PORTLAND WATER BUREAU:
Corrosion Improvement Project Update

Portland City Council
March 1, 2017

Michael Stuhr, Director
Gabriel Solmer, Deputy Director
Scott Bradway, Water Quality Information
Presentation Outline

• Introduction
  • Recap
  • System Overview
  • Lead and Copper Rule (LCR) Overview and Compliance

• Current Status
  • Recent Timeline
  • Water Quality Corrosion Study

• Recommendation
  • Next Steps
  • Treatment Pilot
Decision Tree

Corrosion Study ➔ Improved Treatment? ➔ Improved Corrosion Control Treatment Pilot ➔ Improved Corrosion Treatment Design ➔ Improved Corrosion Treatment Construction

3 years

No ➔ Distribution System Optimization Implementation ➔ Review Optimization

2 years

Pilot test (1 yr seasonal data) Distribution Impacts

Portland City Council Decision
Recommendation

Approve contract with Confluence Engineering Group, LLC in the amount of $664,930 for the Corrosion Control Treatment Pilot Project
System Overview
**Service Area and Water Sources**

- 588,000 retail customers
- 370,400 wholesale customers
- 19 wholesale water districts
- 101 million gallons per day average
Supply System Overview

1. Disinfection: Chlorine
2. Chloramination: Ammonia
3. pH Adjustment: Sodium Hydroxide

Columbia South Shore Well Field

Groundwater is treated to match Bull Run water. Chlorine, ammonia, and sodium hydroxide are added at the Groundwater Pump Station.

Bull Run Watershed
Headworks Treatment Facility
Lusted Hill Treatment Facility
Reservoirs and Storage Tanks
Your Faucet
Sources of Lead in Portland
Where it is *not*

- Not in water supply
- No lead service lines - Portland never used lead service lines
- No lead pigtails - Removed all known lead pigtails
Sources of Lead in Portland
Where it can be

• Copper pipes and lead solder - most common in homes plumbed or built from 1970 - 85

• Home plumbing fixtures installed prior to 1985 can also contribute to lead in water

• In Portland lead paint is the greatest source of exposure to lead
Water System Improvements

• Solder
  • Advocated State ban of lead-based solder in water systems in 1985

• Pigtails
  • Removed all known lead pigtails (>10,000) in the distribution system by 1998 ($10M)

• Meters
  • Replaced 364 large lead-component meters serving schools, hospitals, childcare facilities, community centers, public housing, and large apartment buildings from 2001-2008.
Lead and Copper Rule (LCR)
Overview and Compliance
Lead and Copper Rule (LCR)

• Published by EPA in 1991

• Requires large utilities (>50,000) to maintain optimal corrosion control treatment (OCCT)

• Requires utilities to conduct lead monitoring at high risk customer taps

• Context: More than 10% of high risk homes tested cannot exceed action level of 15 parts per billion (ppb)
## Lead and Copper Rule Compliance

### 1994
Optimized Treatment Study
- Recommends pH 9.0, alkalinity 20 mg/L as Optimized Corrosion Control Treatment
- City Council directs PWB to investigate alternatives to recommended treatment

### 1997
City proposes a comprehensive Lead Hazard Reduction Program (LHRP)

### 1997
State approves LHRP as Optimized Corrosion Control Treatment

### 1997-present
City remains in compliance with Lead and Copper Rule
Lead Hazard Reduction Program

• State Approved Compliance Program (1997)
• 4-part program meets federal regulatory requirements
Portland Joint Monitoring 90th Percentile Lead Levels
Tier 1 Homes

- **Portland Only**
  - Pre-treatment Monitoring
  - Post-treatment Monitoring
- **Spring & Fall**

**pH Targets**
- pH = 7.5
- pH = 7.8
- pH = 8.0

**Action Level**
- 15 ppb
Recent Timeline
## Recent Timeline

### 2014

**Spring**
- PWB begins Water Quality Corrosion Study

### 2016

**April**
- PWB begins conversations with OHA and EPA

**Sept. 8**
- PWB proposes improved corrosion control treatment schedule to OHA

**Oct. 11**
- City Council Work Session

**Nov. 4**
- OHA approves PWB’s proposed schedule and requests interim lead reduction plan

**Dec. 2**
- PWB submits interim lead reduction plan to OHA

### 2017

**Jan. 24**
- OHA accepts PWB’s interim lead reduction plan

**Feb. 7**
- PWB raises entry point pH from 8.0 to 8.1
Water Quality Corrosion Study
Water Quality Corrosion Study

- Authorized by Council in 2014
- Data gathered over entire year to see seasonal variations
- Goal: better understand role of water quality on metals release
- Panel of utility, consultant, and academic experts
Evaluated 3 corrosion mechanisms in premise plumbing

- Uniform Corrosion: influences dissolved lead release
- Biostability (microbial induced corrosion): influences dissolved and particulate lead release
- Scale/transport release: influences particulate lead release
## Corrosion Study: What did we test?

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

• All three corrosion mechanisms contribute to lead release in household plumbing

• Water chemistry can influence all three corrosion mechanisms

• Household plumbing materials dominant source of lead

• No geographic patterns to lead release or water quality trends
Corrosion Study: Results

Water Quality Corrosion Study
3rd Monitoring Period - May to August 2016

- **LCR Sites**
- **Customer Sites**

- **Red**: Lead = 12 ppb or higher
- **Yellow**: Lead = 5 to 11.9 ppb
- **Green**: Lead = 0 to 4.9 ppb
Next Steps
Decision Tree

1. Corrosion Study

   Improved Corrosion Treatment?
   
   Yes:
   - Improved Corrosion Control Treatment Pilot
   - Improved Corrosion Treatment Design
   - Improved Corrosion Treatment Construction
   
   No:
   - Distribution System Optimization Implementation
   - Review Optimization

   Pilot test (1 yr seasonal data) Distribution Impacts

   Portland City Council Decision

2. 3 years

3. 2 years
Treatment Pilot

- What treatment options will the Pilot consider?
  - pH and/or alkalinity adjustment (water chemistry)
  - Phosphate-based corrosion inhibitors (pipe coating)

- What factors will be evaluated?
  - Lead reduction
  - Impacts to sensitive and industrial users
  - Costs
  - Simultaneous compliance with other water quality regulations
  - Compatibility with multiple sources of supply
  - Sanitary and stormwater discharge considerations
## Corrosion Control Treatment Options
### pH and/or Alkalinity Adjustment

<table>
<thead>
<tr>
<th>Chemical Name</th>
<th>Other common uses</th>
<th>Other considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baking Soda (sodium bicarbonate)</td>
<td>Baking leaveners, antacids, toothpaste</td>
<td>Most expensive of alkalinity adjustment chemicals</td>
</tr>
<tr>
<td>Carbon Dioxide</td>
<td>Carbonated beverages</td>
<td>Used in combination with other chemicals</td>
</tr>
<tr>
<td>Caustic Soda (sodium hydroxide)</td>
<td>Soap making, food processing</td>
<td></td>
</tr>
<tr>
<td>Hydrated Lime (calcium hydroxide)</td>
<td>Food processing, calcium supplements</td>
<td>Labor intensive O&amp;M</td>
</tr>
<tr>
<td>Soda Ash (sodium carbonate)</td>
<td>Soaps and detergents, glass making, water softening, food processing</td>
<td></td>
</tr>
</tbody>
</table>
## Corrosion Control Treatment Options
### Corrosion Inhibitors

<table>
<thead>
<tr>
<th>Chemical Name</th>
<th>Other common uses</th>
<th>Other considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Orthophosphate (Phosphoric Acid)</strong></td>
<td>Carbonated beverages, cheese making, baking leaveners</td>
<td>Sanitary and stormwater discharge concerns; compatibility with wholesale customers using other sources</td>
</tr>
<tr>
<td><strong>Zinc orthophosphate</strong></td>
<td>Dental cement</td>
<td>Sanitary and stormwater discharge concerns; compatibility with wholesale customers using other sources</td>
</tr>
</tbody>
</table>
## Corrosion Control Treatment Practices

### Other Utilities

<table>
<thead>
<tr>
<th>Utility</th>
<th>Treatment Chemical</th>
</tr>
</thead>
<tbody>
<tr>
<td>South Fork Water Board, Oregon City, OR</td>
<td>Soda ash</td>
</tr>
<tr>
<td>Clackamas River Water, Clackamas, OR</td>
<td>Soda Ash</td>
</tr>
<tr>
<td>City of Salem, OR</td>
<td>Soda ash</td>
</tr>
<tr>
<td>Eugene Water and Electric Bd, Eugene, OR</td>
<td>Sodium hydroxide</td>
</tr>
<tr>
<td>Lake Oswego-Tigard Water Partnership, Lake Oswego, OR</td>
<td>Sodium hydroxide</td>
</tr>
<tr>
<td>Joint Water Commission, Hillsboro, OR</td>
<td>Sodium hydroxide</td>
</tr>
<tr>
<td>North Clackamas County Water Commission, Oregon City, OR</td>
<td>Soda ash</td>
</tr>
<tr>
<td>Seattle Public Utilities*, Seattle, WA</td>
<td>Lime and carbon dioxide</td>
</tr>
<tr>
<td>Metro Vancouver*, Vancouver, BC</td>
<td>Lime and soda ash</td>
</tr>
<tr>
<td>Massachusetts Water Resources Authority*, Boston, MA</td>
<td>Soda ash and carbon dioxide</td>
</tr>
<tr>
<td>DC Water, Washington, DC</td>
<td>Orthophosphate</td>
</tr>
<tr>
<td>Los Angeles Department of Water &amp; Power, Los Angeles, CA</td>
<td>Zinc orthophosphate</td>
</tr>
<tr>
<td>Southern Nevada Water Authority, Las Vegas, NV</td>
<td>Zinc orthophosphate</td>
</tr>
</tbody>
</table>

*unfiltered water system
Recommendation
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Approve contract with Confluence Engineering Group, LLC in the amount of $664,930 for the Corrosion Control Treatment Pilot Project
What’s next?

• Conduct Corrosion Control Treatment Pilot
  • Pilot is first step in multi-phase project to design and construct a corrosion control treatment facility

• Follow joint PWB/OHA’s compliance schedule for improved Corrosion Control Treatment
  • Design contract - July 2017
  • Construction contract - Fall 2018

• Continue Interim Lead Reduction Plan

• Continue to work with community partners