Lake Oswego · Tigard Water Partnership

sharing water · connecting communities

Construction of a New Willamette River Pipe Crossing

May 5, 2016

American Water Works Association Pacific Northwest Section

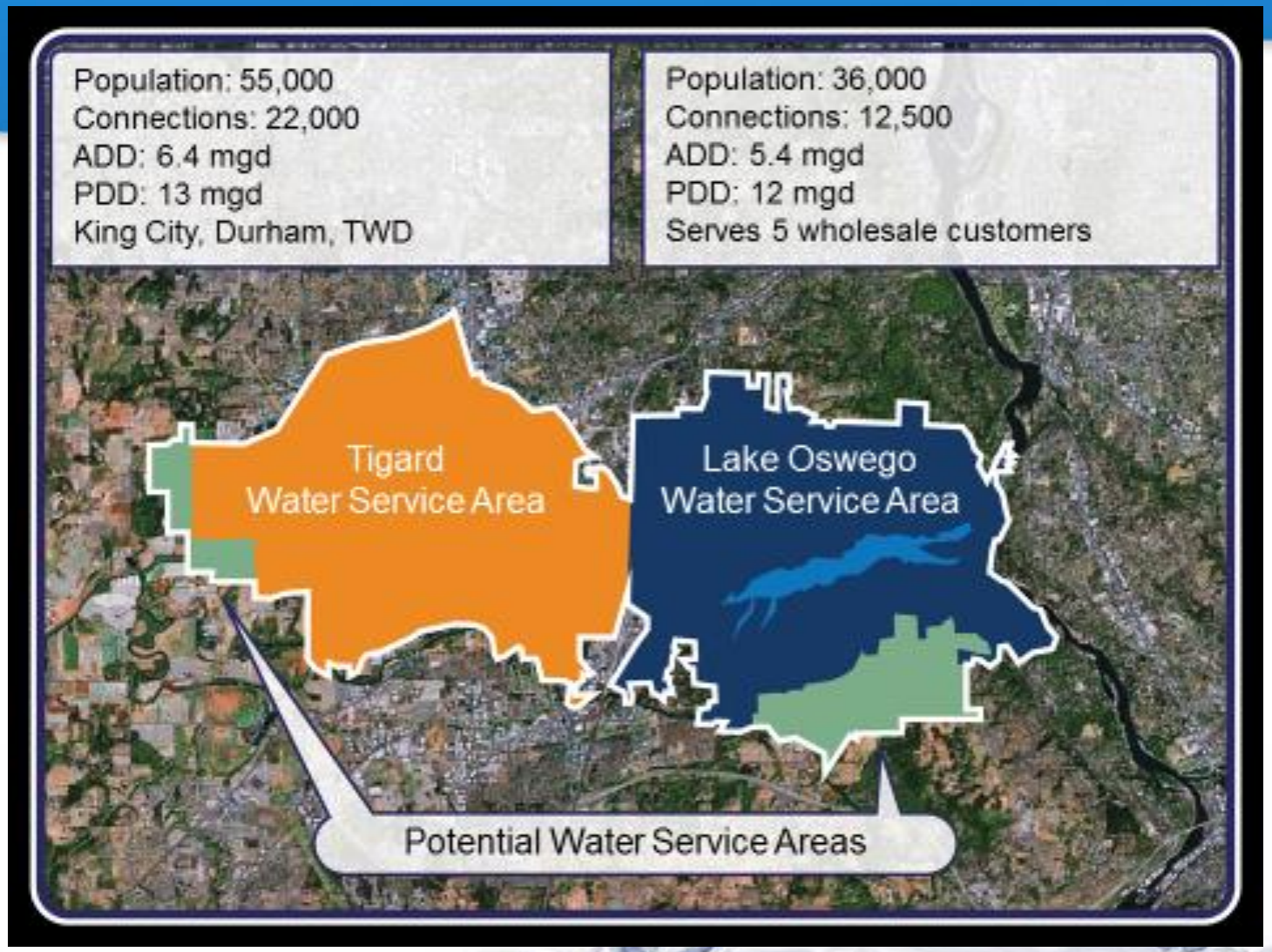
MAY THE SOURCE BE WITH YOU PNWS-AWWA BOISE 2016

Lake Oswego – Tigard Water Partnership
Construction of a New Willamette River Pipe Crossing
Outline

1. Program Background
2. Introduction to Horizontal Directional Drilling (HDD)
3. Willamette River Crossing
4. Construction of HDD Segment
5. Acknowledgements
6. Questions

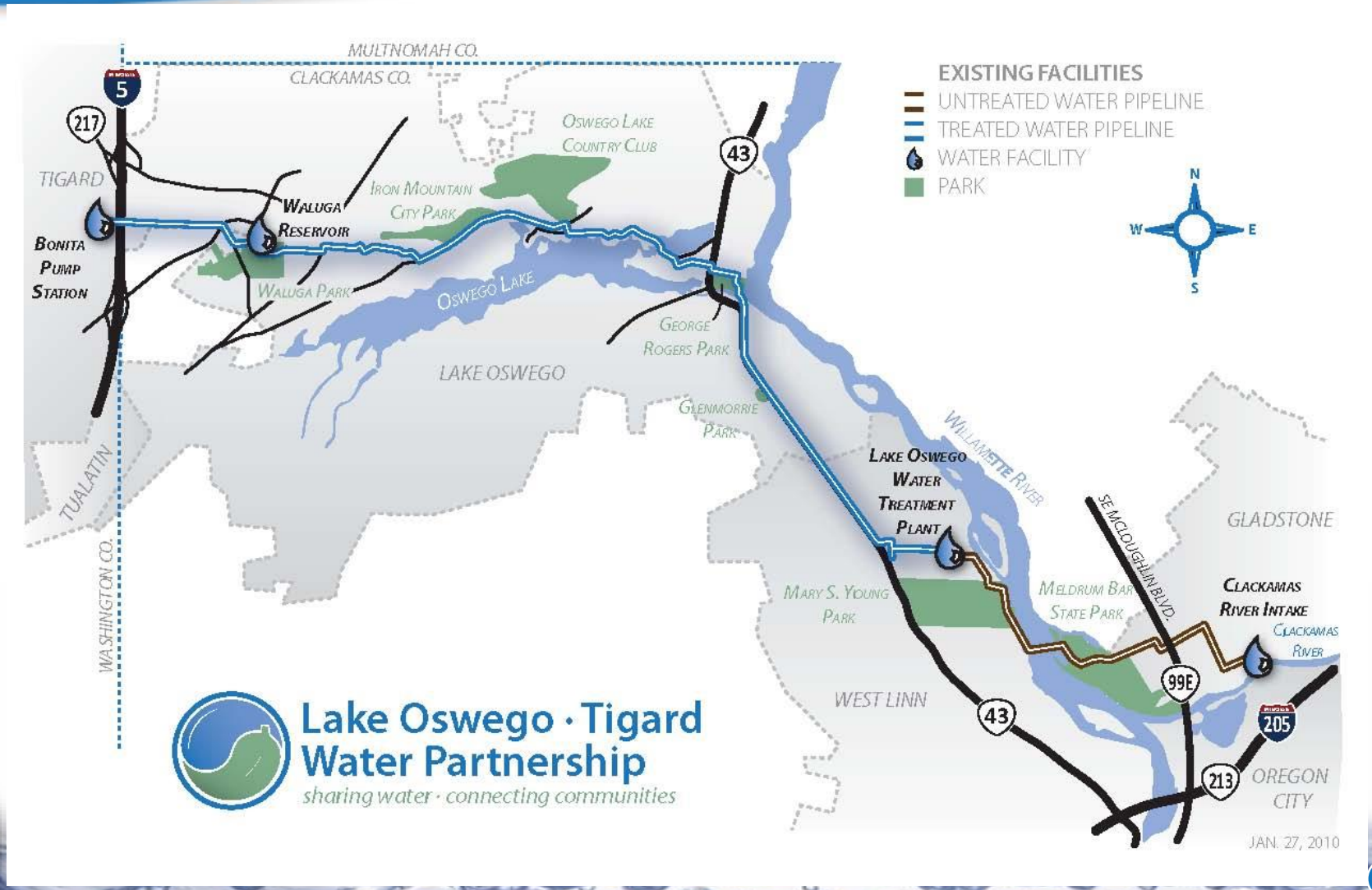
Lake Oswego – Tigard Water Partnership

Lake Oswego – Tigard Water Partnership



PDD
16 mgd
to
38 mgd

Program Overview - Existing Lake Oswego and Tigard Water Supply System



City of Lake Oswego's Infrastructure Needs

- 45+ year old system
- Structural deficiencies
- Obsolete equipment
- Critical lifelines

Lake Oswego – Tigard Water Partnership
Major Project Challenges

- A project completion span of eight-years from concept development.
- Construction within, across, and under a major river – home to endangered salmon and steelhead.
- Legal challenges from local project opponents and conservation groups.
- Project financing amidst recession and economic instability

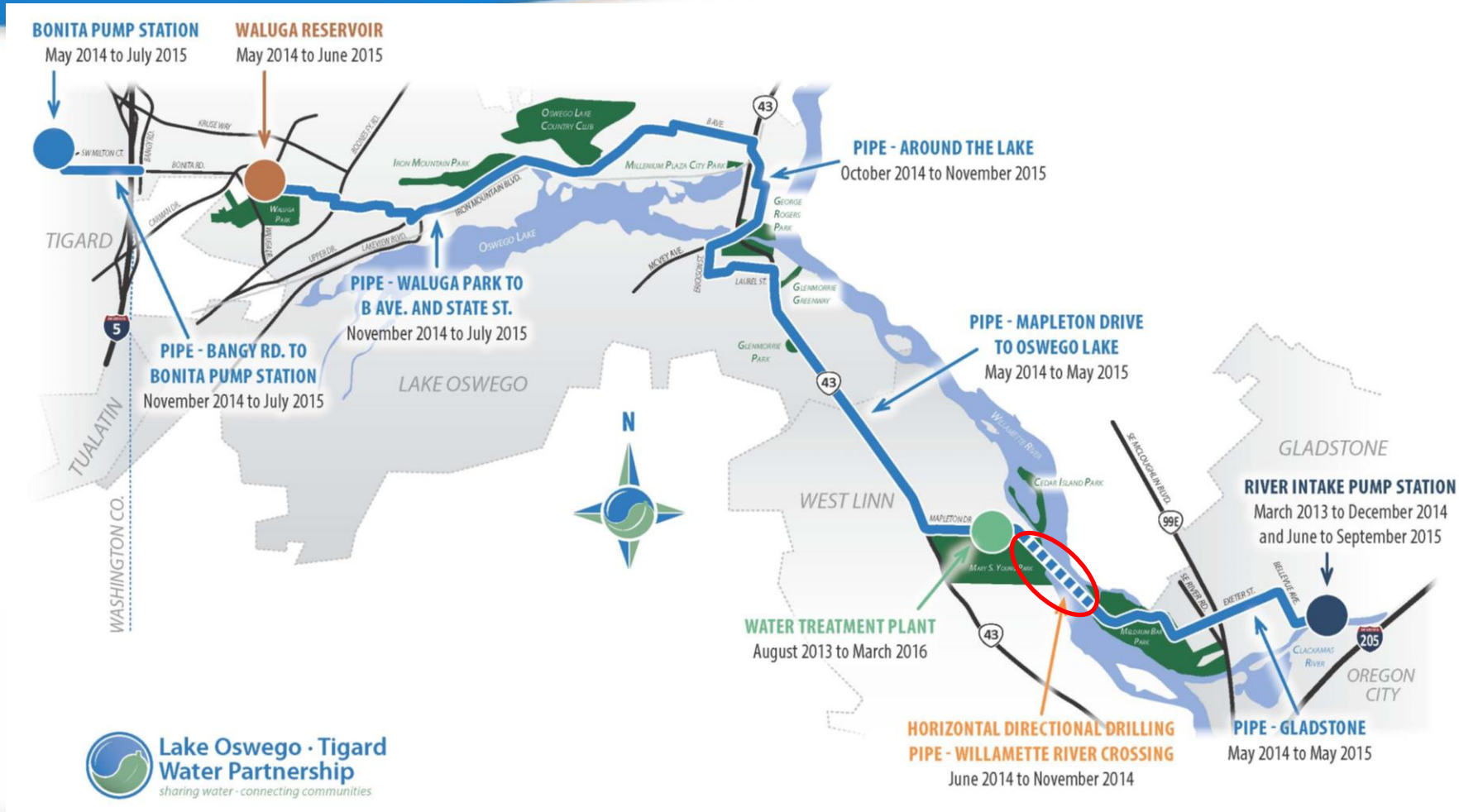
Lake Oswego – Tigard Water Partnership
Major Project Challenges

- Construction of large diameter pipelines within and along narrow local roads in residential neighborhoods and across two major highways and railroads.
- Construction of a new water treatment facility located within a residential neighborhood.
- Maintaining full time operation of the existing WTP while the new WTP is constructed/expanded from 16 mgd to 38 mgd.
- Transitioning from the existing system to the new system.
- Property acquisition.

Lake Oswego – Tigard Water Partnership
Large Water Supply Pipeline

- Water from the Intake on the Clackamas River to Lake Oswego and Tigard
- Pipeline diameter ranges from 24 to 48 inches
- More than 10 miles
- This presentation focuses primarily on the trenchless pipeline crossing of the Willamette River

Water System Improvements – Pipeline Status
Spring 2016



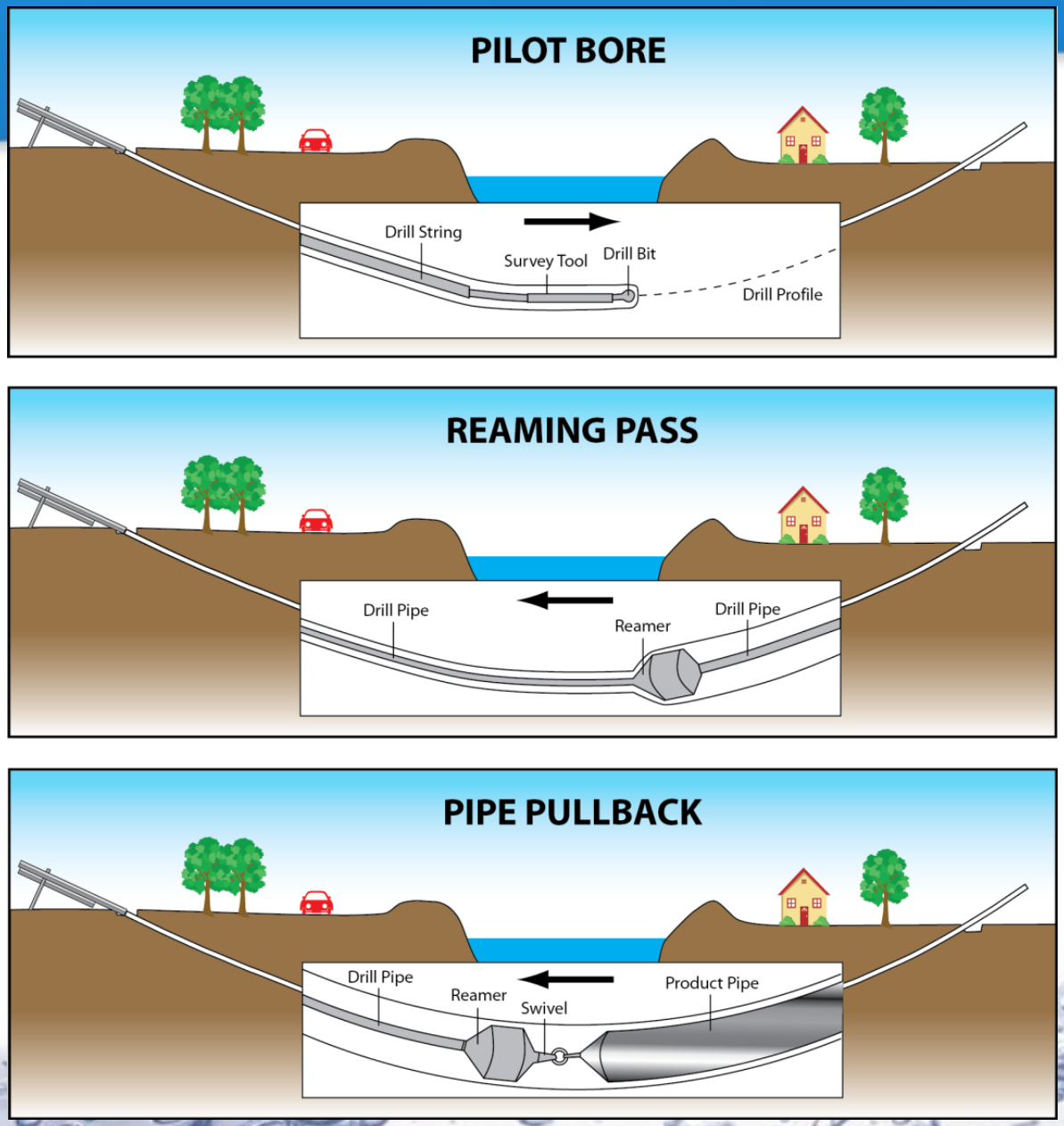
The Willamette River Crossing

- Trenchless Evaluation
  - Microtunneling
  - Horizontal Directional Drilling

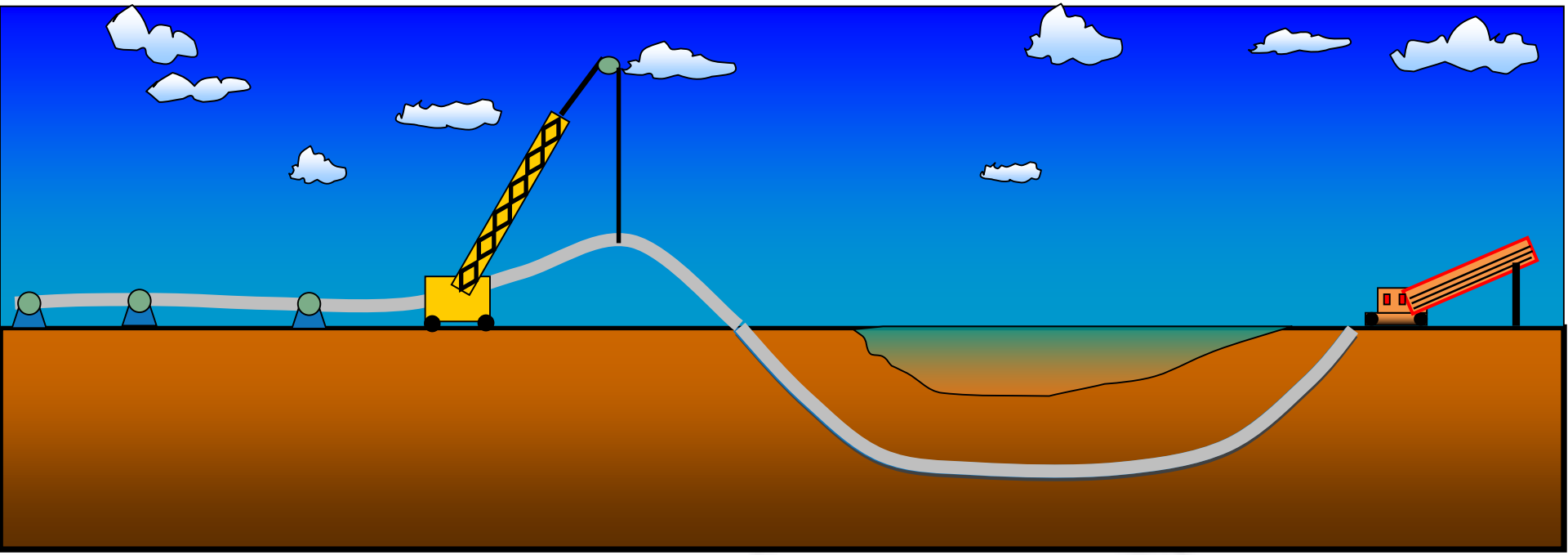
- Geotechnical
- Schedule
- Environmental
- Easements
- Permitting
- Public Acceptability

- Constructability
- O&M Access
- Entry Area (shaft or mud pit)
- Exit Area (shaft or mud pit)
- Construction Access at the Entry/Exit
- Pipe Layout Area (HDD Only)

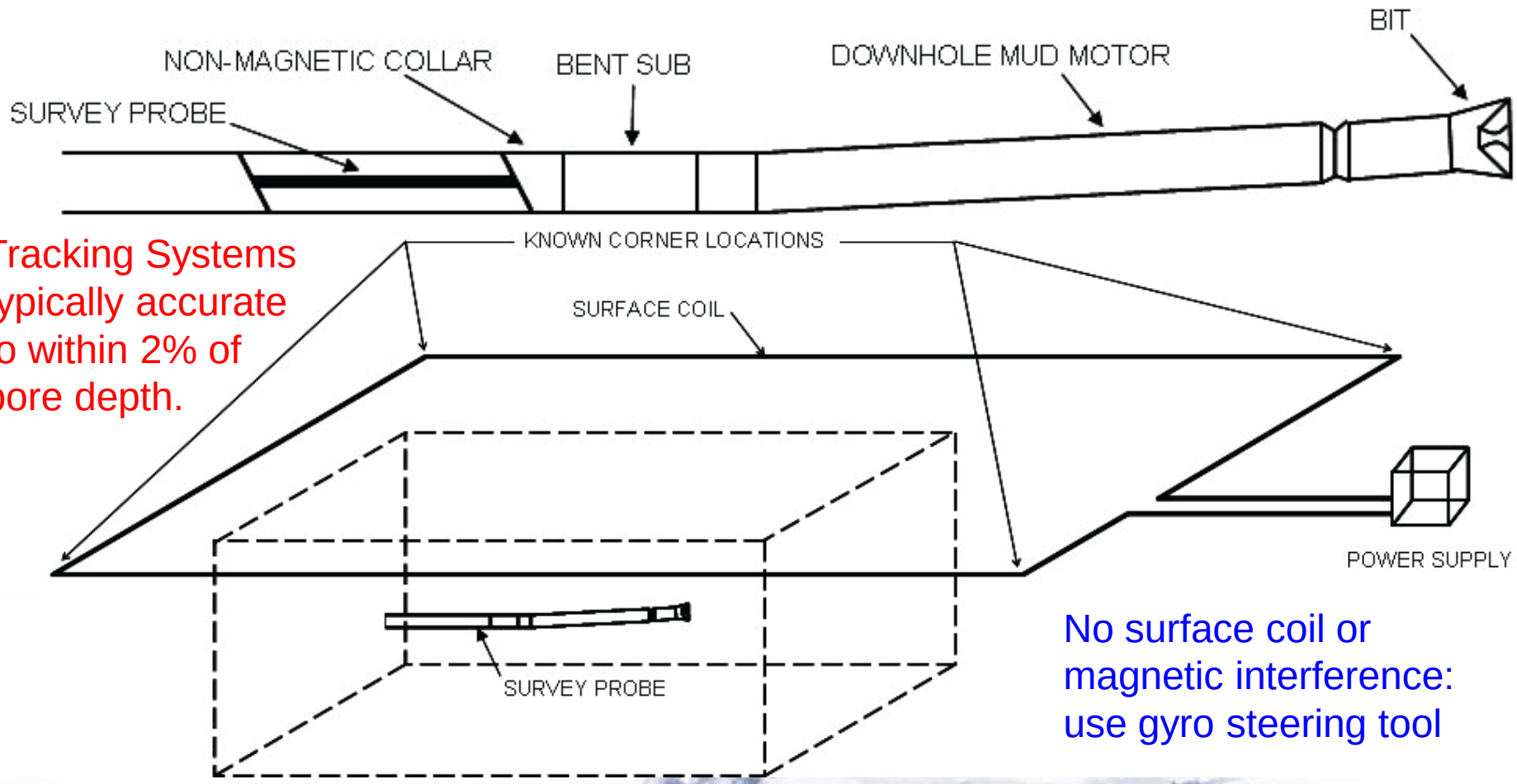
Horizontal Directional Drilling



Horizontal Directional Drilling



Horizontal Directional Drilling Tracking



Tracking Systems typically accurate to within 2% of bore depth.

No surface coil or magnetic interference: use gyro steering tool

Horizontal Directional Drilling

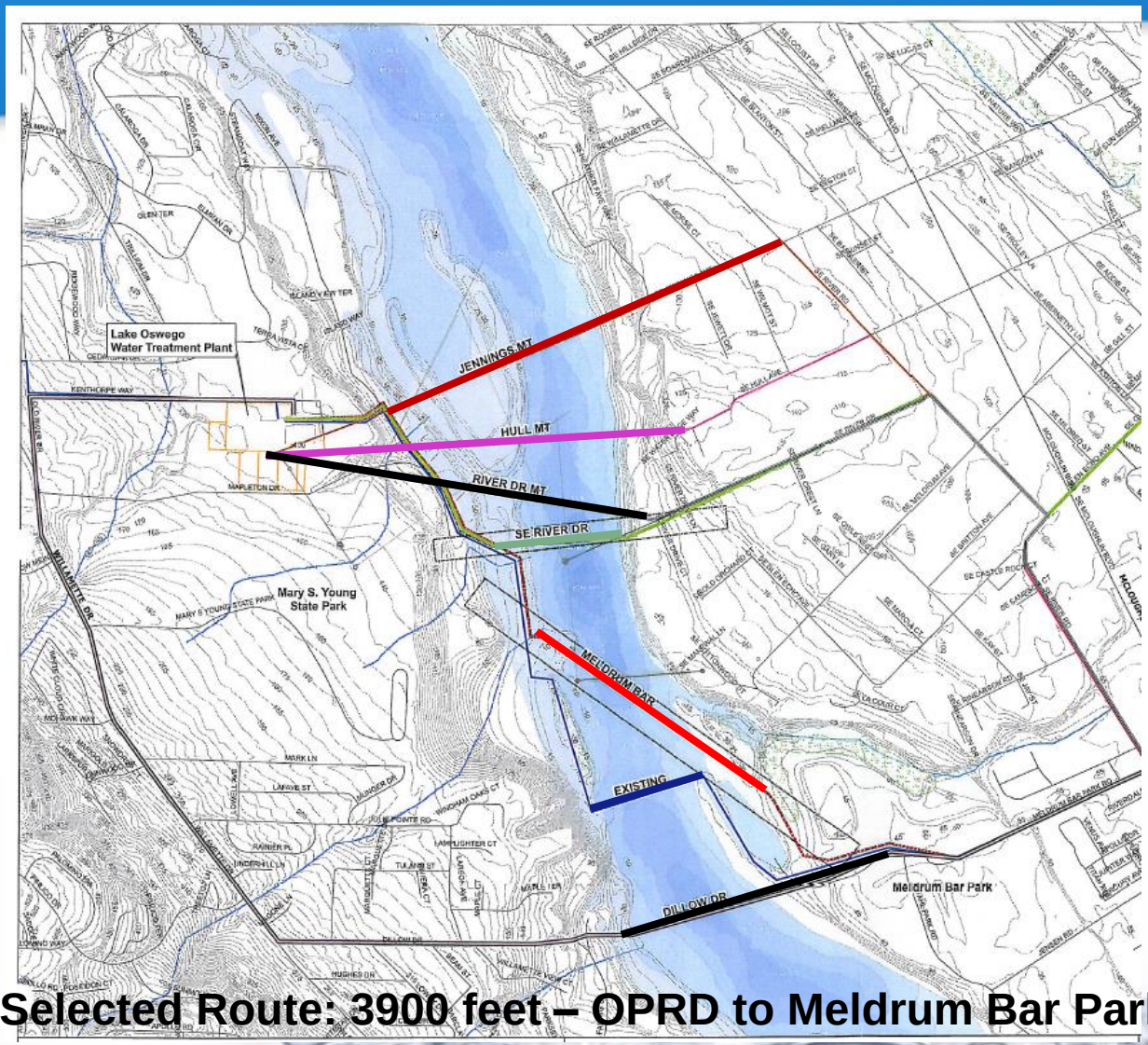
- Surface-to-surface installation
- Small mud pits
  - no deep/large excavations required
- Pressurized mud to cut a borehole
- Drilling mud stabilizes borehole
- Bore size increased by reaming
- Pulls assembled pipe into prepared bore
  - Preferably in one continuous pull
  - Conditions may dictate pulling in sections
- 2-inch to 48-inch commonly installed

Horizontal Directional Drilling

- It’s all about the MUD
- Run a Hydrofracture Analysis
  - Appropriate clearances below critical elements
- Conductor casings – proper installation
- Continuous pullback or analysis of bore stability

The Willamette River Crossing – Route Selection

Design and Constructability Factors:
-Geotechnical
-Staging
-Ingress/Egress
-Pipe Pullback



Selected Route: 3900 feet – OPRD to Meldrum Bar Park

Permits:
-Federal
-State
-Local

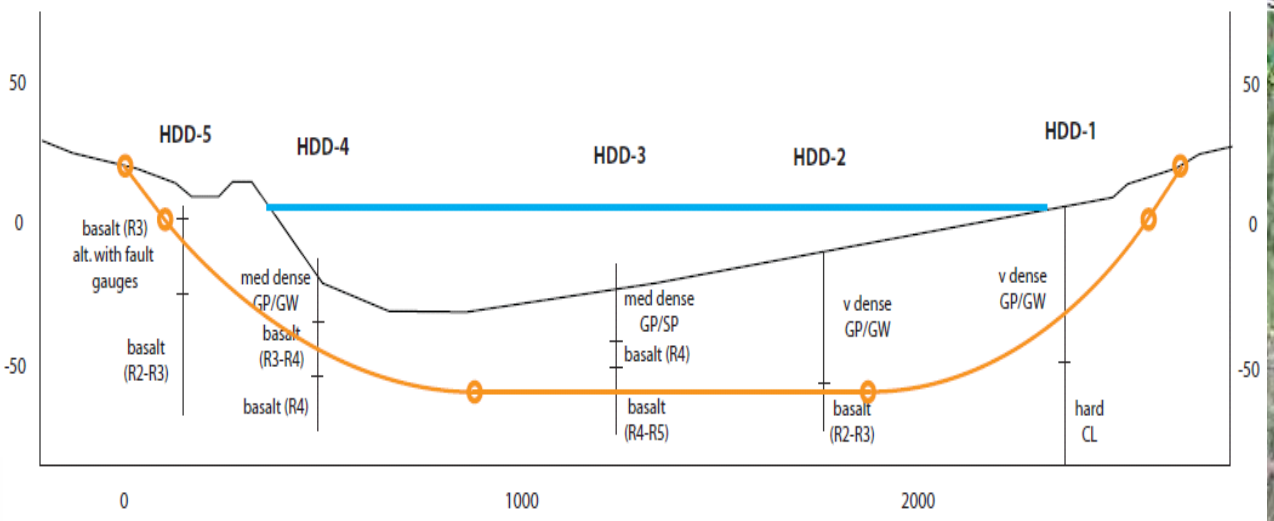
Easements
-Permanent
-Temporary

Community Impacts

The Willamette River Crossing
Geotechnical Evaluation

OPRD / MSY – near surface sands, gravels

Meldrum Bar – gravels, cobbles



Rock strengths in basalt – 40,000+ psi

Willamette River Crossing
Pipe Material Selection for HDD

- **High Density Polyethylene (HDPE)**
  - 4-inch thick wall, 36-inch ID (44-inch OD)
  - Material homogeneity not guaranteed
- **Steel Pipe**
  - Fully Engineered Wall Thickness, Lining and Coating, Joint Type, High Tensile Strength (0.625 inch wall thickness)
  - 36-inch ID AWWA C200 Steel Pipe-- 37.25-inch OD
  - Polyurethane Lining (40 mils.) and Coating (80 mils.)
  - Full Penetration Butt Welded Joints
  - ROT: Bend Radius = 100 x (Nom. Diameter) inches = Bend Radius in Feet
  - For 36-inch Steel Pipe, Bend Radius = 3,600 feet

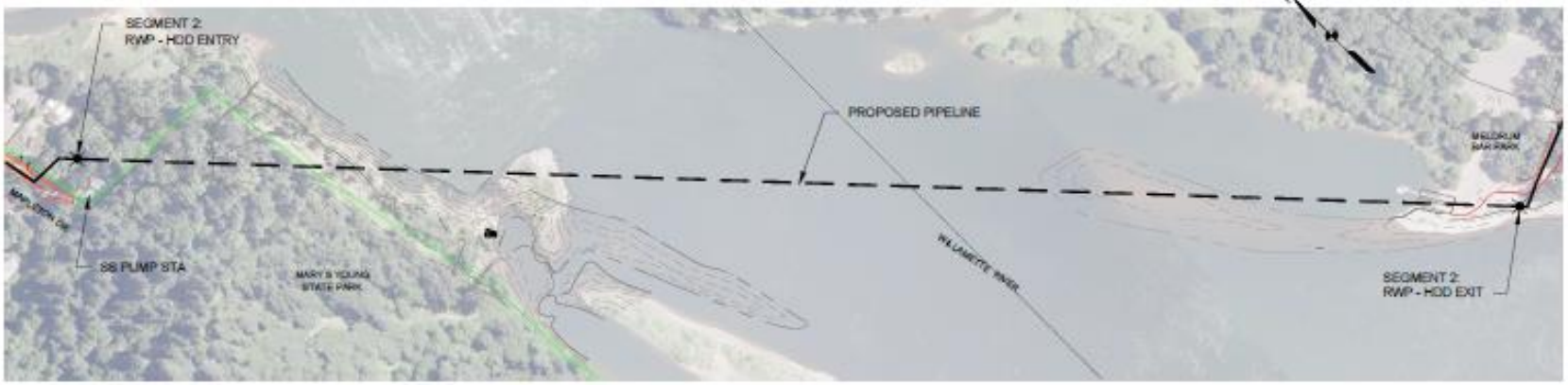
Willamette River Crossing
Steel Pipe Specified for HDD

QUALITY CONTROL - Tensile Test, Bend Test, Spot X-ray Tests,10% X-ray Testing of Spiral Welds, Cylinders Hydro-tested to 75% of Yield

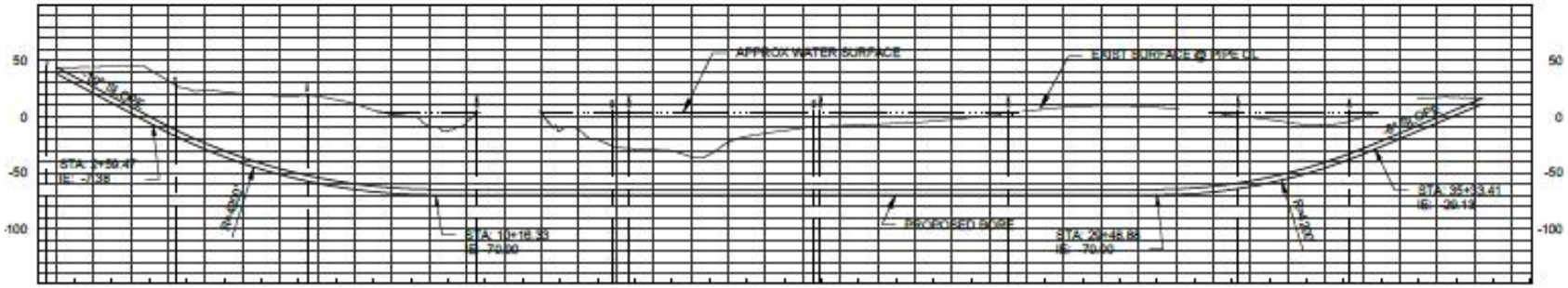
Steel Pipe Project Specifications

- Working Pressure: 150 psi
- Surge Pressure: 225 psi
- Full Vacuum (14.7 psi)
- Allowable Stress: 50% of Yield Strength of Steel
- Steel Coil Specified – ASTM A1018, GR 36, Structural Steel
- Min. Tensile Strength: 53 ksi
- 60-foot Sections of Pipe
- Lining & Coating: Polyurethane (40 mils & 80 mils), 1500 psi adhesion

Willamette River Crossing
Construction of HDD Segment



OPRD Meldrum Bar



Contractor installed a combination of telescoped conductor and wash-over (stabilizing) casings 14, 20, 54, and 60 inches in diameter, with the OPRD site (north of Mary S. Young Park) cased approximately 160 feet from ground surface and the Meldrum Bar Park site cased approximately 600 feet to bridge unstable soils

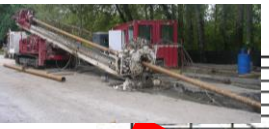
Willamette River Crossing – Construction of HDD Segment

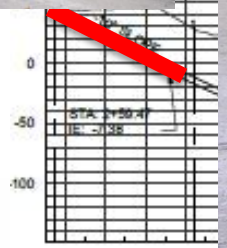
Pipe Ramming Used to Install 60-inch Conductor Casing

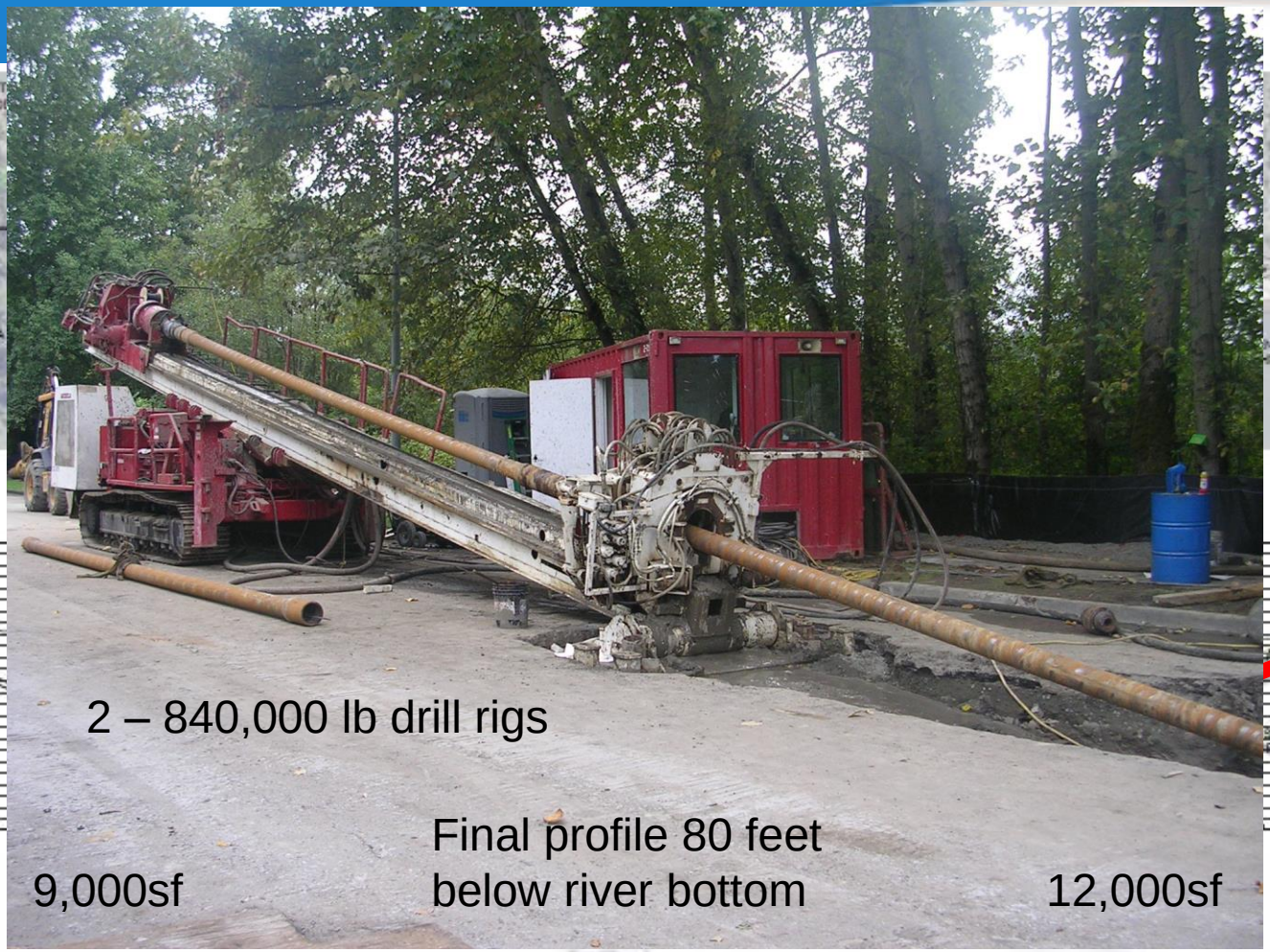
Willamette River Crossing – Construction of HDD Segment

OPRD

Meldrum Bar







2 – 840,000 lb drill rigs

Final profile 80 feet
below river bottom

10º

9,000sf

12,000sf

9º

Intersect Method (x 2)

Willamette River Crossing – Construction of HDD Segment

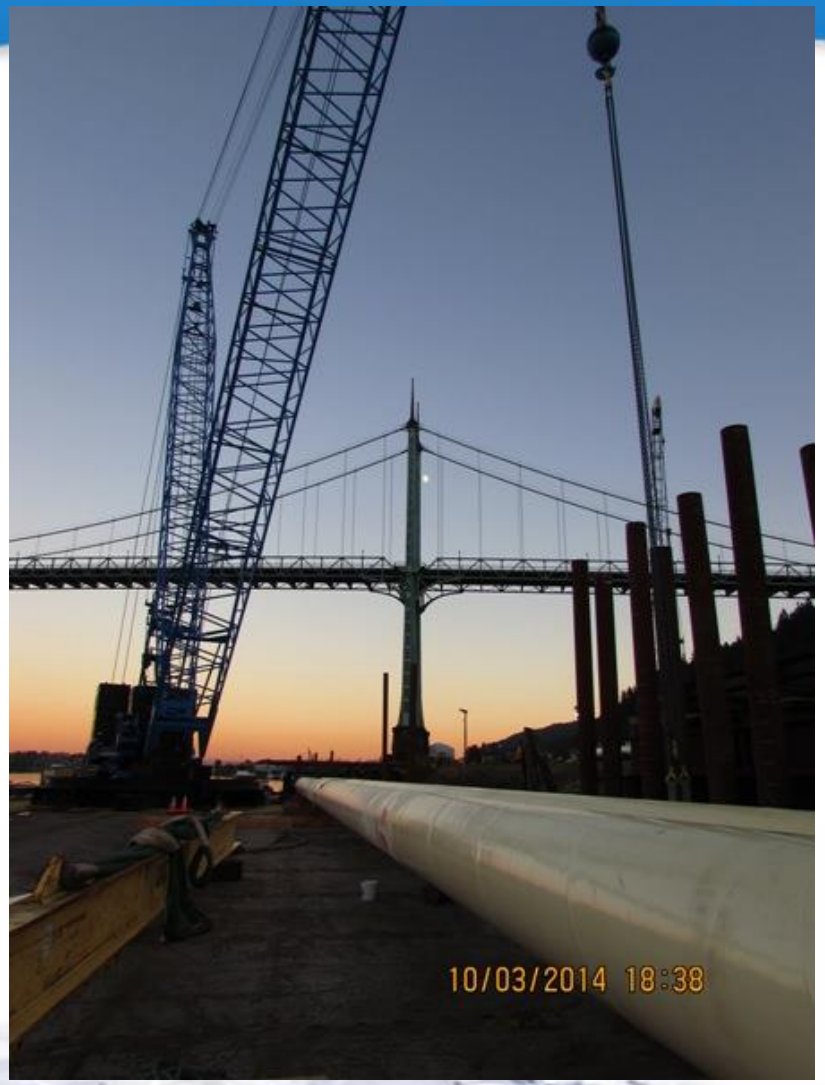
BACK REAMING

- After 12.5-inch pilot hole complete
- Performed in 3 stages, 36-inch, 42-inch and 54-inch
- From OPRD site to Meldrum Bar Park site
- 1st Pass – 13 days, 242 feet/day
- 2nd Pass – 5 days, 630 feet/day
- 3rd Pass – 12 days, 263 feet/day
- 80-foot Section of 36-inch Pipe Passed through as Proof

Willamette River Crossing – Construction of HDD Segment

PIPE PREPARATION & PULLBACK

- 240-ft long sections of steel pipe were welded, as well as lining and coating joint completions performed in Advanced American Construction's yard near the St. John's Bridge, then transported approx. 18 river miles upstream via large derrick barge to Meldrum Bar Park



Willamette River Crossing – Construction of HDD Segment

PIPE PREPARATION & PULLBACK

- Each joint was butt-welded
- Surface prep inside and out w/ Surface Grinder (2 mils profile minimum)
- Testex Tape to Record Anchor Profile (ASTM procedure)
- Lining (40 mils) and Coating (80 mils) sprayed to same dry film thickness (DFT) as Pipe
- Adjacent Lining and Coating Feathered by Grinding
- Holiday Tested (for detection of discontinuities)
- Adhesion Values Tested

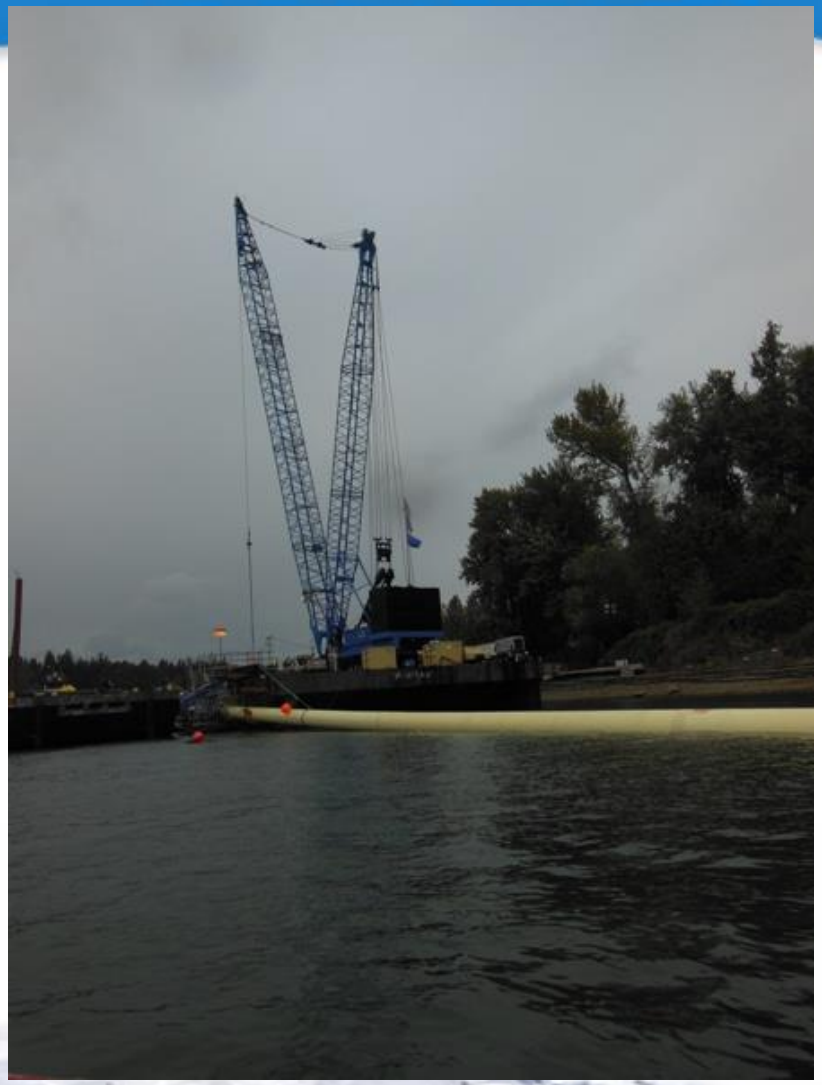
Willamette River Crossing – Construction of HDD Segment

PIPE PREPARATION & PULLBACK

Willamette River Crossing – Construction of HDD Segment

PIPE PREPARATION & PULLBACK

- Over a 10 day period, 16 sections of 240-long welded steel pipe were all welded together and joints completed
- Pipe floated into position and lofted over 100-ft into the air to achieve correct lineup and angle for the 54-inch borehole



Willamette River Crossing – Construction of HDD Segment

Willamette River Crossing – Construction of HDD Segment

PIPE PREPARATION & PULLBACK (pullback completed in 14 hours)
(overall approx. 100 days start to finish)

Willamette River Crossing – Construction of HDD Segment

SITE RESTORATION

Meldrum Bar site

OPRD site

Acknowledgements

OWNER: Lake Oswego – Tigard Water Partnership

PROGRAM MANAGEMENT: Brown and Caldwell

PIPELINE DESIGN: Kennedy/Jenks Consultants

TRENCHLESS DESIGN: Staheli Trenchless Consultants

PRIME CONTRACTOR:

Frank Coluccio Construction Company

TRENCHLESS CONTRACTOR:

Michels Directional Crossings

PIPE SUPPLIER: Northwest Pipe Company

Questions?