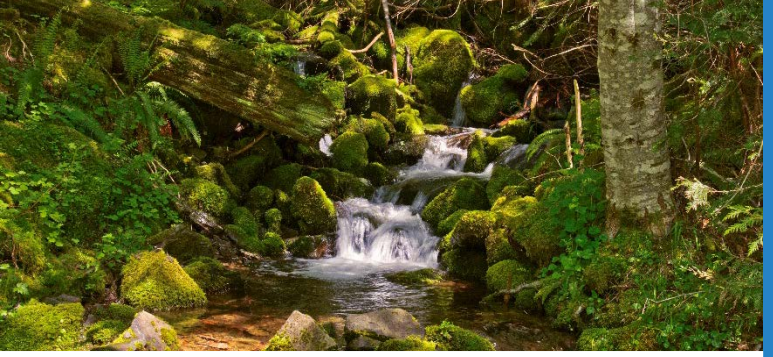
Parsons, Susan

From: Dee White <deewhite1@mindspring.com>
Sent: Monday, March 06, 2017 2:30 PM
To: Moore-Love, Karla
Subject: 7 Agenda item 215/235 for March 8 PWB contract with Confluence
Attachments: 8-22-16 EPA-OHA-PWB LCR Mtg Part 1_FinalDraft08222016.pdf; 187978 Multnomah Co Health Department Lead Hazard Reduction Program program evaluation services contract additional documents.PDF; 11_CH_7_PWB_Proposed_Final Citywide Systems Plan.pdf

Karla,

Please include these documents in the record for this agenda item. Please also send me a receipt that you have received. THANKS so much.

Dee White



PORTLAND WATER BUREAU
LEAD AND COPPER RULE

August 22, 2016
Meeting with OHA and EPA

PORTLAND WATER BUREAU
FROM FOREST TO FAUCET

Presentation Outline

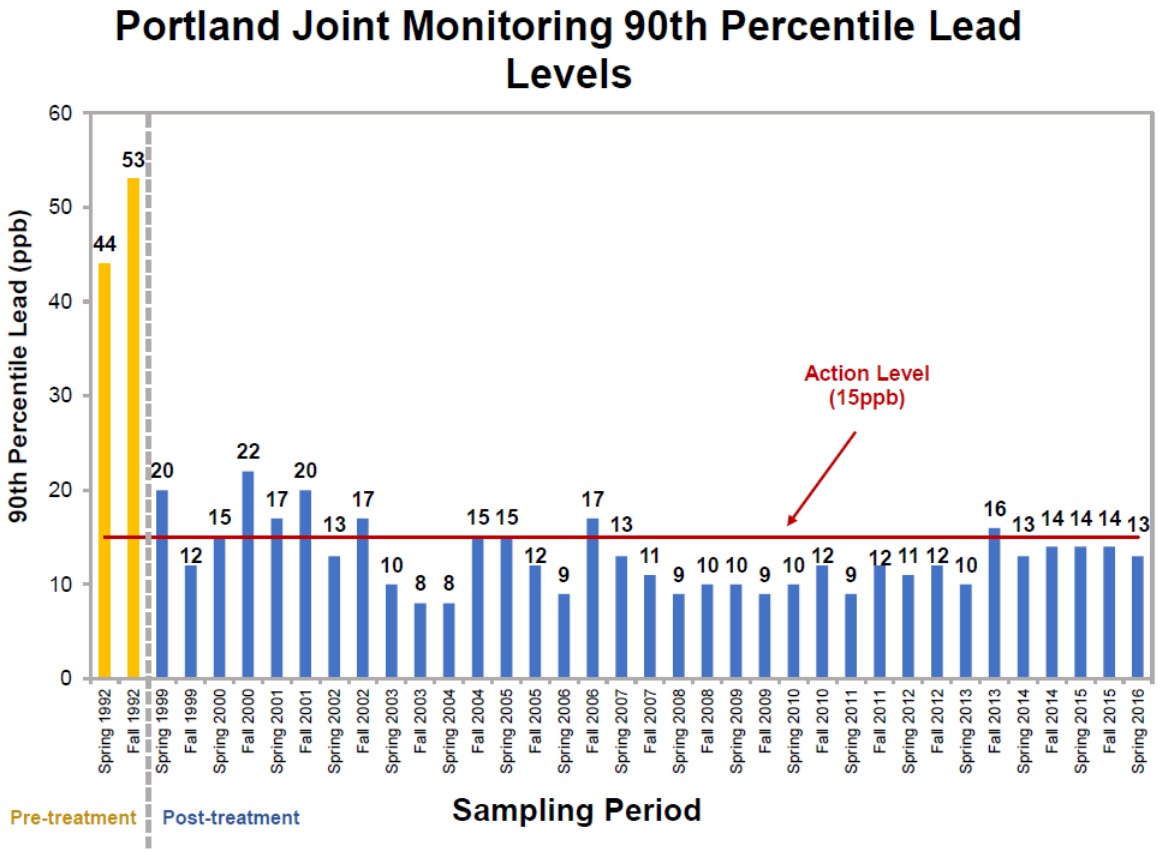
- Recap of April 21, 2016 meeting
- Update on PWB system
- Update on PWB's work with schools and daycares
- Update on customer sampling program
- Update on corrosion study
- Updated timeline
- Next steps

Recap of April 21, 2016 meeting

- Background on PWB and LHRP
  - LHRP Evaluation
- Introduction of Corrosion Study
  - Objectives and timeline
- Corrosion Control Decision Tree
  - Treatment considerations
  - Schedule considerations
- EPA's recommendations for testing select schools and daycares

System updates since April

- Spring LCR Monitoring
- Washington Park – Res 3
  - Lawsuit
- Corrosion study – on-going
  - Q2 report
- LHRP Evaluation going to Council on August 31



PWB's work with schools

- Portland Public Schools (PPS)
  - March – met with PPS to offer sample analysis of district wide sampling (per 3T) ~5000 samples.
  - May – PPS accelerated its sampling to be completed in the second half of June.
  - June – PPS sampled all water fixtures in schools – fountains, classroom/bathroom/utility/kitchen sinks, showers, hose bibs, etc.
  - June and July – PWB analyzed 1814 samples from PPS.
- Other Schools
  - May – PWB met with representatives from all Portland area public schools and offered technical assistance and free sample analysis.
  - August – PWB sent a letter to private schools in the Portland service area to offer technical assistance and free sample analysis.
- PWB is advising all schools to follow the EPA 3T guidance.
- Oregon Department of Education – Healthy and Safe Facilities

Portland Public School Results from PWB

- PPS sampled **all** water fixtures in schools – fountains, classroom/bathroom/utility/kitchen sinks, showers, hose bibs, etc.
- Levels much higher than found elsewhere including Community Centers.
- PWB reaching out to PPS to offer assistance in analyzing results.

	Portland Public Schools (PWB results only)			City of Portland Facilities
	All PWB Results	Consumptive	Non-consumptive	Consumptive
Number of Samples	1814	987	827	305
Minimum Lead Result (ppb)	ND	ND	0.22	ND
Maximim Lead Result (ppb)	13000	1950	13000	447*
Percent of Total Samples	100%	54%	46%	100%
Mean Lead (ppb)	34.1	21.7	48.9	6.50
Percent of Samples > 20 ppb Lead	22%	17%	29%	5.6%

PWB's work with daycares

- Emails and letters sent to 612 in-home daycares
  - 44 responses so far
- Letters with return postcard sent to 300 daycares in 8 languages
- Centers – Sending emails and letters to 261 centers
  - Offering analysis and technical assistance in sampling per 3Ts
- Provided analysis and assistance to other daycare providers upon request such as Headstarts

PWB's work with City Facilities

Prioritized sites:

1 - Infants, children, pregnant women primary population:
27 locations – 4 remaining to test

2 - Primarily serve the public:
372 locations

3 - Built or Plumbed 1985 or earlier:
96 locations

4 - All Other:
269 locations

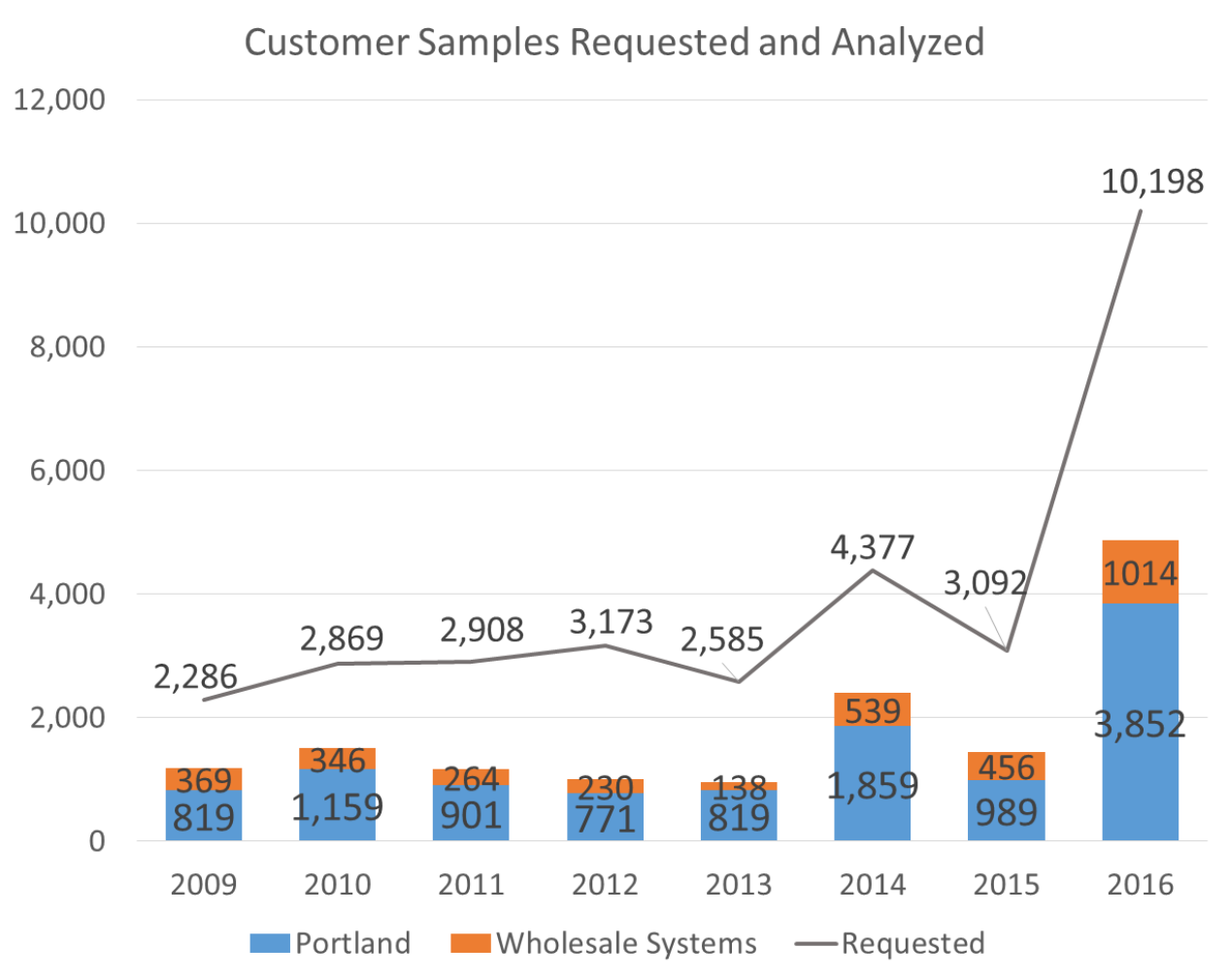
PWB sampling using 3Ts and providing guidance on communicating results.

PWB's LHRP: Lead in Water Education & Testing

Voluntary Customer Sampling

2016 (Jan-Aug) 90th Percentile

Portland: 4.3 ppb
Wholesalers: 9.4 ppb



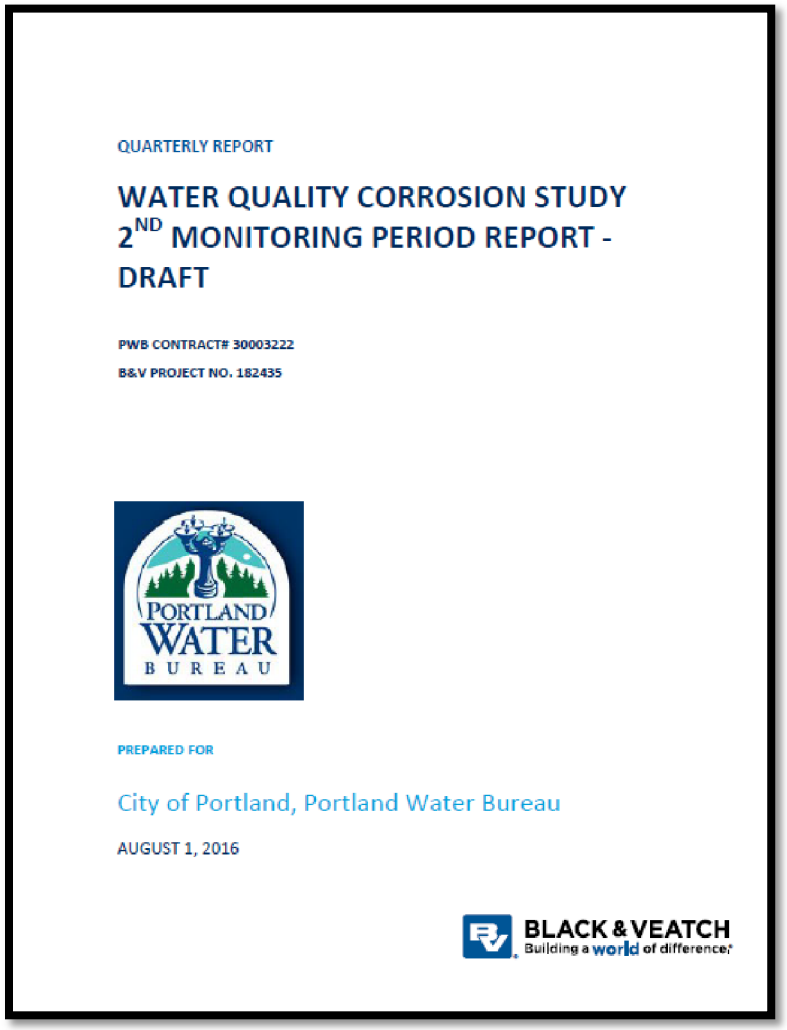
Presentation Outline

Corrosion Study

- Q2 Update and Preliminary Results

Corrosion Control Decision

- Decision Tree
- Schedule


QUARTERLY REPORT

WATER QUALITY CORROSION STUDY
2ND MONITORING PERIOD REPORT -
DRAFT

PWB CONTRACT# 30003222

B&V PROJECT NO. 182435

PORTLAND WATER BUREAU

PREPARED FOR

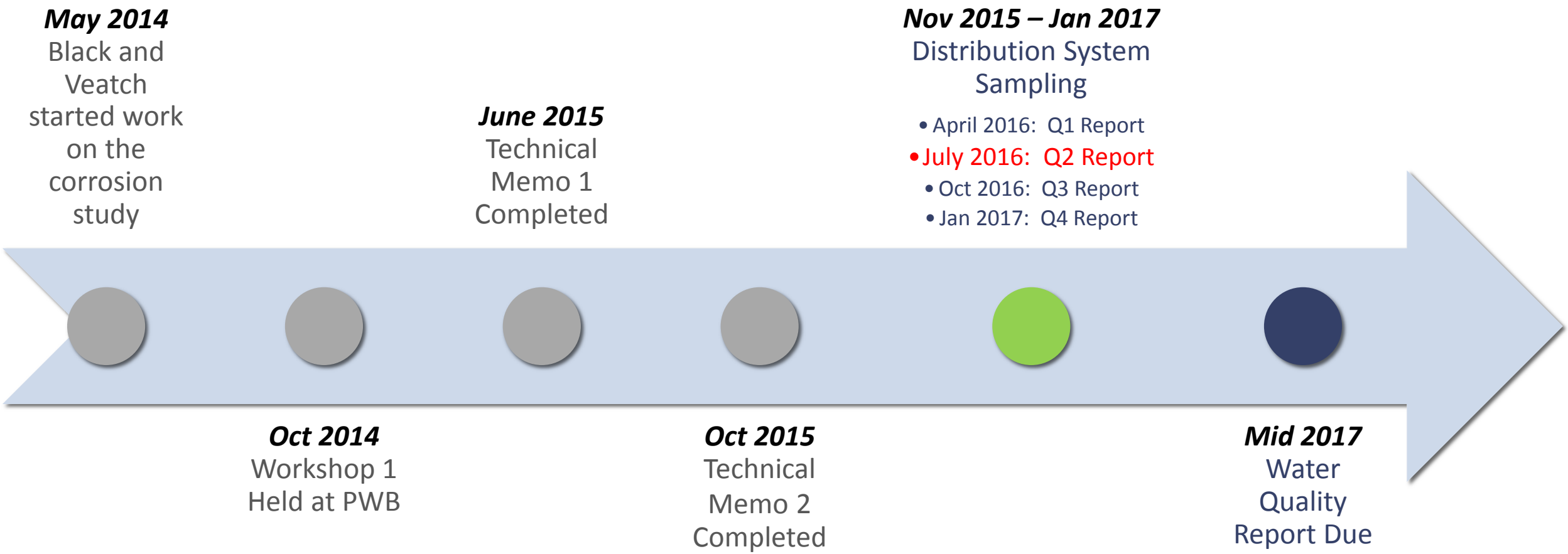
City of Portland, Portland Water Bureau

AUGUST 1, 2016

BLACK & VEATCH
Building a world of difference.

PORTLAND WATER BUREAU
FROM FOREST TO FAUCET

Water Quality Corrosion Study Project Timeline



Recap: Water Quality Corrosion Study Objectives

Project Objectives

- Better understand the causes of lead release in PWB's system
- Identify data gaps and conduct additional sampling required to better understand the role of water quality on lead release
- Specific questions to address include:
  - *Is uniform corrosion contributing to lead observed in LCR samples?*
  - *Is scale release (caused by hydraulic or physical disturbances) or dissolution (caused by chemical changes) contributing to lead observed in LCR samples?*
  - *What premise plumbing and fixture materials are contributing to lead release for PWB customers?*
  - *Is nitrification or other microbiological activity contributing significantly to lead release?*
  - *What impact does the use of groundwater have on lead release?*
  - *Are operational changes affecting lead release in the distribution system? If so, how?*

Recap: Study Sampling Plan

Utilize data from existing programs:

- TCR
- Nitrification
- LCR (tier one homes and water quality parameters)
- Voluntary customer sampling

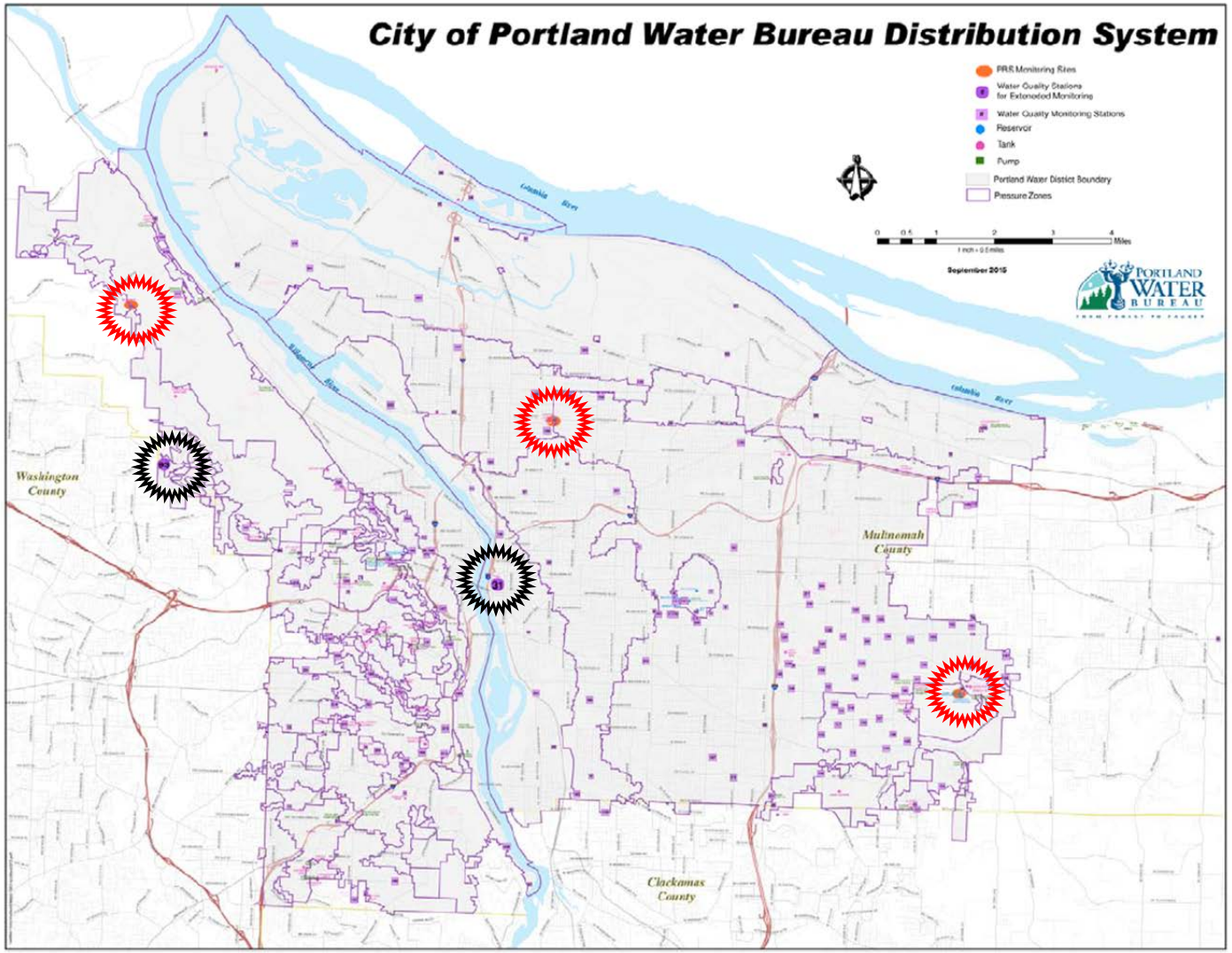
Collect new data:

Weekly sampling over the course of a year in the distribution system

- 3 Process Research Solution (PRS) Monitoring Stations were installed
- 2 distribution system sites

Follow-up sampling at select LCR and customer homes

- Goal is to sample ~ 50 customer homes as well as several of PWB's Tier 1 homes with elevated lead levels



= PRS Stations

= Distribution system sites

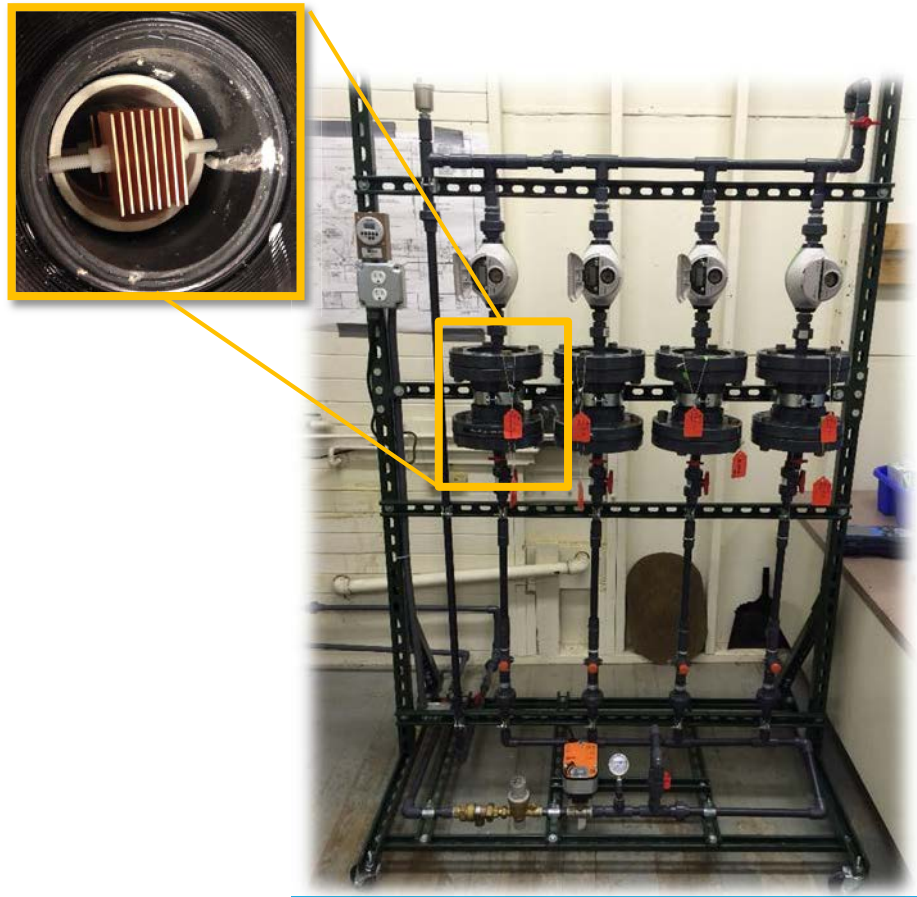
Recap: PRS Stations

These stations allow for controlled stagnation cycles to replicate worst case water quality as seen in customer homes

- Previous PRS monitoring station results have tracked well with LCR first draw samples in other systems

Each station includes four stagnation chambers, each containing different metal types

- Copper with Lead Solder
  - Represents material commonly found in Portland Tier 1 homes
- Galvanized Iron
  - Galvanized iron plates represent indoor piping and plumbing fixtures commonly found in Portland homes
- Brass
  - Similar to galvanized iron, brass plates represent indoor piping and plumbing fixtures commonly found in Portland homes
- Lead
  - Even though PWB does not have lead service lines, lead is used in order to magnify the response of lead to the water characteristics



Parameters Monitored As Part Of The Water Quality Corrosion Study

Field

- pH
- Temperature
- ORP
- Chlorine residual
- Monochloramine
- Free ammonia
- Turbidity
- Conductivity
- ATP

Lab

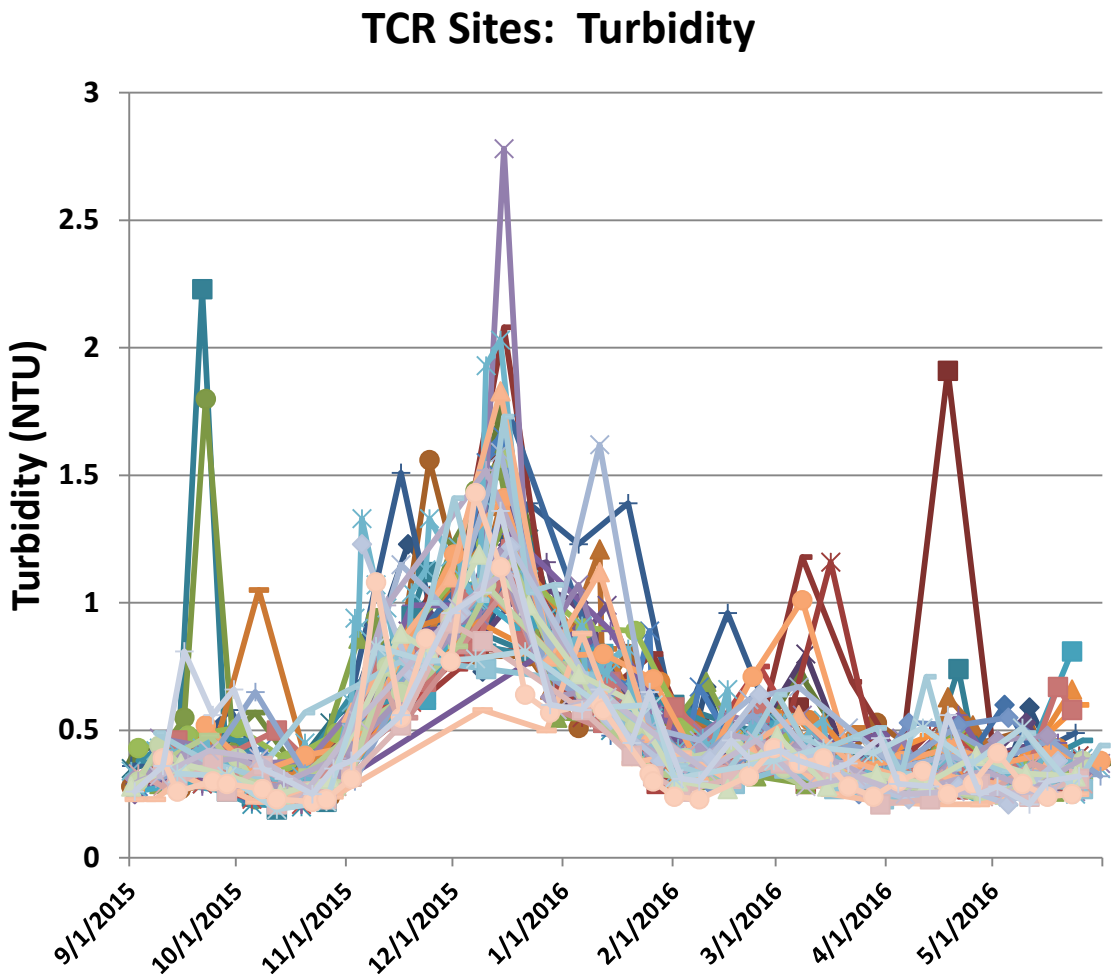
- Total and dissolved metals
  - lead, copper, aluminum, arsenic, cadmium, calcium, chromium, cobalt, iron, magnesium, manganese, nickel, zinc
- Total organic carbon
- Dissolved organic carbon
- Total phosphorus
- Alkalinity
- Hardness
- Chloride
- Sulfate
- Nitrate
- Nitrite
- TDS

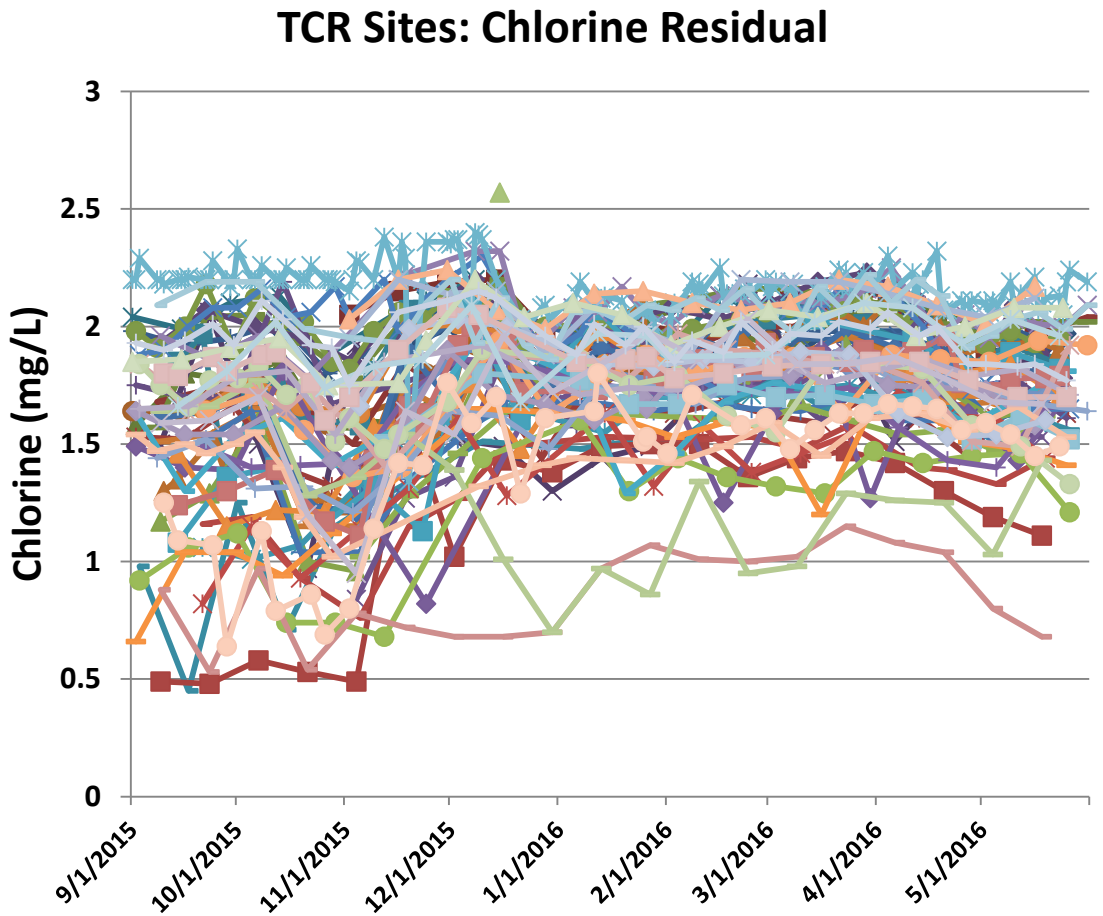
Data Sets Used in the Corrosion Study

Data Set	TCR Monitoring (Alk, Cl2, pH, Temp., Turbidity)	Nitrification Monitoring (Cl2, ORP, HPC, Free NH3, Nitrite, Nitrate, pH, Temp., Turbidity)	LCR Compliance (Total Pb, Cu, Fe, Mn, Zn)	WQP Compliance (Alk, pH)	Voluntary Lead* (Total Pb, Cu, Fe, Mn, Zn)	Supplemental In-home (All parameters)	Extended WQSS and PRS Station (All parameters)
Uniform Corrosion	Alk, pH, Temp.	ORP, pH, Temp.	Total Pb	Alk, pH	Total Pb	All parameters describing uniform corrosion	All parameters describing uniform corrosion
Biostability of Water	Cl2, Temp.	Cl2, Free NH3, Nitrite, Nitrate, ORP, Temp.	Total Pb, Cu	N/A	Total Pb, Cu	All parameters describing biostability	All parameters describing biostability
Scale Transport	Turbidity	Turbidity	Total Pb, Cu, Fe, Mn, Zn	N/A	Total Pb, Cu, Fe, Mn, Zn	All parameters describing scale transport	All parameters describing scale transport

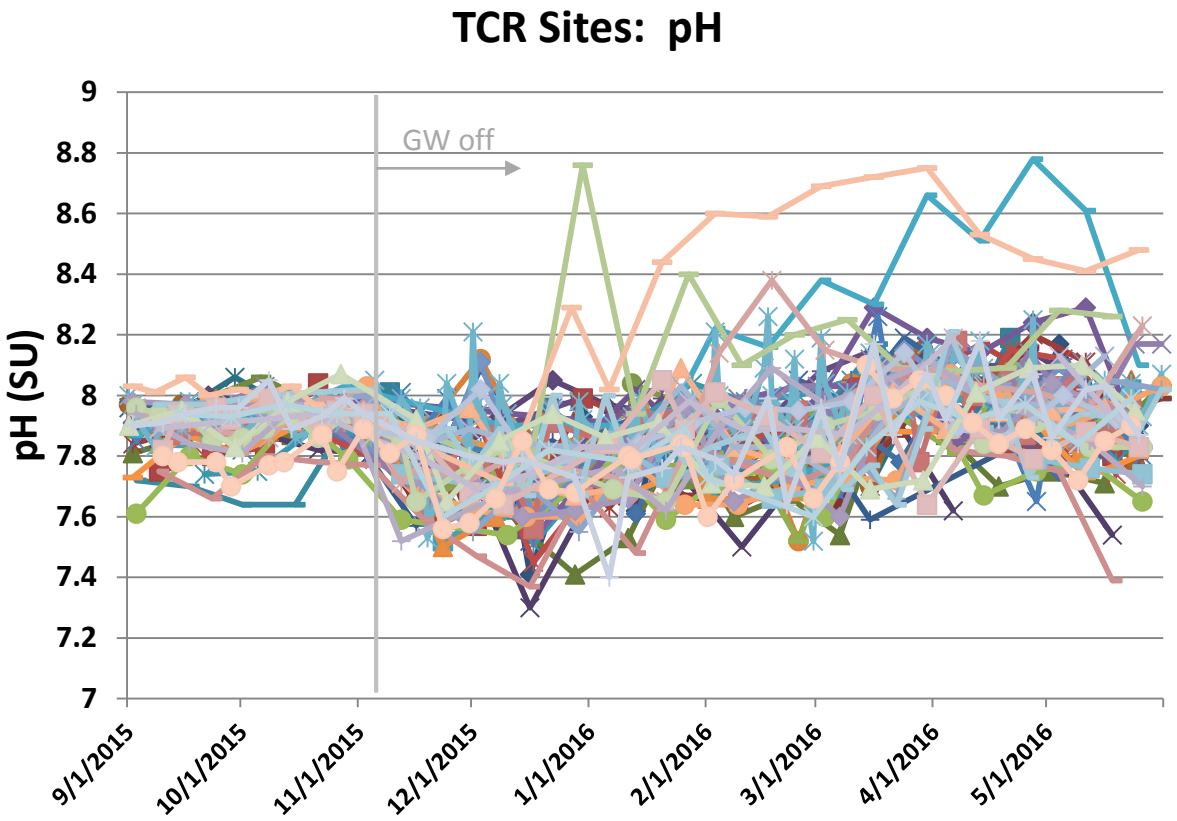
Notes:
* Currently lead is the only parameter measured due to high sample volume

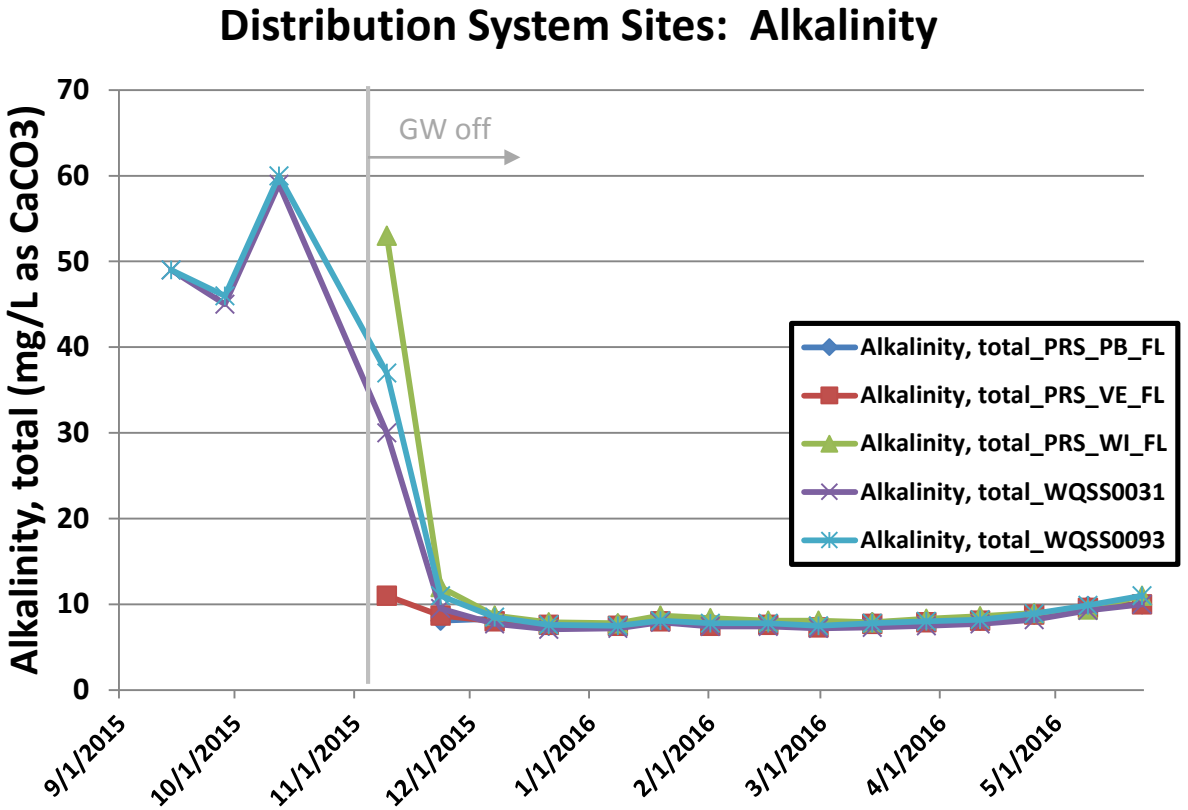
TCR Results


TCR Sites: Turbidity
Turbidity (NTU)
3
2.5
2
1.5
1
0.5
0
9/1/2015
10/1/2015
11/1/2015
12/1/2015
1/1/2016
2/1/2016
3/1/2016
4/1/2016
5/1/2016


TCR Sites: Chlorine Residual
Chlorine (mg/L)
3
2.5
2
1.5
1
0.5
0
9/1/2015
10/1/2015
11/1/2015
12/1/2015
1/1/2016
2/1/2016
3/1/2016
4/1/2016
5/1/2016

Effect of Groundwater





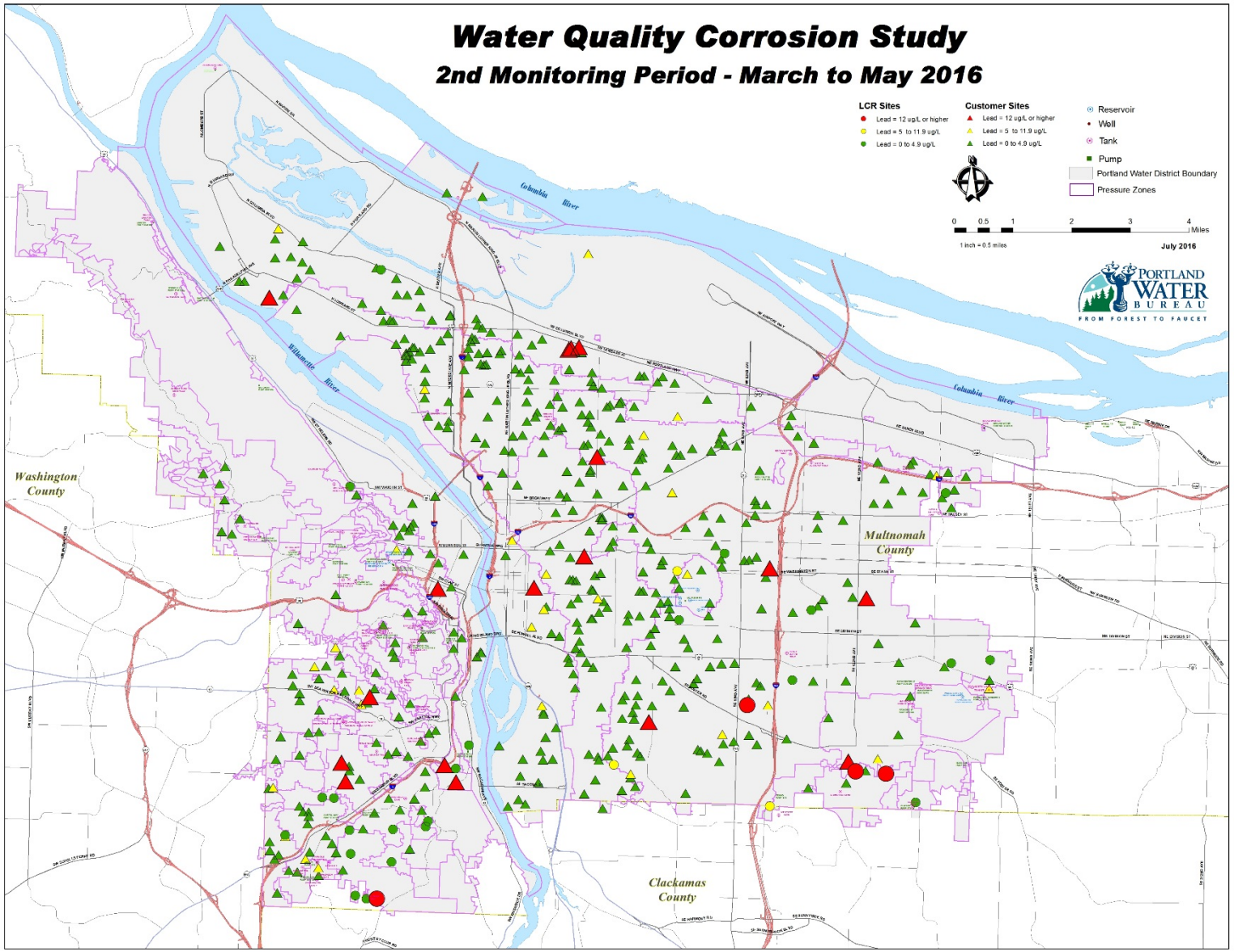
Lead Observed During Q2 (Customer And LCR Samples)

Voluntary customer samples

- The 90th percentile lead concentration for the voluntary customer samples analyzed in Q2 was 5 ug/L
  - Slightly up from 4.3 ug/L for the voluntary customer samples analyzed in Q1
- 15 of 550 voluntary customer samples (2.7%) exceeded 15 ppb
  - 4 of 271 samples (1.4%) exceeded 15 ppb in Q1 2016

LCR Tier One Home Samples

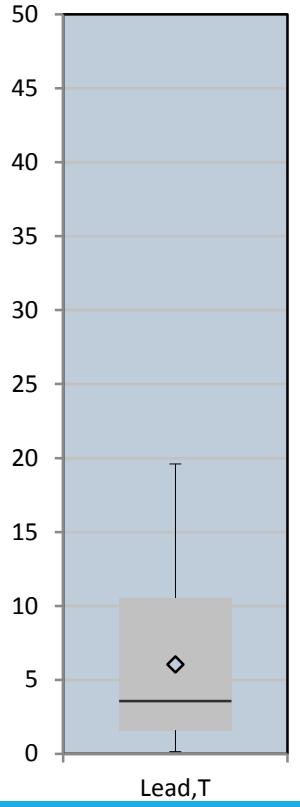
- 3 of 31 Portland homes had results over the action level



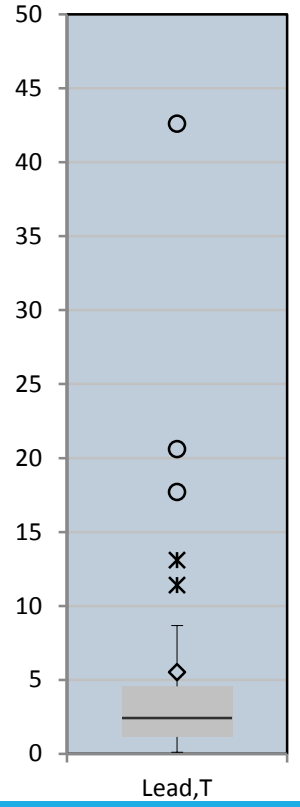
LCR Results (PWB Only)

LEAD

Q1 (Fall 2015)

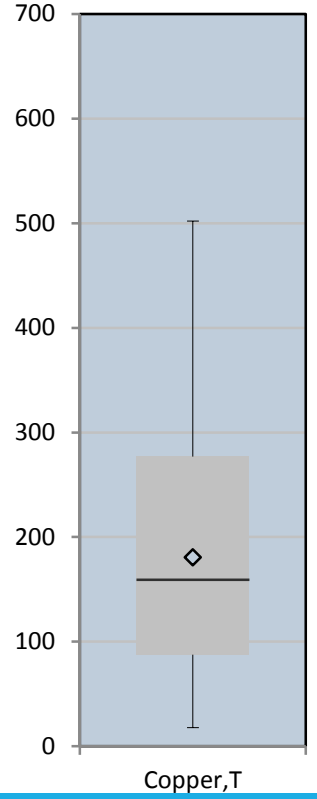


Q2 (Spring 2016)

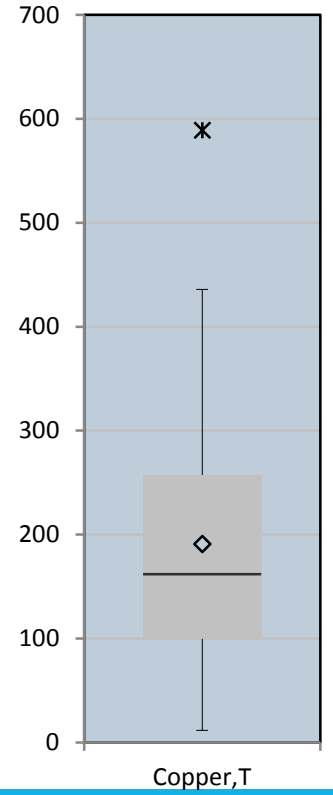


COPPER

Q1 (Fall 2015)

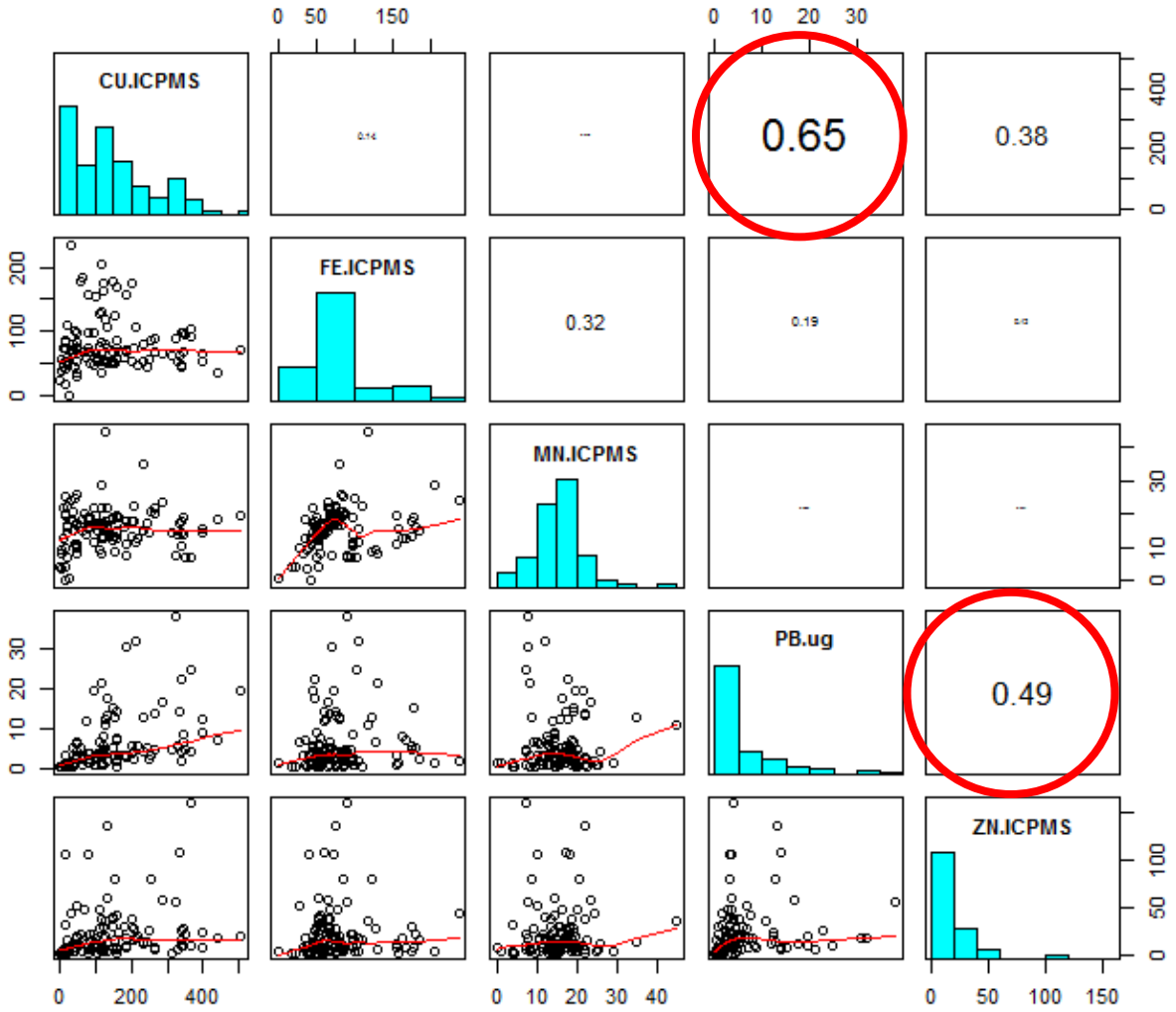


Q2 (Spring 2016)

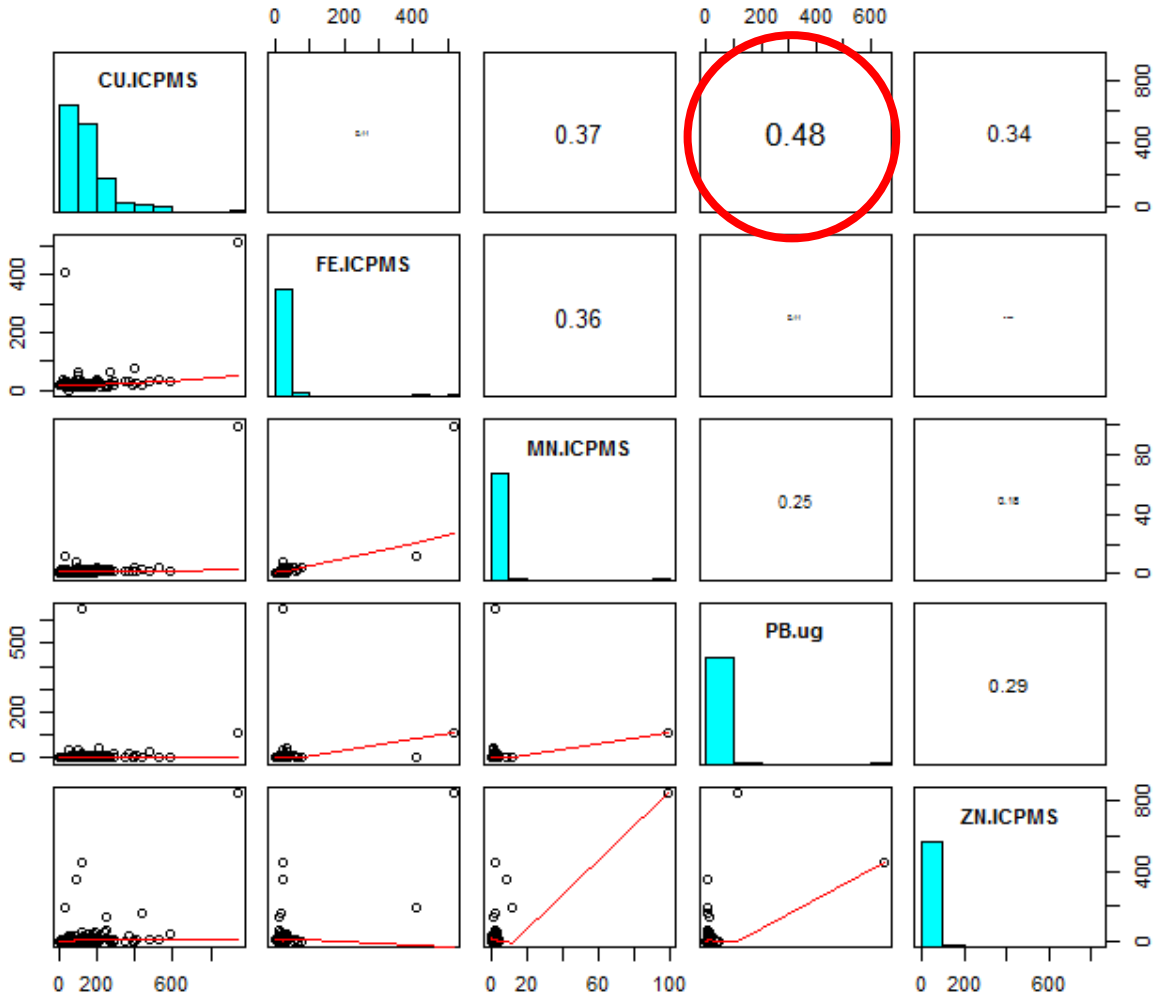


Metals Co-occurrence (LCR Data)

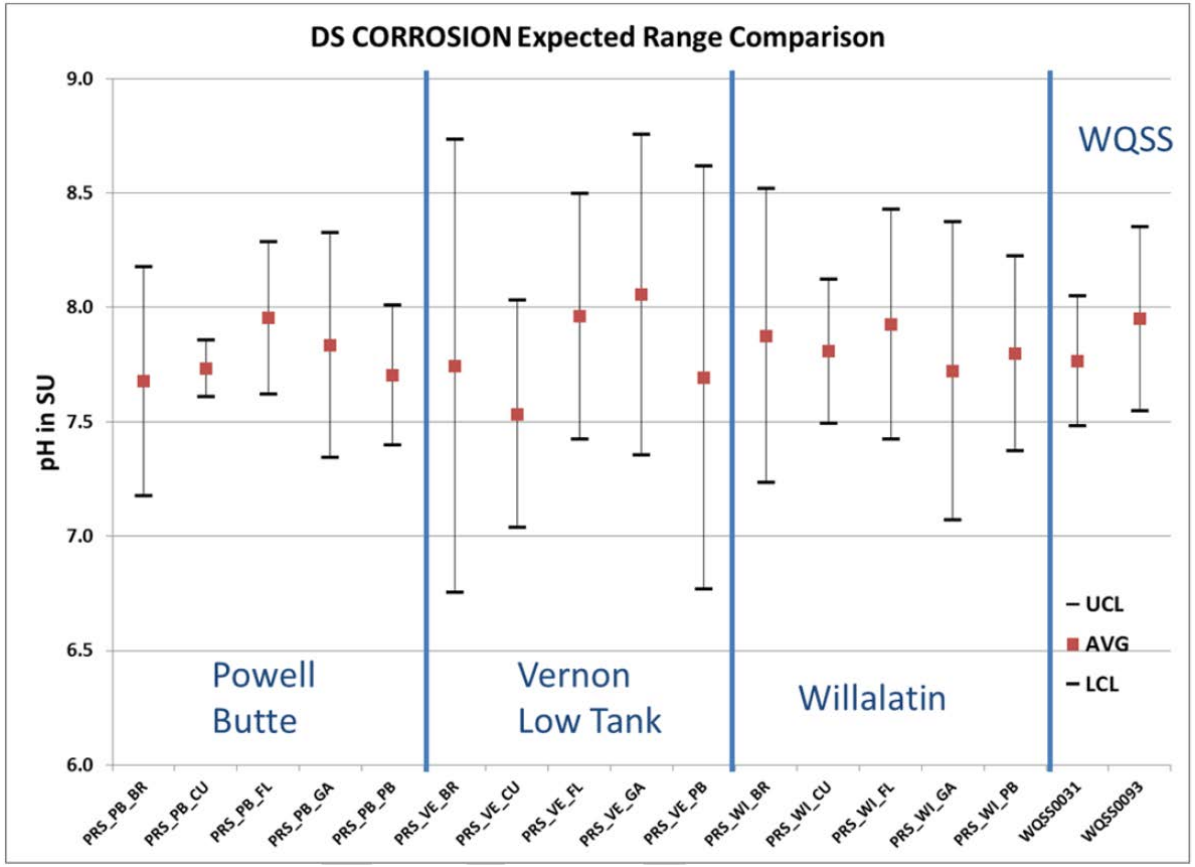
Q1 (Fall 2015)

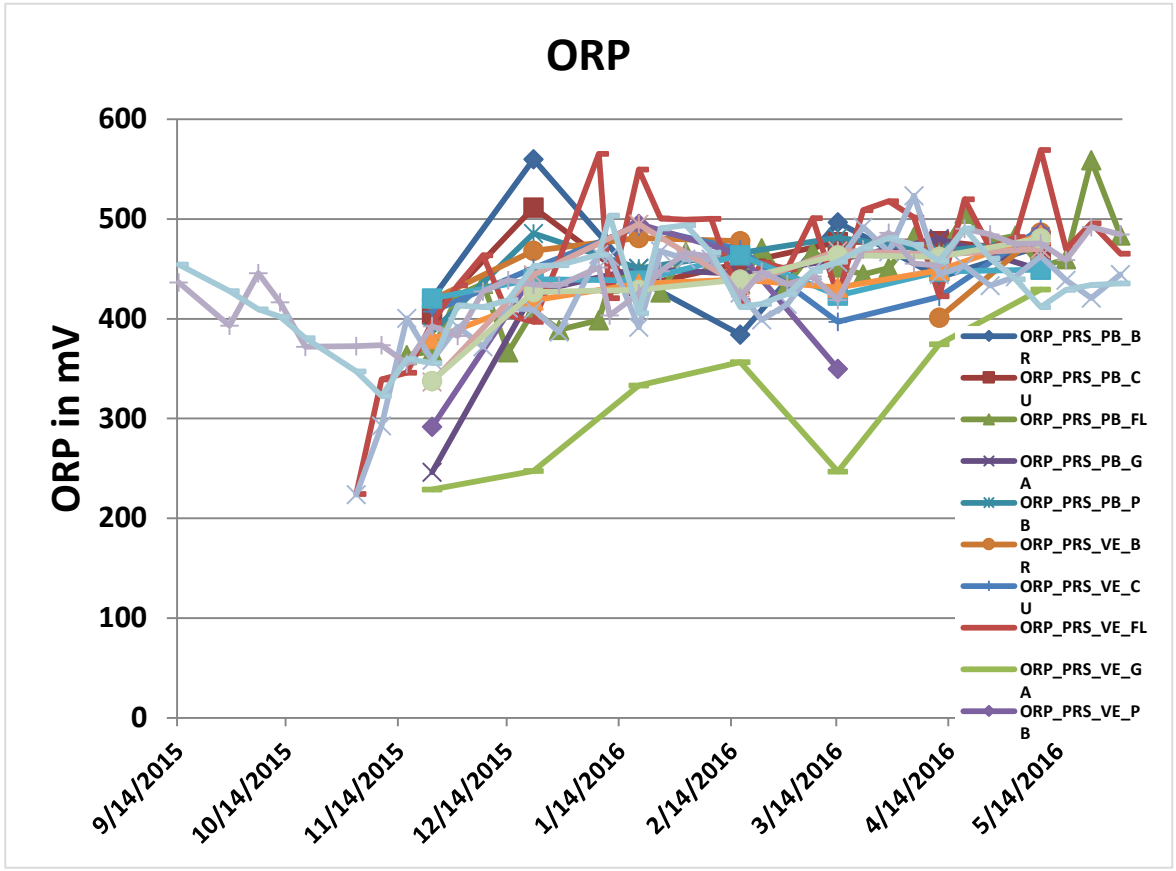


Q2 (Spring 2016)

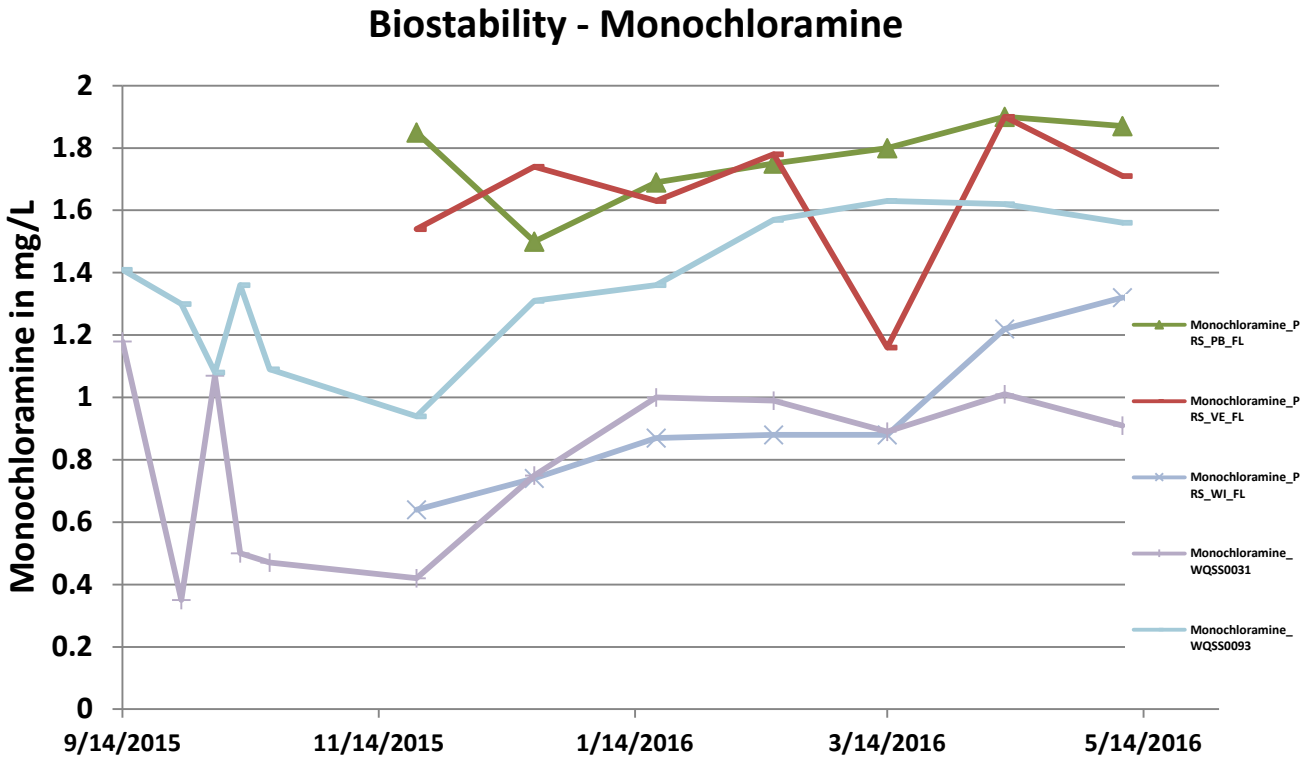


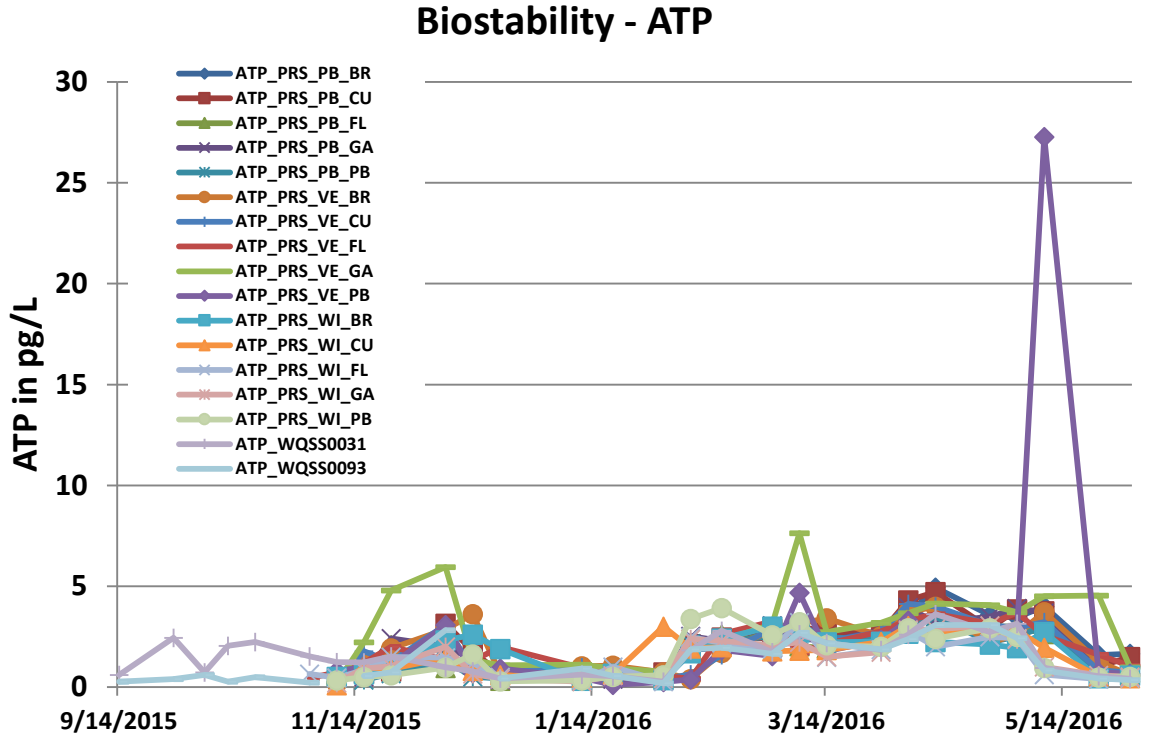
Preliminary Results: Uniform Corrosion



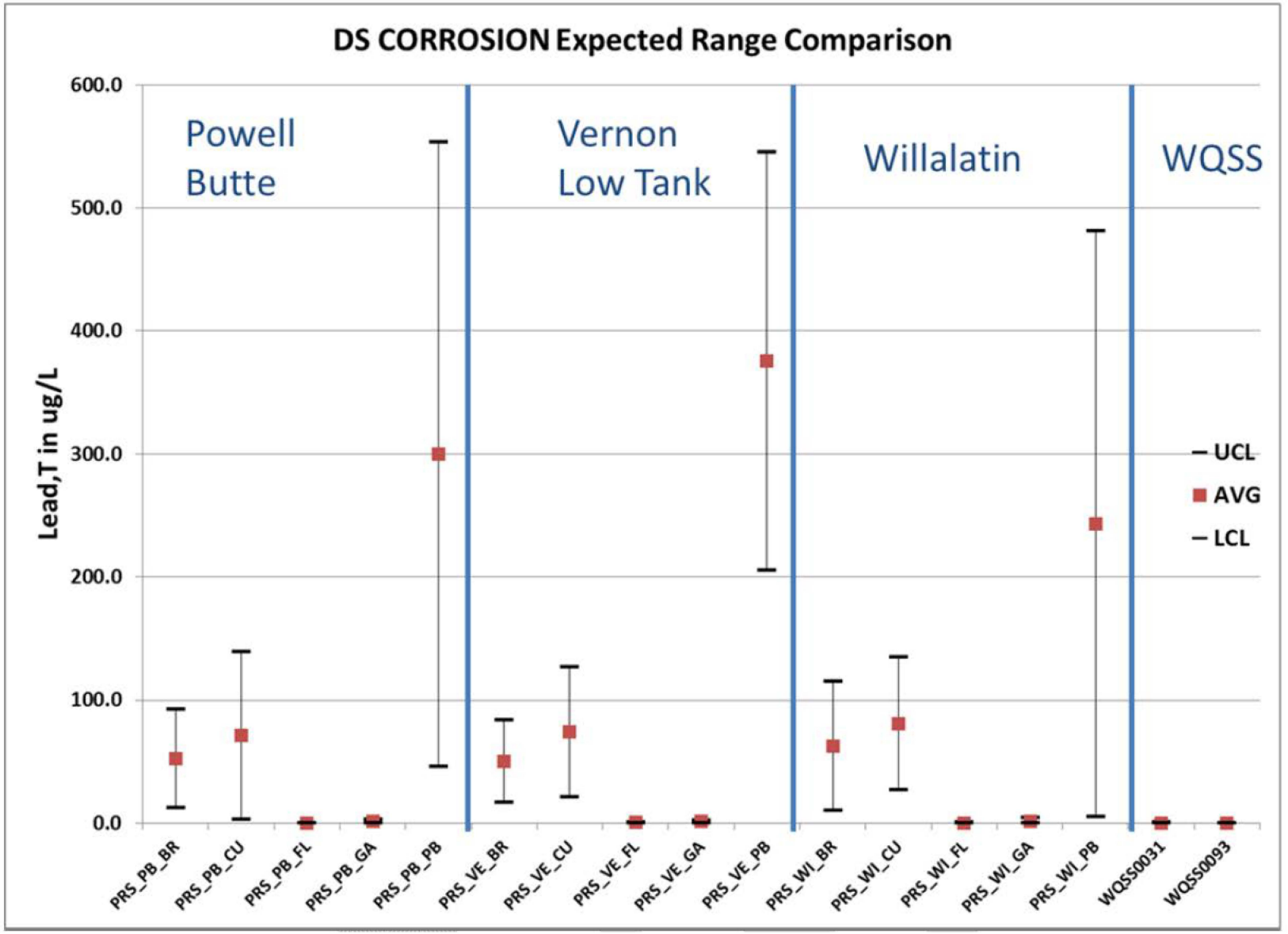


Preliminary Results: Biostability





Lead Release And Premise Plumbing Materials



Corrosion Indexes

Calcium carbonate precipitation potential (CCPP)

- CCPP for the Portland system in Q2 was generally between -6 and -7
- This indicates a very low potential for formation of calcium carbonate layer

Larson's ratio (LR)

- LR for the Portland system in Q2 was generally between 2 and 3
- This indicates that chloride and sulfate may be inhibiting lead carbonate formation and contributing towards increased lead solubility
- It is generally recommended to maintain a LR greater than 5 to ensure carbonate reactions are predominantly controlling lead solubility

Chloride to sulfate mass ratio (CSMR)

- The CSMR for the Portland system in Q2 was between 7 and 8
- While guidance varies, the literature suggests that values can increase the risk of galvanic corrosion when the ratio of chloride to sulfate is greater than 0.6

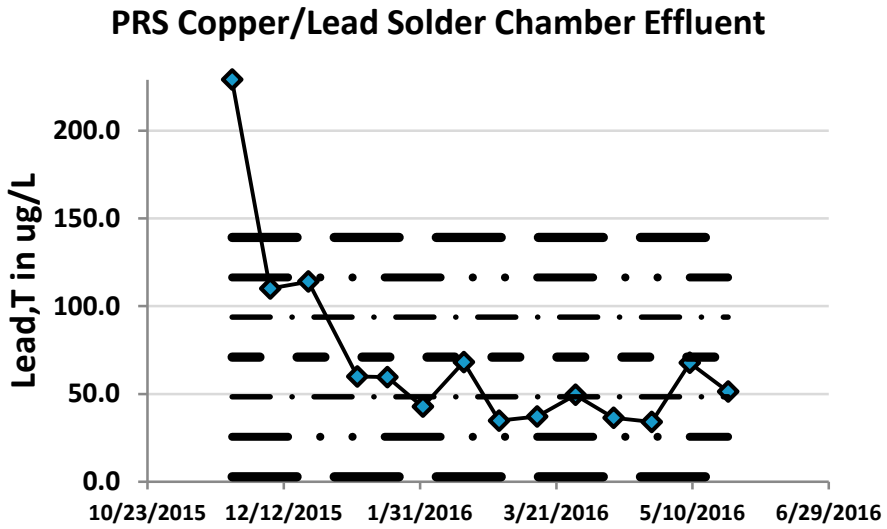
Q2 Results Summary

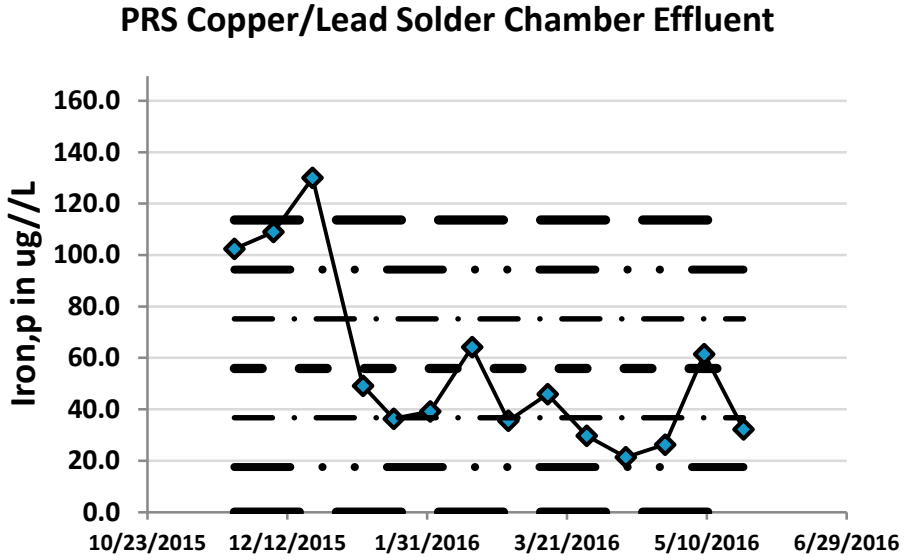
Roughly 50 to 70% of the total lead observed in the PRS monitoring station effluent and the supplemental customer sampling was in the dissolved form, indicating solubility processes related to lead release are occurring

Particulate lead release accounted for approximately 30% to 50% of the total lead release observed in most of the test chambers and supplemental customer sampling

- Occasional spikes in total lead were observed in the test chamber effluents that were predominantly in the particulate form
- These spikes in lead were strongly associated with similar spikes in particulate iron, manganese, and aluminum, indicating that release of these metal scales

Will continue to collect parameters that describe uniform corrosion to determine if a significant relationship exists between the water quality parameters and lead release





Water Quality Corrosion Study Objectives - Status

Project Objectives

• Better understand the causes of lead release in PWB's system	*DS sampling plan in progress*
• Identify data gaps and conduct additional sampling required to better understand the role of water quality on lead release	*Data gaps identified and mid-way through a sampling program designed to fill in those gaps*
• Is uniform corrosion contributing to lead observed in LCR samples?	*Yes, based on preliminary results it appears that uniform corrosion may be a significant factor in lead release in Portland's system*
• Is scale release (caused by hydraulic or physical disturbances) or dissolution (caused by chemical changes) contributing to lead observed in LCR samples?	*Q2 data indicates that this is also occurring*
• What premise plumbing and fixture materials are contributing to lead release for PWB customers?	*Preliminary results indicate copper/lead solder and brass fixtures may contribute most significantly in Portland's system*
• Is nitrification or other microbiological activity contributing significantly to lead release?	*Biostability has been good, but with nitrification season starting in Q3, more data should be available*
• What impact does the use of groundwater have on lead release?	*Q3 data should provide more insight to evaluate this*
• Are operational changes affecting lead release in the distribution system? If so, how?	*An operations log is being maintained and unusual water quality results will be investigated to evaluate whether operational changes could have caused these issues*

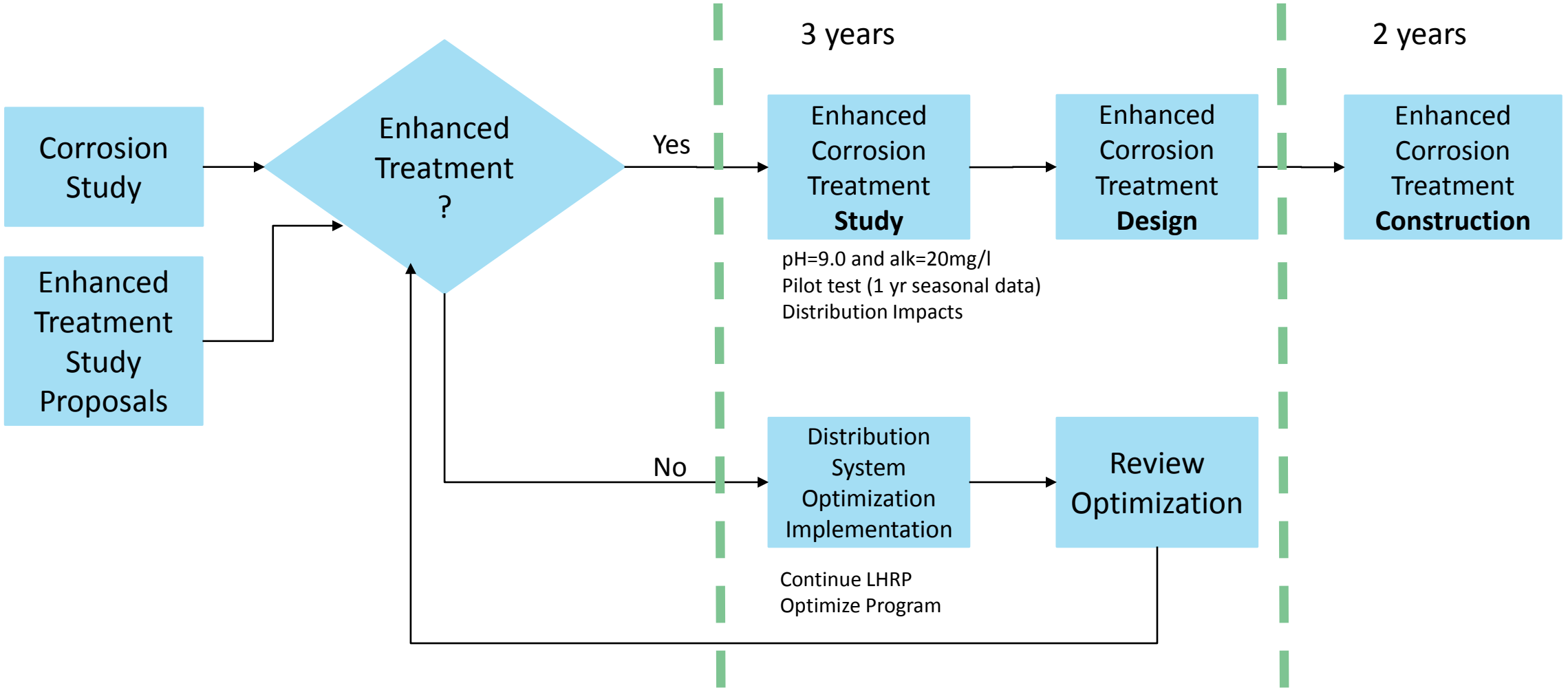
Corrosion Control Decision Treatment Considerations (Recap)

- Meet OCCT requirement of LCR
- Reduce corrosiveness of our water
  - Reduces lead and copper
  - Potentially extend useful life of our pipes
- Water should become more stable
  - System pH would be more consistent
  - Potential for greater formation of monochloramines above pH 8
- WQ Impacts – want to avoid unintended consequences
  - Potential red water
  - DBPs – THMs might increase, but HAAs might decrease
  - Aesthetics
  - Unknown

Corrosion Control Decision Treatment Considerations (Recap)

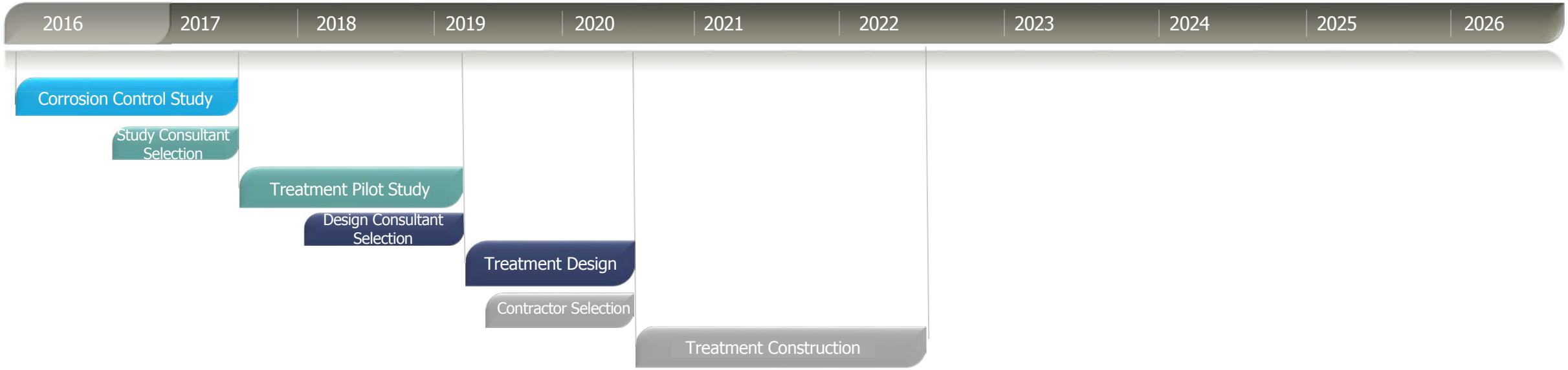
- Adding chemicals to Portland's water (Fluoride experience)
- Possible reduction in public health benefit if reduction of other sources of lead exposure is no longer funded
- Discharge issues
- Schedule
  - 5 year from completion of Corrosion Study
- Cost
  - Capital: approximately $15 Million
  - Operational: will be higher (chemicals, staffing, flushing)

Corrosion Control Decision Decision Tree

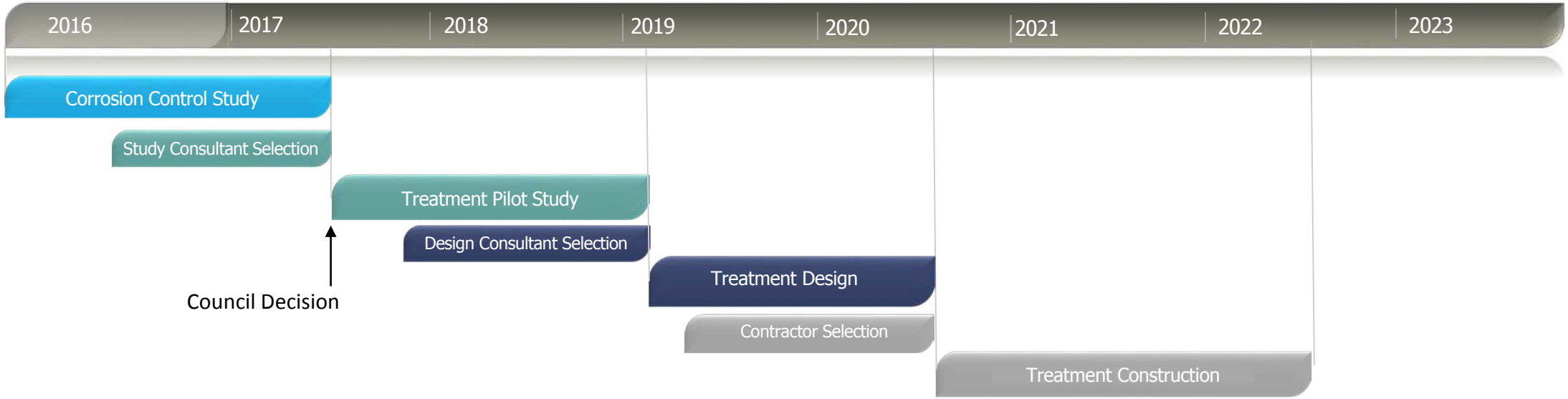


SCHEDULE PER STANDARD TIMELINE

ACCELERATED TIMELINE



ACCELERATED TIMELINE



Risks

- Council Approval
- Land Use/Permitting
- OHA Approval
- Procurement
- Legal Actions
- Available Resources

Corrosion Control Decision Preparations

- Corrosion Study – complete mid-2017
  - Mechanisms of lead release
  - Inform treatment decision
  - Expert Panel
- Pilot Study – Council Decision mid-2017
  - Professional Services Contract
  - Reviewing EPA OOCT Evaluation Technical Recommendations
  - Discussed process with OHA
- Putting together dedicated team – August 2016
- Portland Utility Board (PUB) update – August 2016
- Participate in EPA Training – August 2016
- Council work session – Fall 2016
  - Identifying key customers (brewers, industry)
  - Briefing legislators

Discussion

Chapter 7
Portland Water Bureau

Overview

The Portland Water Bureau has supplied domestic water to residents of the Portland area for more than 100 years and is the largest supplier of domestic water in Oregon. The Portland water system serves drinking water to about 940,000 Oregonians, almost one-quarter of the state's population. In 2012-13, the Portland Water Bureau directly served a retail population of over 570,600 people in 163,000 residential households (both single and multi-family residences) and about 20,000 commercial and industrial customers. Portland's wholesale customers served an estimated population of approximately 450,000 in 2012-13.

Vision, Mission & Values

The mission of the Portland Water Bureau is to provide reliable water service to customers in the quantities they desire and at a quality level that meets or exceeds both customer and regulatory standards; to provide the highest value to customers through excellent business, management, and operational practices, and appropriate application of innovation and technology; to be responsible stewards of the public's water infrastructure, fiscal and natural resources; and to provide the citizens and City Council with a water system that supports their community objectives and overall vision for the City of Portland.

Purpose of this Chapter

This chapter describes the public facilities and services provided by the Portland Water Bureau that are necessary to carry out its mission. It identifies desired levels of service, inventory and condition information for existing public facilities, and future facilities that will be necessary to support the land uses designated in the Comprehensive Plan, as required by Oregon Planning Goal 11: Public Facilities and Oregon Revised Statute 197. Carrying out the Bureau's mission and other City and community goals may also require programs, investments and practices that are not related to public facilities. This chapter may acknowledge – but does not comprehensively address – these measures.

System Services

Service Area

Approximately 940,000 people living within a 225-square-mile service area around Portland are served by the Water Bureau's retail and wholesale water sales, see Figures 7.1 and 7.2. The Water Bureau delivered 33 billion gallons (BG) to customers during fiscal year (FY) 2012-13. The 20 wholesale water customers are located in Multnomah, Clackamas and Washington counties.

Services Provided

The Water Bureau provides reliable water service to customers in the quantities they desire. Water from two sources, the Bull Run watershed and the Columbia South Shore Well Field, is of consistently high quality and meets all regulatory standards.

Service Agreements & Partnerships

The Portland Water Bureau currently has wholesale water sales agreements with 20 water providers in Portland's metropolitan area -- including cities, water districts, and private water companies. Eight of these water providers have service areas within the Urban Services Boundary of the City of Portland. These include: Burlington Water District, Lorna Water Company, Palatine Hills Water District, Raleigh Water District, Rockwood PUD, Tualatin Valley Water District, Valley View Water District, and West Slope Water District. Some wholesale providers also provide service to small groups of Portland citizens through “wheeling” agreements. These agreements are used where it is difficult or overly expensive to provide water directly from Water Bureau facilities.

The Clackamas River Water District and Sunrise Water Authority provide water services to unincorporated areas within Portland’s urban service boundary to the south of Portland. These water districts operate in partnership with each other through a cooperative agreement and use the Clackamas River as their main water supply source.

The Portland Water Bureau is a member of the Regional Water Providers Consortium. Members include more than 20 municipalities (including the City of Portland), water districts and Metro. (Metro is the regional growth management agency serving Clackamas, Multnomah, and Washington counties.) The Consortium serves as a collaborative and coordinating organization to improve the planning and management of regional municipal water supplies, including regional water conservation implementation and emergency preparedness coordination. The Consortium and its members endorse the Regional Water Supply Plan as the region's water supply strategy for the future. Water providers belonging to the Consortium retain full authority to operate and upgrade their systems and infrastructure.

The Portland Water Bureau maintains partnerships and agreements with other city bureaus and regional and state transportation agencies, providing services such as relocating water mains as directed by City Council. The bureau also has agreements with the U.S. Forest Service for activities within the Bull Run watershed, which is located in the Mt. Hood National Forest.

The City of Portland also maintains partnerships with the cities of Gresham and Fairview regarding participation in the Columbia South Shore Well Field Wellhead Protection Program.

Figure 7.1 Drinking Water Supply System Retail and Wholesale Service Areas

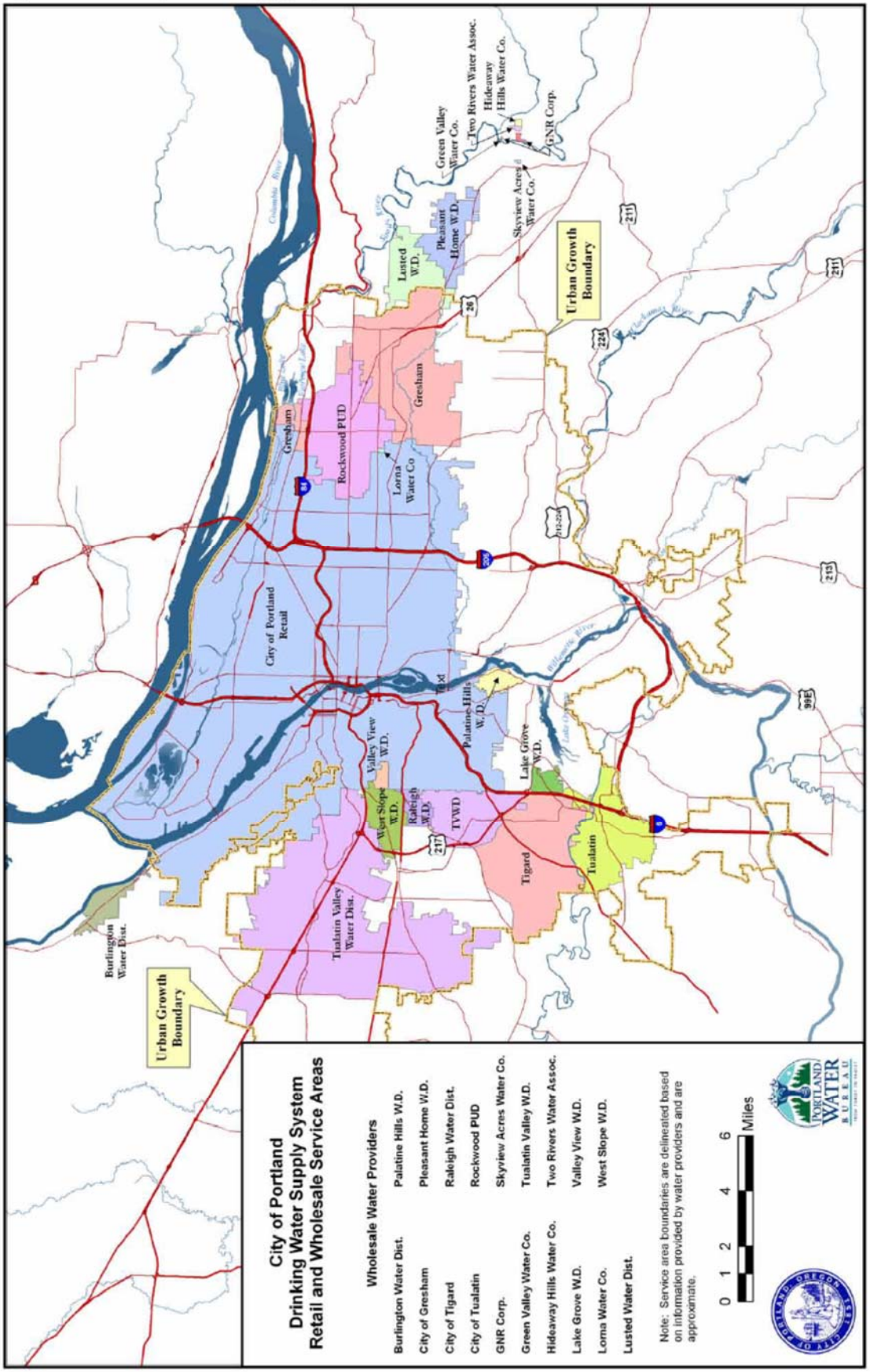
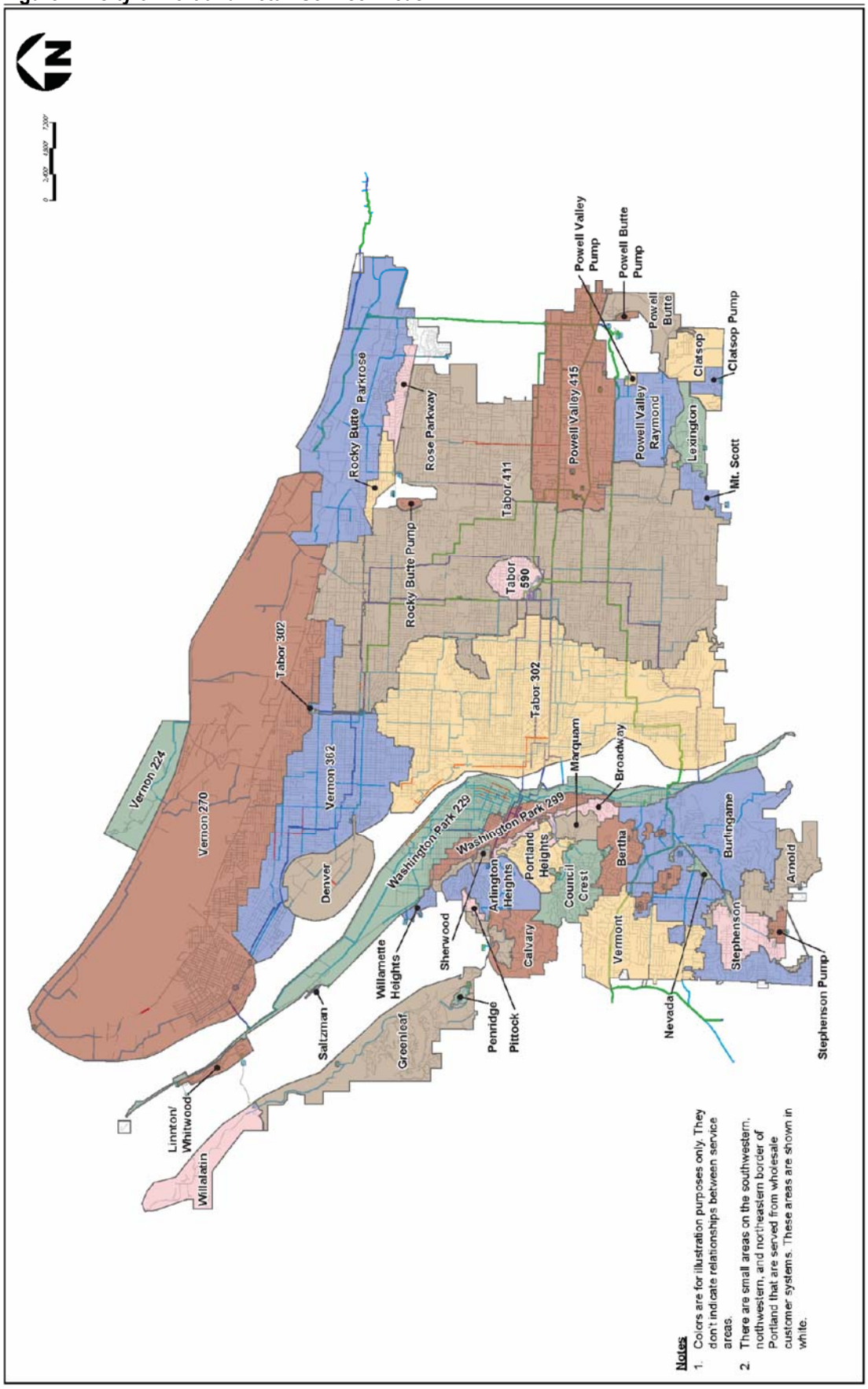


Figure 7.2 City of Portland Retail Service Areas



Inventory Summary

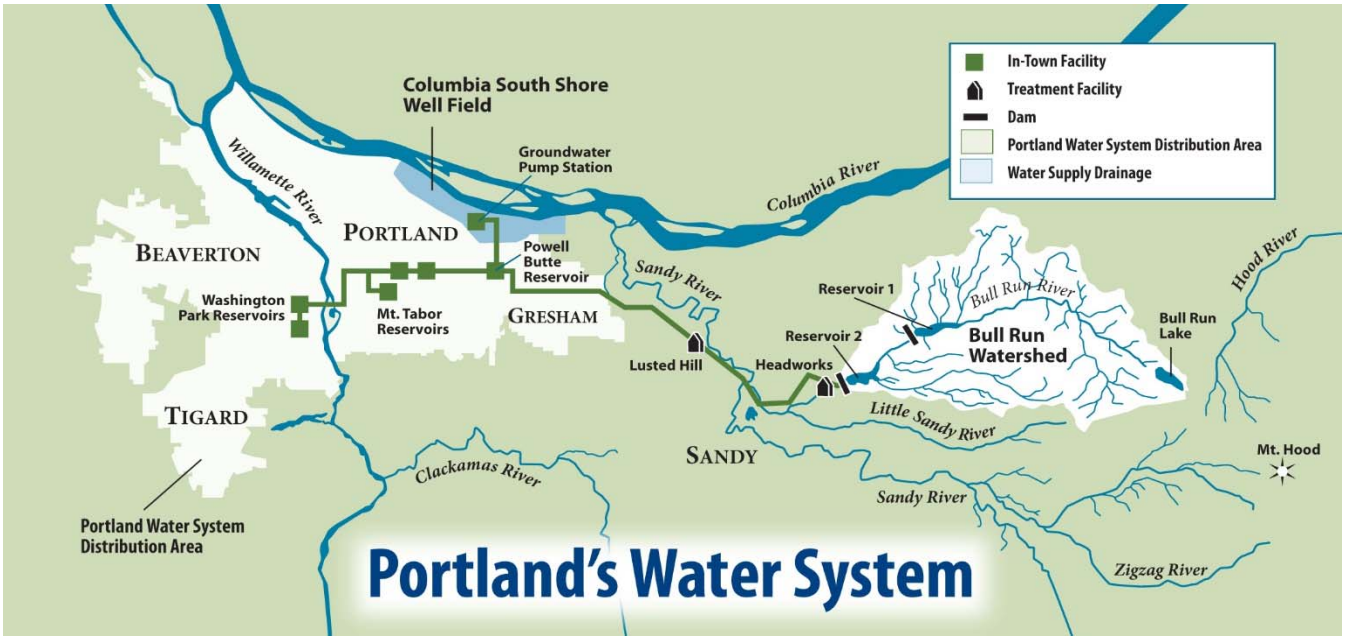
Water is supplied from the Bull Run watershed, located between the city and Mt. Hood, and the Columbia South Shore Well Field, located along the Columbia River, through approximately 2,250 miles of pipes within the City's boundaries. In 2013, the water system was valued at about $7.6 billion.

The City's water system includes five integrated sub-systems:

- a supply system, which collects water from the Bull Run watershed and Columbia South Shore Well Field;
- a transmission system of conduits, which moves water to a number of reservoirs;
- a terminal storage system of reservoirs;
- a distribution system of mains, service lines, pumps and tanks, which distribute water to residences and businesses; and
- support facilities to assist in the operation and maintenance of the water system.

Figure 7.3 illustrates the main components of Portland's water system. The components are described in more detail in Tables 7.1 and 7.2.

Figure 7.3 Portland's Water System



Condition Summary

The most recent Inventory and Condition Report prepared by the Water Bureau is summarized in Tables 7.1 and 7.2. The replacement value of the water system is estimated at $7.6 billion in 2013 dollars. About 63% of the value of the water system is in the distribution system. The supply system constitutes about 13% of the value of the water system, transmission accounts for 16%, terminal storage is 6%, and support facilities account for 2% of the Bureau's asset value.

Roughly 47% of the water system is estimated to be in good condition with 22% being considered very good. Approximately 23% of the water system is considered to be in fair condition, 6% is poor and 2% is considered to be very poor. Table 7.2 provides additional detail on asset value and condition.

Table 7.1 Portland Water Bureau Summary of Value and Condition of Assets, 2013

	Value ($ million)					
Asset Group	**Very Good**	**Good**	**Fair**	**Poor**	**Very Poor**	**Total Value**
Supply	$131.8	$457.2	$276.0	$82.3	$18.2	$967.0
Transmission	$64.9	$513.2	$518.7	$109.7	$0.2	$1,207.0
Terminal Storage	$218,9	$133.8	$18.1	$84.7	$0.0	$455.7
Distribution	$1,182.1	$2,434.1	$912.0	$190.1	$65.7	$4,785.4
Support Facilities	$40.8	$29.2	$18.0	$16.7	$59.3	$163.7
Total	**$1,638.5**	**$3,567.6**	**$1,742.7**	**$483.6**	**$143.4**	**$7,578.8**

Table 7.2 Portland Water System Inventory and Condition, 2013

	Value ($ million)					
Asset Group	**Very Good**	**Good**	**Fair**	**Poor**	**Very Poor**	**Total Value**
Supply	**$131.8**	**$457.2**	**$276.0**	**$82.3**	**$18.2**	**$967.0**
Bull Run Roads	16.6	60.8	95.4	57.4	18.2	249.9
Bull Run Lake Facilities	0	17.2	.1.4	1.8	0	20.4
Dam 1 Facilities	0	119.9	102.1	0	0	222.0
Dam 2 Facilities	30.0	1161.3	34.9	13.8	0	240.0
Headworks & Lusted Hill Facilities	0	33.3	11.4	4.8	0	49.5
Groundwater Well Sites	0	36.5	26.6	2.9	0	66.0
Groundwater Pump Station and Treatment	27.7	27.1	4.2	1.6	0	60.6
Groundwater Collection System	57.5	1.1	0	0	0	58.7
Transmission	**$64.9**	**$513.2**	**$518.7**	**$109.7**	**$0.2**	**$1,207.0**
Bull Run Transmission	46.2	204.6	305.1	76.1	0.2	**619.8**
Transmission Mains	18.8	308.6	213.6	33.7	0	**574.8**
Terminal Storage	**$218.9**	**$133.8**	**$18.1**	**$84.7**	**$0.0**	**$455.7**
Distribution	**$1,182.1**	**$2,434.1**	**$912.0**	**$190.1**	**$65.7**	**$4,785.4**
Distribution & Transport Mains	721.3	1,549.3	254.0	47.7	9.0	**2,582.5**
Services	112.6	323.2	381.1	65.3	17.1	**899.4**
Valves	211.9	287.7	72.2	19.9	12.1	**603.8**
Meters	23.9	24.0	19.4	15.0	5.3	**87.9**
Hydrants	5.1	81.6	59.2	17.5	20.6	**183.7**
Regulators	0.0	7.9	7.9	8.1	0	**24.0**
Fountains	1.9	7.0	7.0	2.8	0.9	**19.4**
Pump Stations	40.6	54.3	19.9	2.9	0.8	**118.5**
Tanks	64.8	99.0	91.4	10.9	0.0	**118.5**
Support Facilities	**$40.8**	**$29.2**	**$18.0**	**$16.7**	**$59.3**	**$163.7**
Interstate Facility	16.0	5.7	0.8	1.5	49.6	73.5
Other Facilities	24.8	23.5	17.1	15.2	9.7	90.2
TOTAL	**$1,638.5**	**$3,567.6**	**$1,742.7**	**$483.6**	**$143.4**	**$7,578.8**

Capacity Summary

Population Growth and Water Use

The population in the Portland metropolitan area is expected to continue to increase. Although the physical boundaries of the retail service area are not expected to be redefined beyond the limits of the urban growth boundary (UGB), vacant land and redevelopment lots within the retail service area are increasingly being developed with higher-density housing and more mixed-use development than in the past. In addition, several of the bureau's 20 wholesale customers have identified growth in existing service areas as well as some small additions to the UGB in 2004.

Historical water use, both retail-only and combined retail and wholesale demand, has not kept pace with the increase in the service area population. Since 1992, the number of gallons per capita per day for the entire retail and wholesale area has declined while the population has grown.

Demand Forecast

Although the growth in demand does not increase at the same rate as the growth in population, analysis of future demand and population shows that demand will increase over time. Using a single-equation econometric model, the Water Bureau estimated the mathematical relationship between the overall demand for water and a series of explanatory variables including population change, weather factors such as precipitation and temperature, the average price of water, weekend use, climate change, and others. The result is a weather-normalized demand forecast for annual demand. The forecast also estimates demand under weather conditions that generated the highest average daily demand during the peak season (1967) and the highest single peak-day water demand (1981). Forecasts for Portland's retail and wholesale annual average daily demand (ADD) have been developed to 2030 for both weather-normalized and 1967 weather conditions for the entire year and for the peak season, respectively.

Population estimates generated as a part of the population and allocation forecasts prepared for the Regional Transportation Plan were provided by METRO. Estimates were made based on approximate service territories of Portland and each wholesale customer. No estimate for future growth outside the existing service territories was included, although some growth outside the existing service territory is likely for some providers as the UGB is expanded to accommodate the required 20-year land supply.

According to the Water Management and Conservation Plan (2010), the average annual daily retail demand for 2030 is predicted to be around 70 million gallons a day (MGD). The average annual daily retail plus wholesale demand for 2030 is predicted to be around 135 million gallons a day (MGD). Both numbers would be a substantial increase from current demands. An update of the Water Management and Conservation Plan is scheduled for 2020.

Key Issues & Concerns

Regulatory Compliance

Many large system projects are moving forward to achieve compliance with the Long Term 2 Enhanced Surface Water Treatment Rule (LT2 rule) of 2006. The rule requires that water systems with uncovered

finished water reservoirs, like those at Mount Tabor and Washington Park, either cover the reservoirs or provide treatment at the outlets of the reservoirs to remove or inactivate *Cryptosporidium*, *Giardia* and viruses. All of the compliance projects are in the Terminal Storage Program. These projects include design and construction for an additional enclosed water storage reservoir at Powell Butte, a replacement storage reservoir at Kelly Butte as well as design work for adjustments necessary to disconnect the uncovered reservoirs at Mt. Tabor and Washington Park from the drinking water system Additional work to replace storage at Washington Park is also necessary. It is expected to cost between $330 million and $400 million to fulfill these requirements.

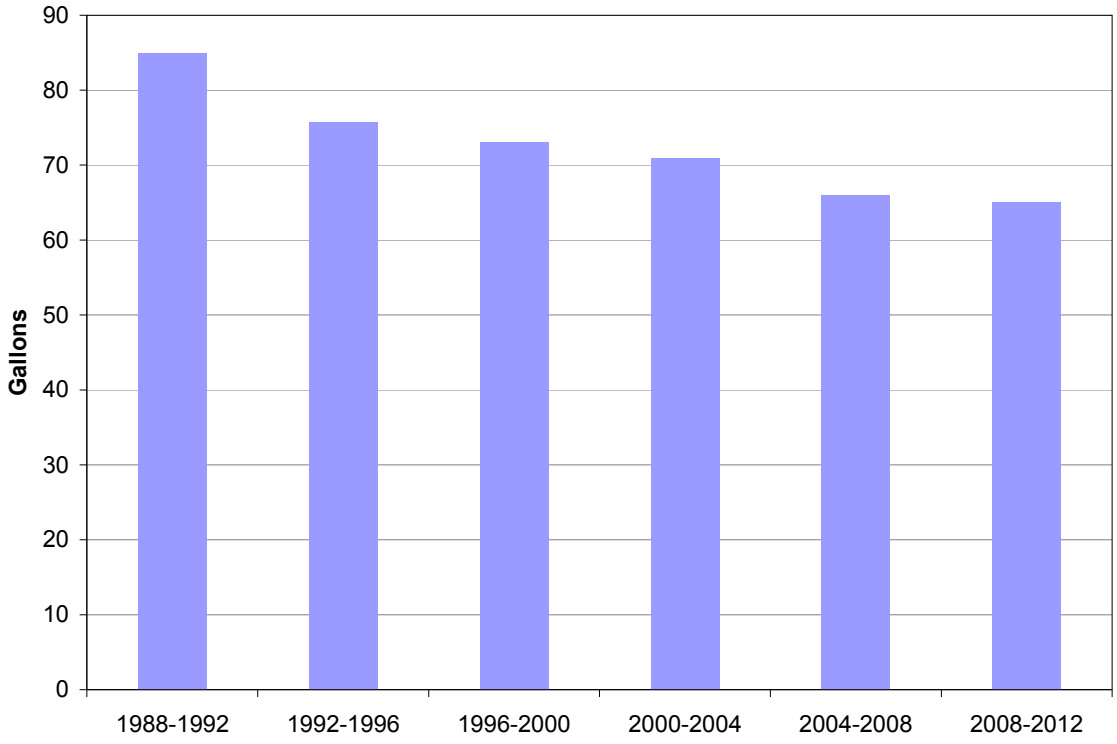
In addition, the bureau has capital projects in and around the Bull Run watershed to achieve compliance with regulations of the Clean Water Act and the Endangered Species Act. These projects are described in the bureau's Bull Run Water Supply Habitat Conservation Plan.

Declining Water Demand

As discussed previously, total water demand for the Portland system has fallen over the last few years, as retail and wholesale customers use less water. Per capita water use for retail single-family residential customers has gone down significantly since 1992. The average consumption for retail single-family customers between 1987 and 1992 was 87 gallons per capita per day (GPC), is now down to about 66 GPC, and has been as low as 62 GPC. Variables such as the water shortage of 1992, updated state and national plumbing codes, the change from flat rates to consumption-based rates for wastewater (in 1994), and behavioral changes resulting from conservation education have helped to reduce each household's overall consumption. Figure 7.4 shows the average annual GPC from 1988–2007.

Water demand forecasts developed by the Water Bureau anticipate that while per capita water demands will continue to decline somewhat over time, the overall demands on the Portland water system will increase due to population growth. The status of continued wholesale water sales is not known at this time, but the bureau anticipates continuing to sell water to wholesale customers.

Figure 7.4 Average Residential Per Capita Daily Water Use[1]



Accommodating Growth

The City of Portland provides water to retail customers within the city limits, as well as a significant number of large wholesale customers. Average daily demand for retail customers in 2012 was 62 million gallons per day (MGD). This is expected to grow to approximately 70 MGD by 2030. While this is not a huge growth rate within the City, it is something that needs to be addressed in the planning of infrastructure.

A larger issue is the impact of regional growth, as the total population in areas served through wholesale water sales agreements is expected to increase significantly. However, as wholesale customers make decisions on future supply sources which may or may not include supply from the City of Portland, it is unknown how this growth will impact the Water Bureau.

Maintaining Existing Infrastructure

The replacement value of water system assets was estimated at $7.6 billion in 2013. Many water system facilities are nearing the end of their useful lives. Half of distribution mains are older than 50 years. The uncovered reservoirs are all over 100 years old. Transmission conduits are 60 to 100 years old. Dams and reservoirs are 50 to 80 years old. The Water Bureau faces new costs to maintain and replace aging

[1] Each bar is an average of the gallons-per capita for the four-year period.

infrastructure, respond to security and vulnerability issues, and comply with regulatory requirements. In the meantime, there is pressure to hold down rate increases.

For 2013, the Water Bureau estimates a $15.5 million annual funding gap, primarily in the replacement of assets in poor condition, including distribution system components, transmission conduits, and the seismic upgrades of tanks and other facilities. Over the next 5 years, the Water Bureau expects to invest over $490 million on water-related capital improvements, primarily on the Distribution Program, which will help reduce the funding gap.

Vulnerability and Security

The City of Portland Water Bureau is dedicated to protecting public health and safety by ensuring that key components of the water system will withstand most human-caused or natural disasters. The Water Bureau has completed a number of studies on vulnerabilities within the system. Significant funding will be required to increase protection of more than 80 critical facilities, including dams, reservoirs, water supply pipelines, pump stations, and operations facilities.

Climate Change

The Water Bureau studies the issue of climate change and is establishing both preparation and mitigation strategies. The ability of Portland's two water systems to meet future demands, as well as the need for conservation and efficiency programs, will be important considerations as climate change impacts become more evident..

The City of Portland has kept detailed climate records for the past 70 years and continues to research and model climate patterns and their effects in the Bull Run watershed. The City also monitors current global and regional climate change information. Information available to date indicates that average winter season precipitation could increase. The average length of summer season, when the water system is drawing more water out of reservoir storage than is being refilled, could also increase. This period is referred to as "reservoir drawdown". In simpler terms, it is approximately the period from when spring rains stop and when fall rains begin. Storage in the Bull Run system is still expected to refill each year, because total flows in the watershed over the winter season are much greater than the amount needed to refill the storage reservoirs.

The City is preparing for climate change through research and monitoring, revising long-term planning models, working with other large drinking water utilities on preparation and mitigation strategies, developing its rights in the Columbia South Shore Well Field to provide summer supply and emergency backup capacity, and supporting efficient water use practices.

Regulatory Compliance

Federal Mandates

The City of Portland must comply with a variety of federal mandates, including the Clean Water Act, the Safe Drinking Water Act, the Lead and Copper Rule, and several mandates related to the protection and

management of the Bull Run watershed. Programs and projects to maintain compliance are included in the Bureau's investment strategy.

Safe Drinking Water Act (SDWA)[2]

Under the Safe Drinking Water Act, which is implemented through Oregon Revised Statutes and Administrative Rules, the Portland Water Bureau is required to conduct water quality sampling and submit results to Oregon Health Authority, in order to demonstrate compliance with maximum contaminant levels. The bureau also participates in on-site inspections (sanitary surveys) of treatment and distribution facilities by State Drinking Water Program personnel every three years, and participate in annual inspections. The Portland Water Bureau is also required to submit a Water System Master Plan every 20 years, submit a list of completed projects annually, produce and distribute annual Consumer Confidence Reports, meet operator certification requirements, and submit annual cross-connection reports.

Unregulated Contaminant Monitoring Rule (UCMR)[5]

The UCMR is administered under direct authority of the U.S. EPA and requires monitoring for 25 unregulated contaminants using five analytical methods during 2008-2010. The U.S. EPA uses the data generated by the UCMR to evaluate and prioritize contaminants on the Drinking Water Contaminants Candidate List, a list of contaminants EPA is considering for possible new drinking water standards.

Stage 2 Disinfection Byproducts Rule[3]

The Stage 2 Disinfection Rule is administered under direct authority of the U.S. EPA and requires the Portland Water Bureau to submit a sample plan and conduct sampling for disinfection byproducts.

Long Term 2 Enhanced Surface Water Treatment Rule, LT2[4]

The Long Term 2 Enhanced Surface Water Treatment Rule (LT2) was promulgated in January 2006. This federal rule applies to surface water or groundwater under direct influence of surface water (GWUDI) systems, and increases regulations regarding *Cryptosporidium* in the water supply. LT2 also addresses the regulation of *Cryptosporidium, Giardia* and viruses in uncovered finished drinking water reservoirs.

Compliance with LT2 has impacts on two separate parts of Portland's water system. First, the rule requires the city to provide additional treatment to its Bull Run supply to either remove or inactivate *Cryptosporidium*. Portland developed a comprehensive treatment variance request based on the results of a one-year water-quality sampling program and study of Bull Run water. A variance to this part of the rule was granted to the Water Bureau by the Oregon Health Authority on March 14, 2012.

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[2] of 1974, 1986, 1996 as administered under the U.S. EPA Primacy Agreement by the Oregon Department of Human Services (ODHS) under Oregon Revised Statutes (ORS) 448 and Oregon Administrative Rules (OAR) 333-061

[3] U.S. EPA Safe Drinking Water Act of 1974, 1986, 1996 - 40 CFR Parts 9, 141, and 142 - Federal Register: January 4, 2006 (Volume 71, Number 2), Rules and Regulations Page 387-493.

[4] U.S. EPA Safe Drinking Water Act of 1974, 1986, 1996 - 40 CFR Parts 9, 141, and 142 - Federal Register: January 5, 2006 (Volume 71, Number 3) - Rules and Regulations Page 703-752

In 2002, new treatment facilities were estimated to cost between $55 and $204 million to construct and millions more to operate on an annual basis. If OHA's variance is revoked, the Water Bureau would likely be required to construct these new treatment facilities. [5]

Second, the rule requires changes to how uncovered finished drinking water reservoirs are managed and operated. The rule requires that water systems with uncovered finished water reservoirs, like those at Mount Tabor and Washington Parks, either cover the reservoirs or provide treatment at the outlets of the reservoirs to inactivate *Cryptosporidium* and viruses. A regulatory schedule for this work has been approved by to the Oregon Health Authority. The bureau is required to eliminate the use of uncovered reservoirs at Mt. Tabor by December 31, 2015 and those in Washington Park by December 31, 2020.

In its 2009 LT2 Storage Recommendation, the Water Bureau estimated that it will cost approximately $400 million to come into compliance with the uncovered reservoir requirements of the rule.

Lead and Copper Rule

Lead and copper enter drinking water primarily through plumbing materials. Exposure to lead and copper may cause health problems ranging from stomach distress to brain damage. On June 7, 1991, EPA published a regulation to control lead and copper in drinking water. This regulation is known as the Lead and Copper Rule (also referred to as the LCR or 1991 Rule).

In January 1997, the Portland Water Bureau began corrosion treatment, raising the pH of the water to make it less acidic and less likely to leach metals. Corrosion treatment has reduced lead levels at the tap by more than 50% since the City began this treatment in 1997.

Americans with Disabilities Act[6]

The Americans with Disabilities Act of 1990 (ADA) prohibits discrimination and ensures equal opportunity for persons with disabilities in employment, State and local government services, public accommodations, commercial facilities, and transportation. ADA requires some new Portland Water Bureau facilities, and in some instances existing facilities, to be brought up to specified accessibility standards.

Bull Run-Related Legislative and Administrative Protections

A variety of federal legislation, regulatory requirements, administrative actions and agreements affects protection, management, and use of the Bull Run watershed that in turn enables the Water Bureau to provide a reliable water supply to the City of Portland. These include federal statutes specific to Bull Run, federal requirements applicable to national forest land, requirements of other federal agencies applicable to Bull Run, and agreements between the City and the Mt. Hood National Forest. Primary examples include the following:

[5] The Water Bureau has plans for an ultraviolet light (UV) treatment facility (completed in early 2012) to address treatment requirements, should the variance be revoked. The UV treatment option was selected by the Portland City Council as the preferred treatment option in 2009 (Resolution 36720).

[6] 1990, administered through Oregon Structural Specialty Code Oregon Administrative Rules 918-460

Federal Statutes and Regulations Specific to Bull Run

- Bull Run Watershed Management Act, P.L. 95-200, (1977) directs the Forest Service to consult and coordinate with the City of Portland to ensure management programs, practices, and standards on watershed lands are protective of drinking water quality
- 2012 Mt. Hood National Forest Closure Order for the Bull Run Watershed Management Unit—Closure Order MH-2012-05 closes forest service lands within the BRWMU to the public
- Oregon Resource Conservation Act (ORCA), P.L. 104-208 (1996), prohibits timber cutting within the hydrographic boundary of the Bull Run River drainage, except as necessary to protect or enhance water quality or for the construction, expansion, protection, or maintenance of water supply, energy transmission, or approved hydroelectric facilities
- Little Sandy Protection Act, P.L. 107-30 (2001), extends the boundaries of the Bull Run Management Unit and applies the land management protections of the 1996 ORCA to the entire management unit

Federal Requirements Implementing Policy Applicable to National Forest Land

- 1990 Mt. Hood National Forest Land and Resource Management Plan provides guidance for natural resource management.
- 1994 Northwest Forest Plan set management direction for the lands within the range of the northern spotted owl.

Requirements of Other Federal Agencies

- 1995 Bureau of Land Management (BLM), Salem District, Record of Decision and Resource Management Plan provides guidance for the management of non-native species
- BLM Permanent Closure Order for the Bull Run Watershed Management Unit (2011) closes BLM lands within the BRWMU to public access
- Bull Run Water Supply Habitat Conservation Plan (2009) defines the actions the City will take to address impacts of the Bull Run water supply system on native fish species in the Bull Run River, as regulated by the federal Endangered Species and Clean Water Acts and administered by the National Marine Fisheries Service and the Oregon Department of Environmental Quality

Agreement with the Mt. Hood National Forest

- The Bull Run Watershed Management Unit Agreement was established in 2007. Under this agreement, the city participates in collaborative efforts to maintain and manage various aspects of the watershed.

State Mandates

In addition to federal mandates, the City of Portland must also comply with state and regional mandates set through Oregon Revised Statutes and Administrative Rules. Projects to maintain compliance are included in the Bureau's investment strategy.

Statewide Planning Goals and Guidelines[7]

Statewide Planning Goals and guidelines require the City to maintain policies, service agreements, public facilities plans, and project lists for water service, through the City's Comprehensive Plan and public facilities plan. These plans must be submitted to the Oregon Department of Land Conservation and Development (DLCD) for acknowledgment as consistent with statewide goals.

Water Rights[8]

To maintain water rights granted by the state, the Portland Water Bureau developed a Water Management and Conservation Plan. This plan was approved by the state in 2010, and reports annual water use. Portland has state statutory right to full flow of the Bull Run and Little Sandy Rivers. The state also granted full extensions for the four primary CSSWF groundwater rights in 2009. The bureau is required to provide plan updates every five years.

Oregon Structural (OSSC), Mechanical (OMSC) and Electrical (OESC) Specialty Codes[9]

Requires new facilities and in some instances existing facilities to be brought up to new building code standards.

House Bill 3543 (2007)

The Oregon Legislative Assembly declared that it is the policy of the state of Oregon for state and local governments, businesses, nonprofit organizations, and individual residents to prepare for the effects of global warming and, by doing so, prevent and reduce the social, economic and environmental effects of global warming. House Bill (HB) 3543 (2007) sets greenhouse gas emissions targets for the state of Oregon with goals for progressively lower greenhouse gas emissions every decade until 2050.[10] The City of Portland and Multnomah County have adopted a Climate Action Plan (2009) with a goal of reducing carbon emissions by 80 percent by the year 2050.[11] The City also adopted Resolution No. 36749 directing its bureaus to implement policies and programs related to the Climate Action Plan.[12]

Regional Plans

Regional Water Supply Plan

The Regional Water Supply Plan (RWSP) (2004) was adopted by most of the region's individual water providers and is coordinated by the Regional Water Providers Consortium. The RWSP provides a

[7] SB 100, Statewide Planning Goals and Guidelines (OAR 660-011), Compliance procedures (ORS 197, and) Goal 11-Public Facilities and Services

[8] ORS 436 and 437 and OAR 690-086, 690-410, and 690-315 Water Rights - Oregon Water Resources Department (OWRD) Oregon Revised Statutes 436, 537 Oregon Administrative Rules 690-086, 690-410, 690-315

[9] 2007 OSSC – OAR 918-460, 2007 OMSC – OAR 918-440, 2005 OESC – OAR 918-305

[10] Oregon Legislative Assembly. 2007. House Bill 3543. An Act relating to climate change; appropriating money; and declaring an emergency. Salem, Oregon.

[11] City of Portland and Multnomah County. 2009. Climate Action Plan. Portland, Oregon. Available at http://www.portlandoregon.gov/bps/index.cfm?c=49989&a=268612. Accessed November 11, 2009.

[12] City of Portland. 2009. Portland City Council Resolution No. 36749. Adopt the joint City of Portland and Multnomah County Climate Action Plan to reduce local greenhouse gas emissions by 80 percent from 1990 levels by 2050.

comprehensive, integrated framework of technical information, resource strategies and implementing actions to meet the water supply needs of the Portland Metropolitan Area to the year 2050.

Metro Regional Framework Plan (2005) - METRO

In 1992, the region's voters adopted a Metro charter for Metro which gave Metro jurisdiction over matters of metropolitan concern and required the adoption of a Regional Framework Plan. The Regional Framework Plan unites all of Metro's adopted land use planning policies and requirements. The charter directs Metro to address the water sources and storage in the plan. The Regional Framework Plan, originally adopted in 1997, was amended in 2005, 2010 and 2011 and contains regional policies contained in the Regional Urban Growth Goals and Objectives (RUGGO), 2040 Growth Concept, Metropolitan Greenspaces Master Plan and Regional Transportation Plan to create a coordinated, integrated Regional Framework Plan.

The Metro 2040 Growth Concept provides a structure for the preferred form of regional growth and development in the Portland metropolitan region. The Water Bureau will need to provide the water infrastructure to meet demands associated with projected population densities.

Section 4.1 of the Regional Framework Plan acknowledges the Regional Water Supply Plan developed and adopted by the Regional Water Providers Consortium. It is the policy of Metro to:

- Promote and achieve regional water conservation and demand management goals as defined in the Regional Water Supply Plan;
- Promote the coordination between regional growth management programs and water supply planning;
- Promote the coordination between land use planning and achieving goals of the Regional Water Supply Plan and;
- Set benchmarks and evaluate achievement of the targets and goals established in the Regional Water Supply Plan in coordination with the region’s water providers.

Urban Growth Management Functional Plan - Title 6 (Metro Code Sections 3.07.610 - 3.07.650) - Centers, Corridors, Station Communities and Main Streets - METRO

The Urban Growth Management Functional Plan was adopted by the Metro Council and codified in Section 3.07 of the Metro Code. The purpose of this functional plan is to implement regional goals and objectives contained in the Regional Framework Plan.

The Regional Framework Plan identifies Centers, Corridors, Main Streets and Station Communities throughout the region and recognizes them as the principal centers of urban life in the region. Title 6 calls for actions and investments by cities and counties, complemented by regional investments, to enhance this role. The Portland Water Bureau is expected to complete infrastructure improvements as needed in order to support activities related to development of these urban environments.

Portland Watershed Management Plan

The Portland Watershed Management Plan (PWMP) is intended to guide City decisions and projects by providing a comprehensive approach to restoring watershed health. The Water Bureau collaborates with other City bureaus on projects like green streets, land acquisition, floodplain restoration and fish and wildlife habitat protection.

Goals & Policies

Draft Goals and Policies related to Water Facilities and services can be found in Chapter 5. Key Infrastructure Policies.

Investment Strategy

The Portland Water Bureau's Investment Strategy for the Citywide System Plan is divided into seven (7) primary programs: Supply, Transmission and Terminal Storage, Distribution, Treatment, Regulatory Compliance, Customer Service, and Administration & Support. The Water Bureau anticipates over $1.5 billion in new investment in these programs over the next twenty years, see Table 7.3. This chapter and Appendix A. Investment Strategy provides greater detail on anticipated water projects and investments.

Table 7.3 Investment Strategy Summary

Program	FY 2013-2018	FY 2018-33
Supply	$14,291,000	$88,500,000
Transmission and Terminal Storage	$191,170,000	$242,000,000
Distribution	$244,197,288	$461,650,000
Treatment	$2,500,000	$150,000,000
Regulatory Compliance	$25,504,000	$30,000,000
Customer Service	$3,057,000	$53,700,000
Support	$10,000,000	$50,500,000
TOTAL	**$490,719,288**	**$1,076,350,000**

Supply System[13]

The primary drinking water source for Portland is the Bull Run watershed, supplemented by a groundwater supply from the Columbia South Shore Well Field (CSSWF) and the wells in the former Powell Valley Road Water District. The Bull Run watershed is located east of Portland and just north of the western foothills of Mt. Hood; the CSSWF is south of the Columbia River and east of the Portland International Airport, see Figure 7.5. The former Powell Valley Road Water District is located in southeast Portland, near Powell Butte.

Since 1895, Portland has relied on the Bull Run watershed as its principal source of supply. Rainfall runoff and snowmelt from within the watershed are captured in the Bull Run storage system, which includes Bull Run Lake, and Reservoirs 1 and 2, all located on the Bull Run River. At Reservoir 2, water enters the Headworks, the origination point of the three conduits that convey water from the Bull Run system to Powell Butte Reservoir. Until 2015 and 2020 respectively, water from Powell Butte will be supplied to Mt. Tabor and Washington Park reservoirs. These reservoirs have served as terminal storage for the water supply transmission system, and as central points for distributing water into the retail water system. As these facilities are decommissioned, water from Powell Butte will follow one of three paths: to Kelly Butte, an enclosed underground storage facility; to other terminal storage-system reservoirs; or through large transmission mains to the distribution system and/or wholesale customers.

The federal Safe Drinking Water Act, which regulates public drinking water supplies, typically requires surface water supplies to be filtered to meet federal drinking water standards. Because the Bull Run source water quality is very high and Portland implements source water protection measures, Portland is currently exempt from filtration requirements. Portland's water supply is disinfected using chloramines. Water is chlorinated at the Headworks at Reservoir 2. Ammonia and caustic soda are added at a second treatment facility, Lusted Hill.

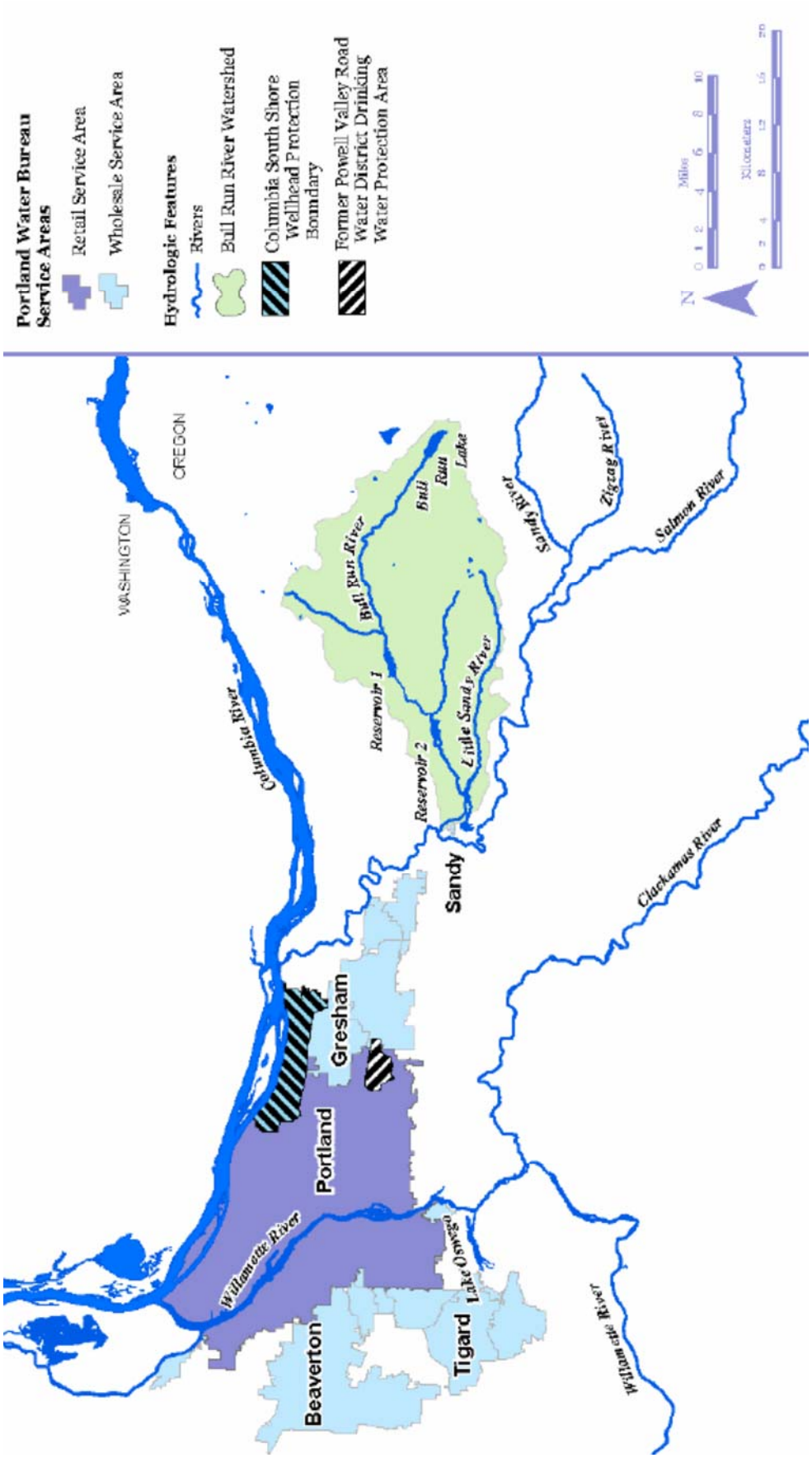
Since 1985, Portland has used groundwater from the Columbia River South Shore Well Field as an emergency seasonal supply and as a backup supply when winter storms cause high turbidity in the Bull Run watershed. The groundwater supply comes from three aquifers along the south shore of the Columbia River. The system includes 27 wells, one storage tank, a groundwater booster pump station, and a treatment facility. Portland also has access to wells previously owned by the Powell Valley Road Water District.

Wholesale Customers

The Water Bureau supplies water to its wholesale customers; the City of Portland does not typically receive water from any sources owned or operated by its wholesale customers. The City's water supply system is interconnected with other water suppliers including the City of Lake Oswego, the City of Milwaukie, and Clackamas River Water. Portland is able to receive water from these other sources on a limited basis in an emergency.

[13] Portland Water Bureau, Distribution System Master Plan and Portland Water Bureau, Water Management and Conservation Plan

Figure 7.5 Drinking Water Supply System Water Sources



Bull Run Watershed

Inventory

The water of the Bull Run River is primarily impounded in two reservoirs: Reservoir 1, completed in 1929, and Reservoir 2, completed in 1962. Periodically, the Water Bureau relies on storage capacity in Bull Run Lake, a natural lake that is upstream of the headwaters of the Bull Run River, to enhance the supply of the two reservoirs.

At the Headworks facility below Dam 2, the raw water is disinfected. The water then flows to the Lusted Hill facility for further treatment, and is fed by gravity to the terminal storage, transmission, and distribution systems. The Bull Run water system includes facilities for generating hydropower. The Portland Hydroelectric Project's hydropower facilities at Dams 1 and 2 generate electricity that the city sells to Portland General Electric (PGE).

The Water Bureau's facilities in the Bull Run Supply system are served by a network of 123 miles of roads and 11 bridges. In total, infrastructure assets in the Bull Run supply system have a 2013 replacement value of $782 million.

Current Condition

The vast majority of assets in the Bull Run watershed are in fair to good condition, see Table 7.2. Eight percent of assets are in poor condition; two percent are in very poor condition.

Adequacy and Reliability of Supply

The Bull Run watershed is the city's primary water source. The approximate median annual water yield from the Bull Run watershed (measured at Headworks) is 180 billion gallons. The median annual diversion for water supply is approximately 20 percent of the total median yield. The reservoirs in the Bull Run are recharged during the fall, winter, and spring when rainfall is abundant. During the dry summer months (starting in June or July), the reservoirs are drawn down. This drawdown period typically lasts until early October but can sometimes last until November or December. During this period, the water flowing out of the reservoirs exceeds the water flowing into the reservoirs from rainfall and tributary flow.

Water demand varies annually, driven primarily by weather. In warm, dry summers when demand is high, the yield from the Bull Run watershed is at its lowest. In cool wet summers, water demand is often lower and yield from the Bull Run tends to be higher.

The duration of the dry season is also important because it determines the time period during which the city will rely on the limited storage in the watershed's reservoirs. Long dry seasons increase the proportion of groundwater that the city uses to meet demand before fall rains return.

The two Bull Run reservoirs are relatively small in comparison to the amount of precipitation and stream discharge in the basin. The reservoirs are not large enough to provide a multi-year water supply. Refill each winter is necessary to ensure supply for the following summer.

Over the last 20 years, the city has examined a number of options for increasing water storage in the Bull Run system. In the future if necessary, the city will continue to explore these and other options, such as water efficiency and conservation, to meet long-term water supply needs.

Columbia South Shore Well Field

The Columbia South Shore Well Field (CSSWF) is the second-largest developed water source in the state (after the Bull Run Supply), and the largest developed groundwater source in the state. Located on the floodplain of the Columbia River northeast of downtown Portland, this 11-square-mile area spans the boundaries of three cities: Portland, Fairview, and Gresham. The wells in the well field provide water when the Bull Run supply is shut down due to emergency conditions such as turbidity events, landslides, fires, or other natural or human-caused disruptions. The groundwater system is also a supplemental supply to meet demands during the summer peak season as needed.

Inventory

As of 2013, there are 27 wells in the CSSWF.[14] These wells draw on three aquifers: the Sand and Gravel Aquifer (SGA); the Troutdale Sandstone Aquifer (TSA), and the Blue Lake Aquifer (BLA). The sum of the nominal instantaneous pumping capacity for all of these wells is approximately 103 to 118 million gallons a day (MGD), based on the maximum pumping rates of the individual wells. In use, the well field has an empirically determined initial 30-day operating capacity of approximately 90 MGD. A large pump station moves water to the city's Powell Butte Reservoir, where it is mixed with Bull Run water (unless the Bull Run supply is off-line).

Current Condition

The wells in the CSSWF are primarily in good or fair condition (53% and 41%, respectively). Collection mains are primarily in good to very good condition (85% and 13%, respectively). The treatment facility is in good condition and the pump station is in fair to good condition. Additional condition information can be found in Table 7.2.

Supplemental and Emergency Use of the CSSWF

According to the Seasonal Water Supply Augmentation and Contingency Plan—also referred to as the Summer Supply Plan (SSP), the CSSWF is used for supplemental and emergency supply under the following conditions:

- Supply Augmentation: Groundwater may be used to augment the Bull Run supply to meet demand during seasonal warm dry periods when the Bull Run water supply is not sufficient to meet the needs of the bureau's retail and wholesale customers; to maintain in-stream flows for fish habitat; or if water demand exceeds the conduit capacity long enough to deplete in-town storage below safe levels.[15]

[14] A map of the Columbia South Shore Well Field can be found in Figure 2-3 of the *Water Management and Conservation Plan*, 2010.

[15] Conduit capacity may be exceeded if demand is exceptionally high or if one or more of the conduits is out of service.

- Turbidity Event Augmentation: Groundwater may be needed to augment or replace the Bull Run surface supply to avoid violating state and federal drinking water standards for turbidity. Turbidity in the surface water supply is typically caused by storm events in the Bull Run watershed.
- Emergency Use: Groundwater may be needed during catastrophic events (in addition to turbidity events) that would cause a loss of part or all of the Bull Run surface water supply. Catastrophic events include, but are not limited to, severe or extended drought, fire in the watershed, flood, landslides, volcanic activity, earthquakes, and acts of vandalism or terrorism. Any of these events could cause significant water quality problems or result in damage to, or shutdown of, the conduits or other critical infrastructure used to transfer Bull Run water to the Bureau's in-town reservoirs. An example of a catastrophic event in the watershed was a landslide in 1995 that damaged two conduits. Groundwater was used for 27 days and provided an average of 25.4 MGD to the distribution system.[16]

Contamination and Remediation

The City of Portland has an extensive network of monitoring wells. The bureau tracks groundwater quality and changes in groundwater levels over time in multiple aquifers within the CSSWF. Data from city groundwater quality monitoring indicate that the deep confined aquifers Portland uses for drinking water are free of contamination within the capture zones of active wells.

Anthropogenic, or human-related, contamination was first discovered in shallow groundwater aquifers near the well field in the 1980s. Since the early 1990s, the city has worked closely with the Oregon Department of Environmental Quality (ODEQ) to expedite the discovery, assessment, and remediation of contaminant sources and plumes, and to keep the well field operational. Remediation technologies used to remove contaminants from soil and groundwater include pump-and-treat, soil vapor extraction, electro-resistive heating, air sparging, and chemical and biological treatment. Remediation in the CSSWF is nearly complete.

High concentrations of naturally-occurring manganese in two wells have limited the ability of the Water Bureau to utilize these wells. Manganese can cause water discoloration which can affect laundry businesses served by the Water Bureau. The Water Bureau avoids using the high-manganese wells unless no Bull Run supplies are available and the full capacity of the well field is needed.

Groundwater Protection Program

The Groundwater Protection Program, adopted in 2003 and updated in 2010, replaced existing programs in Portland and Fairview and initiated a program in Gresham. The Groundwater Protection Program requires businesses that use, store, or transport hazardous material above a certain threshold amount to implement best management practices to prevent chemical spills.

Regulated businesses in Portland are inspected every two years as part of their regular fire inspection to ensure the business is in compliance with the program requirements. In Gresham and Fairview,

[16] Although the average is 25.4 MGD, the actual amounts per day varied widely.

inspections are conducted by Gresham watershed management staff. The Water Bureau and its partners provide free technical assistance to businesses on compliance issues.

The Columbia South Shore Well Head Protection Area delineation was certified by the Oregon Health Authority Drinking Water Program in 2003. A certified wellhead protection area is considered a significant groundwater resource under Statewide Planning Goal 5 if the public water system served by the wellhead area has a service population greater than 10,000 and relies on groundwater as the primary or secondary source of drinking water. Local governments are required to develop a program to reduce the risk of groundwater contamination in such areas. In June 2008, the Department of Environmental Quality certified the Columbia South Shore Well Field Protection Program, which addresses Goal 5 requirements for protecting these groundwater resources.

Adequacy and Reliability of Supply

The Portland Water Bureau has not experienced any major supply deficiencies in the last 10 years. Supply capacity and reliability were both enhanced in the mid-1980s by the development of a high-quality secondary source of drinking water in the Columbia South Shore Well Field (CSSWF). The CSSWF can be used in the event of a supply shortage in the Bull Run watershed. In the past ten years, water from the CSSWF has been used to augment Bull Run supply due to turbidity, for summer supply augmentation, and for maintenance runs. As of December 31, 2012, the CSSWF has been used a total of 29 times—10 times for turbidity events in Bull Run, once for a landslide that took two of the three conduits out of service, 13 times for summer supply augmentation, and five times for maintenance reasons.

Current well field capacity is sufficient to meet short-term (less than 30-day) emergency needs during the non-peak-season. The current capacity of the well field system is not sufficient to meet demand during a full shutdown of the Bull Run system due to emergencies or catastrophic events for periods longer than 30 days. Groundwater availability may also be limited in the future due to increased withdrawal from the aquifer by full-time and growing municipal users in Oregon and Clark County, Washington.

The city has evaluated several options for maintaining and improving the adequacy and reliability of supplies from the Bull Run watershed and the CSSWF... The results of these studies indicate that developing supplies in the CSSWF is the most cost-effective option.

The Water Conservation and Management Plan (2010) anticipates the potential development of 53 MGD in the CSSWF by 2028 to meet the annual average water demand of the current retail and wholesale service areas.

Former Powell Valley Road Water District Wells

On July 1, 2005, the City of Portland annexed areas served by the Powell Valley Road Water District (PVRWD) in southeast Portland, northwest of Powell Butte. Residents of this former water district are now served by the Portland Water Bureau's retail system. Under an intergovernmental agreement, Portland assumed control of all of the district's assets, including six active wells.[17] The PVRWD assets included water rights and water infrastructure. The installed capacity of the Powell Valley wells can be as much as 8.6 MGD, however less than half of this capacity is currently available.[18] Several capital improvement projects are planned to repair various facilities and fully integrate the wells into the Water Bureau system. These projects may be completed in three to ten years.

The former Powell Valley Road Water District wells are in good condition, are productive, and do not have significant water quality issues. In the future, the Water Bureau intends to upgrade these facilities to allow connection of these wells to the main system through Powell Butte. This integration would allow the bureau to increase capacity if needed and to blend well water with water from the Bull Run watershed and/or CSSWF before it enters the distribution system. The Powell Valley Road Water District's wells had a state certified delineation and approved wellhead protection plan (July 1998) at the time of annexation. This protection plan is non-regulatory and relies on best management practices. The Portland Water Bureau reassessed the delineation with an updated methodology and received certification from OHA in October 2010. The protection plan needs to be updated and submitted for re-approval.

The state-approved WMCP includes the potential use of 7.36 MGD of the developed supply to meet future demands.

Current & Projected Demands

Table 7.4 summarizes existing and 2030 retail demands for the distribution system by service area. The 2005 average daily demand was 61.5 mgd.[19] The Distribution System Master Plan, finalized in 2007, estimated that the average daily retail distribution-system demand for 2030 is projected to increase to 70 mgd. Historically, per capita demand in the retail area has shown a steady downward trend since 1993. However, current demand forecasts project relatively steady total demand through 2015, with an upward trend thereafter based on population increase.

Regional population forecasts from Metro, the state-approved Water Management and Conservation Plan, finalized in 2010, estimate the average system-wide demand to be between 132 and 138 million gallons a day. According to the Water Management and Conservation Plan (2010) the average and peak demand for the total service area is anticipated to increase 21% between 2007 and 2030.

[17] A map of the former Powell Valley Road Water District can be found in Figure 2-4 of the *Water Management and Conservation Plan*, 2010.
[18] Additional information on these wells, including size, depth, and capacity can be found in Table 2-2 of the Portland Water Bureau's Water Management and Conservation Plan.
[19] A 2005 demand of 64 mgd was used in capacity evaluations, projected from 2002 demand data at the outset of the study.

Table 7.4 Existing and Projected Retail Water Demands[20]

Service Area	2005 - Daily Demand Avg (mgd)	2005 - Daily Demand Peak (mgd)	2030 – Daily Demand Avg (mgd)	2030 – Daily Demand Peak (mgd)	Service Area	2005 - Daily Demand Avg (mgd)	2005 - Daily Demand Peak (mgd)	2030 – Daily Demand Avg (mgd)	2030 – Daily Demand Peak (mgd)
Arlington Heights	0.7	1	0.9	1.3	Powell Butte Pump	0.02	0.03	0.03	0.05
Arnold	0.5	1	0.6	1.2	Powell Butte	0.2	0.4	0.4	0.7
Bertha	0.5	1.1	0.6	1.3	PV Pump	0.03	0.05	0.03	0.1
Broadway	0.2	0.4	0.3	0.5	PV Raymond	1	1.8	1.3	2.3
Burlingame	1.9	3.3	2.1	3.7	PV 415	2.9	5.1	3.6	6.5
Calvary	0.6	1	0.8	1.3	Rocky Butte Pump	0.02	0.03	0.02	0.04
Council Crest	0.3	0.8	0.4	1.1	Rocky Butte	0.2	0.3	0.2	0.4
Clatsop Pump	0.1	0.2	0.1	0.2	Rose Parkway	0.3	0.6	0.3	0.7
Clatsop	0.2	0.3	0.2	0.4	Saltzman	0.001	0.003	0.002	0.004
Denver	0.9	1.6	1	1.7	Sherwood Field	0.5	0.9	0.6	1.2
Greenleaf	1	1.6	2.1	3.5	Stephenson	0.4	0.7	0.4	0.7
Lexington	0.2	0.4	0.3	0.5	Stephenson Pump	0.1	0.1	0.1	2
Linnton/Whitwood	0.1	0.2	0.2	0.3	Tabor 302	10.6	15.6	12.7	18.7
Marquam	0.7	1.2	0.9	1.6	Tabor 4112	15.1	22.7	16.9	25.4
Mt Scott	0.2	0.4	0.3	0.5	Tabor 590	0.3	0.5	0.3	0.5
Nevada	0.1	0.2	0.1	0.2	Vermont	1.6	2.5	1.8	2.7
Parkrose	1.9	3.6	2	3.9	Vernon3	10	15.2	12.1	18.2
Penridge	0.04	0.1	0.1	0.2	Willalatin	0.1	0.3	0.3	0.8
Pittock	0.04	0.1	0.1	0.1	Washington Park 229	6.2	9.8	8.9	14
Portland Heights	0.6	1	0.8	1.3	Washington Park 299	3.7	5.8	5.2	8.2
Totals[4]	**64.2**	**102.6**	**79.2**	**126.6**					

1 Willamette Heights service area demands are included in Sherwood service area total.
2 The demands for Tabor 411 include Tabor 338.
3 The demands for Vernon include Vernon 224, Vernon 270 and Vernon 362.
4 The area served via Rockwood WD is not included in the total. The average daily demand for this area is estimated to be 0.3 mgd with a peak demand of 0.5 mgd. In the future the average daily demand will remain the same and the peak demand will rise to 0.6 mgd.

Wholesale Water Agreements

The Portland Water Bureau has wholesale water sales agreements with 20 water purveyors in the Portland, Oregon metropolitan area, including cities, water districts, and private water companies.

Portland can potentially sell water to a wholesale population of 450,000 and routinely provides wholesale service to over 375,000 people. Annual wholesale water sales account for 12 percent of annual water sales and about 40 percent of annual water demand. These agreements require the Portland Water Bureau to meet specific levels of service.

[20] Portland Water Bureau, Distribution System Master Plan, June 2007 (Table 2-4)

Table 7.5 Portland Water Bureau Wholesale Agreements[21]

5-Year Agreement	10-Year Agreement	20-Year Agreement
GNR Water Company	Pleasant Home Water District	Burlington Water District
Green Valley Water Company	Lake Grove Water District	City of Gresham
Hideaway Hills Water Company	City of Tigard	City of Sandy
Lorna Water Company	City of Tualatin	Lusted Water District
Skyview Acres Water Company	Tualatin Valley Water District	Palatine Hill Water District
Two Rivers Water Association		Raleigh Water District
		Rockwood Water PUD
		Valley View
		West Slope Water District

Needs & Approach

Bull Run Supply

Although the demand needs are not critical at this juncture, the City will, if it becomes necessary, explore options for increasing water storage in the Bull Run system in order to meet long-term water supply needs.

Groundwater Supply

Current well field capacity is sufficient to meet short-term (less than 30 days) emergency needs during the non-peak-season. The current capacity of the well field system is not sufficient to meet demand during a full shutdown of the Bull Run system due to emergencies or catastrophic events for periods longer than 30 days. Groundwater availability may also be limited in the future due to increased withdrawal from the aquifer by full-time and growing municipal users in Oregon and Clark County, Washington.

Asset Management Plans

Asset management plans are being developed for the Bull Run Supply and Groundwater Supply. These plans will help identify maintenance, repair and replacement strategies necessary to maintain and improve the water system.

Recommended Supply System Improvements

Bull Run Watershed

The function of this program is to allocate funds for the capital projects necessary to maintain, improve, and protect the watershed facilities that are not directly related to the water supply system facilities. This includes Bull Run watershed road reconstruction to ensure continuous, reliable, and safe access to all facilities, as well as maintenance of other city-owned infrastructure within the watershed.

The Dam 2 Tower Improvements Project provides for modification of the north tower inlet to allow selective-depth withdrawal from Bull Run Reservoir 2. The intent is to help regulate temperatures for flows

[21] Portland Water Bureau, 2014.

released to the lower Bull Run River to comply with Clean Water Act requirements and to improve water quality by providing flexibility during turbidity events. The anticipated completion date is 2014.

Dams and Headworks Repair and Rehabilitation

This program provides for assessment of the condition and rehabilitation of dams and facilities at Headworks. As many of these facilities are between 50 and 70 years old, their safe and reliable operation requires ongoing investment. The program includes preliminary engineering and design of needed repairs, rehabilitation of these facilities, and actual repair work.

Columbia South Shore Well Field

The Columbia South Shore Well Field (CSSWF) is Portland's alternative supply of water should the Bull Run watershed supply be interrupted for any reason. Projects funded in this program improve the maintenance of this aging infrastructure, including repairs, selective replacements and upgrades.

Groundwater Collection Main Hardening

Much of the piping connecting the wells to the Groundwater Pump Station is located in liquefiable soils which are vulnerable during a seismic event. This project would design and install measures to "harden" the piping and reduce this vulnerability.

Groundwater Electrical Improvements

This project designs and constructs a new 115kV/4160V transformer and other components to complete a double-ended electrical substation at the Groundwater Pump Station. It will also design and construct a 5kV main breaker replacement and purchase selected spare components.

Groundwater Pump Station (GWPS) Expansion

As water demand increases, the bureau will need to increase the available flows from the groundwater system. The system expansion will include upgrade of the Groundwater Pump Station to provide additional capacity.

Groundwater Well Field Expansion

As water demand increases, the bureau will need to increase the available flows from the groundwater system. The system expansion will include additional well development and collection mains in the Columbia South Shore area.

Groundwater Well Field Reliability Enhancements

The bureau is attempting to increase its flexibility and preparedness to meet the future challenge of an interruption of Bull Run water. The bureau is improving its emergency preparedness by evaluating electrical vulnerability for the pumping system, reviewing the flood inundation vulnerability of the site, and developing a groundwater intertie that would reduce transmission system vulnerability. The inundation review may be partially completed through a partnership with Multnomah County Drainage District.

Powell Valley Well Improvements

The project includes upgrade of the facilities in the previous Powell Valley Road Water District area and connection and integration of these facilities to the Portland Water Bureau's water system.

Transmission and Terminal Storage System

Inventory

Three large-diameter conduits carry the water from the Bull Run watershed to the Water Bureau's in-town storage and distribution system. The conduits have interconnections in three places to ensure reliability, should one or two conduits fail. The water flows downhill from an elevation of 735 feet above mean sea level (MSL) then through the Lusted Treatment facility to Portland's easternmost storage reservoir on Powell Butte, at 530 feet above MSL. Alternatively, groundwater can be pumped to Powell Butte from the Columbia South Shore Well Field through the Groundwater Pump Main when the Bull Run Supply is not available or limited. When water is supplied from both Bull Run and the Columbia South Shore Well Field, the water is blended at Powell Butte. See Figure 7.6 for a schematic diagram of the City's water system.

The Water Bureau maintains water storage, or reservoirs, to provide for daily fluctuation of water use, to fight fires, and to provide time to connect to emergency sources of supply when primary sources are unavailable. In 2012, the terminal storage in Portland's water system consists primarily of Powell Butte Reservoir 1, Mount Tabor Reservoirs 1, 5 and 6, and Washington Park Reservoirs 3 and 4. It also includes storage at Kelly Butte, Sam Jackson and Mayfair. After 2012, the terminal storage system will undergo changes in response to regulations. The system will be reconfigured so that water from Powell Butte will be directed along multiple paths: to Kelly Butte, an enclosed underground storage facility; to the terminal storage-system reservoirs, or through large transmission mains to the distribution system and/or wholesale customers.

Current Condition

The transmission system's 75 miles of conduits is primarily in fair to good condition, although an estimated 12% is in poor or very poor condition. More detailed condition assessments of the conduits are needed. The Washington County Supply Line and Groundwater Pump Main are primarily in good condition (91%), while the Mt. Tabor to Washington Park transmission mains are in fair to good condition.

Terminal storage located at Mount Tabor and Washington Park are classified as uncovered reservoirs, and therefore must be decommissioned or covered as part of the federal LT2 regulations. The Mount Tabor and Washington Park reservoirs are ranked in the condition assessment as poor. As a result of the LT2 regulations, plans are currently underway to build additional terminal storage at Powell Butte (Reservoir #2) and replacement storage at Kelly Butte to replace the function of the Mount Tabor Reservoirs. Design work to replace the uncovered reservoirs at Washington Park is under way.

Terminal storage at Sam Jackson and Mayfair is considered to be in fair condition.

Current Capacity

The conduits have a combined maximum capacity of approximately 212 MGD. The current average annual demand (retail plus wholesale) is approximately 100 MGD. Peak-day demand is approximately 170 MGD. At this time, transmission capacity is available to meet demands when all facilities are in operation. However, transmission system outages and vulnerability remains a concern.

Total storage capacity of the terminal storage reservoirs is currently approximately 195 million gallons (MG). This will be reduced to 148 MG through the elimination of the uncovered reservoirs and construction of new covered storage.

Projected Capacity

At the point in time that peak-day demands are projected to exceed the capacity of the three conduits, Conduit 5 will likely be required. Peak-day demands are not expected to exceed the capacity until near the end of the time period covered by this plan, or later.

Terminal storage capacity will be 148 MG for the time period covered in this plan.

Needs & Approach

The conduits are a critical part of the supply system and represent a significant financial investment for the Water Bureau. Gaining better information on the condition of the conduits and providing the necessary maintenance is therefore of great importance to the Bureau. This work has begun with the completion of a Conduits Asset Management Plan. Over the next few years, the City will need to invest to help improve knowledge of the condition of the conduits. The recently constructed Sandy River crossing reduced vulnerability and replaced conduit sections that were considered in poor condition. A new seismically hardened Willamette River crossing is also planned and included in the capital improvement plan.

Replacement of terminal storage reservoirs is expensive—significant funding is needed to complete the new storage within the time frames required by EPA.[22] Additional transmission main improvements will also be required as part of the reservoir replacement work. An asset management plan for terminal storage is currently being developed. This plan will help identify projects and replacement strategies necessary to maintain and improve the system.

An overall seismic evaluation of the Transmission and Terminal Storage system is recommended.

Recommended Transmission and Terminal Storage System Improvements

Conduits and Transmission Mains

The conduits that bring water to Portland from the Bull Run watershed are large pipes - 56 to 72 inches in diameter. This program funds repairs, replacements and upgrades to the conduits. In future years, the

[22] See the bureau's website on Uncovered Reservoirs, http://www.portlandoregon.gov/water/article/330807, for the most up-to-date information.

Portland Water Bureau plans to upgrade 4-5 miles of conduits each year at an estimated cost of $4-$5 million per mile.

Conduit 5

This project would include installation of sections of a new Conduit 5 as growth occurs and the condition of the existing conduits worsens.

Kelly Butte Reservoir

This project would increase storage capacity from 10MG to 25MG by replacing the existing tank with a buried reservoir. The project includes site access, construction access and easements, staging areas, and on-site storage areas. This project establishes Kelly Butte as a key facility that will be used for system pressure equalization and in-town terminal storage in lieu of the Mt. Tabor uncovered reservoirs.

New Conduit Intertie

This project would address concerns about the capability of the conduit system to withstand hazards and deliver an uninterruptible supply to the City. The project will connect the conduits through additional piping and valving to improve reliability of flow during emergency conditions and for maintenance by providing additional isolation and interconnectivity.

Powell Butte Reservoir 2

This LT2-related project is being constructed in two phases – Phase 1 is complete. The project is currently in Phase 2, the construction of a 50-million-gallon buried reservoir at Powell Butte. It includes a short section of Conduit 5, construction of a maintenance and storage facility, replacing the caretaker's house, construction of an interpretive center and restrooms, reservoir overflow facilities, park improvements and mitigation requirements (required in the 2003 Land Use Review Type III Conditional Use Master Plan).

Powell Butte Reservoir 3

This project constructs a third reservoir at Powell Butte and possible bypass piping around the Butte for additional system reliability.

Sandy River Conduit Relocation, Phase II

The bureau is committed to increasing the flexibility and preparedness to meet the future challenge of a natural disaster. Conduits 2, 3, and 4 were identified in the system vulnerability study as vulnerable to seismic, volcanic, flood, and other natural and human-caused hazards. This project will relocate the Sandy River crossings of Conduit 3. The replacement of crossings of Conduit 2 and 4 have already been completed.

Sandy Wholesale Connection

The project consists of the design and construction of a wholesale meter connection for the City of Sandy to the Portland Water Bureau's supply and is anticipated to be completed early 2014.

Tabor Reservoir Adjustments

This project includes adjustments to piping, structures and other features at Mt. Tabor in order to move storage elsewhere and physically disconnect the uncovered reservoirs from the public water system for compliance with LT2. The project does not include disposition of the reservoirs after they have been disconnected from the public water system.

Washington Park Reservoir 3

The project will plan, design and construct a new buried reservoir to replace uncovered Reservoir 3. This project is one solution toward compliance with LT2 replacement of the uncovered reservoirs. It is assumed that Reservoir 4 will be used as the overflow detention structure. The covered Reservoir 3 will likely retain its visual characteristics and historical features.

West Side Transmission Main Improvements

These mains include the Sam Jackson to Downtown Pipeline and the Jefferson Street Supply mains. These new large transmission mains will strengthen the supply to terminal storage located on the west side of the Willamette River.

Wholesale Connections

This project provides for facilities serving wholesale customers including repairs, replacements, and upgrades of pump stations and meters.

Distribution System

The retail distribution system within the City of Portland comprises approximately 2,200 miles of mains connected to 67 active storage tanks and reservoirs and 39 pump stations, located in 42 service areas. The distribution system configuration has evolved over the past 100+ years in response to changing requirements and regulation. Many parts of the system originated as small, independent water districts that have been incorporated into the Portland Water Bureau's system over the years. Table 7.6 lists the retail distribution service areas and the number of service connections (according to Water Bureau maps as of August 2006). The distribution systems for wholesale water customers are owned and managed by other water service providers and are not included in this report.

Table 7.6 Service Connections by Service Area

Service Area	# of Connections	Service Area	# of Connections
Arlington Heights	825	Powell Butte Pump	50
Arnold	1,548	Powell Valley Road 415	3,782
Bertha	1,730	Powell Valley Road Pump	15
Broadway	604	Powell Valley Road Raymond	2,000
Burlingame	7,816	Rocky Butte	892
Calvary	643	Rocky Butte Pump	46
Clatsop	438	Rose Parkway	766
Clatsop Pump	277	Saltzman	8
Council Crest	1,334	Sherwood	679
Denver	225	Stephenson	1,383
Greenleaf	2,414	Stephenson Pump	379
Lexington	526	Tabor 302	32,362
Linnton/Whitwood	192	Tabor 411	59,070
Marquam	170	Tabor 590	888
Mt Scott	699	Vermont	3,650
Nevada	144	Vernon 224 & 270	15,932
Parkrose	4,167	Vernon 362	18,545
Penridge	37	Washington Park 229	5,223
Pittock	78	Washington Park 299	4,297
Portland Heights	1,323	Willalatin	213
Powell Butte	431	Willamette Heights	292
Total Service Connections	**176,093**		

Figure 7.2 presents a map showing the locations of service areas. Figure 7.6 is a schematic of the City's system, showing key Bull Run and CSSWF supply and transmission facilities, and key distribution system pipelines, pump stations and storage tanks.

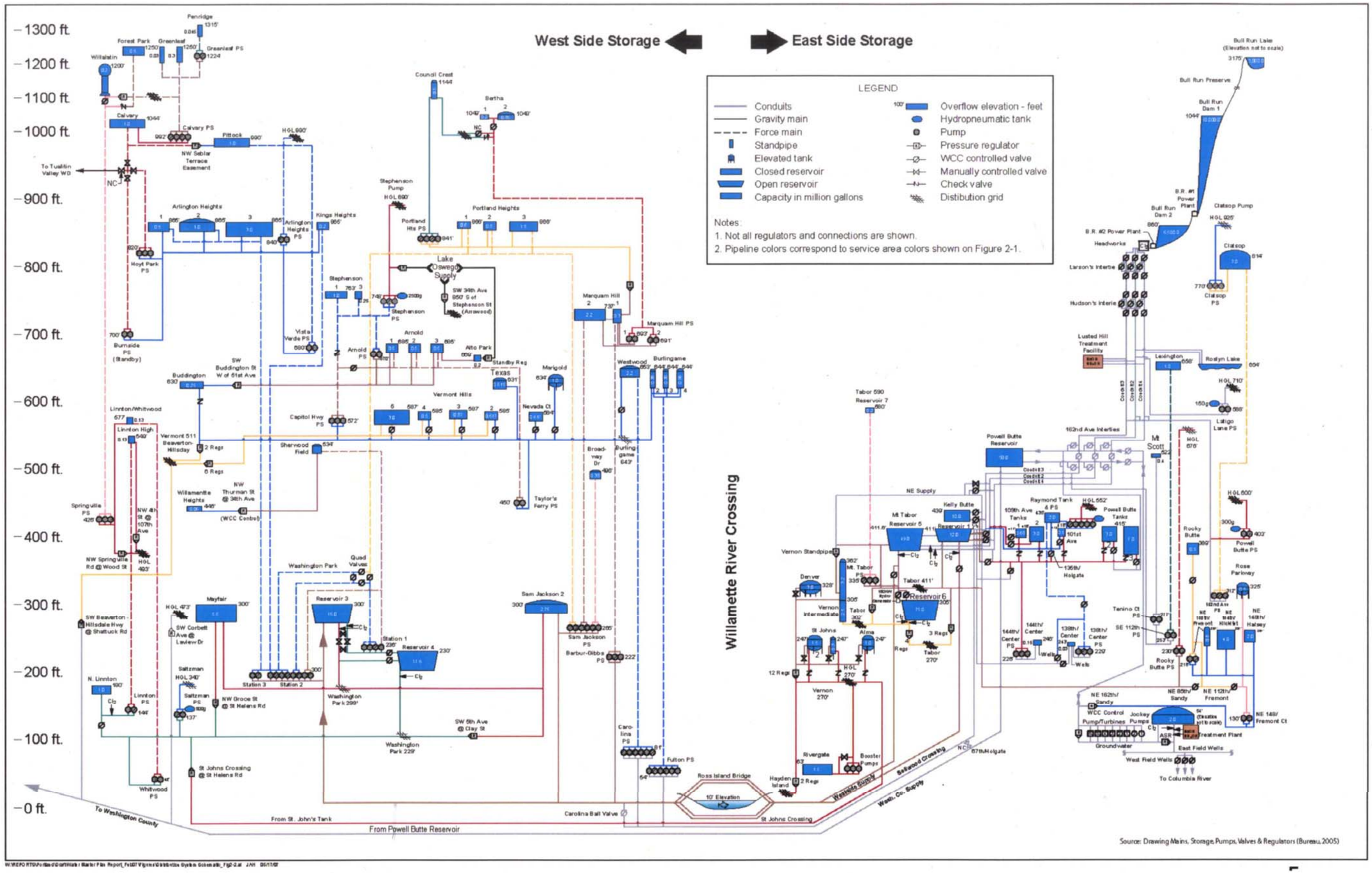
Service areas east of the Willamette River are shown on the right side of Figure 7.6. Most of the areas east of the Willamette are supplied by gravity (without pumping) from Powell Butte and the Mount Tabor Reservoirs, which are fed from the supply and transmission system. Exceptions are small areas in southeast Portland, in and around Powell Butte, the Tabor 590 Service Area, which is located on Mount Tabor, and some areas of northeast Portland, shown on the far right-hand side of the schematic.

Service areas west of the Willamette River are shown schematically on the left side of Figure 7.6. Higher elevation service areas west of the Willamette are served from several key pump stations (Carolina, Fulton, Sam Jackson, and Washington Park) that draw from major transmission lines that currently run from the Mt. Tabor Reservoir complex to the Washington Park Reservoirs.

Inventory

Portland's retail water distribution system is composed of vast networks of distribution mains, service lines, pump stations, and tanks, as well as hydrants, meters, valves, and fountains.

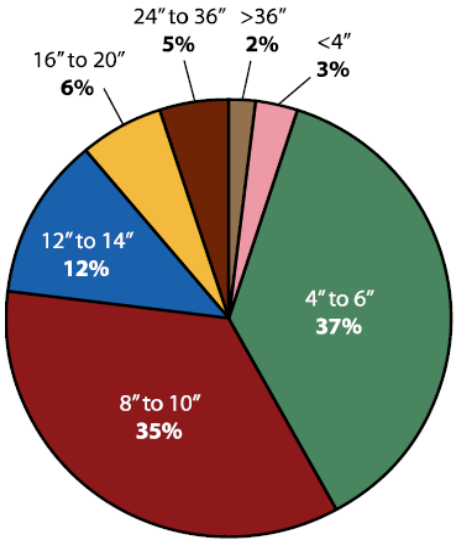
Figure 7.6 City of Portland Water Supply Schematic[23]



Mains

Portland's retail distribution system comprises approximately 2,100 miles of pipeline. Figure 7.7 summarizes pipeline diameters in the distribution system. Distribution piping includes a number of materials, including unlined and lined cast iron (65%), ductile iron (29%), steel (2%), and a small percentage of other materials. The City's distribution mains have a combined replacement value of over $2.2 billion.

Figure 7.7 Pipeline Diameters in the Distribution System[24]



Service Lines

The retail distribution system also includes over 183,000 service lines. The vast majority of these lines (94%) are smaller than 2" in diameter, although larger lines do exist in some areas. The network of service lines has a replacement value of $899 million.

Tanks

The retail water system is served by 67 active storage tanks with a total storage capacity of approximately 270 million gallons. Table 7.7 lists the tank, its service area, capacity information, and whether the condition of the tank was assessed in 2006 as a part of the Distribution System Master Plan. Portland's storage tanks have a replacement value of $266 million.

Pump Stations

The distribution system includes 35 pump stations, valued at $118 million. Table 7.7 lists the capacity of each pump station, and whether a condition assessment was performed in 2006 as a part of the Distribution System Master Plan.

[24] Portland Water Bureau, Distribution System Master Plan, 2007

Meters

The Portland Water Bureau has nearly 180,000 meters worth approximately $88 million. Small meters are replaced every 30 years while large meters are tested and replaced based on condition and criticality.

Valves

The water distribution system contains approximately 43,800 system valves, with a replacement value of $604 million.

Hydrants

The distribution system includes about 14,400 hydrants, with a combined replacement value of $184 million.

Table 7.7 Distribution System Service Areas, Storage Reservoirs and Pump Stations[25]

Service Area and # of Connections		Reservoirs/ Tanks	Capacity (mg)	Pump Stations	Capacity (mg)
Arlington Heights	825	Arlington 1	0.5	Arlington Heights	NA
		Arlington 2	1	Sam Jackson	1700
		Arlington 3	3	Wash. Park 1	3200
		Kings Heights	0.2	Wash. Park 2	7500
				Wash. Park 3	1300
Arnold	1,548	Alto Park	0.2	Capitol Hwy	2500
		Arnold 1	0.5	Taylors Ferry	2000
		Arnold 2	0.5		
		Arnold 3	0.6		
Bertha	1,730	Bertha 1	0.2	Marquam Hill 1 & 2	2410
		Bertha 2	0.9		
Broadway	604	Broadway Drive	0.4	Sam Jackson	800
Burlingame	7,816	Buddington	0.3	Carolina	10800
		Burlingame 2	1.6	Fulton	6400
		Burlingame 3	0.4		
		Burlingame 4	0.9		
		Marigold	1		
		Texas	0.7		
		Westwood	1		
Calvary	643	Calvary	1	Burnside	470
				Hoyt Park	2800
Clatsop	438	Clatsop	3	162nd Avenue	880
Clatsop Pump	277			Clatsop	775
Council Crest	1,334	Council Crest	0.5	Portland Heights	4300
Denver	225	Denver	3		
Greenleaf	2,414	Forest Park	0.5		
		Greenleaf 1	0.03	Calvary	1900
		Greenleaf 2	0.3		
Lexington	526	Lexington	1	112th Avenue	1100
Linwit	192	Whitwood	0.1	Linnton	130
				Whitwood	640
Marquam	170	Marquam Hill 1	0.3	Barbur Gibbs	1300
		Marquam Hill 2	2.3	Sam Jackson	2100
Mt. Scott	699	Mt. Scott	0.4	Tenino Ct.	320
Nevada	144	Nevada Ct	0.6		
Parkrose	4,167	104th/Klickitat	4		
		148th/Halsey	2		
Penridge	37	Penridge	0.1	Greenleaf	130
Pittock	78	Pittock	1	Verde Vista	1000
Portland Heights	1,323	Portland Heights 1	0.6		
		Portland Heights 2	0.5		
		Portland Heights 3	1.9		
Powell Butte	431	Powell Butte N/S	50	1st & Kane	N.A.

[25] *Portland Water Bureau, Water Management and Conservation Plan, 2010 (Tables 2-21 and 2-22)*

PB Pump	50			PB Heights	1480
Powell Valley Road 415	3,782	101st Ave	0.5		
		109th Ave 1	3		
		109th Ave 2	0.7		
		160th Ave 1	7		
		160th Ave 2	3		
		PV 144th/Center	0.2		
PV Rd Pump	15			PV Raymond St	440
PV Road Raymond	2,000	PV 138th/Center	0	PV 138th / Center	1100
		Raymond	2		
Rocky Butte	892	Rocky Butte	0.5		
RB Pump	46			Rocky Butte	200
Rose Pkwy	766	Rose Parkway	0.5		
Saltzman	8			Saltzman	75
Sherwood	679	Sherwood	0.4	Washington Park 2	1400
Stephenson	1,383	Stephenson 1	1.3	Arnold	1000
		Stephenson 3	0.3		
Steph. Pump	379			Stephenson	500
Tabor 302	32,362	Mt. Tabor 6	37.8		
		Vernon 2	2.5		
Tabor 4113	59,070	Kelly Butte	10		
		Mt. Tabor 1	12		
		Mt. Tabor 5	49		
Tabor 590	888	Mt. Tabor 7	0.2	Mt. Tabor	1200
Vermont	3,650	Vermont Hills 2	0.6		
		Vermont Hills 3	0.9		
		Vermont Hills 4	0.5		
		Vermont Hills 5	2.8		
Vernon 224 & 270	15,932	Alma	1		
		St Johns 2	1.5		
Vernon 362	18,545	Vernon 3	3.2		
Washington Park 229	5,223	North Linnton	1		
		Washington Park 3	16		
		Washington Park 4	17.6		
Washington Park 299	4,297	Sam Jackson 2	2.8		
		Mayfair	5.6		
Willalatin	213	Willalatin	0.2	Springville	630
Willamette Heights	292	Willamette Heights	0.1		

Current Condition

In general, the majority of the Water Bureau's distribution system asset groups are in fair to very good condition. However, almost half of the bureau's galvanized steel distribution mains (45%) are in poor to very poor condition, as are over one-fifth of the meters (23%), and hydrants (20%), by value. Half of the 2,200 miles of distribution mains are older than 50 years. More information on the condition of major asset groups can be found in Table 7.2. The Water Bureau evaluates asset condition as one factor in asset management decisions.

Service Area Assessment

In 2007, the Portland Water Bureau completed a series of hydraulic evaluations of the "backbone" distribution system, or the essential distribution-system components. The purpose of the evaluation was to assess the ability of the system to meet demands under both existing (i.e., 2005) peak-day conditions and 2030 peak-day conditions.[26] The evaluation found that the system that will reliably deliver water through 2030. Of the 42 service areas evaluated representing the retail system, 20 service areas, accounting for 86 percent of the 2030 peak-day demand, have no deficiencies.

Table 7.8 summarizes the results of the preliminary screening. Of the remaining 22 service areas, accounting for 14% of 2030 peak day demand:

- Six service areas (Clatsop Pump, Powell Butte Pump, PV Raymond Pump, Rocky Butte Pump, Saltzman Pump, Stephenson Pump) are direct-pump service areas with no storage. Deficiencies are based on providing sufficient capacity to meet fire flows. In some instances, pump stations were designed for lower fire-flow requirements, in place at the time of pump station design. In other instances, the Bureau has designed pumps to meet fire-flow requirements with all units in service. If all units are used in the screening, three (3) service areas show no deficiencies (Powell Butte Pump, PV Raymond Pump, Stephenson Pump).
- Eight service areas have recognized deficiencies and are being evaluated by the Bureau in other studies. These are: Calvary, Council Crest, Greenleaf, Linnton/Whitwood, Penridge, PV Raymond, Willalatin, and Willamette Heights.
- Five service areas were flagged for further assessment in the hydraulic evaluation. These are: Broadway; Mt Scott; Sherwood; Stephenson; and, Tabor 590. Although the preliminary screening did not identify deficiencies in the Burlingame service area for the planning scenarios evaluated, the Bureau has recently completed a Master Plan for the service area that includes several capital projects to remedy previously identified deficiencies.
- The remaining three service areas have mitigating circumstances that relieve some of their identified deficiencies. The Lexington service area was deemed deficient in the outage screening, but the Bureau has purchased a generator to supply the service area in a power outage situation. However, the generator would not address a service outage of the pump main, so the service area was still deemed deficient. The second, Bertha, was deficient for both storage and outage. However, the service area has additional regulated supply from other service areas. The third, the Vernon 362 service area, has a large number of regulators that supply the zone, which addresses the storage deficiencies.

[26] More information can be found in the Portland Water Bureau's Distribution System Master Plan, 2007. Options to integrate the former Powell Valley Road 415 service area with the Tabor 411 service area, and supply capacity through Washington Park were also assessed in this plan.

Table 7.8 Results of 2007 Preliminary Screening of Service Areas[27]

Service Areas that Passed Preliminary Screening for Pumping, Fire, Storage and Outage Service Goals; or Are Being Addressed in Other Studies*

Arlington/Portland Heights **	Arnold	Burlingame
Clatsop	Denver	Marquam Hill
Nevada	Parkrose	Pittock
Powell Butte	PVRWD 415	Rocky Butte Tank
Rose Parkway	Tabor 302	Tabor 411
Vermont	Vernon 270	Washington Park 229
Washington Park 299		

Service Areas that were Deficient for One of More Screening Service Goals

Service Area	Pumping	Fire	Storage	Outage	Notes
Bertha	✓	✓	X	X	Additional regulated supply available
Broadway	X	X	X	X	Additional regulated supply available
Calvary	X	X	X	N/A	Being evaluated in NW Hills study
Clatsop Pump	X	X	N/A	X	
Council Crest	✓	✓	X	X	Being evaluated by Bureau
Greenleaf	✓	✓	X	X	Being evaluated in NW Hills study
Lexington	✓	✓	✓	X	The Bureau has purchased a generator with an automatic transfer switch for 112th St Pump Station. The generator would not address outages due to a pump main break
Linnton / Whitwood	X	X	X	X	In Upper Linnton Tank Analysis
Mt. Scott	X	X	X	X	Additional regulated supply available
Penridge	X	X	X	✓	Being evaluated in NW Hills study
Powell Butte Pump	X	X	N/A	✓	Not deficient if all pumps used
PV Raymond Pump	X	X	N/A	✓	Not deficient if all pumps used
PV Raymond	X	X	X	X	Being evaluated by Bureau
Rocky Butte Pump	X	X	N/A	✓	
Saltzman	X	X	N/A	✓	
Sherwood	X	X	X	X	Additional regulated supply available
Stephenson	X	X	X	✓	
Stephenson Pump	X	X	N/A	✓	Not deficient if all pumps used
Tabor 590	✓	X	X	X	
Vernon 362	N/A	X	X	N/A	Large regulated supplies available
Willalatin	X	X	X	X	Being evaluated in NW Hills study
Willamette Heights	N/A	X	X	X	Being evaluated in Willamette Heights Tank study

* Passed all screening criteria (Arnold, Clatsop, Denver, Marquam Hill, Nevada, Rocky Butte Tank, Vermont), were only deficient in storage screening (Parkrose, Rose Parkway), or passed pumping, storage, and fire screening goals, but were not screened for outages, since these are being addressed by other studies, or are large service areas with adequate redundancy (Arlington/Portland Heights, Burlingame, Powell Butte, PVRWD 415, Tabor 302, Tabor 411, Washington Park 229, Washington Park 299).

** Arlington Heights and Portland Heights service areas are hydraulically interconnected and were evaluated together.

N/A = Not applicable, or not evaluated in DSMP ✓ = Passed screening X = Failed screening

[27] Portland Water Bureau, *Distribution System Master Plan*, 2007

Backbone Hydraulic Evaluation

The backbone evaluation assessed system operation, taking into account system hydraulics, to find further deficiencies not evident in the preliminary screening. The model simulated a 24-hour period on the peak-demand day for 2005 and 2030 demand conditions. Results of the hydraulic evaluation were consistent with the preliminary screening. No additional deficiencies were identified.

Three service areas, however, that had deficiencies in the screening evaluation showed no deficiencies in the hydraulic evaluation. All three (Broadway, Sherwood Field, and Stephenson) have adequate pumping capacity to meet normal demand, but insufficient capacity to meet peak-day demand plus re-fill of storage following a fire within the service area.

Assessment of Pump Stations and Tanks[28]

Condition assessments have been conducted for 35 pump stations and 66 tanks in the distribution system. The pump station assessment found that, in general, the pump stations originally constructed by the Bureau were in good condition. With the exception of the recently acquired Powell Valley system pump stations, pump stations acquired from other formerly independent water systems had more deficiencies.

- 15 pump stations are in good condition with only minor corrective maintenance needed;
- 20 pump stations are operationally and functionally sound, but exhibiting some signs of wear, with some need for corrective action;
- Deficiencies were identified in the Fulton, Linnton, Portland Heights, Sam Jackson, and Taylors Ferry service areas.
- Of the 66 tanks assessed, 4 tanks are in conditions that substantially diminish performance; 55 tanks are operationally and functionally sound, but exhibiting some signs of wear, with some need for corrective action; and 7 tanks are in good condition with only minor corrective maintenance needed.

The tank assessments found that coating and painting for tanks has not been performed routinely in recent years. A strategic coating and painting program was recommended. The analysis also found seven tanks that require further evaluation to address extensive cracks observed during inspections. Fifty-two tanks also had minor repair or maintenance recommendations, and several tanks require anchoring and/or flexible piping connections to reinforce tanks to withstand an earthquake. All work will be performed as part of ongoing capital and maintenance programs.

Seismic Assessment

As part of the Distribution System Master Plan (2007) a qualitative seismic assessment was provided for 32 tanks to identify conceptual-level seismic improvements. The analysis used condition information collected in the tank inspections, along with probabilistic ground-motion data from U.S. Geological Survey, to assess which tanks would be most vulnerable in a large-scale earthquake in the Portland area

[28] Portland Water Bureau, *Distribution System Master Plan*, 2007

(100- year to 500-year frequency). For tanks identified to be the highest risk, conceptual-level improvements were identified to reinforce the tanks.

Needs & Approach

Backbone Hydraulic Evaluation

In selecting improvements, service areas were reviewed to identify water supply issues including service pressures, fire flow requirements, water quality goals and sizing for new facilities.

For direct-pumped service areas, the improvements were developed based on a criterion of meeting peak-hour demands plus fire flow with one pumping unit out of service, rather than peak-day plus fire flow, since direct-pumped areas have no storage and pumps and must be able to meet both normal and fire demands. In some instances, the bureau has designed pump stations to meet fire flows with all units in service. In the Powell Butte Pump, Powell Valley Road Water District Pump and Stephenson Pump service areas, pump stations can provide adequate fire flow if all units are used. The bureau will need to determine whether these pump stations - built to then-current standards - should be upgraded based on the Distribution System Master Plan criteria of meeting peak-hour demands plus fire flows with one unit out of service.

Condition Assessment of Pump Stations and Tanks[29]

All of the pump station projects generated from the pump station condition assessment will be constructed as part of ongoing capital and maintenance programs, or as part of larger planned pump station rehabilitation projects.

Asset Management Plans

Asset management plans are being developed for all assets within the distribution system. These plans will help identify additional projects and replacement strategies necessary to maintain and improve the system. These plans may identify additional projects to be included in the 20-year Project List.

Recommended Distribution System Improvements

Burnside Pump Station Replacement

This project will decommission the old undersized pump station and modify the nearby Verde Vista pump station to serve the Burnside pumping needs for the next 50 years. The project will also acquire property for the future Burnside pump station to be built 50 years from now.

Carolina Pump Main Extension

This project will connect the existing Carolina Pump Main (Westwood Tanks) and the Fulton Pump Main (Burlingame Tanks) together. This will be a pump main from the intersection of SW Capital Hwy and SW Terwilliger Blvd to the Burlingame Tank site. Phase 1 is replacing the existing 16" Fulton pump main with

[29] Portland Water Bureau, *Distribution System Master Plan*, 2007

a 24" pump main from Burlingame Tank site to SW Chestnut and SW Burlingame as well as improvements at the Burlingame Tank site. Phase 2 is the new construction of a 24" pump main from SW Chestnut and SW Burlingame Ave to tie into the existing Carolina Pump main at Capitol Hwy and Terwilliger Boulevard.

Control Center SCADA Server Replacement

This project replaces the aging supervisory control and data acquisition (SCADA) system at the Water Control Center with a secure, Windows based system. The bureau will add, as part of the upgrade, a disaster recovery SCADA system to our Lusted Treatment site. The new system will have better system functionality, improved integration tools, management tools and security and will provide the Water Bureau with critical water supply monitoring and control for 10 years plus. The system includes hot standby real-time and historical servers, client workstations at various facilities, a decision-support server, and a terminal server for remote access.

Distribution Mains

This program includes rehabilitation and replacement of mains with high leakage or break rates, substandard mains (2-inch galvanized steel), expansion due to applications from private developers, increasing supply for fire protection, improving water quality and water system upgrades due to local improvement districts (LIDs), and street improvements. Water main replacements also include appurtenances such as fire hydrants, valves, pressure regulators, service branches, and other facilities.

Field Support

This project funds vehicles and major equipment purchases, including heavy construction equipment such as dump trucks and backhoes, and Bureau-owned computer software with a unit cost greater than $5000.

Forest Park Low Tank

This project will plan, design and construct a single 1.3 million gallon tank at NW Cornell and NW Skyline Drive for the Greenleaf 1034 pressure zone. This storage is to augment regular system capacity and increase fire flow to a large area of Northwest Portland.

Fulton Pump Station Improvements

This project will replace the Fulton Pump Station with a new pump station located in Willamette Park.

Greenleaf Pump Station

This project will plan, design and construct a replacement Greenleaf pump station at the existing site. Flow upgrades will remove the Penridge tank from the system. The new pump station will pump directly to the distribution system.

Hydrants

The bureau maintains about 16,000 fire hydrants. These hydrants allow Portland the flexibility and preparedness to respond to a fire emergency through coordination with the Fire Bureau. This project provides for the replacement of fire hydrants that are no longer repairable. Replacements may also occur as part of the bureau's ongoing efforts to standardize hydrant types for more efficient and effective management of maintenance and repair activities.

Meters

This project funds the purchase and installation of water meters. The Bureau’s objective is increase accuracy based on replacing high usage meters. High usage meters typically wear out faster than others.

Portland Heights Pump Main

This project will replace the portion of the 12" pump main in SW Montgomery Drive between the southern end of the 16" pump main from Washington Park and the Portland Heights Tank site with approximately 3,500 feet of 16" main in Montgomery Drive and Greenway Avenue. The new main will replace a poor condition main and provide additional supply capacity to the area.

Portland Heights Pump Station Electrical Improvements

The project will design and construct a new prefabricated building at the Portland Heights Pump Station to house electrical and control equipment, and also install in the existing pump vault a new 100hp pump and vault improvements.

Portland to Milwaukie Light Rail

This project consists of relocation of over 5,000 feet of main impacted by TriMet’s SE Corridor Light Rail project.

Pump Stations and Tanks

This project includes a large variety of infrastructure consisting of water storage tanks, pumps, and pump and control facilities. The bureau uses a reliability centered maintenance (RCM) approach to manage its assets. A key focus of the next twenty years will be to replace the remote telemetry units at over 140 remote sites. The existing units are over 15 years old, and are becoming obsolete. The servers are at the end of their service cycle, and must also be replaced.

Sam Jackson Pump Station and Mains

This project will make multiple capital improvements to the Sam Jackson Pump Station, including seismic improvements, replacement of RTU and motor controllers, installation of pump control and check valves, extension of the crane rail, a concrete pad, and installation of a security fence and gate.

Services

This project constructs replacement and customer requested water services. A water service is the connection between the water main and any given customer's service meter. Service connections are always performed by Water Bureau crews directed by a certified Water Service Mechanic. An ongoing budget of approximately $5 million per fiscal year provides for installation of about 1,000 water service connections annually and other upgrades to existing water services.

Willamette River Crossings

The project replaces major pipelines to strengthen the transmission link between Powell Butte and the service areas west of the Willamette River, including downtown and the storage reservoirs at Washington Park. It includes construction of a new seismically strengthened river crossing to replace the first one of potentially two Willamette River crossings, and new transmission piping on both sides of the Willamette.

Treatment System

Inventory

The Federal Safe Drinking Water Act, which regulates public drinking water supplies, typically requires surface water supplies to be filtered to meet federal drinking water standards. Because the Bull Run source water quality is very high and Portland implements source water protection measures, Portland is currently exempted from filtration requirements. Portland’s water supply is disinfected using chloramines. Water is chlorinated at the Headworks at Reservoir 2. Ammonia and sodium hydroxide are added at a second treatment facility, Lusted Hill.

Ammonia ensures that disinfection remains adequate throughout the distribution system. Sodium hydroxide increases the pH of the water helping to control lead and copper levels at customers' taps should these metals be present in the customers' home plumbing.

Future federal regulations may require additional treatment processes in the future.

Treatment is also required for the groundwater supply.

Facilities used to provide water treatment include a chlorination building and equipment, and flow metering at Headworks; treatment facilities and equipment at Lusted Hill; and treatment facilities and equipment at the Groundwater Pump Station.

Current and Projected Condition

Headworks treatment facilities are rated as good to fair. The flow meters are rated as poor.

The Lusted Treatment Facility was constructed in 1992. Condition is assessed at good to fair. However, buildings at this site were built as temporary structures and do not reflect the full cost of replacing the facility with permanent buildings. Future facility upgrades will include permanent structure replacements.

The treatment facilities at the Groundwater Pump Station were recently upgraded and are rated in very good to good condition.

Current and Projected Capacity

Due to changing regulations, the suitability of a treatment facility is a moving target. As federal and state rules are modified and as technology changes, treatment facilities must change as well.

With the State granting the Bureau a variance on the treatment provisions of the LT2 rule, many related facility improvements planned at Headworks were postponed as well. Among these improvements were replacement of the chlorination system and the operators' station. Both of these will need significant upgrades within the next 20 years.

Needs & Approach

Asset management plans are being developed for the Bull Run Supply and Groundwater. These plans should help identify needed improvements.

Recommended Treatment System Improvements

Headworks Flow Meters

This project would install new flow meters on the Primary Intake conduits; install new flow meters and flow control valves on Screen house #3 conduits; and address the sump pump drainage system in Bailey pressure-reducing valve vault.

Treatment Facilities Improvements

This project includes several related projects for treatment facilities for the Bull Run water supply, at both the Bull Run Headworks and the Lusted Hill Facility. Specific treatment improvements have not been determined at this time. Projects would likely be driven by state and federal regulations.

Support System

Inventory

The Support system includes miscellaneous facilities and equipment necessary to support the Water Bureau's mission. Support system assets are shown in Table 7.2. Chief among these assets are the Interstate Facility, and Sandy River Station.

Funding for Support system projects often resides in budget programs other than "Support". The Interstate Rehabilitation Project is currently funded through the Distribution program in the CIP.

Current and Projected Condition

The Interstate Maintenance Building is more than 85 years old. Studies have indicated that this building is highly vulnerable to collapse during an earthquake. This building fails to meet building codes in many

areas including structural, mechanical and electrical requirements. Renovations required to bring the building up to code are extensive. A major rehabilitation plan has been developed that will result in the demolition and reconstruction of this building, anticipated to be completed in 2016.

Other buildings include Sandy River Station which is primarily in good to fair condition.

Current and Projected Capacity

Needs & Approach

Buildings classified as part of the Support system will require maintenance and rehabilitation over the next 20 years. An asset management plan for facilities/buildings is being developed that should help identify work that is needed.

Recommended Support System Improvements

Building Maintenance

The bureau maintains hundreds of structures from the Bull Run watershed to downtown Portland. These structures range in size from small pump houses to the maintenance hub on Interstate Avenue. The necessary work involves structural repairs and maintenance.

Interstate Facility Rehabilitation

The project rebuilds the Portland Water Bureau's main maintenance facility. A four-year master planning effort from 2002 – 2006 developed the baseline requirements for both current and long-term needs. Recent updates to the master plan along with additional program summary work has created the basis for the design of the facility now underway. Two new buildings will replace the eighty-five year old Maintenance Building that currently serves as the main office and warehouse. Site improvements to the 11 acre campus improves vehicle and employee circulation. It also brings the property up to current code requirements for storm water management and landscaping.

Planning

This program consists of general planning studies for projects needed to improve the operation of the water system. These include pressure zone adjustments, facility modifications, and system element studies.

Sandy River Station Upgrades

This project consists of upgrades to the Sandy River Station facilities including an evaluation of a potential move to a different site.

West Side Maintenance Facility

A hub is needed on the west side of the Willamette River for maintenance and construction crews, vehicles, equipment and materials, and emergency operations. Property previously owned by the Federal

government (the Jerome Sears site) has been acquired by the City for this purpose. This project includes improvements to the facility over the next 20 years.

Regulatory Compliance

Inventory

The Regulatory Compliance program ensures that water throughout the system meets Federal and State of Oregon drinking water quality standards and environmental protection standards. Included in this program is implementation of the federally approved Habitat Conservation Plan (HCP) and the multiple easements and improvements required by this plan. Chief among these is the Bull Run Dam 2 tower intake structure which will allow the bureau to better control the release of water to enhance downstream conditions for anadromous fish species in compliance with the Endangered Species and Clean Water acts.

Regulatory Compliance system assets are included in Table 7.2.

Needs & Approach

The focus of this program is implementation of the federally approved Habitat Conservation Plan and the multiple easements and improvements required by this plan.

Recommended Regulatory Compliance System Improvements

Bull Run Dam 2 Tower

The Water Bureau is installing steel multi-level intake structures onto the North Dam 2 Tower located in the Bull Run watershed. Modifications are designed to allow selective water withdrawal, proper operation during flood conditions, and enable the tower to better withstand seismic events.

HCP Alder Creek Fish Passage

This project will design and install two fish passage facilities as planned in the Habitat Conservation Plan (HCP). The project is in Alder Creek, a tributary to the Sandy River. There will be a fish ladder at the waterfall and a fish ladder at a water diversion.

Regulatory Compliance

This project responds to requirements of the Endangered Species Act (ESA), including the implementation of the Habitat Conservation Plan (HCP) Consistent with HCP commitments, this project funds easements, purchases land, and also supports projects jointly conducted with other watershed partners.

Customer Service

Inventory

The Customer Services Program includes facilities that provide services for customers other than the direct supply of water. It includes customer billing, collection, and call center facilities and equipment, which is the largest part of the program. It also includes conservation, security, emergency management and grounds maintenance for Bureau-owned properties. Specific assets included in the Customer Services program are Dodge Park and the Security and Emergency Management facilities, including the new City Emergency Coordination Center.

Customer Service system assets are included in the Distribution section and the Support Facilities section in Table 7.2.

Current and Projected Condition

Dodge Park is considered to be in good condition. Upon completion of the new Emergency Coordination Center in 2014, the Security and Emergency Management facilities (including the Ranger Station and security gates) should be in very good condition.

Current and Projected Capacity

Needs & Approach

Automated meter reading would reduce operational costs and provide better customer service (i.e. access to more current consumption data).

Maintenance and upgrades of Water Bureau facilities including Dodge Park and Security and Maintenance facilities will be a continual need. An asset management plan for facilities/buildings has been developed that should help identify work that is needed.

Recommended Customer Service System Improvements

Automated Meter Reading (AMR) Implementation

This project provides for the replacement of customer meters throughout the City with automatic water meter reading equipment.

Emergency Coordination Center

This project designs and constructs the City's Emergency Coordination Center. The bureau will locate its emergency response and security staff at this location. The project location is adjacent to the City's 911 Call Center at SE 99th Ave and Powell Blvd. The total project cost is $19.85 million and Portland Water Bureau is a contributing bureau.

Security and Emergency Management

The bureau is committed to increasing flexibility and preparedness to meet future security challenges, to enhance security throughout the water system and to modernize security practices and infrastructure. This program includes physical security improvements to major and minor facilities as well as improved security in the overall water distribution system and control/communications system.

Investment Strategy

Process

Annually, the Portland Water Bureau prepares capital budgets for the upcoming fiscal year and for the five-year planning horizon. The major components of the water system define the program categories within the capital budgeting process. These capital programs are: Supply, Transmission and Terminal Storage, Distribution, Treatment, Regulatory Compliance, and Customer Service. The Capital Improvement Plan (CIP) is an annual planning process which allows a review of capital projects and programs. The Portland Water Bureau engages the public in developing its budget and the CIP. All Water Bureau CIP projects that affect neighborhoods or that require city, state, and/or federal permit review processes include public involvement elements.

The Engineering Services Group (ESG) receives requests and ideas for CIP projects from a number of sources. Internal bureau stakeholders groups including Asset Management, Development Services, Design or Construction, Operations, Maintenance and Construction, and Resource Protection all may identify the need for a capital project. Other sources include projects generated from ESG CIP Planning Section listed in Master Plans or Public Facility plans, and recommendations from the Asset Management group that include business case studies. In addition, the Portland Water Bureau receives notifications from other agencies or bureaus planning or producing work that may impact the water system. External requests may also come from citizens, wholesale customers, the City Council, and developer requests for projects administered through ESG's Development Services Branch.

The Water Bureau performs economic analyses and/or business cases for new projects, and ensures that investment decisions are economically justified.

Contributing Plans

Asset Management

The Bureau's Asset Management Program is intended to guide the strategic management of physical assets to best support the delivery of identified services. It helps the Bureau to better manage existing assets, and plan for future needs. This process is guiding decisions as to the effective mix of maintenance, repair, renewal or replacement of the water system components, and has led the Bureau to focus on critical assets. A risk analysis methodology has been applied to assess the relative risks of asset failure; those assets with the highest risks are then identified for follow-up actions.

Asset condition assessments have been completed or are underway for many asset classes. Business case methodology is helping ensure that investment decisions deliver good value by comparing the cost of an investment to the benefits it provides. Benchmarking with best practices helps the Bureau better understand process improvement opportunities. Asset Management Plans have been prepared for almost all asset classes, capturing current information on service levels, inventory, condition, failure modes, risks of asset failure, and asset strategies.

System Plans

A number of plans are consulted in preparation of the CIP. These include the Infrastructure Master Plan (2000), the Distribution System Master Plan (2007), the Bull Run Water Supply Habitat Conservation Plan (2008), the Water Management & Conservation Plan (2010), and various master plans and project specific planning documents developed by the Portland Water Bureau.

Alternatives Analysis and Prioritization Process

The Portland Water Bureau's methodology and criteria for the selection and ranking of capital projects depends on the magnitude of the project and duration of the project's lifecycle. For major projects, an initial concept report is developed evaluating possible project alternatives and recommending potential capital projects. Senior management approves projects to continue with a larger planning effort to create a Basis of Design Report. To develop this report, the Water Bureau's Planning section uses industry practices in cost-benefit analysis and risk assessment to identify and weigh alternative solutions, and compare them with service standards. The Portland Water Bureau selects projects based on these quantitative analyses but also considers the logistics of rate impacts, sharing cost with interagency partners, creating revenue opportunities, and achieving compliance with regulatory requirements.

The criteria used to select projects for inclusion in the budget include fulfilling service levels (such as maintaining pressure and limiting customer outages), mitigating high risks of asset failure, operating assets at the most efficient and cost-effective levels, contributing to local and regional sustainability and energy-conservation goals, providing appropriate redundancy within the supply system, complying with all state and federal water-quality regulations, ensuring access to key water-supply facilities, and coordinating with other agency infrastructure projects.

Projects & Programs

The FY 2013-18 CIP provides balance between longer-term infrastructure replacement and maintenance needs and short-term water system infrastructure needs to ensure compliance with drinking water regulations. The CIP priorities for the bureau's budget and capital program include:

- Implement improvements necessary to assure compliance with current safe drinking water regulations, including the LT2 rule.
- Continue to expand the utilization of an asset management system plan and the computerized maintenance management system to support planning and implementation of system maintenance activities.
- Implement the Bull Run HCP, a comprehensive multi-decade Clean Water and Endangered

Species Act compliance agreement for the Bull Run watershed.

- Support other governmental agency capital improvement projects (e.g., light rail, Sellwood Bridge, Columbia River crossing) as directed by City Council.

The 5-year CIP is summarized within the following seven Bureau programs with key projects identified:

Customer Service

The Bureau's participation in the City Emergency Coordination Center is the primary project included within this program over the first five years. Bureau security staff will operate from this location with the Portland Bureau of Emergency Management. In the event of a major emergency, all City coordination staff will operate from this center.

Distribution

Over the first five years, approximately $244 million of the CIP is for improvements to the distribution system. Of the total, about $83 million is to be used for direct water line replacement projects, including work initiated by other bureaus and agencies, as well as replacement of the oldest or most deteriorated portions of the distribution system. About $35 million is to continue rehabilitation of the Interstate maintenance building. There is $57 million for the Willamette River Pipe Crossing Project. Almost $16 million is for pump stations and tanks. Other improvements include services, meters, hydrants, fountains, and vehicle and equipment replacement.

Regulatory Compliance

Over the first five years, more than $25 million has been planned for improvements to the water supply from the watershed, principally the Dam 2 Tower Improvements. Construction continues on the HCP Alder Creek project to enhance fish habitat.

Support

The Support Program includes funding for master system planning, focusing on identifying the need for, and timing of, improvements to or acquisitions for the water system. Master planning uses asset management methods to determine the most cost-effective investments. Individual asset studies help guide the selection of major capital projects for the short and long term. The Portland Water Bureau has included funds for some of the planned studies on vulnerable and aging infrastructure in upcoming fiscal years.

Supply

This program includes projects to improve existing facilities and roads in the Watershed and to improve the groundwater system. An example is the Groundwater Electrical Supply Improvements project that will reduce the risk of an extended electrical supply outage to the groundwater pump station.

Transmission and Terminal Storage

Over the first five years, the major projects in this program include $35 million to continue construction of an additional 50-million-gallon water storage tank at Powell Butte and $119 million for other enclosed storage including Kelly Butte reservoir and Washington Park reservoir. Also included is $33 million for other conduit and transmission main projects.

Treatment

Headworks Flow Meters project, to accurately record treated water flow and regulate chemical additions to the system in compliance with drinking water regulations, is the only project in the first five years.

Financially Constrained Investment Strategy

The Bureau focuses its efforts on regulatory compliance elements, improving the condition of its aging infrastructure, and addressing operations and maintenance needs. The CIP addresses longer term infrastructure replacement and maintenance needs, while addressing short-term water system infrastructure needs to ensure compliance with drinking water regulations.

Recently, the primary focus of the bureau's capital Investment Strategy has been responses to EPA's LT2 rule (reservoir replacement projects), the HCP (Dam 2 towers project), and the Interstate Facility Improvement project. Upon completion of these projects, the focus will return to improving the maintenance and reliability of existing facilities. As facilities within the water system begin showing their age, major reconstruction and maintenance projects will need to be undertaken.

Planned CIP outlays (excluding capitalized overhead) total $491 million over the five-year forecast period.

Table 7.9 Investment Strategy Summary

Program	FY 2013-2018	FY 2018-33
Customer Service	$3,057,000	$53,700,000
Distribution	$244,197,288	$461,650,000
Regulatory Compliance	$25,504,000	$30,000,000
Supply	$14,291,000	$88,500,000
Support	$10,000,000	$50,500,000
Transmission and Terminal Storage	$191,170,000	$242,000,000
Treatment	$2,500,000	$150,000,000
TOTAL	**$490,719,288**	**$1,076,350,000**

Financial Strategy

Existing Financing Strategies

As part of the Bureau's overall mission and values, its financial objective is to "maintain fiscal integrity, undertake sound financing practices and ensure auditable results" which:

- Provides for sufficient annual funding of operating, maintenance, and capital programs approved

by City Council.

- Provides for rates and charges to customers that are equitable and based on generally accepted cost of service principles unless otherwise directed by City Council.
- Strives for a natural optimal balance between financial health, operational effectiveness, infrastructure condition, effective management, rate affordability, and a skilled and experienced workforce.
- Strives to optimize capital financing strategies, today and into the future.
- Ensures the maintenance of appropriate and adequate cash balances (operating fund, construction fund, sinking fund, and rate stabilization account) consistent with City policies, bond covenants, and industry standards

Rates and charges for water services are established annually based, in part, upon cost-of-service principles and methodologies recommended by the American Water Works Association (AWWA). The process used by the Bureau follows the Commodity Demand method set by the AWWA. Under this approach, developed for the Bureau by Raftelis Financial Consultants, Inc in 2006, water system costs are allocated to customers based on their average and peak water demand characteristics and use of the system. Retail rates are then established based on the residual financial requirements of the system.

The Bureau assesses both a volumetric usage charge and a fixed monthly base charge. A monthly base charge is imposed on water services connected directly to the water system. The base charge is in addition to the rates charged for water usage.

Financial Plan and Rate Setting Process

The Bureau annually prepares a requested budget and five-year financial plan. The Bureau's budget process includes a Budget Advisory Committee (BAC). The BAC meets between October and January to review and provide input on the requested budget including the five-year capital improvement plan and proposed retail rates. The financial plan includes operating and capital expenditure and expected rates for each year of the five-year forecast period. The requested budget and financial plan reflects the financial implications of the bureau's priorities, strategies, and service levels.

The financial planning process lays the groundwork for setting rates. Section 11-105 of the City Charter authorizes the City Council to fix fees and charges for connection to and use of the Water System. Water user fees and connection charges are formally reviewed every year by the Bureau. Rates required to support proposed activities for the next year are submitted by the Bureau Administrator to the City Council for review and approval.

Water Funds

The Bureau's financial system is organized into three separate funds:

- The Water Operating Fund serves as the operating fund of the Bureau and, with the exception of debt service; all expenditures made from this fund are for operation and maintenance of capital assets. Receipts from the sale of water are the primary source of revenue for the Water Operating Fund. The cash flow in this fund determines the need for rate increases. The Rate

Stabilization Account is within the Operating Fund.

- The Water Construction Fund is the recipient of proceeds from bond sales to provide for the funding of water system capital improvements. Other sources of revenue include reimbursements for capital expenditures, such as main extensions and service installations, system development charges and sale of assets. Also, a portion of the water sales revenues is transferred to this fund to finance routine system repair and replacement. The Water Construction Fund reimburses the Water Operating Fund for capital asset requirements including capitalized overhead, capitalized interest, and the cost of issuing bonds.
- The Water Bond Sinking Fund provides for the repayment of bonded debt and interest incurred in conjunction with construction of water system facilities. The revenue bond reserve accounts are also maintained in the Sinking Fund. The source of revenue for this fund is a transfer from the Water Operating Fund, reduced by interest earnings on fund balances and a transfer from the Water Construction Fund of interest earnings on bond proceeds.

These three funds enable the Bureau to segregate resources for specific uses and ensure that reserves are not used to supplement daily operating needs. Maintenance of the fiscal integrity of each fund is a key objective of the Bureau's financial planning and analysis efforts.

Anticipated Revenues

The bulk of the Bureau’s CIP is financed by Water revenue bonds. Though not required by bond covenants, the Bureau’s planning standard is to set rates such that Net Revenues provide at least 1.90 times debt service coverage on First Lien Bonds. Additionally, the Bureau maintains a planning standard that results in Stabilized Net Revenues providing at least 1.75 times coverage on the Combined Annual Debt Service (as defined in the Master Second Lien Water Revenue Bond Declaration) for both First and Second Lien Bonds. These standards exceed the debt service coverage required by bond covenants.

Additional revenues to support the capital plan include cash financed capital funding from rate revenues, system development charges, new services and main reimbursements, City interagency reimbursements on capital projects, and sales of assets.

Revenue and expenditure comparison

The Bureau plans for a minimum fiscal year-end operating cash reserve of $15.0 million in the Operating Fund. This represents about 45 to 60 days of operating costs. This standard conforms to the generally accepted industry standard for such reserves, and has been approved by the Office of Management & Finance as a reasonable amount for this reserve.

The Bureau also has a Rate Stabilization Account (RSA) within the Water Operating Fund that is used to smooth rate increases over the financial planning period and beyond. This smoothing is one of the Bureau’s key financial planning objectives and is aimed at maintaining financial stability and predictability.

Financial challenges, unmet needs and risks

The Bureau’s financial projections include key assumptions underlying the revenue and expenditure forecast. Key assumptions in the revenue forecast include:

- Retail water demand
- Wholesale water sales
- User charges
- Issuance of additional First Lien Bonds or Second Lien Bonds to fund capital program requirements

Key assumptions in the expenditure forecast include:

- Annual inflation
- The bureau's cost related to the City's outstanding pension obligation bonds
- Pension system contribution rates
- All costs related to compliance with the LT2 rule including regular monitoring and capital projects
- Continuing to operate under the Bull Run Treatment Variance[30]

[30] On March 14, 2012, OHA issued a Final Order granting the City a variance to the treatment requirements of the LT2 Rule. The variance went into effect on April 1, 2012, and will be in effect for ten years as long as the City is able to meet a set of important conditions designed to protect the health of Portland drinking water customers. These conditions require the Bureau to continue to monitor Bull Run source water for *Cryptosporidium*, maintain all legal protections in the Bull Run, and monitor and manage any potential sources for *Cryptosporidium* contamination in the watershed. In the event of a first detection of *Cryptosporidium,* the Bureau is required to increase its monitoring efforts, coordinate with health officials to determine what, if any, impacts the detection may have, and communicate this information to its customers. The communications requirement in the variance conditions requires, at minimum, a press release to Portland-metro media outlets and posting of the information on the Bureau website if *Cryptosporidium* is detected at the intake. If one or more detections occur during this one-year period of increased monitoring, it is likely that OHA will revoke the variance.

8/31 handout

Portland Water Bureau
Water Quality

PORTLAND WATER BUREAU
FROM FOREST TO FAUCET

18978

Date: August 30, 2016
Author: Sarah Messier

Lead Hazard Reduction Program (LHRP) Evaluations

LHRP Component: Water Treatment and Monitoring		
Report Date	**Report Title**	**Evaluator**
June 1999	**Water Treatment and Water Quality Monitoring Tier One Follow-up Study**	**PWB Staff**
This report summarizes the findings of an investigation conducted in April and May 1999 to better understand factors that contribute to elevated levels of lead and copper in the tap water for some Portland Water Bureau customers.		
June 2001	**Lead and Copper Monitoring Results and Data Analysis for September 2000**	**Kelly Mooney, PWB**
This technical memo summarizes the data analysis of the Lead and Copper Rule home sampling results for September 2000 and examines factors that have potential to affect lead levels.		
September 2003	**Review of Corrosion Control Practices for Portland Water Bureau Water Sources**	**Technical Advisory Committee (Gregory Kirmeyer, P.E., TAC Chair)**
Portland Water Bureau and the EPA convened a Technical Advisory Committee (TAC) to review the PWB corrosion control treatment practices, review monitoring results, and provide recommendations regarding several short-term and long-term issues.		
September 2004	**The effects of moving from consumption-based to Tier-1 home occurrence-based monitoring on lead compliance.**	**Reuben Snyder, PWB**
This analysis examines Tier 1 home data from before and after the Joint Monitoring Plan revision in 2003.		
June 2005	**Tier 1 Home Analysis for Fall 2004**	**Ann Richter, PWB**
The purpose of this report was to evaluate the results of the October 2004 Tier 1 home lead sample period and to determine why the lead 90th percentile increased from previous sampling periods.		
November 2005	**Tier 1 Home analysis for October 2005**	**Ann Richter, PWB**
The purpose of this report was to evaluate the results of the October 2005 Tier 1 home lead sample period and to determine why the lead 90th percentile decreased from previous sampling periods.		
March 2007	**LCR Tier 1 Home analysis for Fall 2006**	**Kristin Anderson, PWB**
Lead and Copper Rule Tier 1 home sample lead results from the Fall 2006 sampling period yielded a 90th percentile value of 0.017 mg/L, above the action level of 0.015 mg/L. An analysis of historic lead results was conducted to try and see what trends or relationships of lead to other water quality parameters are evident.		
July 2014	**Analysis of Fall 2013 LCR Tier One Home Lead Results**	**Sarah Silkie, PWB**
Lead and Copper Rule Tier 1 home sample lead results from the Fall 2013 sampling period yielded a 90th percentile value of 0.016 mg/L, above the action level of 0.015 mg/L. This memo presents an analysis of existing data is to see if there is any evidence of water system operations affecting lead levels, and to see if there are any other trends or relationships evident between the home lead results and other water quality parameters in the distribution systems.		
Fall 2017 (anticipated)	**Corrosion Study**	**Black & Veatch**
This study's objectives include better understanding of the causes of lead release in PWB's system and to identify data gaps and conduct additional sampling required to better understand the role of water quality on lead release.		

LHRP Component: Public Education and Community Outreach		
Report Date	**Report Title**	**Evaluator**
February 2001	**Prevalence of Lead Dust Hazards Study**	**John Dougherty, PhD, Program Design and Evaluation Services (PDES), Multnomah County Health Department (MCHD)**
The goal of this study was to understand the locations and amounts of lead dust hazards in older Portland homes.		
October 2002 – present	**LHRP Partner Quarterly Reports**	**PWB Staff**
PWB collects progress reports from LHRP community partners as a process measure evaluation. The quarterly reports are summarized in a PWB quarterly report, and reported to EPA in the semi-annual report.		
January 2003	**Portland Lead Hazard Control Program (PLHCP) Outreach and Education Program Evaluation**	**Stacy Edwards, PWB**
Provides a qualitative evaluation of the Portland Lead Hazard Control Program that compares program objectives with the types of activities, strategies, and messages actually being used.		
July 2004	**Drinking Water: Safeguarding the District of Columbia's Supplies and Applying Lessons Learned to Other Systems**	**John Stephenson, U.S. Government Accountability Office (GAO)**
At the request of the Subcommittee on Environment and Hazardous Materials, Committee on Energy and Commerce, House of Representatives, the GAO examined issues concerning lead in drinking water generally and the situation in Washington, D.C., in particular. The GAO examined the PWB LHRP as an example of how a water system notifies and educates its customers on lead health risks, and how it interacts with federal, state, and local agencies to respond to lead issues. The GAO visited the PWB, studied the program, toured LHRP partner education and testing events, and summarized its findings in this report.		
August 2005	**Community Energy Project Follow-Up Visit Evaluation Project**	**Elyce Brown, Community Energy Project**
CEP contracted John Dougherty to design an evaluation plan for the CEP Lead Poisoning Prevention workshops. CEP then implemented this plan and produced this report. An evaluation that is modified from the procedures in this report has been conducted annually through present, and the results are reported in CEP's Quarter 4 reports.		
March 2006	**How to Assess and Understand Your Community-Based Lead Education Program**	**John Dougherty, PhD, PDES**
Based on his work with CEP on their follow-up evaluations, John Dougherty developed an evaluation toolkit that other organizations can use to design and implement an evaluation program that is applicable for their program.		
July 2006	**Blood Lead Level Analysis**	**John Dougherty, PhD, PDES**
John Dougherty used GIS data of blood lead level testing from 2000-2005 to identify geographic and other patterns in the data that might inform lead hazard reduction outreach and education efforts by the Portland Water Bureau.		
May 2007	**LHRP FY2005-06 Evaluation**	**James Burke**
James Burke surveyed past clients or participants in LHRP activities conducted by the community partners in FY2005-06. The evaluation resulted in specific recommendations for each community partner to improve their services. In 2008, PWB staff conducted a follow-up evaluation by sending surveys to a random selection of participants who received services from the LeadLine, PWB targeted home outreach, and Growing Gardens. A summary document of these results was drafted but not completed.		
November 2009 – present	**LeadLine Postcard Survey**	**Scott Bradway/Sarah Messier, PWB**
PWB mails a simple postcard survey to people who called the LeadLine in the previous quarter to evaluate this service. This postcard continues to be mailed out quarterly. Results are reported in PWB quarterly reports and to the EPA in the semi-annual reports.		

LHRP Component: Public Education and Community Outreach (cont.)		
Report Date	**Report Title**	**Evaluator**
February 2015 – present	**LeadLine Email Survey**	**Sarah Messier, PWB**
PWB emails a link to a simple survey to people who emailed the LeadLine in the previous quarter to evaluate their experience with the LeadLine. This email continues to be sent out quarterly. Results are reported in PWB quarterly reports and to the EPA in the semi-annual reports.		
December 2017 (anticipated)	**LHRP FY2016-17 Evaluation**	**David Dowler, PhD, PDES**
The objective of the evaluation is to answer questions regarding the efficacy in the LHRP grantees in reaching targeted subgroups, and raising awareness and knowledge around community lead hazards and resources for reducing exposure to lead.		

LHRP Component: Lead in Water Education and Testing		
Report Date	**Report Title**	**Evaluator**
March 2000	**Report on Analysis of Kitchen Sink Tap Water Lead Concentrations from Customer Requested Lead-in-Water Tests**	**John Dougherty, PhD, PDES**
John Dougherty conducted an analysis of the PWB customer data after corrosion control treatment started to determine, in part, the age of home most at-risk for lead in water.		
January 2003	**Lead in Water Education and Testing Program Pilot Program Evaluation**	**John Dougherty, PhD, PDES**
The evaluation focused on the target populations who called the LeadLine, persons who participated in water testing, on participant satisfaction with the LWET, and on changes in behavior that reduce exposure to lead in water.		
February 2004 – present	**Annual Review of LWET Data**	**PWB Staff**
This annual report analyzes the data of the customer-requested lead-in-water kits to identify historical and new trends.		

LHRP Component: Portland Housing Bureau Home (PHB) Lead Hazard Control Program		
Report Date	**Report Title**	**Evaluator**
August 2001	**Portland Lead Hazard Control Program (PLHCP): Lead Hazard Reduction Follow-Up Evaluation Report**	**John Dougherty, PhD, PDES**
January 2010	**Portland Lead Hazard Control Program (PLHCP): Lead Hazard Reduction Follow-Up Evaluation Report: 2009**	**John Dougherty, PhD, PDES**
The purpose of these studies was to collect follow-up data on lead dust loadings in dwellings that have received lead remediation work by contractors hired through the Portland Development Commission as part of the Portland Lead Hazard Control Program (PLHCP), supported by a HUD-funded grant administered by the City of Portland Bureau of Housing and Community Development (BHCD).		

PORTLAND WATER BUREAU
FROM FOREST TO FAUCET

Nick Fish, Commissioner
Michael Stuhr, P.E., Administrator

1120 SW 5th Avenue, Room 600
Portland, Oregon 97204-1926
Information: 503-823-7404
www.portlandoregon.gov/water

187978

IMPACT STATEMENT

Date: July 6, 2016

Council Date: August 24, 2016

Legislation Title: Authorize an Intergovernmental Agreement in the amount of $56,250 with the Multnomah County Health Department for Program Evaluation Services of the Lead Hazard Reduction Program (Ordinance)

Contact Name: Scott Bradway

Contact Phone: 503-823-1951

Presenter Name: Scott Bradway

Purpose of proposed legislation and background information:
The purpose of this legislation is to authorize an Intergovernmental Agreement with the Multnomah County Health Department (MCHD) to provide program evaluation services for the Water Bureau's Lead Hazard Reduction Program (LHRP). The program evaluation will provide essential information related to the effectiveness of the program in reducing exposure to lead in the Bull Run service area.

The Water Bureau, through the LHRP, provides funding to community organizations to provide education and outreach to reduce exposure to lead hazards. The main objective of the LHRP is compliance with the Environmental Protection Agency's Lead and Copper Rule for drinking water. In 1997, the LHRP was approved by the State of Oregon as "optimized treatment" for compliance with the Lead and Copper Rule.

The LHRP has four components: treatment and monitoring; home lead reduction; lead in water testing; and education and outreach. The Water Bureau funds education and outreach programs for lead poisoning prevention through community partner programs. The Water Bureau will evaluate the education and outreach component of the LHRP to determine the effectiveness of the community partner programs in reducing the community's exposure to lead in the Portland area. The MCHD is capable and willing to provide the program evaluation services through its Program Evaluation and Design Services (PDES) group. The scope of work for this agreement has been developed to support the Water Bureau's compliance requirements with the Lead and Copper Rule.

Financial and budgetary impacts:
The not-to-exceed value of the Intergovernmental Agreement is $56,250 and is intended to last no longer than two years. Funding for the Intergovernmental Agreement is available in the FY 2016-17 Budget and will be requested in the FY 2017-18 Budget. The legislation does not create any staffing changes.

Community impacts and community involvement:
The result of the evaluation proposed in this legislation is anticipated to benefit the Portland community with regard to City livability and health. The LHRP education and outreach efforts have focused on targeting the most at-risk populations for lead exposure, which historically has been low income residents in older Portland neighborhoods. The evaluation will examine: if the LHRP community partners are reaching the targeted, at-risk populations in the Portland community; if the LHRP partners are raising awareness and knowledge about lead hazards in the community; and, if the populations reached by LHRP partners are using LHRP partner resources to reduce lead exposure.

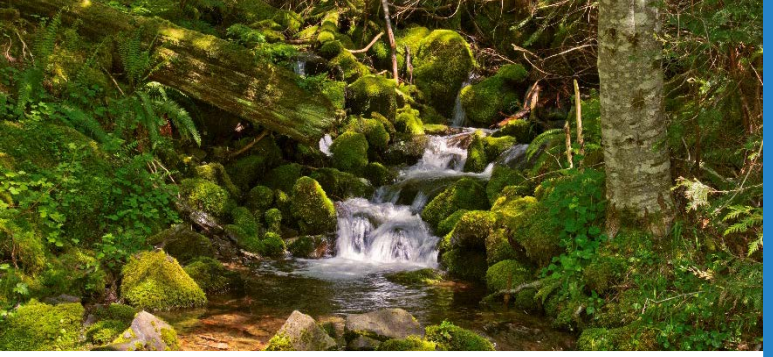
Budgetary Impact Worksheet

Does this action change appropriations?

☐ **YES**: Please complete the information below.
☒ **NO**: Skip this section

Fund	Fund Center	Commitment Item	Functional Area	Funded Program	Grant	Sponsored Program	Amount

Michael Stuhr, P.E., Administrator — Date: 7/21/16



PORTLAND WATER BUREAU
LEAD AND COPPER RULE

August 22, 2016
Meeting with OHA and EPA

PORTLAND WATER BUREAU
FROM FOREST TO FAUCET

Presentation Outline

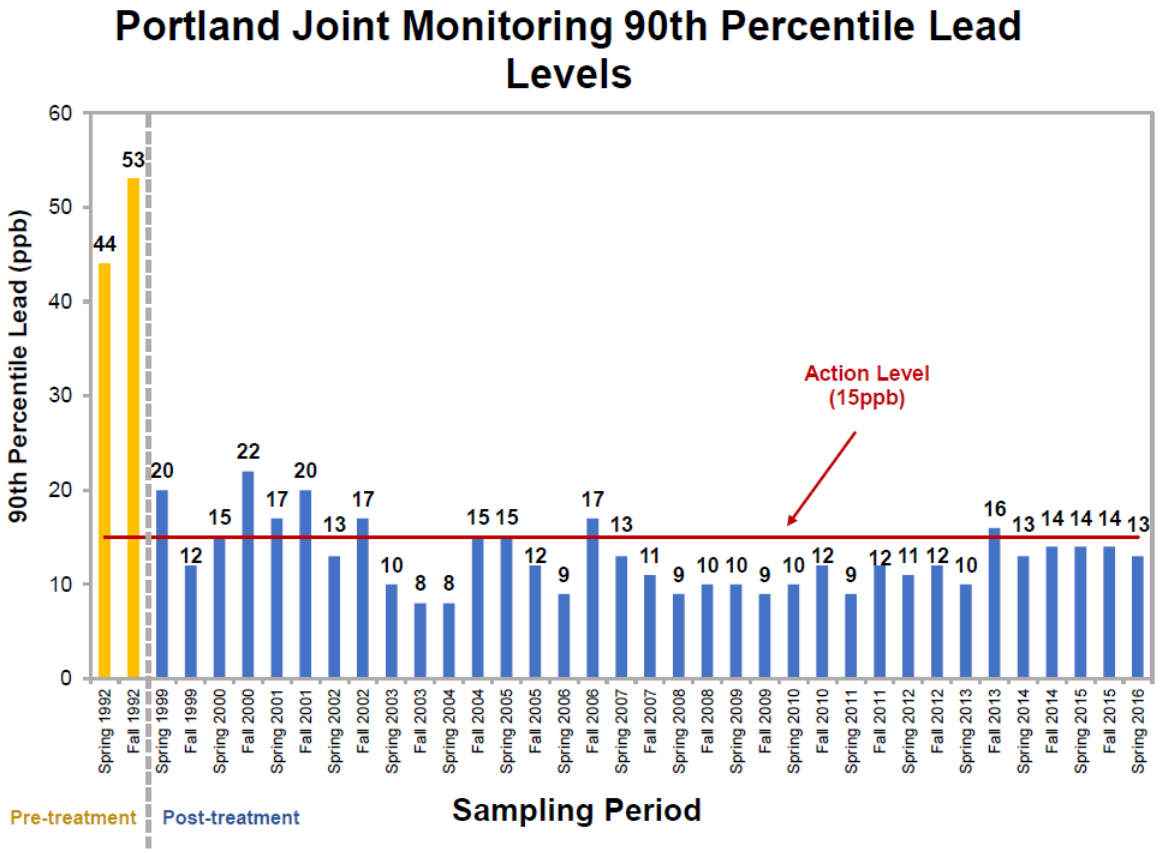
- Recap of April 21, 2016 meeting
- Update on PWB system
- Update on PWB's work with schools and daycares
- Update on customer sampling program
- Update on corrosion study
- Updated timeline
- Next steps

Recap of April 21, 2016 meeting

- Background on PWB and LHRP
  - LHRP Evaluation
- Introduction of Corrosion Study
  - Objectives and timeline
- Corrosion Control Decision Tree
  - Treatment considerations
  - Schedule considerations
- EPA's recommendations for testing select schools and daycares

System updates since April

- Spring LCR Monitoring
- Washington Park – Res 3
  - Lawsuit
- Corrosion study – on-going
  - Q2 report
- LHRP Evaluation going to Council on August 31



PWB's work with schools

- Portland Public Schools (PPS)
  - March – met with PPS to offer sample analysis of district wide sampling (per 3T) ~5000 samples.
  - May – PPS accelerated its sampling to be completed in the second half of June.
  - June – PPS sampled all water fixtures in schools – fountains, classroom/bathroom/utility/kitchen sinks, showers, hose bibs, etc.
  - June and July – PWB analyzed 1814 samples from PPS.
- Other Schools
  - May – PWB met with representatives from all Portland area public schools and offered technical assistance and free sample analysis.
  - August – PWB sent a letter to private schools in the Portland service area to offer technical assistance and free sample analysis.
- PWB is advising all schools to follow the EPA 3T guidance.
- Oregon Department of Education – Healthy and Safe Facilities

Portland Public School Results from PWB

- PPS sampled **all** water fixtures in schools – fountains, classroom/bathroom/utility/kitchen sinks, showers, hose bibs, etc.
- Levels much higher than found elsewhere including Community Centers.
- PWB reaching out to PPS to offer assistance in analyzing results.

	Portland Public Schools (PWB results only)			City of Portland Facilities
	All PWB Results	Consumptive	Non-consumptive	Consumptive
Number of Samples	1814	987	827	305
Minimum Lead Result (ppb)	ND	ND	0.22	ND
Maximim Lead Result (ppb)	13000	1950	13000	447*
Percent of Total Samples	100%	54%	46%	100%
Mean Lead (ppb)	34.1	21.7	48.9	6.50
Percent of Samples > 20 ppb Lead	22%	17%	29%	5.6%

PWB's work with daycares

- Emails and letters sent to 612 in-home daycares
  - 44 responses so far
- Letters with return postcard sent to 300 daycares in 8 languages
- Centers – Sending emails and letters to 261 centers
  - Offering analysis and technical assistance in sampling per 3Ts
- Provided analysis and assistance to other daycare providers upon request such as Headstarts

PWB's work with City Facilities

Prioritized sites:

1 - Infants, children, pregnant women primary population:
27 locations – 4 remaining to test

2 - Primarily serve the public:
372 locations

3 - Built or Plumbed 1985 or earlier:
96 locations

4 - All Other:
269 locations

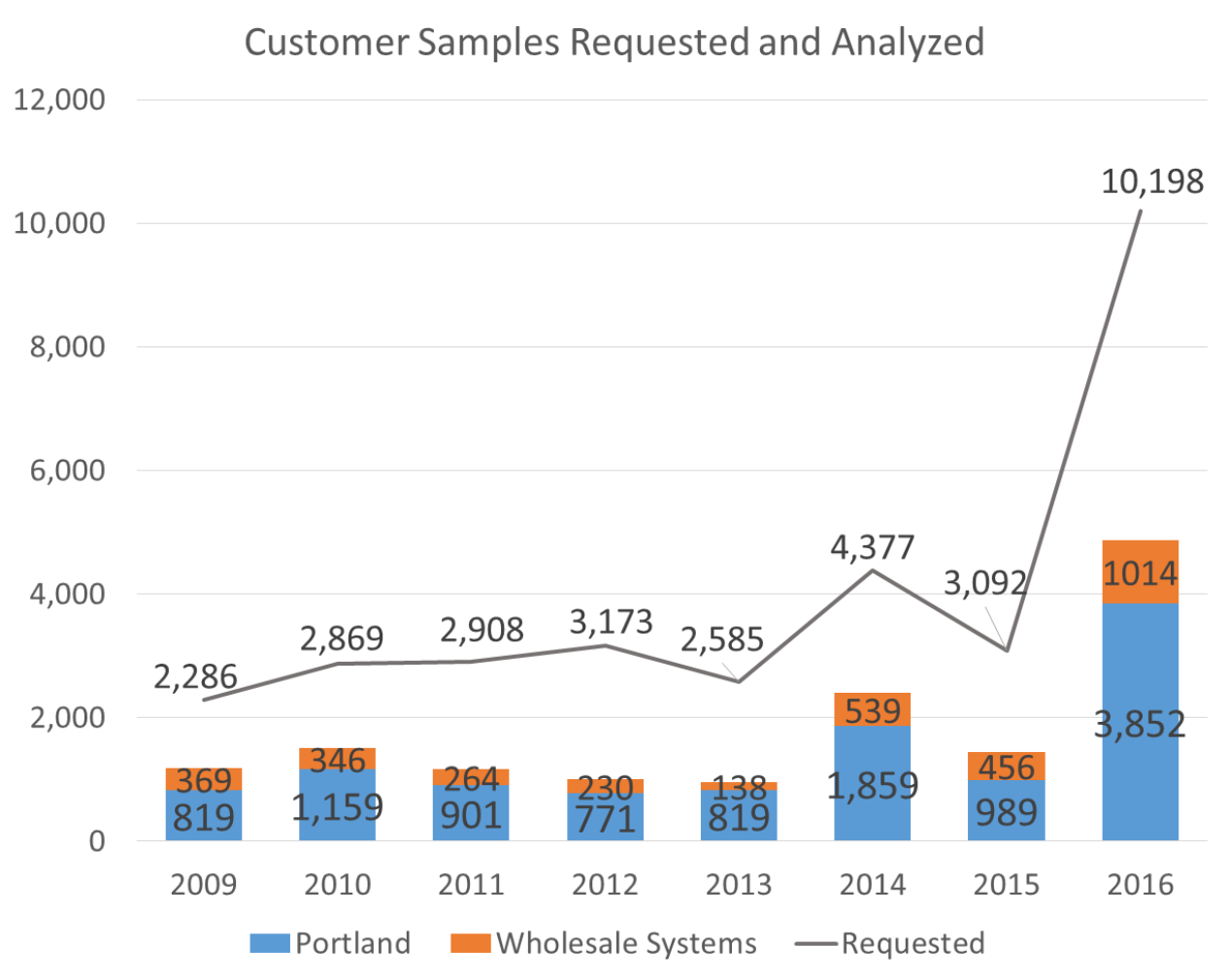
PWB sampling using 3Ts and providing guidance on communicating results.

PWB's LHRP: Lead in Water Education & Testing

Voluntary Customer Sampling

2016 (Jan-Aug) 90th Percentile

Portland: 4.3 ppb
Wholesalers: 9.4 ppb



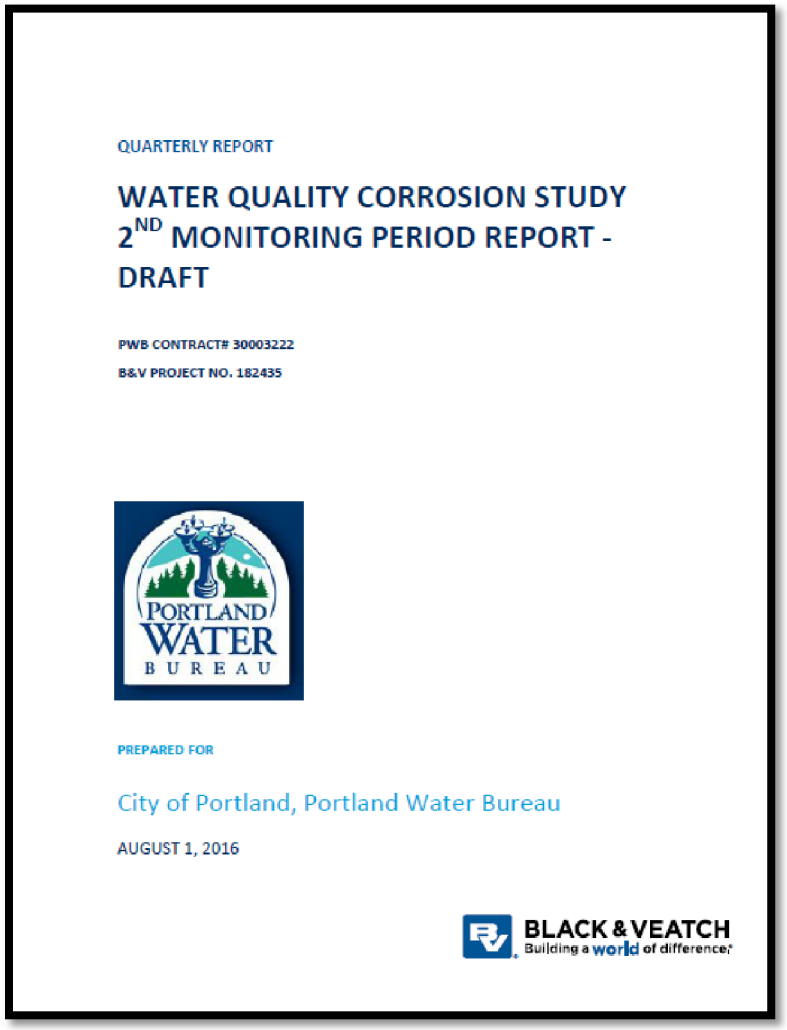
Presentation Outline

Corrosion Study

- Q2 Update and Preliminary Results

Corrosion Control Decision

- Decision Tree
- Schedule


QUARTERLY REPORT

WATER QUALITY CORROSION STUDY
2ND MONITORING PERIOD REPORT -
DRAFT

PWB CONTRACT# 30003222

B&V PROJECT NO. 182435

PORTLAND WATER BUREAU

PREPARED FOR

City of Portland, Portland Water Bureau

AUGUST 1, 2016

BLACK & VEATCH
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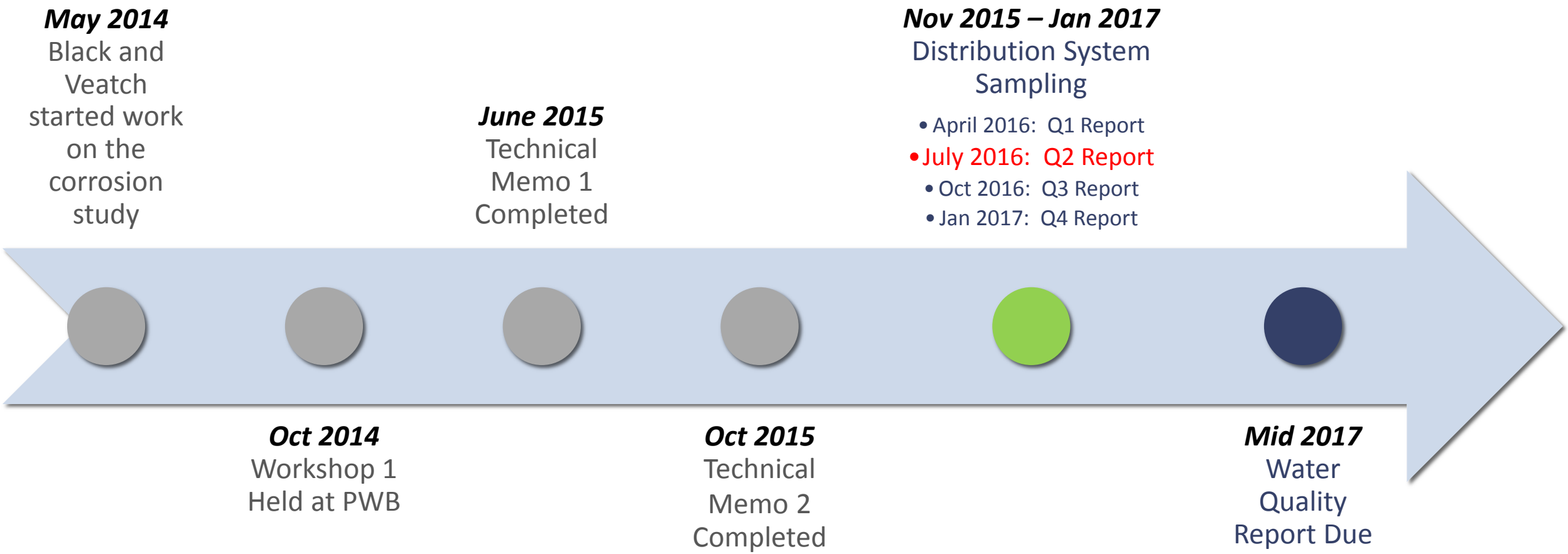
PORTLAND WATER BUREAU
FROM FOREST TO FAUCET

Water Quality Corrosion Study Project Timeline



Recap: Water Quality Corrosion Study Objectives

Project Objectives

- Better understand the causes of lead release in PWB's system
- Identify data gaps and conduct additional sampling required to better understand the role of water quality on lead release
- Specific questions to address include:
  - *Is uniform corrosion contributing to lead observed in LCR samples?*
  - *Is scale release (caused by hydraulic or physical disturbances) or dissolution (caused by chemical changes) contributing to lead observed in LCR samples?*
  - *What premise plumbing and fixture materials are contributing to lead release for PWB customers?*
  - *Is nitrification or other microbiological activity contributing significantly to lead release?*
  - *What impact does the use of groundwater have on lead release?*
  - *Are operational changes affecting lead release in the distribution system? If so, how?*

Recap: Study Sampling Plan

Utilize data from existing programs:

- TCR
- Nitrification
- LCR (tier one homes and water quality parameters)
- Voluntary customer sampling

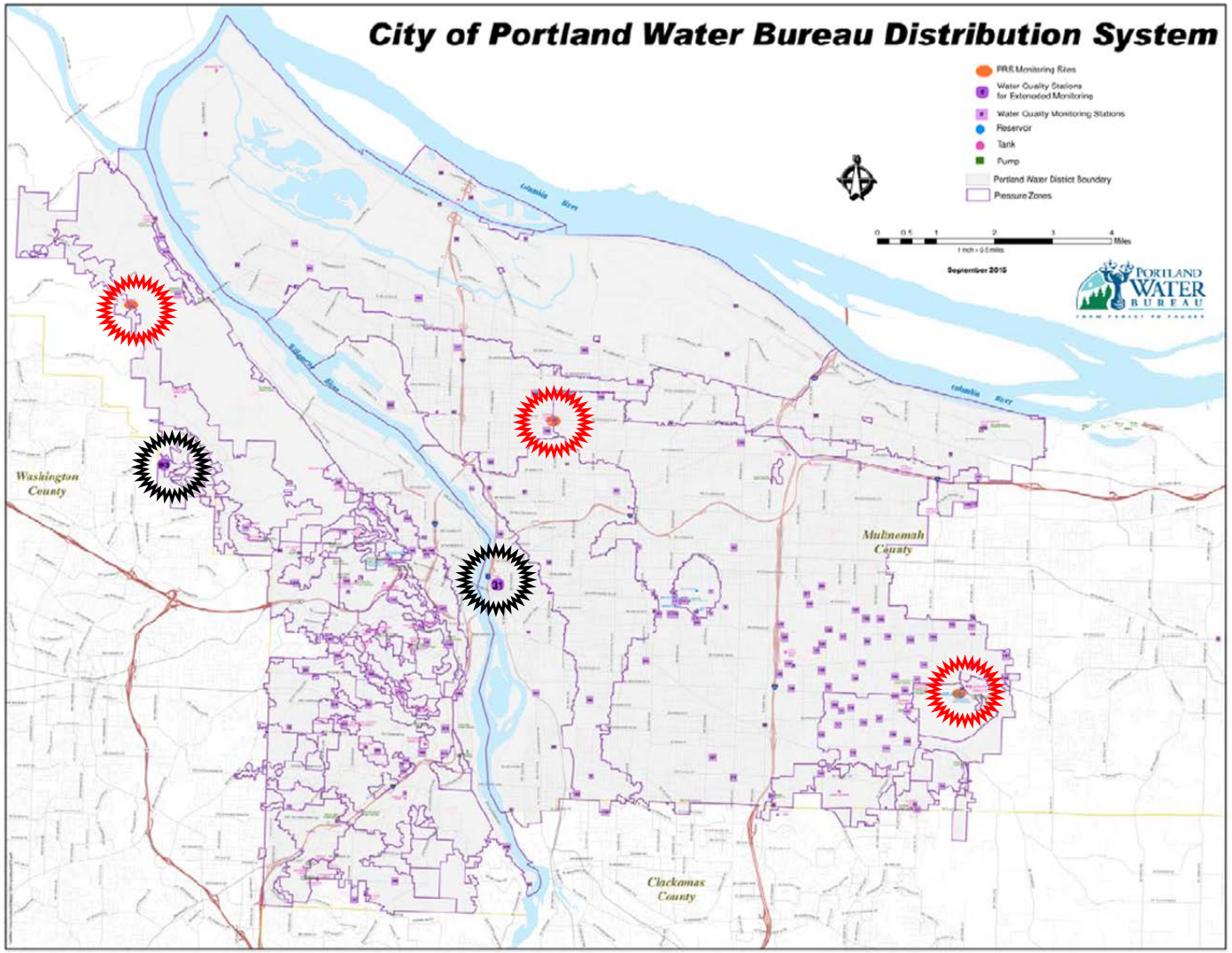
Collect new data:

Weekly sampling over the course of a year in the distribution system

- 3 Process Research Solution (PRS) Monitoring Stations were installed
- 2 distribution system sites

Follow-up sampling at select LCR and customer homes

- Goal is to sample ~ 50 customer homes as well as several of PWB's Tier 1 homes with elevated lead levels



= PRS Stations

= Distribution system sites

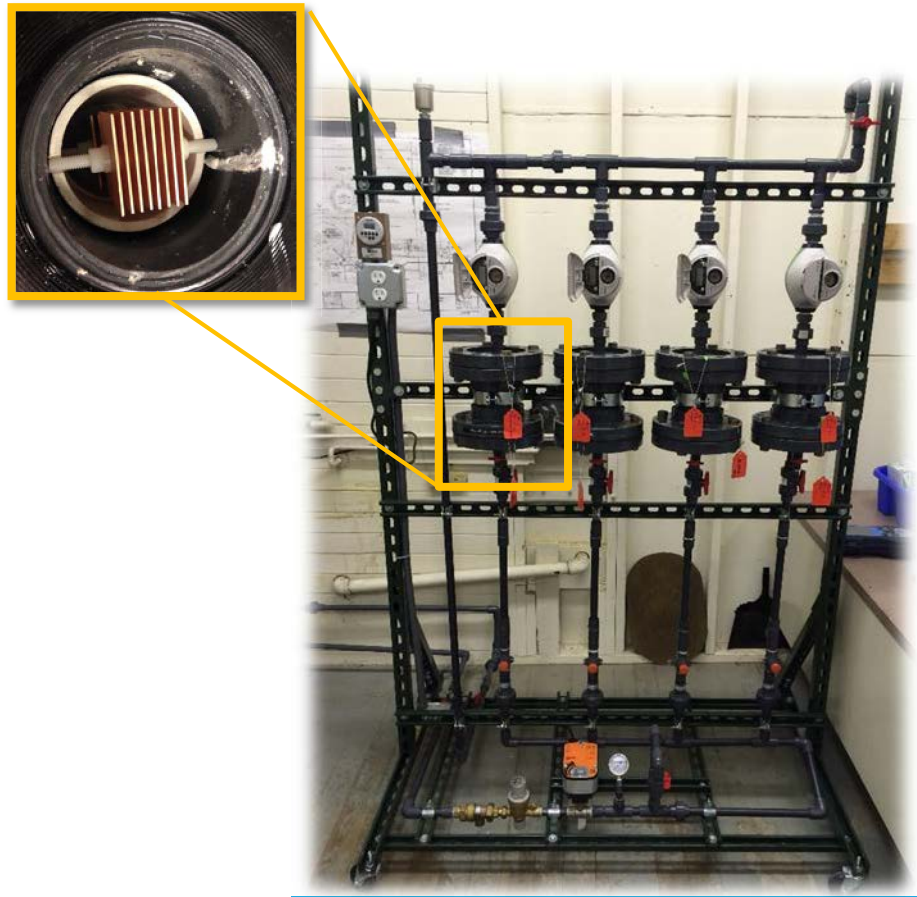
Recap: PRS Stations

These stations allow for controlled stagnation cycles to replicate worst case water quality as seen in customer homes

- Previous PRS monitoring station results have tracked well with LCR first draw samples in other systems

Each station includes four stagnation chambers, each containing different metal types

- Copper with Lead Solder
  - Represents material commonly found in Portland Tier 1 homes
- Galvanized Iron
  - Galvanized iron plates represent indoor piping and plumbing fixtures commonly found in Portland homes
- Brass
  - Similar to galvanized iron, brass plates represent indoor piping and plumbing fixtures commonly found in Portland homes
- Lead
  - Even though PWB does not have lead service lines, lead is used in order to magnify the response of lead to the water characteristics



Parameters Monitored As Part Of The Water Quality Corrosion Study

Field

- pH
- Temperature
- ORP
- Chlorine residual
- Monochloramine
- Free ammonia
- Turbidity
- Conductivity
- ATP

Lab

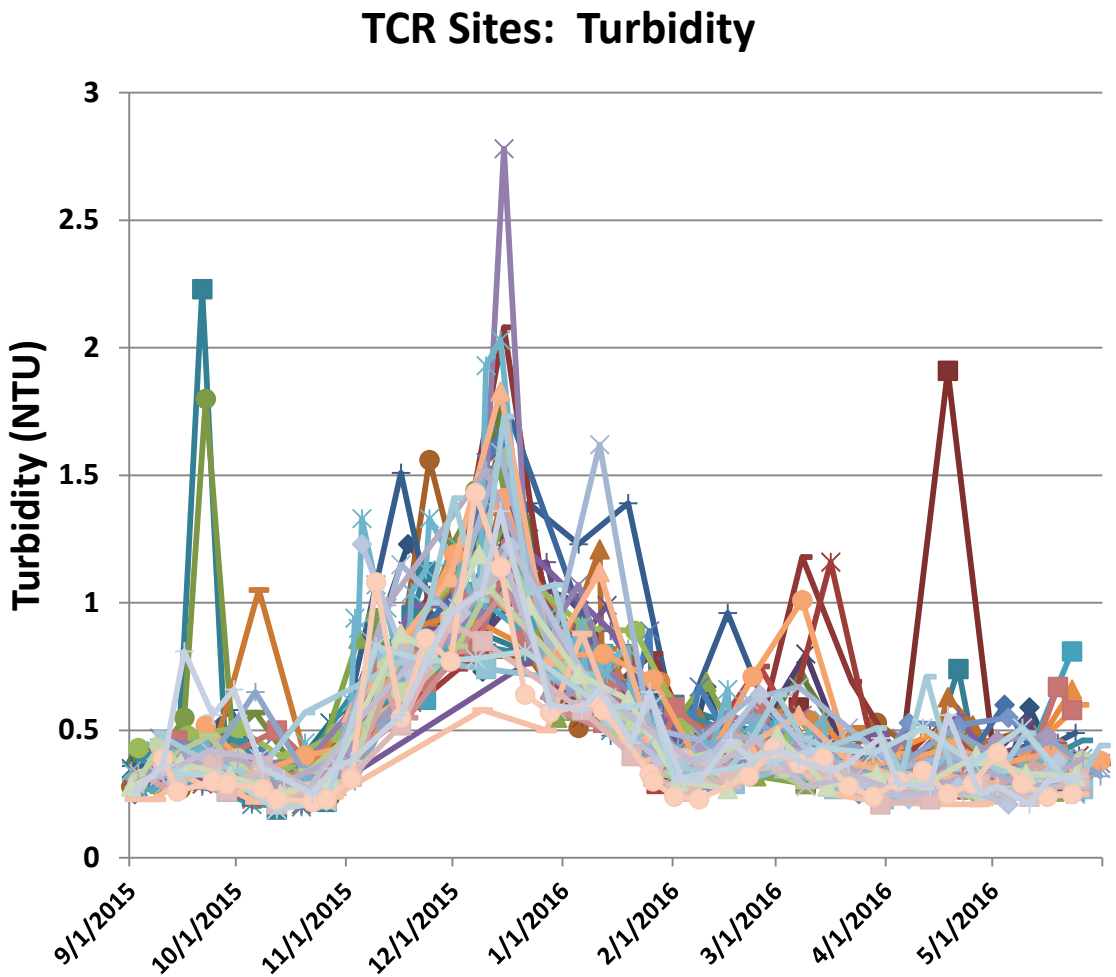
- Total and dissolved metals
  - lead, copper, aluminum, arsenic, cadmium, calcium, chromium, cobalt, iron, magnesium, manganese, nickel, zinc
- Total organic carbon
- Dissolved organic carbon
- Total phosphorus
- Alkalinity
- Hardness
- Chloride
- Sulfate
- Nitrate
- Nitrite
- TDS

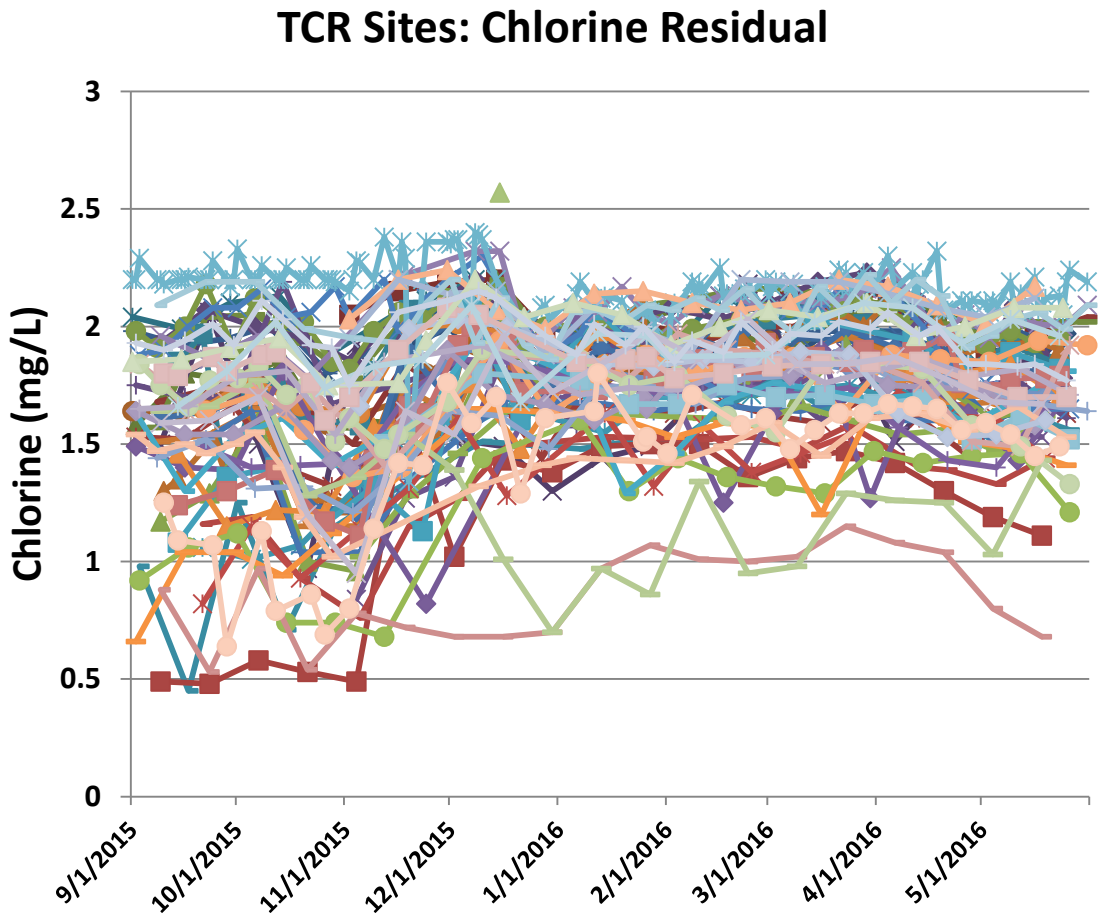
Data Sets Used in the Corrosion Study

Data Set	TCR Monitoring (Alk, Cl2, pH, Temp., Turbidity)	Nitrification Monitoring (Cl2, ORP, HPC, Free NH3, Nitrite, Nitrate, pH, Temp., Turbidity)	LCR Compliance (Total Pb, Cu, Fe, Mn, Zn)	WQP Compliance (Alk, pH)	Voluntary Lead* (Total Pb, Cu, Fe, Mn, Zn)	Supplemental In-home (All parameters)	Extended WQSS and PRS Station (All parameters)
Uniform Corrosion	Alk, pH, Temp.	ORP, pH, Temp.	Total Pb	Alk, pH	Total Pb	All parameters describing uniform corrosion	All parameters describing uniform corrosion
Biostability of Water	Cl2, Temp.	Cl2, Free NH3, Nitrite, Nitrate, ORP, Temp.	Total Pb, Cu	N/A	Total Pb, Cu	All parameters describing biostability	All parameters describing biostability
Scale Transport	Turbidity	Turbidity	Total Pb, Cu, Fe, Mn, Zn	N/A	Total Pb, Cu, Fe, Mn, Zn	All parameters describing scale transport	All parameters describing scale transport

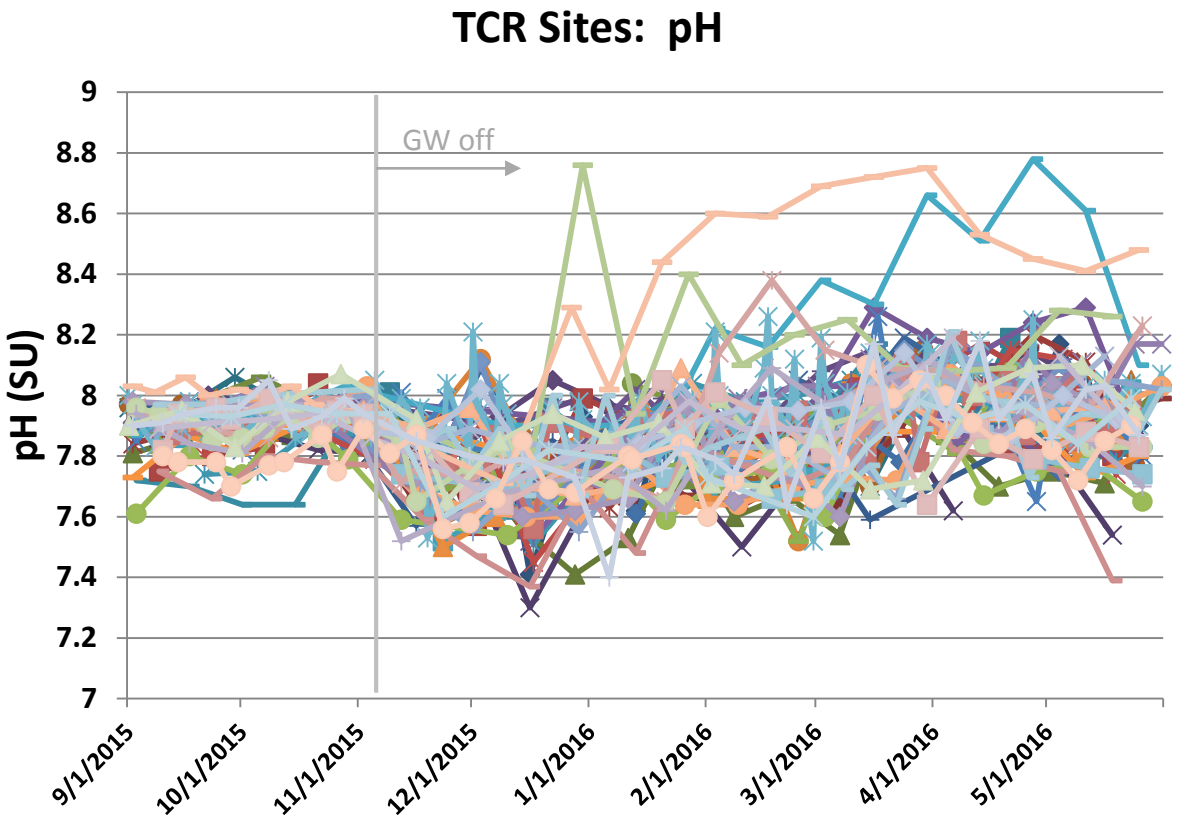
Notes:
* Currently lead is the only parameter measured due to high sample volume

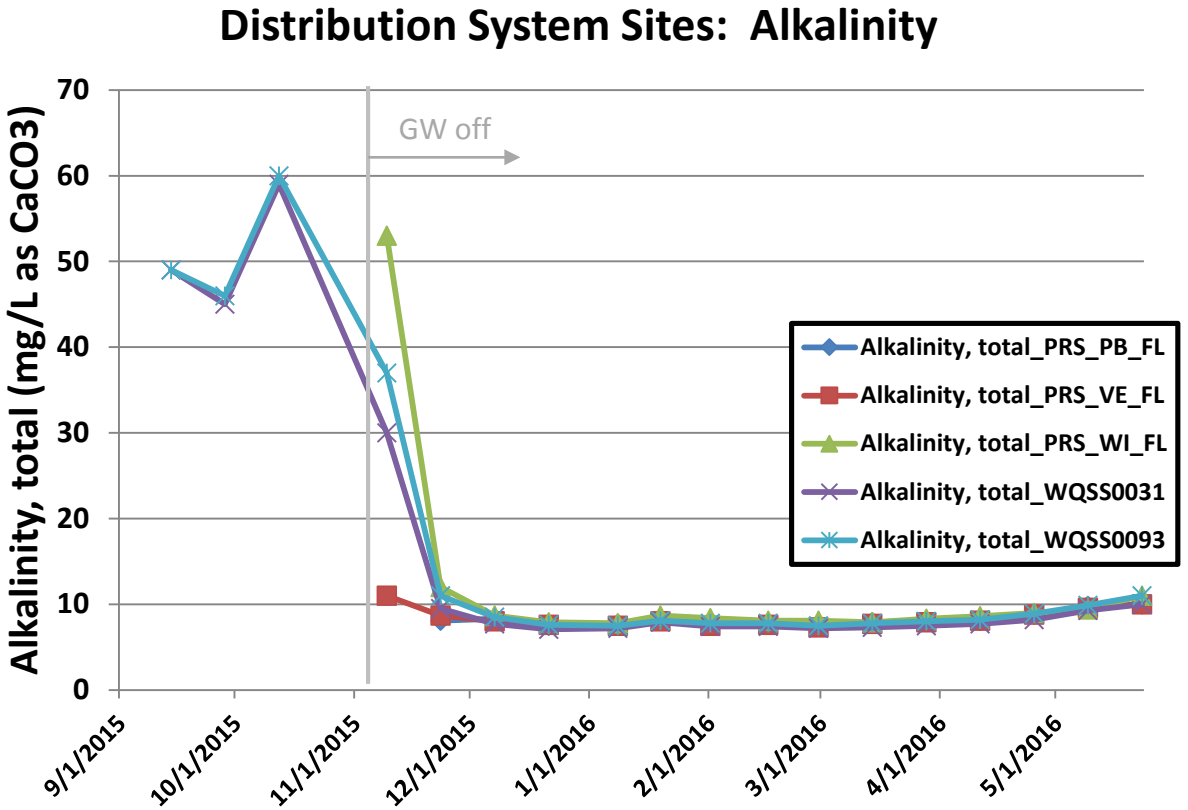
TCR Results


TCR Sites: Turbidity
Turbidity (NTU)
3
2.5
2
1.5
1
0.5
0
9/1/2015
10/1/2015
11/1/2015
12/1/2015
1/1/2016
2/1/2016
3/1/2016
4/1/2016
5/1/2016


TCR Sites: Chlorine Residual
Chlorine (mg/L)
3
2.5
2
1.5
1
0.5
0
9/1/2015
10/1/2015
11/1/2015
12/1/2015
1/1/2016
2/1/2016
3/1/2016
4/1/2016
5/1/2016

Effect of Groundwater





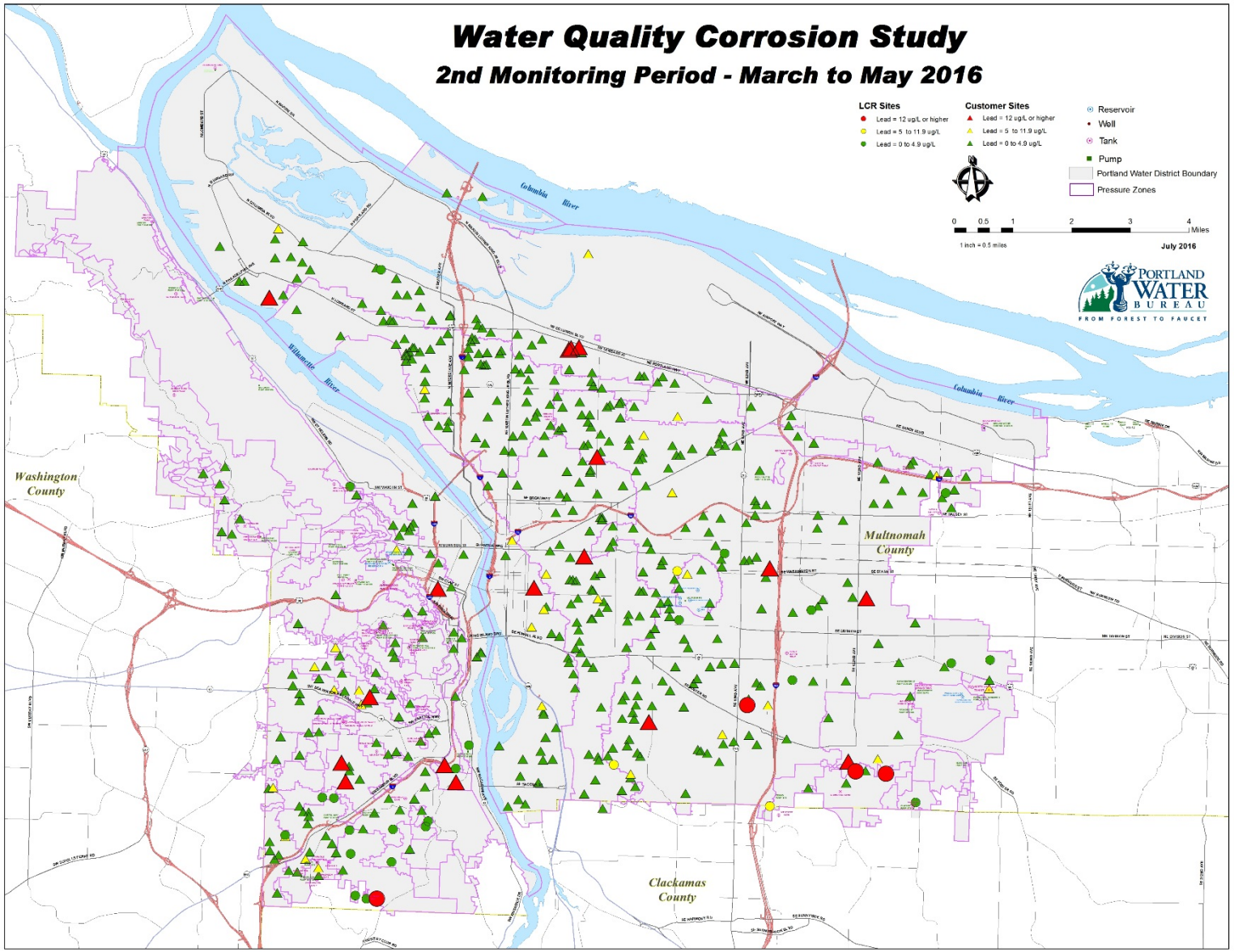
Lead Observed During Q2 (Customer And LCR Samples)

Voluntary customer samples

- The 90th percentile lead concentration for the voluntary customer samples analyzed in Q2 was 5 ug/L
  - Slightly up from 4.3 ug/L for the voluntary customer samples analyzed in Q1
- 15 of 550 voluntary customer samples (2.7%) exceeded 15 ppb
  - 4 of 271 samples (1.4%) exceeded 15 ppb in Q1 2016

LCR Tier One Home Samples

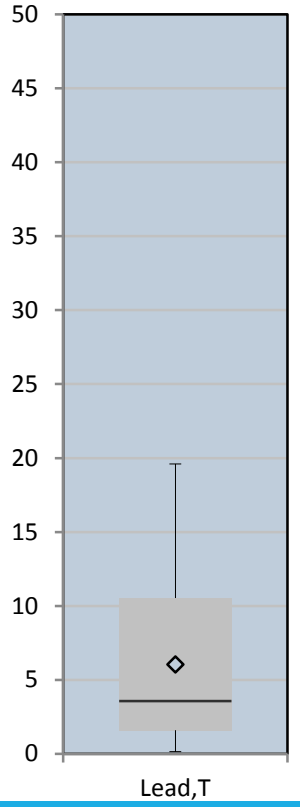
- 3 of 31 Portland homes had results over the action level



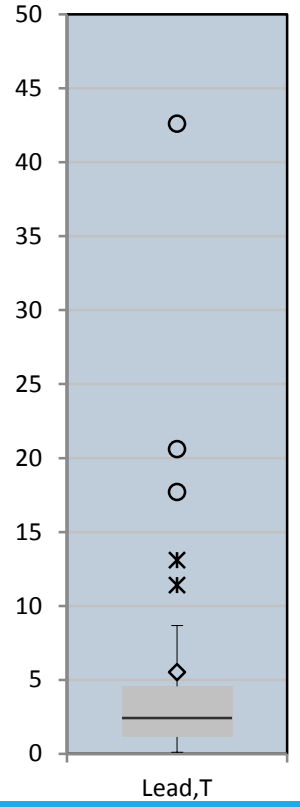
LCR Results (PWB Only)

LEAD

Q1 (Fall 2015)

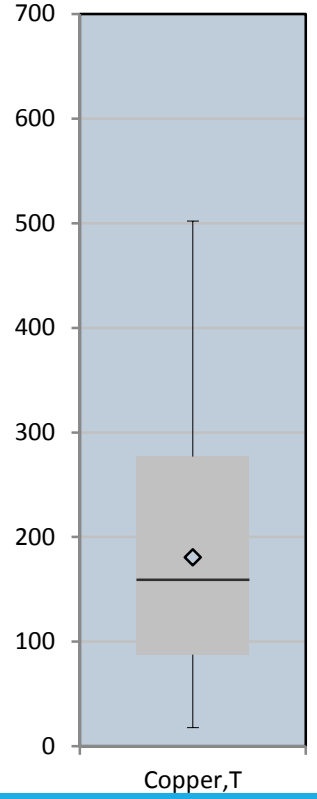


Q2 (Spring 2016)

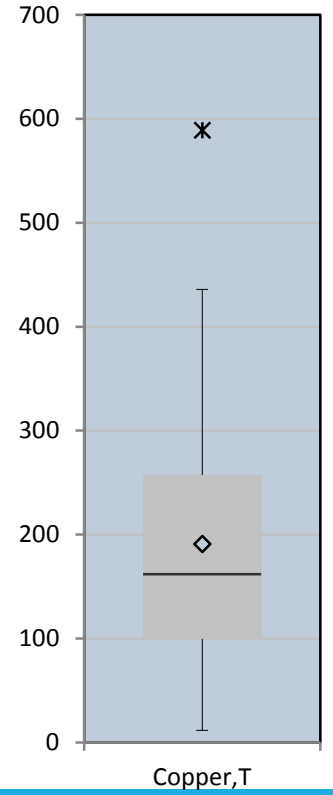


COPPER

Q1 (Fall 2015)

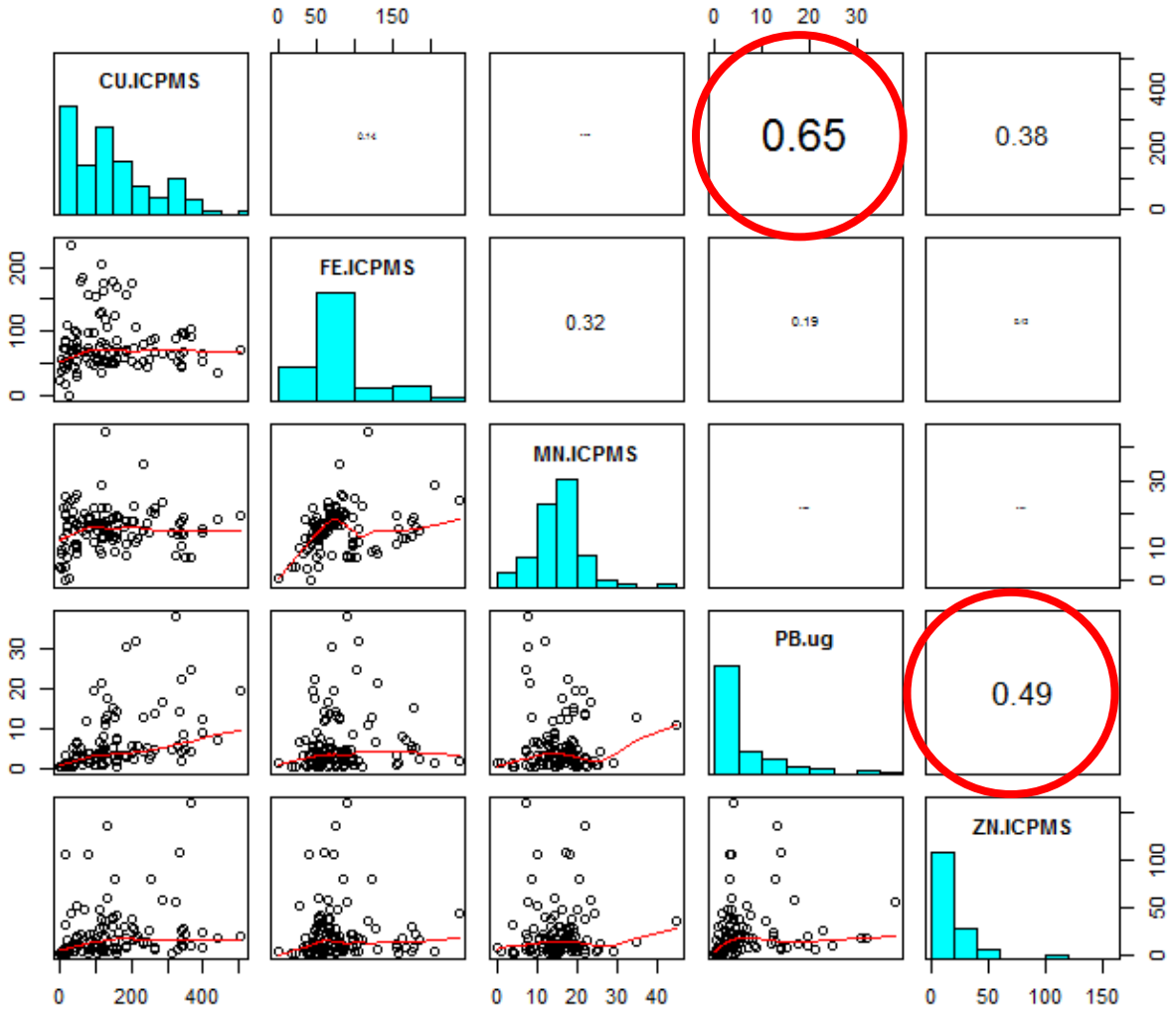


Q2 (Spring 2016)

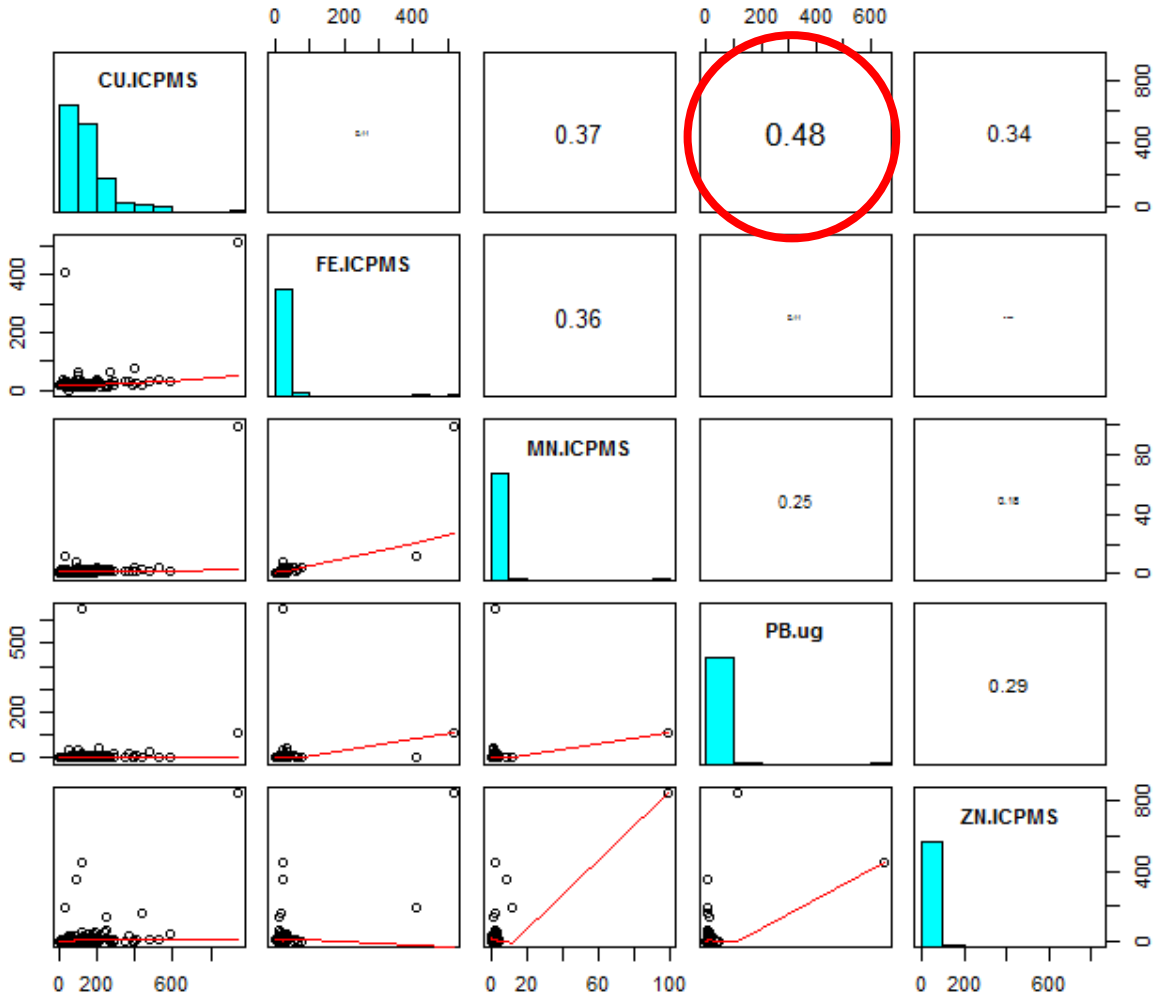


Metals Co-occurrence (LCR Data)

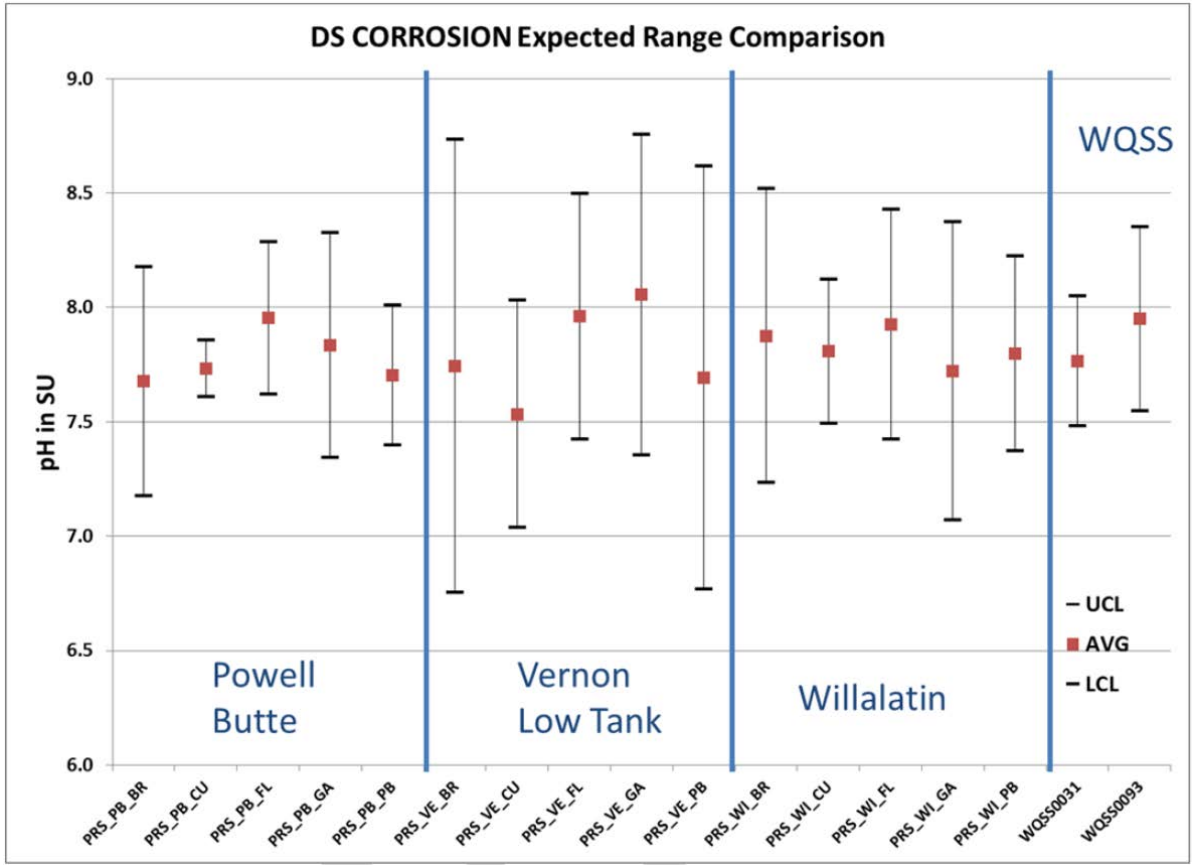
Q1 (Fall 2015)

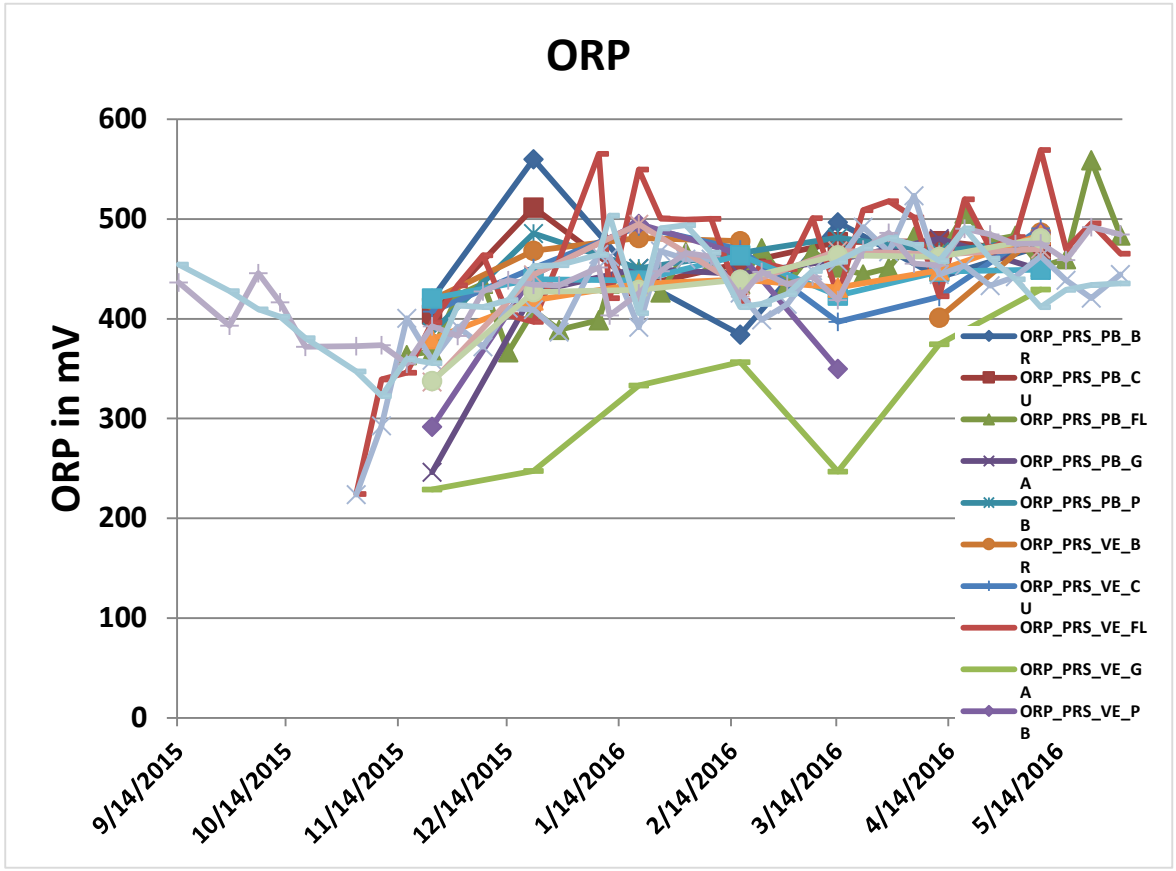


Q2 (Spring 2016)

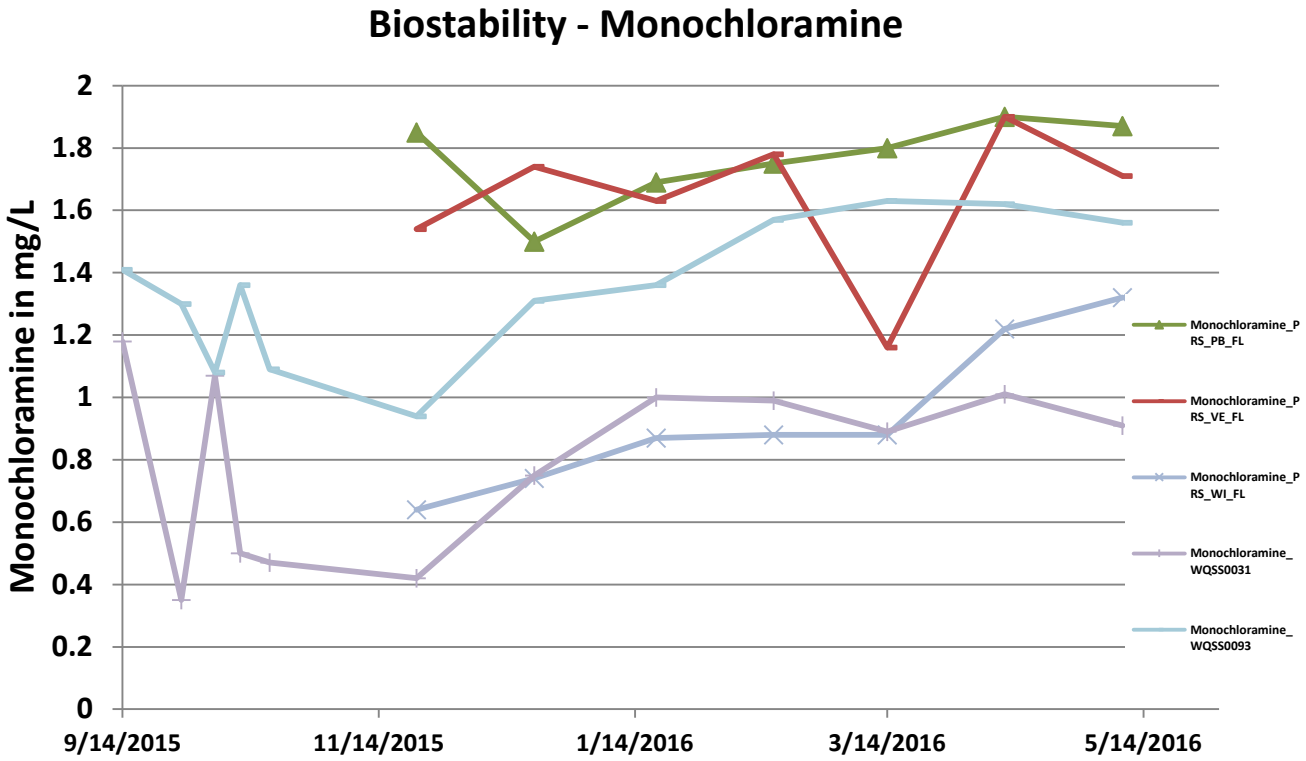


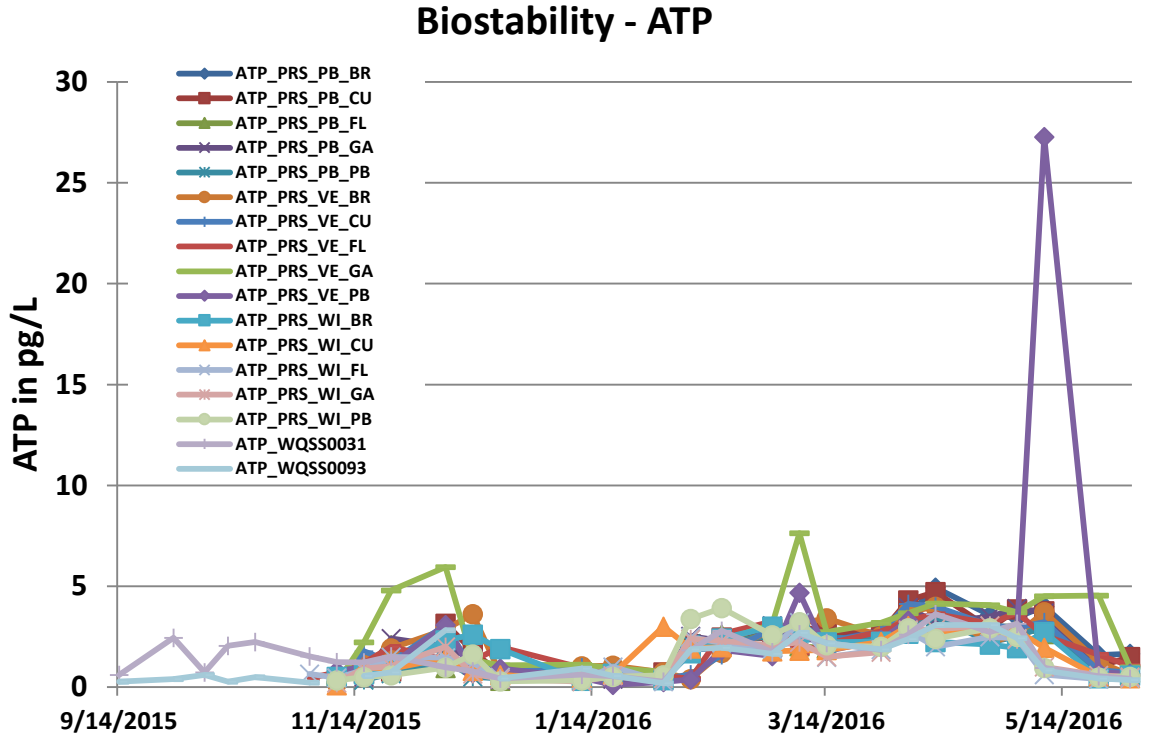
Preliminary Results: Uniform Corrosion



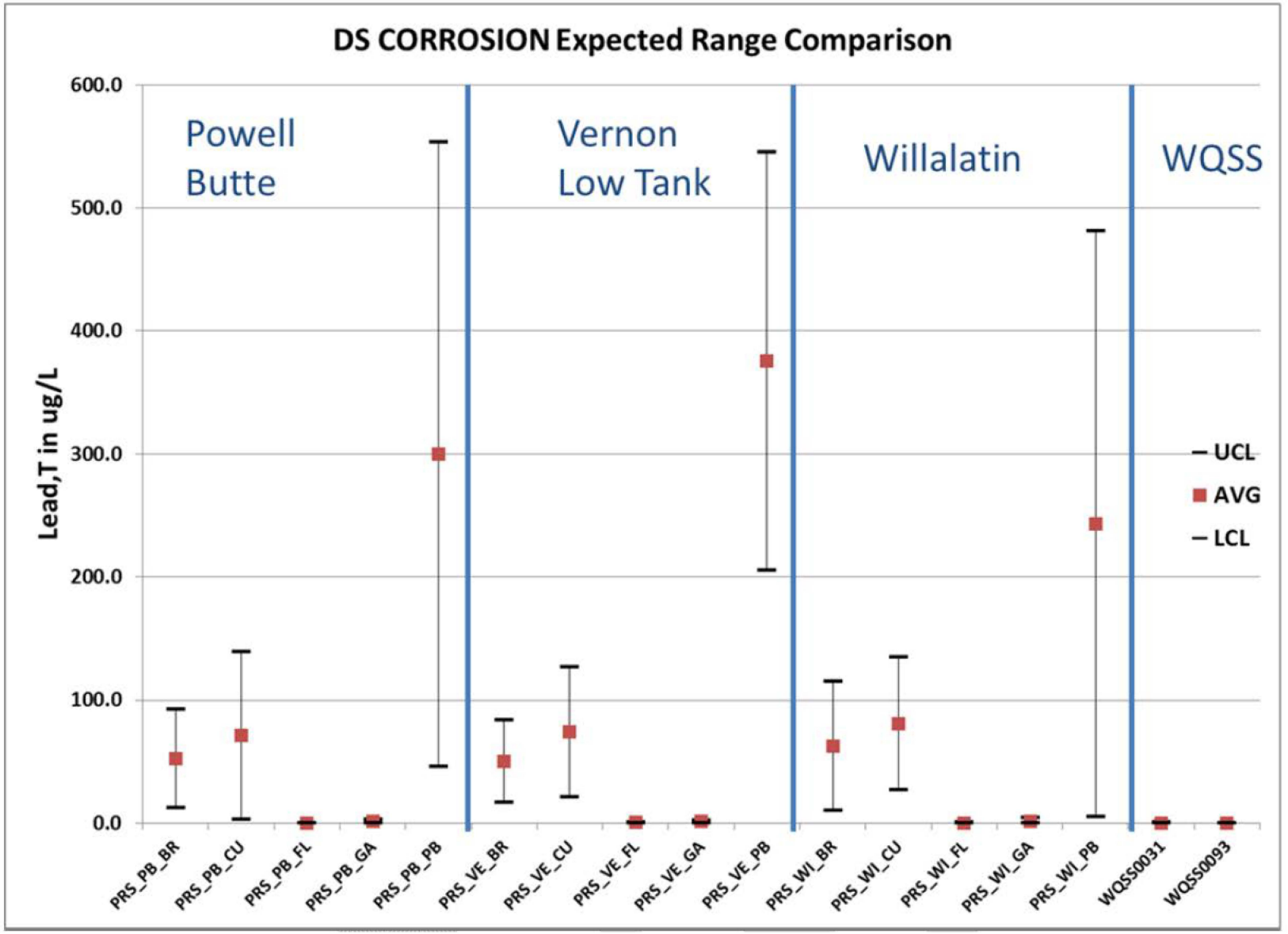


Preliminary Results: Biostability





Lead Release And Premise Plumbing Materials



Corrosion Indexes

Calcium carbonate precipitation potential (CCPP)

- CCPP for the Portland system in Q2 was generally between -6 and -7
- This indicates a very low potential for formation of calcium carbonate layer

Larson's ratio (LR)

- LR for the Portland system in Q2 was generally between 2 and 3
- This indicates that chloride and sulfate may be inhibiting lead carbonate formation and contributing towards increased lead solubility
- It is generally recommended to maintain a LR greater than 5 to ensure carbonate reactions are predominantly controlling lead solubility

Chloride to sulfate mass ratio (CSMR)

- The CSMR for the Portland system in Q2 was between 7 and 8
- While guidance varies, the literature suggests that values can increase the risk of galvanic corrosion when the ratio of chloride to sulfate is greater than 0.6

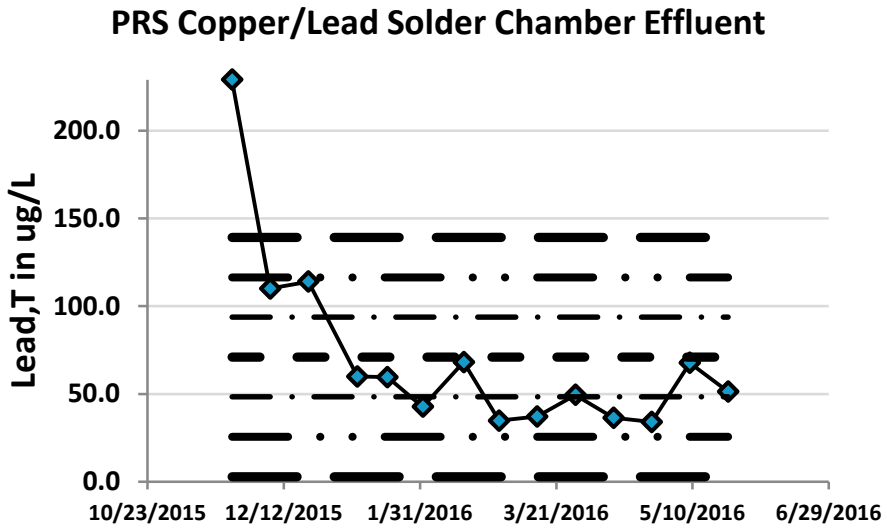
Q2 Results Summary

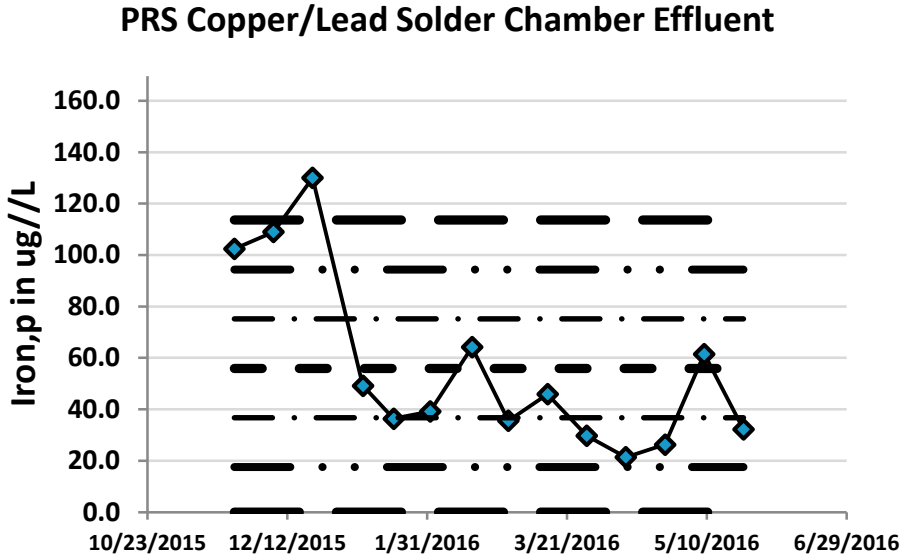
Roughly 50 to 70% of the total lead observed in the PRS monitoring station effluent and the supplemental customer sampling was in the dissolved form, indicating solubility processes related to lead release are occurring

Particulate lead release accounted for approximately 30% to 50% of the total lead release observed in most of the test chambers and supplemental customer sampling

- Occasional spikes in total lead were observed in the test chamber effluents that were predominantly in the particulate form
- These spikes in lead were strongly associated with similar spikes in particulate iron, manganese, and aluminum, indicating that release of these metal scales

Will continue to collect parameters that describe uniform corrosion to determine if a significant relationship exists between the water quality parameters and lead release





Water Quality Corrosion Study Objectives - Status

Project Objectives

• Better understand the causes of lead release in PWB's system	*DS sampling plan in progress*
• Identify data gaps and conduct additional sampling required to better understand the role of water quality on lead release	*Data gaps identified and mid-way through a sampling program designed to fill in those gaps*
• Is uniform corrosion contributing to lead observed in LCR samples?	*Yes, based on preliminary results it appears that uniform corrosion may be a significant factor in lead release in Portland's system*
• Is scale release (caused by hydraulic or physical disturbances) or dissolution (caused by chemical changes) contributing to lead observed in LCR samples?	*Q2 data indicates that this is also occurring*
• What premise plumbing and fixture materials are contributing to lead release for PWB customers?	*Preliminary results indicate copper/lead solder and brass fixtures may contribute most significantly in Portland's system*
• Is nitrification or other microbiological activity contributing significantly to lead release?	*Biostability has been good, but with nitrification season starting in Q3, more data should be available*
• What impact does the use of groundwater have on lead release?	*Q3 data should provide more insight to evaluate this*
• Are operational changes affecting lead release in the distribution system? If so, how?	*An operations log is being maintained and unusual water quality results will be investigated to evaluate whether operational changes could have caused these issues*

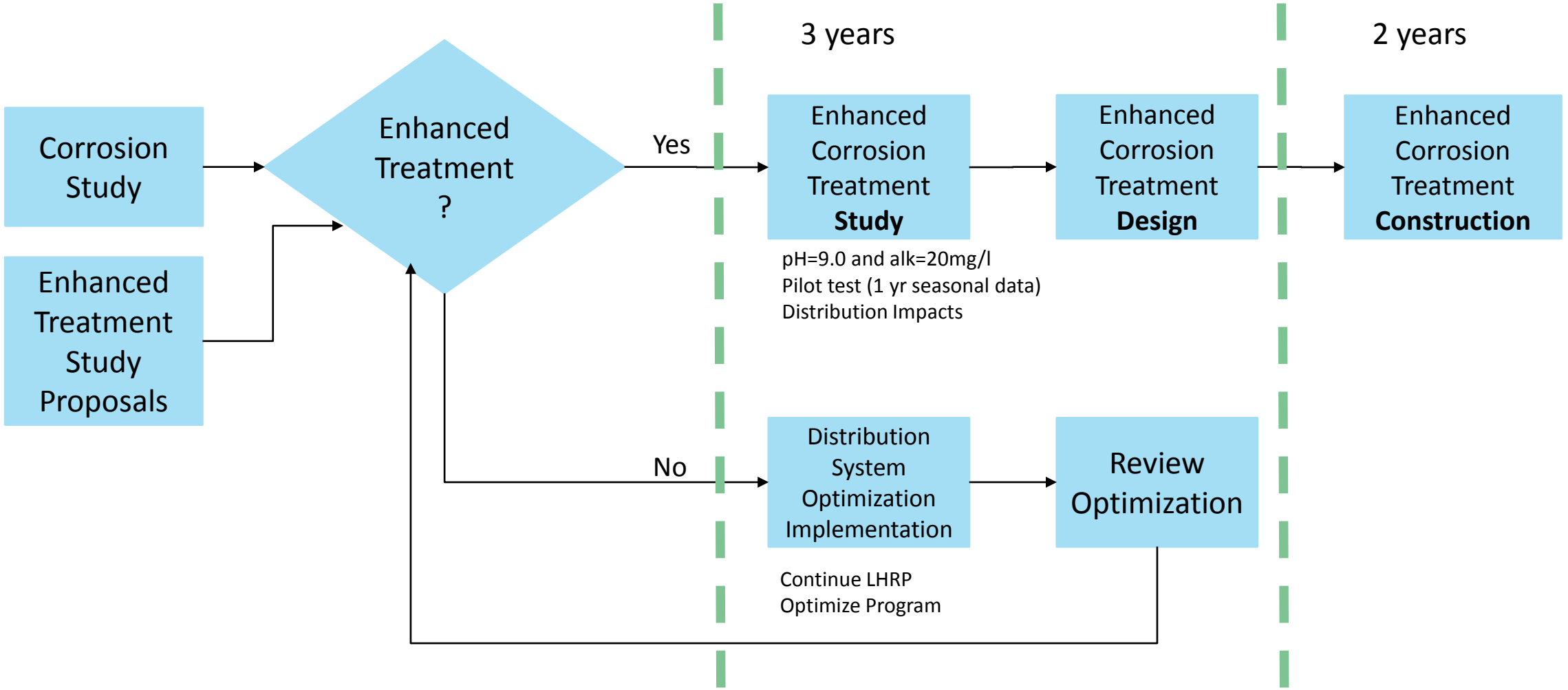
Corrosion Control Decision Treatment Considerations (Recap)

- Meet OCCT requirement of LCR
- Reduce corrosiveness of our water
  - Reduces lead and copper
  - Potentially extend useful life of our pipes
- Water should become more stable
  - System pH would be more consistent
  - Potential for greater formation of monochloramines above pH 8
- WQ Impacts – want to avoid unintended consequences
  - Potential red water
  - DBPs – THMs might increase, but HAAs might decrease
  - Aesthetics
  - Unknown

Corrosion Control Decision Treatment Considerations (Recap)

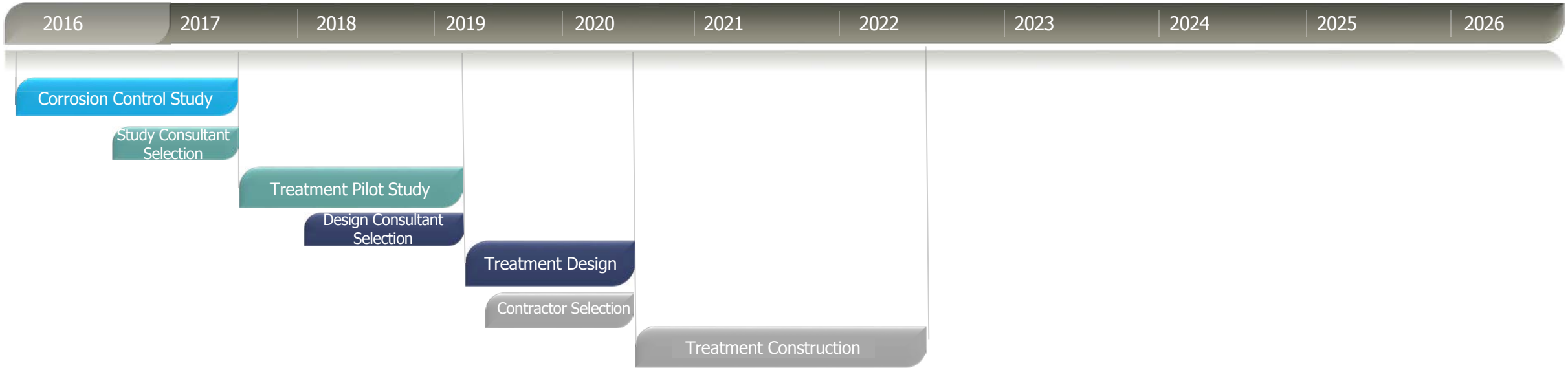
- Adding chemicals to Portland's water (Fluoride experience)
- Possible reduction in public health benefit if reduction of other sources of lead exposure is no longer funded
- Discharge issues
- Schedule
  - 5 year from completion of Corrosion Study
- Cost
  - Capital: approximately $15 Million
  - Operational: will be higher (chemicals, staffing, flushing)

Corrosion Control Decision Decision Tree

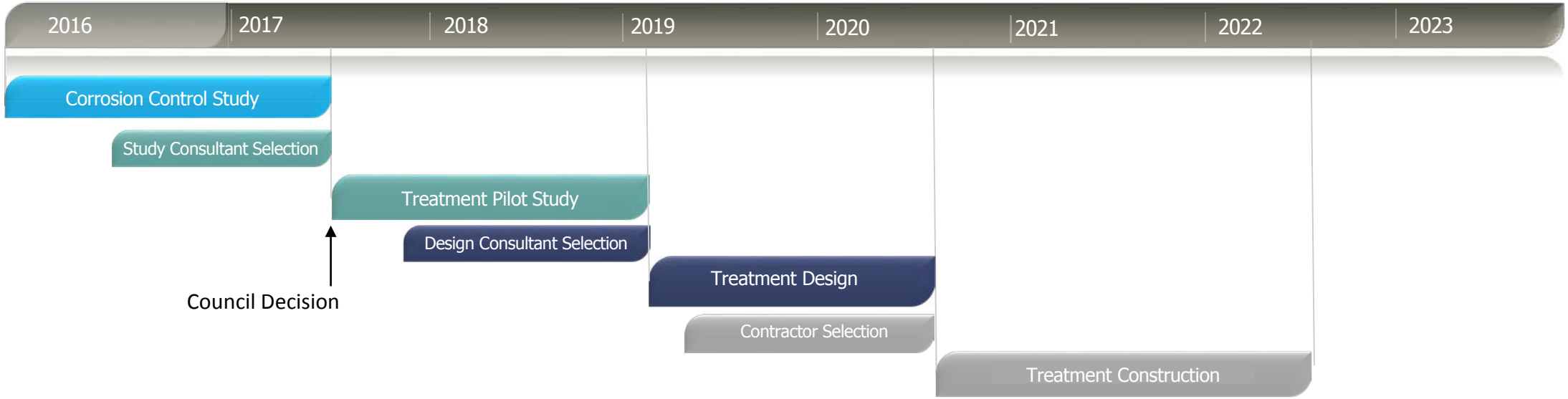


SCHEDULE PER STANDARD TIMELINE

ACCELERATED TIMELINE



ACCELERATED TIMELINE



Risks

- Council Approval
- Land Use/Permitting
- OHA Approval
- Procurement
- Legal Actions
- Available Resources

Corrosion Control Decision Preparations

- Corrosion Study – complete mid-2017
  - Mechanisms of lead release
  - Inform treatment decision
  - Expert Panel
- Pilot Study – Council Decision mid-2017
  - Professional Services Contract
  - Reviewing EPA OOCT Evaluation Technical Recommendations
  - Discussed process with OHA
- Putting together dedicated team – August 2016
- Portland Utility Board (PUB) update – August 2016
- Participate in EPA Training – August 2016
- Council work session – Fall 2016
  - Identifying key customers (brewers, industry)
  - Briefing legislators

Discussion

Chapter 7
Portland Water Bureau

Overview

The Portland Water Bureau has supplied domestic water to residents of the Portland area for more than 100 years and is the largest supplier of domestic water in Oregon. The Portland water system serves drinking water to about 940,000 Oregonians, almost one-quarter of the state's population. In 2012-13, the Portland Water Bureau directly served a retail population of over 570,600 people in 163,000 residential households (both single and multi-family residences) and about 20,000 commercial and industrial customers. Portland's wholesale customers served an estimated population of approximately 450,000 in 2012-13.

Vision, Mission & Values

The mission of the Portland Water Bureau is to provide reliable water service to customers in the quantities they desire and at a quality level that meets or exceeds both customer and regulatory standards; to provide the highest value to customers through excellent business, management, and operational practices, and appropriate application of innovation and technology; to be responsible stewards of the public's water infrastructure, fiscal and natural resources; and to provide the citizens and City Council with a water system that supports their community objectives and overall vision for the City of Portland.

Purpose of this Chapter

This chapter describes the public facilities and services provided by the Portland Water Bureau that are necessary to carry out its mission. It identifies desired levels of service, inventory and condition information for existing public facilities, and future facilities that will be necessary to support the land uses designated in the Comprehensive Plan, as required by Oregon Planning Goal 11: Public Facilities and Oregon Revised Statute 197. Carrying out the Bureau's mission and other City and community goals may also require programs, investments and practices that are not related to public facilities. This chapter may acknowledge – but does not comprehensively address – these measures.

System Services

Service Area

Approximately 940,000 people living within a 225-square-mile service area around Portland are served by the Water Bureau's retail and wholesale water sales, see Figures 7.1 and 7.2. The Water Bureau delivered 33 billion gallons (BG) to customers during fiscal year (FY) 2012-13. The 20 wholesale water customers are located in Multnomah, Clackamas and Washington counties.

Services Provided

The Water Bureau provides reliable water service to customers in the quantities they desire. Water from two sources, the Bull Run watershed and the Columbia South Shore Well Field, is of consistently high quality and meets all regulatory standards.

Service Agreements & Partnerships

The Portland Water Bureau currently has wholesale water sales agreements with 20 water providers in Portland's metropolitan area -- including cities, water districts, and private water companies. Eight of these water providers have service areas within the Urban Services Boundary of the City of Portland. These include: Burlington Water District, Lorna Water Company, Palatine Hills Water District, Raleigh Water District, Rockwood PUD, Tualatin Valley Water District, Valley View Water District, and West Slope Water District. Some wholesale providers also provide service to small groups of Portland citizens through “wheeling” agreements. These agreements are used where it is difficult or overly expensive to provide water directly from Water Bureau facilities.

The Clackamas River Water District and Sunrise Water Authority provide water services to unincorporated areas within Portland’s urban service boundary to the south of Portland. These water districts operate in partnership with each other through a cooperative agreement and use the Clackamas River as their main water supply source.

The Portland Water Bureau is a member of the Regional Water Providers Consortium. Members include more than 20 municipalities (including the City of Portland), water districts and Metro. (Metro is the regional growth management agency serving Clackamas, Multnomah, and Washington counties.) The Consortium serves as a collaborative and coordinating organization to improve the planning and management of regional municipal water supplies, including regional water conservation implementation and emergency preparedness coordination. The Consortium and its members endorse the Regional Water Supply Plan as the region's water supply strategy for the future. Water providers belonging to the Consortium retain full authority to operate and upgrade their systems and infrastructure.

The Portland Water Bureau maintains partnerships and agreements with other city bureaus and regional and state transportation agencies, providing services such as relocating water mains as directed by City Council. The bureau also has agreements with the U.S. Forest Service for activities within the Bull Run watershed, which is located in the Mt. Hood National Forest.

The City of Portland also maintains partnerships with the cities of Gresham and Fairview regarding participation in the Columbia South Shore Well Field Wellhead Protection Program.

Figure 7.1 Drinking Water Supply System Retail and Wholesale Service Areas

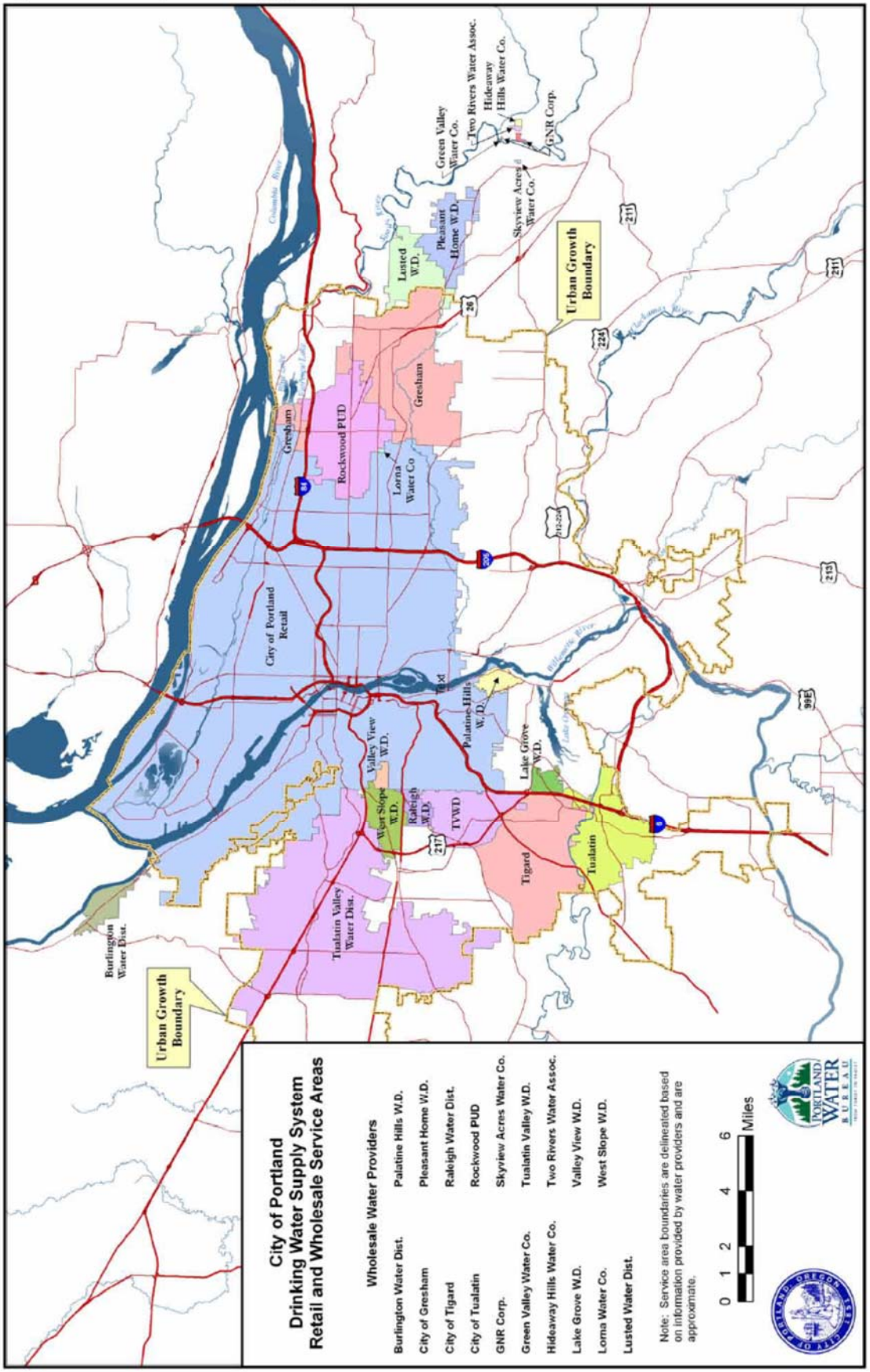
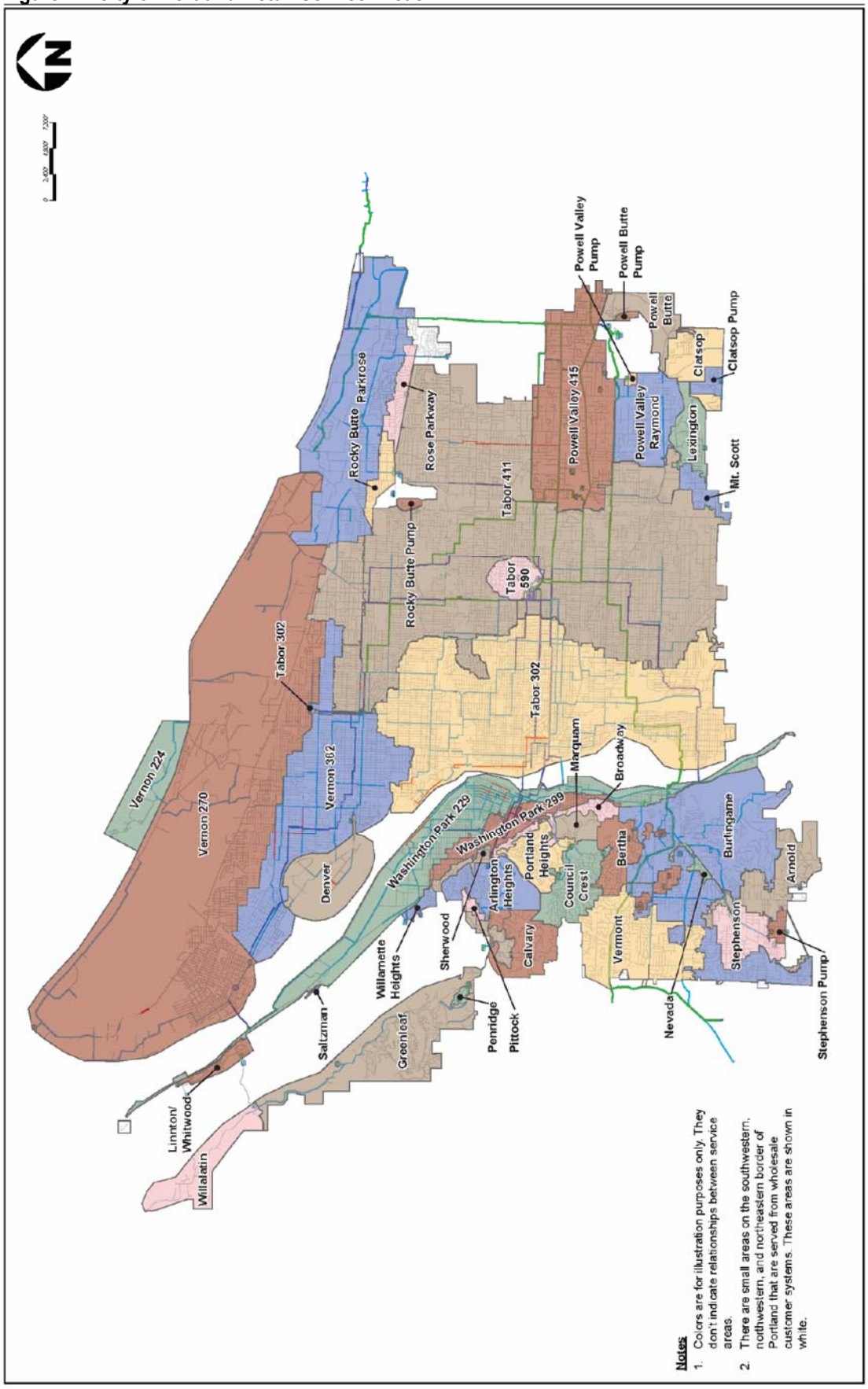


Figure 7.2 City of Portland Retail Service Areas



Inventory Summary

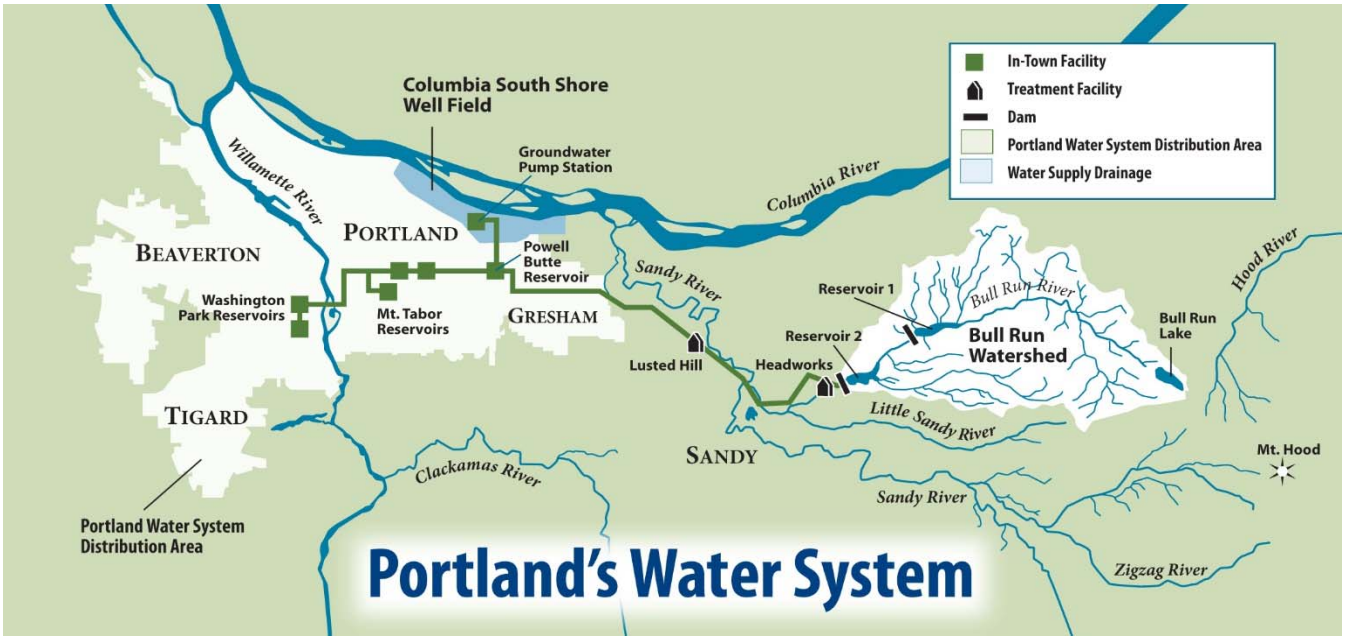
Water is supplied from the Bull Run watershed, located between the city and Mt. Hood, and the Columbia South Shore Well Field, located along the Columbia River, through approximately 2,250 miles of pipes within the City's boundaries. In 2013, the water system was valued at about $7.6 billion.

The City's water system includes five integrated sub-systems:

- a supply system, which collects water from the Bull Run watershed and Columbia South Shore Well Field;
- a transmission system of conduits, which moves water to a number of reservoirs;
- a terminal storage system of reservoirs;
- a distribution system of mains, service lines, pumps and tanks, which distribute water to residences and businesses; and
- support facilities to assist in the operation and maintenance of the water system.

Figure 7.3 illustrates the main components of Portland's water system. The components are described in more detail in Tables 7.1 and 7.2.

Figure 7.3 Portland's Water System



Condition Summary

The most recent Inventory and Condition Report prepared by the Water Bureau is summarized in Tables 7.1 and 7.2. The replacement value of the water system is estimated at $7.6 billion in 2013 dollars. About 63% of the value of the water system is in the distribution system. The supply system constitutes about 13% of the value of the water system, transmission accounts for 16%, terminal storage is 6%, and support facilities account for 2% of the Bureau's asset value.

Roughly 47% of the water system is estimated to be in good condition with 22% being considered very good. Approximately 23% of the water system is considered to be in fair condition, 6% is poor and 2% is considered to be very poor. Table 7.2 provides additional detail on asset value and condition.

Table 7.1 Portland Water Bureau Summary of Value and Condition of Assets, 2013

	Value ($ million)					
Asset Group	**Very Good**	**Good**	**Fair**	**Poor**	**Very Poor**	**Total Value**
Supply	$131.8	$457.2	$276.0	$82.3	$18.2	$967.0
Transmission	$64.9	$513.2	$518.7	$109.7	$0.2	$1,207.0
Terminal Storage	$218,9	$133.8	$18.1	$84.7	$0.0	$455.7
Distribution	$1,182.1	$2,434.1	$912.0	$190.1	$65.7	$4,785.4
Support Facilities	$40.8	$29.2	$18.0	$16.7	$59.3	$163.7
Total	**$1,638.5**	**$3,567.6**	**$1,742.7**	**$483.6**	**$143.4**	**$7,578.8**

Table 7.2 Portland Water System Inventory and Condition, 2013

	Value ($ million)					
Asset Group	**Very Good**	**Good**	**Fair**	**Poor**	**Very Poor**	**Total Value**
Supply	**$131.8**	**$457.2**	**$276.0**	**$82.3**	**$18.2**	**$967.0**
Bull Run Roads	16.6	60.8	95.4	57.4	18.2	249.9
Bull Run Lake Facilities	0	17.2	.1.4	1.8	0	20.4
Dam 1 Facilities	0	119.9	102.1	0	0	222.0
Dam 2 Facilities	30.0	1161.3	34.9	13.8	0	240.0
Headworks & Lusted Hill Facilities	0	33.3	11.4	4.8	0	49.5
Groundwater Well Sites	0	36.5	26.6	2.9	0	66.0
Groundwater Pump Station and Treatment	27.7	27.1	4.2	1.6	0	60.6
Groundwater Collection System	57.5	1.1	0	0	0	58.7
Transmission	**$64.9**	**$513.2**	**$518.7**	**$109.7**	**$0.2**	**$1,207.0**
Bull Run Transmission	46.2	204.6	305.1	76.1	0.2	**619.8**
Transmission Mains	18.8	308.6	213.6	33.7	0	**574.8**
Terminal Storage	**$218.9**	**$133.8**	**$18.1**	**$84.7**	**$0.0**	**$455.7**
Distribution	**$1,182.1**	**$2,434.1**	**$912.0**	**$190.1**	**$65.7**	**$4,785.4**
Distribution & Transport Mains	721.3	1,549.3	254.0	47.7	9.0	**2,582.5**
Services	112.6	323.2	381.1	65.3	17.1	**899.4**
Valves	211.9	287.7	72.2	19.9	12.1	**603.8**
Meters	23.9	24.0	19.4	15.0	5.3	**87.9**
Hydrants	5.1	81.6	59.2	17.5	20.6	**183.7**
Regulators	0.0	7.9	7.9	8.1	0	**24.0**
Fountains	1.9	7.0	7.0	2.8	0.9	**19.4**
Pump Stations	40.6	54.3	19.9	2.9	0.8	**118.5**
Tanks	64.8	99.0	91.4	10.9	0.0	**118.5**
Support Facilities	**$40.8**	**$29.2**	**$18.0**	**$16.7**	**$59.3**	**$163.7**
Interstate Facility	16.0	5.7	0.8	1.5	49.6	73.5
Other Facilities	24.8	23.5	17.1	15.2	9.7	90.2
TOTAL	**$1,638.5**	**$3,567.6**	**$1,742.7**	**$483.6**	**$143.4**	**$7,578.8**

Capacity Summary

Population Growth and Water Use

The population in the Portland metropolitan area is expected to continue to increase. Although the physical boundaries of the retail service area are not expected to be redefined beyond the limits of the urban growth boundary (UGB), vacant land and redevelopment lots within the retail service area are increasingly being developed with higher-density housing and more mixed-use development than in the past. In addition, several of the bureau's 20 wholesale customers have identified growth in existing service areas as well as some small additions to the UGB in 2004.

Historical water use, both retail-only and combined retail and wholesale demand, has not kept pace with the increase in the service area population. Since 1992, the number of gallons per capita per day for the entire retail and wholesale area has declined while the population has grown.

Demand Forecast

Although the growth in demand does not increase at the same rate as the growth in population, analysis of future demand and population shows that demand will increase over time. Using a single-equation econometric model, the Water Bureau estimated the mathematical relationship between the overall demand for water and a series of explanatory variables including population change, weather factors such as precipitation and temperature, the average price of water, weekend use, climate change, and others. The result is a weather-normalized demand forecast for annual demand. The forecast also estimates demand under weather conditions that generated the highest average daily demand during the peak season (1967) and the highest single peak-day water demand (1981). Forecasts for Portland's retail and wholesale annual average daily demand (ADD) have been developed to 2030 for both weather-normalized and 1967 weather conditions for the entire year and for the peak season, respectively.

Population estimates generated as a part of the population and allocation forecasts prepared for the Regional Transportation Plan were provided by METRO. Estimates were made based on approximate service territories of Portland and each wholesale customer. No estimate for future growth outside the existing service territories was included, although some growth outside the existing service territory is likely for some providers as the UGB is expanded to accommodate the required 20-year land supply.

According to the Water Management and Conservation Plan (2010), the average annual daily retail demand for 2030 is predicted to be around 70 million gallons a day (MGD). The average annual daily retail plus wholesale demand for 2030 is predicted to be around 135 million gallons a day (MGD). Both numbers would be a substantial increase from current demands. An update of the Water Management and Conservation Plan is scheduled for 2020.

Key Issues & Concerns

Regulatory Compliance

Many large system projects are moving forward to achieve compliance with the Long Term 2 Enhanced Surface Water Treatment Rule (LT2 rule) of 2006. The rule requires that water systems with uncovered

finished water reservoirs, like those at Mount Tabor and Washington Park, either cover the reservoirs or provide treatment at the outlets of the reservoirs to remove or inactivate *Cryptosporidium*, *Giardia* and viruses. All of the compliance projects are in the Terminal Storage Program. These projects include design and construction for an additional enclosed water storage reservoir at Powell Butte, a replacement storage reservoir at Kelly Butte as well as design work for adjustments necessary to disconnect the uncovered reservoirs at Mt. Tabor and Washington Park from the drinking water system Additional work to replace storage at Washington Park is also necessary. It is expected to cost between $330 million and $400 million to fulfill these requirements.

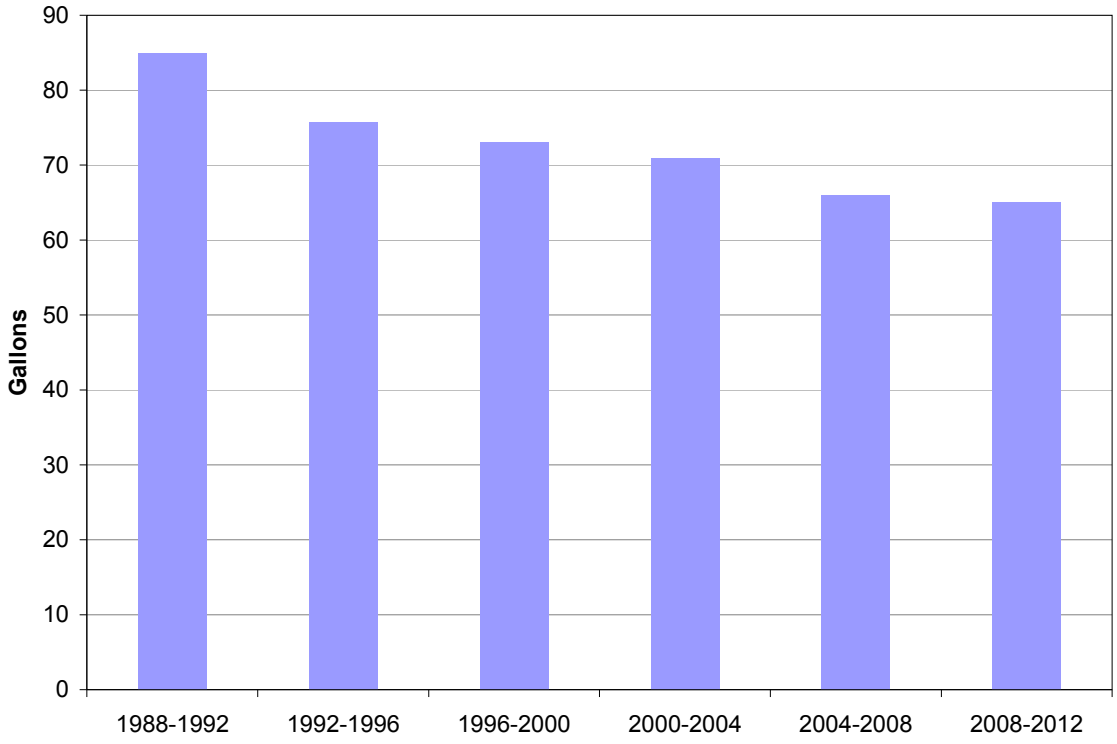
In addition, the bureau has capital projects in and around the Bull Run watershed to achieve compliance with regulations of the Clean Water Act and the Endangered Species Act. These projects are described in the bureau's Bull Run Water Supply Habitat Conservation Plan.

Declining Water Demand

As discussed previously, total water demand for the Portland system has fallen over the last few years, as retail and wholesale customers use less water. Per capita water use for retail single-family residential customers has gone down significantly since 1992. The average consumption for retail single-family customers between 1987 and 1992 was 87 gallons per capita per day (GPC), is now down to about 66 GPC, and has been as low as 62 GPC. Variables such as the water shortage of 1992, updated state and national plumbing codes, the change from flat rates to consumption-based rates for wastewater (in 1994), and behavioral changes resulting from conservation education have helped to reduce each household's overall consumption. Figure 7.4 shows the average annual GPC from 1988–2007.

Water demand forecasts developed by the Water Bureau anticipate that while per capita water demands will continue to decline somewhat over time, the overall demands on the Portland water system will increase due to population growth. The status of continued wholesale water sales is not known at this time, but the bureau anticipates continuing to sell water to wholesale customers.

Figure 7.4 Average Residential Per Capita Daily Water Use[1]



Accommodating Growth

The City of Portland provides water to retail customers within the city limits, as well as a significant number of large wholesale customers. Average daily demand for retail customers in 2012 was 62 million gallons per day (MGD). This is expected to grow to approximately 70 MGD by 2030. While this is not a huge growth rate within the City, it is something that needs to be addressed in the planning of infrastructure.

A larger issue is the impact of regional growth, as the total population in areas served through wholesale water sales agreements is expected to increase significantly. However, as wholesale customers make decisions on future supply sources which may or may not include supply from the City of Portland, it is unknown how this growth will impact the Water Bureau.

Maintaining Existing Infrastructure

The replacement value of water system assets was estimated at $7.6 billion in 2013. Many water system facilities are nearing the end of their useful lives. Half of distribution mains are older than 50 years. The uncovered reservoirs are all over 100 years old. Transmission conduits are 60 to 100 years old. Dams and reservoirs are 50 to 80 years old. The Water Bureau faces new costs to maintain and replace aging

[1] Each bar is an average of the gallons-per capita for the four-year period.

infrastructure, respond to security and vulnerability issues, and comply with regulatory requirements. In the meantime, there is pressure to hold down rate increases.

For 2013, the Water Bureau estimates a $15.5 million annual funding gap, primarily in the replacement of assets in poor condition, including distribution system components, transmission conduits, and the seismic upgrades of tanks and other facilities. Over the next 5 years, the Water Bureau expects to invest over $490 million on water-related capital improvements, primarily on the Distribution Program, which will help reduce the funding gap.

Vulnerability and Security

The City of Portland Water Bureau is dedicated to protecting public health and safety by ensuring that key components of the water system will withstand most human-caused or natural disasters. The Water Bureau has completed a number of studies on vulnerabilities within the system. Significant funding will be required to increase protection of more than 80 critical facilities, including dams, reservoirs, water supply pipelines, pump stations, and operations facilities.

Climate Change

The Water Bureau studies the issue of climate change and is establishing both preparation and mitigation strategies. The ability of Portland's two water systems to meet future demands, as well as the need for conservation and efficiency programs, will be important considerations as climate change impacts become more evident..

The City of Portland has kept detailed climate records for the past 70 years and continues to research and model climate patterns and their effects in the Bull Run watershed. The City also monitors current global and regional climate change information. Information available to date indicates that average winter season precipitation could increase. The average length of summer season, when the water system is drawing more water out of reservoir storage than is being refilled, could also increase. This period is referred to as "reservoir drawdown". In simpler terms, it is approximately the period from when spring rains stop and when fall rains begin. Storage in the Bull Run system is still expected to refill each year, because total flows in the watershed over the winter season are much greater than the amount needed to refill the storage reservoirs.

The City is preparing for climate change through research and monitoring, revising long-term planning models, working with other large drinking water utilities on preparation and mitigation strategies, developing its rights in the Columbia South Shore Well Field to provide summer supply and emergency backup capacity, and supporting efficient water use practices.

Regulatory Compliance

Federal Mandates

The City of Portland must comply with a variety of federal mandates, including the Clean Water Act, the Safe Drinking Water Act, the Lead and Copper Rule, and several mandates related to the protection and

management of the Bull Run watershed. Programs and projects to maintain compliance are included in the Bureau's investment strategy.

Safe Drinking Water Act (SDWA)[2]

Under the Safe Drinking Water Act, which is implemented through Oregon Revised Statutes and Administrative Rules, the Portland Water Bureau is required to conduct water quality sampling and submit results to Oregon Health Authority, in order to demonstrate compliance with maximum contaminant levels. The bureau also participates in on-site inspections (sanitary surveys) of treatment and distribution facilities by State Drinking Water Program personnel every three years, and participate in annual inspections. The Portland Water Bureau is also required to submit a Water System Master Plan every 20 years, submit a list of completed projects annually, produce and distribute annual Consumer Confidence Reports, meet operator certification requirements, and submit annual cross-connection reports.

Unregulated Contaminant Monitoring Rule (UCMR)[5]

The UCMR is administered under direct authority of the U.S. EPA and requires monitoring for 25 unregulated contaminants using five analytical methods during 2008-2010. The U.S. EPA uses the data generated by the UCMR to evaluate and prioritize contaminants on the Drinking Water Contaminants Candidate List, a list of contaminants EPA is considering for possible new drinking water standards.

Stage 2 Disinfection Byproducts Rule[3]

The Stage 2 Disinfection Rule is administered under direct authority of the U.S. EPA and requires the Portland Water Bureau to submit a sample plan and conduct sampling for disinfection byproducts.

Long Term 2 Enhanced Surface Water Treatment Rule, LT2[4]

The Long Term 2 Enhanced Surface Water Treatment Rule (LT2) was promulgated in January 2006. This federal rule applies to surface water or groundwater under direct influence of surface water (GWUDI) systems, and increases regulations regarding *Cryptosporidium* in the water supply. LT2 also addresses the regulation of *Cryptosporidium, Giardia* and viruses in uncovered finished drinking water reservoirs.

Compliance with LT2 has impacts on two separate parts of Portland's water system. First, the rule requires the city to provide additional treatment to its Bull Run supply to either remove or inactivate *Cryptosporidium*. Portland developed a comprehensive treatment variance request based on the results of a one-year water-quality sampling program and study of Bull Run water. A variance to this part of the rule was granted to the Water Bureau by the Oregon Health Authority on March 14, 2012.

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[2] of 1974, 1986, 1996 as administered under the U.S. EPA Primacy Agreement by the Oregon Department of Human Services (ODHS) under Oregon Revised Statutes (ORS) 448 and Oregon Administrative Rules (OAR) 333-061

[3] U.S. EPA Safe Drinking Water Act of 1974, 1986, 1996 - 40 CFR Parts 9, 141, and 142 - Federal Register: January 4, 2006 (Volume 71, Number 2), Rules and Regulations Page 387-493.

[4] U.S. EPA Safe Drinking Water Act of 1974, 1986, 1996 - 40 CFR Parts 9, 141, and 142 - Federal Register: January 5, 2006 (Volume 71, Number 3) - Rules and Regulations Page 703-752

In 2002, new treatment facilities were estimated to cost between $55 and $204 million to construct and millions more to operate on an annual basis. If OHA's variance is revoked, the Water Bureau would likely be required to construct these new treatment facilities. [5]

Second, the rule requires changes to how uncovered finished drinking water reservoirs are managed and operated. The rule requires that water systems with uncovered finished water reservoirs, like those at Mount Tabor and Washington Parks, either cover the reservoirs or provide treatment at the outlets of the reservoirs to inactivate *Cryptosporidium* and viruses. A regulatory schedule for this work has been approved by to the Oregon Health Authority. The bureau is required to eliminate the use of uncovered reservoirs at Mt. Tabor by December 31, 2015 and those in Washington Park by December 31, 2020.

In its 2009 LT2 Storage Recommendation, the Water Bureau estimated that it will cost approximately $400 million to come into compliance with the uncovered reservoir requirements of the rule.

Lead and Copper Rule

Lead and copper enter drinking water primarily through plumbing materials. Exposure to lead and copper may cause health problems ranging from stomach distress to brain damage. On June 7, 1991, EPA published a regulation to control lead and copper in drinking water. This regulation is known as the Lead and Copper Rule (also referred to as the LCR or 1991 Rule).

In January 1997, the Portland Water Bureau began corrosion treatment, raising the pH of the water to make it less acidic and less likely to leach metals. Corrosion treatment has reduced lead levels at the tap by more than 50% since the City began this treatment in 1997.

Americans with Disabilities Act[6]

The Americans with Disabilities Act of 1990 (ADA) prohibits discrimination and ensures equal opportunity for persons with disabilities in employment, State and local government services, public accommodations, commercial facilities, and transportation. ADA requires some new Portland Water Bureau facilities, and in some instances existing facilities, to be brought up to specified accessibility standards.

Bull Run-Related Legislative and Administrative Protections

A variety of federal legislation, regulatory requirements, administrative actions and agreements affects protection, management, and use of the Bull Run watershed that in turn enables the Water Bureau to provide a reliable water supply to the City of Portland. These include federal statutes specific to Bull Run, federal requirements applicable to national forest land, requirements of other federal agencies applicable to Bull Run, and agreements between the City and the Mt. Hood National Forest. Primary examples include the following:

[5] The Water Bureau has plans for an ultraviolet light (UV) treatment facility (completed in early 2012) to address treatment requirements, should the variance be revoked. The UV treatment option was selected by the Portland City Council as the preferred treatment option in 2009 (Resolution 36720).

[6] 1990, administered through Oregon Structural Specialty Code Oregon Administrative Rules 918-460

Federal Statutes and Regulations Specific to Bull Run

- Bull Run Watershed Management Act, P.L. 95-200, (1977) directs the Forest Service to consult and coordinate with the City of Portland to ensure management programs, practices, and standards on watershed lands are protective of drinking water quality
- 2012 Mt. Hood National Forest Closure Order for the Bull Run Watershed Management Unit—Closure Order MH-2012-05 closes forest service lands within the BRWMU to the public
- Oregon Resource Conservation Act (ORCA), P.L. 104-208 (1996), prohibits timber cutting within the hydrographic boundary of the Bull Run River drainage, except as necessary to protect or enhance water quality or for the construction, expansion, protection, or maintenance of water supply, energy transmission, or approved hydroelectric facilities
- Little Sandy Protection Act, P.L. 107-30 (2001), extends the boundaries of the Bull Run Management Unit and applies the land management protections of the 1996 ORCA to the entire management unit

Federal Requirements Implementing Policy Applicable to National Forest Land

- 1990 Mt. Hood National Forest Land and Resource Management Plan provides guidance for natural resource management.
- 1994 Northwest Forest Plan set management direction for the lands within the range of the northern spotted owl.

Requirements of Other Federal Agencies

- 1995 Bureau of Land Management (BLM), Salem District, Record of Decision and Resource Management Plan provides guidance for the management of non-native species
- BLM Permanent Closure Order for the Bull Run Watershed Management Unit (2011) closes BLM lands within the BRWMU to public access
- Bull Run Water Supply Habitat Conservation Plan (2009) defines the actions the City will take to address impacts of the Bull Run water supply system on native fish species in the Bull Run River, as regulated by the federal Endangered Species and Clean Water Acts and administered by the National Marine Fisheries Service and the Oregon Department of Environmental Quality

Agreement with the Mt. Hood National Forest

- The Bull Run Watershed Management Unit Agreement was established in 2007. Under this agreement, the city participates in collaborative efforts to maintain and manage various aspects of the watershed.

State Mandates

In addition to federal mandates, the City of Portland must also comply with state and regional mandates set through Oregon Revised Statutes and Administrative Rules. Projects to maintain compliance are included in the Bureau's investment strategy.

Statewide Planning Goals and Guidelines[7]

Statewide Planning Goals and guidelines require the City to maintain policies, service agreements, public facilities plans, and project lists for water service, through the City's Comprehensive Plan and public facilities plan. These plans must be submitted to the Oregon Department of Land Conservation and Development (DLCD) for acknowledgment as consistent with statewide goals.

Water Rights[8]

To maintain water rights granted by the state, the Portland Water Bureau developed a Water Management and Conservation Plan. This plan was approved by the state in 2010, and reports annual water use. Portland has state statutory right to full flow of the Bull Run and Little Sandy Rivers. The state also granted full extensions for the four primary CSSWF groundwater rights in 2009. The bureau is required to provide plan updates every five years.

Oregon Structural (OSSC), Mechanical (OMSC) and Electrical (OESC) Specialty Codes[9]

Requires new facilities and in some instances existing facilities to be brought up to new building code standards.

House Bill 3543 (2007)

The Oregon Legislative Assembly declared that it is the policy of the state of Oregon for state and local governments, businesses, nonprofit organizations, and individual residents to prepare for the effects of global warming and, by doing so, prevent and reduce the social, economic and environmental effects of global warming. House Bill (HB) 3543 (2007) sets greenhouse gas emissions targets for the state of Oregon with goals for progressively lower greenhouse gas emissions every decade until 2050.[10] The City of Portland and Multnomah County have adopted a Climate Action Plan (2009) with a goal of reducing carbon emissions by 80 percent by the year 2050.[11] The City also adopted Resolution No. 36749 directing its bureaus to implement policies and programs related to the Climate Action Plan.[12]

Regional Plans

Regional Water Supply Plan

The Regional Water Supply Plan (RWSP) (2004) was adopted by most of the region's individual water providers and is coordinated by the Regional Water Providers Consortium. The RWSP provides a

[7] SB 100, Statewide Planning Goals and Guidelines (OAR 660-011), Compliance procedures (ORS 197, and) Goal 11-Public Facilities and Services

[8] ORS 436 and 437 and OAR 690-086, 690-410, and 690-315 Water Rights - Oregon Water Resources Department (OWRD) Oregon Revised Statutes 436, 537 Oregon Administrative Rules 690-086, 690-410, 690-315

[9] 2007 OSSC – OAR 918-460, 2007 OMSC – OAR 918-440, 2005 OESC – OAR 918-305

[10] Oregon Legislative Assembly. 2007. House Bill 3543. An Act relating to climate change; appropriating money; and declaring an emergency. Salem, Oregon.

[11] City of Portland and Multnomah County. 2009. Climate Action Plan. Portland, Oregon. Available at http://www.portlandoregon.gov/bps/index.cfm?c=49989&a=268612. Accessed November 11, 2009.

[12] City of Portland. 2009. Portland City Council Resolution No. 36749. Adopt the joint City of Portland and Multnomah County Climate Action Plan to reduce local greenhouse gas emissions by 80 percent from 1990 levels by 2050.

comprehensive, integrated framework of technical information, resource strategies and implementing actions to meet the water supply needs of the Portland Metropolitan Area to the year 2050.

Metro Regional Framework Plan (2005) - METRO

In 1992, the region's voters adopted a Metro charter for Metro which gave Metro jurisdiction over matters of metropolitan concern and required the adoption of a Regional Framework Plan. The Regional Framework Plan unites all of Metro's adopted land use planning policies and requirements. The charter directs Metro to address the water sources and storage in the plan. The Regional Framework Plan, originally adopted in 1997, was amended in 2005, 2010 and 2011 and contains regional policies contained in the Regional Urban Growth Goals and Objectives (RUGGO), 2040 Growth Concept, Metropolitan Greenspaces Master Plan and Regional Transportation Plan to create a coordinated, integrated Regional Framework Plan.

The Metro 2040 Growth Concept provides a structure for the preferred form of regional growth and development in the Portland metropolitan region. The Water Bureau will need to provide the water infrastructure to meet demands associated with projected population densities.

Section 4.1 of the Regional Framework Plan acknowledges the Regional Water Supply Plan developed and adopted by the Regional Water Providers Consortium. It is the policy of Metro to:

- Promote and achieve regional water conservation and demand management goals as defined in the Regional Water Supply Plan;
- Promote the coordination between regional growth management programs and water supply planning;
- Promote the coordination between land use planning and achieving goals of the Regional Water Supply Plan and;
- Set benchmarks and evaluate achievement of the targets and goals established in the Regional Water Supply Plan in coordination with the region’s water providers.

Urban Growth Management Functional Plan - Title 6 (Metro Code Sections 3.07.610 - 3.07.650) - Centers, Corridors, Station Communities and Main Streets - METRO

The Urban Growth Management Functional Plan was adopted by the Metro Council and codified in Section 3.07 of the Metro Code. The purpose of this functional plan is to implement regional goals and objectives contained in the Regional Framework Plan.

The Regional Framework Plan identifies Centers, Corridors, Main Streets and Station Communities throughout the region and recognizes them as the principal centers of urban life in the region. Title 6 calls for actions and investments by cities and counties, complemented by regional investments, to enhance this role. The Portland Water Bureau is expected to complete infrastructure improvements as needed in order to support activities related to development of these urban environments.

Portland Watershed Management Plan

The Portland Watershed Management Plan (PWMP) is intended to guide City decisions and projects by providing a comprehensive approach to restoring watershed health. The Water Bureau collaborates with other City bureaus on projects like green streets, land acquisition, floodplain restoration and fish and wildlife habitat protection.

Goals & Policies

Draft Goals and Policies related to Water Facilities and services can be found in Chapter 5. Key Infrastructure Policies.

Investment Strategy

The Portland Water Bureau's Investment Strategy for the Citywide System Plan is divided into seven (7) primary programs: Supply, Transmission and Terminal Storage, Distribution, Treatment, Regulatory Compliance, Customer Service, and Administration & Support. The Water Bureau anticipates over $1.5 billion in new investment in these programs over the next twenty years, see Table 7.3. This chapter and Appendix A. Investment Strategy provides greater detail on anticipated water projects and investments.

Table 7.3 Investment Strategy Summary

Program	FY 2013-2018	FY 2018-33
Supply	$14,291,000	$88,500,000
Transmission and Terminal Storage	$191,170,000	$242,000,000
Distribution	$244,197,288	$461,650,000
Treatment	$2,500,000	$150,000,000
Regulatory Compliance	$25,504,000	$30,000,000
Customer Service	$3,057,000	$53,700,000
Support	$10,000,000	$50,500,000
TOTAL	**$490,719,288**	**$1,076,350,000**

Supply System[13]

The primary drinking water source for Portland is the Bull Run watershed, supplemented by a groundwater supply from the Columbia South Shore Well Field (CSSWF) and the wells in the former Powell Valley Road Water District. The Bull Run watershed is located east of Portland and just north of the western foothills of Mt. Hood; the CSSWF is south of the Columbia River and east of the Portland International Airport, see Figure 7.5. The former Powell Valley Road Water District is located in southeast Portland, near Powell Butte.

Since 1895, Portland has relied on the Bull Run watershed as its principal source of supply. Rainfall runoff and snowmelt from within the watershed are captured in the Bull Run storage system, which includes Bull Run Lake, and Reservoirs 1 and 2, all located on the Bull Run River. At Reservoir 2, water enters the Headworks, the origination point of the three conduits that convey water from the Bull Run system to Powell Butte Reservoir. Until 2015 and 2020 respectively, water from Powell Butte will be supplied to Mt. Tabor and Washington Park reservoirs. These reservoirs have served as terminal storage for the water supply transmission system, and as central points for distributing water into the retail water system. As these facilities are decommissioned, water from Powell Butte will follow one of three paths: to Kelly Butte, an enclosed underground storage facility; to other terminal storage-system reservoirs; or through large transmission mains to the distribution system and/or wholesale customers.

The federal Safe Drinking Water Act, which regulates public drinking water supplies, typically requires surface water supplies to be filtered to meet federal drinking water standards. Because the Bull Run source water quality is very high and Portland implements source water protection measures, Portland is currently exempt from filtration requirements. Portland's water supply is disinfected using chloramines. Water is chlorinated at the Headworks at Reservoir 2. Ammonia and caustic soda are added at a second treatment facility, Lusted Hill.

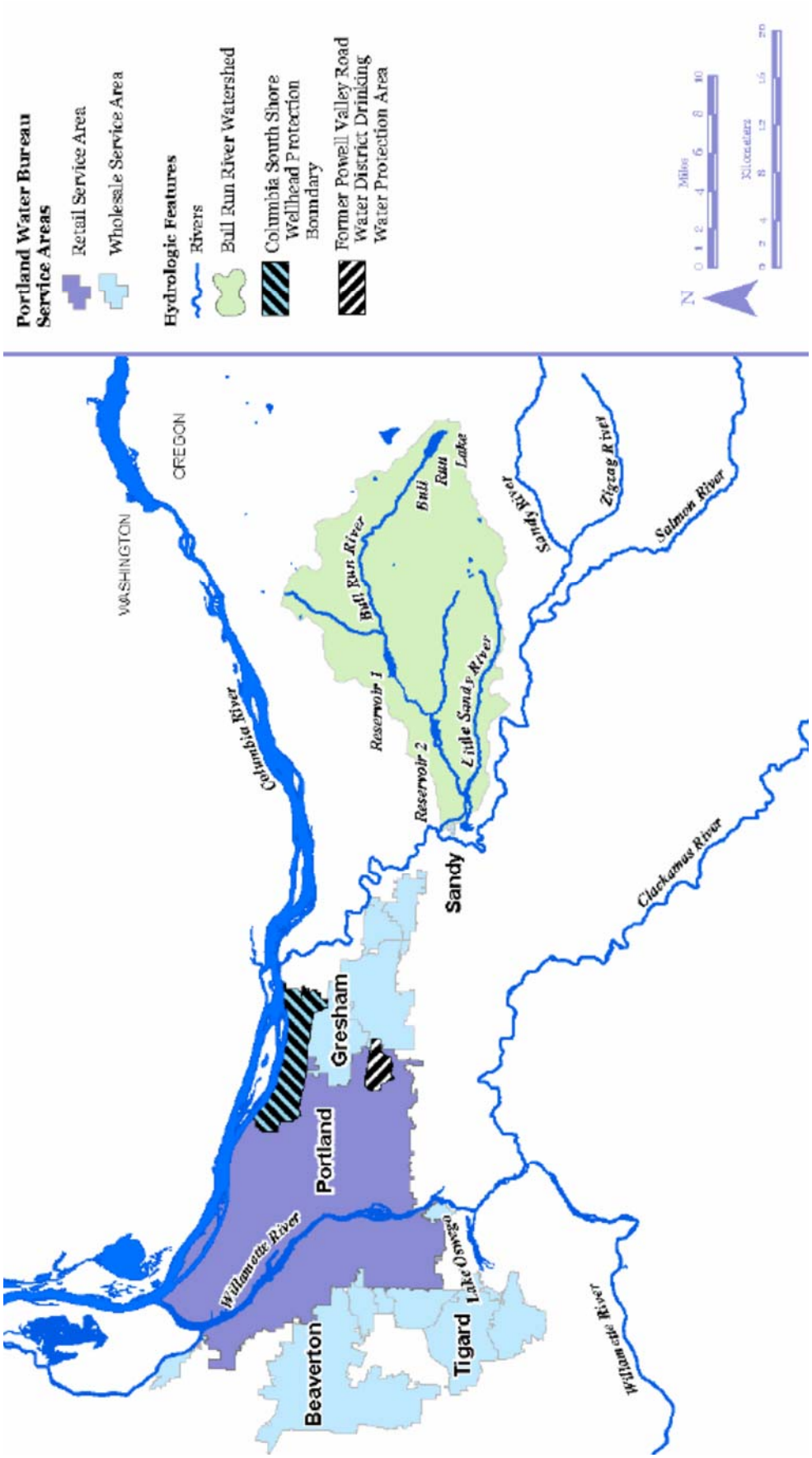
Since 1985, Portland has used groundwater from the Columbia River South Shore Well Field as an emergency seasonal supply and as a backup supply when winter storms cause high turbidity in the Bull Run watershed. The groundwater supply comes from three aquifers along the south shore of the Columbia River. The system includes 27 wells, one storage tank, a groundwater booster pump station, and a treatment facility. Portland also has access to wells previously owned by the Powell Valley Road Water District.

Wholesale Customers

The Water Bureau supplies water to its wholesale customers; the City of Portland does not typically receive water from any sources owned or operated by its wholesale customers. The City's water supply system is interconnected with other water suppliers including the City of Lake Oswego, the City of Milwaukie, and Clackamas River Water. Portland is able to receive water from these other sources on a limited basis in an emergency.

[13] Portland Water Bureau, Distribution System Master Plan and Portland Water Bureau, Water Management and Conservation Plan

Figure 7.5 Drinking Water Supply System Water Sources



Bull Run Watershed

Inventory

The water of the Bull Run River is primarily impounded in two reservoirs: Reservoir 1, completed in 1929, and Reservoir 2, completed in 1962. Periodically, the Water Bureau relies on storage capacity in Bull Run Lake, a natural lake that is upstream of the headwaters of the Bull Run River, to enhance the supply of the two reservoirs.

At the Headworks facility below Dam 2, the raw water is disinfected. The water then flows to the Lusted Hill facility for further treatment, and is fed by gravity to the terminal storage, transmission, and distribution systems. The Bull Run water system includes facilities for generating hydropower. The Portland Hydroelectric Project's hydropower facilities at Dams 1 and 2 generate electricity that the city sells to Portland General Electric (PGE).

The Water Bureau's facilities in the Bull Run Supply system are served by a network of 123 miles of roads and 11 bridges. In total, infrastructure assets in the Bull Run supply system have a 2013 replacement value of $782 million.

Current Condition

The vast majority of assets in the Bull Run watershed are in fair to good condition, see Table 7.2. Eight percent of assets are in poor condition; two percent are in very poor condition.

Adequacy and Reliability of Supply

The Bull Run watershed is the city's primary water source. The approximate median annual water yield from the Bull Run watershed (measured at Headworks) is 180 billion gallons. The median annual diversion for water supply is approximately 20 percent of the total median yield. The reservoirs in the Bull Run are recharged during the fall, winter, and spring when rainfall is abundant. During the dry summer months (starting in June or July), the reservoirs are drawn down. This drawdown period typically lasts until early October but can sometimes last until November or December. During this period, the water flowing out of the reservoirs exceeds the water flowing into the reservoirs from rainfall and tributary flow.

Water demand varies annually, driven primarily by weather. In warm, dry summers when demand is high, the yield from the Bull Run watershed is at its lowest. In cool wet summers, water demand is often lower and yield from the Bull Run tends to be higher.

The duration of the dry season is also important because it determines the time period during which the city will rely on the limited storage in the watershed's reservoirs. Long dry seasons increase the proportion of groundwater that the city uses to meet demand before fall rains return.

The two Bull Run reservoirs are relatively small in comparison to the amount of precipitation and stream discharge in the basin. The reservoirs are not large enough to provide a multi-year water supply. Refill each winter is necessary to ensure supply for the following summer.

Over the last 20 years, the city has examined a number of options for increasing water storage in the Bull Run system. In the future if necessary, the city will continue to explore these and other options, such as water efficiency and conservation, to meet long-term water supply needs.

Columbia South Shore Well Field

The Columbia South Shore Well Field (CSSWF) is the second-largest developed water source in the state (after the Bull Run Supply), and the largest developed groundwater source in the state. Located on the floodplain of the Columbia River northeast of downtown Portland, this 11-square-mile area spans the boundaries of three cities: Portland, Fairview, and Gresham. The wells in the well field provide water when the Bull Run supply is shut down due to emergency conditions such as turbidity events, landslides, fires, or other natural or human-caused disruptions. The groundwater system is also a supplemental supply to meet demands during the summer peak season as needed.

Inventory

As of 2013, there are 27 wells in the CSSWF.[14] These wells draw on three aquifers: the Sand and Gravel Aquifer (SGA); the Troutdale Sandstone Aquifer (TSA), and the Blue Lake Aquifer (BLA). The sum of the nominal instantaneous pumping capacity for all of these wells is approximately 103 to 118 million gallons a day (MGD), based on the maximum pumping rates of the individual wells. In use, the well field has an empirically determined initial 30-day operating capacity of approximately 90 MGD. A large pump station moves water to the city's Powell Butte Reservoir, where it is mixed with Bull Run water (unless the Bull Run supply is off-line).

Current Condition

The wells in the CSSWF are primarily in good or fair condition (53% and 41%, respectively). Collection mains are primarily in good to very good condition (85% and 13%, respectively). The treatment facility is in good condition and the pump station is in fair to good condition. Additional condition information can be found in Table 7.2.

Supplemental and Emergency Use of the CSSWF

According to the Seasonal Water Supply Augmentation and Contingency Plan—also referred to as the Summer Supply Plan (SSP), the CSSWF is used for supplemental and emergency supply under the following conditions:

- Supply Augmentation: Groundwater may be used to augment the Bull Run supply to meet demand during seasonal warm dry periods when the Bull Run water supply is not sufficient to meet the needs of the bureau's retail and wholesale customers; to maintain in-stream flows for fish habitat; or if water demand exceeds the conduit capacity long enough to deplete in-town storage below safe levels.[15]

[14] A map of the Columbia South Shore Well Field can be found in Figure 2-3 of the *Water Management and Conservation Plan*, 2010.

[15] Conduit capacity may be exceeded if demand is exceptionally high or if one or more of the conduits is out of service.

- Turbidity Event Augmentation: Groundwater may be needed to augment or replace the Bull Run surface supply to avoid violating state and federal drinking water standards for turbidity. Turbidity in the surface water supply is typically caused by storm events in the Bull Run watershed.
- Emergency Use: Groundwater may be needed during catastrophic events (in addition to turbidity events) that would cause a loss of part or all of the Bull Run surface water supply. Catastrophic events include, but are not limited to, severe or extended drought, fire in the watershed, flood, landslides, volcanic activity, earthquakes, and acts of vandalism or terrorism. Any of these events could cause significant water quality problems or result in damage to, or shutdown of, the conduits or other critical infrastructure used to transfer Bull Run water to the Bureau's in-town reservoirs. An example of a catastrophic event in the watershed was a landslide in 1995 that damaged two conduits. Groundwater was used for 27 days and provided an average of 25.4 MGD to the distribution system.[16]

Contamination and Remediation

The City of Portland has an extensive network of monitoring wells. The bureau tracks groundwater quality and changes in groundwater levels over time in multiple aquifers within the CSSWF. Data from city groundwater quality monitoring indicate that the deep confined aquifers Portland uses for drinking water are free of contamination within the capture zones of active wells.

Anthropogenic, or human-related, contamination was first discovered in shallow groundwater aquifers near the well field in the 1980s. Since the early 1990s, the city has worked closely with the Oregon Department of Environmental Quality (ODEQ) to expedite the discovery, assessment, and remediation of contaminant sources and plumes, and to keep the well field operational. Remediation technologies used to remove contaminants from soil and groundwater include pump-and-treat, soil vapor extraction, electro-resistive heating, air sparging, and chemical and biological treatment. Remediation in the CSSWF is nearly complete.

High concentrations of naturally-occurring manganese in two wells have limited the ability of the Water Bureau to utilize these wells. Manganese can cause water discoloration which can affect laundry businesses served by the Water Bureau. The Water Bureau avoids using the high-manganese wells unless no Bull Run supplies are available and the full capacity of the well field is needed.

Groundwater Protection Program

The Groundwater Protection Program, adopted in 2003 and updated in 2010, replaced existing programs in Portland and Fairview and initiated a program in Gresham. The Groundwater Protection Program requires businesses that use, store, or transport hazardous material above a certain threshold amount to implement best management practices to prevent chemical spills.

Regulated businesses in Portland are inspected every two years as part of their regular fire inspection to ensure the business is in compliance with the program requirements. In Gresham and Fairview,

[16] Although the average is 25.4 MGD, the actual amounts per day varied widely.

inspections are conducted by Gresham watershed management staff. The Water Bureau and its partners provide free technical assistance to businesses on compliance issues.

The Columbia South Shore Well Head Protection Area delineation was certified by the Oregon Health Authority Drinking Water Program in 2003. A certified wellhead protection area is considered a significant groundwater resource under Statewide Planning Goal 5 if the public water system served by the wellhead area has a service population greater than 10,000 and relies on groundwater as the primary or secondary source of drinking water. Local governments are required to develop a program to reduce the risk of groundwater contamination in such areas. In June 2008, the Department of Environmental Quality certified the Columbia South Shore Well Field Protection Program, which addresses Goal 5 requirements for protecting these groundwater resources.

Adequacy and Reliability of Supply

The Portland Water Bureau has not experienced any major supply deficiencies in the last 10 years. Supply capacity and reliability were both enhanced in the mid-1980s by the development of a high-quality secondary source of drinking water in the Columbia South Shore Well Field (CSSWF). The CSSWF can be used in the event of a supply shortage in the Bull Run watershed. In the past ten years, water from the CSSWF has been used to augment Bull Run supply due to turbidity, for summer supply augmentation, and for maintenance runs. As of December 31, 2012, the CSSWF has been used a total of 29 times—10 times for turbidity events in Bull Run, once for a landslide that took two of the three conduits out of service, 13 times for summer supply augmentation, and five times for maintenance reasons.

Current well field capacity is sufficient to meet short-term (less than 30-day) emergency needs during the non-peak-season. The current capacity of the well field system is not sufficient to meet demand during a full shutdown of the Bull Run system due to emergencies or catastrophic events for periods longer than 30 days. Groundwater availability may also be limited in the future due to increased withdrawal from the aquifer by full-time and growing municipal users in Oregon and Clark County, Washington.

The city has evaluated several options for maintaining and improving the adequacy and reliability of supplies from the Bull Run watershed and the CSSWF... The results of these studies indicate that developing supplies in the CSSWF is the most cost-effective option.

The Water Conservation and Management Plan (2010) anticipates the potential development of 53 MGD in the CSSWF by 2028 to meet the annual average water demand of the current retail and wholesale service areas.

Former Powell Valley Road Water District Wells

On July 1, 2005, the City of Portland annexed areas served by the Powell Valley Road Water District (PVRWD) in southeast Portland, northwest of Powell Butte. Residents of this former water district are now served by the Portland Water Bureau's retail system. Under an intergovernmental agreement, Portland assumed control of all of the district's assets, including six active wells.[17] The PVRWD assets included water rights and water infrastructure. The installed capacity of the Powell Valley wells can be as much as 8.6 MGD, however less than half of this capacity is currently available.[18] Several capital improvement projects are planned to repair various facilities and fully integrate the wells into the Water Bureau system. These projects may be completed in three to ten years.

The former Powell Valley Road Water District wells are in good condition, are productive, and do not have significant water quality issues. In the future, the Water Bureau intends to upgrade these facilities to allow connection of these wells to the main system through Powell Butte. This integration would allow the bureau to increase capacity if needed and to blend well water with water from the Bull Run watershed and/or CSSWF before it enters the distribution system. The Powell Valley Road Water District's wells had a state certified delineation and approved wellhead protection plan (July 1998) at the time of annexation. This protection plan is non-regulatory and relies on best management practices. The Portland Water Bureau reassessed the delineation with an updated methodology and received certification from OHA in October 2010. The protection plan needs to be updated and submitted for re-approval.

The state-approved WMCP includes the potential use of 7.36 MGD of the developed supply to meet future demands.

Current & Projected Demands

Table 7.4 summarizes existing and 2030 retail demands for the distribution system by service area. The 2005 average daily demand was 61.5 mgd.[19] The Distribution System Master Plan, finalized in 2007, estimated that the average daily retail distribution-system demand for 2030 is projected to increase to 70 mgd. Historically, per capita demand in the retail area has shown a steady downward trend since 1993. However, current demand forecasts project relatively steady total demand through 2015, with an upward trend thereafter based on population increase.

Regional population forecasts from Metro, the state-approved Water Management and Conservation Plan, finalized in 2010, estimate the average system-wide demand to be between 132 and 138 million gallons a day. According to the Water Management and Conservation Plan (2010) the average and peak demand for the total service area is anticipated to increase 21% between 2007 and 2030.

[17] A map of the former Powell Valley Road Water District can be found in Figure 2-4 of the *Water Management and Conservation Plan*, 2010.
[18] Additional information on these wells, including size, depth, and capacity can be found in Table 2-2 of the Portland Water Bureau's Water Management and Conservation Plan.
[19] A 2005 demand of 64 mgd was used in capacity evaluations, projected from 2002 demand data at the outset of the study.

Table 7.4 Existing and Projected Retail Water Demands[20]

Service Area	2005 - Daily Demand Avg (mgd)	2005 - Daily Demand Peak (mgd)	2030 – Daily Demand Avg (mgd)	2030 – Daily Demand Peak (mgd)	Service Area	2005 - Daily Demand Avg (mgd)	2005 - Daily Demand Peak (mgd)	2030 – Daily Demand Avg (mgd)	2030 – Daily Demand Peak (mgd)
Arlington Heights	0.7	1	0.9	1.3	Powell Butte Pump	0.02	0.03	0.03	0.05
Arnold	0.5	1	0.6	1.2	Powell Butte	0.2	0.4	0.4	0.7
Bertha	0.5	1.1	0.6	1.3	PV Pump	0.03	0.05	0.03	0.1
Broadway	0.2	0.4	0.3	0.5	PV Raymond	1	1.8	1.3	2.3
Burlingame	1.9	3.3	2.1	3.7	PV 415	2.9	5.1	3.6	6.5
Calvary	0.6	1	0.8	1.3	Rocky Butte Pump	0.02	0.03	0.02	0.04
Council Crest	0.3	0.8	0.4	1.1	Rocky Butte	0.2	0.3	0.2	0.4
Clatsop Pump	0.1	0.2	0.1	0.2	Rose Parkway	0.3	0.6	0.3	0.7
Clatsop	0.2	0.3	0.2	0.4	Saltzman	0.001	0.003	0.002	0.004
Denver	0.9	1.6	1	1.7	Sherwood Field	0.5	0.9	0.6	1.2
Greenleaf	1	1.6	2.1	3.5	Stephenson	0.4	0.7	0.4	0.7
Lexington	0.2	0.4	0.3	0.5	Stephenson Pump	0.1	0.1	0.1	2
Linnton/Whitwood	0.1	0.2	0.2	0.3	Tabor 302	10.6	15.6	12.7	18.7
Marquam	0.7	1.2	0.9	1.6	Tabor 4112	15.1	22.7	16.9	25.4
Mt Scott	0.2	0.4	0.3	0.5	Tabor 590	0.3	0.5	0.3	0.5
Nevada	0.1	0.2	0.1	0.2	Vermont	1.6	2.5	1.8	2.7
Parkrose	1.9	3.6	2	3.9	Vernon3	10	15.2	12.1	18.2
Penridge	0.04	0.1	0.1	0.2	Willalatin	0.1	0.3	0.3	0.8
Pittock	0.04	0.1	0.1	0.1	Washington Park 229	6.2	9.8	8.9	14
Portland Heights	0.6	1	0.8	1.3	Washington Park 299	3.7	5.8	5.2	8.2
Totals[4]	**64.2**	**102.6**	**79.2**	**126.6**					

1 Willamette Heights service area demands are included in Sherwood service area total.
2 The demands for Tabor 411 include Tabor 338.
3 The demands for Vernon include Vernon 224, Vernon 270 and Vernon 362.
4 The area served via Rockwood WD is not included in the total. The average daily demand for this area is estimated to be 0.3 mgd with a peak demand of 0.5 mgd. In the future the average daily demand will remain the same and the peak demand will rise to 0.6 mgd.

Wholesale Water Agreements

The Portland Water Bureau has wholesale water sales agreements with 20 water purveyors in the Portland, Oregon metropolitan area, including cities, water districts, and private water companies.

Portland can potentially sell water to a wholesale population of 450,000 and routinely provides wholesale service to over 375,000 people. Annual wholesale water sales account for 12 percent of annual water sales and about 40 percent of annual water demand. These agreements require the Portland Water Bureau to meet specific levels of service.

[20] Portland Water Bureau, Distribution System Master Plan, June 2007 (Table 2-4)

Table 7.5 Portland Water Bureau Wholesale Agreements[21]

5-Year Agreement	10-Year Agreement	20-Year Agreement
GNR Water Company	Pleasant Home Water District	Burlington Water District
Green Valley Water Company	Lake Grove Water District	City of Gresham
Hideaway Hills Water Company	City of Tigard	City of Sandy
Lorna Water Company	City of Tualatin	Lusted Water District
Skyview Acres Water Company	Tualatin Valley Water District	Palatine Hill Water District
Two Rivers Water Association		Raleigh Water District
		Rockwood Water PUD
		Valley View
		West Slope Water District

Needs & Approach

Bull Run Supply

Although the demand needs are not critical at this juncture, the City will, if it becomes necessary, explore options for increasing water storage in the Bull Run system in order to meet long-term water supply needs.

Groundwater Supply

Current well field capacity is sufficient to meet short-term (less than 30 days) emergency needs during the non-peak-season. The current capacity of the well field system is not sufficient to meet demand during a full shutdown of the Bull Run system due to emergencies or catastrophic events for periods longer than 30 days. Groundwater availability may also be limited in the future due to increased withdrawal from the aquifer by full-time and growing municipal users in Oregon and Clark County, Washington.

Asset Management Plans

Asset management plans are being developed for the Bull Run Supply and Groundwater Supply. These plans will help identify maintenance, repair and replacement strategies necessary to maintain and improve the water system.

Recommended Supply System Improvements

Bull Run Watershed

The function of this program is to allocate funds for the capital projects necessary to maintain, improve, and protect the watershed facilities that are not directly related to the water supply system facilities. This includes Bull Run watershed road reconstruction to ensure continuous, reliable, and safe access to all facilities, as well as maintenance of other city-owned infrastructure within the watershed.

The Dam 2 Tower Improvements Project provides for modification of the north tower inlet to allow selective-depth withdrawal from Bull Run Reservoir 2. The intent is to help regulate temperatures for flows

[21] Portland Water Bureau, 2014.

released to the lower Bull Run River to comply with Clean Water Act requirements and to improve water quality by providing flexibility during turbidity events. The anticipated completion date is 2014.

Dams and Headworks Repair and Rehabilitation

This program provides for assessment of the condition and rehabilitation of dams and facilities at Headworks. As many of these facilities are between 50 and 70 years old, their safe and reliable operation requires ongoing investment. The program includes preliminary engineering and design of needed repairs, rehabilitation of these facilities, and actual repair work.

Columbia South Shore Well Field

The Columbia South Shore Well Field (CSSWF) is Portland's alternative supply of water should the Bull Run watershed supply be interrupted for any reason. Projects funded in this program improve the maintenance of this aging infrastructure, including repairs, selective replacements and upgrades.

Groundwater Collection Main Hardening

Much of the piping connecting the wells to the Groundwater Pump Station is located in liquefiable soils which are vulnerable during a seismic event. This project would design and install measures to "harden" the piping and reduce this vulnerability.

Groundwater Electrical Improvements

This project designs and constructs a new 115kV/4160V transformer and other components to complete a double-ended electrical substation at the Groundwater Pump Station. It will also design and construct a 5kV main breaker replacement and purchase selected spare components.

Groundwater Pump Station (GWPS) Expansion

As water demand increases, the bureau will need to increase the available flows from the groundwater system. The system expansion will include upgrade of the Groundwater Pump Station to provide additional capacity.

Groundwater Well Field Expansion

As water demand increases, the bureau will need to increase the available flows from the groundwater system. The system expansion will include additional well development and collection mains in the Columbia South Shore area.

Groundwater Well Field Reliability Enhancements

The bureau is attempting to increase its flexibility and preparedness to meet the future challenge of an interruption of Bull Run water. The bureau is improving its emergency preparedness by evaluating electrical vulnerability for the pumping system, reviewing the flood inundation vulnerability of the site, and developing a groundwater intertie that would reduce transmission system vulnerability. The inundation review may be partially completed through a partnership with Multnomah County Drainage District.

Powell Valley Well Improvements

The project includes upgrade of the facilities in the previous Powell Valley Road Water District area and connection and integration of these facilities to the Portland Water Bureau's water system.

Transmission and Terminal Storage System

Inventory

Three large-diameter conduits carry the water from the Bull Run watershed to the Water Bureau's in-town storage and distribution system. The conduits have interconnections in three places to ensure reliability, should one or two conduits fail. The water flows downhill from an elevation of 735 feet above mean sea level (MSL) then through the Lusted Treatment facility to Portland's easternmost storage reservoir on Powell Butte, at 530 feet above MSL. Alternatively, groundwater can be pumped to Powell Butte from the Columbia South Shore Well Field through the Groundwater Pump Main when the Bull Run Supply is not available or limited. When water is supplied from both Bull Run and the Columbia South Shore Well Field, the water is blended at Powell Butte. See Figure 7.6 for a schematic diagram of the City's water system.

The Water Bureau maintains water storage, or reservoirs, to provide for daily fluctuation of water use, to fight fires, and to provide time to connect to emergency sources of supply when primary sources are unavailable. In 2012, the terminal storage in Portland's water system consists primarily of Powell Butte Reservoir 1, Mount Tabor Reservoirs 1, 5 and 6, and Washington Park Reservoirs 3 and 4. It also includes storage at Kelly Butte, Sam Jackson and Mayfair. After 2012, the terminal storage system will undergo changes in response to regulations. The system will be reconfigured so that water from Powell Butte will be directed along multiple paths: to Kelly Butte, an enclosed underground storage facility; to the terminal storage-system reservoirs, or through large transmission mains to the distribution system and/or wholesale customers.

Current Condition

The transmission system's 75 miles of conduits is primarily in fair to good condition, although an estimated 12% is in poor or very poor condition. More detailed condition assessments of the conduits are needed. The Washington County Supply Line and Groundwater Pump Main are primarily in good condition (91%), while the Mt. Tabor to Washington Park transmission mains are in fair to good condition.

Terminal storage located at Mount Tabor and Washington Park are classified as uncovered reservoirs, and therefore must be decommissioned or covered as part of the federal LT2 regulations. The Mount Tabor and Washington Park reservoirs are ranked in the condition assessment as poor. As a result of the LT2 regulations, plans are currently underway to build additional terminal storage at Powell Butte (Reservoir #2) and replacement storage at Kelly Butte to replace the function of the Mount Tabor Reservoirs. Design work to replace the uncovered reservoirs at Washington Park is under way.

Terminal storage at Sam Jackson and Mayfair is considered to be in fair condition.

Current Capacity

The conduits have a combined maximum capacity of approximately 212 MGD. The current average annual demand (retail plus wholesale) is approximately 100 MGD. Peak-day demand is approximately 170 MGD. At this time, transmission capacity is available to meet demands when all facilities are in operation. However, transmission system outages and vulnerability remains a concern.

Total storage capacity of the terminal storage reservoirs is currently approximately 195 million gallons (MG). This will be reduced to 148 MG through the elimination of the uncovered reservoirs and construction of new covered storage.

Projected Capacity

At the point in time that peak-day demands are projected to exceed the capacity of the three conduits, Conduit 5 will likely be required. Peak-day demands are not expected to exceed the capacity until near the end of the time period covered by this plan, or later.

Terminal storage capacity will be 148 MG for the time period covered in this plan.

Needs & Approach

The conduits are a critical part of the supply system and represent a significant financial investment for the Water Bureau. Gaining better information on the condition of the conduits and providing the necessary maintenance is therefore of great importance to the Bureau. This work has begun with the completion of a Conduits Asset Management Plan. Over the next few years, the City will need to invest to help improve knowledge of the condition of the conduits. The recently constructed Sandy River crossing reduced vulnerability and replaced conduit sections that were considered in poor condition. A new seismically hardened Willamette River crossing is also planned and included in the capital improvement plan.

Replacement of terminal storage reservoirs is expensive—significant funding is needed to complete the new storage within the time frames required by EPA.[22] Additional transmission main improvements will also be required as part of the reservoir replacement work. An asset management plan for terminal storage is currently being developed. This plan will help identify projects and replacement strategies necessary to maintain and improve the system.

An overall seismic evaluation of the Transmission and Terminal Storage system is recommended.

Recommended Transmission and Terminal Storage System Improvements

Conduits and Transmission Mains

The conduits that bring water to Portland from the Bull Run watershed are large pipes - 56 to 72 inches in diameter. This program funds repairs, replacements and upgrades to the conduits. In future years, the

[22] See the bureau's website on Uncovered Reservoirs, http://www.portlandoregon.gov/water/article/330807, for the most up-to-date information.

Portland Water Bureau plans to upgrade 4-5 miles of conduits each year at an estimated cost of $4-$5 million per mile.

Conduit 5

This project would include installation of sections of a new Conduit 5 as growth occurs and the condition of the existing conduits worsens.

Kelly Butte Reservoir

This project would increase storage capacity from 10MG to 25MG by replacing the existing tank with a buried reservoir. The project includes site access, construction access and easements, staging areas, and on-site storage areas. This project establishes Kelly Butte as a key facility that will be used for system pressure equalization and in-town terminal storage in lieu of the Mt. Tabor uncovered reservoirs.

New Conduit Intertie

This project would address concerns about the capability of the conduit system to withstand hazards and deliver an uninterruptible supply to the City. The project will connect the conduits through additional piping and valving to improve reliability of flow during emergency conditions and for maintenance by providing additional isolation and interconnectivity.

Powell Butte Reservoir 2

This LT2-related project is being constructed in two phases – Phase 1 is complete. The project is currently in Phase 2, the construction of a 50-million-gallon buried reservoir at Powell Butte. It includes a short section of Conduit 5, construction of a maintenance and storage facility, replacing the caretaker's house, construction of an interpretive center and restrooms, reservoir overflow facilities, park improvements and mitigation requirements (required in the 2003 Land Use Review Type III Conditional Use Master Plan).

Powell Butte Reservoir 3

This project constructs a third reservoir at Powell Butte and possible bypass piping around the Butte for additional system reliability.

Sandy River Conduit Relocation, Phase II

The bureau is committed to increasing the flexibility and preparedness to meet the future challenge of a natural disaster. Conduits 2, 3, and 4 were identified in the system vulnerability study as vulnerable to seismic, volcanic, flood, and other natural and human-caused hazards. This project will relocate the Sandy River crossings of Conduit 3. The replacement of crossings of Conduit 2 and 4 have already been completed.

Sandy Wholesale Connection

The project consists of the design and construction of a wholesale meter connection for the City of Sandy to the Portland Water Bureau's supply and is anticipated to be completed early 2014.

Tabor Reservoir Adjustments

This project includes adjustments to piping, structures and other features at Mt. Tabor in order to move storage elsewhere and physically disconnect the uncovered reservoirs from the public water system for compliance with LT2. The project does not include disposition of the reservoirs after they have been disconnected from the public water system.

Washington Park Reservoir 3

The project will plan, design and construct a new buried reservoir to replace uncovered Reservoir 3. This project is one solution toward compliance with LT2 replacement of the uncovered reservoirs. It is assumed that Reservoir 4 will be used as the overflow detention structure. The covered Reservoir 3 will likely retain its visual characteristics and historical features.

West Side Transmission Main Improvements

These mains include the Sam Jackson to Downtown Pipeline and the Jefferson Street Supply mains. These new large transmission mains will strengthen the supply to terminal storage located on the west side of the Willamette River.

Wholesale Connections

This project provides for facilities serving wholesale customers including repairs, replacements, and upgrades of pump stations and meters.

Distribution System

The retail distribution system within the City of Portland comprises approximately 2,200 miles of mains connected to 67 active storage tanks and reservoirs and 39 pump stations, located in 42 service areas. The distribution system configuration has evolved over the past 100+ years in response to changing requirements and regulation. Many parts of the system originated as small, independent water districts that have been incorporated into the Portland Water Bureau's system over the years. Table 7.6 lists the retail distribution service areas and the number of service connections (according to Water Bureau maps as of August 2006). The distribution systems for wholesale water customers are owned and managed by other water service providers and are not included in this report.

Table 7.6 Service Connections by Service Area

Service Area	# of Connections	Service Area	# of Connections
Arlington Heights	825	Powell Butte Pump	50
Arnold	1,548	Powell Valley Road 415	3,782
Bertha	1,730	Powell Valley Road Pump	15
Broadway	604	Powell Valley Road Raymond	2,000
Burlingame	7,816	Rocky Butte	892
Calvary	643	Rocky Butte Pump	46
Clatsop	438	Rose Parkway	766
Clatsop Pump	277	Saltzman	8
Council Crest	1,334	Sherwood	679
Denver	225	Stephenson	1,383
Greenleaf	2,414	Stephenson Pump	379
Lexington	526	Tabor 302	32,362
Linnton/Whitwood	192	Tabor 411	59,070
Marquam	170	Tabor 590	888
Mt Scott	699	Vermont	3,650
Nevada	144	Vernon 224 & 270	15,932
Parkrose	4,167	Vernon 362	18,545
Penridge	37	Washington Park 229	5,223
Pittock	78	Washington Park 299	4,297
Portland Heights	1,323	Willalatin	213
Powell Butte	431	Willamette Heights	292
Total Service Connections	**176,093**		

Figure 7.2 presents a map showing the locations of service areas. Figure 7.6 is a schematic of the City's system, showing key Bull Run and CSSWF supply and transmission facilities, and key distribution system pipelines, pump stations and storage tanks.

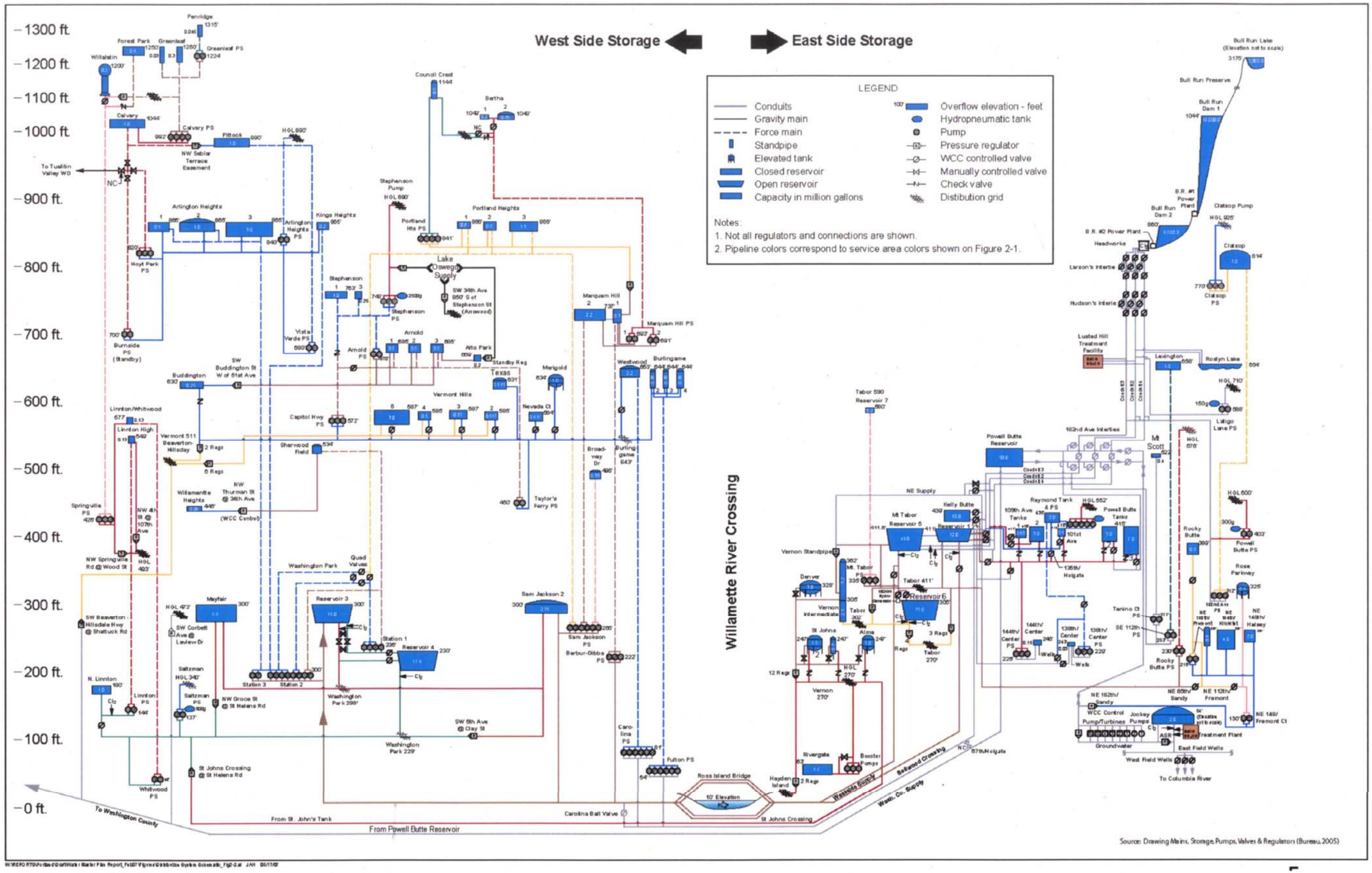
Service areas east of the Willamette River are shown on the right side of Figure 7.6. Most of the areas east of the Willamette are supplied by gravity (without pumping) from Powell Butte and the Mount Tabor Reservoirs, which are fed from the supply and transmission system. Exceptions are small areas in southeast Portland, in and around Powell Butte, the Tabor 590 Service Area, which is located on Mount Tabor, and some areas of northeast Portland, shown on the far right-hand side of the schematic.

Service areas west of the Willamette River are shown schematically on the left side of Figure 7.6. Higher elevation service areas west of the Willamette are served from several key pump stations (Carolina, Fulton, Sam Jackson, and Washington Park) that draw from major transmission lines that currently run from the Mt. Tabor Reservoir complex to the Washington Park Reservoirs.

Inventory

Portland's retail water distribution system is composed of vast networks of distribution mains, service lines, pump stations, and tanks, as well as hydrants, meters, valves, and fountains.

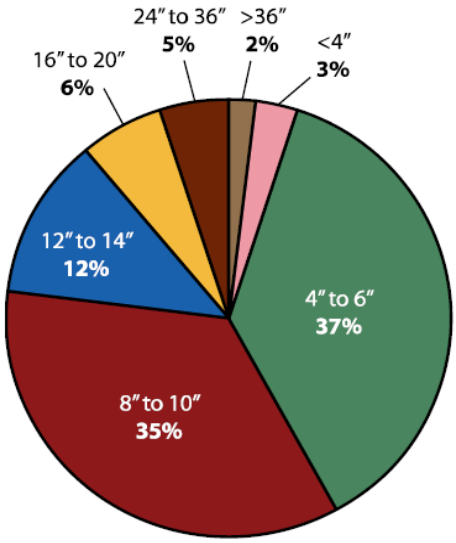
Figure 7.6 City of Portland Water Supply Schematic[23]



Mains

Portland's retail distribution system comprises approximately 2,100 miles of pipeline. Figure 7.7 summarizes pipeline diameters in the distribution system. Distribution piping includes a number of materials, including unlined and lined cast iron (65%), ductile iron (29%), steel (2%), and a small percentage of other materials. The City's distribution mains have a combined replacement value of over $2.2 billion.

Figure 7.7 Pipeline Diameters in the Distribution System[24]



Service Lines

The retail distribution system also includes over 183,000 service lines. The vast majority of these lines (94%) are smaller than 2" in diameter, although larger lines do exist in some areas. The network of service lines has a replacement value of $899 million.

Tanks

The retail water system is served by 67 active storage tanks with a total storage capacity of approximately 270 million gallons. Table 7.7 lists the tank, its service area, capacity information, and whether the condition of the tank was assessed in 2006 as a part of the Distribution System Master Plan. Portland's storage tanks have a replacement value of $266 million.

Pump Stations

The distribution system includes 35 pump stations, valued at $118 million. Table 7.7 lists the capacity of each pump station, and whether a condition assessment was performed in 2006 as a part of the Distribution System Master Plan.

[24] Portland Water Bureau, Distribution System Master Plan, 2007

Meters

The Portland Water Bureau has nearly 180,000 meters worth approximately $88 million. Small meters are replaced every 30 years while large meters are tested and replaced based on condition and criticality.

Valves

The water distribution system contains approximately 43,800 system valves, with a replacement value of $604 million.

Hydrants

The distribution system includes about 14,400 hydrants, with a combined replacement value of $184 million.

Table 7.7 Distribution System Service Areas, Storage Reservoirs and Pump Stations[25]

Service Area and # of Connections		Reservoirs/ Tanks	Capacity (mg)	Pump Stations	Capacity (mg)
Arlington Heights	825	Arlington 1	0.5	Arlington Heights	NA
		Arlington 2	1	Sam Jackson	1700
		Arlington 3	3	Wash. Park 1	3200
		Kings Heights	0.2	Wash. Park 2	7500
				Wash. Park 3	1300
Arnold	1,548	Alto Park	0.2	Capitol Hwy	2500
		Arnold 1	0.5	Taylors Ferry	2000
		Arnold 2	0.5		
		Arnold 3	0.6		
Bertha	1,730	Bertha 1	0.2	Marquam Hill 1 & 2	2410
		Bertha 2	0.9		
Broadway	604	Broadway Drive	0.4	Sam Jackson	800
Burlingame	7,816	Buddington	0.3	Carolina	10800
		Burlingame 2	1.6	Fulton	6400
		Burlingame 3	0.4		
		Burlingame 4	0.9		
		Marigold	1		
		Texas	0.7		
		Westwood	1		
Calvary	643	Calvary	1	Burnside	470
				Hoyt Park	2800
Clatsop	438	Clatsop	3	162nd Avenue	880
Clatsop Pump	277			Clatsop	775
Council Crest	1,334	Council Crest	0.5	Portland Heights	4300
Denver	225	Denver	3		
Greenleaf	2,414	Forest Park	0.5		
		Greenleaf 1	0.03	Calvary	1900
		Greenleaf 2	0.3		
Lexington	526	Lexington	1	112th Avenue	1100
Linwit	192	Whitwood	0.1	Linnton	130
				Whitwood	640
Marquam	170	Marquam Hill 1	0.3	Barbur Gibbs	1300
		Marquam Hill 2	2.3	Sam Jackson	2100
Mt. Scott	699	Mt. Scott	0.4	Tenino Ct.	320
Nevada	144	Nevada Ct	0.6		
Parkrose	4,167	104th/Klickitat	4		
		148th/Halsey	2		
Penridge	37	Penridge	0.1	Greenleaf	130
Pittock	78	Pittock	1	Verde Vista	1000
Portland Heights	1,323	Portland Heights 1	0.6		
		Portland Heights 2	0.5		
		Portland Heights 3	1.9		
Powell Butte	431	Powell Butte N/S	50	1st & Kane	N.A.

[25] *Portland Water Bureau, Water Management and Conservation Plan, 2010 (Tables 2-21 and 2-22)*

PB Pump	50			PB Heights	1480
Powell Valley Road 415	3,782	101st Ave	0.5		
		109th Ave 1	3		
		109th Ave 2	0.7		
		160th Ave 1	7		
		160th Ave 2	3		
		PV 144th/Center	0.2		
PV Rd Pump	15			PV Raymond St	440
PV Road Raymond	2,000	PV 138th/Center	0	PV 138th / Center	1100
		Raymond	2		
Rocky Butte	892	Rocky Butte	0.5		
RB Pump	46			Rocky Butte	200
Rose Pkwy	766	Rose Parkway	0.5		
Saltzman	8			Saltzman	75
Sherwood	679	Sherwood	0.4	Washington Park 2	1400
Stephenson	1,383	Stephenson 1	1.3	Arnold	1000
		Stephenson 3	0.3		
Steph. Pump	379			Stephenson	500
Tabor 302	32,362	Mt. Tabor 6	37.8		
		Vernon 2	2.5		
Tabor 4113	59,070	Kelly Butte	10		
		Mt. Tabor 1	12		
		Mt. Tabor 5	49		
Tabor 590	888	Mt. Tabor 7	0.2	Mt. Tabor	1200
Vermont	3,650	Vermont Hills 2	0.6		
		Vermont Hills 3	0.9		
		Vermont Hills 4	0.5		
		Vermont Hills 5	2.8		
Vernon 224 & 270	15,932	Alma	1		
		St Johns 2	1.5		
Vernon 362	18,545	Vernon 3	3.2		
Washington Park 229	5,223	North Linnton	1		
		Washington Park 3	16		
		Washington Park 4	17.6		
Washington Park 299	4,297	Sam Jackson 2	2.8		
		Mayfair	5.6		
Willalatin	213	Willalatin	0.2	Springville	630
Willamette Heights	292	Willamette Heights	0.1		

Current Condition

In general, the majority of the Water Bureau's distribution system asset groups are in fair to very good condition. However, almost half of the bureau's galvanized steel distribution mains (45%) are in poor to very poor condition, as are over one-fifth of the meters (23%), and hydrants (20%), by value. Half of the 2,200 miles of distribution mains are older than 50 years. More information on the condition of major asset groups can be found in Table 7.2. The Water Bureau evaluates asset condition as one factor in asset management decisions.

Service Area Assessment

In 2007, the Portland Water Bureau completed a series of hydraulic evaluations of the "backbone" distribution system, or the essential distribution-system components. The purpose of the evaluation was to assess the ability of the system to meet demands under both existing (i.e., 2005) peak-day conditions and 2030 peak-day conditions.[26] The evaluation found that the system that will reliably deliver water through 2030. Of the 42 service areas evaluated representing the retail system, 20 service areas, accounting for 86 percent of the 2030 peak-day demand, have no deficiencies.

Table 7.8 summarizes the results of the preliminary screening. Of the remaining 22 service areas, accounting for 14% of 2030 peak day demand:

- Six service areas (Clatsop Pump, Powell Butte Pump, PV Raymond Pump, Rocky Butte Pump, Saltzman Pump, Stephenson Pump) are direct-pump service areas with no storage. Deficiencies are based on providing sufficient capacity to meet fire flows. In some instances, pump stations were designed for lower fire-flow requirements, in place at the time of pump station design. In other instances, the Bureau has designed pumps to meet fire-flow requirements with all units in service. If all units are used in the screening, three (3) service areas show no deficiencies (Powell Butte Pump, PV Raymond Pump, Stephenson Pump).
- Eight service areas have recognized deficiencies and are being evaluated by the Bureau in other studies. These are: Calvary, Council Crest, Greenleaf, Linnton/Whitwood, Penridge, PV Raymond, Willalatin, and Willamette Heights.
- Five service areas were flagged for further assessment in the hydraulic evaluation. These are: Broadway; Mt Scott; Sherwood; Stephenson; and, Tabor 590. Although the preliminary screening did not identify deficiencies in the Burlingame service area for the planning scenarios evaluated, the Bureau has recently completed a Master Plan for the service area that includes several capital projects to remedy previously identified deficiencies.
- The remaining three service areas have mitigating circumstances that relieve some of their identified deficiencies. The Lexington service area was deemed deficient in the outage screening, but the Bureau has purchased a generator to supply the service area in a power outage situation. However, the generator would not address a service outage of the pump main, so the service area was still deemed deficient. The second, Bertha, was deficient for both storage and outage. However, the service area has additional regulated supply from other service areas. The third, the Vernon 362 service area, has a large number of regulators that supply the zone, which addresses the storage deficiencies.

[26] More information can be found in the Portland Water Bureau's Distribution System Master Plan, 2007. Options to integrate the former Powell Valley Road 415 service area with the Tabor 411 service area, and supply capacity through Washington Park were also assessed in this plan.

Table 7.8 Results of 2007 Preliminary Screening of Service Areas[27]

Service Areas that Passed Preliminary Screening for Pumping, Fire, Storage and Outage Service Goals; or Are Being Addressed in Other Studies*

Arlington/Portland Heights **	Arnold	Burlingame
Clatsop	Denver	Marquam Hill
Nevada	Parkrose	Pittock
Powell Butte	PVRWD 415	Rocky Butte Tank
Rose Parkway	Tabor 302	Tabor 411
Vermont	Vernon 270	Washington Park 229
Washington Park 299		

Service Areas that were Deficient for One of More Screening Service Goals

Service Area	Pumping	Fire	Storage	Outage	Notes
Bertha	✓	✓	X	X	Additional regulated supply available
Broadway	X	X	X	X	Additional regulated supply available
Calvary	X	X	X	N/A	Being evaluated in NW Hills study
Clatsop Pump	X	X	N/A	X	
Council Crest	✓	✓	X	X	Being evaluated by Bureau
Greenleaf	✓	✓	X	X	Being evaluated in NW Hills study
Lexington	✓	✓	✓	X	The Bureau has purchased a generator with an automatic transfer switch for 112th St Pump Station. The generator would not address outages due to a pump main break
Linnton / Whitwood	X	X	X	X	In Upper Linnton Tank Analysis
Mt. Scott	X	X	X	X	Additional regulated supply available
Penridge	X	X	X	✓	Being evaluated in NW Hills study
Powell Butte Pump	X	X	N/A	✓	Not deficient if all pumps used
PV Raymond Pump	X	X	N/A	✓	Not deficient if all pumps used
PV Raymond	X	X	X	X	Being evaluated by Bureau
Rocky Butte Pump	X	X	N/A	✓	
Saltzman	X	X	N/A	✓	
Sherwood	X	X	X	X	Additional regulated supply available
Stephenson	X	X	X	✓	
Stephenson Pump	X	X	N/A	✓	Not deficient if all pumps used
Tabor 590	✓	X	X	X	
Vernon 362	N/A	X	X	N/A	Large regulated supplies available
Willalatin	X	X	X	X	Being evaluated in NW Hills study
Willamette Heights	N/A	X	X	X	Being evaluated in Willamette Heights Tank study

* Passed all screening criteria (Arnold, Clatsop, Denver, Marquam Hill, Nevada, Rocky Butte Tank, Vermont), were only deficient in storage screening (Parkrose, Rose Parkway), or passed pumping, storage, and fire screening goals, but were not screened for outages, since these are being addressed by other studies, or are large service areas with adequate redundancy (Arlington/Portland Heights, Burlingame, Powell Butte, PVRWD 415, Tabor 302, Tabor 411, Washington Park 229, Washington Park 299).

** Arlington Heights and Portland Heights service areas are hydraulically interconnected and were evaluated together.

N/A = Not applicable, or not evaluated in DSMP ✓ = Passed screening X = Failed screening

[27] Portland Water Bureau, *Distribution System Master Plan*, 2007

Backbone Hydraulic Evaluation

The backbone evaluation assessed system operation, taking into account system hydraulics, to find further deficiencies not evident in the preliminary screening. The model simulated a 24-hour period on the peak-demand day for 2005 and 2030 demand conditions. Results of the hydraulic evaluation were consistent with the preliminary screening. No additional deficiencies were identified.

Three service areas, however, that had deficiencies in the screening evaluation showed no deficiencies in the hydraulic evaluation. All three (Broadway, Sherwood Field, and Stephenson) have adequate pumping capacity to meet normal demand, but insufficient capacity to meet peak-day demand plus re-fill of storage following a fire within the service area.

Assessment of Pump Stations and Tanks[28]

Condition assessments have been conducted for 35 pump stations and 66 tanks in the distribution system. The pump station assessment found that, in general, the pump stations originally constructed by the Bureau were in good condition. With the exception of the recently acquired Powell Valley system pump stations, pump stations acquired from other formerly independent water systems had more deficiencies.

- 15 pump stations are in good condition with only minor corrective maintenance needed;
- 20 pump stations are operationally and functionally sound, but exhibiting some signs of wear, with some need for corrective action;
- Deficiencies were identified in the Fulton, Linnton, Portland Heights, Sam Jackson, and Taylors Ferry service areas.
- Of the 66 tanks assessed, 4 tanks are in conditions that substantially diminish performance; 55 tanks are operationally and functionally sound, but exhibiting some signs of wear, with some need for corrective action; and 7 tanks are in good condition with only minor corrective maintenance needed.

The tank assessments found that coating and painting for tanks has not been performed routinely in recent years. A strategic coating and painting program was recommended. The analysis also found seven tanks that require further evaluation to address extensive cracks observed during inspections. Fifty-two tanks also had minor repair or maintenance recommendations, and several tanks require anchoring and/or flexible piping connections to reinforce tanks to withstand an earthquake. All work will be performed as part of ongoing capital and maintenance programs.

Seismic Assessment

As part of the Distribution System Master Plan (2007) a qualitative seismic assessment was provided for 32 tanks to identify conceptual-level seismic improvements. The analysis used condition information collected in the tank inspections, along with probabilistic ground-motion data from U.S. Geological Survey, to assess which tanks would be most vulnerable in a large-scale earthquake in the Portland area

[28] Portland Water Bureau, *Distribution System Master Plan*, 2007

(100- year to 500-year frequency). For tanks identified to be the highest risk, conceptual-level improvements were identified to reinforce the tanks.

Needs & Approach

Backbone Hydraulic Evaluation

In selecting improvements, service areas were reviewed to identify water supply issues including service pressures, fire flow requirements, water quality goals and sizing for new facilities.

For direct-pumped service areas, the improvements were developed based on a criterion of meeting peak-hour demands plus fire flow with one pumping unit out of service, rather than peak-day plus fire flow, since direct-pumped areas have no storage and pumps and must be able to meet both normal and fire demands. In some instances, the bureau has designed pump stations to meet fire flows with all units in service. In the Powell Butte Pump, Powell Valley Road Water District Pump and Stephenson Pump service areas, pump stations can provide adequate fire flow if all units are used. The bureau will need to determine whether these pump stations - built to then-current standards - should be upgraded based on the Distribution System Master Plan criteria of meeting peak-hour demands plus fire flows with one unit out of service.

Condition Assessment of Pump Stations and Tanks[29]

All of the pump station projects generated from the pump station condition assessment will be constructed as part of ongoing capital and maintenance programs, or as part of larger planned pump station rehabilitation projects.

Asset Management Plans

Asset management plans are being developed for all assets within the distribution system. These plans will help identify additional projects and replacement strategies necessary to maintain and improve the system. These plans may identify additional projects to be included in the 20-year Project List.

Recommended Distribution System Improvements

Burnside Pump Station Replacement

This project will decommission the old undersized pump station and modify the nearby Verde Vista pump station to serve the Burnside pumping needs for the next 50 years. The project will also acquire property for the future Burnside pump station to be built 50 years from now.

Carolina Pump Main Extension

This project will connect the existing Carolina Pump Main (Westwood Tanks) and the Fulton Pump Main (Burlingame Tanks) together. This will be a pump main from the intersection of SW Capital Hwy and SW Terwilliger Blvd to the Burlingame Tank site. Phase 1 is replacing the existing 16" Fulton pump main with

[29] Portland Water Bureau, *Distribution System Master Plan*, 2007

a 24" pump main from Burlingame Tank site to SW Chestnut and SW Burlingame as well as improvements at the Burlingame Tank site. Phase 2 is the new construction of a 24" pump main from SW Chestnut and SW Burlingame Ave to tie into the existing Carolina Pump main at Capitol Hwy and Terwilliger Boulevard.

Control Center SCADA Server Replacement

This project replaces the aging supervisory control and data acquisition (SCADA) system at the Water Control Center with a secure, Windows based system. The bureau will add, as part of the upgrade, a disaster recovery SCADA system to our Lusted Treatment site. The new system will have better system functionality, improved integration tools, management tools and security and will provide the Water Bureau with critical water supply monitoring and control for 10 years plus. The system includes hot standby real-time and historical servers, client workstations at various facilities, a decision-support server, and a terminal server for remote access.

Distribution Mains

This program includes rehabilitation and replacement of mains with high leakage or break rates, substandard mains (2-inch galvanized steel), expansion due to applications from private developers, increasing supply for fire protection, improving water quality and water system upgrades due to local improvement districts (LIDs), and street improvements. Water main replacements also include appurtenances such as fire hydrants, valves, pressure regulators, service branches, and other facilities.

Field Support

This project funds vehicles and major equipment purchases, including heavy construction equipment such as dump trucks and backhoes, and Bureau-owned computer software with a unit cost greater than $5000.

Forest Park Low Tank

This project will plan, design and construct a single 1.3 million gallon tank at NW Cornell and NW Skyline Drive for the Greenleaf 1034 pressure zone. This storage is to augment regular system capacity and increase fire flow to a large area of Northwest Portland.

Fulton Pump Station Improvements

This project will replace the Fulton Pump Station with a new pump station located in Willamette Park.

Greenleaf Pump Station

This project will plan, design and construct a replacement Greenleaf pump station at the existing site. Flow upgrades will remove the Penridge tank from the system. The new pump station will pump directly to the distribution system.

Hydrants

The bureau maintains about 16,000 fire hydrants. These hydrants allow Portland the flexibility and preparedness to respond to a fire emergency through coordination with the Fire Bureau. This project provides for the replacement of fire hydrants that are no longer repairable. Replacements may also occur as part of the bureau's ongoing efforts to standardize hydrant types for more efficient and effective management of maintenance and repair activities.

Meters

This project funds the purchase and installation of water meters. The Bureau’s objective is increase accuracy based on replacing high usage meters. High usage meters typically wear out faster than others.

Portland Heights Pump Main

This project will replace the portion of the 12" pump main in SW Montgomery Drive between the southern end of the 16" pump main from Washington Park and the Portland Heights Tank site with approximately 3,500 feet of 16" main in Montgomery Drive and Greenway Avenue. The new main will replace a poor condition main and provide additional supply capacity to the area.

Portland Heights Pump Station Electrical Improvements

The project will design and construct a new prefabricated building at the Portland Heights Pump Station to house electrical and control equipment, and also install in the existing pump vault a new 100hp pump and vault improvements.

Portland to Milwaukie Light Rail

This project consists of relocation of over 5,000 feet of main impacted by TriMet’s SE Corridor Light Rail project.

Pump Stations and Tanks

This project includes a large variety of infrastructure consisting of water storage tanks, pumps, and pump and control facilities. The bureau uses a reliability centered maintenance (RCM) approach to manage its assets. A key focus of the next twenty years will be to replace the remote telemetry units at over 140 remote sites. The existing units are over 15 years old, and are becoming obsolete. The servers are at the end of their service cycle, and must also be replaced.

Sam Jackson Pump Station and Mains

This project will make multiple capital improvements to the Sam Jackson Pump Station, including seismic improvements, replacement of RTU and motor controllers, installation of pump control and check valves, extension of the crane rail, a concrete pad, and installation of a security fence and gate.

Services

This project constructs replacement and customer requested water services. A water service is the connection between the water main and any given customer's service meter. Service connections are always performed by Water Bureau crews directed by a certified Water Service Mechanic. An ongoing budget of approximately $5 million per fiscal year provides for installation of about 1,000 water service connections annually and other upgrades to existing water services.

Willamette River Crossings

The project replaces major pipelines to strengthen the transmission link between Powell Butte and the service areas west of the Willamette River, including downtown and the storage reservoirs at Washington Park. It includes construction of a new seismically strengthened river crossing to replace the first one of potentially two Willamette River crossings, and new transmission piping on both sides of the Willamette.

Treatment System

Inventory

The Federal Safe Drinking Water Act, which regulates public drinking water supplies, typically requires surface water supplies to be filtered to meet federal drinking water standards. Because the Bull Run source water quality is very high and Portland implements source water protection measures, Portland is currently exempted from filtration requirements. Portland’s water supply is disinfected using chloramines. Water is chlorinated at the Headworks at Reservoir 2. Ammonia and sodium hydroxide are added at a second treatment facility, Lusted Hill.

Ammonia ensures that disinfection remains adequate throughout the distribution system. Sodium hydroxide increases the pH of the water helping to control lead and copper levels at customers' taps should these metals be present in the customers' home plumbing.

Future federal regulations may require additional treatment processes in the future.

Treatment is also required for the groundwater supply.

Facilities used to provide water treatment include a chlorination building and equipment, and flow metering at Headworks; treatment facilities and equipment at Lusted Hill; and treatment facilities and equipment at the Groundwater Pump Station.

Current and Projected Condition

Headworks treatment facilities are rated as good to fair. The flow meters are rated as poor.

The Lusted Treatment Facility was constructed in 1992. Condition is assessed at good to fair. However, buildings at this site were built as temporary structures and do not reflect the full cost of replacing the facility with permanent buildings. Future facility upgrades will include permanent structure replacements.

The treatment facilities at the Groundwater Pump Station were recently upgraded and are rated in very good to good condition.

Current and Projected Capacity

Due to changing regulations, the suitability of a treatment facility is a moving target. As federal and state rules are modified and as technology changes, treatment facilities must change as well.

With the State granting the Bureau a variance on the treatment provisions of the LT2 rule, many related facility improvements planned at Headworks were postponed as well. Among these improvements were replacement of the chlorination system and the operators' station. Both of these will need significant upgrades within the next 20 years.

Needs & Approach

Asset management plans are being developed for the Bull Run Supply and Groundwater. These plans should help identify needed improvements.

Recommended Treatment System Improvements

Headworks Flow Meters

This project would install new flow meters on the Primary Intake conduits; install new flow meters and flow control valves on Screen house #3 conduits; and address the sump pump drainage system in Bailey pressure-reducing valve vault.

Treatment Facilities Improvements

This project includes several related projects for treatment facilities for the Bull Run water supply, at both the Bull Run Headworks and the Lusted Hill Facility. Specific treatment improvements have not been determined at this time. Projects would likely be driven by state and federal regulations.

Support System

Inventory

The Support system includes miscellaneous facilities and equipment necessary to support the Water Bureau's mission. Support system assets are shown in Table 7.2. Chief among these assets are the Interstate Facility, and Sandy River Station.

Funding for Support system projects often resides in budget programs other than "Support". The Interstate Rehabilitation Project is currently funded through the Distribution program in the CIP.

Current and Projected Condition

The Interstate Maintenance Building is more than 85 years old. Studies have indicated that this building is highly vulnerable to collapse during an earthquake. This building fails to meet building codes in many

areas including structural, mechanical and electrical requirements. Renovations required to bring the building up to code are extensive. A major rehabilitation plan has been developed that will result in the demolition and reconstruction of this building, anticipated to be completed in 2016.

Other buildings include Sandy River Station which is primarily in good to fair condition.

Current and Projected Capacity

Needs & Approach

Buildings classified as part of the Support system will require maintenance and rehabilitation over the next 20 years. An asset management plan for facilities/buildings is being developed that should help identify work that is needed.

Recommended Support System Improvements

Building Maintenance

The bureau maintains hundreds of structures from the Bull Run watershed to downtown Portland. These structures range in size from small pump houses to the maintenance hub on Interstate Avenue. The necessary work involves structural repairs and maintenance.

Interstate Facility Rehabilitation

The project rebuilds the Portland Water Bureau's main maintenance facility. A four-year master planning effort from 2002 – 2006 developed the baseline requirements for both current and long-term needs. Recent updates to the master plan along with additional program summary work has created the basis for the design of the facility now underway. Two new buildings will replace the eighty-five year old Maintenance Building that currently serves as the main office and warehouse. Site improvements to the 11 acre campus improves vehicle and employee circulation. It also brings the property up to current code requirements for storm water management and landscaping.

Planning

This program consists of general planning studies for projects needed to improve the operation of the water system. These include pressure zone adjustments, facility modifications, and system element studies.

Sandy River Station Upgrades

This project consists of upgrades to the Sandy River Station facilities including an evaluation of a potential move to a different site.

West Side Maintenance Facility

A hub is needed on the west side of the Willamette River for maintenance and construction crews, vehicles, equipment and materials, and emergency operations. Property previously owned by the Federal

government (the Jerome Sears site) has been acquired by the City for this purpose. This project includes improvements to the facility over the next 20 years.

Regulatory Compliance

Inventory

The Regulatory Compliance program ensures that water throughout the system meets Federal and State of Oregon drinking water quality standards and environmental protection standards. Included in this program is implementation of the federally approved Habitat Conservation Plan (HCP) and the multiple easements and improvements required by this plan. Chief among these is the Bull Run Dam 2 tower intake structure which will allow the bureau to better control the release of water to enhance downstream conditions for anadromous fish species in compliance with the Endangered Species and Clean Water acts.

Regulatory Compliance system assets are included in Table 7.2.

Needs & Approach

The focus of this program is implementation of the federally approved Habitat Conservation Plan and the multiple easements and improvements required by this plan.

Recommended Regulatory Compliance System Improvements

Bull Run Dam 2 Tower

The Water Bureau is installing steel multi-level intake structures onto the North Dam 2 Tower located in the Bull Run watershed. Modifications are designed to allow selective water withdrawal, proper operation during flood conditions, and enable the tower to better withstand seismic events.

HCP Alder Creek Fish Passage

This project will design and install two fish passage facilities as planned in the Habitat Conservation Plan (HCP). The project is in Alder Creek, a tributary to the Sandy River. There will be a fish ladder at the waterfall and a fish ladder at a water diversion.

Regulatory Compliance

This project responds to requirements of the Endangered Species Act (ESA), including the implementation of the Habitat Conservation Plan (HCP) Consistent with HCP commitments, this project funds easements, purchases land, and also supports projects jointly conducted with other watershed partners.

Customer Service

Inventory

The Customer Services Program includes facilities that provide services for customers other than the direct supply of water. It includes customer billing, collection, and call center facilities and equipment, which is the largest part of the program. It also includes conservation, security, emergency management and grounds maintenance for Bureau-owned properties. Specific assets included in the Customer Services program are Dodge Park and the Security and Emergency Management facilities, including the new City Emergency Coordination Center.

Customer Service system assets are included in the Distribution section and the Support Facilities section in Table 7.2.

Current and Projected Condition

Dodge Park is considered to be in good condition. Upon completion of the new Emergency Coordination Center in 2014, the Security and Emergency Management facilities (including the Ranger Station and security gates) should be in very good condition.

Current and Projected Capacity

Needs & Approach

Automated meter reading would reduce operational costs and provide better customer service (i.e. access to more current consumption data).

Maintenance and upgrades of Water Bureau facilities including Dodge Park and Security and Maintenance facilities will be a continual need. An asset management plan for facilities/buildings has been developed that should help identify work that is needed.

Recommended Customer Service System Improvements

Automated Meter Reading (AMR) Implementation

This project provides for the replacement of customer meters throughout the City with automatic water meter reading equipment.

Emergency Coordination Center

This project designs and constructs the City's Emergency Coordination Center. The bureau will locate its emergency response and security staff at this location. The project location is adjacent to the City's 911 Call Center at SE 99th Ave and Powell Blvd. The total project cost is $19.85 million and Portland Water Bureau is a contributing bureau.

Security and Emergency Management

The bureau is committed to increasing flexibility and preparedness to meet future security challenges, to enhance security throughout the water system and to modernize security practices and infrastructure. This program includes physical security improvements to major and minor facilities as well as improved security in the overall water distribution system and control/communications system.

Investment Strategy

Process

Annually, the Portland Water Bureau prepares capital budgets for the upcoming fiscal year and for the five-year planning horizon. The major components of the water system define the program categories within the capital budgeting process. These capital programs are: Supply, Transmission and Terminal Storage, Distribution, Treatment, Regulatory Compliance, and Customer Service. The Capital Improvement Plan (CIP) is an annual planning process which allows a review of capital projects and programs. The Portland Water Bureau engages the public in developing its budget and the CIP. All Water Bureau CIP projects that affect neighborhoods or that require city, state, and/or federal permit review processes include public involvement elements.

The Engineering Services Group (ESG) receives requests and ideas for CIP projects from a number of sources. Internal bureau stakeholders groups including Asset Management, Development Services, Design or Construction, Operations, Maintenance and Construction, and Resource Protection all may identify the need for a capital project. Other sources include projects generated from ESG CIP Planning Section listed in Master Plans or Public Facility plans, and recommendations from the Asset Management group that include business case studies. In addition, the Portland Water Bureau receives notifications from other agencies or bureaus planning or producing work that may impact the water system. External requests may also come from citizens, wholesale customers, the City Council, and developer requests for projects administered through ESG's Development Services Branch.

The Water Bureau performs economic analyses and/or business cases for new projects, and ensures that investment decisions are economically justified.

Contributing Plans

Asset Management

The Bureau's Asset Management Program is intended to guide the strategic management of physical assets to best support the delivery of identified services. It helps the Bureau to better manage existing assets, and plan for future needs. This process is guiding decisions as to the effective mix of maintenance, repair, renewal or replacement of the water system components, and has led the Bureau to focus on critical assets. A risk analysis methodology has been applied to assess the relative risks of asset failure; those assets with the highest risks are then identified for follow-up actions.

Asset condition assessments have been completed or are underway for many asset classes. Business case methodology is helping ensure that investment decisions deliver good value by comparing the cost of an investment to the benefits it provides. Benchmarking with best practices helps the Bureau better understand process improvement opportunities. Asset Management Plans have been prepared for almost all asset classes, capturing current information on service levels, inventory, condition, failure modes, risks of asset failure, and asset strategies.

System Plans

A number of plans are consulted in preparation of the CIP. These include the Infrastructure Master Plan (2000), the Distribution System Master Plan (2007), the Bull Run Water Supply Habitat Conservation Plan (2008), the Water Management & Conservation Plan (2010), and various master plans and project specific planning documents developed by the Portland Water Bureau.

Alternatives Analysis and Prioritization Process

The Portland Water Bureau's methodology and criteria for the selection and ranking of capital projects depends on the magnitude of the project and duration of the project's lifecycle. For major projects, an initial concept report is developed evaluating possible project alternatives and recommending potential capital projects. Senior management approves projects to continue with a larger planning effort to create a Basis of Design Report. To develop this report, the Water Bureau's Planning section uses industry practices in cost-benefit analysis and risk assessment to identify and weigh alternative solutions, and compare them with service standards. The Portland Water Bureau selects projects based on these quantitative analyses but also considers the logistics of rate impacts, sharing cost with interagency partners, creating revenue opportunities, and achieving compliance with regulatory requirements.

The criteria used to select projects for inclusion in the budget include fulfilling service levels (such as maintaining pressure and limiting customer outages), mitigating high risks of asset failure, operating assets at the most efficient and cost-effective levels, contributing to local and regional sustainability and energy-conservation goals, providing appropriate redundancy within the supply system, complying with all state and federal water-quality regulations, ensuring access to key water-supply facilities, and coordinating with other agency infrastructure projects.

Projects & Programs

The FY 2013-18 CIP provides balance between longer-term infrastructure replacement and maintenance needs and short-term water system infrastructure needs to ensure compliance with drinking water regulations. The CIP priorities for the bureau's budget and capital program include:

- Implement improvements necessary to assure compliance with current safe drinking water regulations, including the LT2 rule.
- Continue to expand the utilization of an asset management system plan and the computerized maintenance management system to support planning and implementation of system maintenance activities.
- Implement the Bull Run HCP, a comprehensive multi-decade Clean Water and Endangered

Species Act compliance agreement for the Bull Run watershed.

- Support other governmental agency capital improvement projects (e.g., light rail, Sellwood Bridge, Columbia River crossing) as directed by City Council.

The 5-year CIP is summarized within the following seven Bureau programs with key projects identified:

Customer Service

The Bureau's participation in the City Emergency Coordination Center is the primary project included within this program over the first five years. Bureau security staff will operate from this location with the Portland Bureau of Emergency Management. In the event of a major emergency, all City coordination staff will operate from this center.

Distribution

Over the first five years, approximately $244 million of the CIP is for improvements to the distribution system. Of the total, about $83 million is to be used for direct water line replacement projects, including work initiated by other bureaus and agencies, as well as replacement of the oldest or most deteriorated portions of the distribution system. About $35 million is to continue rehabilitation of the Interstate maintenance building. There is $57 million for the Willamette River Pipe Crossing Project. Almost $16 million is for pump stations and tanks. Other improvements include services, meters, hydrants, fountains, and vehicle and equipment replacement.

Regulatory Compliance

Over the first five years, more than $25 million has been planned for improvements to the water supply from the watershed, principally the Dam 2 Tower Improvements. Construction continues on the HCP Alder Creek project to enhance fish habitat.

Support

The Support Program includes funding for master system planning, focusing on identifying the need for, and timing of, improvements to or acquisitions for the water system. Master planning uses asset management methods to determine the most cost-effective investments. Individual asset studies help guide the selection of major capital projects for the short and long term. The Portland Water Bureau has included funds for some of the planned studies on vulnerable and aging infrastructure in upcoming fiscal years.

Supply

This program includes projects to improve existing facilities and roads in the Watershed and to improve the groundwater system. An example is the Groundwater Electrical Supply Improvements project that will reduce the risk of an extended electrical supply outage to the groundwater pump station.

Transmission and Terminal Storage

Over the first five years, the major projects in this program include $35 million to continue construction of an additional 50-million-gallon water storage tank at Powell Butte and $119 million for other enclosed storage including Kelly Butte reservoir and Washington Park reservoir. Also included is $33 million for other conduit and transmission main projects.

Treatment

Headworks Flow Meters project, to accurately record treated water flow and regulate chemical additions to the system in compliance with drinking water regulations, is the only project in the first five years.

Financially Constrained Investment Strategy

The Bureau focuses its efforts on regulatory compliance elements, improving the condition of its aging infrastructure, and addressing operations and maintenance needs. The CIP addresses longer term infrastructure replacement and maintenance needs, while addressing short-term water system infrastructure needs to ensure compliance with drinking water regulations.

Recently, the primary focus of the bureau's capital Investment Strategy has been responses to EPA's LT2 rule (reservoir replacement projects), the HCP (Dam 2 towers project), and the Interstate Facility Improvement project. Upon completion of these projects, the focus will return to improving the maintenance and reliability of existing facilities. As facilities within the water system begin showing their age, major reconstruction and maintenance projects will need to be undertaken.

Planned CIP outlays (excluding capitalized overhead) total $491 million over the five-year forecast period.

Table 7.9 Investment Strategy Summary

Program	FY 2013-2018	FY 2018-33
Customer Service	$3,057,000	$53,700,000
Distribution	$244,197,288	$461,650,000
Regulatory Compliance	$25,504,000	$30,000,000
Supply	$14,291,000	$88,500,000
Support	$10,000,000	$50,500,000
Transmission and Terminal Storage	$191,170,000	$242,000,000
Treatment	$2,500,000	$150,000,000
TOTAL	**$490,719,288**	**$1,076,350,000**

Financial Strategy

Existing Financing Strategies

As part of the Bureau's overall mission and values, its financial objective is to "maintain fiscal integrity, undertake sound financing practices and ensure auditable results" which:

- Provides for sufficient annual funding of operating, maintenance, and capital programs approved

by City Council.

- Provides for rates and charges to customers that are equitable and based on generally accepted cost of service principles unless otherwise directed by City Council.
- Strives for a natural optimal balance between financial health, operational effectiveness, infrastructure condition, effective management, rate affordability, and a skilled and experienced workforce.
- Strives to optimize capital financing strategies, today and into the future.
- Ensures the maintenance of appropriate and adequate cash balances (operating fund, construction fund, sinking fund, and rate stabilization account) consistent with City policies, bond covenants, and industry standards

Rates and charges for water services are established annually based, in part, upon cost-of-service principles and methodologies recommended by the American Water Works Association (AWWA). The process used by the Bureau follows the Commodity Demand method set by the AWWA. Under this approach, developed for the Bureau by Raftelis Financial Consultants, Inc in 2006, water system costs are allocated to customers based on their average and peak water demand characteristics and use of the system. Retail rates are then established based on the residual financial requirements of the system.

The Bureau assesses both a volumetric usage charge and a fixed monthly base charge. A monthly base charge is imposed on water services connected directly to the water system. The base charge is in addition to the rates charged for water usage.

Financial Plan and Rate Setting Process

The Bureau annually prepares a requested budget and five-year financial plan. The Bureau's budget process includes a Budget Advisory Committee (BAC). The BAC meets between October and January to review and provide input on the requested budget including the five-year capital improvement plan and proposed retail rates. The financial plan includes operating and capital expenditure and expected rates for each year of the five-year forecast period. The requested budget and financial plan reflects the financial implications of the bureau's priorities, strategies, and service levels.

The financial planning process lays the groundwork for setting rates. Section 11-105 of the City Charter authorizes the City Council to fix fees and charges for connection to and use of the Water System. Water user fees and connection charges are formally reviewed every year by the Bureau. Rates required to support proposed activities for the next year are submitted by the Bureau Administrator to the City Council for review and approval.

Water Funds

The Bureau's financial system is organized into three separate funds:

- The Water Operating Fund serves as the operating fund of the Bureau and, with the exception of debt service; all expenditures made from this fund are for operation and maintenance of capital assets. Receipts from the sale of water are the primary source of revenue for the Water Operating Fund. The cash flow in this fund determines the need for rate increases. The Rate

Stabilization Account is within the Operating Fund.

- The Water Construction Fund is the recipient of proceeds from bond sales to provide for the funding of water system capital improvements. Other sources of revenue include reimbursements for capital expenditures, such as main extensions and service installations, system development charges and sale of assets. Also, a portion of the water sales revenues is transferred to this fund to finance routine system repair and replacement. The Water Construction Fund reimburses the Water Operating Fund for capital asset requirements including capitalized overhead, capitalized interest, and the cost of issuing bonds.
- The Water Bond Sinking Fund provides for the repayment of bonded debt and interest incurred in conjunction with construction of water system facilities. The revenue bond reserve accounts are also maintained in the Sinking Fund. The source of revenue for this fund is a transfer from the Water Operating Fund, reduced by interest earnings on fund balances and a transfer from the Water Construction Fund of interest earnings on bond proceeds.

These three funds enable the Bureau to segregate resources for specific uses and ensure that reserves are not used to supplement daily operating needs. Maintenance of the fiscal integrity of each fund is a key objective of the Bureau's financial planning and analysis efforts.

Anticipated Revenues

The bulk of the Bureau’s CIP is financed by Water revenue bonds. Though not required by bond covenants, the Bureau’s planning standard is to set rates such that Net Revenues provide at least 1.90 times debt service coverage on First Lien Bonds. Additionally, the Bureau maintains a planning standard that results in Stabilized Net Revenues providing at least 1.75 times coverage on the Combined Annual Debt Service (as defined in the Master Second Lien Water Revenue Bond Declaration) for both First and Second Lien Bonds. These standards exceed the debt service coverage required by bond covenants.

Additional revenues to support the capital plan include cash financed capital funding from rate revenues, system development charges, new services and main reimbursements, City interagency reimbursements on capital projects, and sales of assets.

Revenue and expenditure comparison

The Bureau plans for a minimum fiscal year-end operating cash reserve of $15.0 million in the Operating Fund. This represents about 45 to 60 days of operating costs. This standard conforms to the generally accepted industry standard for such reserves, and has been approved by the Office of Management & Finance as a reasonable amount for this reserve.

The Bureau also has a Rate Stabilization Account (RSA) within the Water Operating Fund that is used to smooth rate increases over the financial planning period and beyond. This smoothing is one of the Bureau’s key financial planning objectives and is aimed at maintaining financial stability and predictability.

Financial challenges, unmet needs and risks

The Bureau’s financial projections include key assumptions underlying the revenue and expenditure forecast. Key assumptions in the revenue forecast include:

- Retail water demand
- Wholesale water sales
- User charges
- Issuance of additional First Lien Bonds or Second Lien Bonds to fund capital program requirements

Key assumptions in the expenditure forecast include:

- Annual inflation
- The bureau's cost related to the City's outstanding pension obligation bonds
- Pension system contribution rates
- All costs related to compliance with the LT2 rule including regular monitoring and capital projects
- Continuing to operate under the Bull Run Treatment Variance[30]

[30] On March 14, 2012, OHA issued a Final Order granting the City a variance to the treatment requirements of the LT2 Rule. The variance went into effect on April 1, 2012, and will be in effect for ten years as long as the City is able to meet a set of important conditions designed to protect the health of Portland drinking water customers. These conditions require the Bureau to continue to monitor Bull Run source water for *Cryptosporidium*, maintain all legal protections in the Bull Run, and monitor and manage any potential sources for *Cryptosporidium* contamination in the watershed. In the event of a first detection of *Cryptosporidium,* the Bureau is required to increase its monitoring efforts, coordinate with health officials to determine what, if any, impacts the detection may have, and communicate this information to its customers. The communications requirement in the variance conditions requires, at minimum, a press release to Portland-metro media outlets and posting of the information on the Bureau website if *Cryptosporidium* is detected at the intake. If one or more detections occur during this one-year period of increased monitoring, it is likely that OHA will revoke the variance.

8/31 handout

Portland Water Bureau
Water Quality

PORTLAND WATER BUREAU
FROM FOREST TO FAUCET

18978

Date: August 30, 2016
Author: Sarah Messier

Lead Hazard Reduction Program (LHRP) Evaluations

LHRP Component: Water Treatment and Monitoring		
Report Date	**Report Title**	**Evaluator**
June 1999	**Water Treatment and Water Quality Monitoring Tier One Follow-up Study**	**PWB Staff**
This report summarizes the findings of an investigation conducted in April and May 1999 to better understand factors that contribute to elevated levels of lead and copper in the tap water for some Portland Water Bureau customers.		
June 2001	**Lead and Copper Monitoring Results and Data Analysis for September 2000**	**Kelly Mooney, PWB**
This technical memo summarizes the data analysis of the Lead and Copper Rule home sampling results for September 2000 and examines factors that have potential to affect lead levels.		
September 2003	**Review of Corrosion Control Practices for Portland Water Bureau Water Sources**	**Technical Advisory Committee (Gregory Kirmeyer, P.E., TAC Chair)**
Portland Water Bureau and the EPA convened a Technical Advisory Committee (TAC) to review the PWB corrosion control treatment practices, review monitoring results, and provide recommendations regarding several short-term and long-term issues.		
September 2004	**The effects of moving from consumption-based to Tier-1 home occurrence-based monitoring on lead compliance.**	**Reuben Snyder, PWB**
This analysis examines Tier 1 home data from before and after the Joint Monitoring Plan revision in 2003.		
June 2005	**Tier 1 Home Analysis for Fall 2004**	**Ann Richter, PWB**
The purpose of this report was to evaluate the results of the October 2004 Tier 1 home lead sample period and to determine why the lead 90th percentile increased from previous sampling periods.		
November 2005	**Tier 1 Home analysis for October 2005**	**Ann Richter, PWB**
The purpose of this report was to evaluate the results of the October 2005 Tier 1 home lead sample period and to determine why the lead 90th percentile decreased from previous sampling periods.		
March 2007	**LCR Tier 1 Home analysis for Fall 2006**	**Kristin Anderson, PWB**
Lead and Copper Rule Tier 1 home sample lead results from the Fall 2006 sampling period yielded a 90th percentile value of 0.017 mg/L, above the action level of 0.015 mg/L. An analysis of historic lead results was conducted to try and see what trends or relationships of lead to other water quality parameters are evident.		
July 2014	**Analysis of Fall 2013 LCR Tier One Home Lead Results**	**Sarah Silkie, PWB**
Lead and Copper Rule Tier 1 home sample lead results from the Fall 2013 sampling period yielded a 90th percentile value of 0.016 mg/L, above the action level of 0.015 mg/L. This memo presents an analysis of existing data is to see if there is any evidence of water system operations affecting lead levels, and to see if there are any other trends or relationships evident between the home lead results and other water quality parameters in the distribution systems.		
Fall 2017 (anticipated)	**Corrosion Study**	**Black & Veatch**
This study's objectives include better understanding of the causes of lead release in PWB's system and to identify data gaps and conduct additional sampling required to better understand the role of water quality on lead release.		

LHRP Component: Public Education and Community Outreach		
Report Date	**Report Title**	**Evaluator**
February 2001	**Prevalence of Lead Dust Hazards Study**	**John Dougherty, PhD, Program Design and Evaluation Services (PDES), Multnomah County Health Department (MCHD)**
The goal of this study was to understand the locations and amounts of lead dust hazards in older Portland homes.		
October 2002 – present	**LHRP Partner Quarterly Reports**	**PWB Staff**
PWB collects progress reports from LHRP community partners as a process measure evaluation. The quarterly reports are summarized in a PWB quarterly report, and reported to EPA in the semi-annual report.		
January 2003	**Portland Lead Hazard Control Program (PLHCP) Outreach and Education Program Evaluation**	**Stacy Edwards, PWB**
Provides a qualitative evaluation of the Portland Lead Hazard Control Program that compares program objectives with the types of activities, strategies, and messages actually being used.		
July 2004	**Drinking Water: Safeguarding the District of Columbia's Supplies and Applying Lessons Learned to Other Systems**	**John Stephenson, U.S. Government Accountability Office (GAO)**
At the request of the Subcommittee on Environment and Hazardous Materials, Committee on Energy and Commerce, House of Representatives, the GAO examined issues concerning lead in drinking water generally and the situation in Washington, D.C., in particular. The GAO examined the PWB LHRP as an example of how a water system notifies and educates its customers on lead health risks, and how it interacts with federal, state, and local agencies to respond to lead issues. The GAO visited the PWB, studied the program, toured LHRP partner education and testing events, and summarized its findings in this report.		
August 2005	**Community Energy Project Follow-Up Visit Evaluation Project**	**Elyce Brown, Community Energy Project**
CEP contracted John Dougherty to design an evaluation plan for the CEP Lead Poisoning Prevention workshops. CEP then implemented this plan and produced this report. An evaluation that is modified from the procedures in this report has been conducted annually through present, and the results are reported in CEP's Quarter 4 reports.		
March 2006	**How to Assess and Understand Your Community-Based Lead Education Program**	**John Dougherty, PhD, PDES**
Based on his work with CEP on their follow-up evaluations, John Dougherty developed an evaluation toolkit that other organizations can use to design and implement an evaluation program that is applicable for their program.		
July 2006	**Blood Lead Level Analysis**	**John Dougherty, PhD, PDES**
John Dougherty used GIS data of blood lead level testing from 2000-2005 to identify geographic and other patterns in the data that might inform lead hazard reduction outreach and education efforts by the Portland Water Bureau.		
May 2007	**LHRP FY2005-06 Evaluation**	**James Burke**
James Burke surveyed past clients or participants in LHRP activities conducted by the community partners in FY2005-06. The evaluation resulted in specific recommendations for each community partner to improve their services. In 2008, PWB staff conducted a follow-up evaluation by sending surveys to a random selection of participants who received services from the LeadLine, PWB targeted home outreach, and Growing Gardens. A summary document of these results was drafted but not completed.		
November 2009 – present	**LeadLine Postcard Survey**	**Scott Bradway/Sarah Messier, PWB**
PWB mails a simple postcard survey to people who called the LeadLine in the previous quarter to evaluate this service. This postcard continues to be mailed out quarterly. Results are reported in PWB quarterly reports and to the EPA in the semi-annual reports.		

LHRP Component: Public Education and Community Outreach (cont.)		
Report Date	**Report Title**	**Evaluator**
February 2015 – present	**LeadLine Email Survey**	**Sarah Messier, PWB**
PWB emails a link to a simple survey to people who emailed the LeadLine in the previous quarter to evaluate their experience with the LeadLine. This email continues to be sent out quarterly. Results are reported in PWB quarterly reports and to the EPA in the semi-annual reports.		
December 2017 (anticipated)	**LHRP FY2016-17 Evaluation**	**David Dowler, PhD, PDES**
The objective of the evaluation is to answer questions regarding the efficacy in the LHRP grantees in reaching targeted subgroups, and raising awareness and knowledge around community lead hazards and resources for reducing exposure to lead.		

LHRP Component: Lead in Water Education and Testing		
Report Date	**Report Title**	**Evaluator**
March 2000	**Report on Analysis of Kitchen Sink Tap Water Lead Concentrations from Customer Requested Lead-in-Water Tests**	**John Dougherty, PhD, PDES**
John Dougherty conducted an analysis of the PWB customer data after corrosion control treatment started to determine, in part, the age of home most at-risk for lead in water.		
January 2003	**Lead in Water Education and Testing Program Pilot Program Evaluation**	**John Dougherty, PhD, PDES**
The evaluation focused on the target populations who called the LeadLine, persons who participated in water testing, on participant satisfaction with the LWET, and on changes in behavior that reduce exposure to lead in water.		
February 2004 – present	**Annual Review of LWET Data**	**PWB Staff**
This annual report analyzes the data of the customer-requested lead-in-water kits to identify historical and new trends.		

LHRP Component: Portland Housing Bureau Home (PHB) Lead Hazard Control Program		
Report Date	**Report Title**	**Evaluator**
August 2001	**Portland Lead Hazard Control Program (PLHCP): Lead Hazard Reduction Follow-Up Evaluation Report**	**John Dougherty, PhD, PDES**
January 2010	**Portland Lead Hazard Control Program (PLHCP): Lead Hazard Reduction Follow-Up Evaluation Report: 2009**	**John Dougherty, PhD, PDES**
The purpose of these studies was to collect follow-up data on lead dust loadings in dwellings that have received lead remediation work by contractors hired through the Portland Development Commission as part of the Portland Lead Hazard Control Program (PLHCP), supported by a HUD-funded grant administered by the City of Portland Bureau of Housing and Community Development (BHCD).		

PORTLAND WATER BUREAU
FROM FOREST TO FAUCET

Nick Fish, Commissioner
Michael Stuhr, P.E., Administrator

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Portland, Oregon 97204-1926
Information: 503-823-7404
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187978

IMPACT STATEMENT

Date: July 6, 2016

Council Date: August 24, 2016

Legislation Title: Authorize an Intergovernmental Agreement in the amount of $56,250 with the Multnomah County Health Department for Program Evaluation Services of the Lead Hazard Reduction Program (Ordinance)

Contact Name: Scott Bradway

Contact Phone: 503-823-1951

Presenter Name: Scott Bradway

Purpose of proposed legislation and background information:
The purpose of this legislation is to authorize an Intergovernmental Agreement with the Multnomah County Health Department (MCHD) to provide program evaluation services for the Water Bureau's Lead Hazard Reduction Program (LHRP). The program evaluation will provide essential information related to the effectiveness of the program in reducing exposure to lead in the Bull Run service area.

The Water Bureau, through the LHRP, provides funding to community organizations to provide education and outreach to reduce exposure to lead hazards. The main objective of the LHRP is compliance with the Environmental Protection Agency's Lead and Copper Rule for drinking water. In 1997, the LHRP was approved by the State of Oregon as "optimized treatment" for compliance with the Lead and Copper Rule.

The LHRP has four components: treatment and monitoring; home lead reduction; lead in water testing; and education and outreach. The Water Bureau funds education and outreach programs for lead poisoning prevention through community partner programs. The Water Bureau will evaluate the education and outreach component of the LHRP to determine the effectiveness of the community partner programs in reducing the community's exposure to lead in the Portland area. The MCHD is capable and willing to provide the program evaluation services through its Program Evaluation and Design Services (PDES) group. The scope of work for this agreement has been developed to support the Water Bureau's compliance requirements with the Lead and Copper Rule.

Financial and budgetary impacts:
The not-to-exceed value of the Intergovernmental Agreement is $56,250 and is intended to last no longer than two years. Funding for the Intergovernmental Agreement is available in the FY 2016-17 Budget and will be requested in the FY 2017-18 Budget. The legislation does not create any staffing changes.

Community impacts and community involvement:
The result of the evaluation proposed in this legislation is anticipated to benefit the Portland community with regard to City livability and health. The LHRP education and outreach efforts have focused on targeting the most at-risk populations for lead exposure, which historically has been low income residents in older Portland neighborhoods. The evaluation will examine: if the LHRP community partners are reaching the targeted, at-risk populations in the Portland community; if the LHRP partners are raising awareness and knowledge about lead hazards in the community; and, if the populations reached by LHRP partners are using LHRP partner resources to reduce lead exposure.

Budgetary Impact Worksheet

Does this action change appropriations?

☐ **YES**: Please complete the information below.
☒ **NO**: Skip this section

Fund	Fund Center	Commitment Item	Functional Area	Funded Program	Grant	Sponsored Program	Amount

Michael Stuhr, P.E., Administrator — Date: 7/21/16