City of Bellevue
Asbestos Cement Main Replacement Program

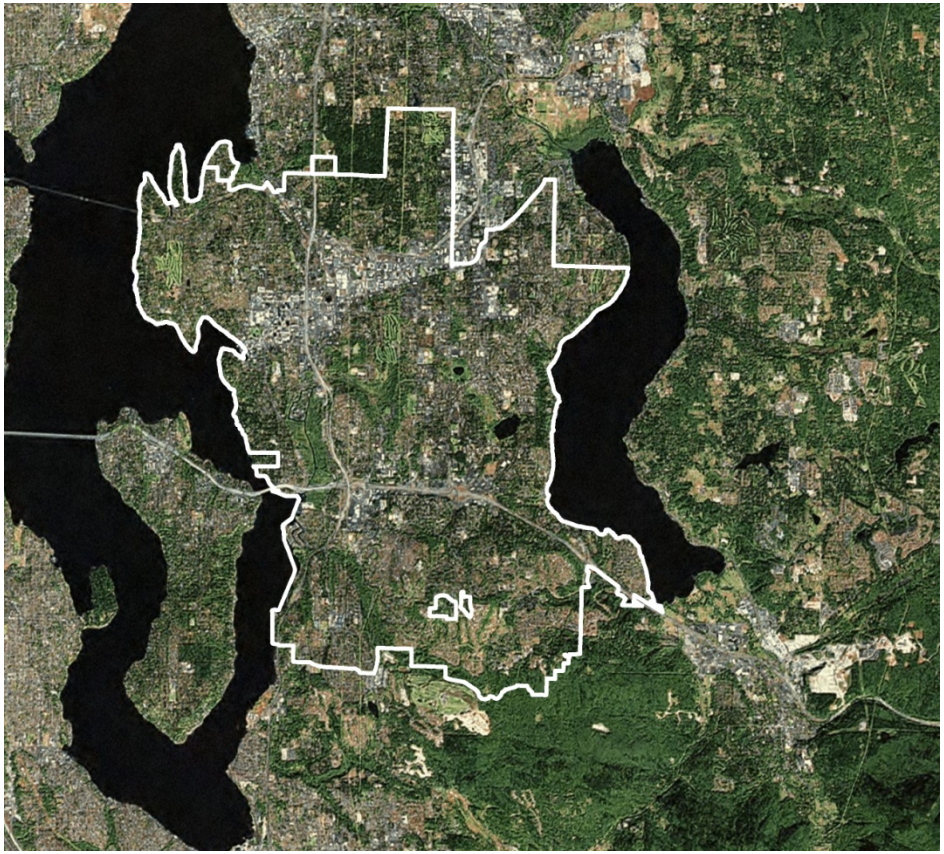
Pacific Northwest AWWA Spring Conference

Tacoma Washington

May 13, 2010

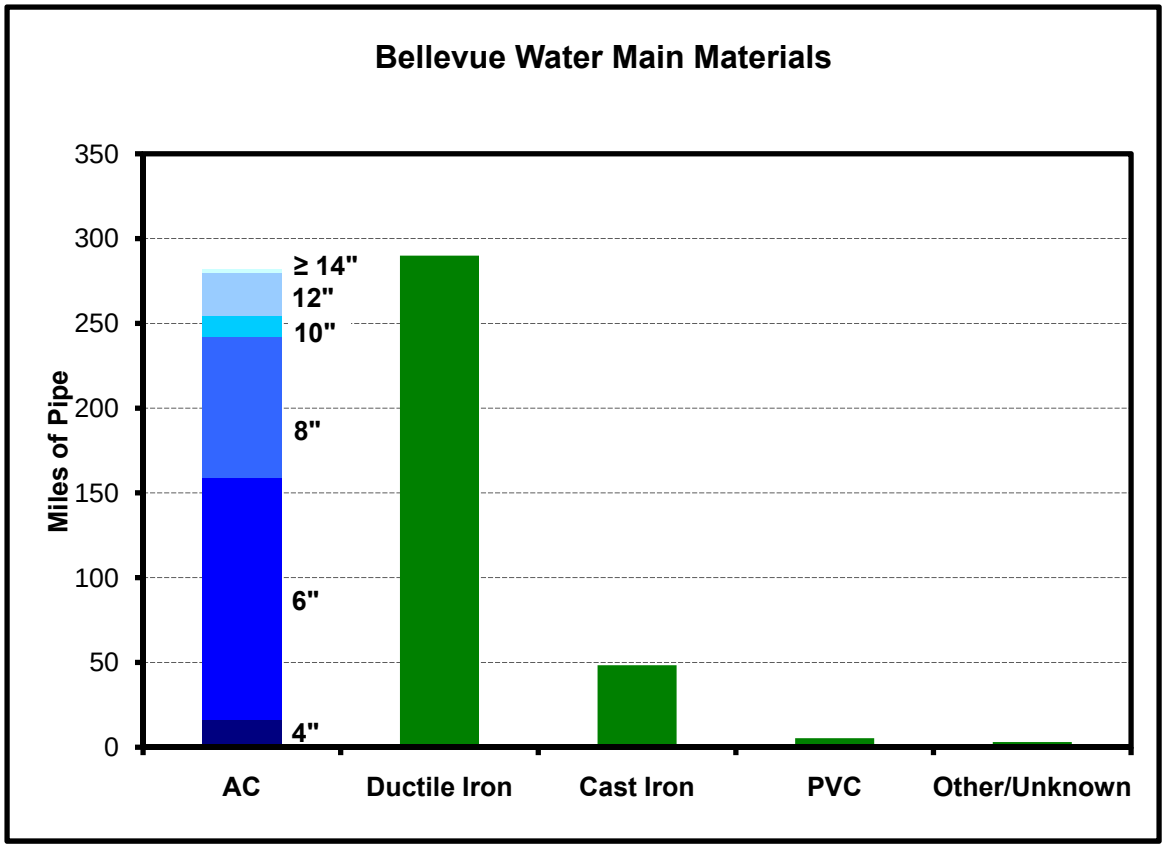
Bellevue Water System

- Supply: Tolt and Cedar Rivers (Seattle Public Utilities) via Cascade Water Alliance
- Elevation served varies from 25 ft to 1450 ft
- Service Area
  - Bellevue, Medina, Clyde Hill, Yarrow Point, Hunts Point, Beaux Arts, pockets of unincorporated King County
    - Population served: 135,000
    - Average Day Demand: 17 MG
  - Wheel water to Redmond and Issaquah

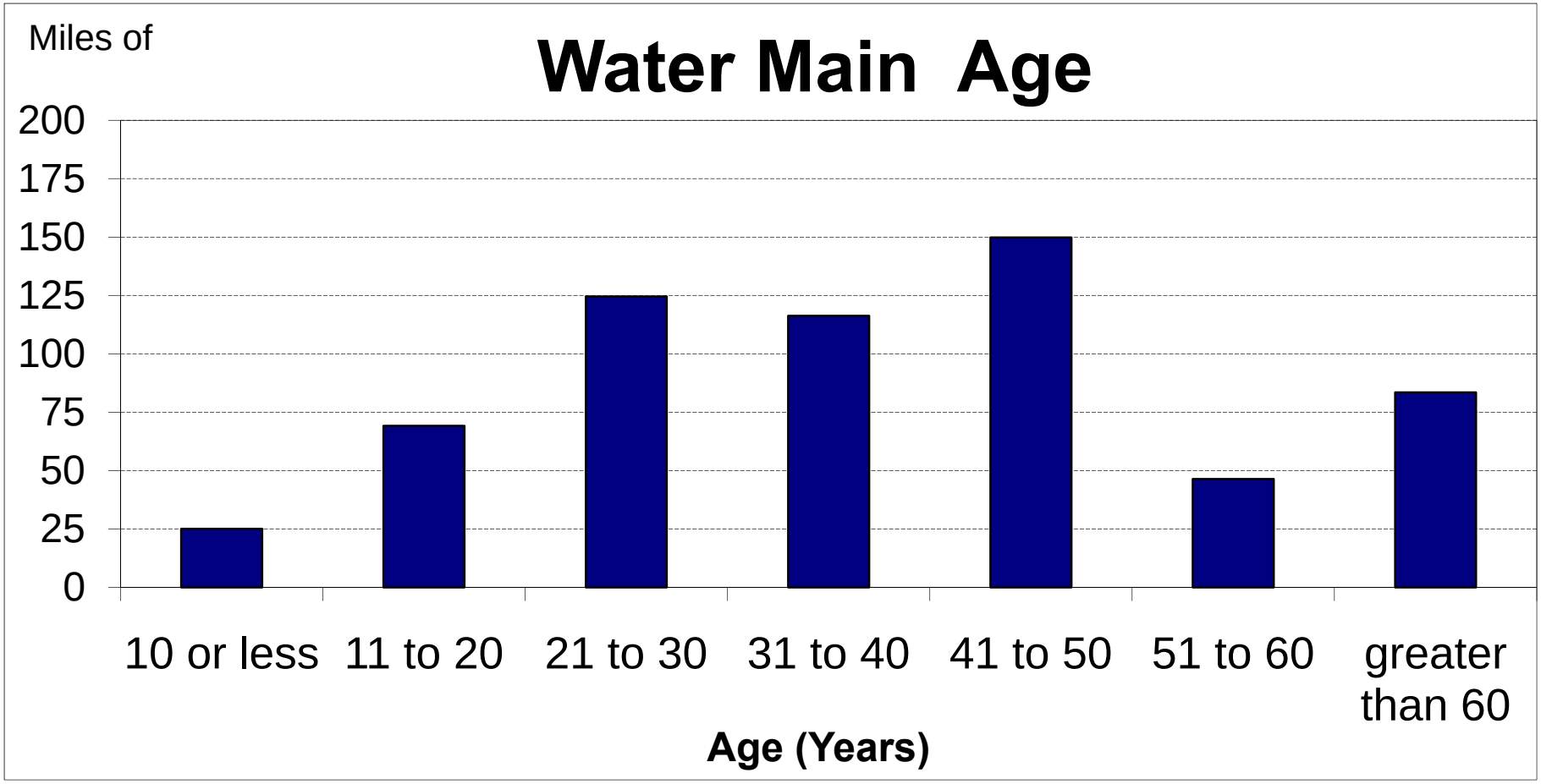


Bellevue Water System(continued)

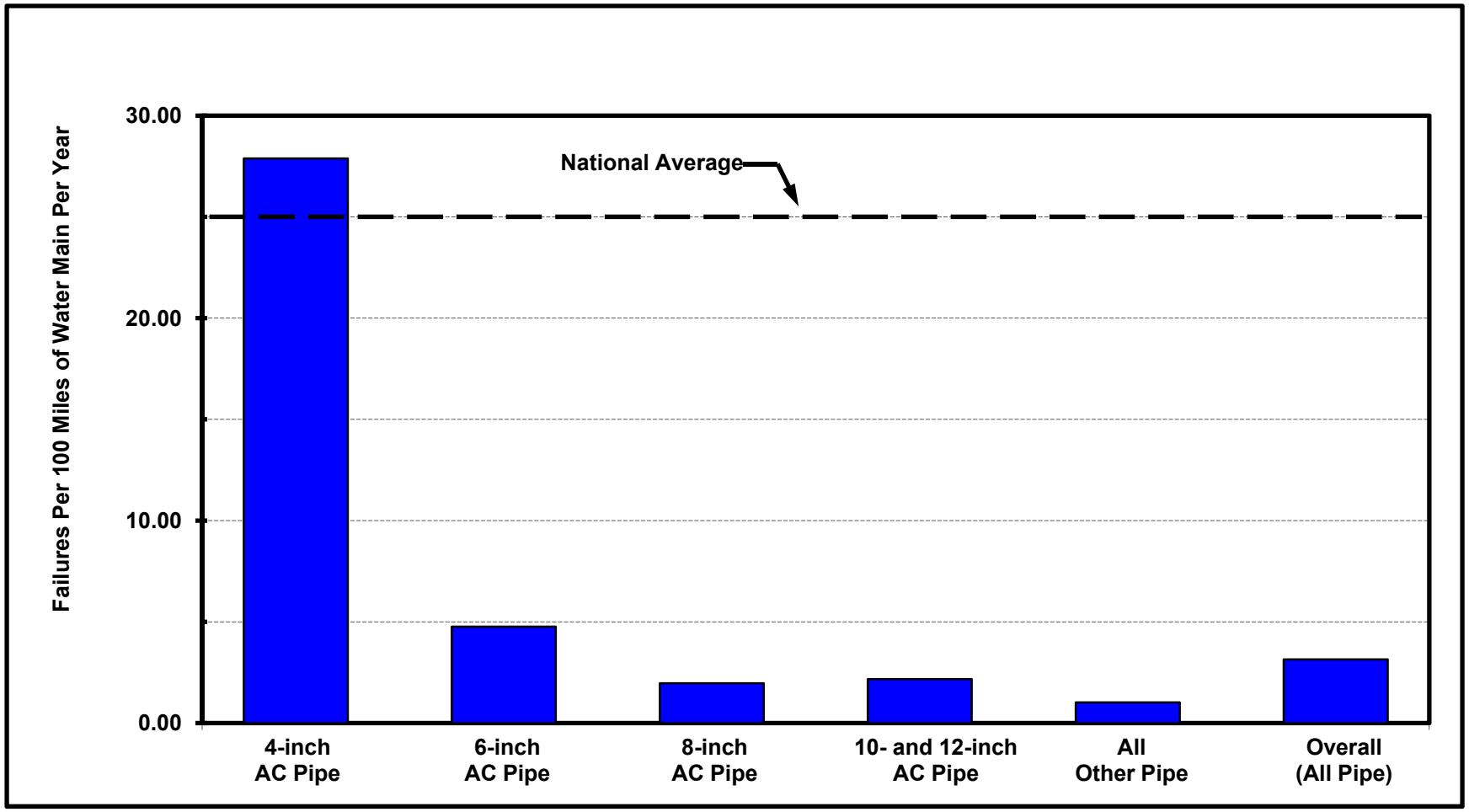
- Facilities
  - 14 Inlets
  - 30 Reservoirs (including joint use)
  - 22 Pump Stations
- Water Mains (615 miles)



Pipe Age


Miles of
Water Main Age
200
175
150
125
100
75
50
25
0
10 or less
11 to 20
21 to 30
31 to 40
41 to 50
51 to 60
greater than 60
Age (Years)

Bellevue Historical Water Main Failure Rates



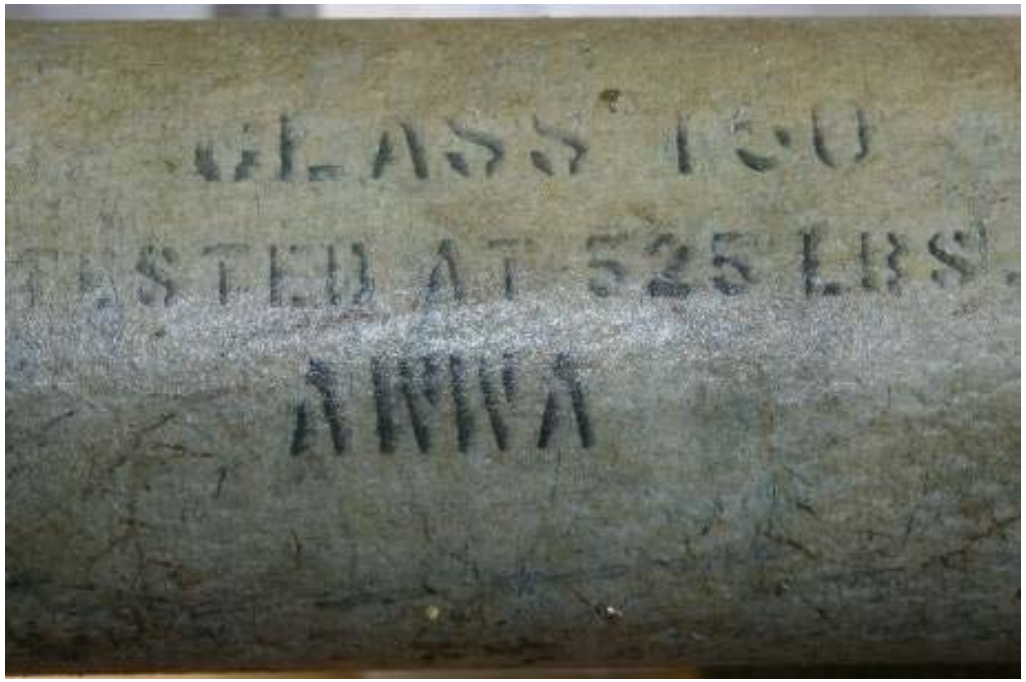
Asbestos Cement Pipe

- Early 1900’s: First installed in Italy
- 1929: Introduced to North America
- Through Mid-1930’s: Type I – 20% asbestos, 80% Portland cement
- After Mid1930’s: Type II

  – 20% asbestos,

  30% silica,

  50% Portland cement



1940's – 1960's: The Glory Days of Asbestos Cement Pipe …

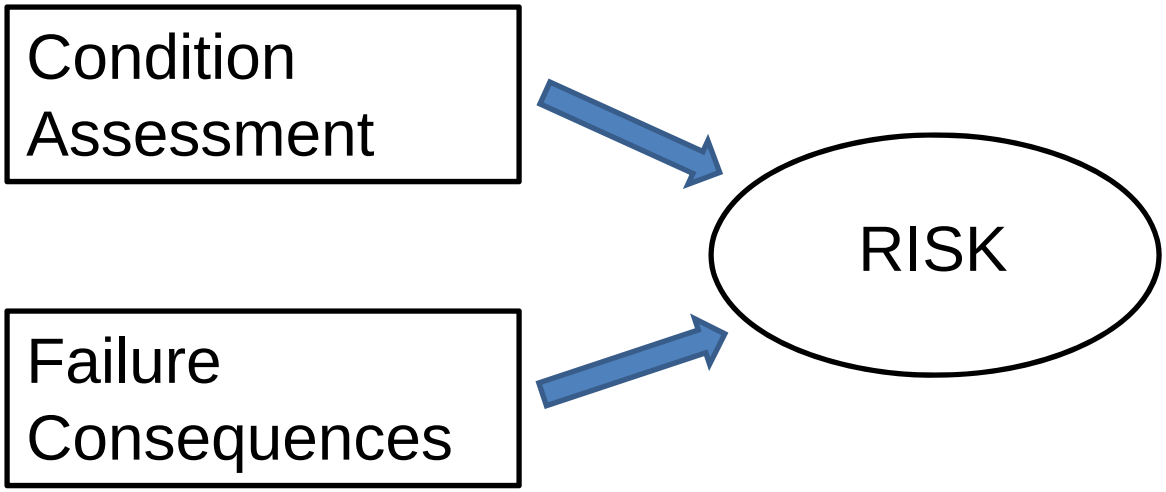
...Which Led to the Harsh Realities of Today

The New York Times

ASBESTOS PIPE REPLACEMENT IS URGED

- Hazardous material
- Useful life of as little as 25 or 30 years
- 18% of water system mains in North America (2004)
- Failure rates doubling in less than 10 years

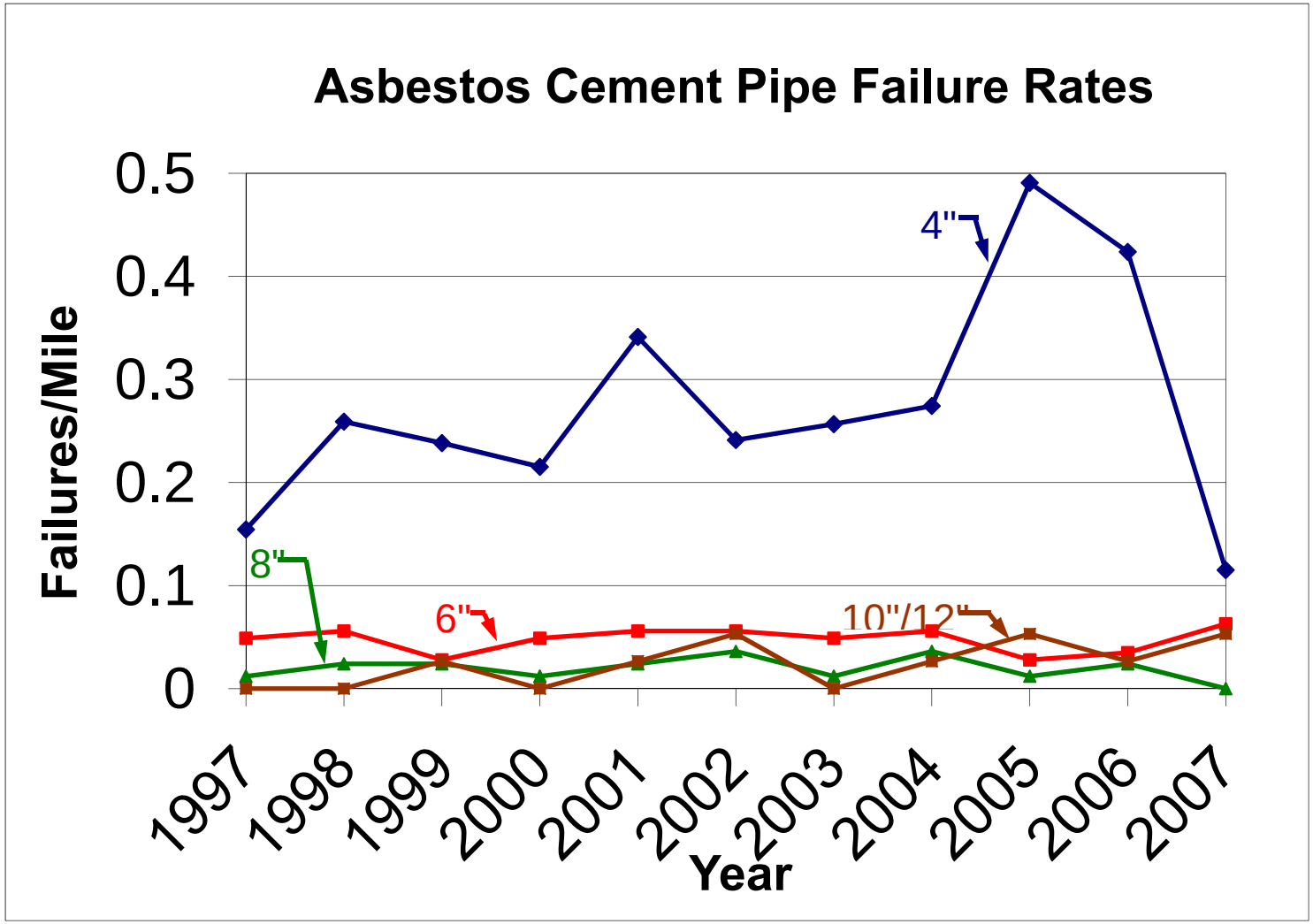
Replacement Prioritization



Condition-Related Factors

- Pipe Diameter
- Material and Joint Type
- Soil Conditions
  - Aggressiveness (pH, sulphate content)
  - Backfill (native vs. engineered)
  - Soil clay content
  - Drainage
- Water Aggressiveness
- Failure History
- Age

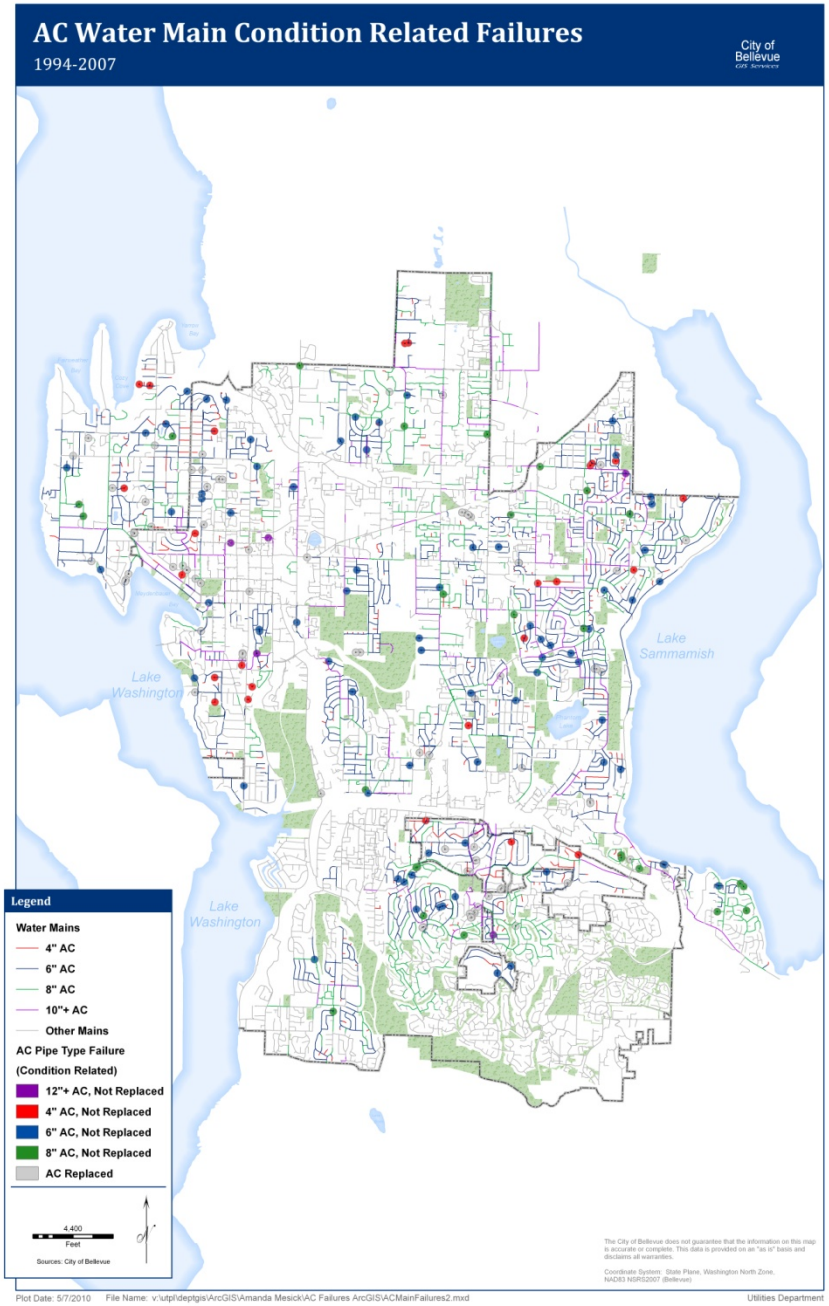
Failure Rates vs Diameter



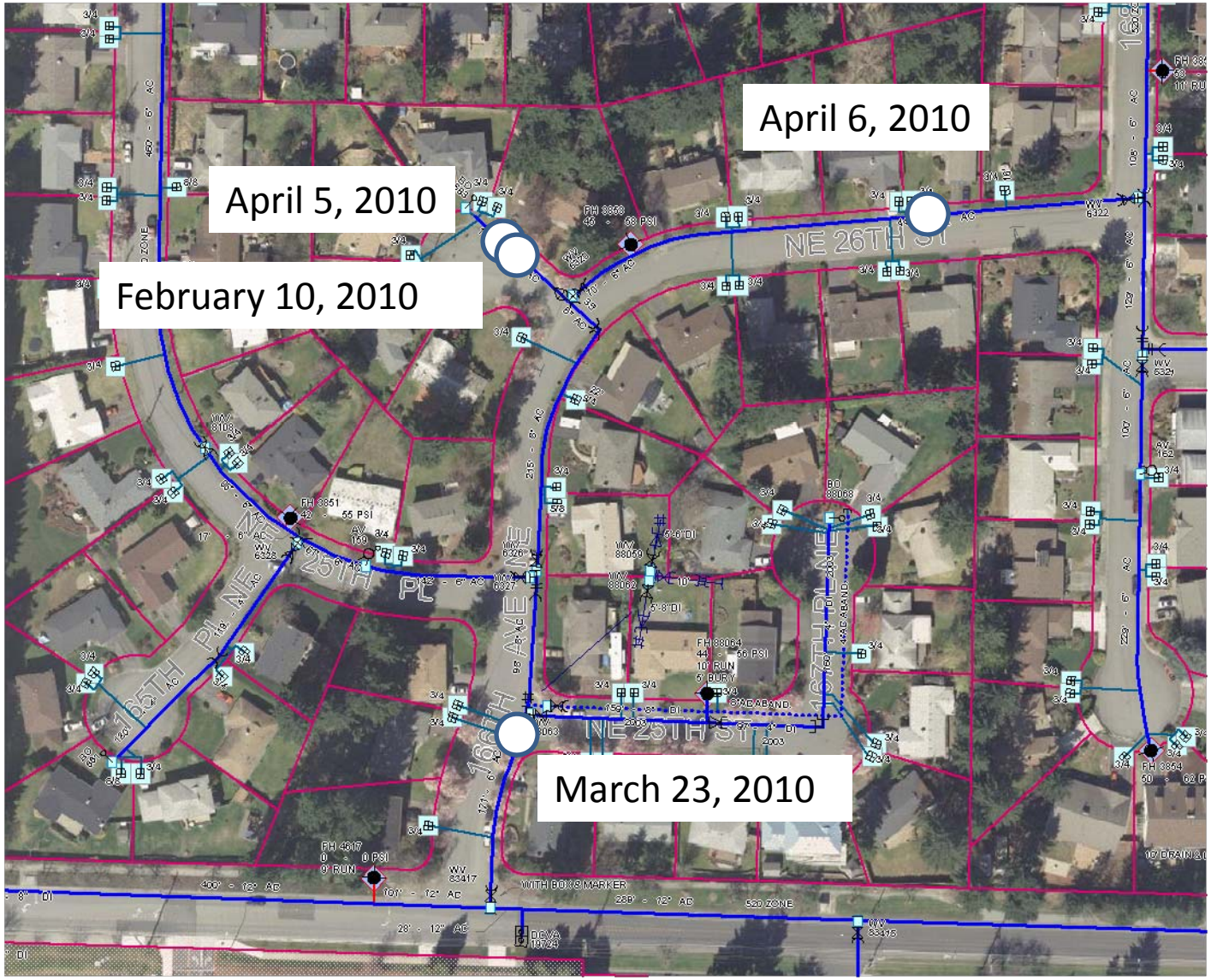
Length of Machining at Pipe Ends

Bedding Conditions

Condition Assessment – Failure History



Failure Clusters



Condition Assessment – Staff Observations

Water Main and Service/Saddle Observation Report

(circle appropriate answer or fill in blank)

GENERAL INFORMATION

Name of Observer: BRIAN JAMES Date: MAY 03, 2010

Address: 12204 SE 54TH Grid: G-15

Notes: _____

Pipe Depth: less than 3 ft. X 3 feet more than 3 ft. _____

Observation includes an existing service line connection: Yes (No) *(If yes, fill out reverse side)*

Observation is associated with a facility failure or break: Yes (No) *(If yes, fill out reverse side)*

PIPE INFORMATION

Diameter: 4" (6") 8" 10" 12" 14" 16" 18" 24" Other _____

Material: AC (Simplex? Yes No (Unknown) DI CI PVC Other _____

*If pipe is **DI***, is exterior covered with plastic? Yes - bagged Yes - wrapped No

*If pipe is **metal***, is the interior lined? Unknown Yes - mortar Yes - composite No

CONDITION INFORMATION

Was a Tapping Coupon saved and labeled with the address on this report: Yes (No)

*If pipe is **AC***, surface condition is: (Hard) Punky Soft Other PIPE IN GOOD CONDITION.

*If pipe is **metal***, any external corrosion: None Slight Moderate Extensive

*If pipe is **metal***, any internal corrosion: Unknown None Slight Moderate Extensive

SOIL INFORMATION

Type: (Sand) Peat Clay Loam Hard Pan Cinder (Pit Run) Gravel

Other _____

Moisture: Unknown (due to pipe break) (Dry) Wet Saturated

If this main observation included a service line connection and/or is associated with a facility failure, Please fill out the appropriate information on the reverse side of this report.

Water Main Observation Report - Page 2

SERVICE LINE AND SADDLE INFORMATION – if observed

Service Line Diameter: ¾-inch 1-inch 1 ½-inch 2-inch 3-inch Other _____

Service Line Material: Carlon HDPE PVC galvanized copper Other _____

*If service line is **metal***, any corrosion or pitting: None Slight Moderate Extensive

Notes: _____

Saddle Strap Material: Cor-ten Stainless Steal Other _____

Saddle Strap Corrosion: None Slight Moderate Extensive

Saddle photographed and the photo labeled with the address on this report: Yes No

Saddle replaced: Yes No

Notes: _____

FAILURE INFORMATION – if applicable

Failed Facility: Service Line Saddle Main

Failure Type: Crack – Circumferential Crack – Longitudinal Crack – Other

Hole – Small (Leak) Hole – Large (Burst)

Joint – Separation Joint – Gasket

Failure Cause: Dig-up Settlement Roots Land Slide Earthquake

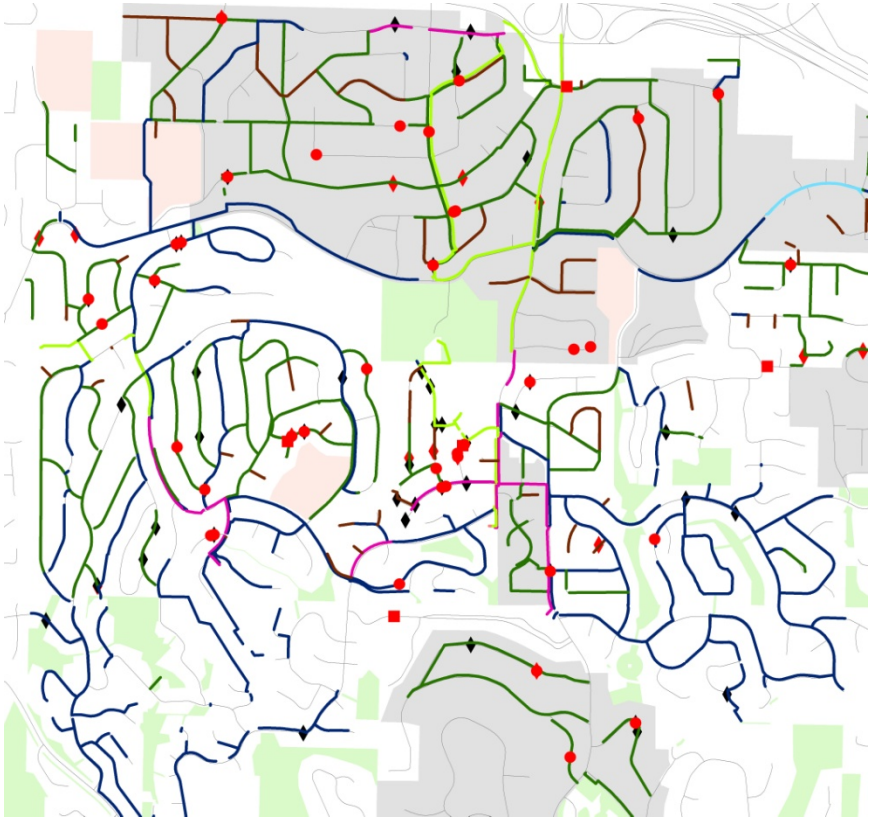
Poor Construction Poor Repair Reduced Pipe Strength Corrosion

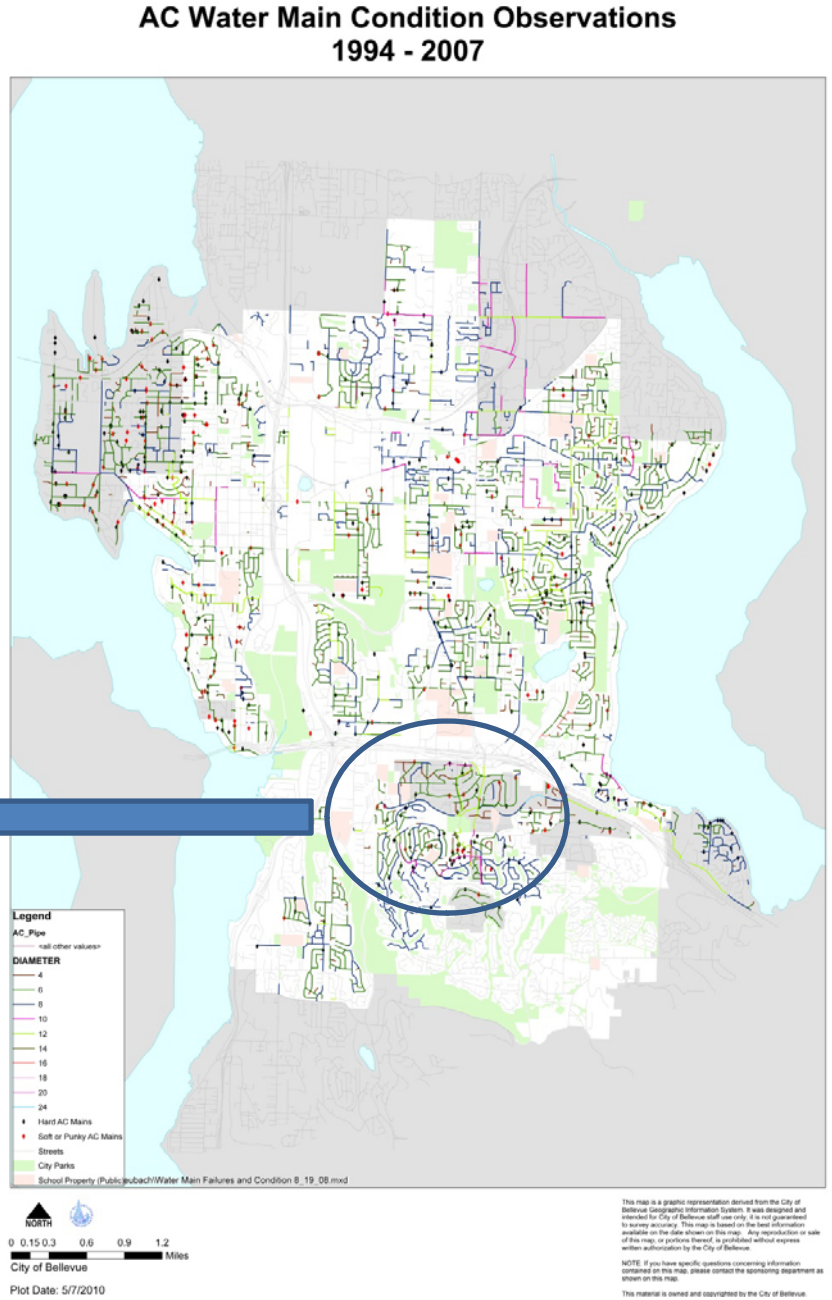
Pressure Surge Unknown Other _____

Repair Method: Clamp Replacement Other _____

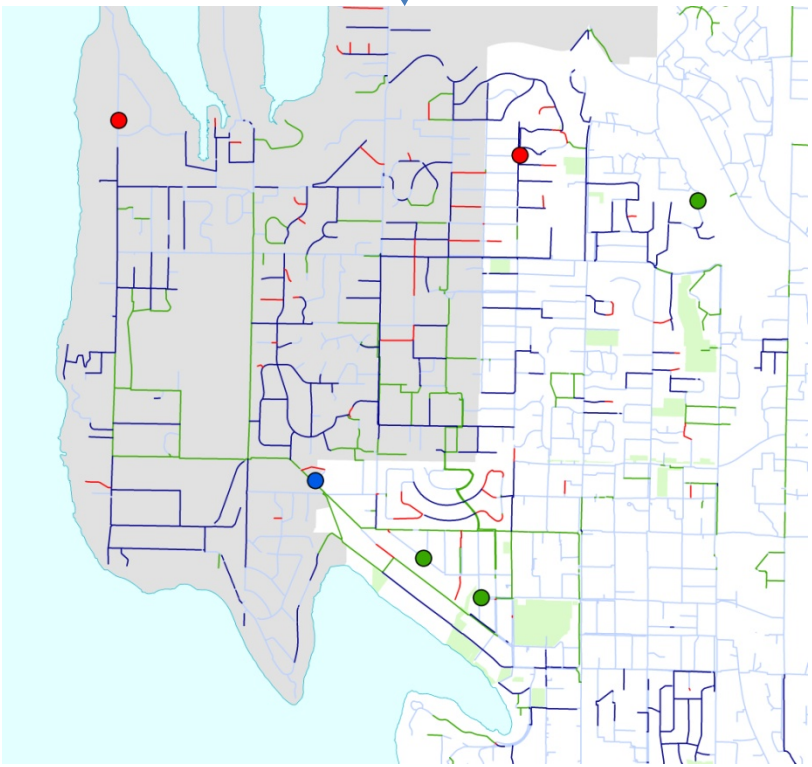
Notes: _____

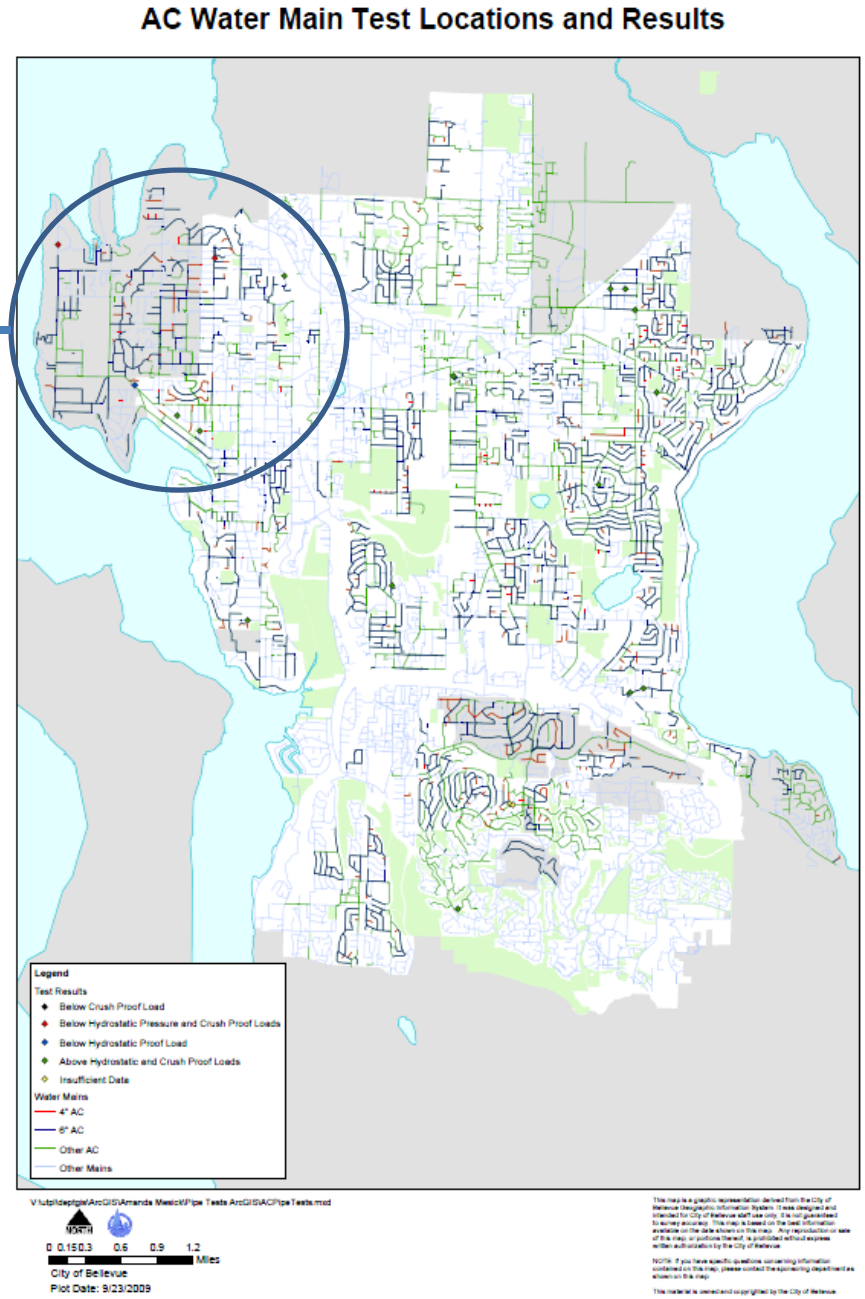
Condition Assessment – Field Observations





Condition Assessment – Laboratory Testing

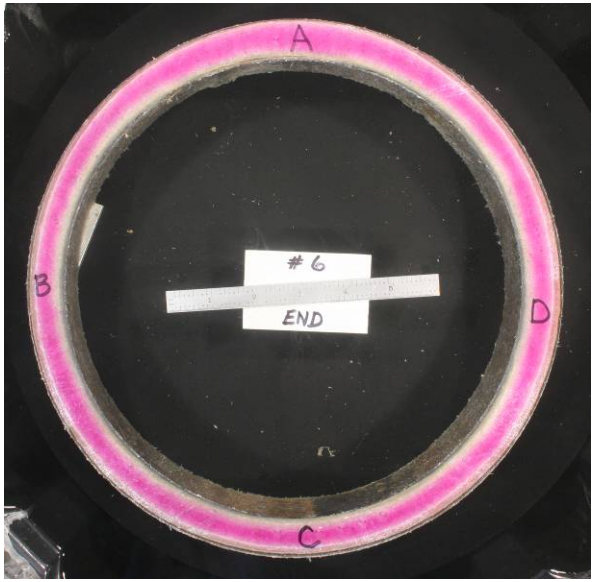


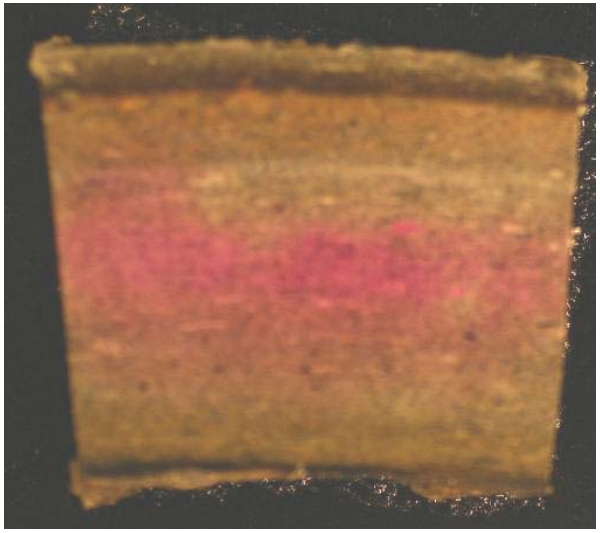


Condition Assessment – Laboratory Testing

- Hardness
- Hydrostatic Burst Capacity
- Crush Strength
- Phenolphthalein Dye Testing
- Energy Dispersive Spectroscopy

Dye Observations and EDS





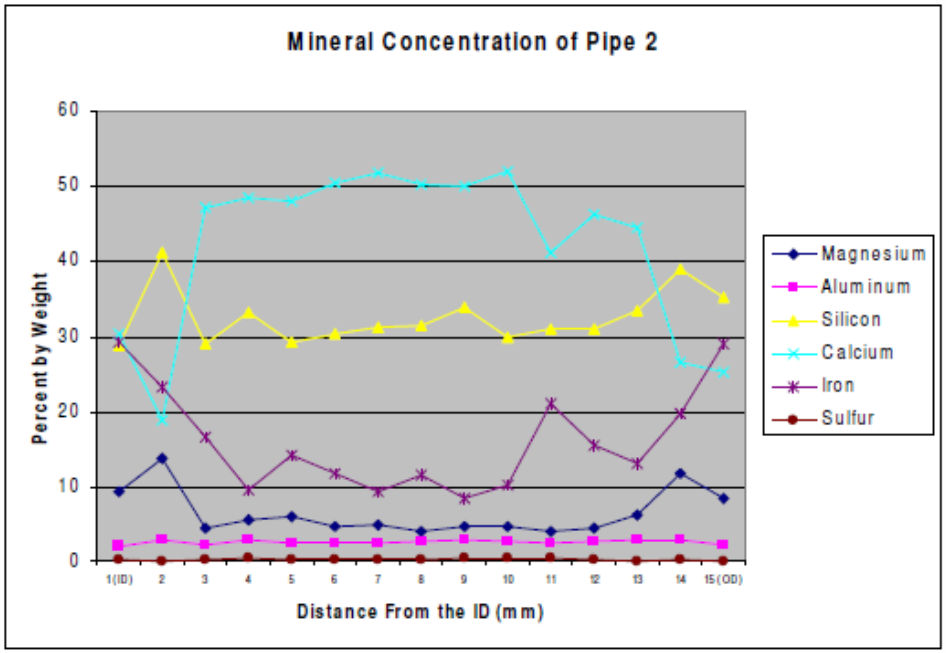


Fig. 15. Elemental Distribution through Cross Section of Pipe #2

Hydrostatic (and Crush) Testing

Failure Consequences

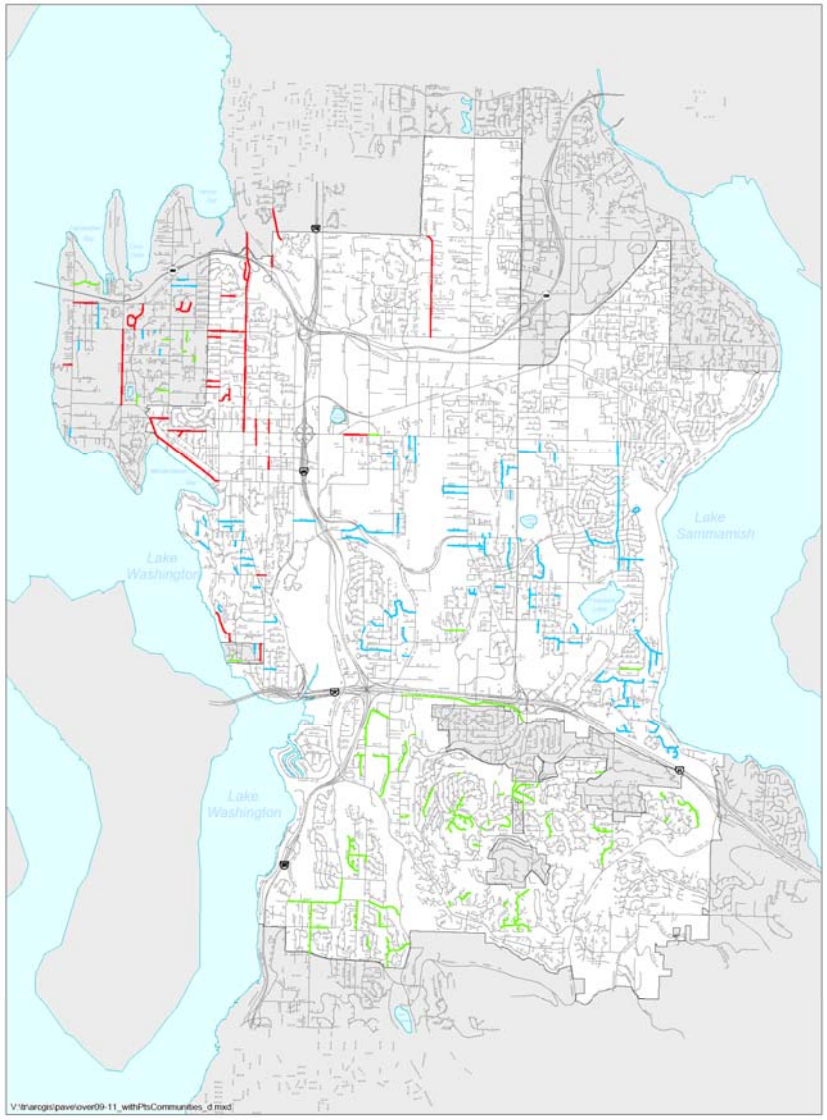
- Main size
  - Damage potential
  - System effects
- Slope/run off impacts
- Critical facilities
- Environmental
- Coordination with other CIP

Slope/Run Off Impacts

CIP Coordination

City of Bellevue

2009-2011 Overlay Candidates



NORTH

= 2,000 feet

City of Bellevue
IT Department
GIS Services
Plot Date: 9/30/2008

Overlay Candidates

- 2009 Overlay
- 2010 Overlay
- 2011 Overlay

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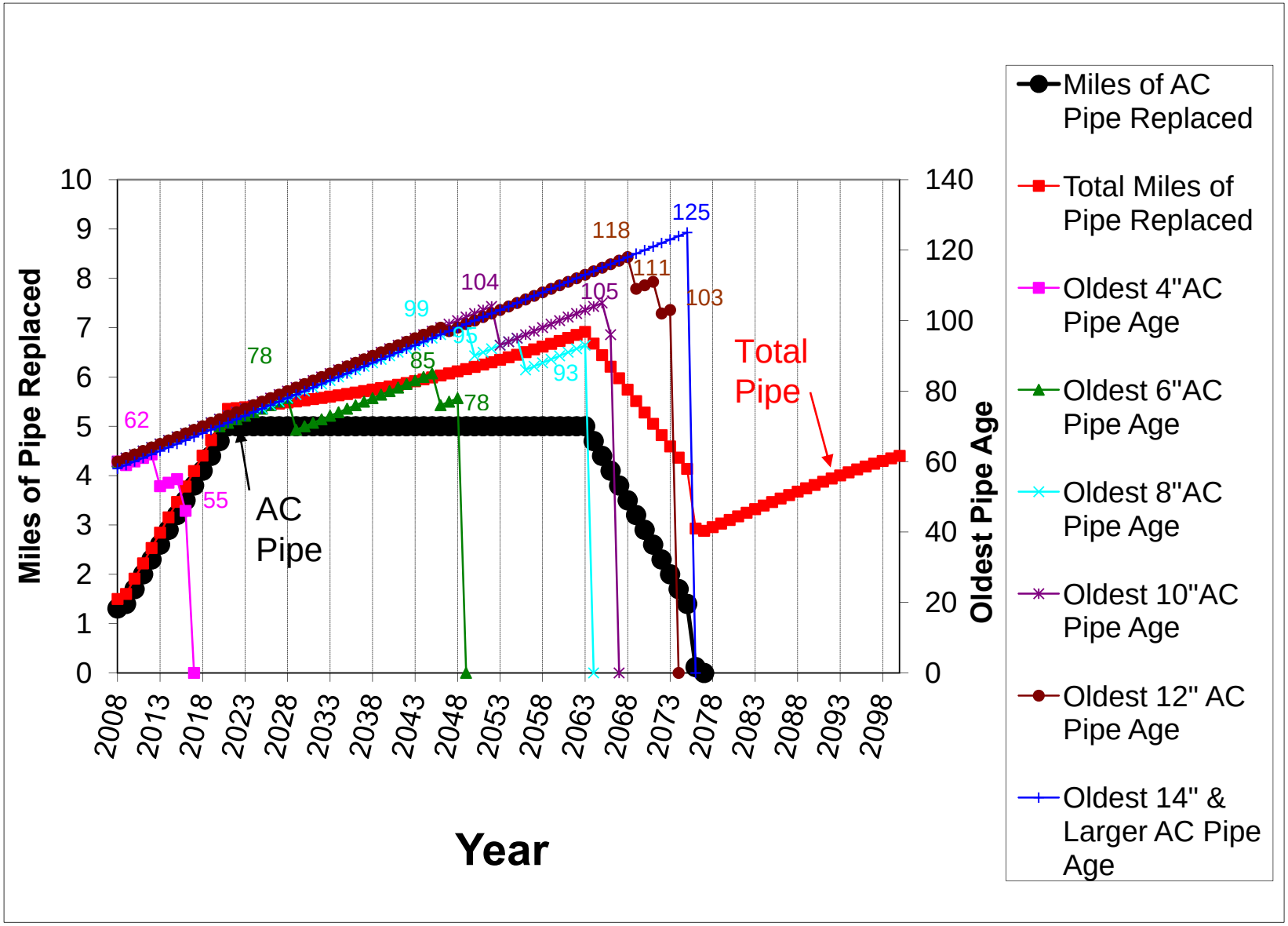
AC Main Replacement Schedule



Further Information

Project Abstract: Long Term Performance of Asbestos Cement Pipe #4093 - Windows Internet Explorer

http://waterresearchfoundation.net/research/TopicsAndProjects/abstract.aspx?pn=4093

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Project Abstract: Long Term Performance of Asbestos...

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Project Abstract

Long Term Performance of Asbestos Cement Pipe #4093

Use of asbestos-cement (AC) pipes in North America began in the 1930s and continued to the early 1980s, when AC pipe installation ceased. AC pipes were popular in areas where metallic pipes were subject to external corrosion. Also, its light weight made it easier to handle than iron pipe and more convenient for installation in remote areas. Use of AC pipe ceased due to health concerns associated with the mining, installation, removal, and disposal of asbestos products. The primary health concern associated with asbestos is airborne asbestos fibers, and the general consensus is that AC pipes used in the water industry do not constitute a health hazard to water consumers. A considerable amount of AC pipe remains in service in North America, and its immediate replacement is not practical. A survey made by AWWA in the 2002 estimated that 18 percent of the North American potable water pipe inventory consists of AC pipe. The objective of this project is to produce a comprehensive document on strategic management of the remaining AC pipe in service in North America. This project will identify the performance of AC pipe, methods to assess expected life expectancy, and practical approaches for repair, replacement, and disposal of AC pipe, given worker safety and environmental requirements.

This abstract was created by Water Research Foundation based on either the original project description or executive summary, depending on the status of the project when this abstract was created. The abstract is intended as general information about the project and may not reflect the final work that evolves over the course of the research. More information about the project may be available as a project update, project profile, or supporting resource (links on the Project Snapshot if available) .

Project Snapshot

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Long Term Performance of Asbestos Cement Water Pipe

Objective

To provide water utilities with a comprehensive guidance document that will facilitate the strategic management of asbestos cement (AC) water distribution pipes.

Background

AC water distribution pipes are vulnerable to chemical and physical deterioration and frequent breakage, which can lead to water quality problems, economic losses and public inconvenience. Because they form a large part of the installed water distribution systems in many North American cities, water utilities need comprehensive rehabilitation and replacement strategies for AC water mains, which will in turn require capabilities to assess and map their present condition and forecast future failures. As well, proper handling and disposal of AC pipes removed from service is required.

Statement of Work

- Review available methods and models for managing AC pipe, and adapt or modify them to North American conditions.
- Calibrate, refine, and verify the models based on information from participating utilities.
- Develop practical approaches for the rehabilitation or

AC pipe sample after Phenolphthalein test

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