Tualatin Valley Water District's Systematic Approach to Developing New Standards to Address Aging Pipeline Infrastructure

2014 PNWS Conference

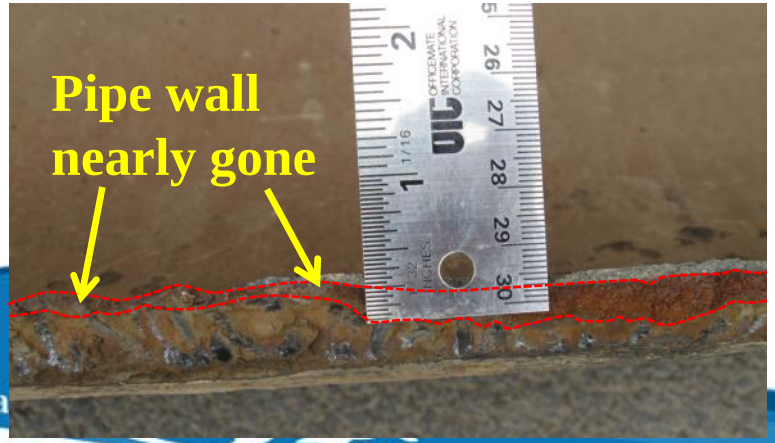
Tualatin Valley Water District

Why is This a Problem?

- Why is premature failure of ductile (and cast) iron pipe a problem?

You see this after only 30 yrs

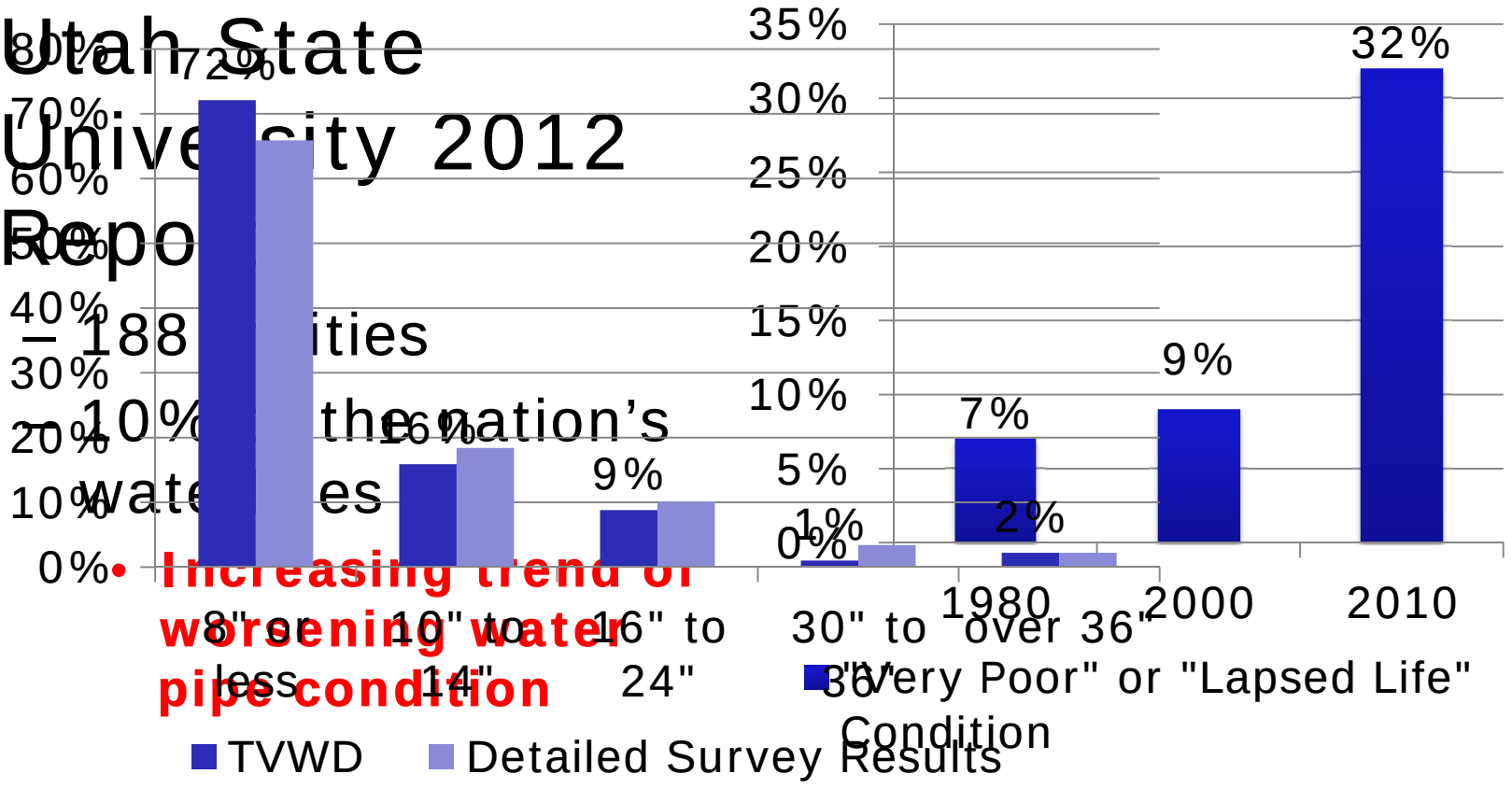
You make the morning news



You disrupt a major road

National Trends & Statistics

- Utah State University 2012 Report
  - 188 cities
  - 10% of the nation's water utilities
  - **Increasing trend of worsening water pipe condition**

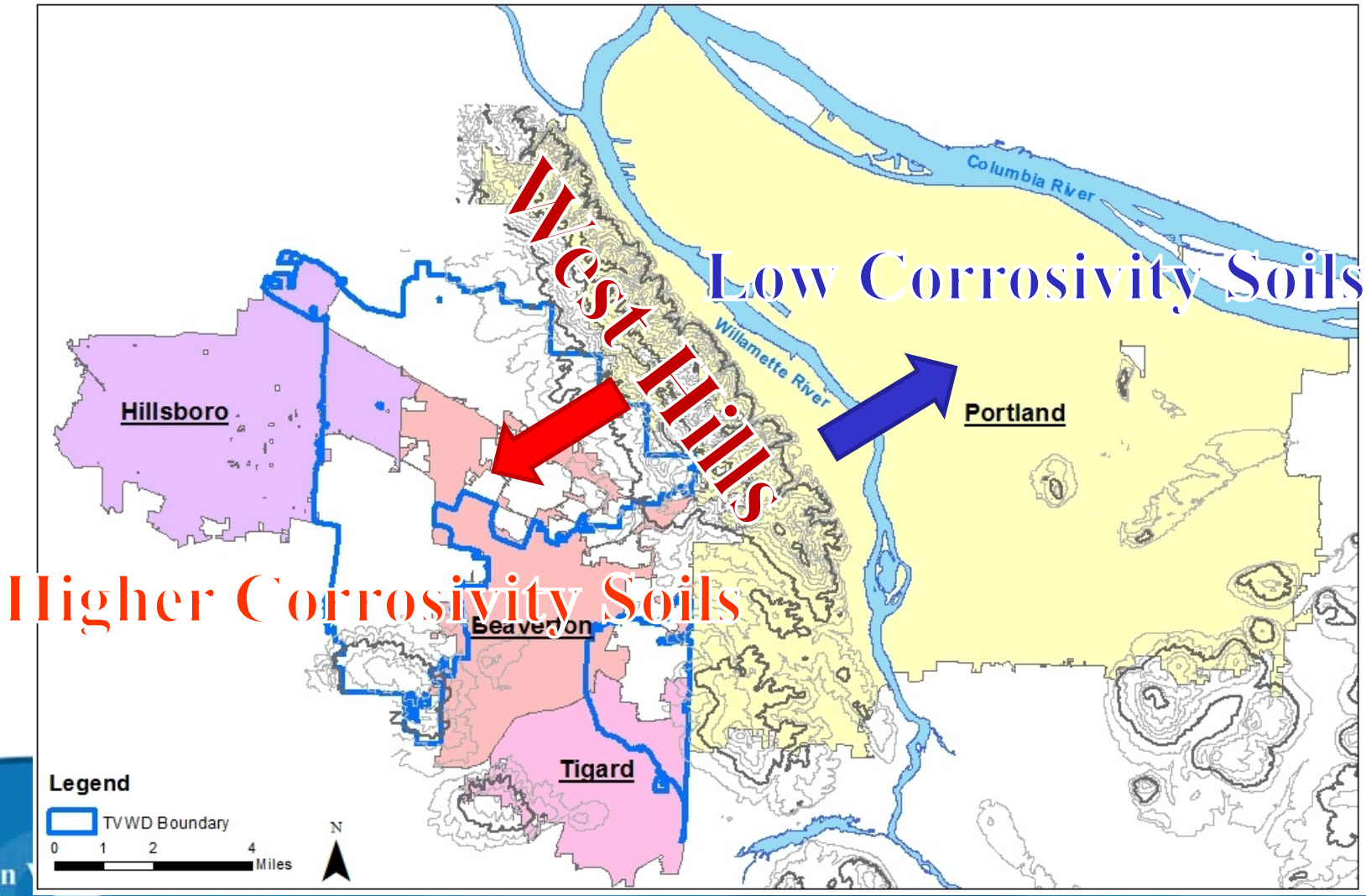


Why It's Important to Us

Pipe Infrastructure Replacement Value **$600 Million** to **$1 Billion**

Assumed Design Life (yrs)	Average Annual Replacement Cost
30	$20 million
40	$15 million
50	$12 million
60	$10 million
70	$8.6 million
80	$7.5 million
90	$6.7 million
100	$6 million

Understanding Your Situation



Tualatin

Portland Water Bureau Pipe

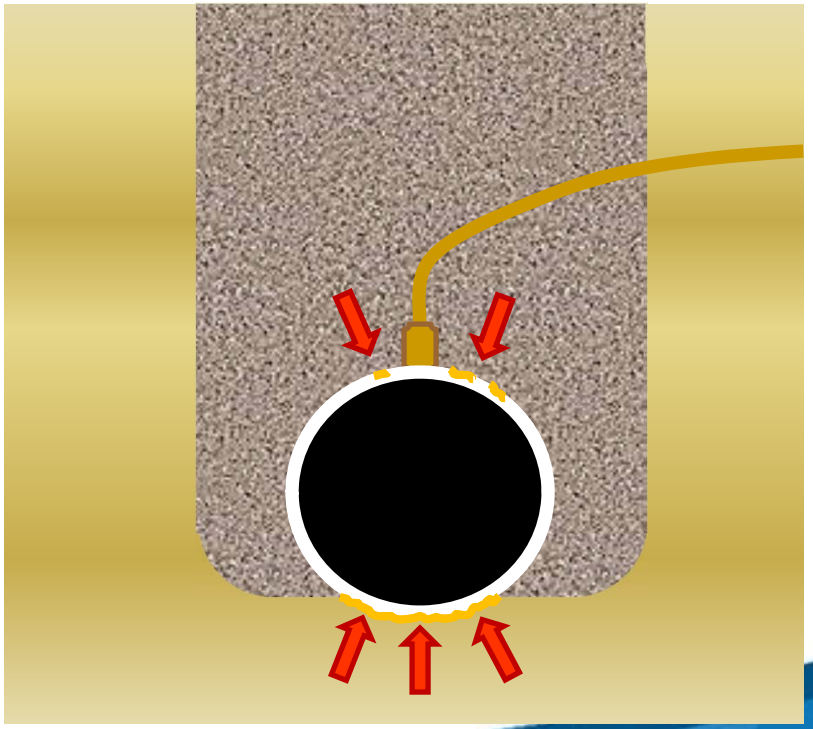
- Cast Iron Pipe
  - Manufactured by the Florence Foundry in New Jersey in 1883
  - Expected life 250 yrs

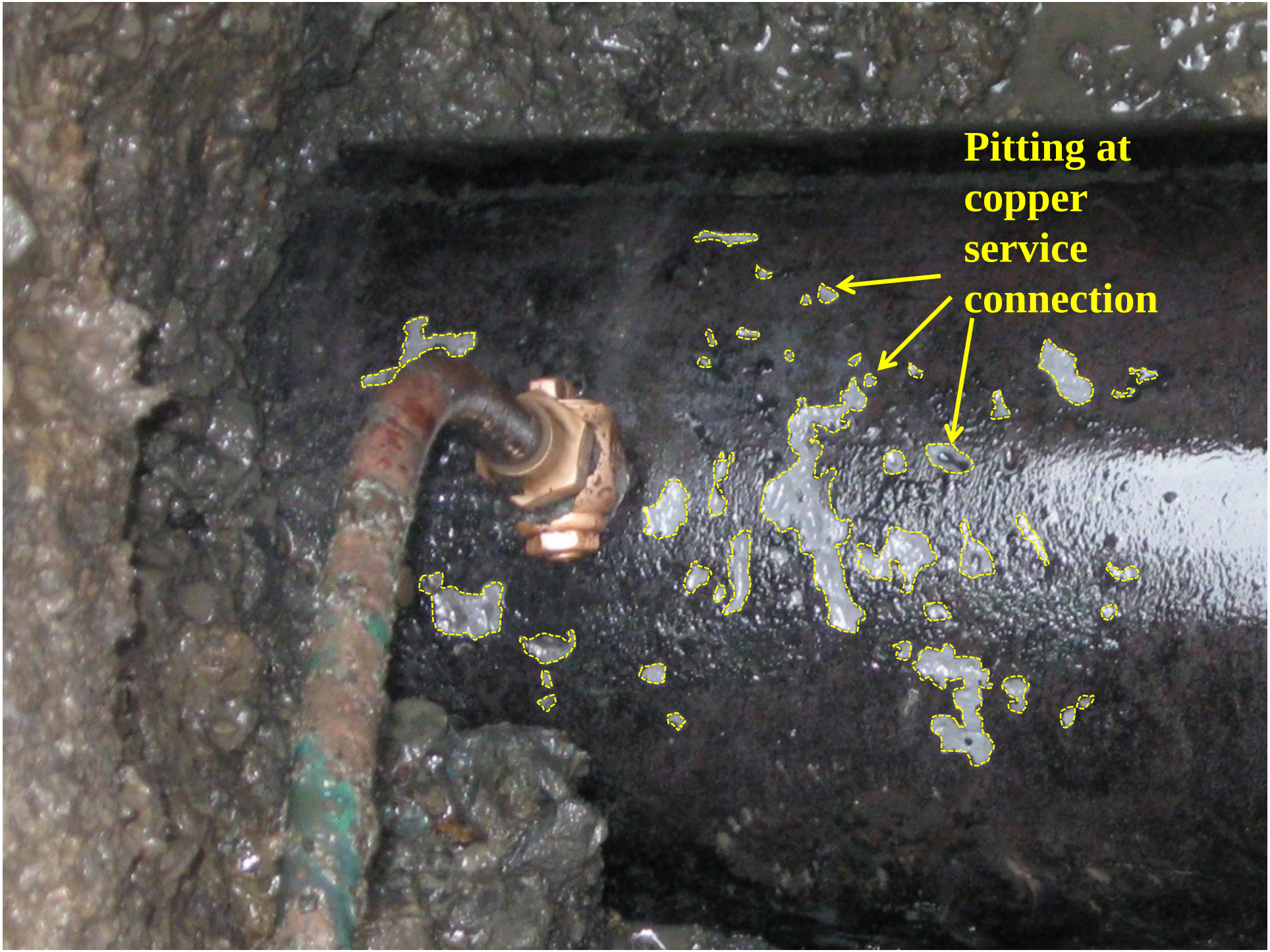
TVWD Ductile Iron After 30 Yrs

- Key Issues:
  - Corrosive soils
  - Fluctuating groundwater
  - Slopes that allow groundwater to flow along pipe
  - Stray current
  - Current from houses grounded to water system
  - Dissimilar metals

Understanding Your Situation

- History of installations and observed corrosion
  - Pipe installed on native ground
  - Pitting of pipe at copper services




Pitting at copper service connection

Standards and Methods

- Three industry schools of thought[1]
  - The Ductile Iron Pipe Research Association (DIPRA)
    - Advocates the exclusive use of polyethylene loose wrap for most installations
  - Corrosion engineers
    - Recommend use of a tightly bonded coatings with joint bonding and cathodic protection
  - European countries and Japan
    - Advocate a combination of a zinc coating with additional synthetic polymer coating

[1] "Protection of ductile iron water mains against external corrosion: review of methods and case histories", Rajani and Kleiner, National Research Council Canada, NRCC-45225, 2003

DIP Bonded Coatings Concerns

- Cited by U.S. pipe manufacturers [2]:
  - Pipe (substrate) damage, including blisters and slivers, caused by abrasive blasting
    - Unlike steel surfaces, it is possible to "overblast" the external surface of ductile iron pipe… Overblasting normally occurs when attempts are made to remove the tenacious, tightly adherent annealing oxide from the external surface [3]
    - Narrative visual descriptions and/or visual standards prepared for steel surfaces are not applicable to ductile iron surfaces[3]

[2] Review of Bureau of Reclamation's Corrosion Prevention Standards for Ductile Iron Pipe
[3] NAPF 500-03 Surface Preparation Standard for Ductile Iron Pipe and Fittings

What to Test?

- DIPRA – polyethylene bags
- Corrosion Engineers – tightly bonded coatings
- Plastics Industry – PVC and HPDE

Polyethylene Bags

- Polyethylene (PE) bags
  - 4 mil cross-laminated HDPE
  - 8 mil LDPE
  - AWWA C105 Method A
- Advantage – low cost
- Some of the stated problems with PE bags
  - Difficult to install without breaches
  - Difficult to seal at joints and appurtenances
  - May be susceptible to microbial influenced corrosion (MIC) due to depletion of oxygen
  - Leak detection
  - Mixed results with use of PE bags

Ductile Iron with PE Bags

- Our installation goals:
  - Be able to install it without:
    - Holes
    - Tears
    - Leaks
  - Particularly a concern for us since we generally have moist soils with groundwater near surface seasonally depending on location
  - Test different size backfill so see what impact that has on installations
  - Additional care required for proper installation

Tightly Bonded Coatings

- Our product goals:
  - Have a durable long-term coating
    - Low water absorption and high dielectric strength
  - Application
    - Adequate surface prep
    - Good adhesion
    - Acceptable number of holidays
  - Have workable solutions for
    - Pipe installation
    - Joint and assembly (relates to tolerances)
    - Thrust restraint
  - Cost effective

PVC Pipe

- 8” and smaller
- Push-on joints
  - AWWA C-900
  - Thicker pressure class
    - DR 18 (235 psi Pressure Class)[1]
  - Tap with saddle and PVC bit
  - DI fittings w/ FBE and anodes
  - Pipe needs proper bedding
  - Make sure we don’t over-stab the joints
  - Limit deflection

[1] Based on July 30, 2010 addendum modification to AWWA Manual M23 – PVC Pipe Design and Installation. Factor of safety reduced from 2.5 to 2.0. Previously 150 PVC pressure class

Thermoplastic Coating

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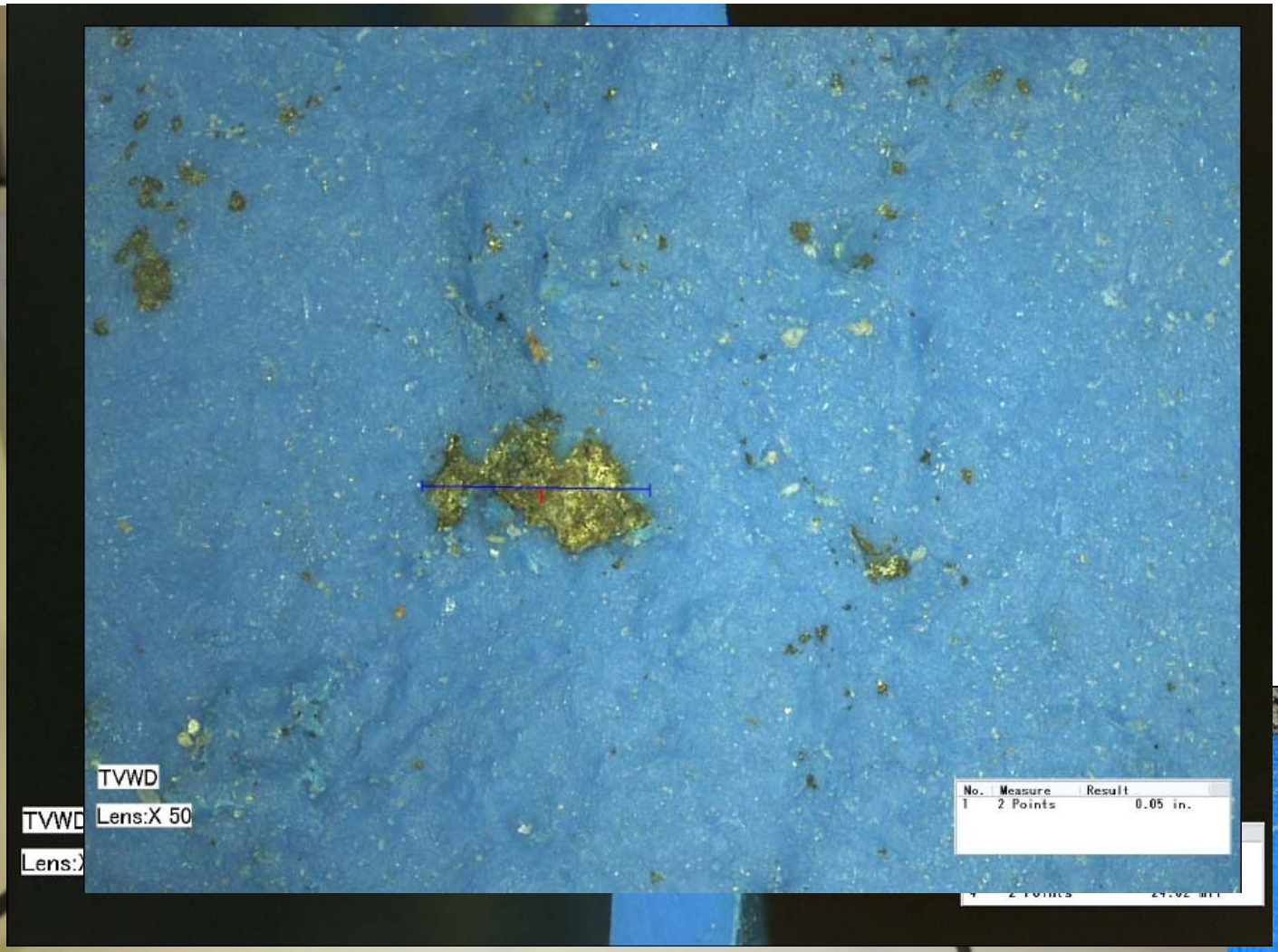
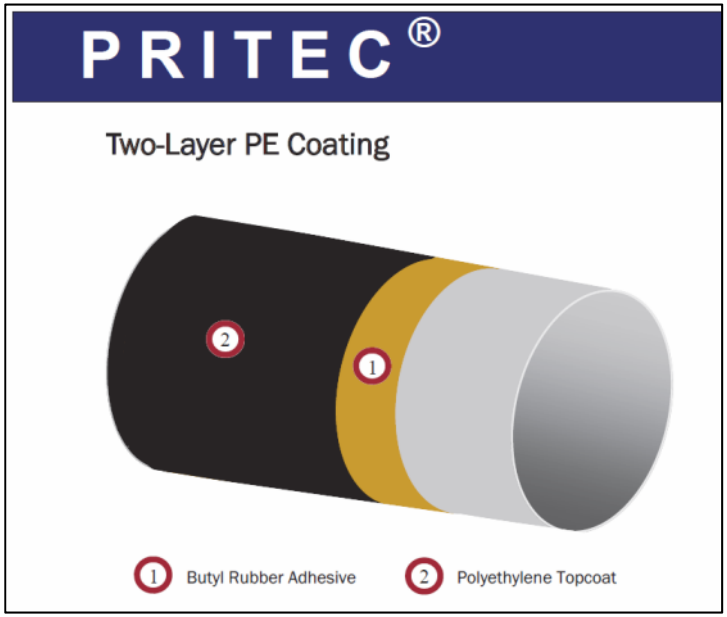


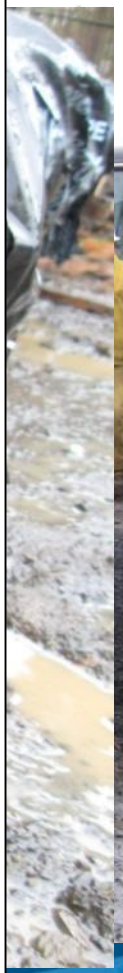
Polyurethane Coating

- Adhesion testing

Extruded Polyethylene



Pre-Installation Testing



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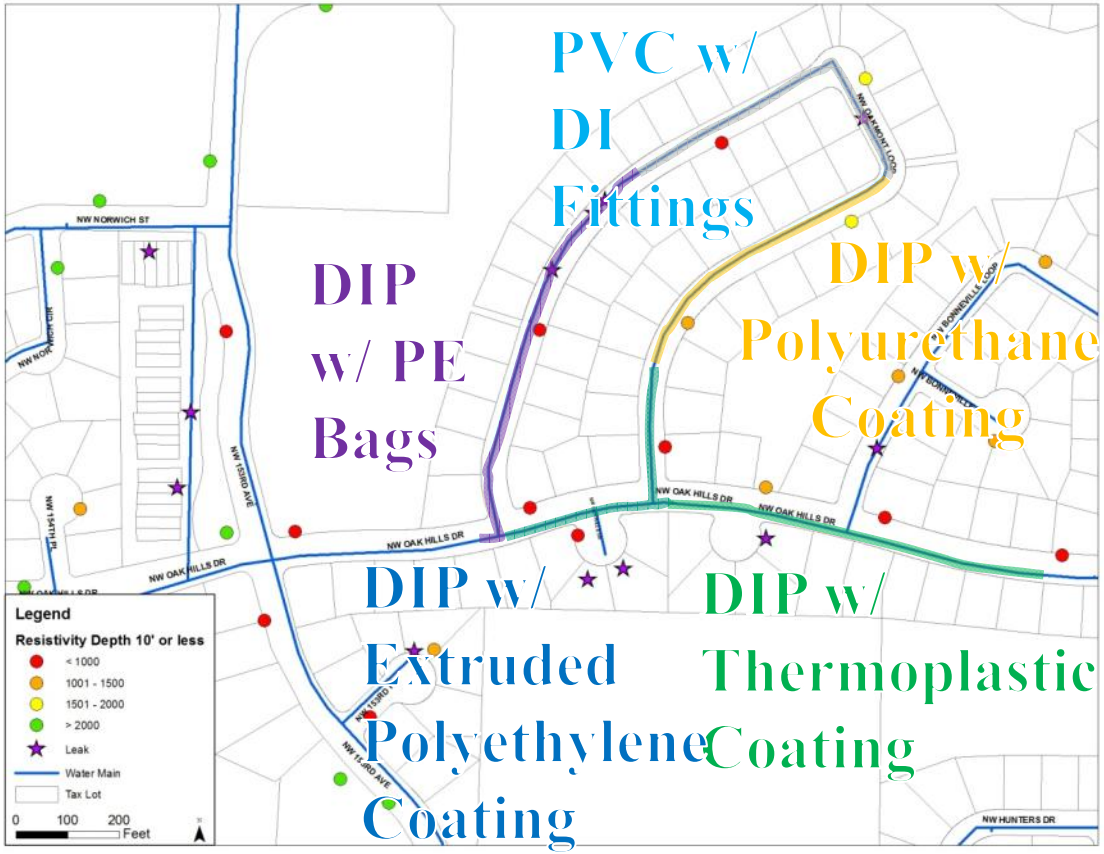
Pre-Installation Testing

Pre-Installation Testing

Pre-Installation Testing

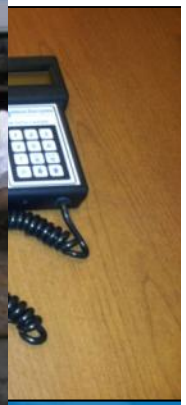
Pilot Program Installation

- Target Oak Hills Area
  - Install different pipe pilot materials
  - Track costs
  - Assess installation issues
  - Evaluate long-term corrosion resistance



DIP w/ Polyethylene Bags

- Two bags used
  - 8 mil LLDPE
  - 4 mil cross-



PVC Pipe

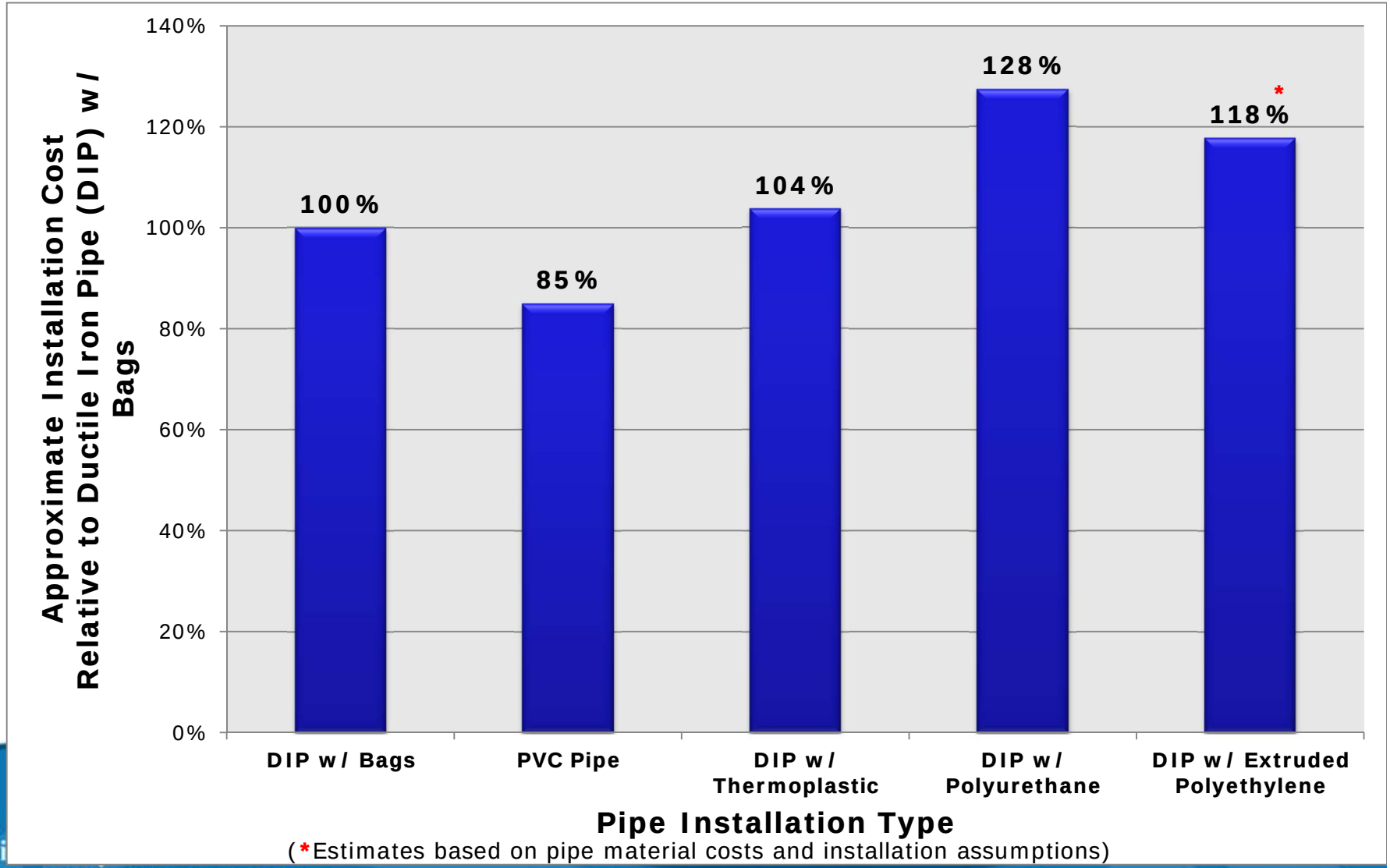
Thermoplastic Coating

Polyurethane Coating

Extruded Polyethylene

- Not installed

Comparison of Costs



(*Estimates based on pipe material costs and installation assumptions)

8” Water Main Installation

Criteria	DIP w/ Polyethylene Bags	PVC Pipe	DIP w/ Thermoplastic Coating	DIP w/ Polyurethane Coating	DIP w/ Extruded Polyethylene Coating *
Constructability	–	+	+	O	–
Cost	O	+	O	–	–
Corrosion Effectiveness	O	+	+	+	+
Procurement	+	+	–	–	–
Resiliency / Reliability	+	–	+	+	+

* Not installed. Constructability and costs estimated.

Ratings:

+ High O Medium – Low

TVWD focus for updated standards

Proposed Updates

Level of Soil Corrosivity	Non-Critical Pipe and Pipe 8 in (200 mm) and Smaller	Critical and High Consequence of Failure Pipe and Pipe 12 in (300 mm) and Larger
Non-corrosive	Normal Ductile Iron Pipe installation or PVC Pipe (>5,000 ohm-cm)	Normal Ductile Iron Pipe installation (>10,000 ohm-cm)
		Ductile Iron Pipe w/ polyethylene bags (>5,000 – 10,000 ohm-cm)
Slightly corrosive (>2,500 – 5,000 ohm-cm)	Ductile Iron Pipe with w/ polyethylene bags or PVC pipe (protect fittings same as ductile pipe)	Ductile Iron Pipe w/ bonded joints, anodes, & PE bags ***or possibly*** no anodes and no bonded joints with good PE bag installation, no groundwater issues, sand bedding and more inspection
Moderately corrosive (>1,500 – 2,500 ohm-cm)	Ductile Iron Pipe w/ bonded joints, anodes, & polyethylene bags or PVC pipe (protect fittings same as ductile pipe)	Ductile Pipe w/ tightly bonded coating, bonded joints, & anodes
Highly corrosive (=1,500 ohm-cm)	Ductile Iron Pipe w/ tightly bonded coating, bonded joints, & anodes or PVC pipe (protect fittings same as ductile pipe)	Ductile Iron Pipe w/ tightly bonded coating, steel or CCP; w/ bonded joints & anodes or impressed current

Modify Approach & Standards

- Details are important
  - Needs to be well thought out, constructible and biddable for outside contractors
  - Examples of new things to think about:
    - Isolation for services and anodes for copper service lines / other service line materials
    - Improving on cad welds and pin brazing
    - Having qualified applicators
    - Competition in the marketplace
  - Comply with applicable water industry standards for new products

Modify Approach & Standards

- Follow-up activities:
  - Testing bag installations for use with crushed rock backfill

Modify Approach & Standards

4 mil HDPE Cross Laminated Bags

8 mil LLDPE Bags

Questions?

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