,039,000	476,000	654,000	459,000	378,000	583,000	851,000	1,148,000	601,000	418,000

Clackamas River Water

P.O. Box 2439
Clackamas, Oregon 97015-2439
(503) 722-9220
Fax (503) 656-7086
16770 SE 82nd Drive, Clackamas
customerservice@crwater.com

April 18, 2011

Mr. Tony Konkol, Community Development Director
City of Oregon City Planning Department
221 Molalla Avenue, Suite 200
Oregon City, OR 97045

RE: Notice of and Hearing for Update of Water Distribution System Master Plan for
L 10-02;Clackamas River Water ("CRW") Water Master Plan Response

Mr. Konkol:

This letter contains CRW's comments to support CRW's request that the application for the above referenced updated master plan should be deemed incomplete by the City. CRW is a domestic water supply district organized under ORS Chapter 264 and is therefore a necessary party to this proceeding.

This filing is CRW's initial comments concerning the proposed update of Water Distribution System Master Plan (L 10-02) for Oregon City. These comments are related to the three major work products that resulted for the updated water master plan.

- The Diurnal Curve development Technical Memorandum
  - **CRW Response** : No Comment
- The recommended Capital Improvement Program (CIP) for the City's existing and future water system including renewal and replacement pipeline projects.
  - **CRW Response:** Based on Figure ES-2, the map indicated several essential transmission mains that are currently owned and operated by CRW appear to be incorporated into the City future distribution system. These transmission mains will remain critical to the continuation of operations of CRW. If service is provide by the City in these proposed expanded areas we should mutually agree to negotiate a service agreement, similar to what we have done in other areas of the distribution system.

    The City's updated Master Plan has not yet been communicated with CRW. Absent such communication we run the risk of developing and maintaining dual mains within common service areas and possible duplication of storage requirements.
  - It should be noted that Figure ES-2 does not include the boundaries of the Urban and Rural Reserves. These boundaries are critical in long term planning for water for both the City and CRW. Areas such as Henrici Road, the Park Place Concept

Plan area, Barlow Crest/Forsythe are all within the boundaries as outlined in the IGA between Metro and Clackamas County. These areas need to be closely coordinated to provide water service at the most reasonable cost.

- The financing plan addresses implementation of the recommended CIP. It is our understanding that the 1996 city charter requires the rates to be rolled back to pro-bond levels once the bonds are paid, which will occur in the Fiscal Year 2014-15. It is also our belief that the City is required to address this requirement before any long term water fund planning can realistically be established.
  - **CRW Comment:** It appears that the City may have future financing issues related to water improvements. Both the City and CRW would benefit financially if common use of facilities could be determined as part of the long term plan to service.

    In addressing the financial criteria required for future infrastructure the City may want to consider whether the Water Master Plan will eliminate or avoid unnecessary duplication of services between our respective entities.

While this list is a partial list of comments, CRW will also reserve the right to raise additional issues that are not, and cannot be, adequately addressed until a final copy of the master plan is development and provided for CRW's review.

It is understood that annexations and service boundary withdrawals are not covered in the water master plan. In working with the City's City Engineer/Public Works Director both the City and CRW are in the process of bringing this issue to a discussion level. These discussions will need to address assumption of liabilities and indebtedness as provided under ORS 222.520.

While CRW would like to support this update of Water Distribution System Master Plan, it cannot do so at this time because of the issues discussed above. CRW is confident that through continued discussions with the City's City Engineer/Public Works Director these issues will be resolved. Both the City and CRW are planning and budgeting toward this end. If the City has any questions or need additional information concerning our comments, please do not hesitate to contact me (503-722-9240) or CRW's District Engineer, Bob George (503-722-9248)

Very truly yours,

Lee E. Moore, Sr.
General Manager

cc: Bob George
Dean M. Phillips
Nancy Kraushaar

Pete Walter

From: Paul Edgar [pauloedgar@qwest.net]
Sent: Wednesday, January 26, 2011 1:57 PM
To: Pete Walter; Tom Geil - Chair CIC
Cc: William Gifford; Nancy Kraushaar; John Burrell; David Frasher; Doug Neeley; Howard Post - Canemah
Subject: Re: LE 10-02 Water Master Plan Update - Email Transmittal

Some of what maybe outlined in the plan for Canemah, may not be applicable in today's world. Could this be true for other areas?

How we cover the cost of growth in SDC's collections and fees for water and sanitary/storm sewer must be accurately reflected in what is being shown, are they?

What is the detail for each encumbered fund account, with short and long term projections? How do we pay for all of this?

Each neighborhood should go through these plans/projections. Neighborhood "Town Hall Meetings"?

The implication are too great and this is a lot of money. There should be NO rush of this!

My thoughts.

Paul

On 1/21/2011 11:59 AM, Pete Walter wrote:
Dear CIC and all Neighborhood Association representatives:

COMMENTS DUE BY: **Please provide written comments two weeks in advance of the hearings** for inclusion in the staff report, however, comments will be accepted until the close of the Public Hearings.

HEARING DATE: Type IV – March 14, 2011 (Planning Commission) & April 6, 2011 (City Commission)

HEARING BODY: ___Staff Review; __**X**__PC; _**X**___CC

IN REFERENCE TO Oregon City Water Master Plan Update

FILE # & TYPE: LE 10-02 (Legislative)

PLANNER: Pete Walter, AICP, Associate Planner (503) 722-3789

APPLICANT: Oregon City Public Works – Attn. John Burrell

REQUEST: The Applicant Requests Approval of an Update to the City's Adopted Water Distribution System Master Plan, an Ancillary Document to the Adopted Oregon City Comprehensive Plan (2004).

LOCATION: City-Wide

This application material is referred to you for your information, study and official comments. If extra copies are required, please contact the Planning Department. Your recommendations and suggestions will be used to guide the Planning staff when reviewing this proposal. If you wish to have your comments considered and incorporated into the staff report, **please return the attached copy of the Transmittal form** to facilitate the processing of this application and ensure prompt consideration of your recommendations.

Thanks,

Pete Walter

Pete Walter, AICP, Associate Planner
pwalter@orcity..org
Community Development Department
Planning Division
221 Molalla Avenue, Ste. 200
Oregon City, Oregon 97045
503-496-1568 Direct
503-722-3789 Front Desk
503-722-3880 Fax
Website: www.orcity.org

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Property Zoning Report
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Email scanned by PC Tools - No viruses or spyware found.
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APPENDIX A

City of Oregon City, Water System – Diurnal Curve Development
Technical Memorandum, March 3, 2010

WEST YOST ASSOCIATES
Consulting Engineers

REGISTERED PROFESSIONAL ENGINEER 73588PE OREGON Jan. 13, 2004 CORIE PETERSON EXPIRES: 12/31/2010

TECHNICAL MEMORANDUM

DATE:	March 3, 2010	Project No. : 526-03-09-08
TO:	John Burrell, Project Manager	
FROM:	Corie Peterson	
REVIEWED BY:	Charles Duncan	
SUBJECT:	City of Oregon City, Water System – Diurnal Curve Development Technical Memorandum	

The purpose of this Technical Memorandum (TM) is to document West Yost Associates' (WYA) development of a city wide diurnal curve for the development of an Extended Period Simulation (EPS) hydraulic water model of the City of Oregon City (City) water system. The following sections of this TM describe the data, methodology, and results used to create the diurnal curve for the City's water system. Subsequent sections of this TM are as follows:

- Summary of Results
- Pressure Zone Description
- Diurnal Curve Development

SUMMARY OF RESULTS

Overall, the results from the diurnal curve development are inconclusive due to lack of sufficient hourly data to produce accurate demands in the system and chart the flow of water. Due to the quantity of assumptions that were required to generate a hourly diurnal curve and the resulting inconsistencies with the hydraulic model, validation of the model was not undertaken at this time. It is our recommendation that the City continue to update/verify pipeline system configurations in the model as new facilities are constructed and to collect additional data to support a more accurate approach to developing an hourly diurnal curve. In addition, it is our recommendation to reallocate demands using existing metered information prior to attempting a serious validation of this the developed curve and the hydraulic model.

PRESSURE ZONE DESCRIPTION

Figure 1 represents the existing pressure zone boundaries within the City's service area. Per the Oregon City Water Master Plan 2003, under normal operating conditions, the City's water system shall maintain a minimum pressure of 40 pounds per square inch (psi) and a maximum pressure of 100 psi at the service connection. Because of this requirement and the variation in elevation, the City's water distribution system is divided into eleven (11) separate pressure zones. There are eight (8) pressure zones interconnected by pressure reducing or pressure sustaining valves (PRV). The separate service levels mitigate the problem of excessive pressures in lower elevations and insufficient pressures at higher elevations. Table 1 summarizes the approximate service elevation range for each of the eleven pressure zones. The lower end of the pressure range is based on reservoirs at 80 percent full and the upper end is based on full reservoirs. Figure 2 shows the entire system schematic.

Table 1. Pressure Zone Elevations and Pressure Ranges[(a)]

Zone	Zone Bottom Elevation, feet	Zone Top Elevation, feet	Pressure Range, psi
Lower Pressure Zone	10	116	68 - 114
Paper Mill Pressure Zone	54	54	102
Canemah District Pressure Zone	74	140	54 –83
Lower Park Place Pressure Zone	44	218	43 – 118
Intermediate Pressure Zone	98	378	40 – 161
Intermediate Park Place Pressure Zone	222	434	47 –142
View Manor Park Place Pressure Zone	324	326	35 –36
Livesay Road Park Place Pressure Zone	222	272	70-100
Upper Pressure Pressure Zone	292	500	34 – 141
Fairway Downs Pressure Zone	470	518	55 –80
Upper Park Place Pressure Zone – CRW	434	522	203 –233

(a) Based on node elevation allocation in the hydraulic model not including the public open space.

Lower Pressure Zone

The Lower Pressure Zone is located within the northwestern portion of the City's service area. The general boundaries of the pressure zone are from the Interstate 205 in the west to Apperson Boulevard in the east, from Interstate 205 and Clackamas River Drive in the north to Railroad Avenue and Abernethy Road in the south.

The Lower Pressure Zone receives supply from eight (8) PRV's from Lower Park Place and Intermediate Pressure Zones. Flow leaves the pressure zone through one (1) master meter serving Clackamas River Water (CRW). Each facility is presented in Table 2.

Table 2. Lower Pressure Zone Facilities

Supplied From	Facility	Supplied To
Lower Park Place Pressure Zone	PRV- Harley Avenue & Foresythe (south)	Lower Pressure Zone
Lower Park Place Pressure Zone	PRV-Harley Avenue & Foresythe (north)	Lower Pressure Zone
Lower Park Place Pressure Zone	PRV-Apperson Boulevard & La Rae Road	Lower Pressure Zone
Lower Park Place Pressure Zone	PRV-Abernethy Road & Redland Road	Lower Pressure Zone
Intermediate Pressure Zone	PRV-15th Street & Madison Street	Lower Pressure Zone
Intermediate Pressure Zone	PRV-11th Street & Washington Street	Lower Pressure Zone
Intermediate Pressure Zone	PRV-3rd Street & Bluff	Lower Pressure Zone
Paper Mill Pressure Zone	PRV-Highway 99 E & Main Street (bi-directional)	Lower Pressure Zone
Lower Pressure Zone	Master Meter No. 2	CRW

Paper Mill Pressure Zone

The Paper Mill Pressure Zone is located within the northwestern portion of the City's service area. The general boundaries of the pressure zone are from the Willamette River in the west to Highway 99E in the east, from approximately 5th Street in the north to the Paper Mill's Road and the south property line in the south.

The Paper Mill Pressure Zone receives supply from one (1) PRV from Intermediate Pressure Zone. Flow leaves the zone through a bi-directional PRV at 99E and Main Street, but can be reversed in case of an emergency in the Paper Mill Pressure Zone. Each station is presented in Table 3.

Table 3. Paper Mill Pressure Zone Facilities

Supplied From	Facility	Supplied To
Intermediate Pressure Zone	PRV-3rd Street & Bluff	Paper Mill Pressure Zone
Paper Mill Pressure Zone	PRV-Highway 99E & Main Street (bi-directional)	Lower Pressure Zone

Canemah District Pressure Zone

The Canemah District Pressure Zone is located within the southwestern portion of the City's service area. The general boundaries of the pressure zone are from Paquet Street in the west to

Ganong Street in the east, Willamette River in the north to Railroad Avenue and Abernethy Road in the south.

The Canemah District Pressure Zone receives supply from one (1) PRV from the Intermediate Pressure Zone. This station is presented in Table 4.

Table 4. Canemah District Pressure Zone

Supplied From	Facility	Supplied To
Intermediate Pressure Zone	PRV-4th Street and Jerome Street	Canemah District Pressure Zone

Lower Park Place Pressure Zone

Lower Park Place Pressure Zone is in the North-eastern portion of the City's service area. The general boundaries of this service level are from Apperson Boulevard in the west to Frank Avenue in the east and from Taylor Lane on the north to Livesay Road on the south.

The Lower Park Place Pressure Zone is served from one (1) South Fork Water Board (SFWB) master meter connection and four (4) PRV's from Intermediate and Intermediate Park Place Pressure Zones. Flow leaves this zone through four (4) PRV's. Each station is presented in Table 5.

Table 5. Lower Park Place Pressure Zone Facilities

Supplied From	Facility	Supplied To
South Fork Water Board	Master Meter 1	Lower Park Place Pressure Zone
Intermediate Park Place Pressure Zone	PRV- Cleveland Street & Hiram Avenue (inactive)	Lower Park Place Pressure Zone
Intermediate Park Place Pressure Zone	PRV-Hunter Pump Station	Lower Park Place Pressure Zone
Intermediate Park Place Pressure Zone	PRV- Swan Avenue & Holcomb Boulevard	Lower Park Place Pressure Zone
Intermediate Pressure Zone	PRV-18th Street & Anchor Way	Lower Park Place Pressure Zone
Lower Park Place Pressure Zone	PRV-Harley Avenue & Forsythe Road (south)	Lower Pressure Zone
Lower Park Place Pressure Zone	PRV-Harley Avenue & Forsythe Road (north)	Lower Pressure Zone
Lower Park Place Pressure Zone	PRV-Apperson Boulevard & La Rae Road	Lower Pressure Zone
Lower Park Place Pressure Zone	PRV-Abernethy Road & Redland Road	Lower Pressure Zone

Intermediate Pressure Zone

Intermediate Pressure Zone is in the northwestern portion of the City's service area. The general boundaries of this pressure zone are from Highway 99E in the west to the Oregon City city limits in the east and from 18th Street in the north to Ogden Drive and Pearl Street in the south.

Intermediate Pressure Zone is served from one (1) SFWB master meter connection, the Mountainview Reservoirs and two (2) PRV's from SFWB and Upper Pressure Zone. Flow leaves this zone through five (5) PRV's. Each station is presented in Table 6.

Table 6. Intermediate Pressure Zone Facilities

Supplied From	Facility	Supplied To
South Fork Water Board	Master Meter 4	Intermediate Pressure Zone
Upper Pressure Zone	PRV- 5th Street & Canemah Road	Intermediate Pressure Zone
South Fork Water Board	PRV-16th Street & Division Street	Intermediate Pressure Zone
Intermediate Pressure Zone	PRV-18th Street & Anchor Way	Lower Park Place Pressure Zone
Intermediate Pressure Zone	PRV-11th Street & Washington Street	Lower Pressure Zone
Intermediate Pressure Zone	PRV-15th Street & Madison Street	Lower Pressure Zone
Intermediate Pressure Zone	PRV-3rd Street & Bluff	Lower Pressure Zone
Intermediate Pressure Zone	PRV-4th Street and Jerome Street	Canemah District Pressure Zone

Intermediate Park Place Pressure Zone

Intermediate Park Place Pressure Zone is in the northern portion of the City's service area. The general boundaries of this pressure zone are from Hiram Avenue in the west to Oregon City city limits on the east and from Forsythe Road in the north to Oak Tree Terrace in the south.

Intermediate Park Place Pressure Zone is served from one (1) SFWB master meter connection via the Hunter Avenue Pump Station. Flow leaves the zone through one (1) master meter serving CRW and four (4) PRV's. Each station is presented in Table 7.

Table 7. Intermediate Park Place Pressure Zone Facilities

Supplied From	Facility	Supplied To
South Fork Water Board	Master Meter 10	Intermediate Park Place Pressure Zone
Intermediate Park Place Pressure Zone	Master Meter 13	CRW
Intermediate Park Place Pressure Zone	PRV-Cleveland Street & Hiram Avenue (inactive)	Lower Park Place Pressure Zone
Intermediate Park Place Pressure Zone	PRV-Swan Avenue & Holcomb Boulevard	Lower Park Place Pressure Zone
Intermediate Park Place Pressure Zone	PRV-Hunter Avenue Pump Station	Lower Park Place Pressure Zone
Intermediate Park Place Pressure Zone	PRV-Jennifer Estates	Jennifer Estates

View Manor Park Place Pressure Zone

View Manor Park Place Pressure Zone serves a very small area in the northern portion of the City's service area. The general boundaries of this pressure zone are from Swan Avenue in the west to Longview Way in the east and from Pittock Place in the north to Holcomb Boulevard in the south.

The View Manor Park Place Pressure Zone receives supply from one (1) PRV from Intermediate Park Place Pressure Zone. The station is presented in Table 8.

Table 8. View Manor Park Place Pressure Zone Facilities

Supplied From	Facility	Supplied To
Intermediate Park Place Pressure Zone	PRV- View Manor	View Manor Park Place Pressure Zone

Livesay Road Park Place Pressure Zone

Livesay Road Park Place Pressure Zone is a closed loop zone serving three (3) homes outside Oregon City city limits, but within the Urban Growth Boundary. The general boundaries of this pressure zone are from Witke Court in the west to Tracey Lee Court in the east and from Journey Drive in the north to Livesay Road in the south.

The Livesay Road Park Place Pressure Zone receives supply from one (1) pump station from Intermediate Park Place Pressure Zone. The station is presented in Table 9.

Table 9. Livesay Road Park Place Pressure Zone Facilities

Supplied From	Facility	Supplied To
Lower Park Place Pressure Zone	Livesay Pump Station	Livesay Rd Park Place Pressure Zone

Upper Pressure Zone

Upper Pressure Zone is in the southern portion of the City's service area. The general boundaries of this pressure zone are from Maywood Street in the west to the Oregon City city limits in the east and from Peal Street in the north to Oregon City city limits in the south.

Upper Pressure Zone is served from one (1) SFWB master meter connection. Mountainview 2, Boynton and Henrici are the reservoir's serving this zone. Flow leaves this zone through the Fairway Downs Pump Station and two (2) master meters serving CRW. Each station is presented in Table 10.

Table 10. Upper Pressure Zone Facilities

Supplied From	Facility	Supplied To
South Fork Water Board	Master Meter 5	Upper Pressure Zone
Upper Pressure Zone	Master Meter 8	CRW
Upper Pressure Zone	Master Meter 9	CRW

Fairway Downs Pressure Zone

Fairway Downs Pressure Zone is a closed loop zone in the southeastern portion of the City's service area. The general boundaries of this pressure zone are from Coquille Drive in the west to Urban Growth Boundary in the east and from Glen Oak Road in the north to the Urban Growth Boundary in the south.

The Fairway Downs Pressure Zone receives supply from one (1) pump station from the Upper Pressure Zone. The station is presented in Table 11.

Table 11. Fairway Downs Pressure Zone Facilities

Supplied From	Facility	Supplied To
Upper Pressure Zone	Fairway Downs Pump Station	Fairway Downs Pressure Zone

Upper Park Place Pressure Zone

Upper Park Place Pressure Zone is in the northeastern portion of the City's service area. The general boundaries of this pressure zone are from Winston Drive in the west to the Oregon City city limits in the east and from the Oregon City city limits in the north to Journey Drive in the south. This pressure zone is served by CRW and is therefore not considered part of the Oregon City distribution system.

DIURNAL CURVE DEVELOPMENT

A diurnal pattern is required for extended period simulations. A diurnal pattern shows the hourly variations in customer demand (hourly peaking factors) over a 24-hour period. Diurnal patterns are typically developed from historic hourly flow data that is analyzed to determine variations in customer demands that have been adjusted to account for flows going into storage or passed through to other zones, i.e., during parts of the day, some flows in the system may be going to re-fill storage rather than to meet customer demands.

If detailed system-specific information is not available, then WYA reviews diurnal pattern information developed by other agencies to recommend a typical diurnal pattern for the analysis. For this evaluation, system-specific hourly data was not available for the entire City; therefore, the diurnal pattern is based on available information, incorporating as much of the actual hourly flow data as possible. The following paragraphs describe the steps WYA followed in developing the composite diurnal curve for the City.

WYA collected electronic and hard copy data available from the City and SFWB during the period from July 1 to September 31, 2007 and July 1 to September 31, 2008. Facilities for which data was requested included pump stations, reservoirs, PRVs and master meters between Oregon City, CRW and SFWB. Table 12, provides a summary of the electronic data available to develop the diurnal curve for Oregon City. As shown, SCADA does not collect PRV flow or pressure readings; master meters are only read monthly; and up and downstream pressures are not collected for pump stations. Due to these limitations, complete diurnal curves for each pressure zone or for the whole City were not possible. The only zone that has no master meters or PRVs in or out of the zone is the Fairway Downs Pressure Zone. WYA considered using this zone to create a diurnal curve and apply it to the entire city, but elected not to because it is not representative of the system as a whole since it is only residential.

Using the best data available, WYA determined that generic diurnal trends could be created by observing the filling and draining of the two groups of reservoirs in the City. One curve was created for the upper zones, including the Upper Pressure Zone and Fairway Downs Pressure Zone, that trended the filling and draining of the Henrici and Boynton Reservoirs. Another curve was created for the lower zones, including the Intermediate Pressure Zone, the Lower Pressure Zone and the Canemah District Pressure Zone, that trended the filling and draining of the Mountainview Reservoirs. The date of July 15, 2008 was selected from SCADA as a peak day to create these curves as they are presented in Figure 3.

Table 12. Available City SCADA Information

Service Level	Facility	SCADA – Electronic: Pressure: Discharge	Pressure: Suction	Level	Flow
Lower Service Level					
	Master Meter 2	NA	NA	NA	Monthly
	PRV- Harley Avenue & Forsythe (south)	None	None	NA	None
	PRV-Harley Avenue & Forsythe (north)	None	None	NA	None
	PRV-Apperson Boulevard & La Rae Road	None	None	NA	None
	PRV-Abernethy Road & Redland Road	None	None	NA	None
	PRV-15th Street & Madison Street	None	None	NA	None
	PRV-11th Street & Washington Street	None	None	NA	None
	PRV-3rd Street & Bluff	None	None	NA	None
	PRV-Highway 99 E & Main Street (bi-directional)	None	None	NA	None
Paper Mill Service Level					
	PRV-3rd Street & Bluff	None	None	NA	None
	PRV-Highway 99E & Main Street (bi-directional)	None	None	NA	None
Canemah District Service Level					
	PRV-4th Street and Jerome Street	None	None	NA	None
Lower Park Place Service Level					
	Hunter Avenue Pump Station	Hourly	Hourly	NA	Hourly
	Master Meter 1	None	None	NA	Monthly
	Master Meter 10	None	None	NA	Monthly
	PRV- Cleveland Street & Hiram Avenue (inactive)	None	None	NA	None
	PRV-Hunter Pump Station	None	None	NA	None
	PRV- Swan Avenue & Holcomb Boulevard	None	None	NA	None
	PRV-18th Street & Anchor Way	None	None	NA	None
Intermediate Service Level					
	Division Street Pump Station	None	None	NA	None
	Mountainview Reservoir No. 1	NA	NA	Hourly	NA
	Mountainview Reservoir No. 2	NA	NA	Hourly	NA
	Master Meter 3	None	None	NA	Monthly
	Master Meter 4	None	None	NA	Monthly
	Master Meter 7	None	None	NA	Monthly
	PRV- 5th Street & Canemah Road	None	None	NA	None
	PRV-16th Street & Division Street	None	None	NA	None
	PRV-Jennifer Estates	None	None	NA	None
View Manor Park Place Service Level					
	PRV- View Manor	None	None	NA	None
Livesay Road Park Place Service Level					
	Livesay Pump Station	None	None	None	None
Upper Service Level					
	Mountainview Pump Station	Hourly	Hourly	NA	Hourly
	Henrici Reservoir	NA	NA	Hourly	NA
	Boynton Reservoir	NA	NA	Hourly	NA
	Boynton Pump Station	None	None	None	None
	Master Meter 5	None	None	NA	Monthly
	Master Meter 8	None	None	NA	Monthly
	Master Meter 9	None	None	NA	Monthly
Fairway Downs Service Level					
	Fairway Downs Pump Station	None	None	No	None
Upper Park Place Service Level					
	Barlow Crest Reservoir	NA	NA	Hourly	NA
	Barlow Crest Pump Station (CRW)	None	None	NA	Hourly
	Master Meter 11	None	None	NA	Monthly
	Master Meter 12	None	None	NA	Monthly

Upper Zones Curve Development

The upper zone diurnal curve was developed using fill and drain data from Boynton and Henrici Reservoirs, flows from the Mountainview Pump Station and an hourly flow generated from the monthly data for the CRW Master Meters leaving the Upper Pressure Zone. The calculation for the demand curve adds all the flow into the two zones from the pump station and reservoir and subtracts the master meters and any filling of the two reservoirs for each hourly time step. The demand is then divided by the average demand for the day to yield a unitless diurnal curve as shown in Figure 3.

Lower Zones Curve Development

The lower zones diurnal curve was developed using fill and drain data from the Mountainview Reservoirs only. Hourly data for the Division Street Pump Station was not available but reservoirs alone are adequate to see the diurnal trend of the lower zones. The calculation for the demand curve is simply the flow out of the reservoirs minus the flow in for each hourly time step. The demand is then divided by the average demand for the day to yield a unitless diurnal curve as shown in Figure 3.

City-wide Diurnal

While both the upper and lower zones curves appeared to yield reasonable diurnal patterns, the upper zones consist predominately of residential customers and the lower zones have a broader mix of uses. To get a representative city wide diurnal curve a composite hourly curve was produced from the upper and lower zone curves. Figure 4 shows the diurnal pattern used for the Oregon City's system. Figure 4 is a unitless profile that shows the ratio of the hourly flow to the average daily flow rate over a 24-hour period (starting with 0 hours at midnight). The hourly factors are applied to the average daily flow to obtain the hourly flow rates. This diurnal patterns reflect the variation of customer demands over a 24-hour period, and account for use of storage within the City's system, e.g., filling of storage and taking water out of storage to meet demands.

In the future, if the City obtains complete system-specific hourly flow data over a 24-hour period for the system as a whole and/or by pressure zone, that reflects customer demands and accounts for use of storage, this hourly information could be used to develop more accurate system-specific diurnal patterns for the City system.

FINDINGS AND CONCLUSIONS

In the absence of hourly City wide flow and pressure data, a combination of hourly and monthly production data from Oregon City and SFWB was used to generate the maximum day demand for Oregon City. Resulting demands are lower than what was reported in the 2003 water master plan report. The primary method in developing the hourly diurnal curve was based the tanks filling and draining, which encompasses only a portion of the overall City. With only these two inputs, lower demands and a partial City diurnal, being based on significant assumptions, our confidence in an accurate validation of the hydraulic model is extremely low. Because of this, it can be concluded that the developed diurnal curve is adequate for use in planning, however should not be used to support operational decisions. Furthermore, it is recommended that the City look at installing temporary digital meters at those key locations in the distribution system to allow for a more representative diurnal curve to be developed.

If the City desires to continue pursuit of an operational EPS model, demands in the system could be reallocated which would remove one of the two major uncertainties that currently exist. The uncertainties surrounding curve generation using only tank filling and draining cycles would remain but validation may be more realistic.

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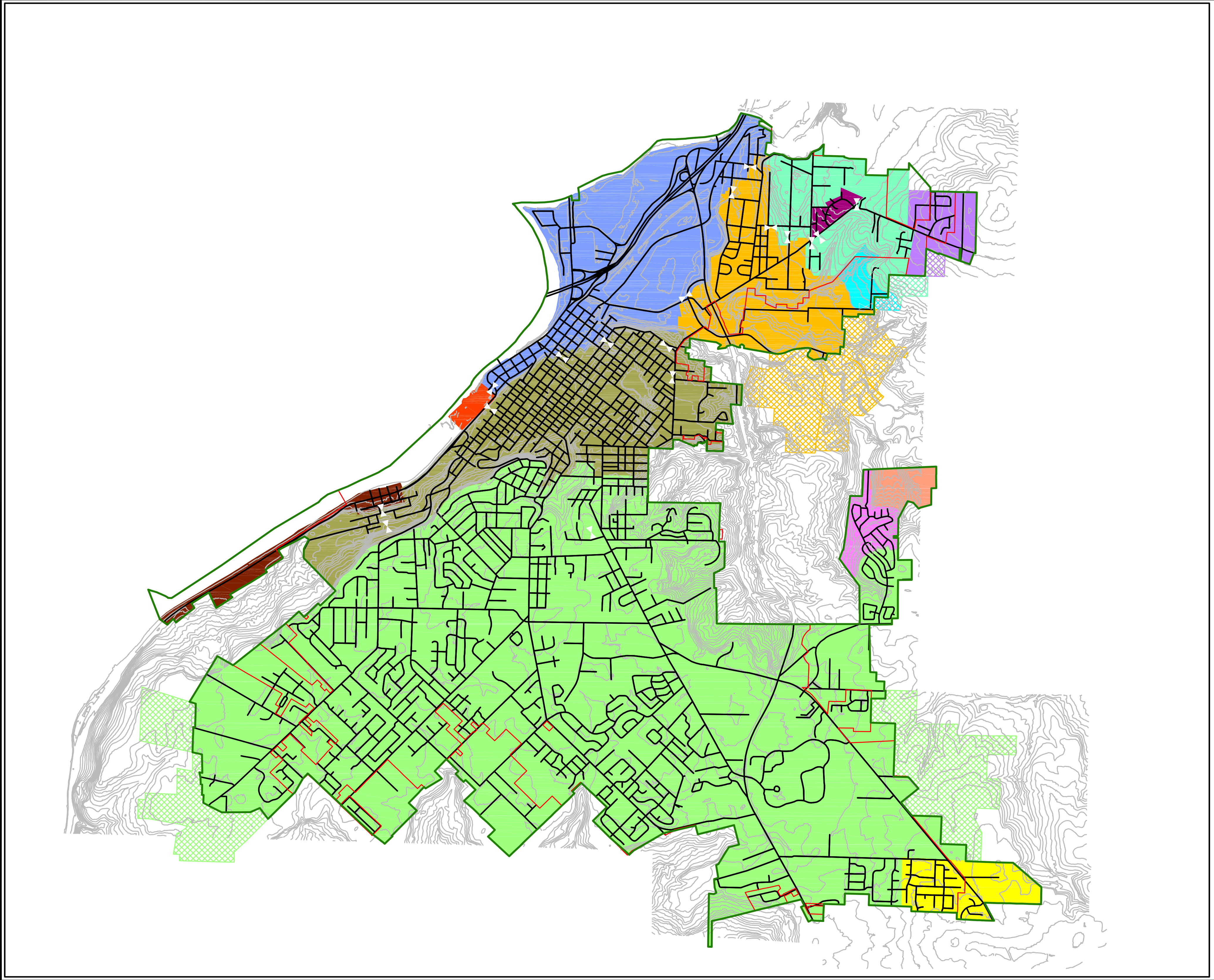


OREGON CITY

FIGURE 1

CITY OF OREGON CITY

PRESSURE ZONES

N

0 1500 3000

SCALE IN FEET

LEGEND:

- URBAN GROWTH BOUNDARY (UGB)
- PROPOSED UGB EXPANSION AREA
- CITY LIMITS
- 20' CONTOURS
- LOWER ZONE
- INTERMEDIATE ZONE
- UPPER ZONE
- FAIRWAY DOWNS
- CANEMAH DISTRICT
- COUNTRY VILLAGE (CRW)
- CANYON (CRW)
- LOWER–PARK PLACE
- INTERMEDIATE–PARK PLACE
- UPPER–PARK PLACE (CRW)
- LIVESAY ROAD–PARK PLACE
- VIEW MANOR–PARK PLACE
- PAPER MILL ZONE
- PRESSURE REDUCING VALVE STATION

(FUTURE)

WEST YOST ASSOCIATES

Consulting Engineers

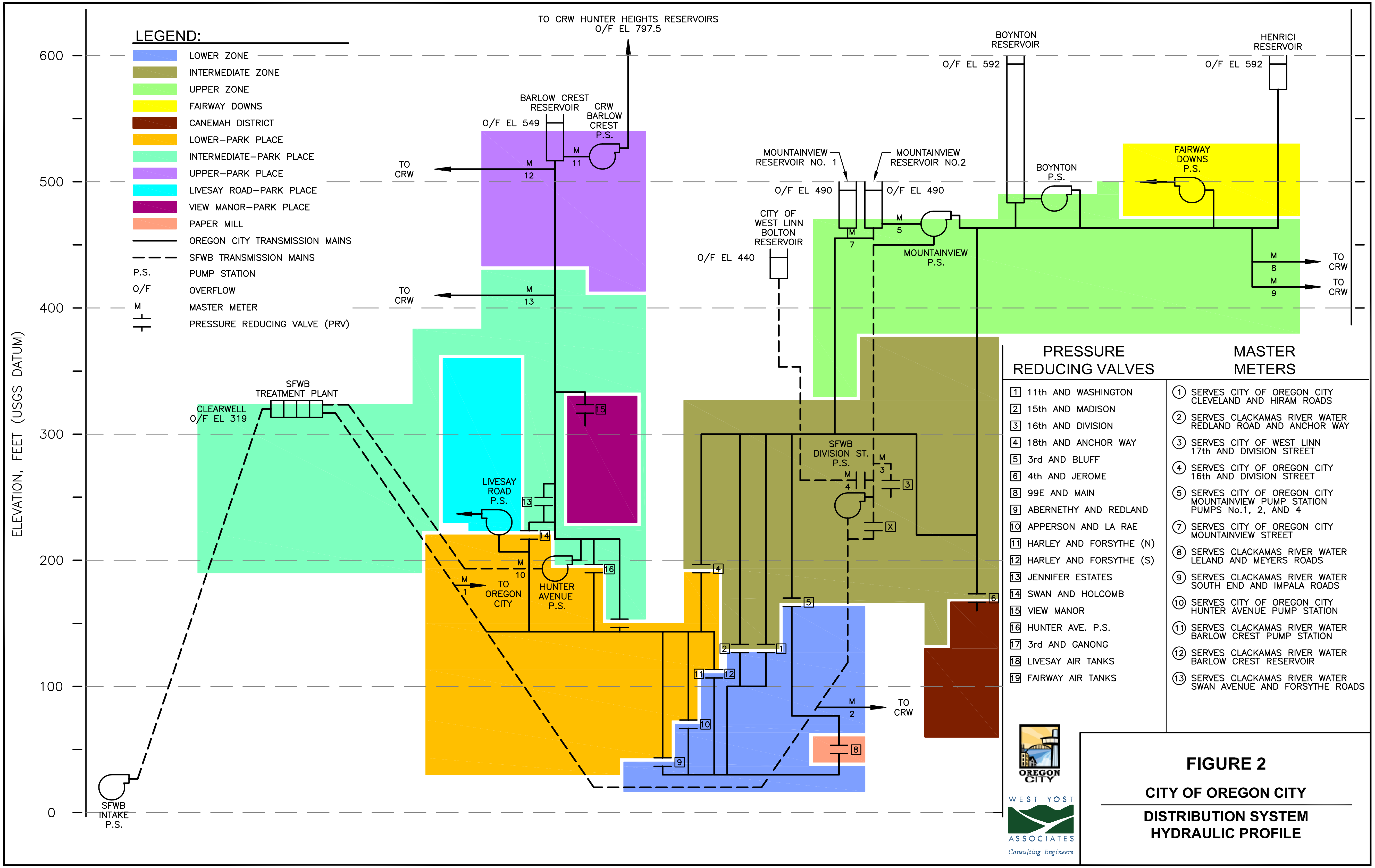
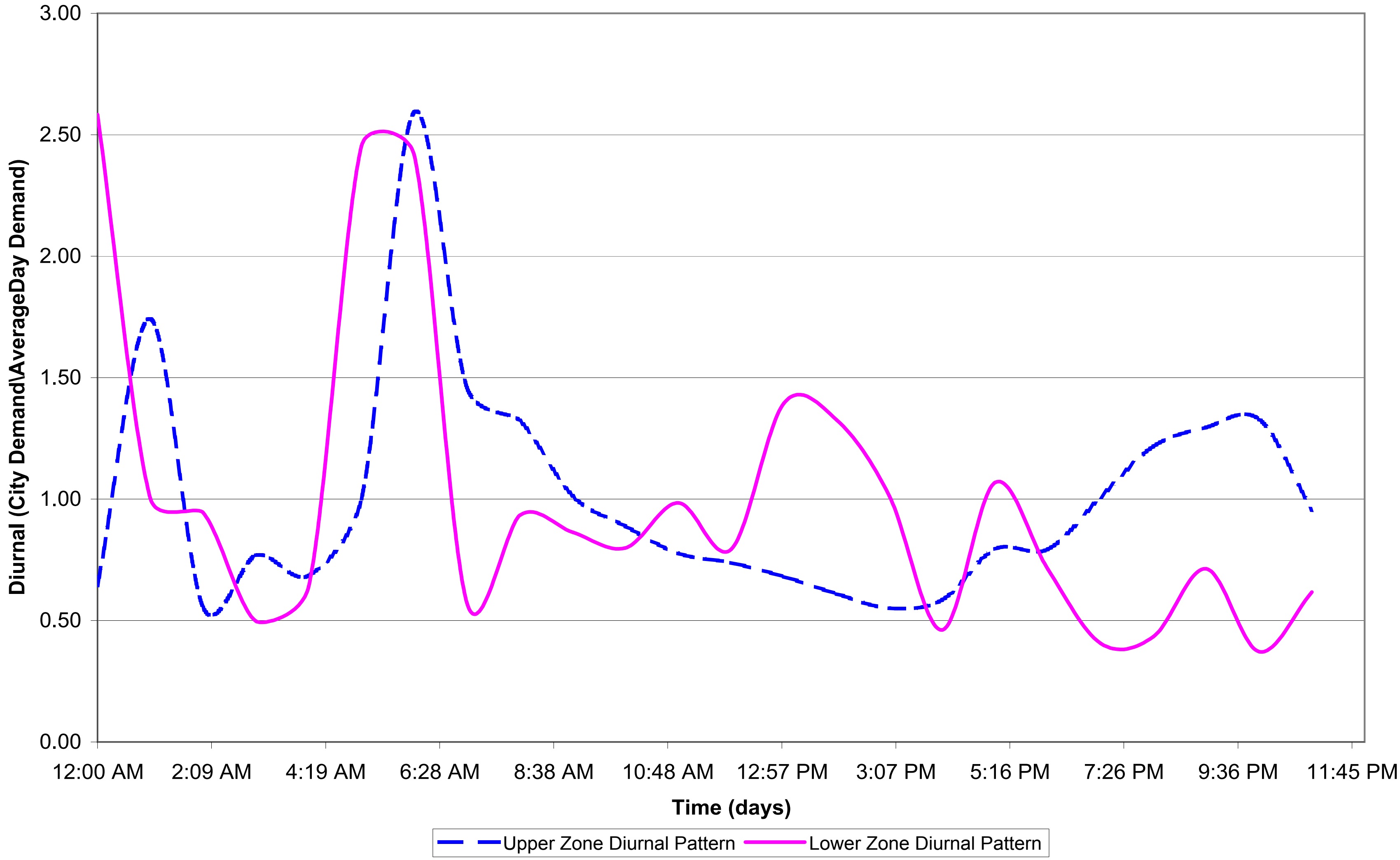


FIGURE 2

CITY OF OREGON CITY

DISTRIBUTION SYSTEM HYDRAULIC PROFILE

Figure 3. Oregon City Diurnal Pattern July 15, 2008



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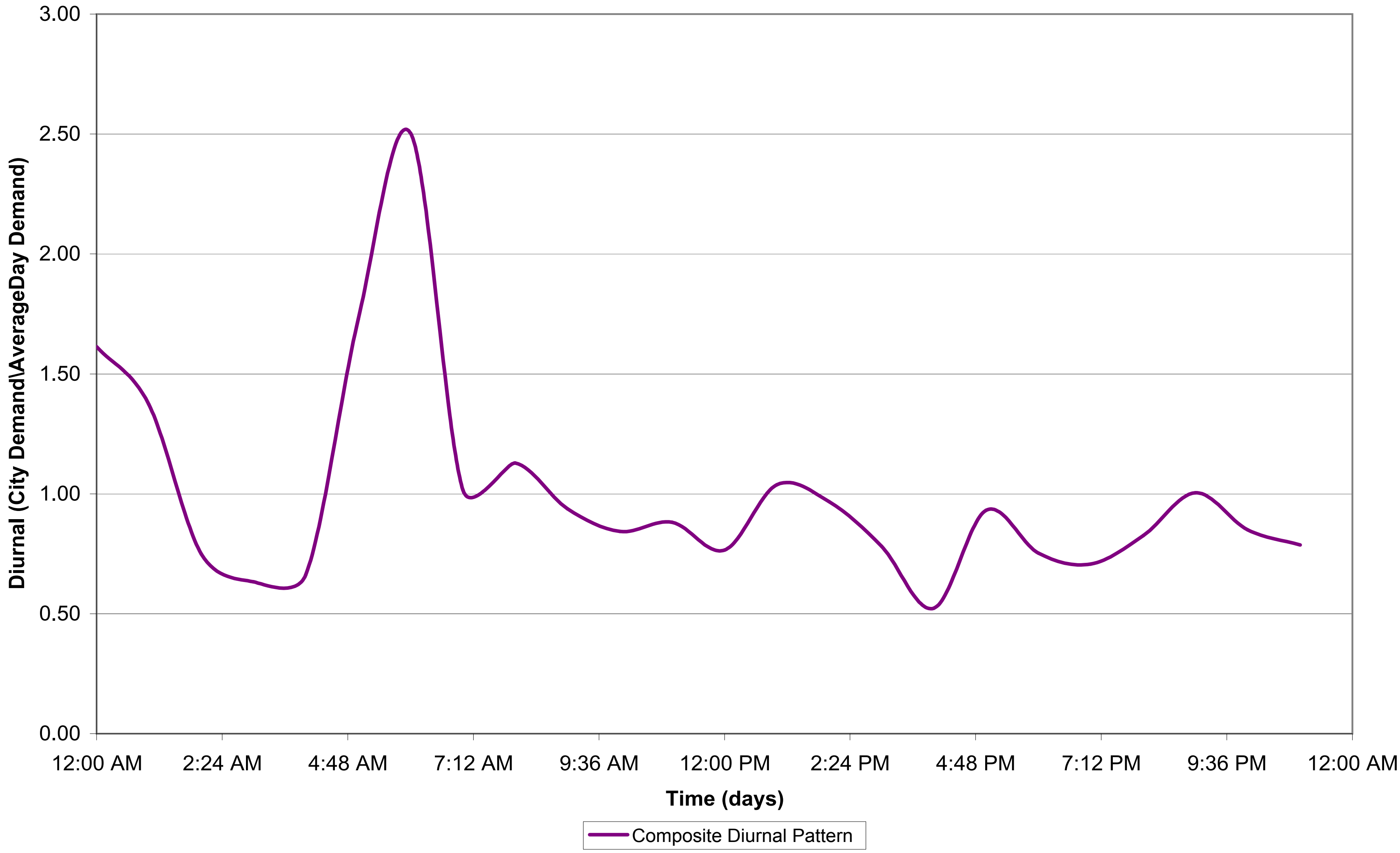
Last Revised: 04-27-09

City of Oregon City
Diurnal Curve Development
Technical Memorandum

Figure 4. Oregon City Diurnal Pattern July 15, 2008



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Last Revised: 04-27-09

City of Oregon City
Diurnal Curve Development
Technical Memorandum

APPENDIX B

Water System Seismic Vulnerability Assessment
City of Oregon City, Oregon, December 2002

ABS Consulting
EQE STRUCTURAL ENGINEERS DIVISION

FINAL REPORT

Water System Seismic Vulnerability Assessment

City of Oregon City, Oregon

December 2002

Prepared for:

West Yost and Associates

Prepared by:

ABS Consulting
1411 4th Ave. Bldg, #500
Seattle, WA 98101
(206) 624-8687

ABS Project #1053895

ABS Consulting
EQE STRUCTURAL ENGINEERS DIVISION

December 30, 2002, 2002

Mr. Mark Zinniker
WEST YOST & ASSOCIATES, LLC
132 East Broadway, Suite 431
Eugene, OR 97401

Subject: Transmittal of Draft Report: Water System Seismic Vulnerability Assessment, City of Oregon City, OR

Dear Mark:

Enclosed please find seven (7) copies of the subject report. If you have any questions on this or other matters, please do not hesitate to call. It is a pleasure to be of service to the City of Oregon City and West Yost and Associates.

Sincerely yours,
ABSG CONSULTING INC.

Donald B. Ballantyne, P.E.

General Manager, Seattle Office

V P Lifeline Services

Enclosures

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www.absconsulting.com *www.eqeseattle.com*

Table of Contents

1. Introduction

This report presents the findings of ABS Consulting's seismic vulnerability assessment of the Oregon City's water facilities. This vulnerability assessment was performed in accordance with the agreement between ABS Consulting and West Yost and Associates dated December 12, 2001. The assessments are based on review of available drawings, site walk-downs conducted on January 28 and 29, 2002, and performance of similar facilities in previous earthquakes.

1.1. Purpose

The purpose of this report is to assess the seismic vulnerability of the City's water distribution facilities. The vulnerabilities of the various facilities were projected based on the following factors: type and quality of construction, configuration, age, and condition of each structure (if such information was available), design criteria used; structural design and details; local geology and seismicity; distance from faults; site susceptibility to liquefaction and lateral spreading; and performance of similar structures in previous earthquakes.

1.2. Scope of Work

Seven tasks step through the vulnerability assessment project as described below. This proposal is based on evaluating five pump stations, four tanks (one 10.5-MG concrete, and three 2-MG steel), 15 PRV vaults, and the pipeline distribution system. A qualitative assessment of the pipeline distribution system is included.

The scope of work for this project included the following:

1.2.1. Task 1, Kickoff Meeting, Gather, and Review Information.

ABS Consulting met with City representatives to review the project objectives and scope. We reviewed information provided by the City, including drawings for the tanks. We also obtained and reviewed hazard information from the United States Geological Survey (USGS) and Oregon State Department of Geology and Mineral Industries (DOGAMI). We visited four tanks, five pump stations, and selected PRV vaults, and observed the general layout of the service area.

1.2.2. Task 2, Hazard Assessment.

ABS Consulting evaluated ground motion, soil liquefaction, and lateral spread hazards using information available from the USGS and DOGAMI, and other reports available from the City. This information was used to estimate the damage to pipelines, tanks, and pump stations. The earthquake assessment was conducted for three levels of earthquakes: 1) 72-year return period (50% probability in 50 years), 2) 475-year return period (10% probability of exceedance in 50 years), and 3) for an earthquake located on the Portland Hills Fault (PHF). An opinion of the duration of shaking for the three different earthquakes was also provided. DOGAMI has developed liquefaction susceptibility mapping for the City service area that we used to assist in evaluating pipeline vulnerability. We prepared a summary of the hazard information to be used in the project report.

1.2.3. Task 3, Facility Evaluation.

ABS Consulting engineers evaluated the five pump stations, PRV vaults, and four tanks. We used the ground motion information available from the USGS. The task findings are documented in the report.

For the pump stations and PRV vaults, we reviewed the structures to identify possible deficiencies. Available drawings were reviewed. Generally small structures such as pump stations are resistant to earthquakes with the exception that they may not have adequate roof-to-wall and wall-to-foundation anchorage. We reviewed pump station equipment installations to determine anchorage. If there are deficiencies with the buildings, vaults, or equipment, we provided sketches of mitigation alternatives, and a preliminary rough-order-of-magnitude (ROM) opinion of construction cost. We provided a preliminary assessment of the electrical power reliability based on previous work in the Portland area, and observation of the transformer installations serving the pump stations. We evaluated SCADA equipment installations used by the City.

For the tanks, we performed preliminary structural calculations to determine how the tanks will perform in each of the three levels of earthquakes. The assessment considered the foundation, tank shell anchorage to the foundation, tank geometry, and shell structure/wall thickness. Impact to the tank roof from sloshing was also considered. For the tanks that are not anchored, we identified deficiencies with connecting piping. For foundation, tank, or piping deficiencies, we provided sketches of mitigation options and an ROM opinion of construction cost.

1.2.4. Task 4, Qualitative Pipeline Evaluation.

ABS Consulting qualitatively evaluated the vulnerability of the pipeline distribution system. This assessment was based on observations of performance of similar pipe types in past earthquakes, and knowledge of pipe damage mechanisms. We documented the damage mechanisms for the pipe types found in the system and the earthquake hazards to which they can be subjected. We observed the relative locations between the distribution piping and soil liquefaction and landslide hazards, and developed the likely performance of the system. For example, cast iron pipe with leaded joints performs much worse than ductile iron pipe with elastomeric gaskets. Pipe performs worse in soils that liquefy than in competent soils. Mitigation recommendations are provided for identified pipeline deficiencies. The pipeline evaluation is documented in a section of the project report.

1.2.5. Task 5, System Evaluation.

Based on the findings of the two previous tasks, we developed a water system damage scenario for each of the three levels of earthquakes. Each scenario describes the likely performance of the various system components, and the system as a whole. We recommended improvements so that the system can meet suggested performance objectives over the long term. The damage scenarios and recommendations are documented in a section of the report.

1.2.6. *Task 6, Mitigation Recommendations.*

We gathered the mitigation recommendations identified for the facilities, pipelines, and the system evaluation into a single prioritized list. Preliminary construction costs are provided. The City can use this list as input into a capital improvement plan. The mitigation recommendations are prioritized on risk to the system considering probability of occurrence and consequences of failure.

1.2.7. *Task 7. Report Preparation and Presentation to the City.*

ABS Consulting developed a draft report and provided the City with seven (7) copies of the report for review. We made a presentation to City representatives on the project findings and recommendations, incorporated comments into a final report, and delivered seven report copies to the City.

1.3. Limitations

Our professional services have been performed using the degree of care and skill ordinarily exercised, under similar circumstances, by reputable engineers practicing in the field of structural or civil engineering in this or similar localities at this time. No other warranty, expressed or implied, is made as to the professional advice included in this report. This report has been prepared for the City of Oregon City to be used solely in its evaluation of the subject facilities. The report has not been prepared for use by other parties, and may not contain sufficient information for purposes of other parties of other uses.

1.4. Report Outline

An overview of the City's service area and system, seismic hazards, and findings and recommendations are described in Chapter 2. Chapter 3 discusses the regional and site-specific seismic hazards. Chapter 4 provides a description of seismic vulnerabilities for the reservoirs, pump stations, and PRVs. Chapter 5 discusses the expected performance of the pipeline system. Based on the identified vulnerabilities and the system characteristics, overall system performance findings and system level upgrade recommendations are described in Chapter 6.

1.5. Terminology

Design Basis Earthquake (DBE) – defined to have a 10 percent chance of exceedance in 50 years (equivalent to a 475-year average return interval).

Lateral Spreading – Horizontal ground movement initiated by strong ground shaking. Lateral spreading tends to occur in liquefiable soils involving coastlines and riverbanks.

Liquefaction – occurs when saturated, cohesionless soils are strongly vibrated and soil shear strength is lost. If the liquefaction is sloped, the liquefied soils may flow (lateral spread). Soil liquefaction can allow structures to sink or allow buoyant elements such as empty pipelines to float.

Maximum Credible Earthquake (MCE) – represents a conservative upper bound on the maximum expected ground shaking that could occur at the site independent of time considerations. The MCE generally represented a worst-case scenario in regard to potential assess damage and business interruption.

Modified Mercalli Index (MMI) – A qualitative intensity scale based on observed damage. MMI intensities of I to V represent low levels of ground shaking and do not cause damage to structures. MMI intensities VI to X are characterized by increasing damage to facilities and economic loss. Intensities XI and XII only occur in the epicentral region of great earthquakes (M8+) and relate primarily to permanent ground displacement.

Operating Basis Earthquake (OBE) – defined to have a 50 percent chance of exceedance in 50 years (equivalent to a 72-year average return interval).

Richter Magnitude (M) – An objective, instrumentally determined scale based on a standardized measure of the amplitude of seismic waves 100 kilometers from the earthquake epicenter. The scale is logarithmic in design with each whole number representing an increase in the measured earthquake wave amplitude and an approximate increase of 32 times in the amount of energy released.

2. Summary

2.1. Summary

The seismic vulnerability assessment of the Oregon City water system includes four tanks, five pump stations, 15 PRV vaults, and the pipeline distribution system.

The purpose of the effort was to assess the seismic vulnerability of the above facilities and develop prioritized upgrade mitigation costs. The vulnerabilities are projected based on the following factors: type and quality of construction; configuration, age, and condition of each structure (if such information was available); design criteria; structural design and details; local geology and seismicity; distance from faults; site susceptibility to soil liquefaction and lateral spreading; and performance of similar structures in previous earthquakes.

Our findings and mitigation recommendations are discussed in the following sections.

2.2. System Description

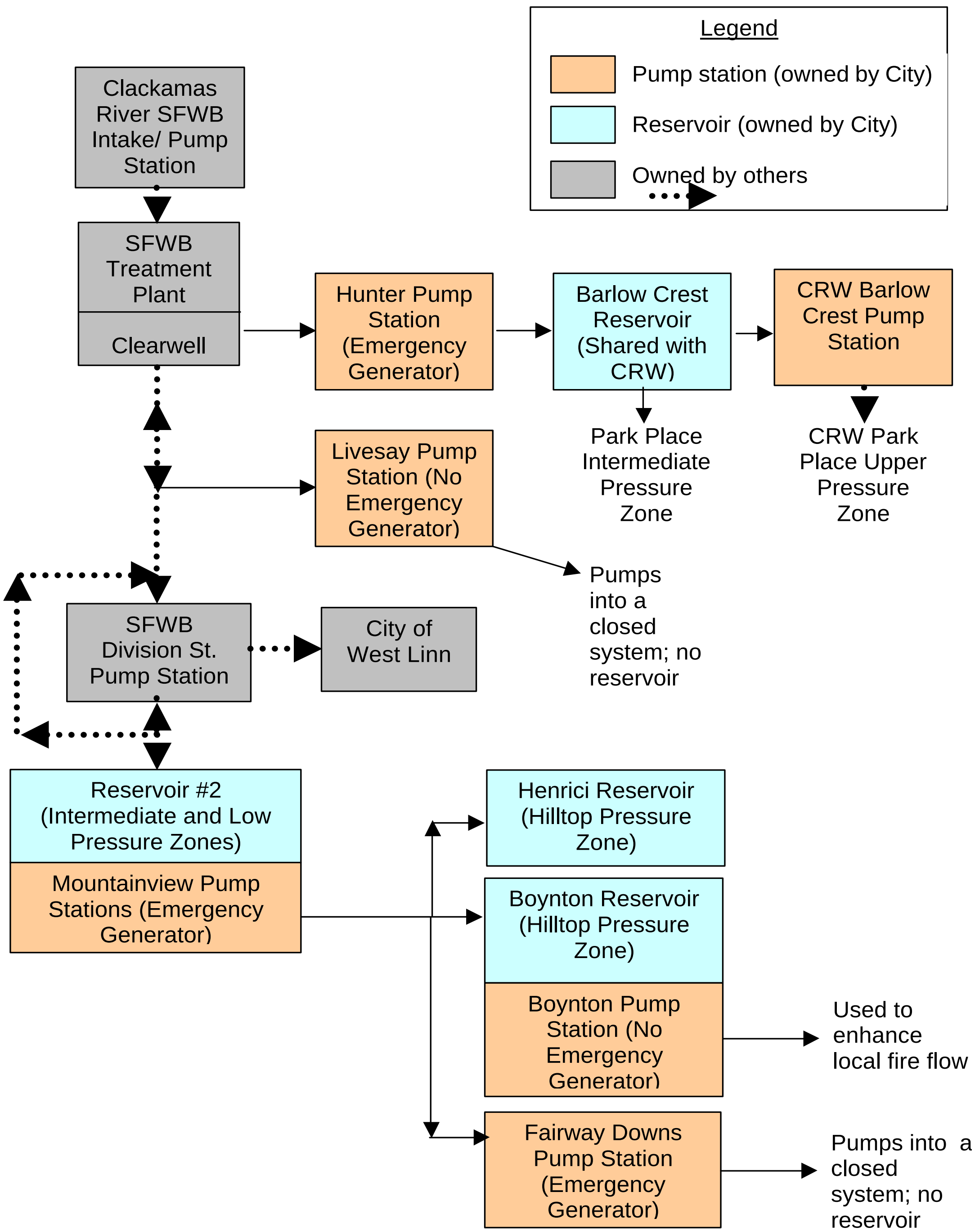
The South Fork Water Board (SFWB), an agency equally owned by the City of Oregon City and the City of West Linn, owns and operates the system backbone as shown in Figure 2-1. They pump water from the Clackamas River to the SFWB treatment plant. From there, water flows by gravity to the Division St. Pump Station that pumps it to Reservoir #2. Reservoir #2 serves the Intermediate and Low Pressure Zones, as well as supplies the City of West Linn when the SFWB is not pumping. The Mountainview Pump Stations move water from Reservoir #2 to the Upper Pressure Zone. The redundant Boynton and Henrici reservoirs float on the Upper Pressure Zone. The Boynton Pump Station is used to boost pressure for fireflows. The Mountainview Pump Stations have diesel emergency generators with adequate capacity to operate pumps to provide winter flow demands. The Boynton Pump Station does not have an emergency generator.

The Hunter Pump Station pumps water from the SFWB treatment plant clearwell to the Barlow Crest Reservoir that serves the Park Place Intermediate Pressure Zone, as well as a portion of the CRW system. The Clackamas River Water (CRW) Barlow Crest Pump Station pumps from the tank into the CRW's Park Place Upper Pressure Zone. The Livesay and Fairway Downs pump station each pump into a small pressure zone with no storage. The Hunter and Fairway Downs pump stations have emergency generators. The Livesay Pump Station does not.

Other than the two reservoirs for the Upper Pressure Zones (Boynton and Henrici), there are no redundant facilities in the system including supply, storage, and pumping. If the SFWB treatment plant is not operating, water can be backfed from Reservoir # 2, around the Division St. Pump Station, into the treatment plant clearwell, as well as to the City of West Linn.

Reservoir #1 and the Elevated Tank, both on the same site as the Mountainview Pump Stations and Reservoir #2, have been permanently removed from service. Antennas for City police, fire, and public works communications have recently been relocated from the Elevated Tank to a new communication tower across the street.

Figure 2-1: System Schematic



2.3. Earthquake Levels Evaluated

The effects of earthquake ground motions expected in an operating basis earthquake (OBE) (8 to 10 percent of gravity; 50 percent chance of occurring in 50 years), and a design basis earthquake (DBE) (15 to 20 percent of gravity; 10 percent chance of occurring in 50 years), were evaluated. Some observations are provided for expected water system performance following an event on the Portland Hills Fault that would be expected to produce ground accelerations of 50 to 60 percent of gravity. A Portland Hills Fault event is expected to occur on the average every 5,000 to 10,000 years.

2.4. Seismic Stability of Site Soils

Soils under all the reservoirs and pump stations are generally competent. Pockets of soil along the Willamette and Clackamas rivers are liquefiable.

2.5. Findings

This section summarizes findings in terms of expected performance of system components for three earthquakes, the OBE, DBE, and a Portland Hills Fault event.

The entire system is totally dependent on the SFWB supply. Our scope of work did not include evaluation of the SFWB system.

2.5.1. OBE Expected Performance

For the OBE, with a recurrence interval of 72 years, the system is expected to perform relatively well. Ground motions in the order of 8 to 10 percent times gravity are expected. Minimal liquefaction is expected even in the areas that are highly susceptible.

The four tanks and five pump stations all have a low vulnerability to ground motions expected in an OBE, and minimal damage is expected. It is likely that there will be a regional loss of power that will last on the order of one day following an OBE. All of the

City pump stations have emergency generators except Livesay, but this pump station only serves three customers.

2.5.2. DBE Expected Performance

For the DBE, with a recurrence interval of approximately 475 years, significant damage is expected. The most likely source for this earthquake is a Cascadia Subduction event, with ground motions on the order of 15 to 20 percent times gravity. Soils with a high liquefaction susceptibility in the Central Business District, along I-205, and along Redland Road may liquefy in this scenario.

There is a high probability of failure of the upper wall sections of Reservoir #2. Sloshing is likely to damage the roof as well. Depending on the extent of the damage, the reservoir would likely not be usable. <u>Loss of Reservoir #2 storage capacity would impact the entire system operation.</u>

The Henrici Reservoir should perform well with the exception that sloshing may damage the roof. The redundant Boynton Reservoir is moderately vulnerable.

The Mountainview Pump Stations and Pump No. 3 House are expected to have some structural damage, but would likely remain functional. There may be some damage to unanchored/inadequately-anchored equipment at all facilities. <u>If the elevated tank is full, there is a significant potential that it may collapse and damage the adjacent Mountainview Pump Stations.</u>

Pipeline damage due to liquefaction is expected in the Central Business District, along I-205, and along Redland Road. Pipe connections to PRV vaults will likely be damaged in areas where liquefaction occurs. Damage is expected to the 16-inch-diameter cement-lined steel pipe with leaded joints transmission line serving the Henrici Reservoir, however, portions of this pipeline were replaced during the summer of 2002.

2.5.3. *Portland Hills Fault Expected Performance*

The Portland Hills Fault event is expected to recur every 5,000 to 10,000 years. Ground motions would be expected to be four times those from a Cascadia Subduction or 475-year return earthquake, and three to four times larger than the forces that facilities were designed to resist. For this scenario, infrastructure throughout the entire region will be heavily damaged.

All four reservoirs would be expected to be damaged. Extensive structural damage is expected at the Mountainview Pump Stations, with the ability to continue operation doubtful. The modern pump stations may have limited damage. Pipeline damage would be more severe than in the DBE. Liquefaction would be more extensive, and pipe damage due to wave propagation more severe.

2.6. Recommendations

This section describes recommended mitigation measures for the short, medium, and long term planning scenarios.

2.6.1. *Short-Term Mitigation (2 years) ($25,000)*

These quick-fix recommendations would enhance the emergency response following a 475-year return earthquake.

- Drain and/or remove the elevated tank at the Mountainview site. (TBD)
- Anchor miscellaneous equipment in pump stations and PRV vaults. ($5,000, potentially in-house project)
- Structurally upgrade the Mountainview Pump Stations. ($20,000)
- Document and exercise valves on pipelines in liquefiable soils in the Central Old Town district, along I-205, and Redland Road. (in-house project)
- Communicate with the jurisdiction providing fire protection about the vulnerability and potential failure of water service in these areas following a major earthquake. (incidental cost)

- If the SFWB transmission line seismic vulnerability has not been evaluated, the City should encourage that a hydraulic, structural, and condition assessment be performed. (TBD by SFWB)
- Transfer the Livesay Pump Station service area to the Barlow Crest Tank. (non-seismic related budget)

2.6.2. Medium-Term Mitigation (5 years) ($700,000)

This recommendation would result in maintaining system operation following a 475-year return event.

- Seismically upgrade Reservoir #2. ($700,000)

2.6.3. Long-Term Mitigation (20 years) ($50,000)

These recommendations would enhance post-earthquake recovery, particularly following a 475-year event.

- Complete replacement of the 16" steel pipe transmission line with leaded joints serving the Henrici Reservoir. (cost TBD)
- Replace the cast iron pipe with leaded joints in the Central Old Town district in liquefiable soils with ductile iron pipe with restrained joints. (cost TBD)
- Seismically upgrade the Boynton Reservoir. ($50,000).

Please note that the above costs include construction only. Approximately 40% should be added for design, inspectors, construction support, project management, contingency, permitting, and taxes.

3. Seismic Hazards

3.1. Introduction

This section addresses seismic hazards including ground motion and liquefaction.

3.2. Regional Seismicity and Ground Motions

Seismic hazards in the Portland area are dominated by two sources: deep earthquakes along the Cascadia subduction zone occurring at the interface between the subducting Juan de Fuca Plate and the North American Plate, and shallow crustal events within the North American Plate. The regional tectonic structure is shown in Figure 3-1.

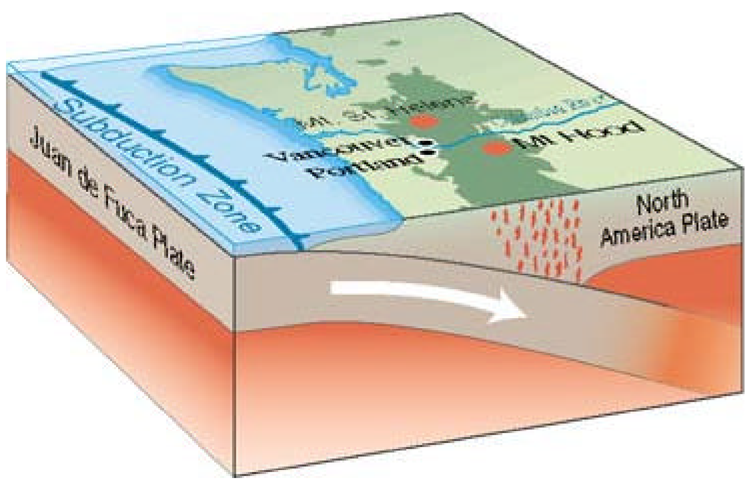


Figure 3-1

Pacific Northwest Tectonic Structure (after USGS)

There is geologic evidence that subduction earthquakes occur approximately every 500 years, the most recent being in 1700.

The USGS has included a third earthquake source zone in the Seattle area but not in the Portland area, even though the two areas arguably have a similar tectonic structure. In the USGS model, earthquakes that occur within the Juan de Fuca Plate (termed intraplate earthquakes) are not considered likely in the Portland area because of the subducting plate geometry. The 1949 magnitude 7.1, 1965 magnitude 6.5 , and 2001 M6.8 earthquakes near Seattle were intraplate events. As a result, the probabilistic earthquake ground motions in the Portland area are lower than those used for the Seattle area.

The 1993 magnitude 5.6 Scott's Mills Earthquake, and the 1962 magnitude 5.2 Portland earthquakes were crustal events. The USGS and other researchers have identified shallow (crustal) faults and lineaments in the Portland area, the most pronounced of which is the Portland Hills Fault paralleling the Willamette River through downtown Portland. The Portland Hills Fault is modeled with a slip rate of 0.1 mm/yr, with a characteristic earthquake of magnitude 7.0 with a return period on the order of 10,000 years. Other investigators have assigned slightly higher slip rates with a corresponding return period of 5,000 years. With the low slip rate/long return periods, the fault has little effect on 475-year return probabilistic ground motions. The Portland Hills Fault runs south directly toward Oregon City, but may stop short just north of the Clackamas River. If the fault broke south, moving towards Oregon City, there could be directional effects that would result in very large ground motions. If the fault broke moving north, the ground motions would be somewhat less. Other regional faults include the Molalla-Canby Fault and the Mount Angel Fault.

3.2.1. Strong Ground Motion

Strong ground motion is a significant hazard to City facilities, whose vulnerability varies depending primarily on the type of construction and the earthquake criteria to which the facility was designed.

Strong ground motion can be characterized in two ways:

- **Probabilistic**, where a hazard curve is developed for a site, expressing the probability of various levels of PGA due to all sources.
- **Scenario**, where peak ground acceleration (PGA) is determined at a site or sites given a specified earthquake occurrence; i.e., magnitude and epicentral location are uniquely defined.

Peak ground acceleration (PGA) is a measure of earthquake ground motion. It is often presented as a percent of gravity. Typically, the largest component of PGA is in the horizontal direction, with about two-thirds of the value in the vertical direction. PGA is the result of earthquake waves propagating through the ground. These waves have a range of frequencies. The highest PGAs are at frequencies of less than 1 cycle/second. Sometimes ground motion information is provided in response spectra that includes accelerations over a range of frequencies.

PGA damages structures because it effectively pushes on them laterally. Damage to vulnerable structures can occur at very low PGAs of say 5 percent times gravity. Structures can be designed to resist loads as high as 100 percent of gravity or more. Ground motion can also cause soils to consolidate/settle differentially, liquefy, spread laterally, and lurch. Structures or pipe buried in the soil can be damaged if the soil moves.

PGAs can be estimated for a specific earthquake given the earthquake magnitude and distance away from the site. Ground motion can be amplified by soft soils on the site.

Probabilistic PGAs are calculated by combining ground motions from all the possible earthquakes and weighting their contribution depending on their probability of occurrence. The probabilistic earthquake ground motion, probability of occurrence, and return period are all related. The lower the probability of occurrence within a given period, the larger the expected ground motion, and the longer the return period.

In the Oregon City area, the ground motion for an earthquake with a 50 percent probability of occurrence in 50 years is about 8 to 10 percent times gravity. Such an earthquake has a 72-year return period. Similarly, the ground motion for an earthquake with a 10 percent probability of occurrence would be about 15 to 20 percent times gravity, with a recurrence period of 475 years. The 475-year return event's primary ground motion contribution is from a subduction earthquake. These ground motions are generally consistent across the Portland area, with a slight reduction moving east away from the potential subduction earthquake source zone. The Portland Hills fault may produce a PGA in the order of 60 to 80 percent times gravity in the City.

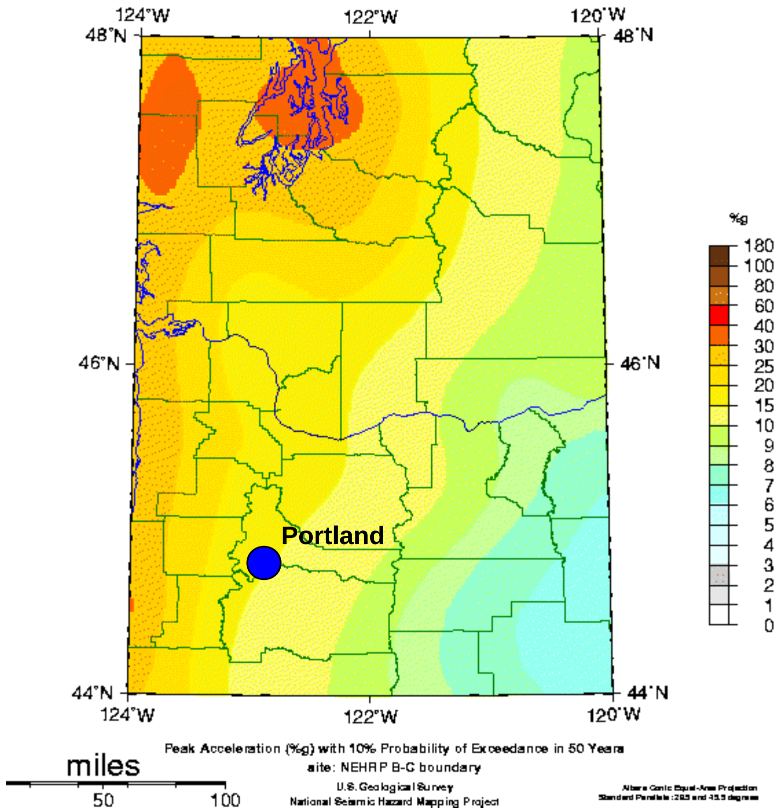


Figure 3-2

Peak Acceleration With 10% Probability of Exceedance in 50 Years

Surface faulting is not a concern in the Portland area, based on:

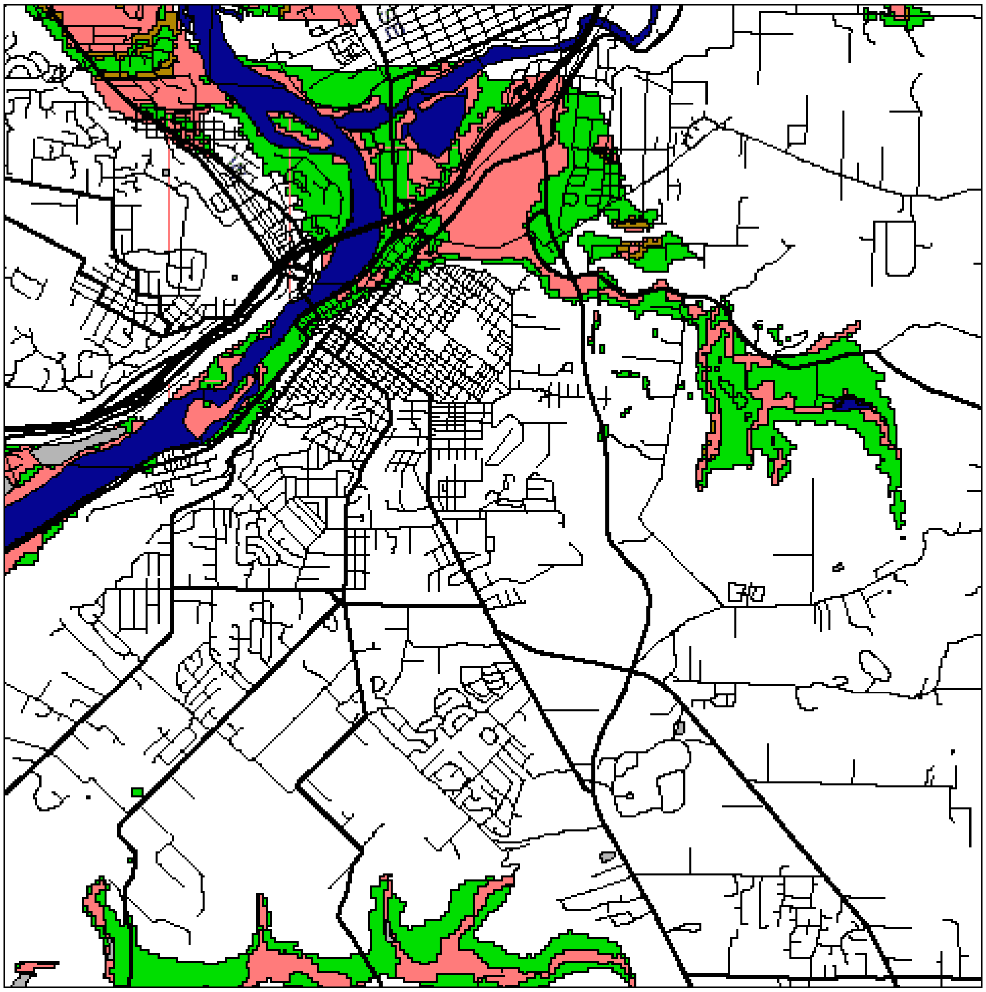
- Fault rupture associated with a subduction earthquake would be located off the Oregon coast, and should be of no consequence to City facilities.
- Thrust or reverse faults that may result from north-south crustal compression typically do not reach the surface. By comparison, the San Andreas and Hayward strike slip faults in California have a very significant surface expression, and are considered when design facilities cross them.
- There is no evidence of surface faulting in the Portland area over the last 5,000 years.

3.2.2. Earthquake Hazard Summary

Probabilistic earthquake ground motions on the order of 8-10 percent gravity for a 72-year return, and 15-20 percent gravity for a 475-year earthquake can be expected in Oregon City. These will be amplified on soft soil sites. Scenario earthquake ground motions, such as from the Portland Hills Fault, may be as large as 60 to 80 percent times gravity, but these would only be expected to occur every 5,000 years.

3.3. Liquefaction Susceptibility

The Oregon Department of Geology and Mineral Industries (DOGAMI) has developed liquefaction susceptibility mapping for the City's service area (Figure 3-3). The pink shaded area has the highest liquefaction susceptibility. Minimal liquefaction is expected in an OBE event, whereas significant liquefaction would likely occur in a DBE event, or an event on the Portland Hills Fault. The liquefaction information is of most significance to City pipeline vulnerability, and will be discussed in that section.



Legend:
pink = high susceptibility
brown = moderate susceptibility
green = low susceptibility
white = not liquefiable

Figure 3-3: Liquefaction Areas in Oregon City (DOGAMI).

4. Facility Evaluation

4.1. General

The seismic vulnerability assessments for the City's water system components are presented in this chapter. The facilities included were the City's reservoirs (No. 2, Boynton, Henrici, and Barlow Crest); five pump stations and pump houses, and 15 PRVs. Assessments were made for the seismic hazards associated with the OBE and DBE and Portland Hill's Fault events defined in Chapter 3. The sites were visited by ABS Consulting engineers on January 28 and 29, 2002.

Our findings and upgrade recommendations in the event of these scenario earthquakes are discussed in the following sections. A discussion of the water system vulnerabilities and prioritized recommendations are presented in Chapter 6.

4.2. Criteria for Review

This assessment is based on the following:

- A review of the available civil and structural drawings for the facilities.
- A visual survey of the structures to establish their condition and the general quality of construction.
- A review of geological, fault, and earthquake data for the sites.
- An estimate of the probable ground motions at each site for three levels of earthquakes.
- Knowledge of the performance of similar facilities in past earthquakes and engineering judgment.
- Limited engineering calculations.

4.3. Reservoirs

The City's water reservoirs include both steel and reinforced concrete construction. Table 4-1 summarizes reservoir age, construction type, seismic risk, and applicable seismic upgrade costs. The following paragraphs summarize typical seismic vulnerabilities for these types of reservoirs.

Evaluation of the elevated tank at Mountainview is not included in the scope of work. However, if the tank collapses, it is likely to heavily damage the Mountainview Pump Stations. In the short-term, the City should either remove the tank, or drain the tank to reduce its vulnerability to collapse.

Ground-supported steel-shell reservoirs have traditionally been designed based on AWWA standards, which permit tanks to be unanchored under certain conditions. In an earthquake, the shell rigidly contains a lower portion of the liquid, while the remaining upper portion sloshes inside. The critical tank elements are: 1) the vertical shell which may buckle along the bottom due to tank rocking, 2) the welded seam between the bottom plate and the vertical shell, 3) the roof-to-shell connections, and 4) the attached piping. Typical upgrade solutions involve foundation anchors along the perimeter of the tank or flexible piping connections.

Oregon City steel reservoir descriptions and findings are included in Table 4-1. In summary, the Boynton standpipe includes a reinforced concrete mat foundation with anchor bolts at the base of the tank. The existing standpipe is adequate for the OBE scenario. The existing anchorage is inadequate to resist the DBE forces. There is potential for anchorage failure and/or shell rupture. For the PHF scenario, substantial foundation improvements would also be required.

The Henrici reservoir is relatively flat in profile. Consequently sloshing of water dominates the tank response. The tank appears to be adequately designed for the OBE scenario. In the DBE scenario there exists potential for roof damage due to sloshing. Roof damage and piping damage is likely in the PHF scenario.

The Barlow Crest is a modern steel reservoir of base anchorage which appears to be adequate for the OBE event and marginal for the DBE scenario. In the PHF scenario there is potential roof damage due to sloshing.

Historically, reinforced concrete water storage tanks have generally performed well in previous earthquakes. (There is a concern about Reservoir #2.) The primary cause of reinforced concrete tank failure can be attributed to the lack of positive connections between elements, tank deterioration, or foundation failure. The wall-to-foundation connection is the most critical in maintaining tank integrity and preventing leakage. Roofs that are not connected to the walls can slide. In addition to roof damage, interior columns may be subjected to excessive lateral forces if the roof is not anchored. Sloshing forces can also damage roofs or walls near the roof-to-wall interface. This type of damage usually occurs near or above the water level line, and these tanks are expected to remain functional after experiencing sloshing damage. Tank walls would only be expected to experience damage from inertial forces if they have deteriorated from the original design condition. Consequently, wall cracking with significant efflorescence should be investigated to determine if reinforcement corrosion has occurred. Vertical wall cracks are most significant because they may indicate a loss in hoop (tangential) stress capacity, or lead to deterioration of reinforcing designed to resist hoop stresses.

Reservoir #2 construction consists of a 1915-vintage open concrete reservoir that was modified in 1951 (concrete perimeter wall) to add storage capacity. In 1978 a wood-framed roof and interior posts were added.

The principal concern is the adequacy of the perimeter walls and roof damage due to sloshing effects. The reservoir appears to be adequate for the OBE scenario. In the DBE scenario, roof damage is possible due to sloshing. The perimeter wall is marginal if overtopped by a sloshing wave. The reservoir would likely fail in the PHF scenario.

4.4. Pump Stations

In general, the pump stations consist of relatively small “box-like” structures housing pumps and electrical panels. Construction consists of wood-framing or reinforced masonry units (CMU). Significant damage for these types of structures generally occurs due to a lack of wall connections at the roof or foundation level, or due to a soil failure. Table 4-2 summarizes general characteristics, findings, and recommendations for each structure.

The Mountainview Pump Stations may lack foundation anchorage. Consequently, both of these facilities are considered moderate risks and may experience severe structural damage in a DBE event. Verification of wall/roof anchorage for these structures is recommended.

Soil stability issues (landsliding and liquefaction) do not appear to be a significant issue at pump station sites.

Equipment and nonstructural issues were also noted during our walkthroughs of the pump stations. In general, the electrical panels, pumps, and motors were found to be adequately anchored to prevent damage in a major earthquake. However, a space heater and start-up batteries at the Hunter Pump Station should be properly restrained.

4.5. Pressure Reducing Valve Vaults

Generally, pressure-reducing valves are housed in below ground, reinforced concrete vaults. In the absence of soil failures, such structures are reliable in earthquakes. However, if liquefaction/PGD occurs, the vault may move with the surrounding soil or float. In either case the connecting piping would likely be damaged. Liquefaction susceptibility and associated pipeline vulnerability is discussed further in Chapter 5.

The piping inside the vault is generally supported at the vault wall penetrations and usually has a gravity support under the pressure-reducing valve. This should be adequate to resist lateral loading for OBE and DBE events. In a Portland Hills Fault event, piping inside the vaults could fail laterally, in bending. We noted installations where air/vacuum release valves were supported only on the small diameter threaded piping connecting them to the larger pipe. There is a significant potential for the heavy air/vacuum release valve to respond as an inverted pendulum. In a DBE it could break off where small diameter pipe is attached to the larger diameter pipe. Addition of lateral bracing is recommended.

Table 4-1

RESERVOIR DESCRIPTIONS AND FINDINGS

Water Reservoir	Pressure Zone	Year Built	Capacity (MG)	Structural Material and System	Seismic Concerns	Scenario Seismic Risk[1] OBE	DBE	PH3	Upgrade Priority	ROM Upgrade Cost (DBE)
No. 2	Low and intermediate	1915/ 1951 1978	10.5	Reinforced concrete, wood-framed roof	• Concrete wall failure • Wood-framed roof damage (sloshing)	Low	High	Very High	High	$700,000
Boynton	Upper	1984	2.0	Steel anchored	• Inadequate foundation anchorage (DBE event) • Pipe rupture • Inadequate foundation (pH)	Low	Moderate	High	Moderate	$50,000
Henrici	Upper	1994	2.0	Steel unanchored	• Sloshing • Pipe rupture	Low	Low	Moderate	N/A	N/A
Barlow Crest	Low and Intermediate Park Place	1999	1.75	Steel anchored	• None (OBE event)	Low	Low	Moderate	N/A	N/A

1. Scenarios:
   OBE = Operational Basis Earthquake
   DBE = Design Basis Earthquake
   PHF = Portland Hills Fault Earthquake

Table 4-2

PUMP HOUSE DESCRIPTIONS AND FINDINGS

Pump House	Reservoir Served	Year Built	Structural System	Seismic Concerns	Scenario Seismic Risk			Upgrade Priority	ROM Upgrade Cost
					OBE	DBE	PH		
Pump House No. 3	Henrici, Boynton	1950s	CMU walls w/ wood-framed roof	Verify foundation and roof anchorage	Low	Moderate	High	High	$10,000
Pump House No. 1, 2, 4	Henrici, Boynton	1960s	CMU walls w/ wood-framed roof	Verify foundation and anchorage	Low	Moderate	High	High	$10,000
Boynton	local fire flow	1984	CMU walls w/ wood-framed roof	None observed	Low	Low	Moderate	Low	N/A
Fairway Downs	none	1998	Wood-framed roof and walls	None observed	Low	Low	Moderate	Low	N/A
Hunter	Barlow Crest	1999	CMU walls w/ wood-framed roof	Anchor suspended space heater Strap start-up batteries	Low	Low	Moderate	Low	$1,000

1. Scenarios:
   OBE = Operational Basis Earthquake
   DBE = Design Basis Earthquake
   PHF = Portland Hills Fault Earthquake

5. Pipeline Evaluation

5.1. Introduction

In this chapter the vulnerability of the pipeline distribution system is evaluated geographically relating soils susceptible to liquefaction with City pipelines. The general vulnerability of the pipeline network to ground shaking and liquefaction is then described, and specific vulnerabilities related to liquefaction are addressed. Mitigation recommendations are provided.

5.2. Pipeline Vulnerability

Buried pipelines are vulnerable to ground shaking and liquefaction/lateral spreading. The failure rate for pipelines subjected to liquefaction/lateral spread is on the order of ten times that for ground shaking.

Pipelines with bell and spigot joints with elastomeric gaskets perform well when subjected to ground motion. Even asbestos cement pipe performs well when there is no permanent ground deformation because it is more flexible than cast iron. Asbestos cement pipe has a shorter laying length and has a “double” bell and spigot (coupling works as a double bell and spigot). Pipe with rigid joints and/or a weak barrel performs the worst in an earthquake-shaking environment. Cast-iron pipe installed before about 1960 (approximate) may have leaded joints. Leaded joints have brittle behavior.

Thin-walled steel pipe has performed poorly particularly when weakened by corrosion. Screwed joint pipe also has a poor track record when subjected to shaking because it has no longitudinal flexibility. That is compounded by the fact that the threads reduce the structural cross section of the pipe, and the material properties of the steel are changed when the threads are cut.

Pipe subjected to permanent ground deformation from liquefaction/lateral spreading or landslide generally does not perform well. Only strong ductile pipe with restrained joints or continuous pipe such as high-density polyethylene or steel with welded joints performs moderately well.

5.3. Expected Performance of City Pipelines

Expected performance of sections of the pipeline transmission and distribution system is described. The locations of concern due to liquefaction are listed below, and shown in Figure 5-1.

SFWB transmission pipeline Clackamas River to Treatment Plant (Raw Water Line), and Treatment Plant to Reservoir #2 – We understand that this is concrete cylinder pipe with bell and spigot joints. There have been joint failures in the past. The pipe generally traverses along areas of competent soil with the exception of the slope from the Clackamas River to the treatment plant, and the low point near Redland Road. We understand that the slope from the Clackamas River to the Treatment Plant has been addressed over the past few years. This is a critical pipeline. If it has not been evaluated, we recommend that the City encourage the SFWB to conduct a detailed hydraulic (transients), structural, and condition assessment of this pipeline in the short-term.

South end of system south of Warner Milne Road –It appears that this is a newer portion of the system constructed with ductile iron pipe. There are no liquefiable soils in this area, so the pipe vulnerability should be low in a DBE, and moderate in a PHF event.

Transmission line from Mountainview Pump Stations to Henrici Reservoir along Beaver Creek Road – We understand that this pipe is steel with leaded joints. Leaded joints do not perform well when subjected to earthquake wave propagation. This pipe vulnerability is Low in an OBE, Moderate in a DBE, and High in a PHF event. We understand that a portion of this transmission line was replaced in the summer of 2002.

Central Old Town portion of system north of Warner Milne Road – Much of the pipe in this area appears to be cast iron. The joint type is unknown. There are several blocks where the soil has a high susceptibility to liquefaction (see Figure 5.1). The vulnerability of cast iron pipe with leaded joints in a DBE is Moderate in competent soils, and High in liquefiable soils. If this pipeline fails, water service may be lost locally. We recommend documenting the location and regularly exercising valves required to isolate the section of pipe in liquefiable soils in the short term, and replacing it in the long-term.

Northeast section of system north of Redland Road – Much of the pipe in this area appears to be asbestos cement. The soils are competent. Asbestos cement pipe performs well in competent soils, accommodating the differential movement due to wave propagation in the gasketed joint. The pipe has a low vulnerability in a DBE, and a moderate vulnerability in a PHF event.

Northwest section of system in the area of I-205 – Much of the pipe in this area is ductile iron, but the soils are liquefiable (see Figure 5.1). If significant liquefaction and associated lateral spreading occurs, the ductile iron pipe joints could pull apart. The pipe has a moderate vulnerability in a DBE, and High vulnerability in a PHF. We recommend documenting the location and regularly exercising valves in this area that would be required to isolate the damaged pipe from the system.

Redland Road – Sections of the pipe are identified to be cast iron (joint type unknown), and is an area identified to be highly susceptible to liquefaction (DOGAMI) (see Figure 5.1). The vulnerability of cast iron pipe with leaded joints in a DBE is Moderate in competent soils, and High in liquefiable soils. If this pipeline fails, water service may be lost locally. We recommend documenting the location and regularly exercising valves required to isolate the section of pipe in liquefiable soils in the short term, and replacing it in the long-term. If this pipeline serves as a transmission line to other parts of the system, consideration should be given to replacing it in the short-term. This is the periphery of the Oregon City system; the transmission pipeline for Clackamas River Water District continues outside of the service area.

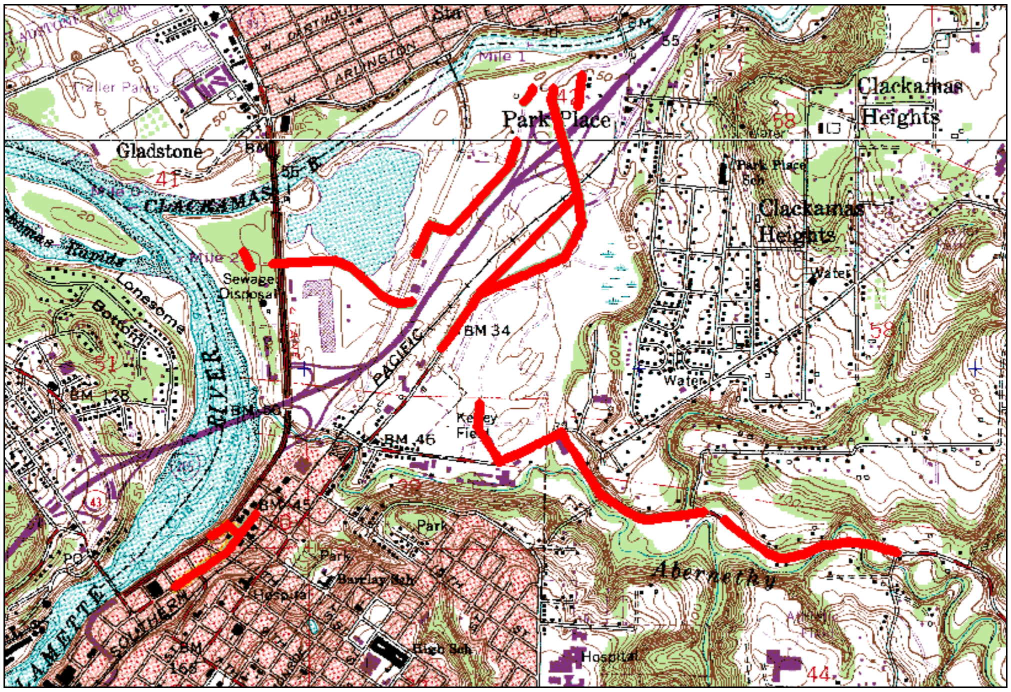


Figure 5-1. Pipelines in the Oregon City system that are in areas susceptible to liquefaction (shown in red).

5.4. Mitigation Recommendation Summary

This section summarizes recommendations to address pipeline vulnerability.

Short-Term (2 years) – For pipelines in liquefiable soils in Central Old Town, along I-205, and Redland Road, the City should document and exercise valves. In addition, the City should communicate with the jurisdiction providing fire protection about the vulnerability and potential failure of water service in these areas following a major earthquake. If the SFWB transmission line seismic vulnerability has not been evaluated, the City should encourage that a hydraulic, structural, and condition assessment be performed.

Long-Term (20 years) – The steel pipe transmission line with leaded joints serving the Henrici Reservoir should be replaced. The cast iron pipe with leaded joints in the Central Old Town in liquefiable soils should be replaced with ductile iron pipe with restrained joints.

6. Findings and Recommendations

6.1. Findings

This section summarizes findings in terms of expected performance of system components for three earthquakes, the OBE, DBE, and the PHF event.

The entire system is totally dependent on the SFWB supply. The scope of work did not include evaluation of that system.

6.1.1. OBE Expected Performance

For the OBE, with a recurrence interval of 72 years, the system is expected to perform well. Ground motions in the order of 8 to 10 percent times gravity are expected. Minimal liquefaction is expected even in the areas that are highly susceptible.

The four tanks and five pump stations all have a low vulnerability to ground motions expected in an OBE, so minimal damage is expected.

It is likely that there will be a regional loss of power that will last on the order of one day following an OBE. All of the City pump stations have emergency generators except Livesay. Further, there is no storage in the Livesay service area, so service would be lost immediately on loss of power. We understand that the Livesay Pump Station service area could receive service through a new PRV from the Barlow Crest Reservoir. We recommend that this project move ahead.

6.1.2. DBE Expected Performance

For the DBE, with a recurrence interval of approximately 475 years, significant damage is expected. The most likely source for this earthquake is a Cascadia Subduction event, with ground motions on the order of 15 to 20 percent times gravity. Soils with a high liquefaction susceptibility in Central Old Town, along I-205, and along Redland Road are expected to liquefy.

There is a high probability of failure of the upper wall sections of Reservoir #2. Sloshing is likely to damage the roof as well. Depending on the extent of the damage, the reservoir would likely not be usable. This could result in failure of the entire system.

The Boynton Reservoir is moderately vulnerable. Tank wall buckling would be likely, with some potential of the tank bursting a seam at the bottom. The Henrici Reservoir should perform well with the exception that sloshing, particularly from a Cascadia Subduction Earthquake, may damage the roof.

The Mountainview Pump Stations are expected to have some structural damage, but would likely remain functional. There may be some damage to unanchored/ inadequately-anchored equipment at all facilities. If the elevated tank is full, there is a significant potential that it may collapse and damage the Mountainview Pump Stations. Its collapse would also result in failure of the radio communication system as the tank supports the system antennas. Regional power outage is expected to last three days, so the Livesay Pump Station service area would be without water.

Pipeline damage due to liquefaction is expected in Central Old Town, along I-205, and along Redland Road. Pipe connections will likely be damaged to PRV vaults in areas where liquefaction occurs. Damage is expected to the steel transmission line serving the Henrici Reservoir.

6.1.3. Portland Hills Fault Expected Performance

The Portland Hills Fault event is expected to recur every 5,000 to 10,000 years. Ground motions would be expected to be four times those from a Cascadia Subduction or 475-year return earthquake, and three to four times larger than the facilities were designed to resist. With such ground motions, infrastructure throughout the entire region will be heavily damaged.

All four reservoirs would be expected to fail. Extensive structural damage is expected at the Mountainview Pump Stations, with the ability to continue operation doubtful. The modern pump stations may have little damage.

Pipeline damage would be more severe than in the DBE. Liquefaction would be more extensive, and pipe damage due to wave propagation more severe.

6.2. Mitigation Recommendations

This section describes recommended mitigation measures to be addressed in the short, medium, and long term.

6.2.1. Short-Term Mitigation (2 years) ($25,000)

These quick-fix recommendations would enhance the emergency response following a 475-year return earthquake.

- Drain and/or remove the elevated tank at the Mountainview site. (TBD)
- Anchor miscellaneous equipment in pump stations and PRV vaults. ($5,000, potentially in-house project)
- Structurally upgrade the Mountainview Pump Stations. ($20,000) See Figure 6-1 for foundation anchorage detail.
- Document and exercise valves on pipelines in liquefiable soils in Central Old Town, along I-205, and Redland Road. (in-house project)
- Communicate with the jurisdiction providing fire protection about the vulnerability and potential failure of water service in these areas following a major earthquake. (incidental cost)
- If the SFWB transmission line seismic vulnerability has not been evaluated, the City should encourage that a hydraulic, structural, and condition assessment be performed. (TBD by SFWB)
- Transfer the Livesay Pump Station service area to the Barlow Crest Tank.

6.2.2. Medium-Term Mitigation (5 years) ($700,000)

This recommendation would result in maintaining system operation following a 475-year return event.

- Seismically upgrade Reservoir #2. ($700,000) See wall upgrade concept in Figure 6-2.

6.2.3. Long-Term Mitigation (20 years) ($50,000)

These recommendations would enhance post-earthquake recovery, particularly following a 475-year event.

- Replace the steel pipe transmission line with leaded joints serving the Henrici Reservoir. (cost TBD)
- Replace the cast iron pipe with leaded joints in Central Old Town in liquefiable soils with ductile iron pipe with restrained joints. (cost TBD)
- Seismically upgrade the Boynton Reservoir. ($50,000) See tank anchorage detail in Figure 6-3.

Please note that the above costs include construction only. Approximately 40% should be added for design, inspectors, construction support, project management, contingency, permitting, and taxes.

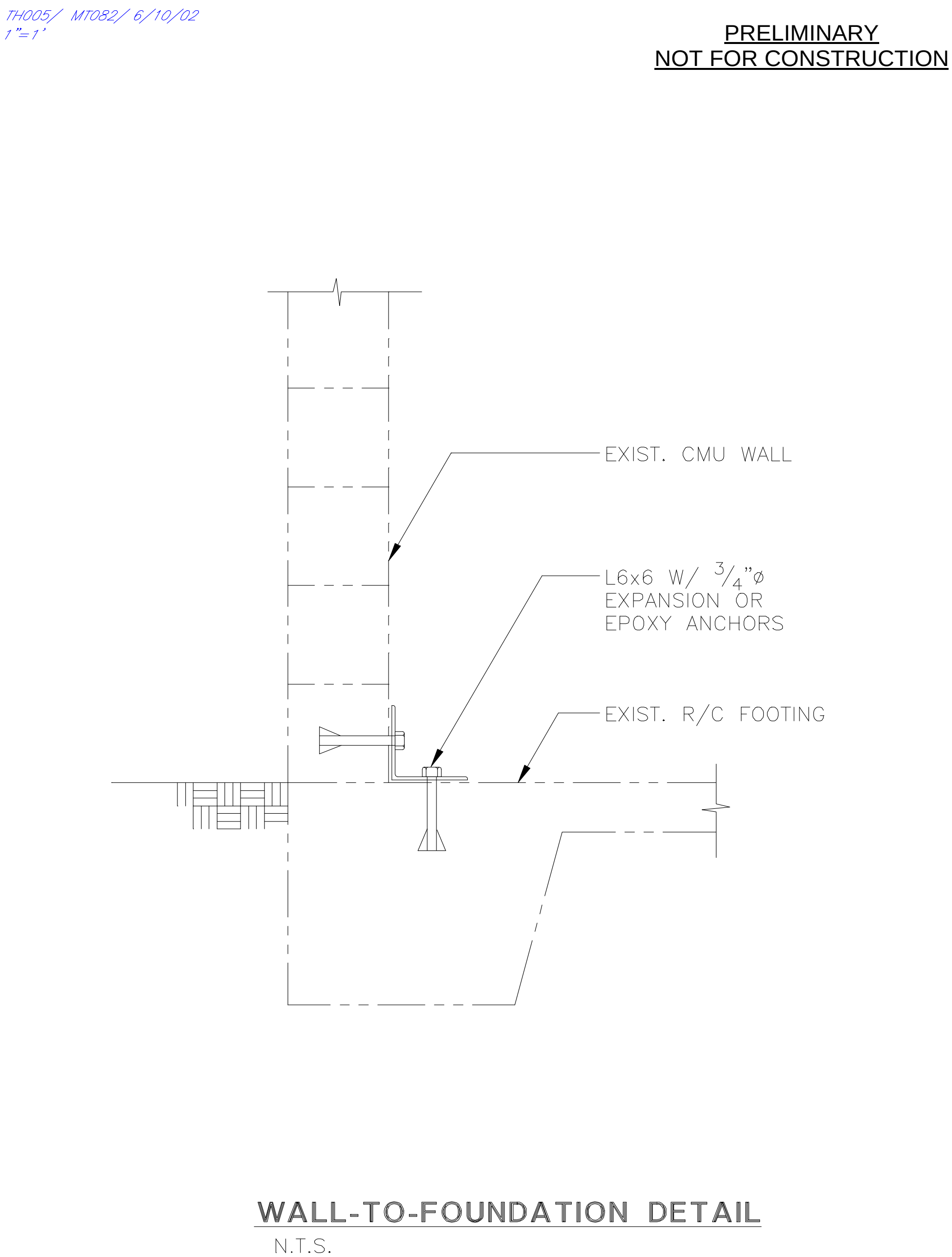


Figure 6-1: Pump Station Foundation Anchorage

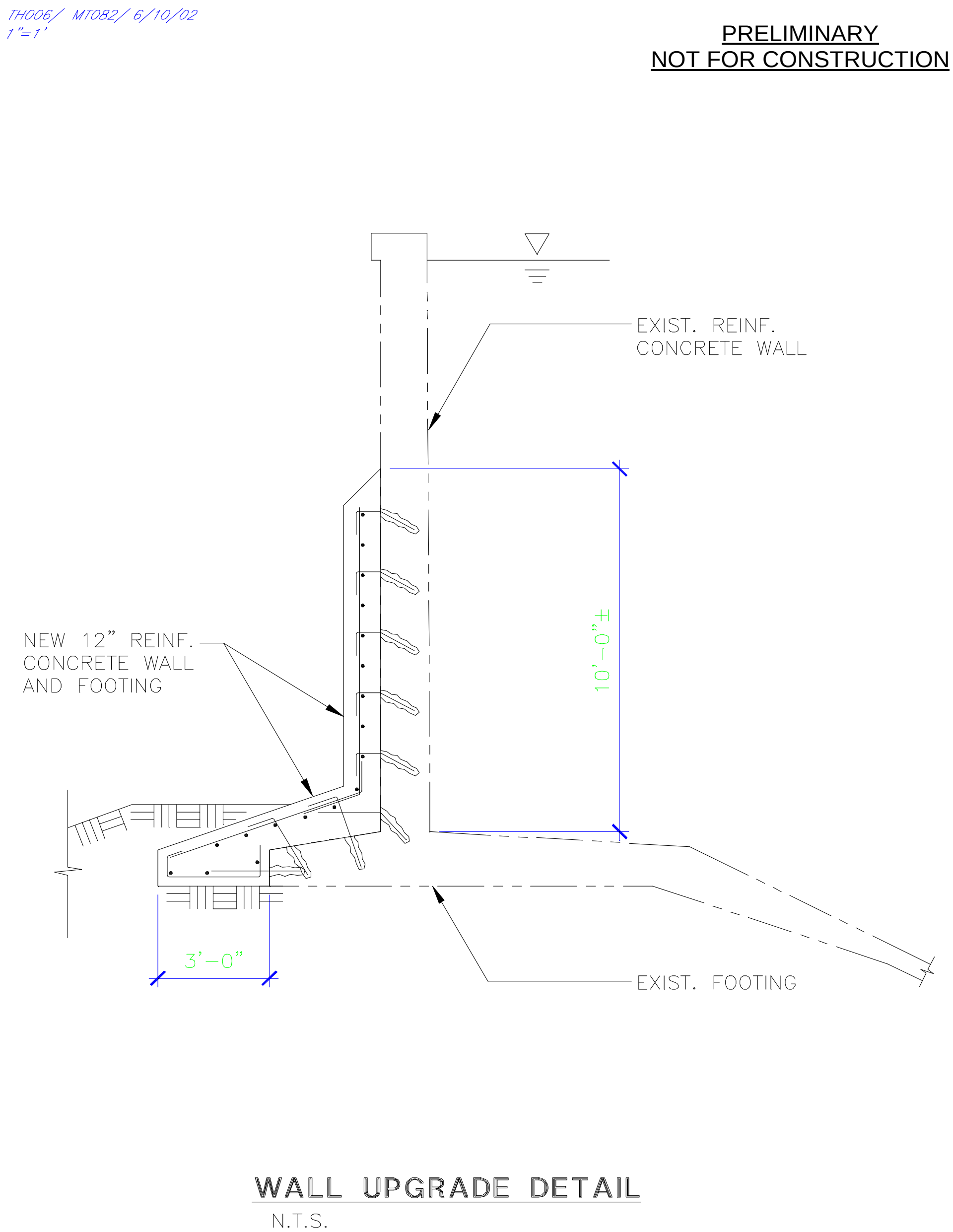


Figure 6-2: Reservoir #2 Wall Retrofit Concept

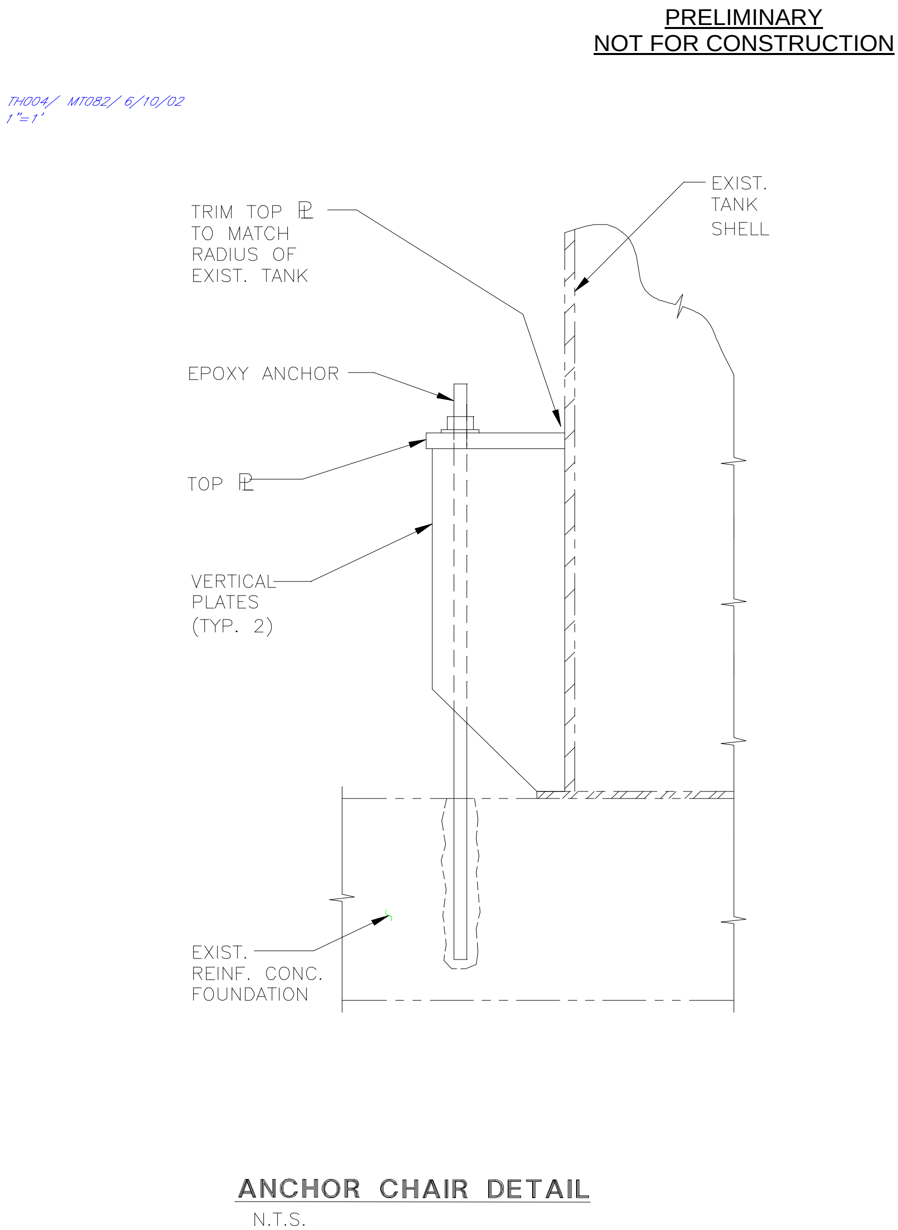


Figure 6-3: Steel Tank Anchorage Detail

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Americas
Beaverton, OR
Bethesda, MD
Boston, MA
Cleveland, OH
Denver, CO
Fremont, CA
Houston, TX
Knoxville, TN
Richland, WA
Rockville, MD
San Antonio, TX
Shillington, PA
Stratham, NH
Wilmington, DE

Ciudad del Carmen, Mexico
Mexico City, Mexico
Monterrey, Mexico
Reynosa, Mexico
Veracruz, Mexico

Sao Paulo, Brazil
Rio de Janeiro, Brazil
Buenos Aires, Argentina
Valparaiso, Chile

Europe
Aberdeen, UK
Abu Dhabi, UAE
Doha, Qatar
Dubai, UAE
Genoa, Italy
Istanbul, Turkey
Dammam, Saudi Arabia
London, UK
Muscat, Oman
Paris, France
Piraeus, Greece
Rotterdam,
The Netherlands
Sofia, Bulgaria
Vizcaya, Spain
Warrington, UK

Asia-Pacific
Bangkok, Thailand
Jakarta, Indonesia
Kuala Lumpur, Malaysia
Manila, Philippines
Mumbai, India
Pusan, Korea
Seoul, Korea
Shanghai, China
Singapore
Taiwan
Tokyo, Japan
Yokohama, Japan

APPENDIX C

Cost Estimating Assumptions

COST ESTIMATING ASSUMPTIONS

This appendix provides the assumptions used by West Yost to estimate the construction costs for the planning and design of recommended water system facilities for the City of Oregon City. The costs were developed based on 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.

Additionally, these costs are for construction only and do not include estimating uncertainties or unexpected construction costs (e.g., variations in final quantities) or cost estimates for land acquisition, engineering, legal costs, environmental review, inspections and/or contract administration. These additional cost items are referred to as construction contingency costs and project cost allowances, and are further described in the last section of this appendix.

All construction costs have been adjusted to reflect October 2009 costs at an Engineering News Record (ENR) Construction Cost Index (CCI) of 8596 (20 Cities Average). These costs are to be used for conceptual cost estimates only, 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. The planning level cost estimates have been prepared for guidance in evaluating various options, and are intended for budgetary purposes only, within the context of this master planning effort.

CONSTRUCTION COSTS

Pipelines

Unit construction costs for potable water pipelines 6 through 36 inches in diameter are provided in Table 1. These costs are to be used for typical pipeline construction in developed areas and for construction across open fields or areas that are not yet developed (undeveloped). These costs generally include pipeline materials, trenching, placing and jointing pipe, valves, fittings, hydrants, service connections, placing imported pipe bedding, native backfill material, and asphalt pavement replacement, if required. The costs presented in Table 1 do not include the cost of boring and jacking pipe. The costs shown in Table 2 should be added where required for this purpose.

Table 1. Unit Construction Costs for Pipelines[a]

Pipe Diameter, inches	Unit Construction Cost, $/linear foot	
	Developed Areas	Undeveloped Areas
6	110	100
8	140	120
10	160	140
12	200	160
14	220	190
16	250	210
18	280	230
20	300	260
24	350	290
30	430	360
36	500	410

(a) Based on the October 2009 ENR index of 8596.

Table 2. Unit Construction Costs for Jack & Boring[a]

Size	Unit Construction Cost, $/linear foot[b]
8-inch pipe (16-inch casing)	390
12-inch pipe (21-inch casing)	450
16-inch pipe (24-inch casing)	520
20-inch pipe (30-inch casing)	640
54-inch pipe (66-inch casing)	1,280
Tunnel	2,670

(a) Based on the October 2009 ENR index of 8596.
(b) Conductor pipe not included in cost.

Treated Water Storage Reservoirs

Table 3 lists the estimated construction costs for water storage reservoirs between the size ranges of 0.1 to 6.0 MG. These costs generally include the storage tank, site piping, earthwork, paving, instrumentation, and all related sitework. As previously stated, these costs are representative of construction conducted under normal excavation and foundation conditions, and would be significantly higher for special or difficult foundation requirements.

Table 3. Construction Costs for Treated Water Storage Reservoirs[a]

Capacity, MG	Estimated Construction Cost, million dollars	
	Partially Buried Pre-Stressed Concrete	Welded Steel
0.1	1.6	1.0
0.5	1.9	1.3
1.0	2.3	1.6
2.0	3.0	2.2
3.0	3.7	2.8
4.0	4.5	3.4
5.0	5.2	4.0
6.0	5.9	4.6

(a) Based on the October 2009 ENR index of 8596.

Treated Water Booster Pump Stations

Distribution pumping station costs vary considerably, depending on such factors as architectural design, pumping head, and station capacity. Estimated average construction costs for distribution pumping stations, as shown in Table 4, are based on enclosed stations with architectural and landscaping treatment suitable for residential areas. Booster pump station cost estimates include a backup/standby generator plus SCADA, and are based on a typical industry configuration, which includes 1 to 3 pumps at approximately 1 to 2 mgd.

Table 4. Construction Costs for Booster Pump Stations[a]

Firm Capacity[b], mgd	Estimated Construction Cost, million dollars
0.5	1.0
1	1.0
2	1.2
3	1.3
5	1.5
10	2.1

(a) Based on the October 2009 ENR index of 8596.
(b) The pumping capacity with the largest pump out of service or on standby.

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 assist the City of Oregon City with budgeting for these future construction projects, contingency costs have been added to the planning budget as percentages of the estimated construction cost using these two categories: Construction Contingency Costs and Other Project Cost Allowances.

Construction Contingency Costs

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 for which it is wise to make allowances in these preliminary cost estimates. An allowance of 20 percent of the base construction cost will be included to cover such project related construction contingencies.

Other Project Cost Allowances

Other project cost allowances are divided into three subcategories, totaling 28 percent:

- Design services associated with new facilities include preliminary investigations and reports, right-of-way acquisition, foundation explorations, preparation of drawings and specifications for construction, surveying and staking, sampling of testing material, and start-up services. The cost of these items may vary, but for the purpose of this study, it is assumed that engineering design costs will equal 10 percent of the construction costs after construction contingencies have been applied.
- Construction management covers items such as contract management and inspection during construction. The cost of these items may vary, but for the purpose of this study, it is assumed that construction management costs will equal 10 percent of the construction costs after construction contingencies have been applied.
- Administration costs cover items such as legal fees, environmental compliance requirements, financing expenses, and interest during construction. The cost of these items may vary, but for the purpose of this study, it is assumed that program implementation costs will equal 8 percent of the construction costs after construction contingencies have been applied.

An example application of these allowances 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) is approximately 54 percent of the base construction cost for each project.

Table 5. Example Application of Construction Contingency Costs and Other Project Cost Allowances

Cost Component	Percent	Cost	Total Cost
Estimated Base Construction Cost before Contingencies		$1,000,000[(a)]	
Construction Contingency Costs	20%	200,000	
Estimated Construction Cost with Contingencies			*$1,200,000*
Other Project Cost Allowances:			
Design	10%	$120,000	
Construction Management	10%	120,000	
Administration	8%	96,000	
Total Project Cost Allowances			$336,000
Estimated Total Project Cost			**$1,536,000**

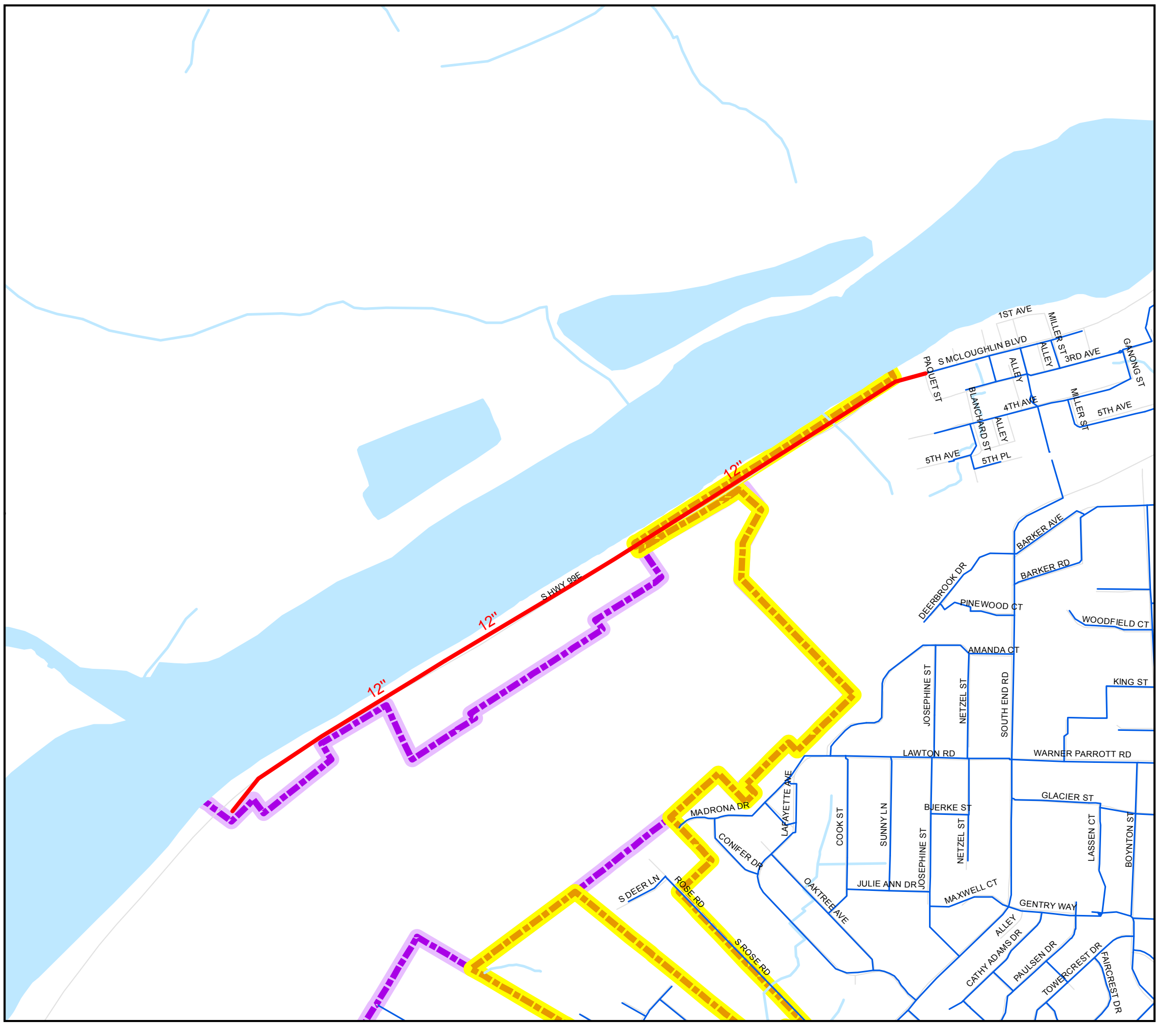
(a) Assumed cost of example project.

APPENDIX D

Project Sheets

APPENDIX D. PROJECT SHEETS

The following data sheets provide a summary of the location, size and length of each project identified in the CIP. The alignments of future pipeline extensions shown on the drawings are estimates and actual alignments may be modified as necessary to accommodate actual development patterns.



Pipeline Project Number: 1

Project Vicinity: Highway 99E/McLoughlin Blvd.

Project Description: This project is intended to provide service and fire flow protection to the service area along Highway 99E and the Willamette River. Add 6,863 feet of 12-inch diameter piping along Highway 99E.

Existing Pipeline
CIP Pipeline
City Limits
UGB

OREGON CITY

WEST YOST ASSOCIATES

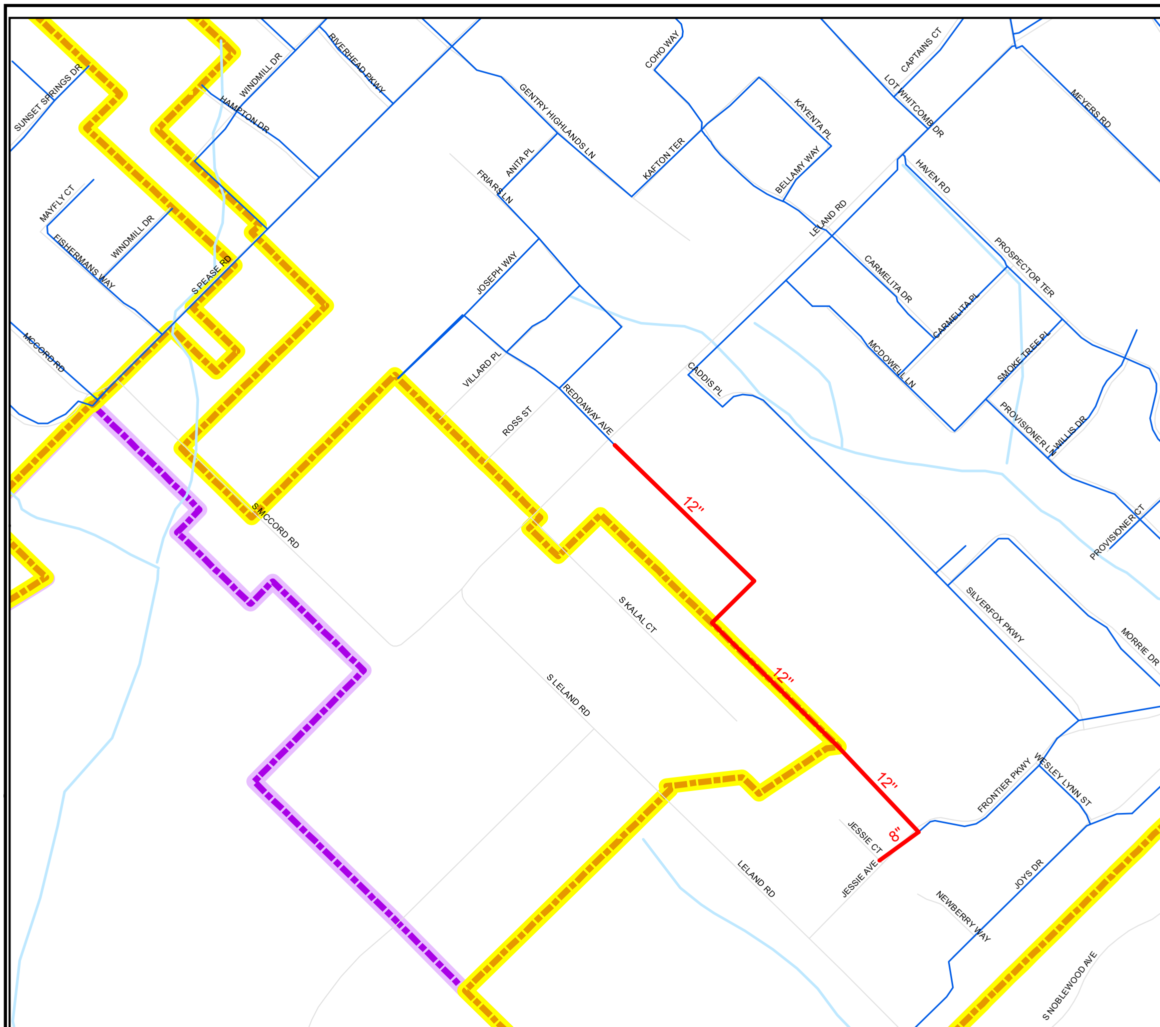
Project Data Table

	Pipe Size (inch)	Pipe Length (feet)	Construction Cost/ft ($)	Total Construction Cost ($)
	12	6863	$200	$1,372,600
Total		6,863		$1,372,600

N

0 500 1,000
Scale in Feet

1



Pipeline Project Number: 8

Project Vicinity: Joseph Way and S Leland Rd to S Jessie Ave.

Project Description: This project is intended to improve fire flows in the area and add additional looping for added reliability. Route shown may have constructability issues and will need refinement at the time of design. Add 1,839 feet of 12-inch diameter piping between Leland Road and Frontier Parkway South of Silverfox Parkway..

Existing Pipeline
CIP Pipeline
City Limits
UGB

OREGON CITY

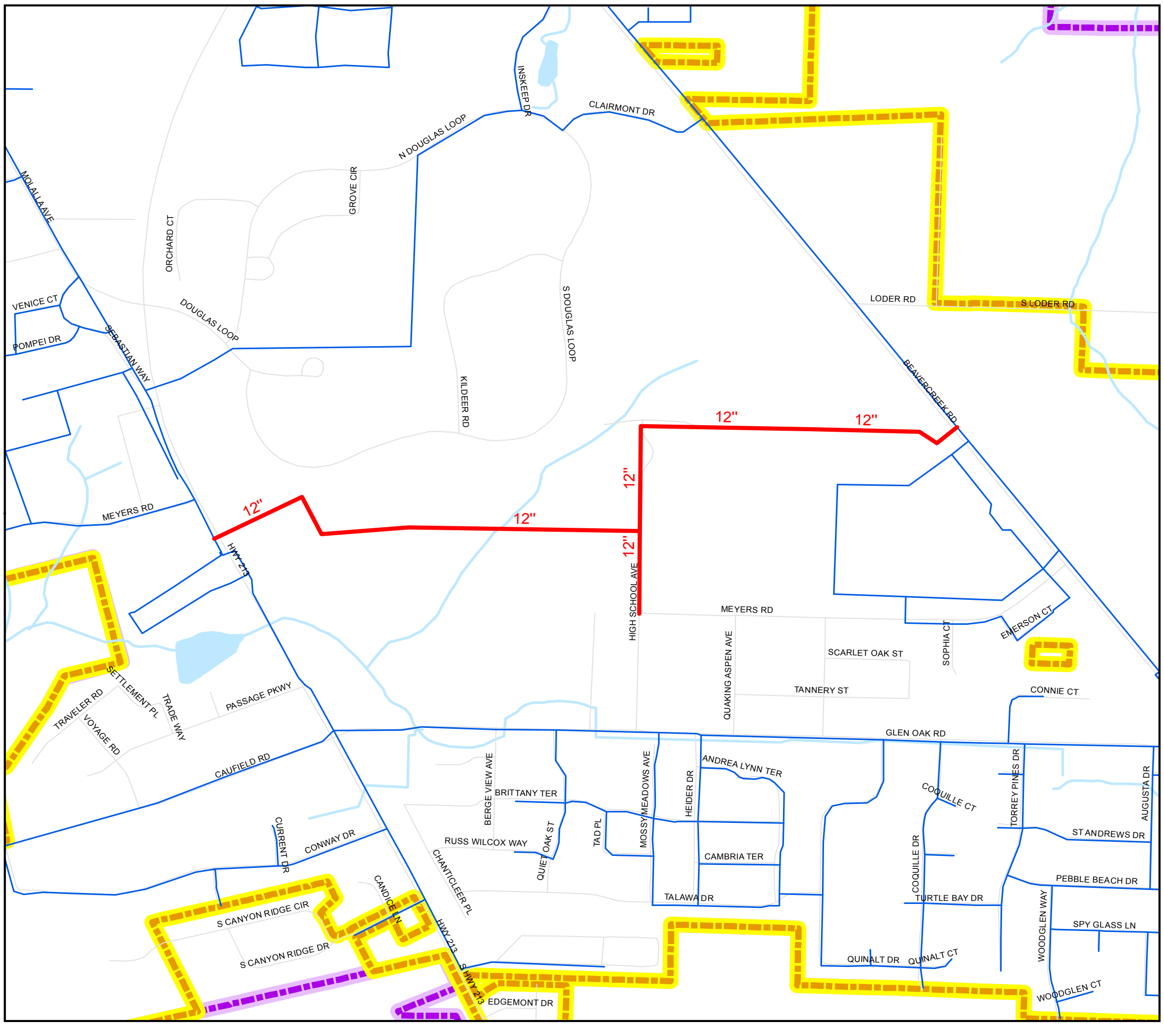
WEST YOST ASSOCIATES

Project Data Table				
	Pipe Size (inch)	Pipe Length (feet)	Construction Cost/ft ($)	Total Construction Cost ($)
	8	161	$140	$22,540
	12	1,839	$200	$367,800
Total		2,000		$390,340

N

0 200 400
Scale in Feet

2



Pipeline Project Number: 11

Project Vicinity: Between Highway 213 and Beavercreek Rd.

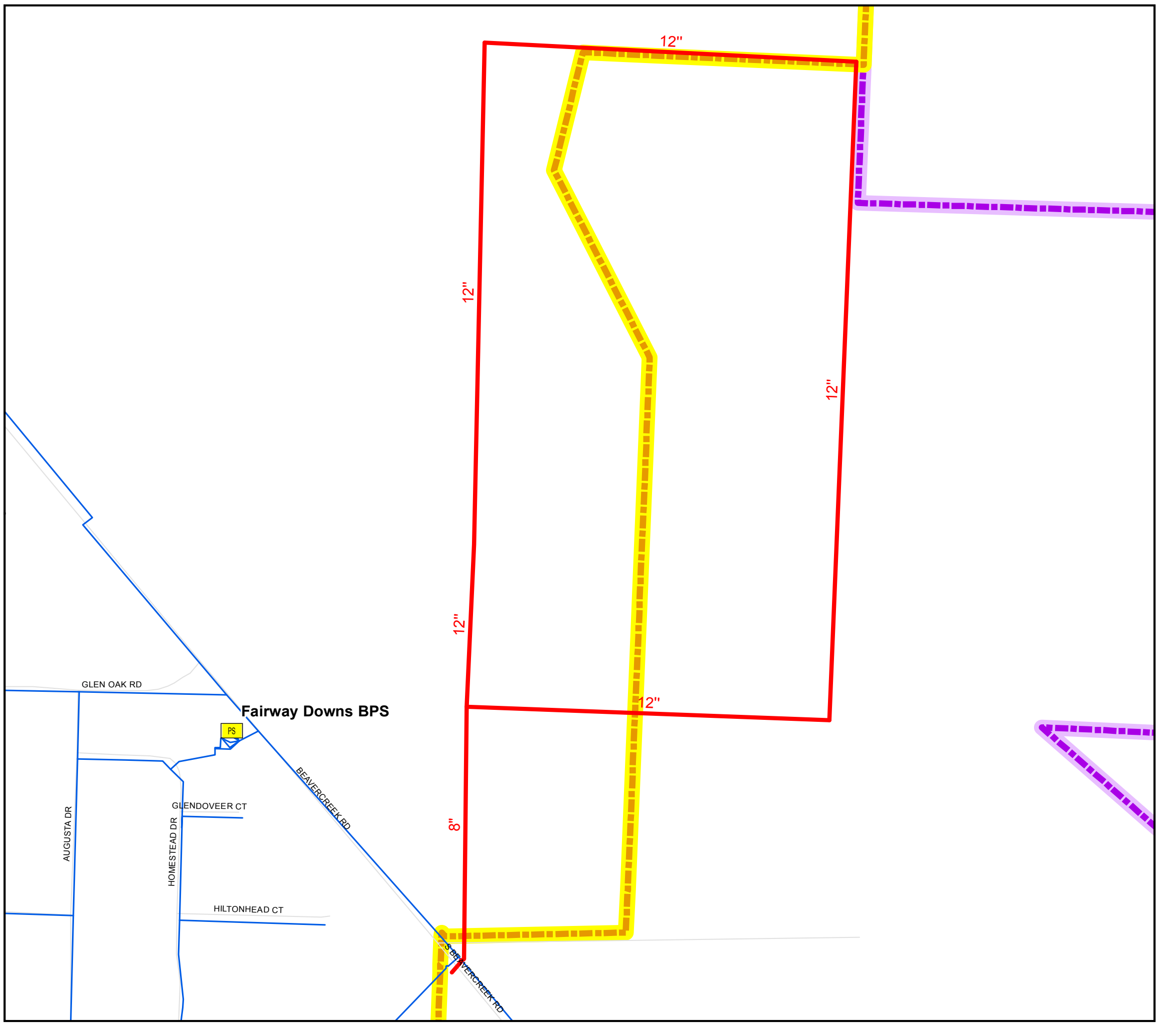
Project Description: This project is intended to supply future growth in the area, improve fire flows in the area and add additional looping for added reliability. Route shown may have constructability issues and will need refinement at the time of design. Add 5,662 feet of 12- inch diameter piping between Beavercreek Road and Highway 213 near Meyers Road.

Existing Pipeline
CIP Pipeline
City Limits
UGB

Project Data Table				
	Pipe Size (inch)	Pipe Length (feet)	Construction Cost/ft ($)	Total Construction Cost ($)
	12	5662	$200	$1,132,400
Total		5,662		$1,132,400

0 350 700
Scale in Feet

3



Pipeline Project Number: 12

Project Vicinity: East side of Beavercreek Rd, adjacent to Fairway Downs Pump Station.

Project Description: This project is intended to supply future growth in the area and will likely be developer driven. Route shown may have constructability issues and will need refinement at the time of design. Add 5,187 feet of 12-inch diameter piping and 688 feet of 8-inch diameter piping North of Beavercreek road.

Existing Pipeline
CIP Pipeline
City Limits
UGB

OREGON CITY

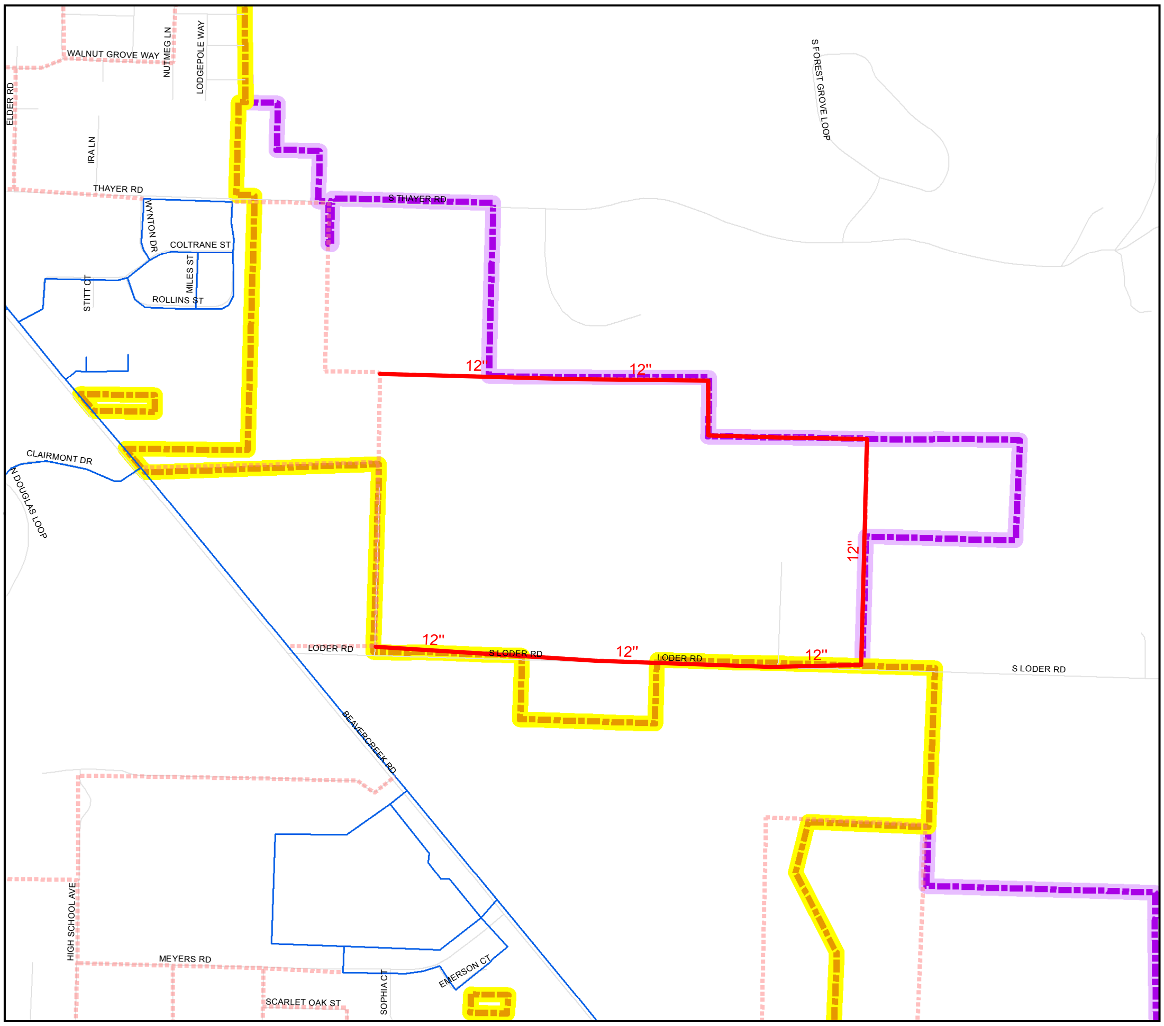
WEST YOST ASSOCIATES

Project Data Table

	Pipe Size (inch)	Pipe Length (feet)	Construction Cost/ft ($)	Total Construction Cost ($)
	8	688	$140	$96,320
	12	5,187	$200	$1,037,400
Total		5,875		$1,133,720

N

0 150 300
Scale in Feet



Pipeline Project Number: 13

Project Vicinity: Loder Road.

Project Description: This project is intended to supply future growth in the area and will likely be developer driven. Route shown may have constructability issues and will need refinement at the time of design. Add 7,303 feet of 12-inch diameter piping Northeast of Beavercreek Road.

Existing Pipeline
CIP Pipeline
Future System Pipeline
City Limits
UGB

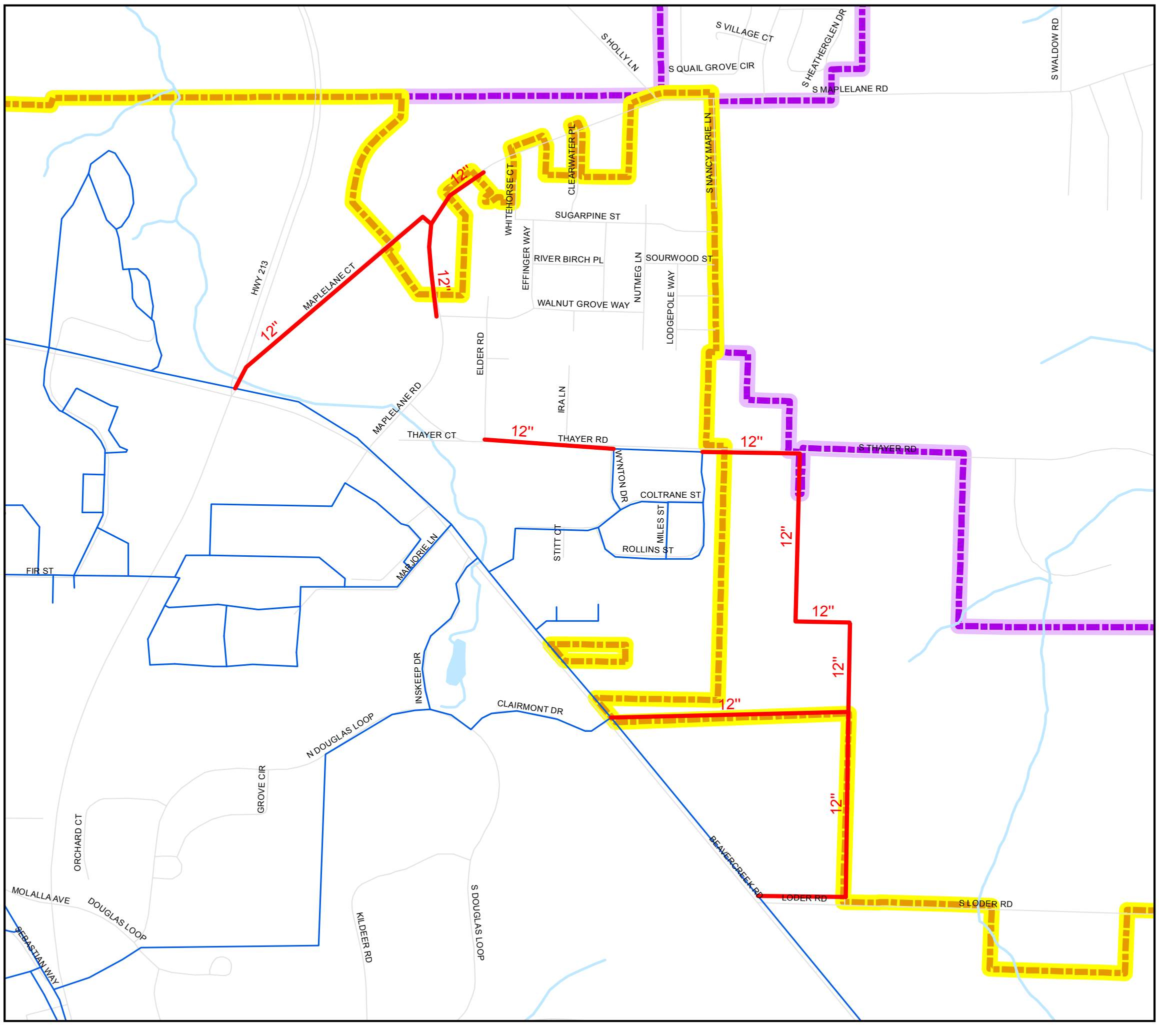
OREGON CITY
WEST YOST ASSOCIATES

Project Data Table				
	Pipe Size (inch)	Pipe Length (feet)	Construction Cost/ft ($)	Total Construction Cost ($)
	12	7,303	$200	$1,460,600
Total		7,303		$1,460,600

N

0 350 700
Scale in Feet

5



Pipeline Project Number: 14

Project Vicinity: East side of Beavercreek Rd from Loder Road to Maplelane Ct.

Project Description: This project is intended to supply future growth in the area and will likely be developer driven. Route shown may have constructability issues and will need refinement at the time of design. Add 8,690 feet of 12-inch diameter piping Northeast of Beavercreek Road.

Existing Pipeline
CIP Pipeline
City Limits
UGB

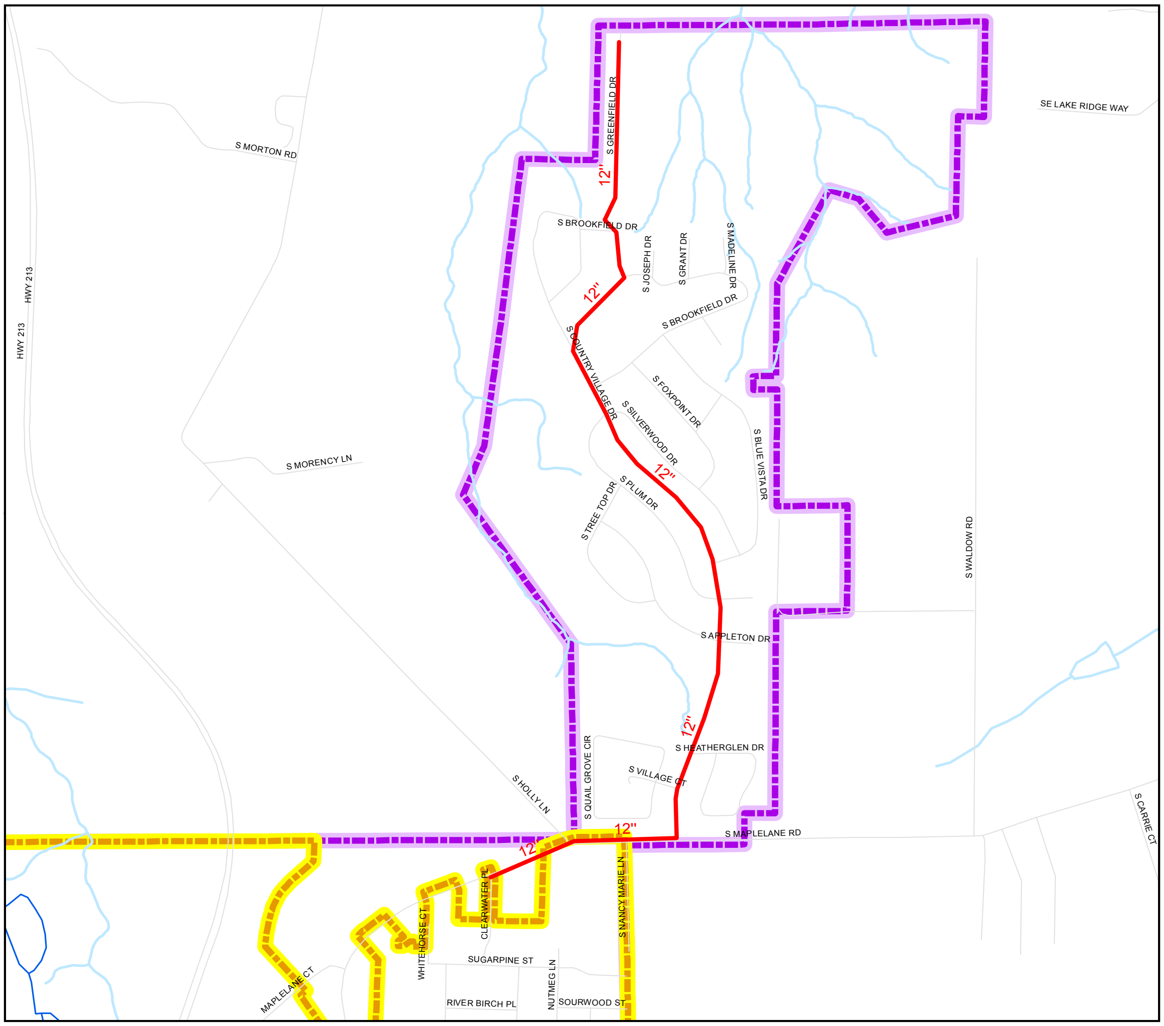
OREGON CITY

WEST YOST ASSOCIATES

Project Data Table				
	Pipe Size (inch)	Pipe Length (feet)	Construction Cost/ft ($)	Total Construction Cost ($)
	12	8,690	$200	$1,738,000
Total		8,690		$1,738,000

N

0 350 700
Scale in Feet



Pipeline Project Number: 15

Project Vicinity: Maplelane Rd to S Greenfield Dr

Project Description: This project is intended to supply future growth in the area and will likely be developer driven. Route shown may have constructability issues and will need refinement at the time of design. Add 6,311 feet of 12-inch diameter piping North of Maplelane Road.

Existing Pipeline
CIP Pipeline
City Limits
UGB

OREGON CITY

WEST YOST ASSOCIATES

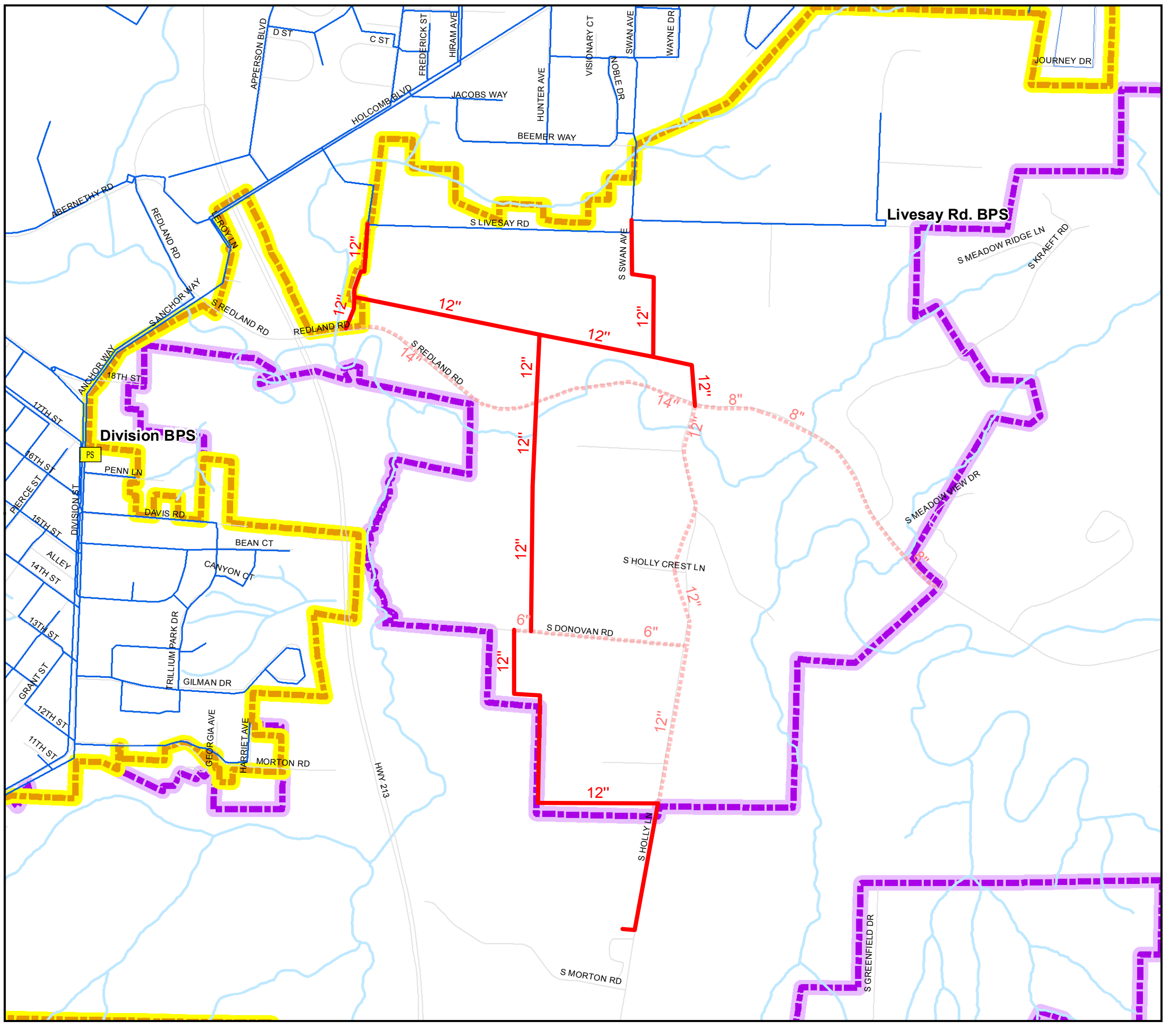
Project Data Table				
	Pipe Size (inch)	Pipe Length (feet)	Construction Cost/ft ($)	Total Construction Cost ($)
	12	6,311	$200	$1,262,200
Total		6,311		$1,262,200

N

0 350 700

Scale in Feet

7



Pipeline Project Number: 20

Project Vicinity: S Livesay Rd south to new Holly Lane Reservoir (west side).

Project Description: This project is intended to supply future growth in the area and will likely be developer driven. Route shown may have constructability issues and will need refinement at the time of design. Add 9,580 feet of 12-inch diameter piping and and 1,070 feet of 16-inch diameter piping South of Livesay Road.

Existing Pipeline
CIP Pipeline
City Limits
UGB

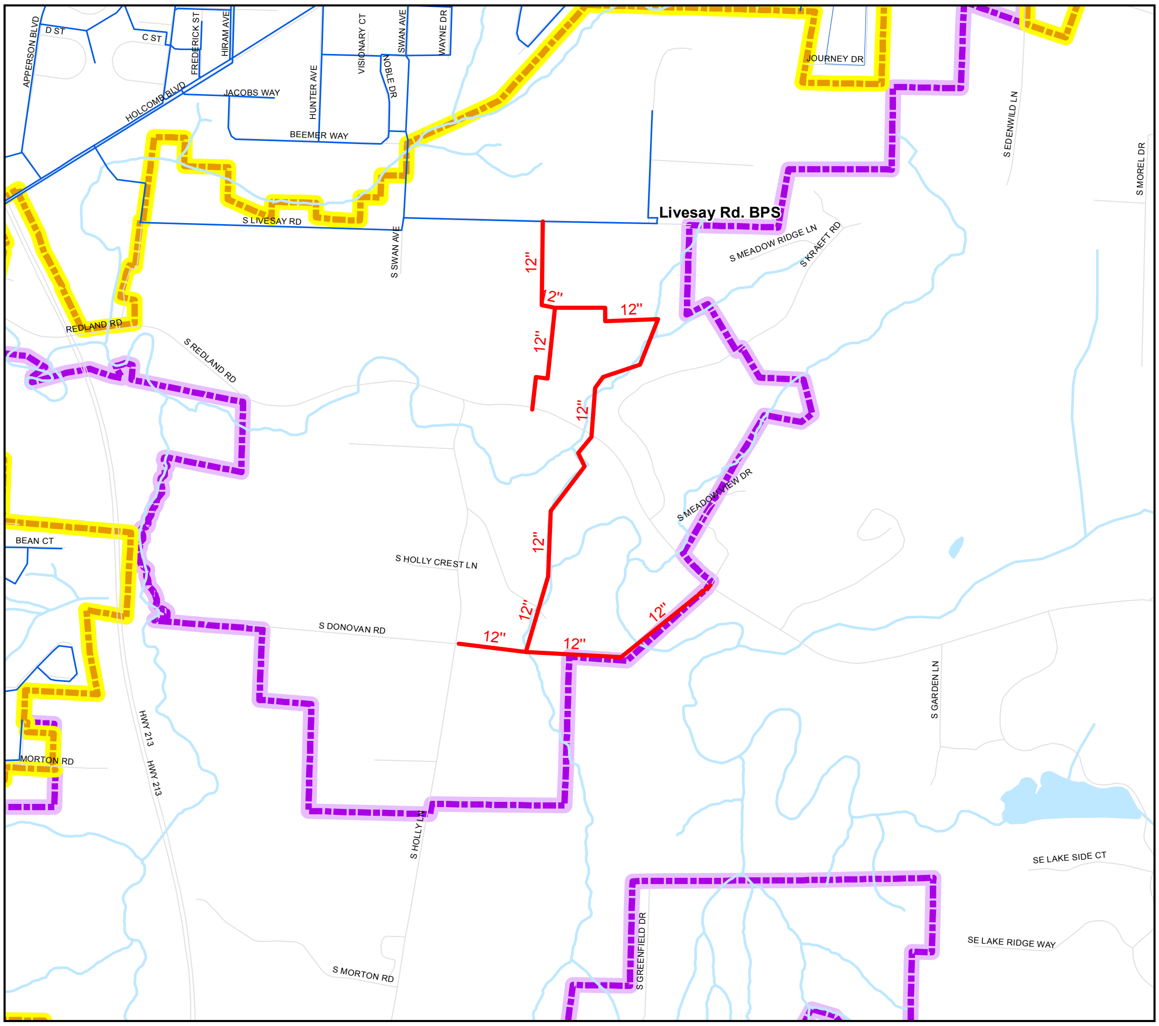
OREGON CITY

WEST YOST ASSOCIATES

Project Data Table				
	Pipe Size (inch)	Pipe Length (feet)	Construction Cost/ft ($)	Total Construction Cost ($)
	12	9,580	$200	$1,916,000
	16	1,070	$250	$267,500
Total		10,650		$2,183,500

N

0 400 800
Scale in Feet



Pipeline Project Number: 21

Project Vicinity: S Livesay Rd south to new Holly Lane Reservoir (east side).

Project Description: This project is intended to supply future growth in the area and will likely be developer driven. Route shown may have constructability issues and will need refinement at the time of design. Add 7,497 feet of 12-inch diameter piping South of Livesay Road.

Existing Pipeline
CIP Pipeline
City Limits
UGB

OREGON CITY

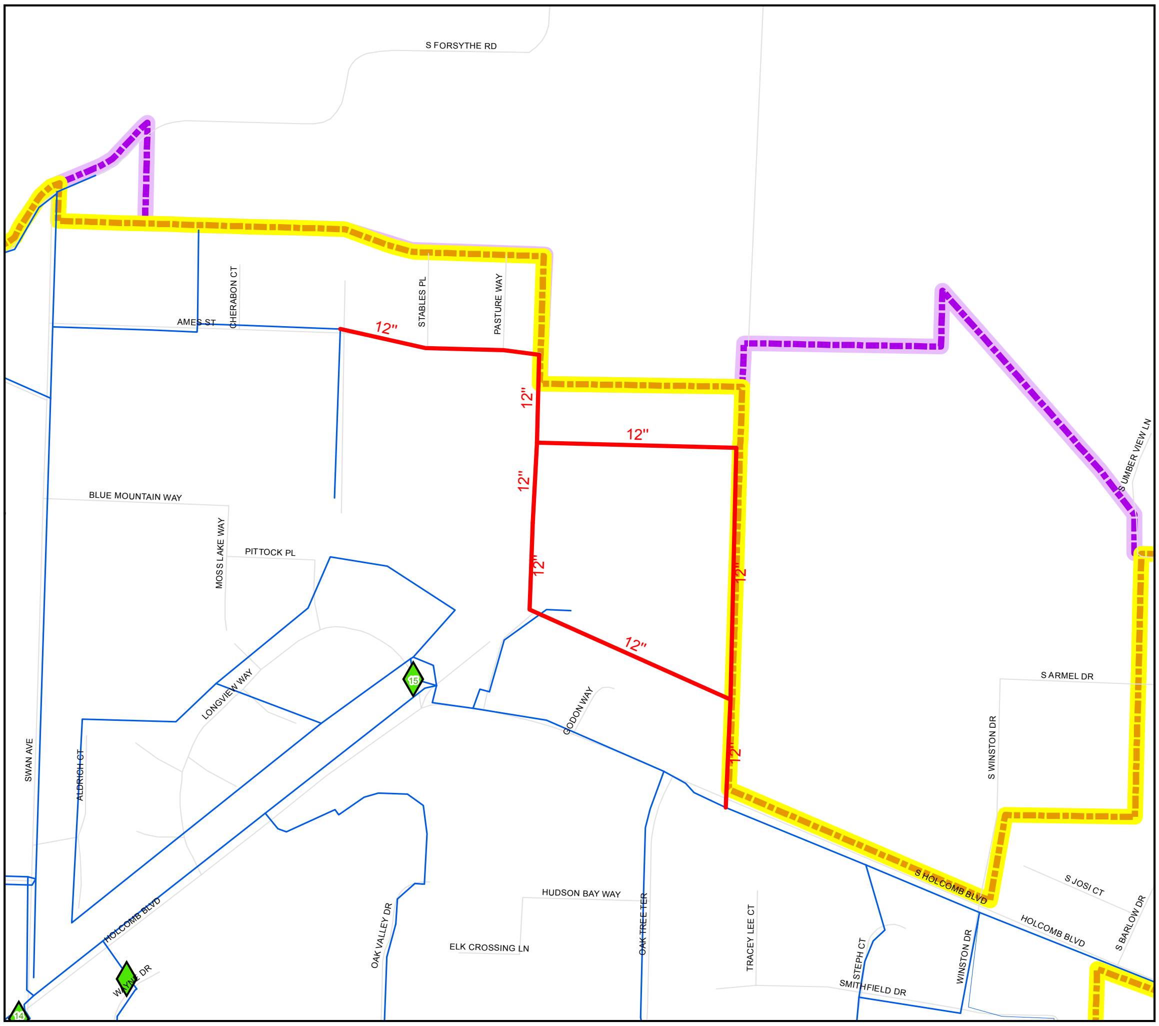
WEST YOST ASSOCIATES

Project Data Table

	Pipe Size (inch)	Pipe Length (feet)	Construction Cost/ft ($)	Total Construction Cost ($)
	12	7,497	$200	$1,499,400
Total		7,497		$1,499,400

N

0 400 800
Scale in Feet



Pipeline Project Number: 24

Project Vicinity: Ames St to S Holcomb Blvd.

Project Description: This project is intended to supply future growth in the area and will likely be developer driven. It also completes a loop in the area providing enhanced reliability of the system. Route shown may have constructability issues near the school and will need refinement at the time of design. Add 4,140 feet of 12-inch diameter piping North of Holcomb Boulevard.

Existing Pipeline
CIP Pipeline
City Limits
UGB
PRV Station

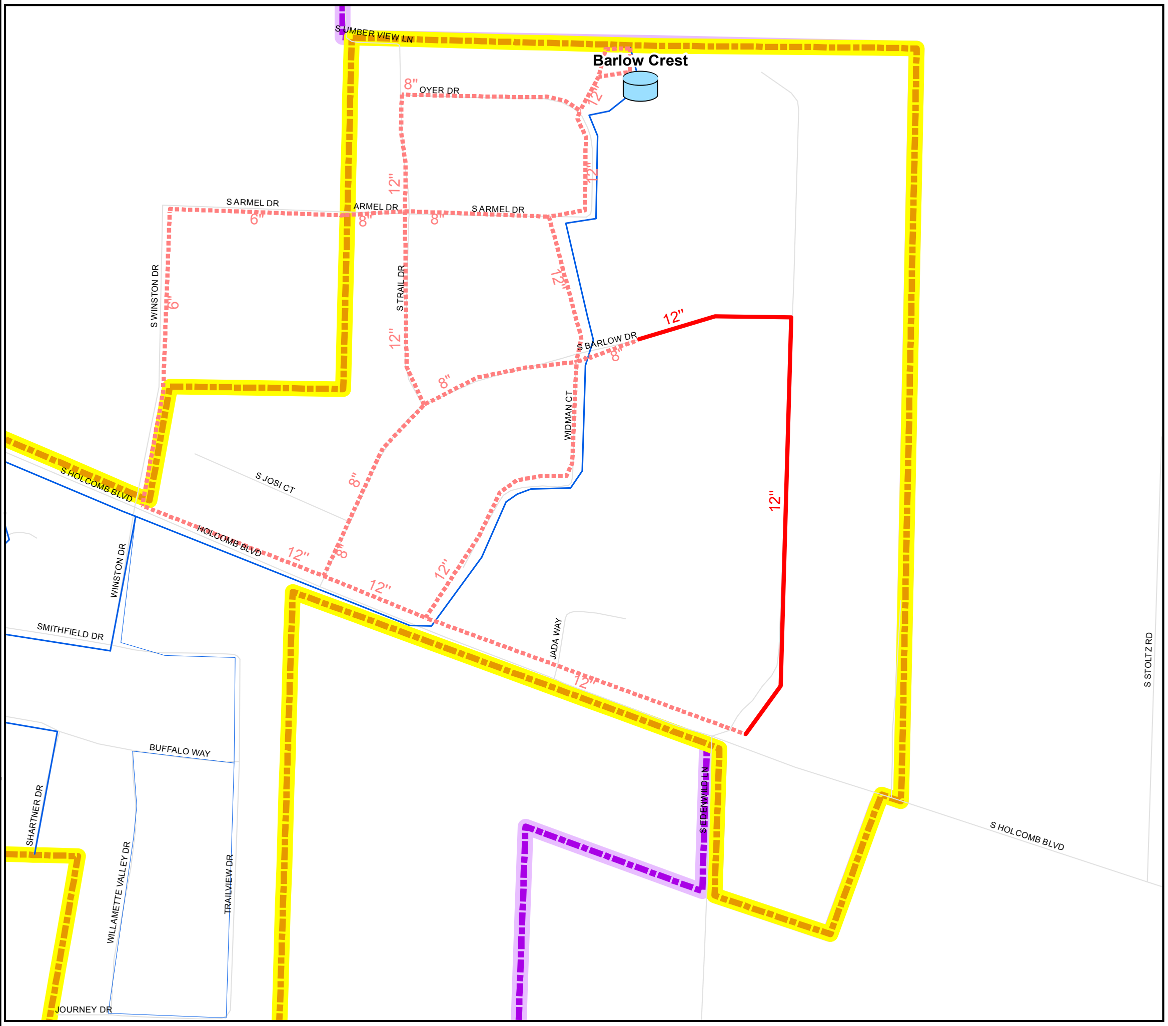
OREGON CITY

WEST YOST ASSOCIATES

Project Data Table				
	Pipe Size (inch)	Pipe Length (feet)	Construction Cost/ft ($)	Total Construction Cost ($)
	12	4,140	$200	$828,000
Total		4,140		$828,000

N

0 200 400
Scale in Feet



Pipeline Project Number: 25

Project Vicinity: Clackamas Heights Airport from S Barlow Dr to S Holcomb Blvd.

Project Description: This project is intended to supply future growth in the area and add additional looping for added reliability. It will likely be developer driven, and will not be the responsibility of the City until this area is taken over from CRW. Route shown may have constructability issues and will need refinement at the time of design. Add 1,472 feet of 12-inch diameter piping North of Holcomb Boulevard.

Existing Pipeline
CIP Pipeline
CRW Pipeline
City Limits
UGB

OREGON CITY

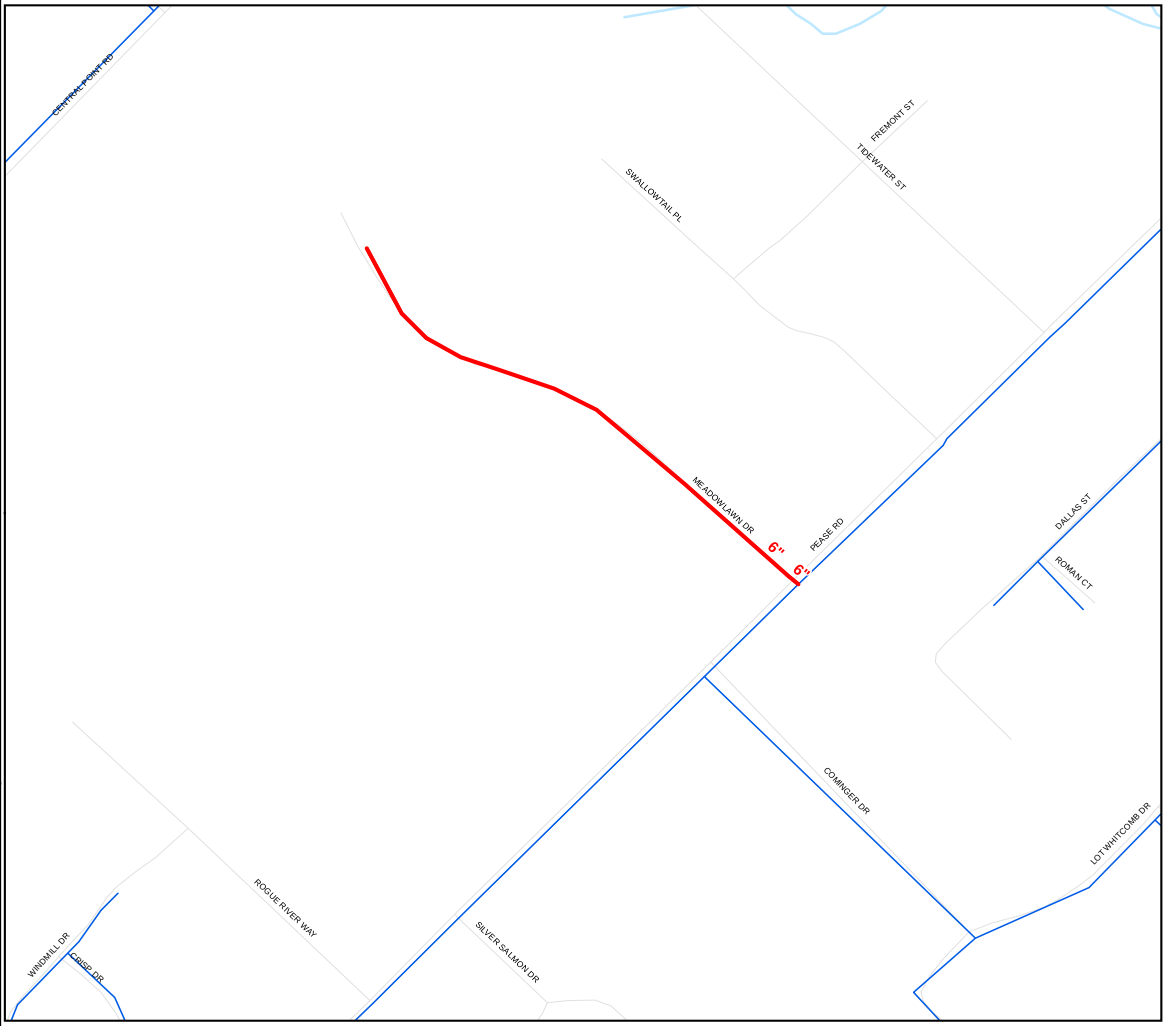
WEST YOST ASSOCIATES

Project Data Table				
	Pipe Size (inch)	Pipe Length (feet)	Construction Cost/ft ($)	Total Construction Cost ($)
	12	1,472	$200	$294,400
Total		1,472		$294,400

N

0 150 300
Scale in Feet

11



Pipeline Project Number: 27

Existing Pipeline
CIP Pipeline

Project Vicinity: S. Meadowlawn Court and Pease Road.

Project Description: This project consists of 893 feet of 6-inch diameter piping to be added along S. Meadowlawn Court to improve fireflows in the area.

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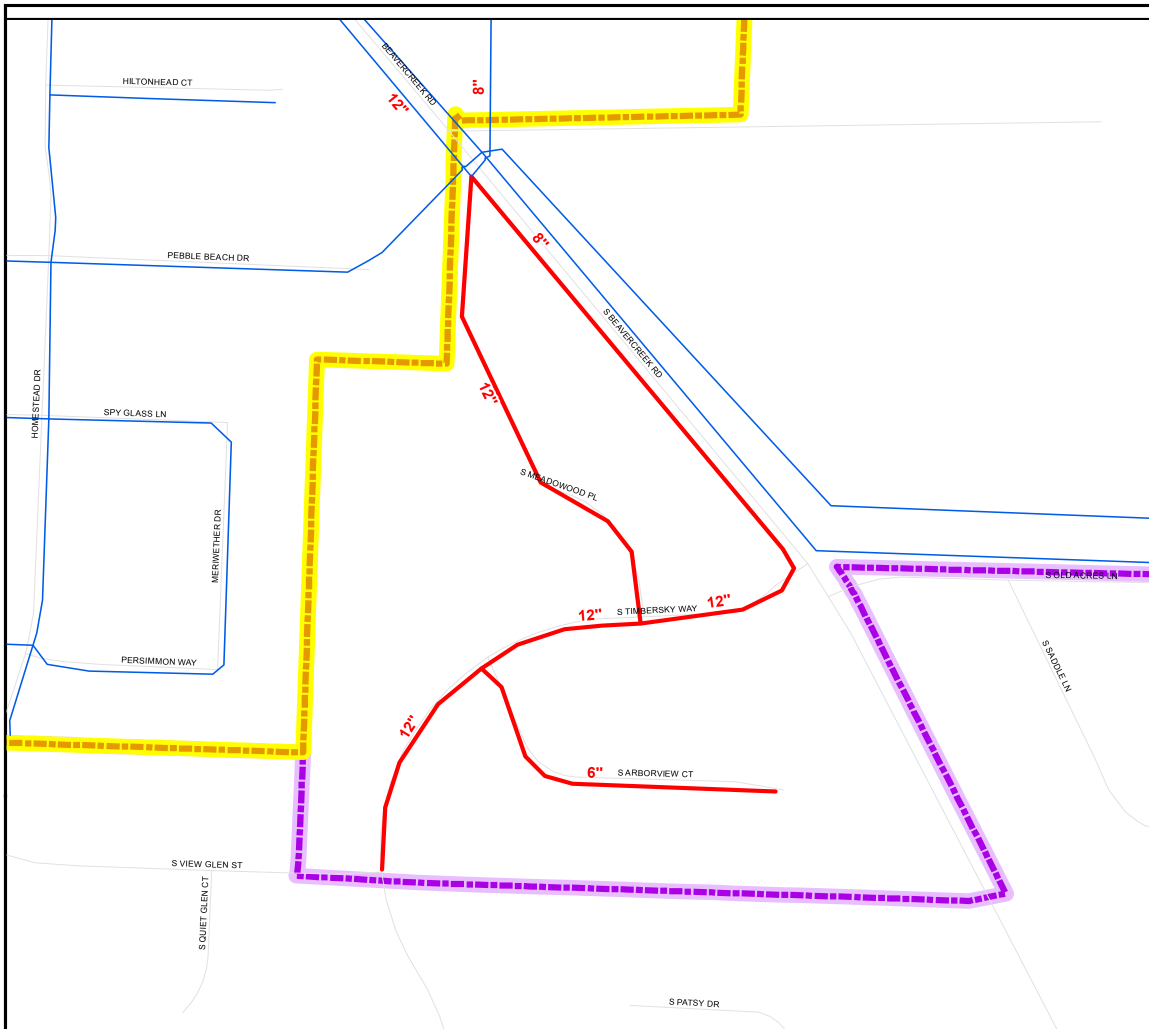
Project Data Table

	Pipe Size (inch)	Pipe Length (feet)	Construction Cost/ft ($)	Total Construction Cost ($)
	6	893	$110	$98,230
Total		893		$98,230

N

0 90 180
Scale in Feet

12



Pipeline Project Number: 28

Project Vicinity: West side of Beavercreek Rd, Southeast of the Fairway Downs Pump Station.

Project Description: This project is intended to supply future growth in the area and improve looping. Add 1,774 feet of 12-inch diameter piping, 27 feet of 8-inch diameter piping and 582 feet of 6-inch diameter piping West of Beavercreek road.

Existing Pipeline
CIP Pipeline
City Limits
UGB

Project Data Table

	Pipe Size (inch)	Pipe Length (feet)	Construction Cost/ft ($)	Total Construction Cost ($)
	6	582	$110	$64,020
	8	827	$140	$115,780
	12	1,774	$200	$354,800
Total		3,183		$534,600

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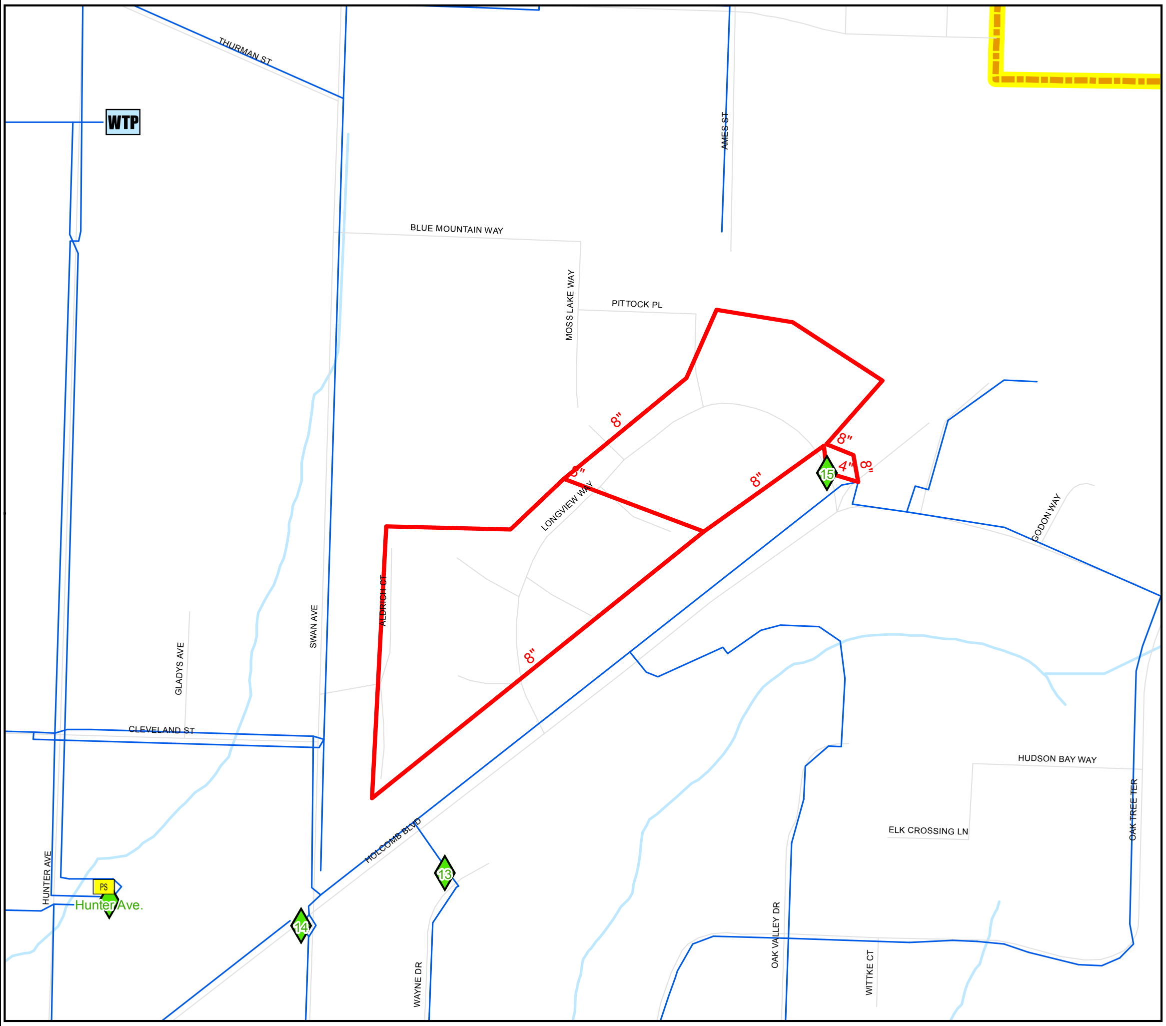
WEST YOST ASSOCIATES

0 150 300
Scale in Feet



Pipeline Project Number: CIP-50

Project Vicinity: View Manor Pressure Zone.

Project Description: This project is intended to replace piping in the vicinity of the View Manor Pressure Zone Northwest of Holcomb Boulevard. Add a new PRV 15, 150 feet of 4-inch diameter piping and 4,397 feet of 8-inch diameter piping.

Existing Pipeline
CIP Pipeline
City Limits
PRV Station

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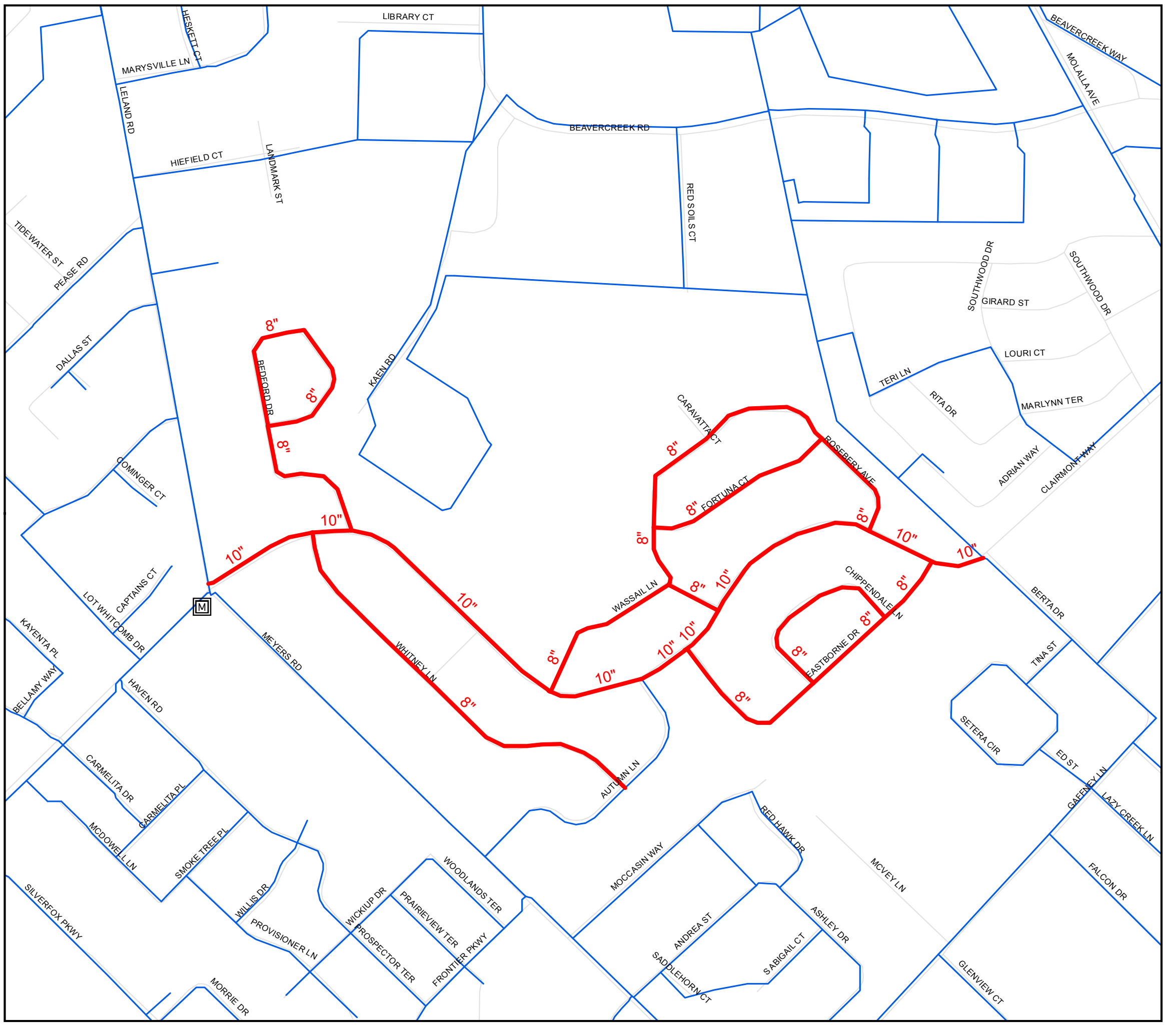
WEST YOST ASSOCIATES

Project Data Table				
	Pipe Size (inch)	Pipe Length (feet)	Construction Cost/ft ($)	Total Construction Cost ($)
	4	150	100	$15,000
	8	4,397	140	$615,580
4" PRV				$70,000
Total				$700,580

N

0 150 300
Scale in Feet



Pipeline Project Number: CIP-51

Project Vicinity: Clairmont area.

Project Description: This project is intended to replace piping in the Clairmont area East of Leland Road and Meyers Road. Add 9,513 feet of 8-inch diameter piping and 3,920 feet of 10-inch diameter piping.

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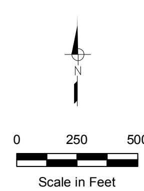
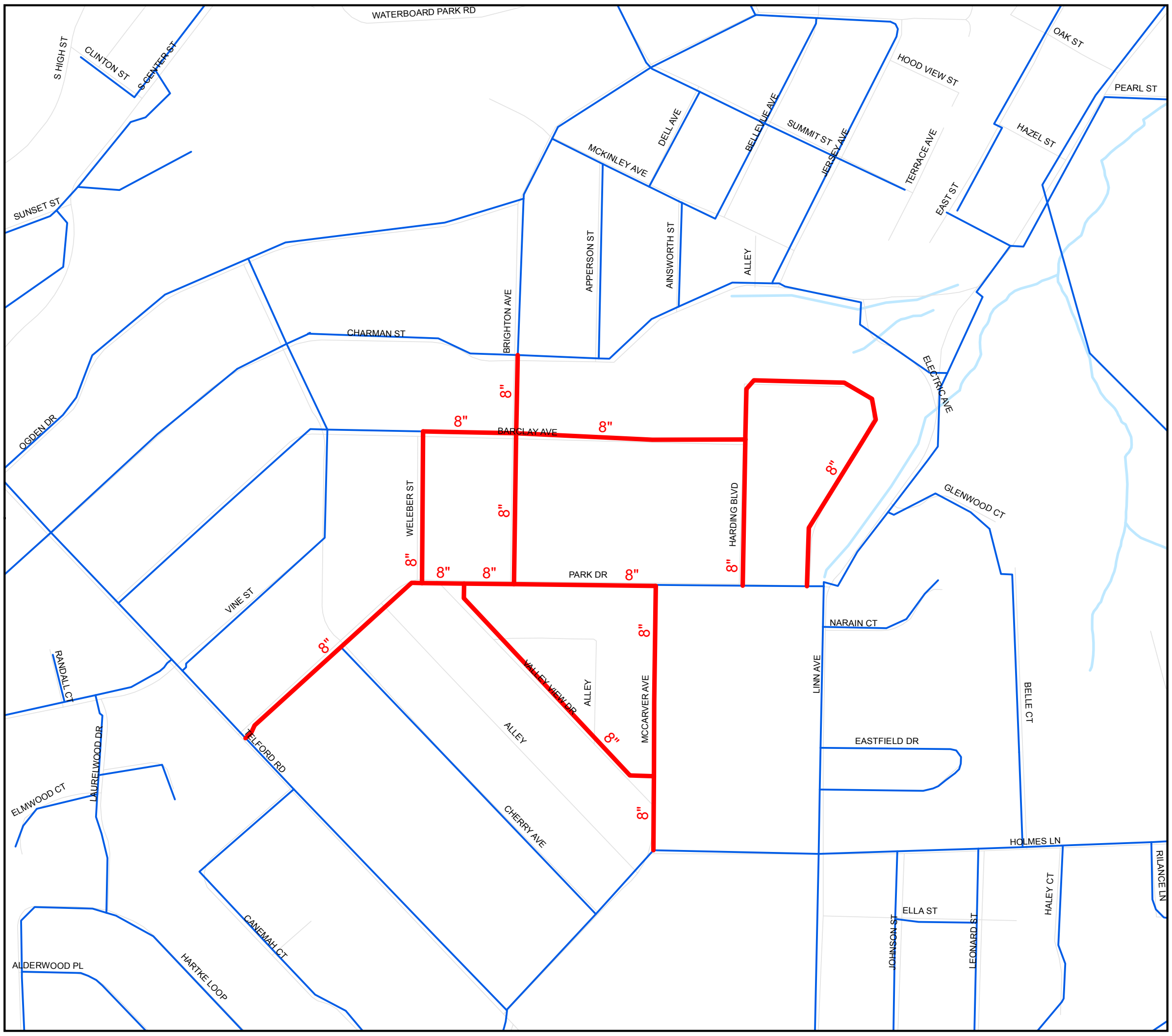
WEST YOST ASSOCIATES

Project Data Table				
	Pipe Size (inch)	Pipe Length (feet)	Construction Cost/ft ($)	Total Construction Cost ($)
	8	9,513	$140	$1,331,820
	10	3,920	$160	$627,200
Total		13,433		$1,959,020





Pipeline Project Number: CIP-52

Project Vicinity: Weleber St to Harding Blvd.

Project Description: This project is intended to replace piping in the area of Weleber Street and Harding Boulevard. Add 7,521 feet of 8-inch diameter piping.

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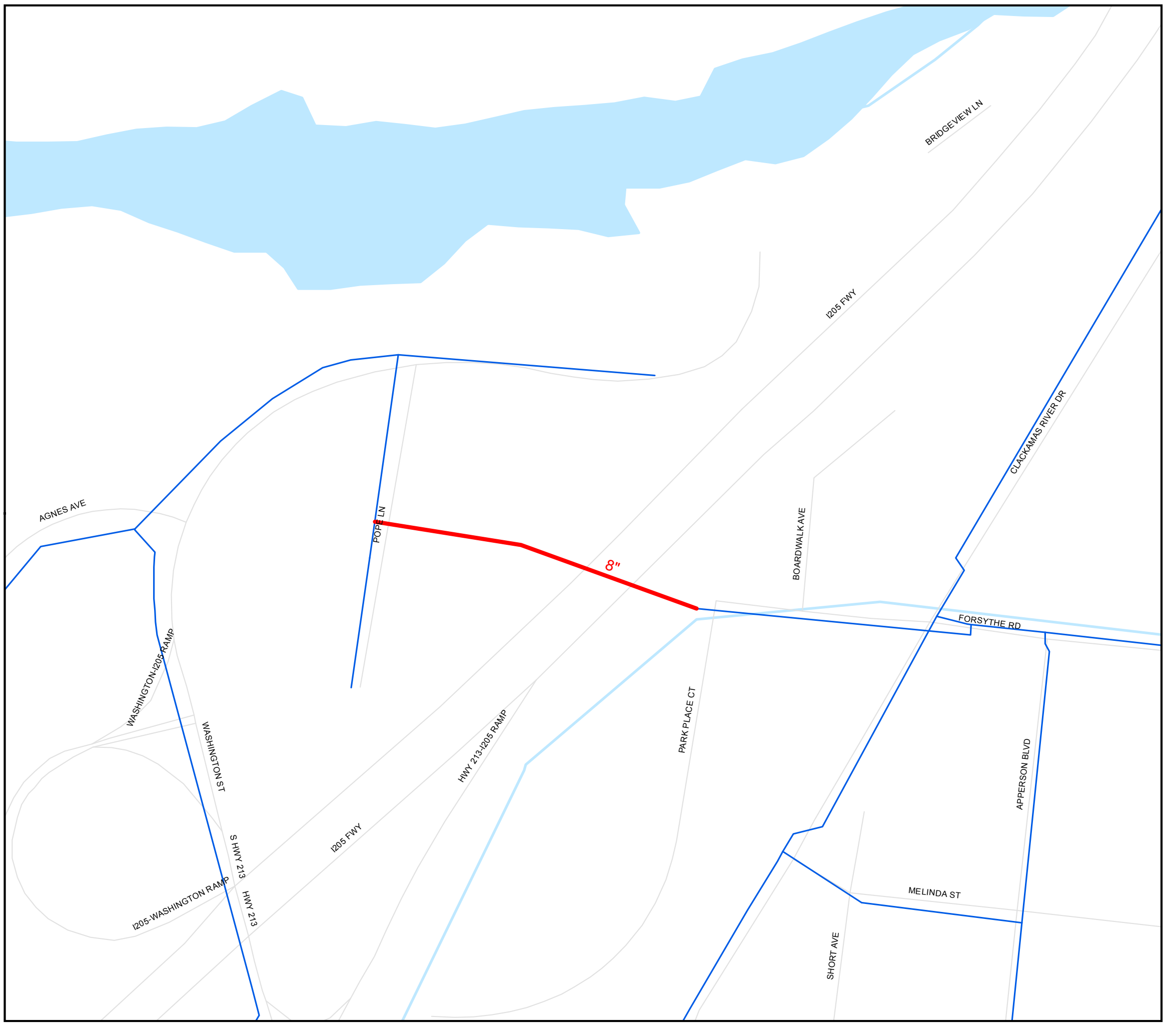
Project Data Table				
	Pipe Size (inch)	Pipe Length (feet)	Construction Cost/ft ($)	Total Construction Cost ($)
	8	7,521	$140	$1,052,940
Total		7,521		$1,052,940

0 200 400

Scale in Feet

16



Pipeline Project Number: CIP-53

Existing Pipeline
CIP Pipeline

Project Vicinity: I-205 crossing between Pope Lane and Park Place Ct.

Project Description: This project is intended to replace piping that crosses the I-205 Freeway at Forsythe Road. Add 555 feet of 8-inch diameter piping and a freeway crossing.

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Project Data Table

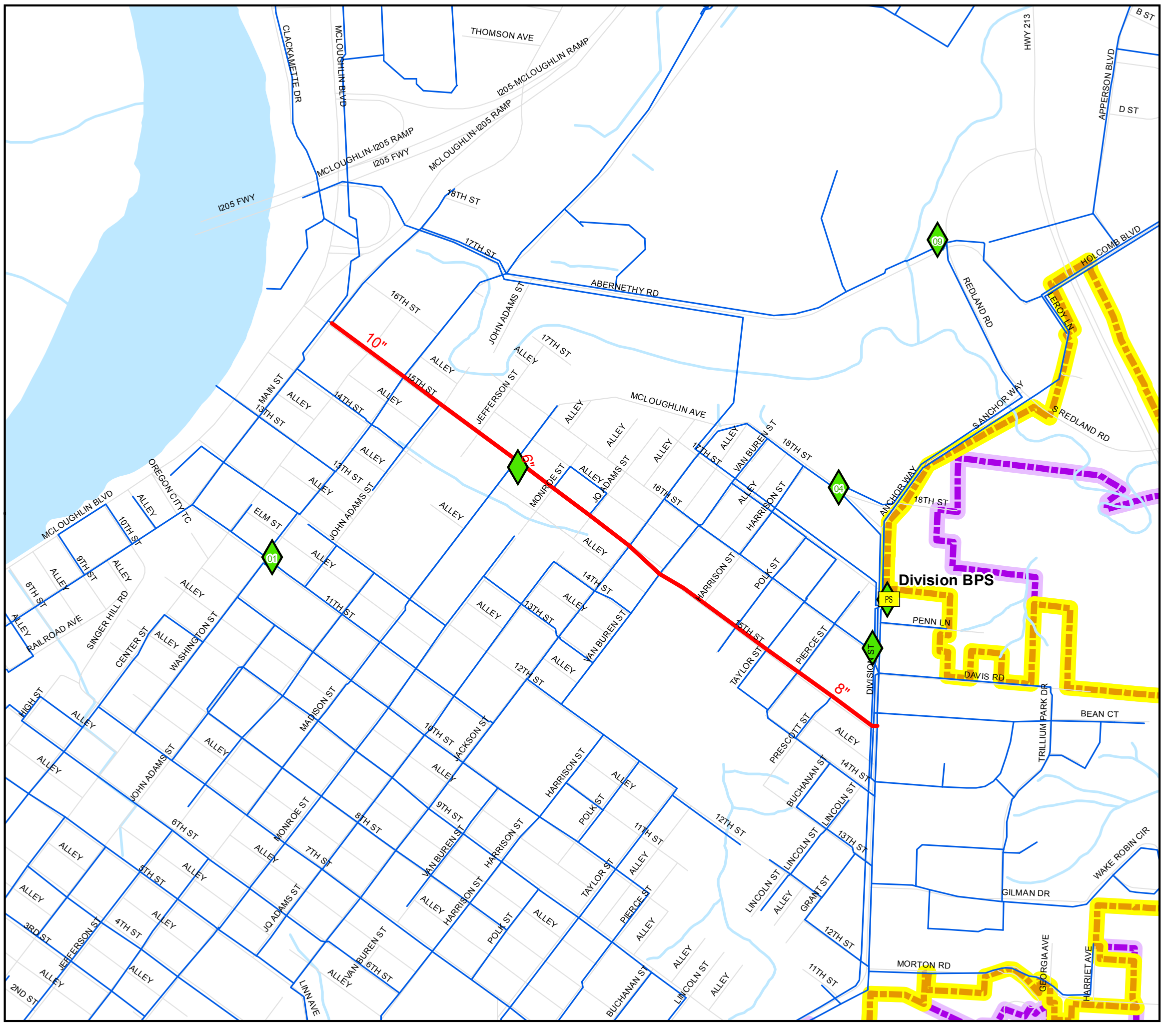
	Pipe Size (inch)	Pipe Length (feet)	Construction Cost/ft ($)	Total Construction Cost ($)
	8	555	$140	$77,700
Total		555		$77,700

N

0 100 200
Scale in Feet

17

3a. L 10-02: Water Master Plan Update



Pipeline Project Number: CIP-55

Project Vicinity: 15th St from Main St to Division St.

Project Description: This project is intended to replace piping along 15th Street. Add a new PRV 2, 85 feet of 6-inch diameter piping, 1,797 feet of 8-inch diameter piping and 2,174 feet of 10-inch diameter piping.

Existing Pipeline
CIP Pipeline
City Limits
UGB
PRV Station

Project Data Table

	Pipe Size (inch)	Pipe Length (feet)	Construction Cost/ft ($)	Total Construction Cost ($)
	6	85	$110	$9,350
	8	1,797	$140	$251,580
	10	2,174	$160	$347,840
PRV				$70,000
Total		4,056		$678,770

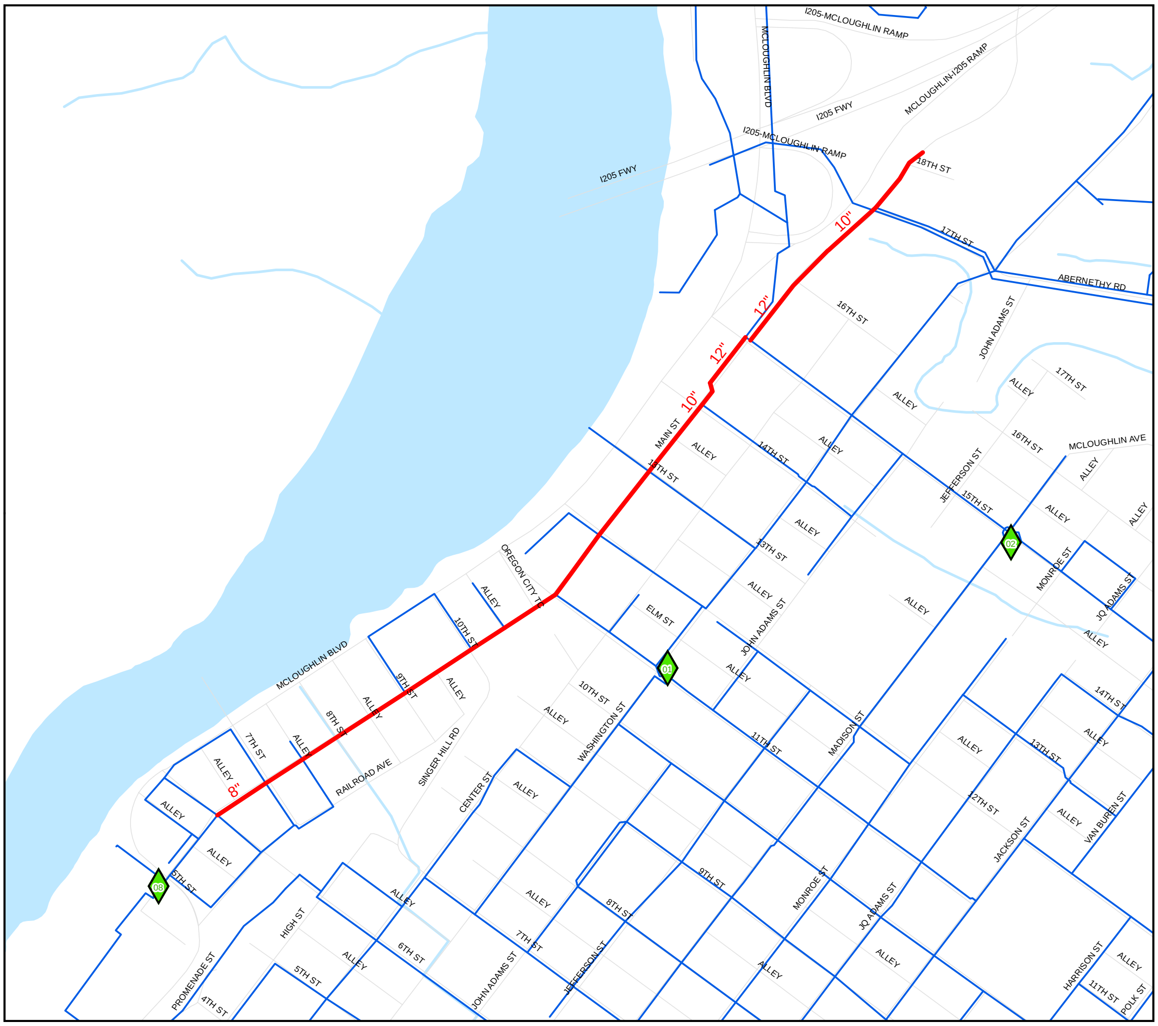
OREGON CITY

WEST YOST ASSOCIATES

N

0 350 700

Scale in Feet



Pipeline Project Number: CIP-58

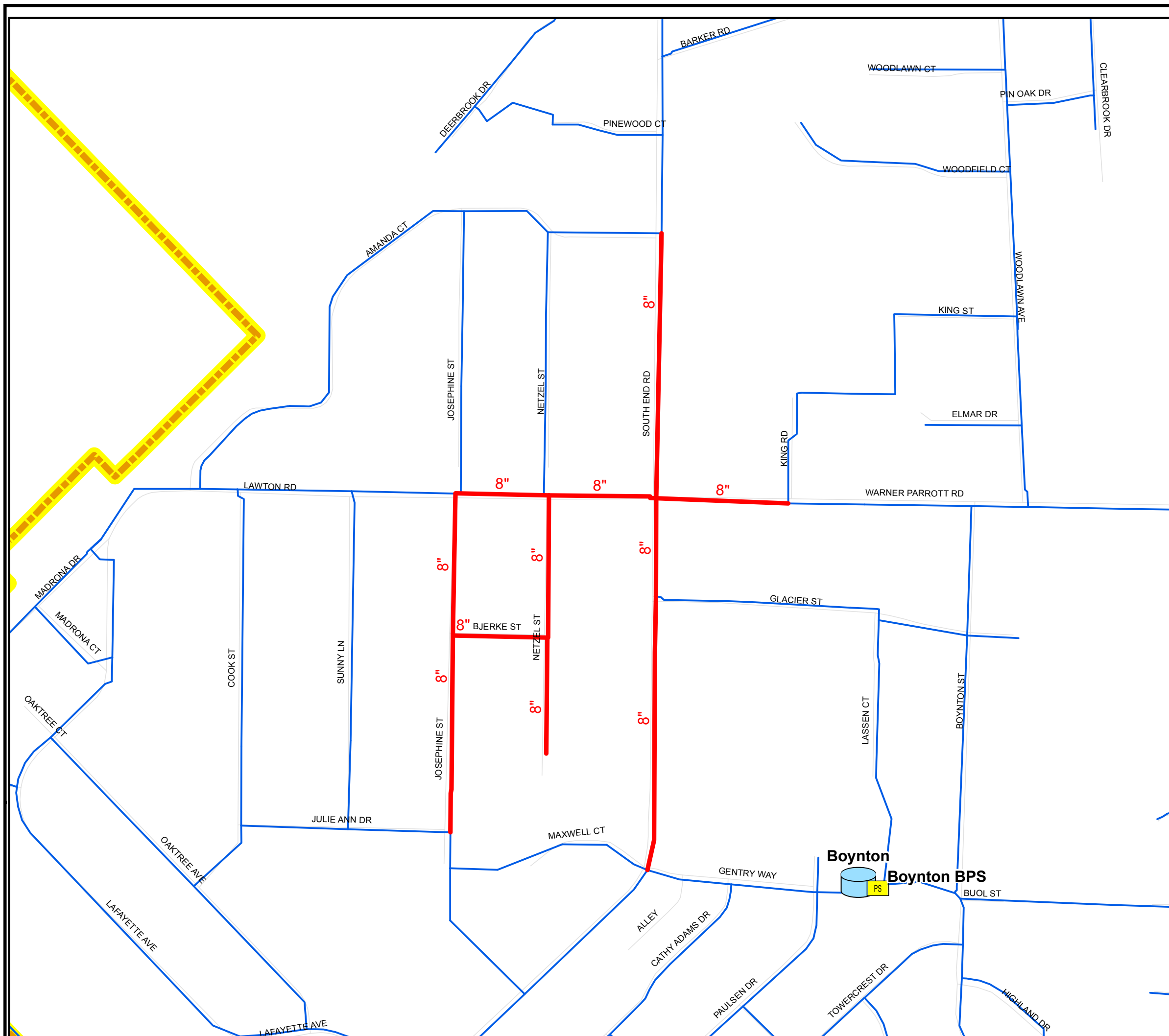
Project Vicinity: Main St from 5th St to 18th St

Project Description: This project is intended to replace piping along Main Street in the downtown area. Add 241 feet of 8-inch diameter piping, 3,340 feet of 10-inch diameter piping and 535 feet of 12-inch diameter piping.

Existing Pipeline
CIP Pipeline
PRV Station

Project Data Table				
	Pipe Size (inch)	Pipe Length (feet)	Construction Cost/ft ($)	Total Construction Cost ($)
	8	241	$140	$33,740
	10	3,340	$160	$534,400
	12	535	$200	$107,000
Total		4,116		$675,140

0 250 500
Scale in Feet



Pipeline Project Number: CIP-59

Project Vicinity: South End Rd and Warner Parrott Rd.

Project Description: This project is intended to replace piping along South End Road and Warner Parrot Road. Add 5,535 feet of 8-inch diameter piping.

Existing Pipeline

CIP Pipeline

City Limits

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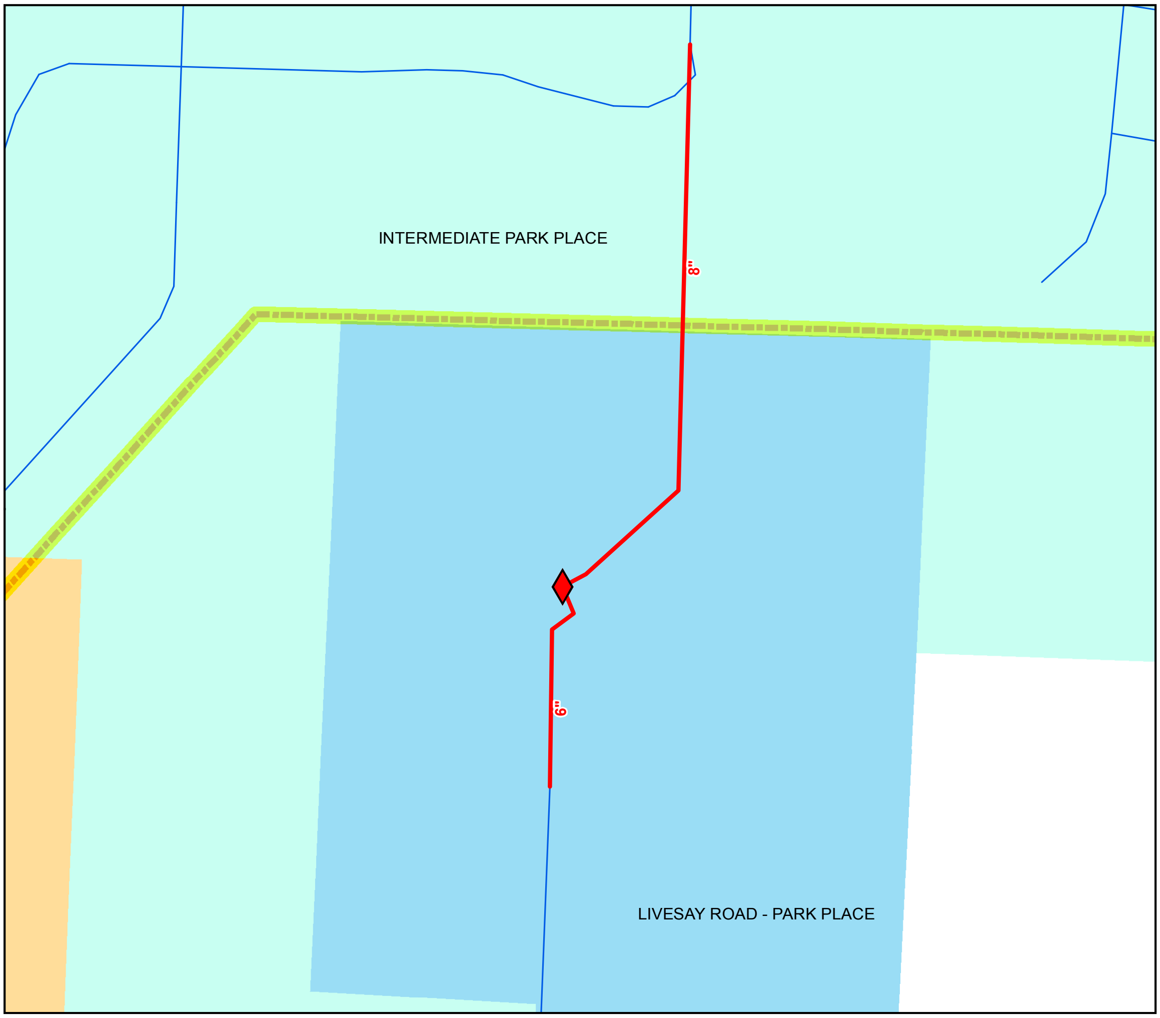
Project Data Table				
	Pipe Size (inch)	Pipe Length (feet)	Construction Cost/ft ($)	Total Construction Cost ($)
	8	5,535	$140	$774,900
Total		5,535		$774,900

0 200 400

Scale in Feet

20



Pipeline Project Number: CIP-V-101

Project Vicinity: S Livesay Rd

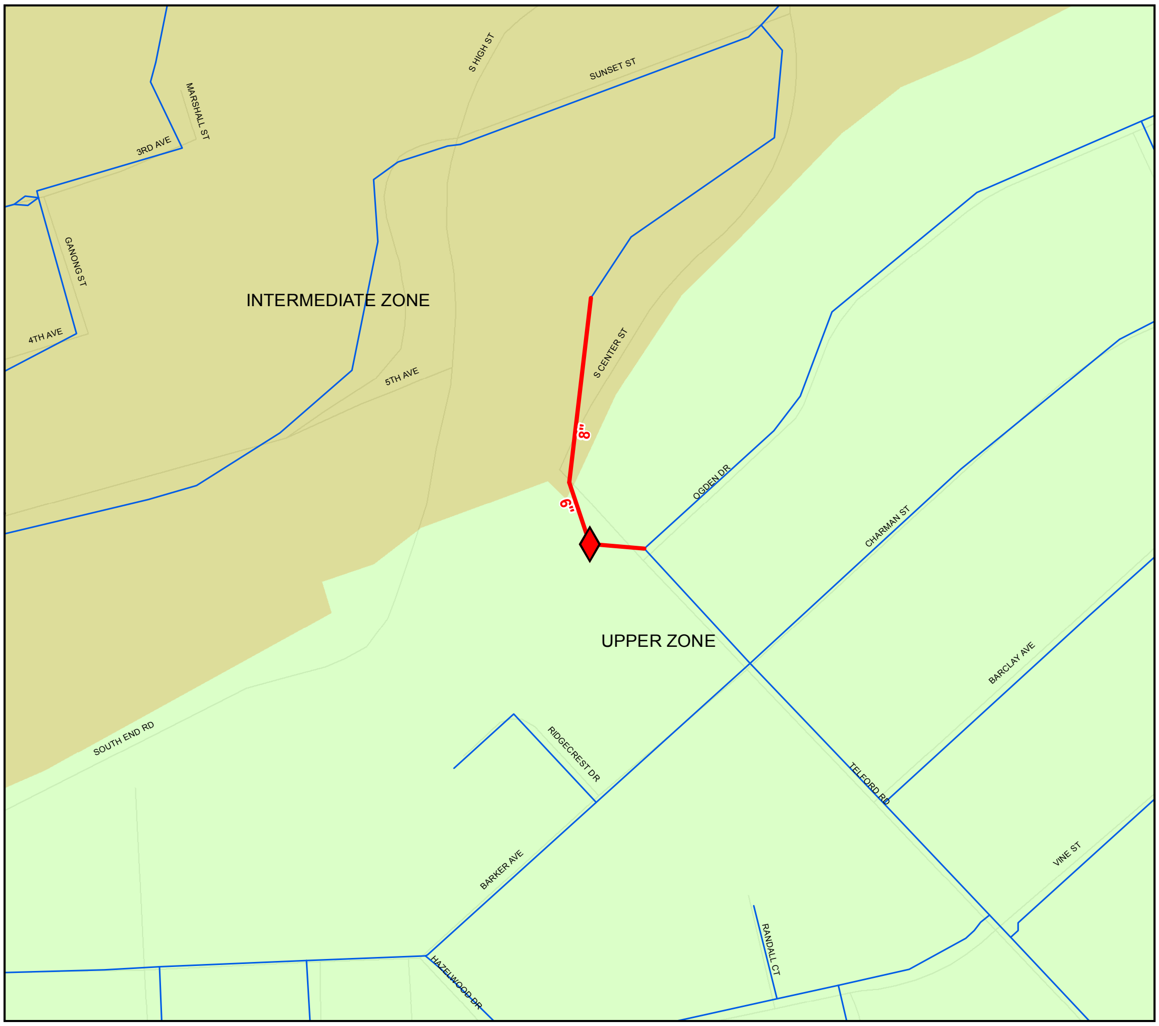
Project Description: This project consists of a 6-inch diameter PRV station from the Intermediate Park Place Pressure Zone to the Livesay Road-Park Place Pressure Zone. It is intended to provide adequate fire flows to the Livesay Road area. Add a 6-inch diameter PRV station, 410 feet of 6-inch diameter piping on Livesay Road and 980 feet of 8-inch diameter piping between Oak Tree Terrace and Livesay Road.

Existing Pipeline
CIP Pipeline
PRV Station
City Limits

Project Data Table

	Pipe Size (inch)	Pipe Length (feet)	Construction Cost/ft ($)	Total Construction Cost ($)
	8	980	$140	$137,200
	6	410	$110	$45,100
6" PRV				$70,000
Total		1,390		$252,300

0 100 200
Scale in Feet



Pipeline Project Number: CIP-V-102

Project Vicinity: S Center St and Odgen Dr

Project Description: This project consists of a 6-inch diameter PRV station from the Upper Pressure Zone to the Intermediate Pressure Zone. It is intended to provide adequate fire flows to the Upper Zone near Ogden Drive and Teleford Road. Route shown may have constructability issues and will need refinement at the time of design. Add a 6-inch diameter PRV station, 200 feet of 6-inch diameter piping and 315 feet of 8-inch diameter piping as shown.

Existing Pipeline
CIP Pipeline
PRV Station

Project Data Table

	Pipe Size (inch)	Pipe Length (feet)	Construction Cost/ft ($)	Total Construction Cost ($)
	8	315	$140	$44,100
	6	200	$110	$22,000
6" PRV				$70,000
Total		515		$136,100

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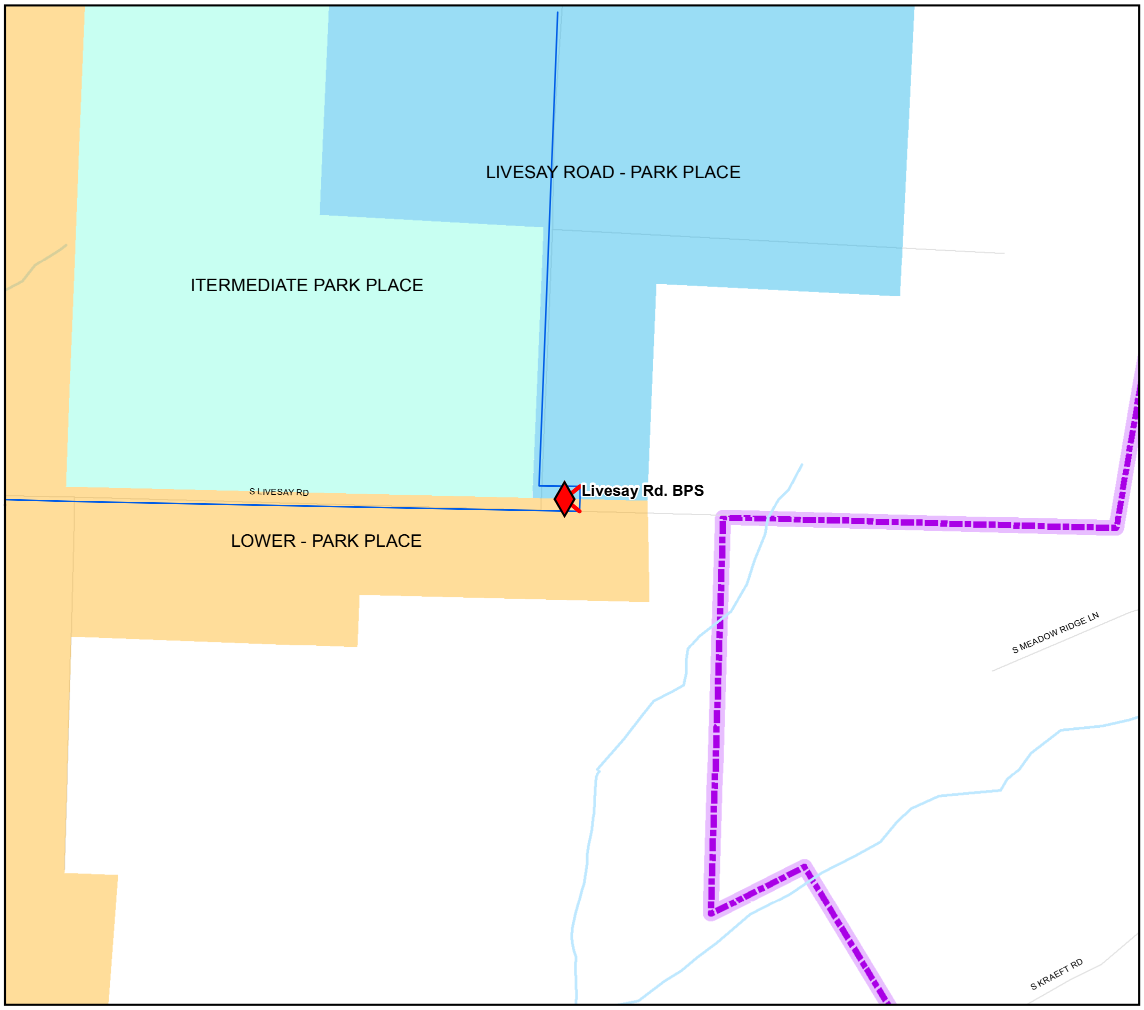
WEST YOST ASSOCIATES

N

0 100 200
Scale in Feet



Pipeline Project Number: CIP-V-103

Project Vicinity: Livesay Pump Station

Project Description: This project consists of a 6-inch diameter PRV station from the Livesay Road-Park Place Pressure Zone to the Lower Park Place Pressure Zone. It is intended to provide adequate fire flows to the Lower Park Place area. Add a 6-inch diameter PRV station and 67 feet of 6-inch diameter pipeline.

Existing Pipeline
CIP Pipeline
PRV Station
UGB

OREGON CITY

WEST YOST ASSOCIATES

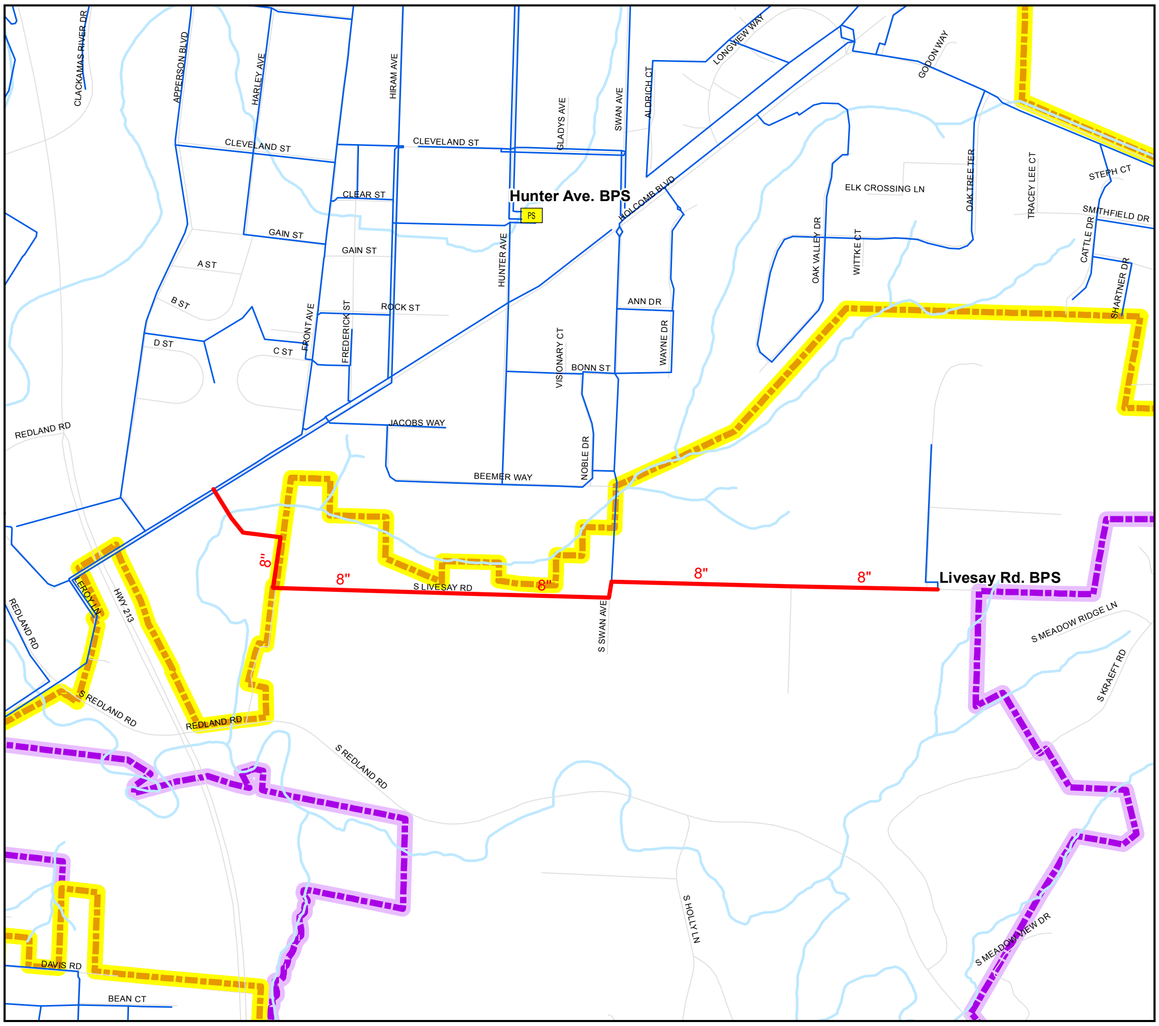
Project Data Table

	Pipe Size (inch)	Pipe Length (feet)	Construction Cost/ft ($)	Total Construction Cost ($)
	6	67	$110	$7,370
6" PRV				$70,000
Total		67		$77,370

N

0 100 200
Scale in Feet

23



Pipeline Project Number: CIP-P-104

Project Vicinity: Livesay Rd.

Project Description: This project consists of the upsizing of a pipeline that is intended to provide adequate fire flow to the Livesay Road area. Upsize 4,767 feet of pipeline to 8-inch diameter along and extended from Livesay Road.

- Existing Pipeline
- CIP Pipeline
- City Limits
- UGB

OREGON CITY

WEST YOST ASSOCIATES

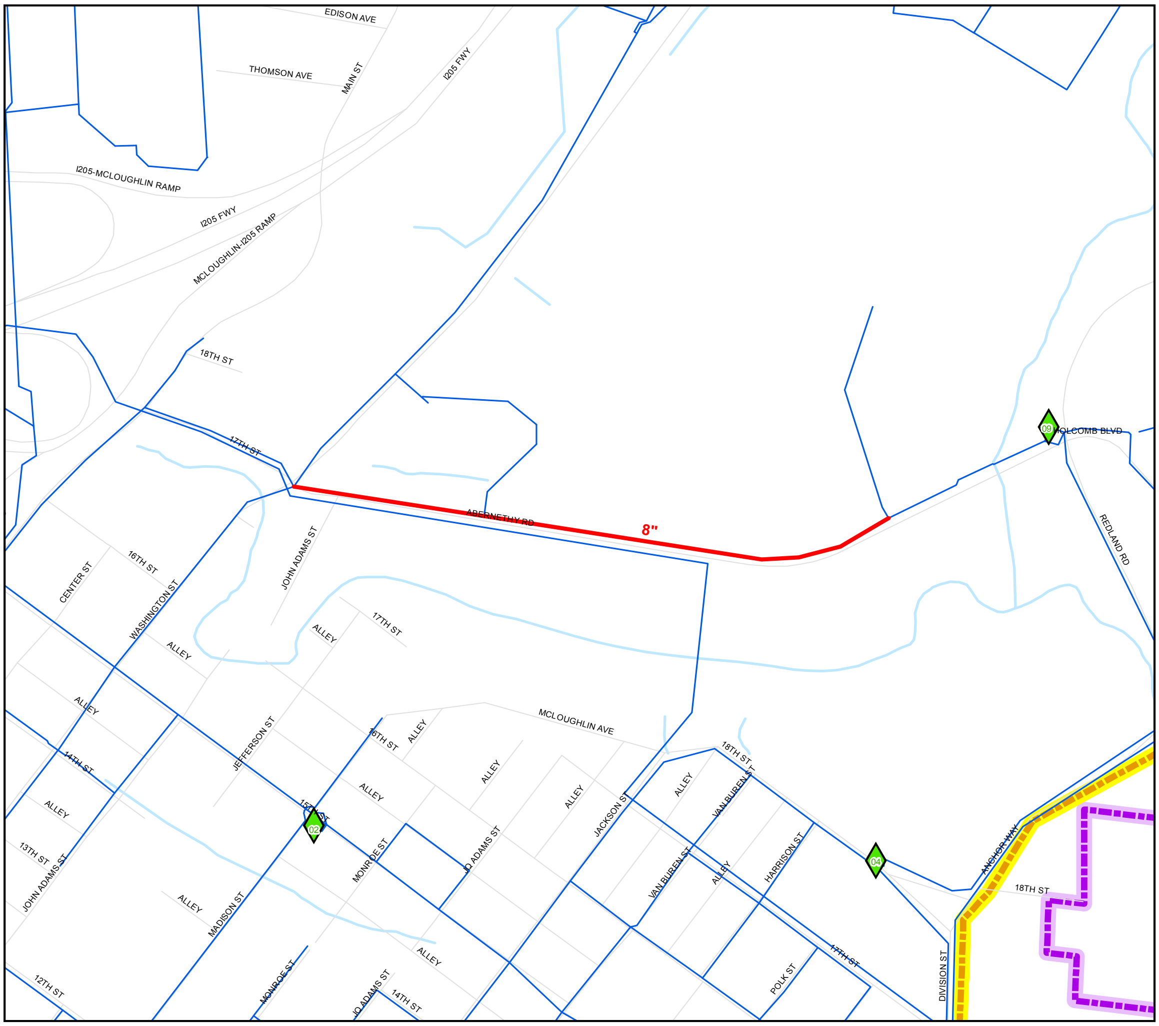
Project Data Table

	Pipe Size (inch)	Pipe Length (feet)	Construction Cost/ft ($)	Total Construction Cost ($)
	8	4767	$140	$667,380
Total		4,767		$667,380

N

0 350 700

Scale in Feet



Pipeline Project Number: CIP-P-105

Project Vicinity: Abernethy Rd.

Project Description: This project is intended to improve fire flows in the area by upsizing a loop of piping. Upsize 2,022 feet of pipeline to 8-inch diameter piping along Abernethy Road.

Existing Pipeline
CIP Pipeline
City Limits
UGB
PRV Station

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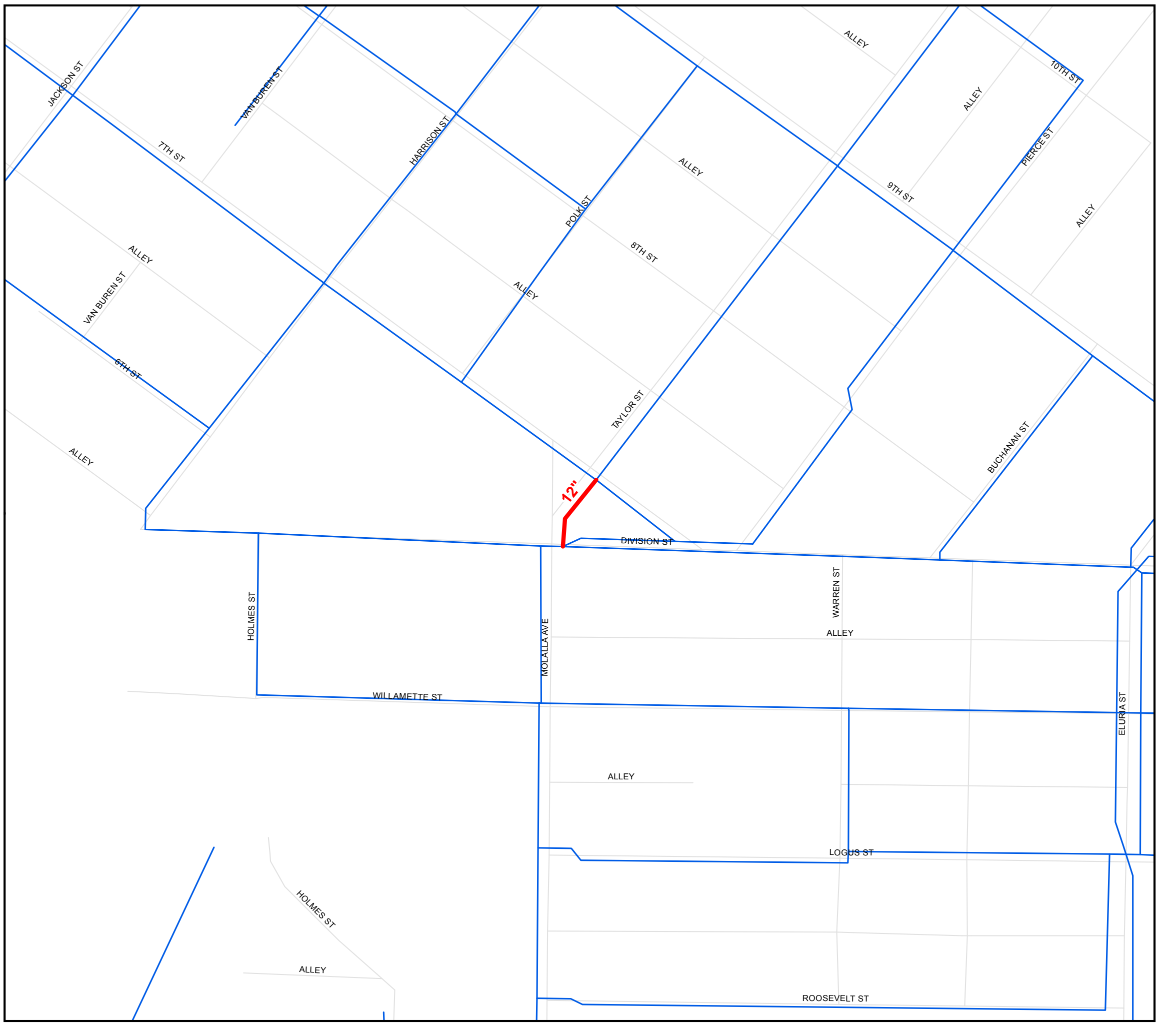
WEST YOST ASSOCIATES

Project Data Table

	Pipe Size (inch)	Pipe Length (feet)	Construction Cost/ft ($)	Total Construction Cost ($)
	8	2022	$140	$283,080
Total		2,022		$283,080

0 200 400
Scale in Feet



Pipeline Project Number: CIP-P-108

Project Vicinity: Abernethy Rd.

Project Description: This project is intended to improve fire flows in the area by upsizing a loop of piping. Upsize 130 feet of pipeline to 12-inch diameter piping on Taylor Street.

Existing Pipeline

CIP Pipeline

WEST YOST ASSOCIATES

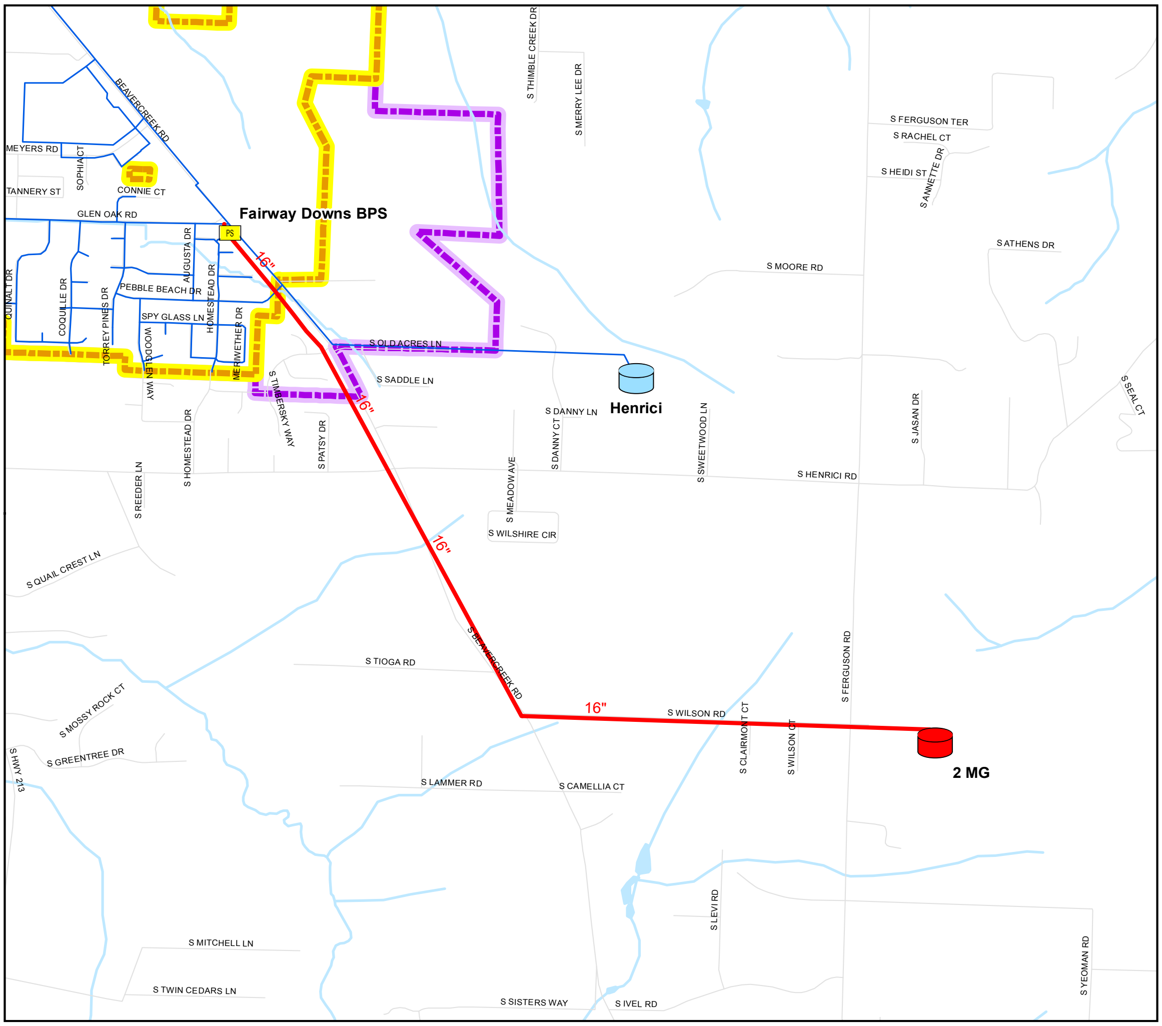
Project Data Table				
	Pipe Size (inch)	Pipe Length (feet)	Construction Cost/ft ($)	Total Construction Cost ($)
	12	130	$200	$26,000
Total		130		$26,000

N

0 100 200

Scale in Feet

26



Pipeline Project Number: CIP-TF-123

Project Vicinity: South Wilson Rd.

Project Description: This project is intended to create storage for a newly created pressure zone in the Fairway Downs areas. It will require a siting study prior to design. Add a 2 mgd storage facility and 10,750 feet of 16-inch diameter piping out South Wilson Road South of the Henrici Storage Reservoir.

Existing Pipeline
CIP Pipeline
Storage Reservoir
City Limits
UGB

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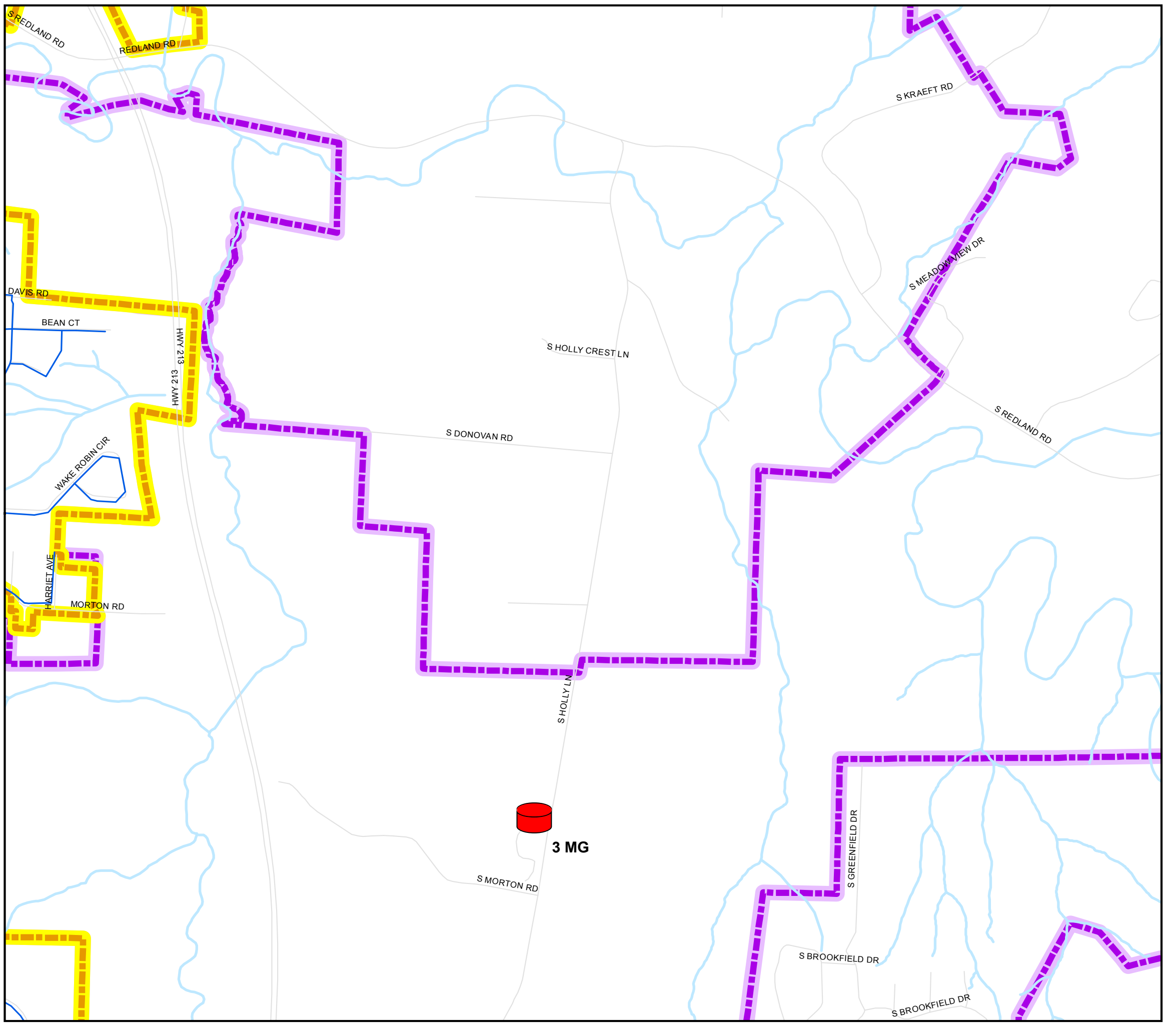
WEST YOST ASSOCIATES

Project Data Table

	Pipe Size (inch)	Pipe Length (feet)	Construction Cost/ft ($)	Total Construction Cost ($)
	16	10,750	$250	$2,687,500
2mgd Storage				$3,000,000
Total		10,750		$5,687,500

N

0 650 1,300
Scale in Feet



Pipeline Project Number: CIP-TF-124

Project Vicinity: North of S Morton Rd along S Holly Ln.

Project Description: This project is intended to add storage to the Lower Park Place Pressure Zone and will be needed as development increases in the area. The project will require a siting study prior to design. Add a 3 mgd storage facility.

Existing Pipeline
Storage Reservoir
City Limits
UGB

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WEST YOST ASSOCIATES

Project Data Table				
	Pipe Size (inch)	Pipe Length (feet)	Construction Cost/ft ($)	Total Construction Cost ($)
3 mgd Storage				$3,729,000
Total				$3,729,000

N

0 400 800
Scale in Feet

28

Agenda Item No.
Meeting Date: 10 Oct 2011

COMMISSION REPORT: CITY OF OREGON CITY

TO:	Planning Commission
FROM:	Pete Walter, Planner
PRESENTER:	Pete Walter, Planner
SUBJECT:	Update on Street Tree and Sidewalk Public Outreach
Agenda Heading: Communications	
Approved by: Tony Konkol, Community Development Director	

RECOMMENDED ACTION (Motion):

BACKGROUND:

Planning and Public Works staff have made two presentations to date to the Tower Vista and Caufield Neighborhood Associations to explain the City's Street Tree and Sidewalk replacement process pursuant to OCMC 12.04 and 12.08.

Staff will present an overview of the presentation and discuss various issues related to this topic.

The next scheduled presentation will be to the Barclay Hills Neighborhood Association at 7:00 P.M. on October 11 at the Christ Apostolic Church at 600 Barclay Hills Drive. The public is welcome.

BUDGET IMPACT:

FY(s):
Funding Source:

ATTACHMENTS:

PowerPoint Presentation to Tower Vista N.A.

Greening our Streets

September 14, 2011 - Tower Vista Neighborhood Association

Did you know?

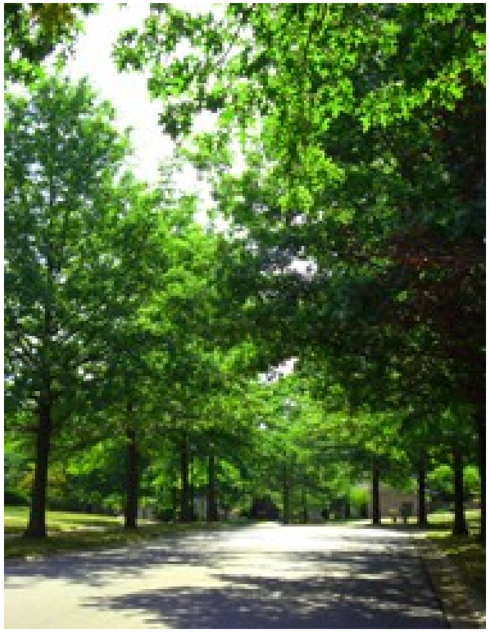
- Canopy cover in Oregon City in 2007 was estimated at 1,697 acres or **26%** of the land area within the city.
- Compared to the following cities, Oregon City is slightly below the average of 32% canopy cover (based on 2009 study by Audubon / PSU)

	Lake Oswego	West Linn	Milwaukie	Gladstone	Portland	Clack. Co. (UGB)
Percent Canopy	47.1%	38.7%	23.9%	27%	29.4%	23.9%

- (Based on 2009 study by Audubon Society / Metro / PSU)

The Benefits of Street Trees

- Carbon Storage and Uptake
- Energy Conservation
- Water Quality
- Wildlife Habitat
- Real Estate Values
- Community Health Benefits



Air and Water Quality

- *Trees play a crucial role in protecting water quality. Leaves and needles break the force of rain, slowing the movement of water and reducing water pollution, runoff and flooding.*
- *Mature street trees shade impervious surfaces (paved areas), lowering the temperature of stormwater run-off into streams, which helps increase available oxygen for fish and other aquatic life.*
- *Trees provide oxygen, they also remove airborne pollutants (including ozone, carbon monoxide, sulphur dioxide, and particulate matter)*

Property Values

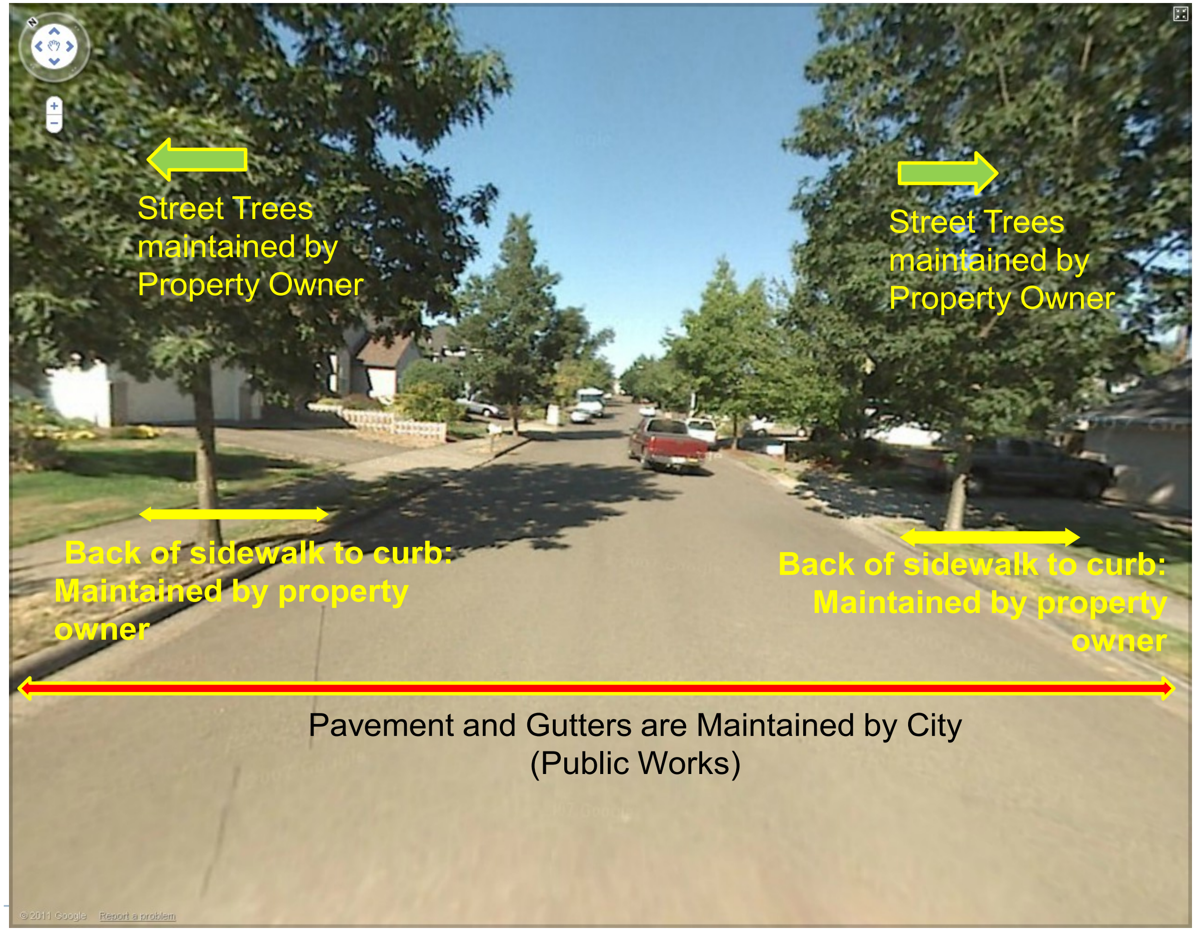
Studies have shown the property value benefit of trees:

- In Portland (2007) a mature street (based on canopy size and within 100 feet of the house) added an average of $7,020 to the price of a house.
- Total value of Portland's street trees = $1.1 billion. This translates to a $45-million benefit annually. For comparison, the city of Portland estimates that the annual maintenance of Portland's street trees costs $4.6 million ($3.3 million paid by landowners)
- In Lake Oswego, more than $1.9 million in property resale value per year is due to the presence of trees.
- According to Northwest Builder Magazine, one mature tree can add approximately $6,000 to a property’s value.

Brief Overview of Street Tree Policy

- City first adopted street tree code in 1998
- Prior to 1998, no adopted standards for appropriate species (no street tree list until 2001)
- Very narrow planter strips (3' and less)
- Also, developers may have planted inappropriate species
- Sidewalks lifted and curbs crack as street trees begin to outgrow these spaces

Who maintains what?



Removal and Replacement when a hazard exists

- **What is a hazard?**
  - **Tripping hazard:** Lifting sidewalks with a lip greater than 1/2 inch is considered hazardous.
  - An "**Imminent hazard tree**" and is defined by state law. It means a tree that has or is going to fall onto a public ROW or a target that cannot be protected, restricted, moved, or removed.
  - A **dead, diseased, dying or hazardous street tree,** as determined by a qualified arborist, may be removed upon approval by the City, so long as it is replaced with a suitable tree of at least 1.5" in size.

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Sidewalk Repair (Public Works)

- Apply separately for a reduced- fee ROW permit
- City inspector will visit before and after the repair
- To assure the work meets minimum public works and ADA requirements

Street Tree Permit (Planning)

- Apply for no-fee street tree permit
- Use approved street tree list or arborist recommendation for replacement
- Remove and replant tree
- Planning Staff will inspect after planting

Sidewalk Analysis for Tower Vista Neighborhood

2010 Oregon City Sidewalk Analysis for Tower Vista Neighborhood

Total Setback Sidewalks (w/planter strip)	220
Total Curbtight Sidewalks (No planter strip)	23
Sidewalk Linear Feet	79,487
Sidewalk Linear Miles	15
Minimum Width of Sidewalk (feet)	4

Sidewalk Segment Rating	Total	Percentage
Excellent	33	13.6%
Above Average	108	44.4%
Average	62	25.5%
Below Average	26	10.7%
Poor	14	5.8%

Raised Panels (exceeds 1/2 inch)	238

Sidewalk Conditions for Tower Vista Neighborhood

Tower Vista Boundary

Sidewalk Condition Rating

- Excellent
- Above Average
- Average
- Below Average
- Poor

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Raised Sidewalk Panels for Tower Vista Neighborhood

Tower Vista Boundary

Number of Raised Sidewalk Panels

- 0
- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 11
- 15
- 17

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Alternatives to Removal

- The City Engineer may approve the following:
  - Use of pervious pavers
  - Rubber sidewalks
  - Narrower sidewalk, meandering sidewalk
  - Shaving down roots and replacing panel (tree may not survive)
  - Saw-cut panel / shave down panel
- All repairs / alterations must meet approval of city Engineer for compliance with city standards / ADA

Proper Tree Care Suggestions

- Choose the right tree for the planter strip size
- Observe required clearances (5’ from hydrants, 15’ from street lights, 20’ from intersections, 5’ below powerlines)
- Install a root barrier parallel to the sidewalk if appropriate when planting.
- Prune dead branches immediately, since they're a conduit for insects and disease.
- Don't drown your trees. Most need watering once a week at most.
- Don't over-fertilize. Add only the nutrients your tree needs.
- Don't pile mulch against your trees' trunk, since it can encourage rot.
- Always use a certified arborist if you need a professional.

Questions?