Take Me to the Other Side:

The Importance of Trenchless Crossings in Routing Water Supply Transmission

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Willamette Water Supply
Our Reliable Water

PURPOSE:

Develop an additional water supply through a partnership to support growth in the West Portland, Oregon Metro area

PARTNERS:

Currently Tualatin Valley Water District and the City of Hillsboro

Other water providers in the region are considering joining the partnership

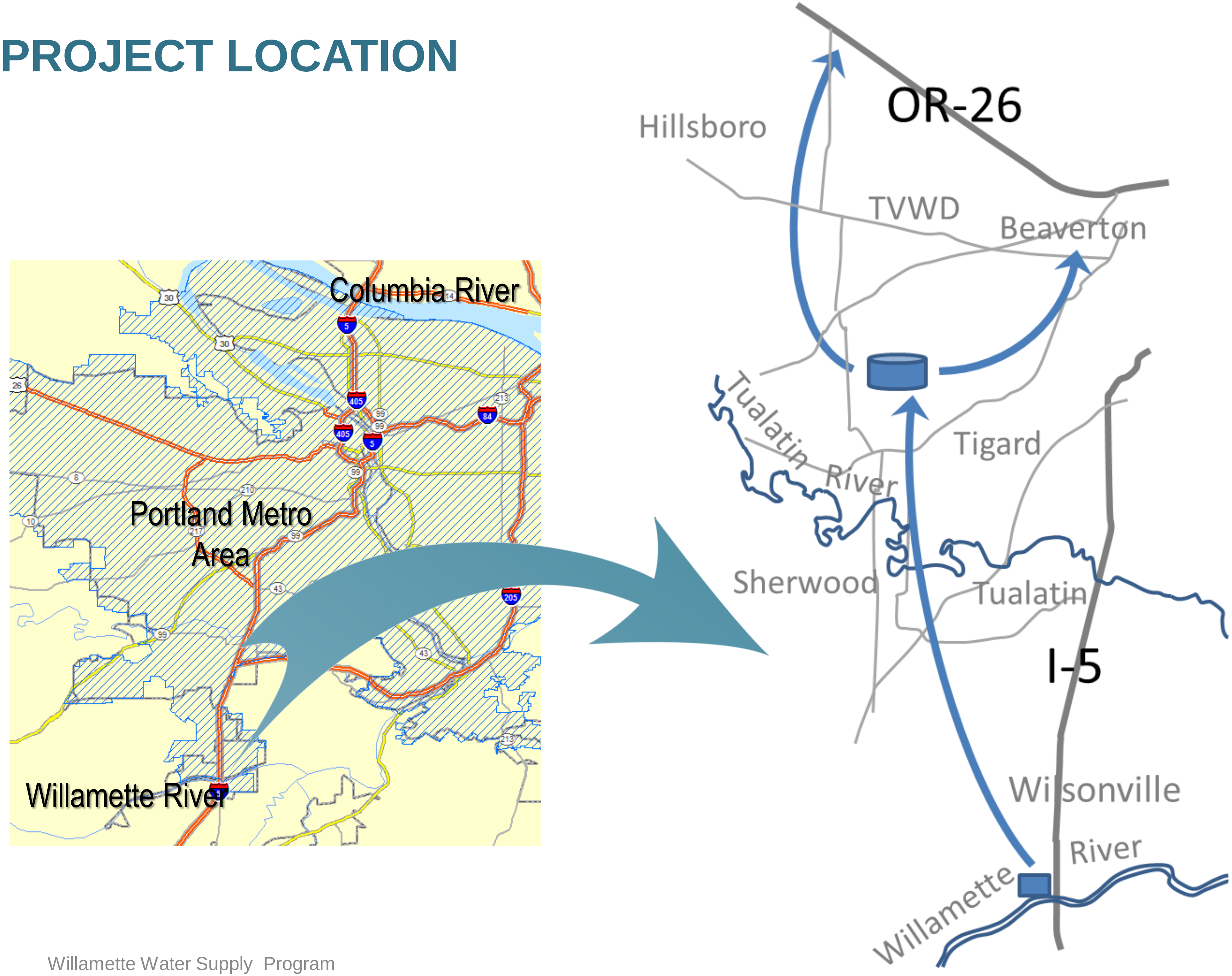
PLAN:

Transmission line online by 2026

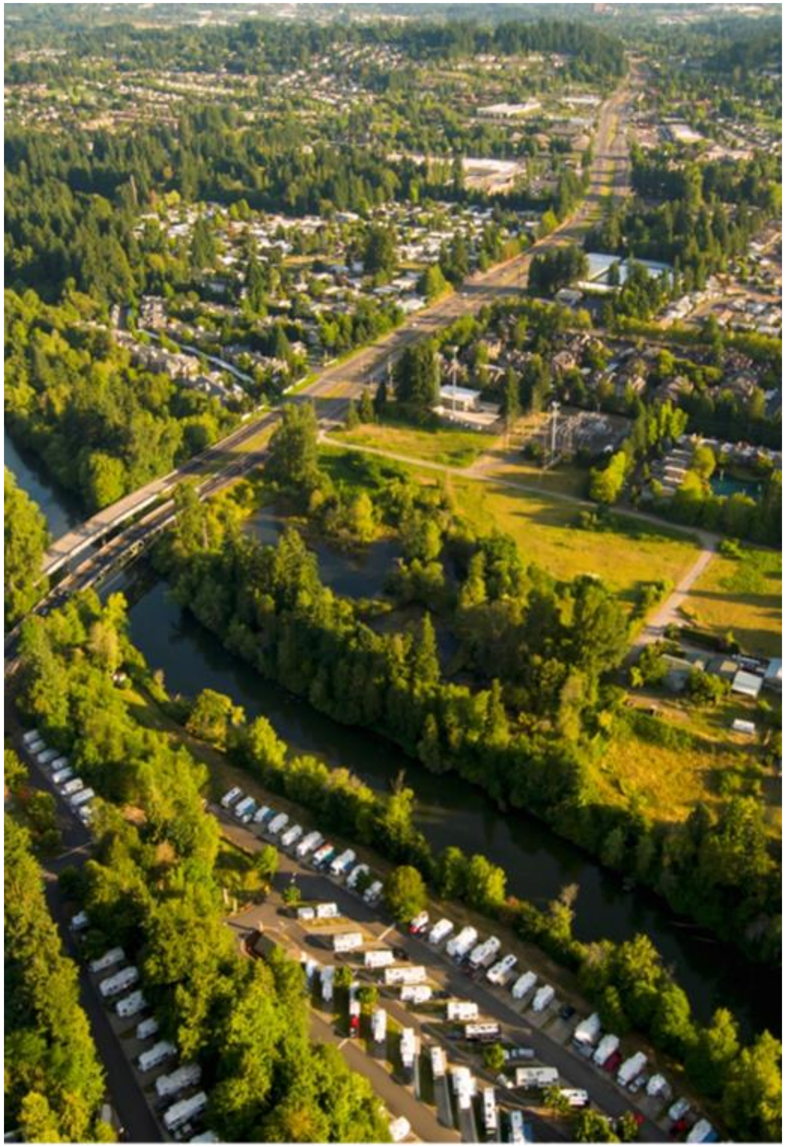
Hillsboro Water

Tualatin Valley Water District

PROJECT LOCATION



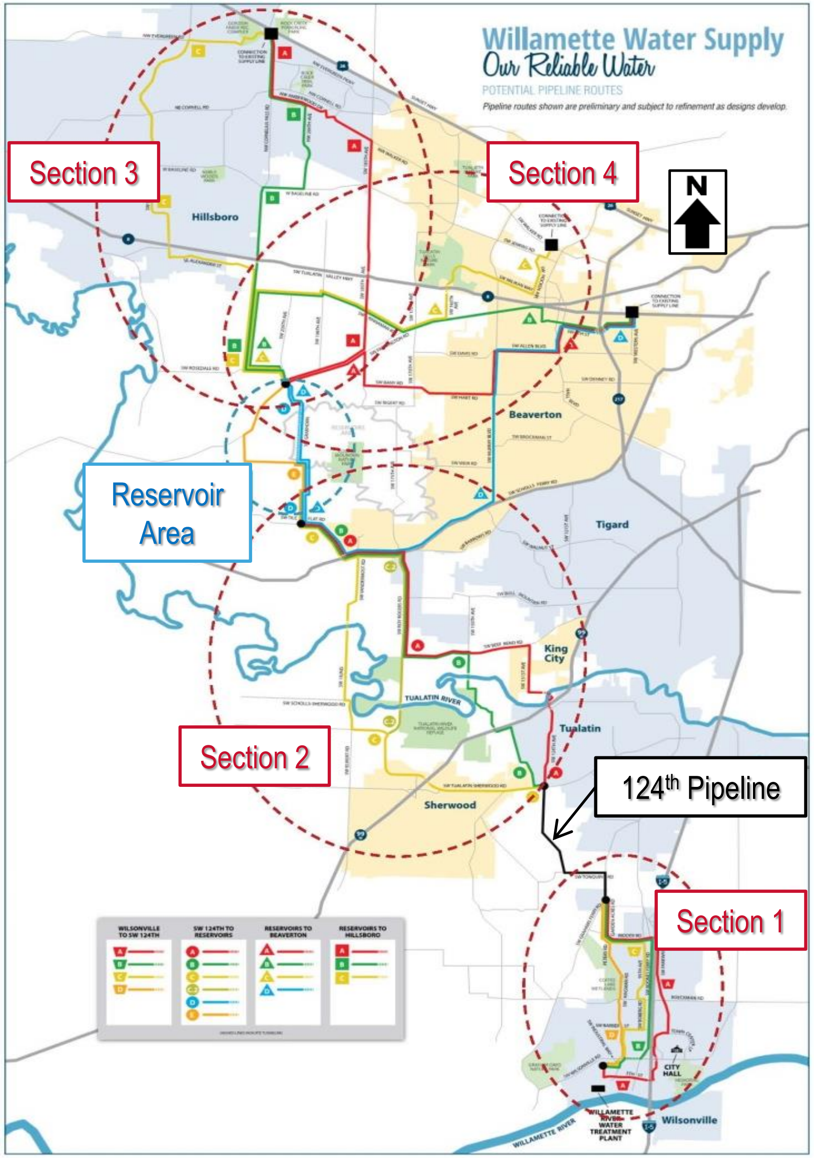
PROJECT COMPONENTS



- Water treatment plant master plan
- Terminal storage
- Delivery to two service areas
- New supply source-Willamette River
- ~32 miles of water transmission line:
  - ~16 miles of 66-inch welded steel pipe on the pumped side
  - ~16 miles of 30- to 66-inch pipe on the gravity side

PIPELINE ROUTING

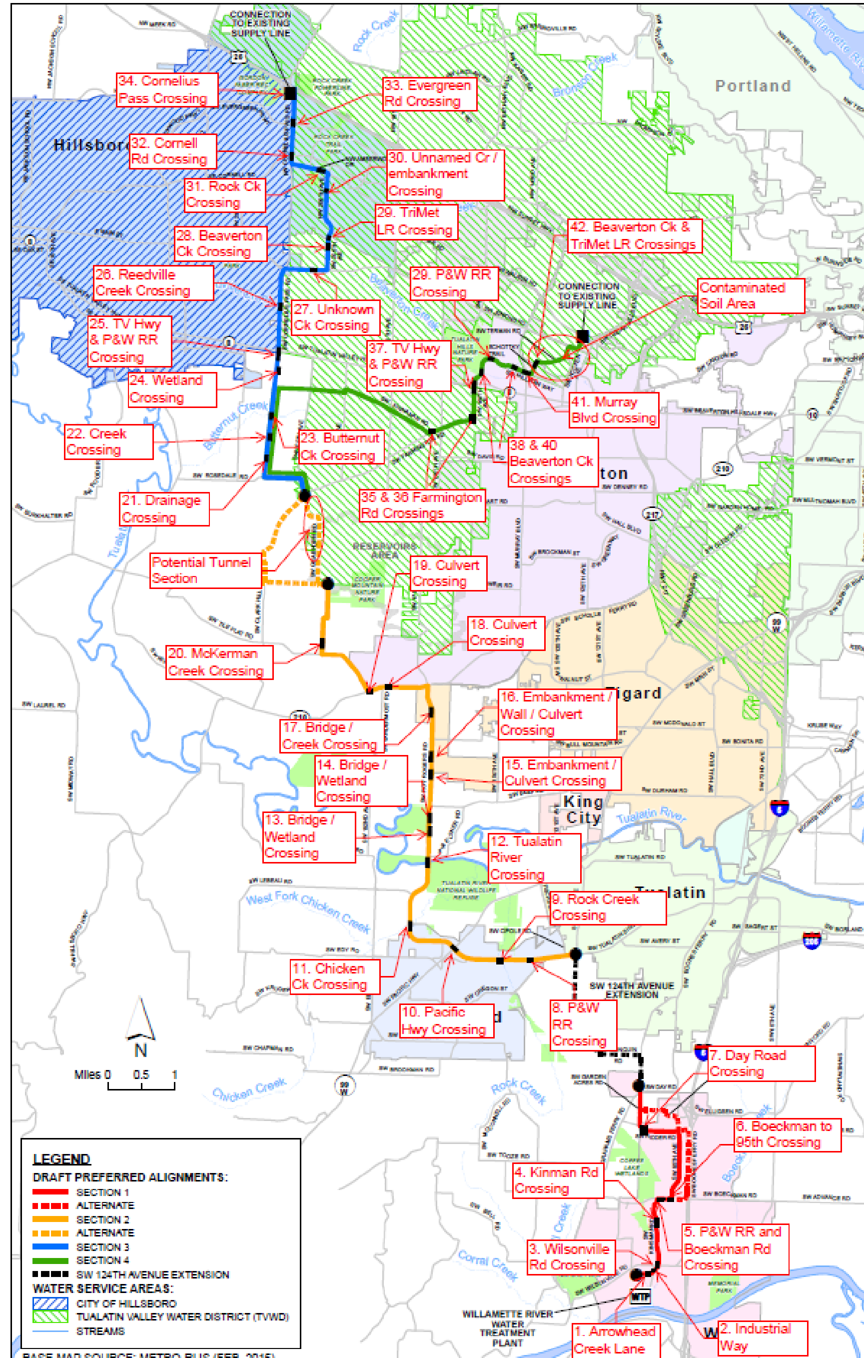
- Project divided into four sections
- Over 100 routes and sub-routes considered
- Route selection criteria extensive
  - Social/Community Impacts
  - Opportunities/Benefits
  - Environmental Impacts/Permitting
  - System Compatibility
  - System Resiliency
  - Constructability
  - Operation and Maintenance (O&M)
- Trenchless crossings a major driver



TRENCHLESS CROSSINGS

WWSP Crossings

- 36 crossings:
  - Creeks
  - Tualatin River
  - Wetlands
  - Roadways
  - Railroad tracks
- Most trenchless crossings:
  - Microtunnel
  - Auger bore
  - Pipe jacking
- Other:
  - One aerial
  - One FRP encased
  - 10 standard open cut



TRENCHLESS SITING CRITERIA

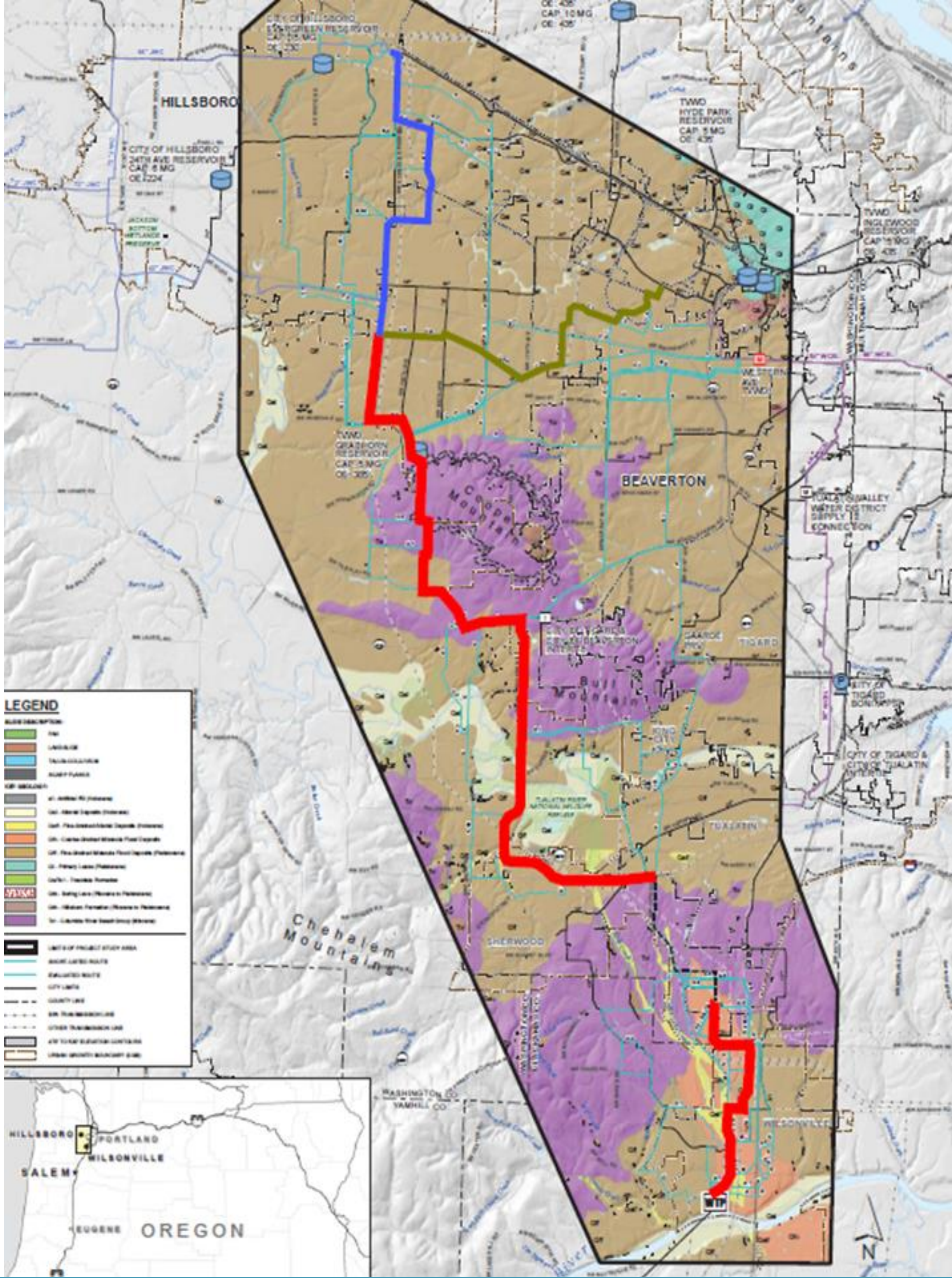
- **ROW**
  - Shaft Location
  - Staging
- **Avoidance of buried obstructions**
  - Utilities
  - Boulders
  - Abandoned bridge piles
- **Avoidance of specific areas**
  - Tualatin NWR
  - EFU Zoning
- **Trenchless constructability requirements**

Look Deeper!-

GEOTECHNICAL DESIGN CONSIDERATIONS

GEOTECHNICAL
Project Geologic Setting

- Major soil & rock units
  - Fills
  - Recent alluvium
  - Coarse-grained flood deposits (gravel/sand)
  - Fine-grained flood deposits (Willamette silt)
  - Basalt (fresh, weathered and residuals)
  - Hillsboro formation (clayey deposits)



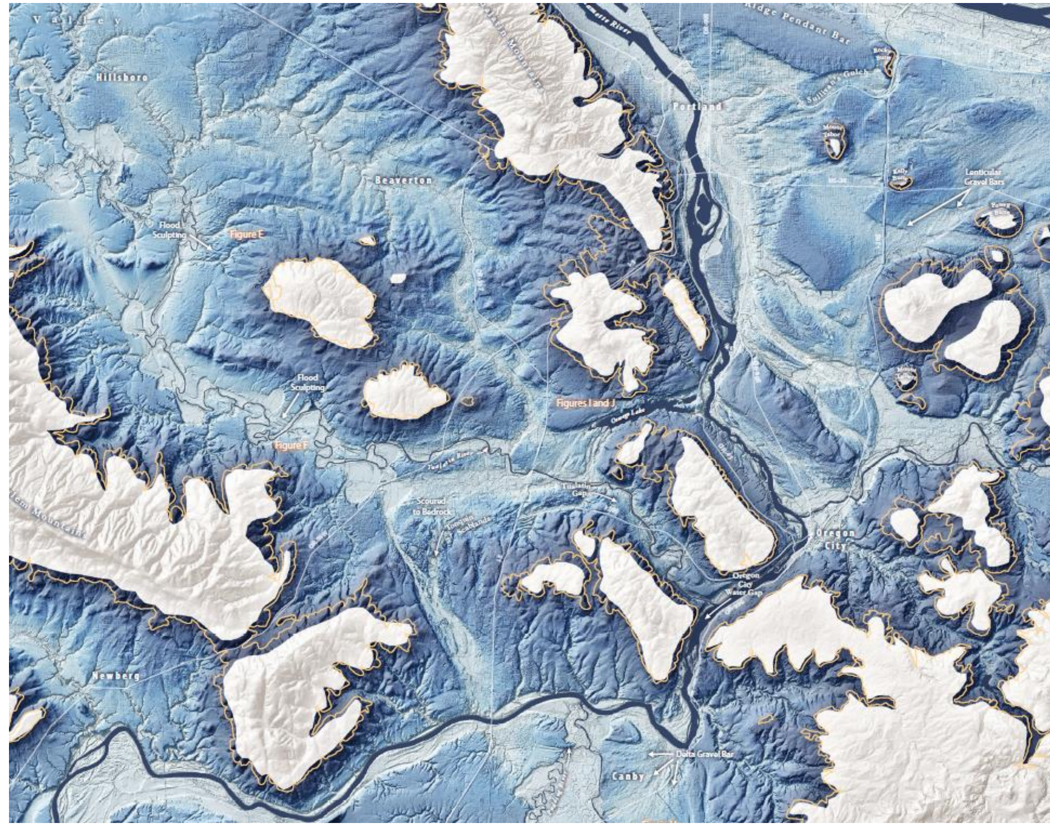
GEOTECHNICAL

Primary Geologic Issues

- Shallow groundwater
- Soft subgrade/disturbance of fine-grained soils
- Localized organic soils/peat
- Rock excavation
- Boulder excavation
- Minor landslide risk

GEOTECHNICAL
Geologic Risks -Trenchless Crossings

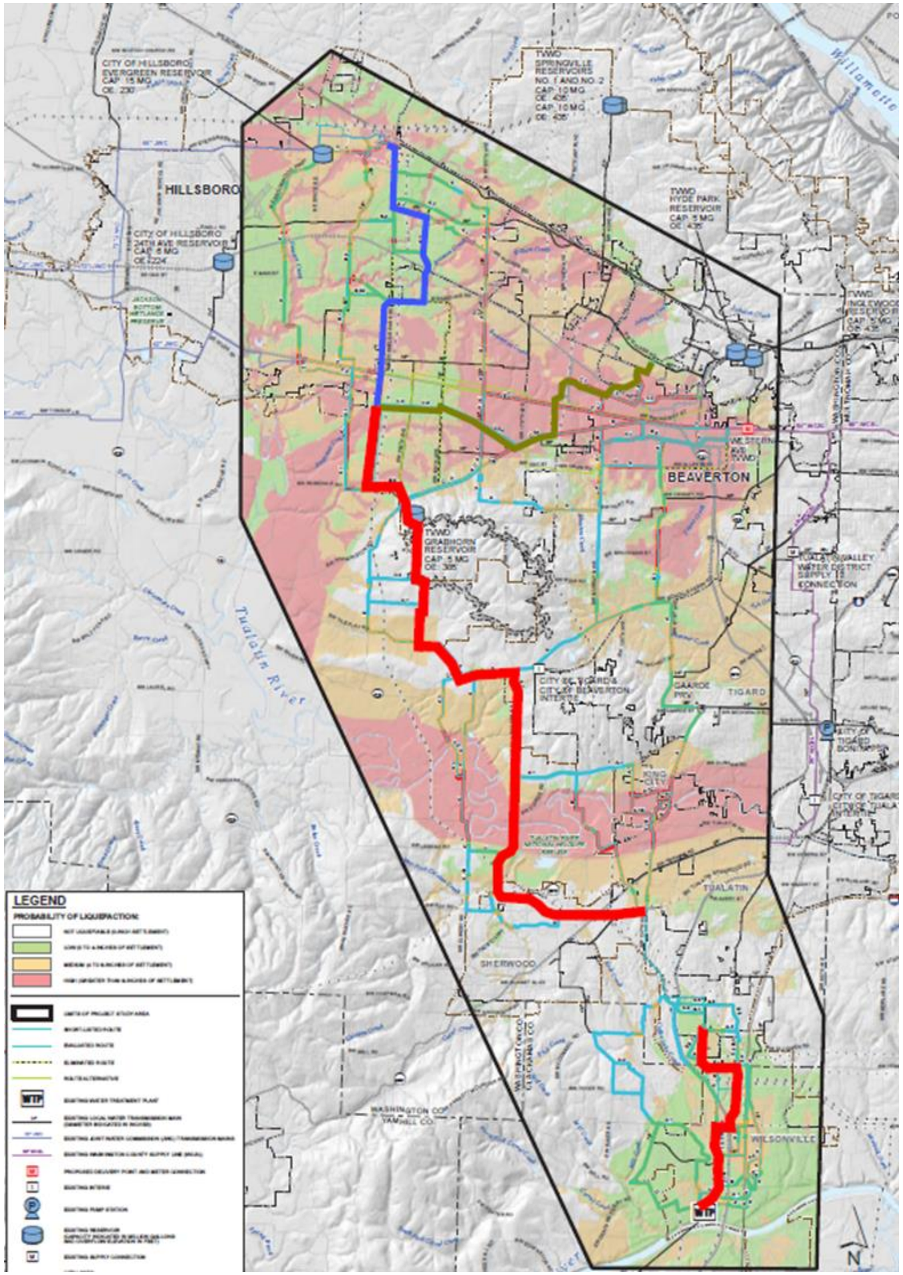
- Geologic Risks:
  - Groundwater
  - Erratics (boulders)
  - Gravel deposits
  - Soil/rock contacts
  - Flowing ground conditions



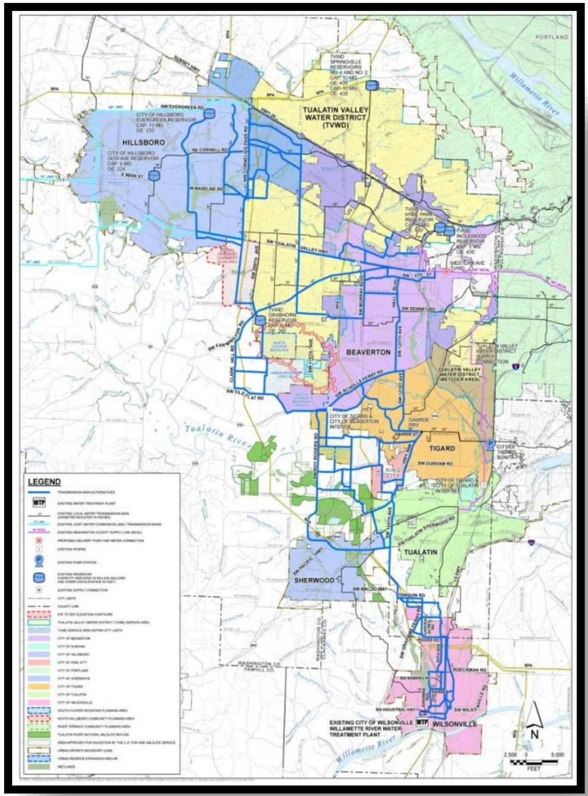
IMS-36, Missoula floods - inundation extent and primary flood features in the Portland metropolitan area, Clark, Cowlitz, and Skamania Counties, Washington, and Clackamas, Columbia, Marion, Multnomah, Washington, and Yamhill Counties, Oregon, by William J. Burns and Daniel E Coe.

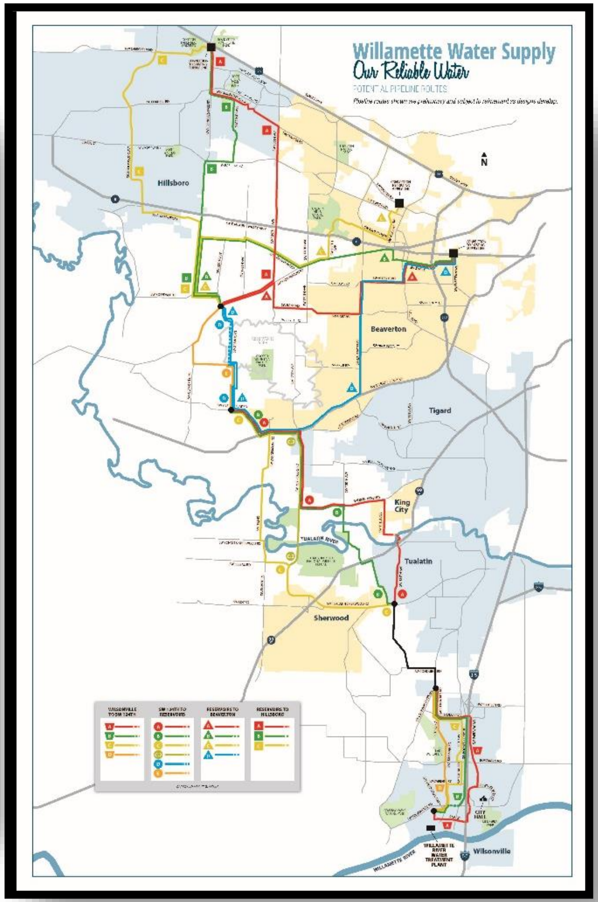
GEOTECHNICAL
Project Seismic Risks

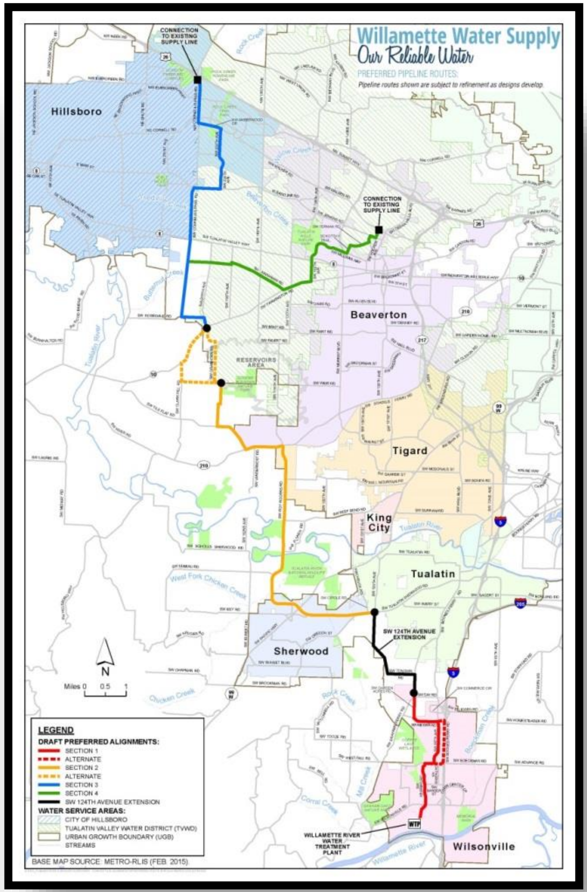
- Permanent ground deformation
  - Slope stability
  - Liquefaction
  - Lateral spreading



PROCESS SUMMARY







Promoted → Short-listed → Preferred

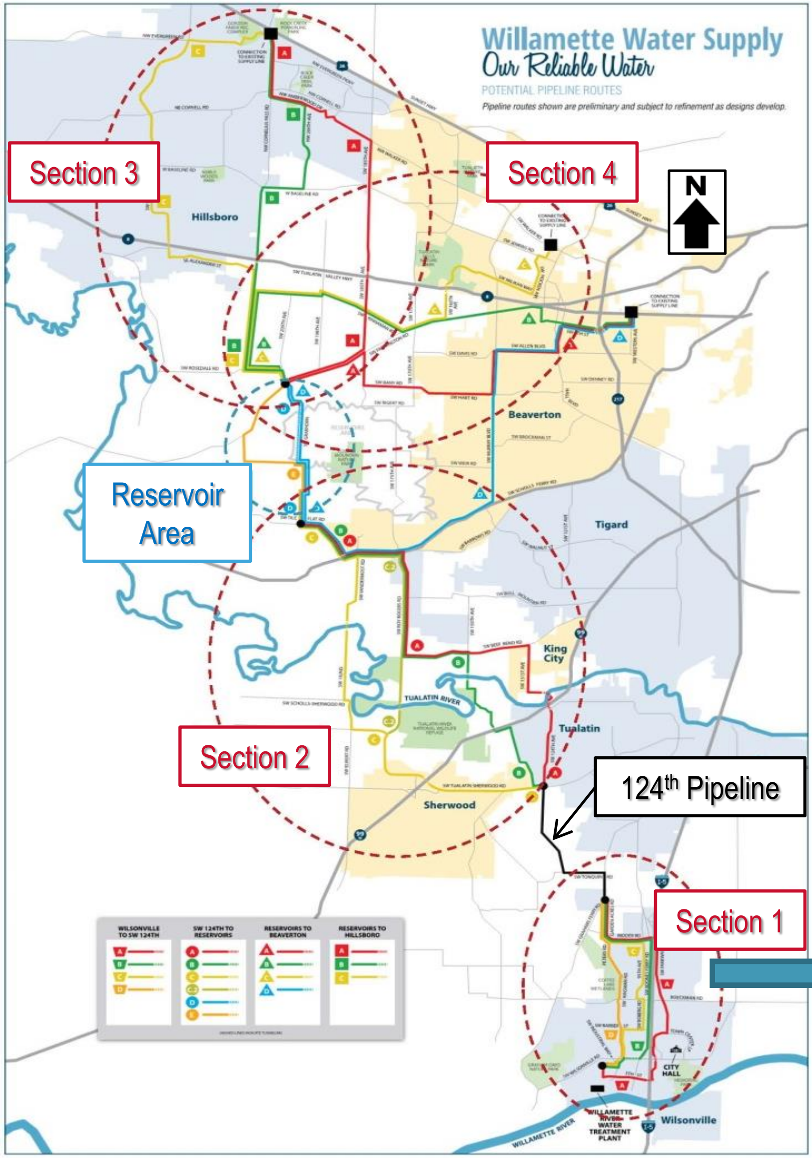
CROSSINGS-PROJECT EXAMPLES

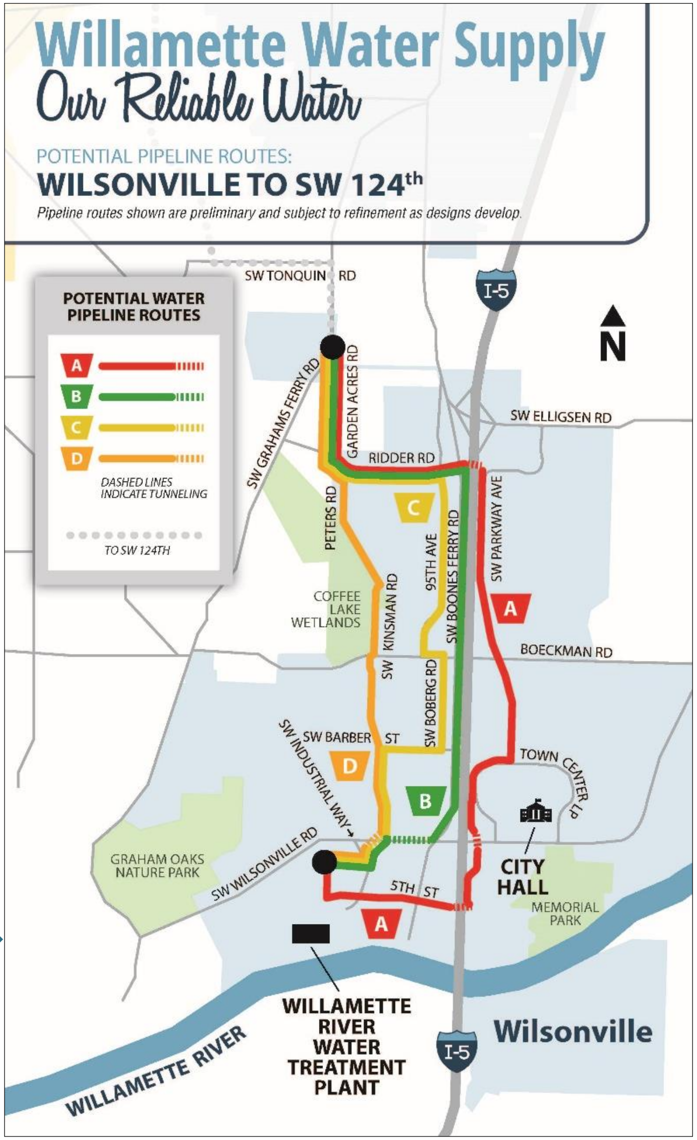
Avoidance

Alternative

Mitigation

TRENCHLESS CROSSING AVOIDED-ROUTE AVOIDED



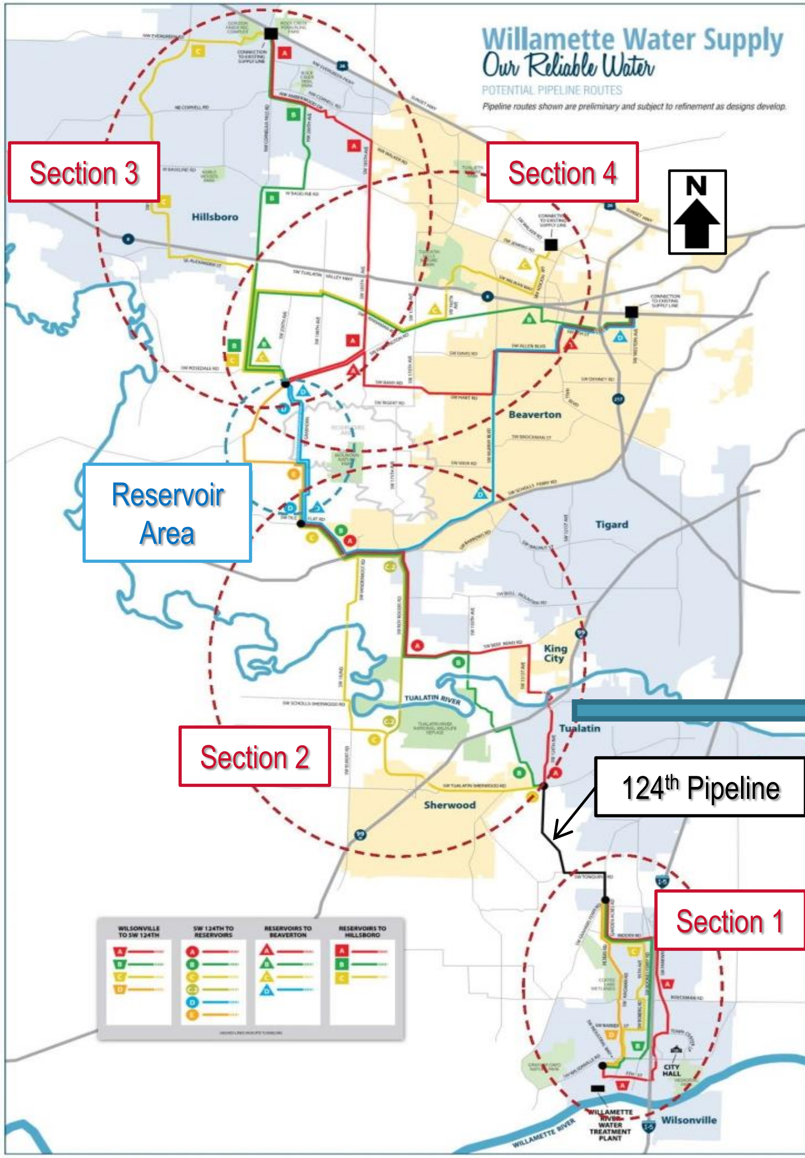


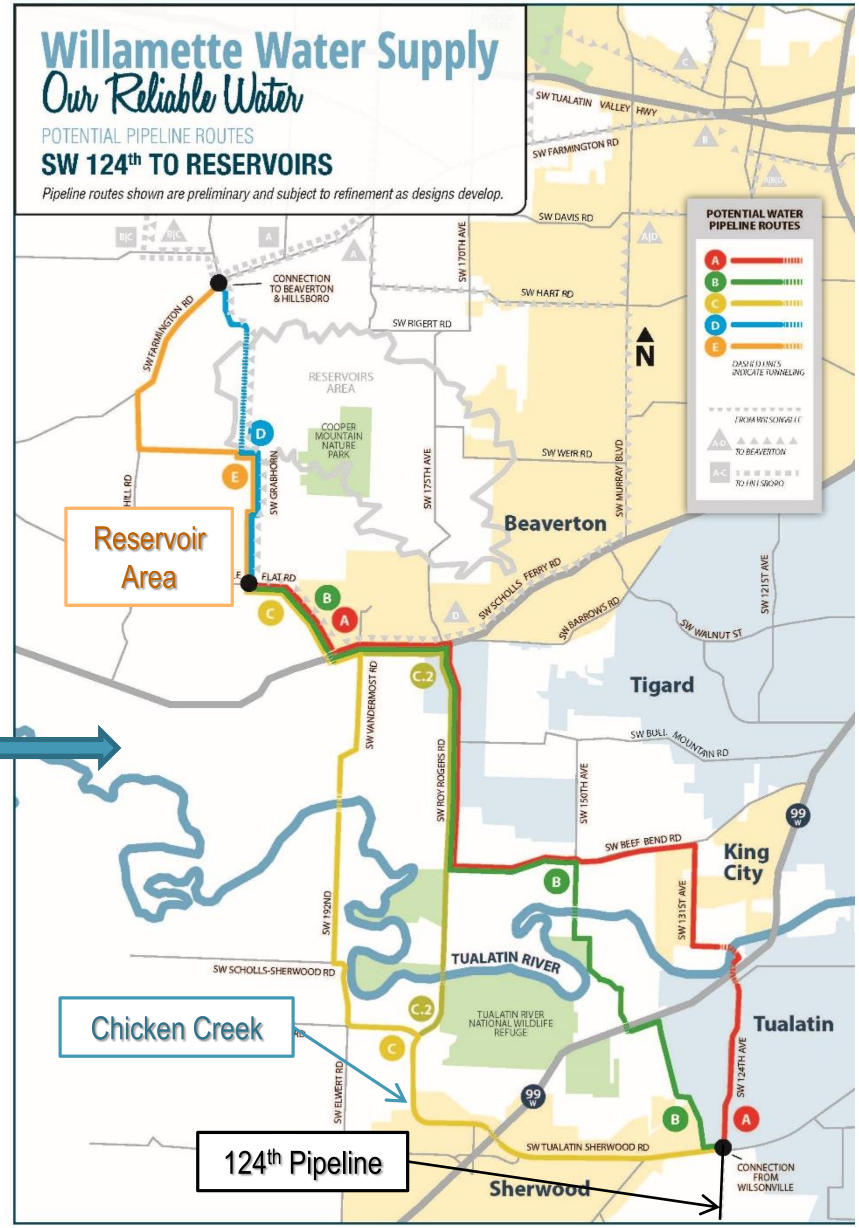
TRENCHLESS CROSSING AVOIDED-ROUTE AVOIDED

Kolk Ponds

- ~14,000-year-old geologic features
- Missoula flood-era
- Bedrock depression scoured by flood vortex
- Trenchless pipe installation impact to subsurface hydrology
- Oregon Department of Fish and Wildlife

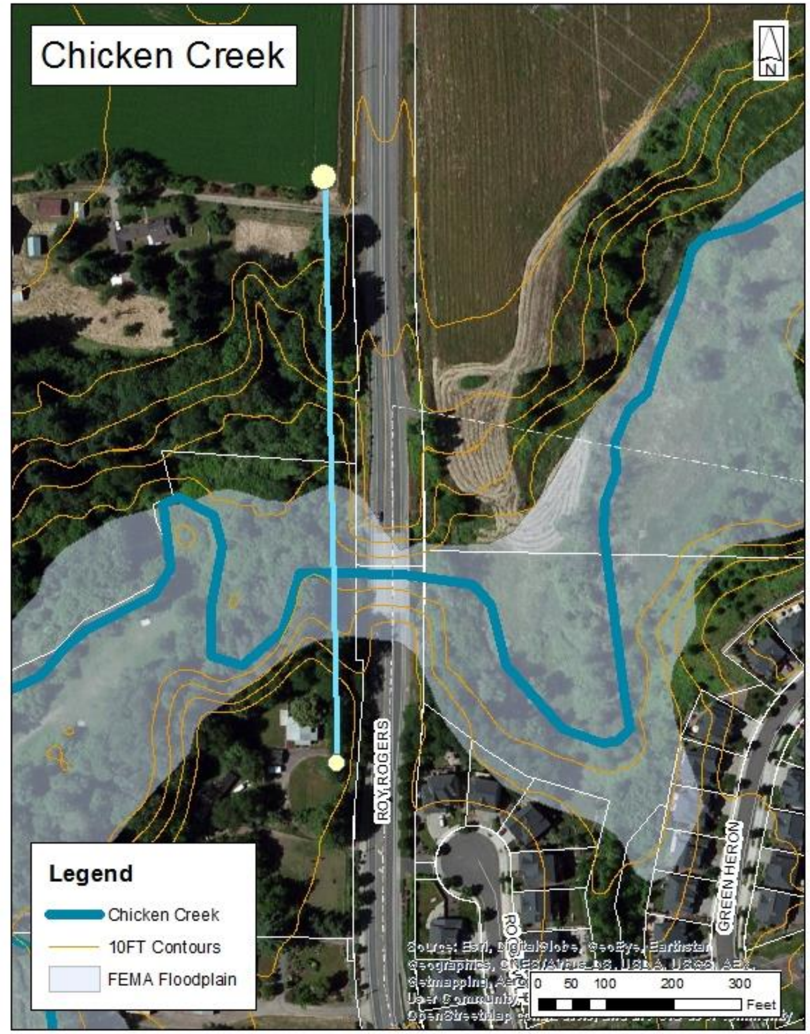
ALTERNATIVE TO TRENCHLESS CROSSING
Chicken Creek





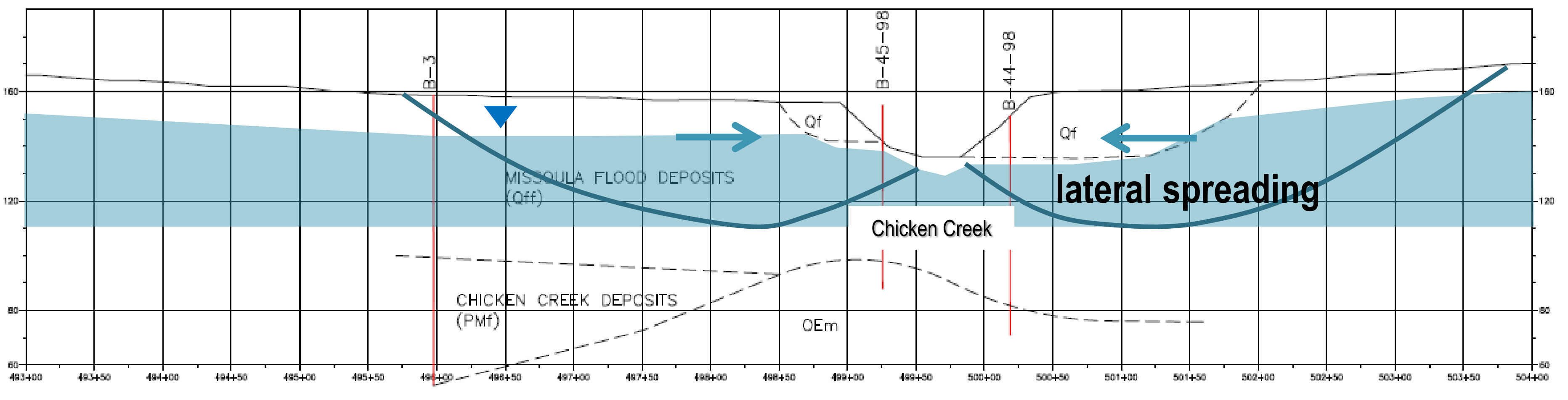
TRENCHLESS CROSSING
Chicken Creek

- Initial Concept = Microtunnel
  - 950 feet
- Launch Shaft
  - 30-ft ID
  - Located north
- Receiving Shaft
  - 20-ft ID
  - Located south
- Limited space for shafts/staging/ topography just the beginning of crossing challenges



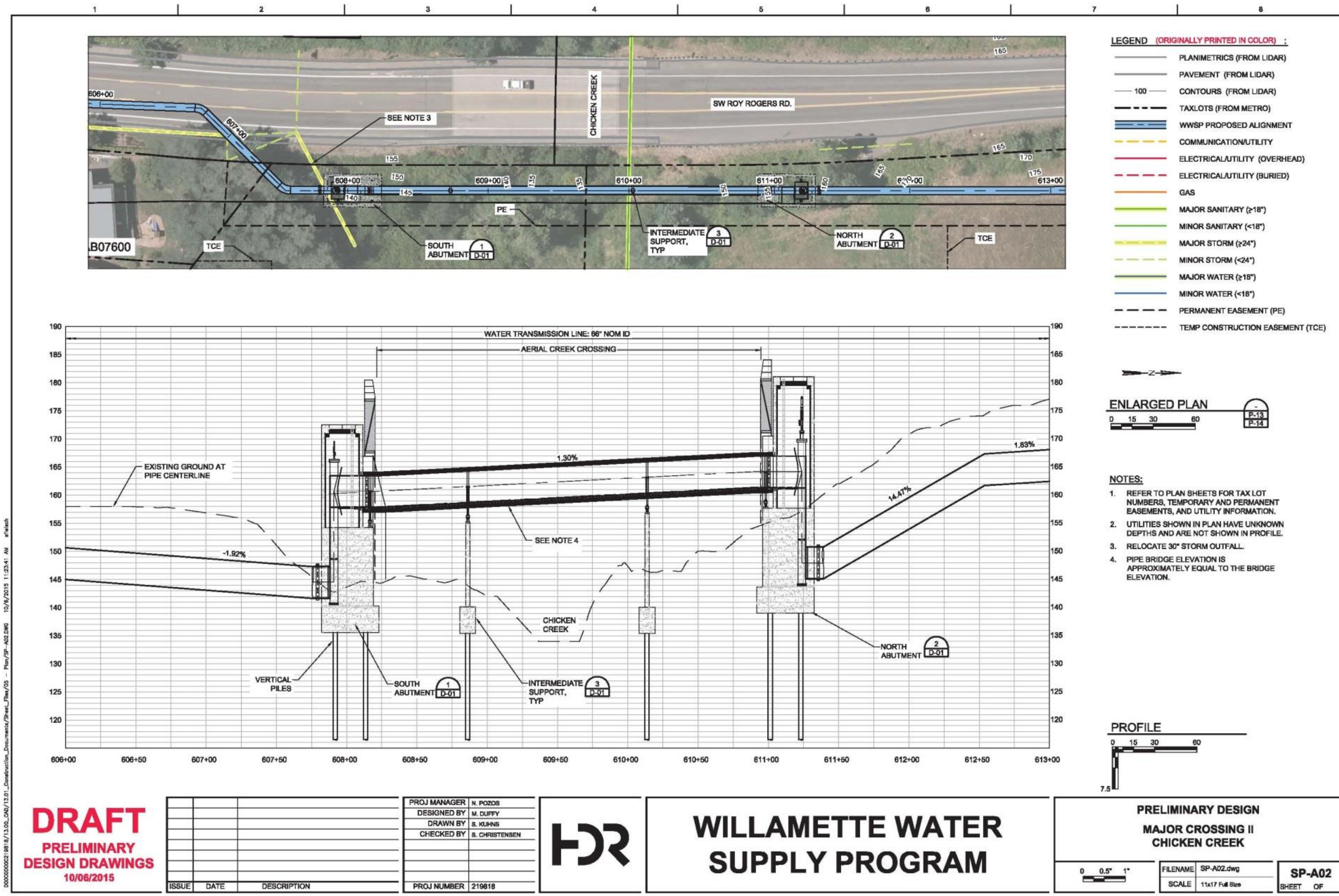
TRENCHLESS CROSSING CHALLENGES
Chicken Creek

- Min. 3D (~20 ft⁺) below bottom of creek
- Shallow groundwater
- Very soft soils south of the creek – zero blow material to 75 ft below roadway
  - Increases risk of shaft and machine settlement
  - Estimated settlement of 10 inches
- Mixed face conditions
- Siltstone bedrock
- Lateral spreading-shaft require a setback of 350 ft from the banks

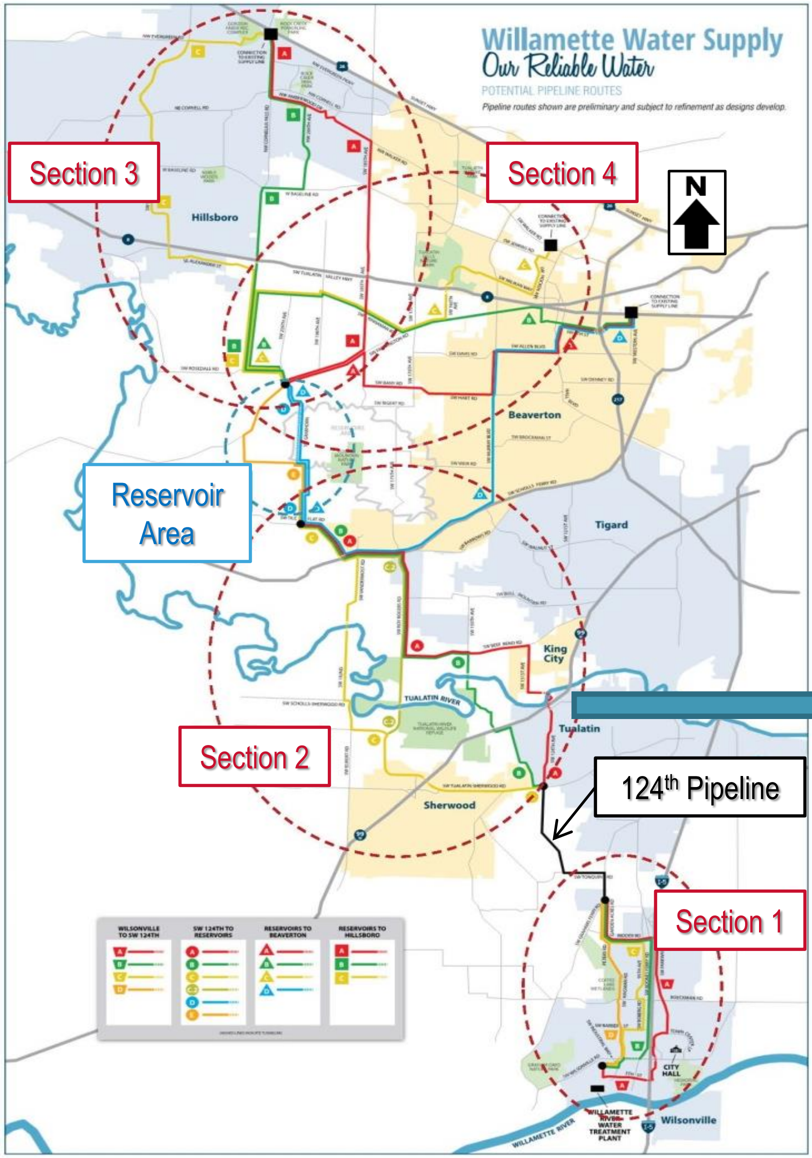


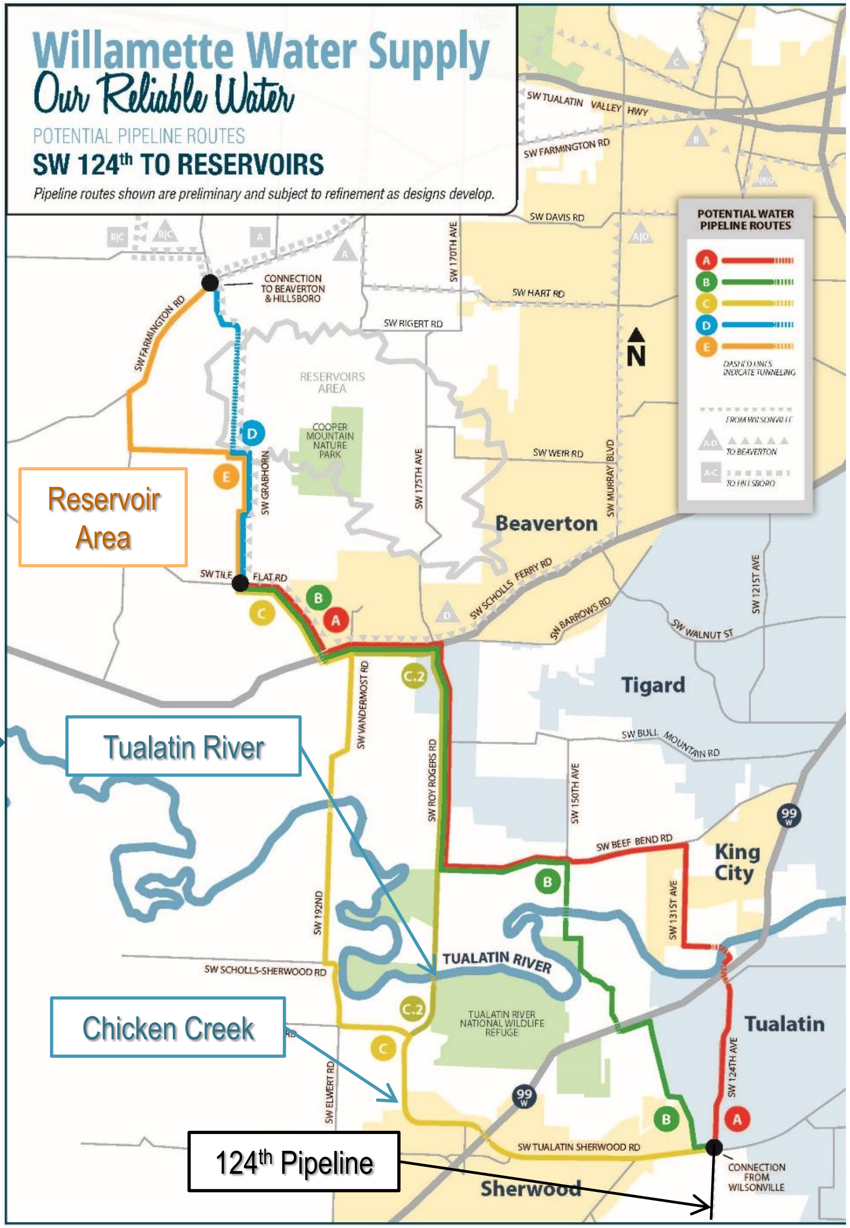
ALTERNATIVE CROSSING ACCEPTED

Chicken Creek



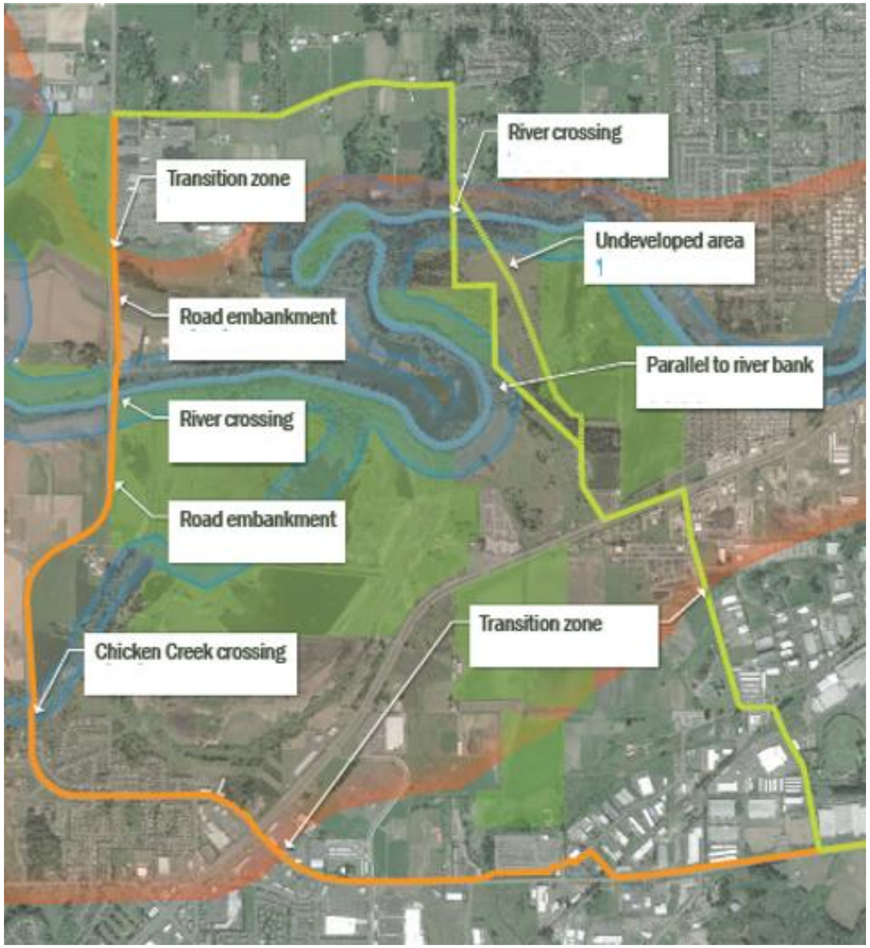
TRENCHLESS CROSSING MITIGATED-ROUTE ACCEPTED
Tualatin River

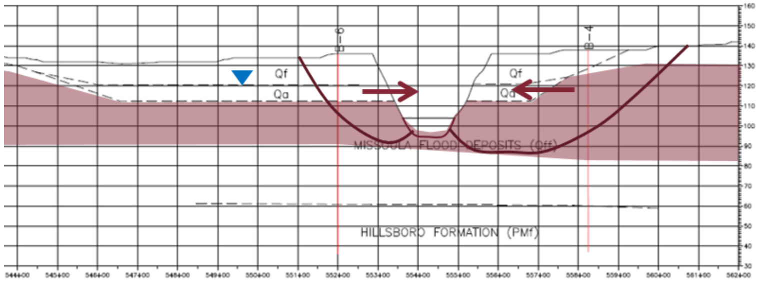


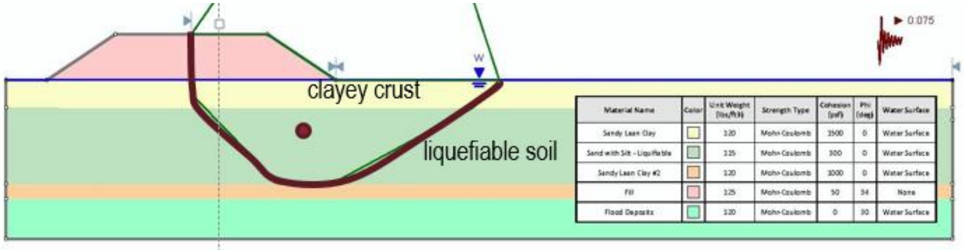


TRENCHLESS CROSSING CHALLENGES
Tualatin River

- Flowing ground
- Liquefaction to down ~ 50 ft
- Lateral spreading zones:
  ~200 ft south bank
  ~600 ft north bank
  (with horizontal movement >3 in)
- Embankment Stability

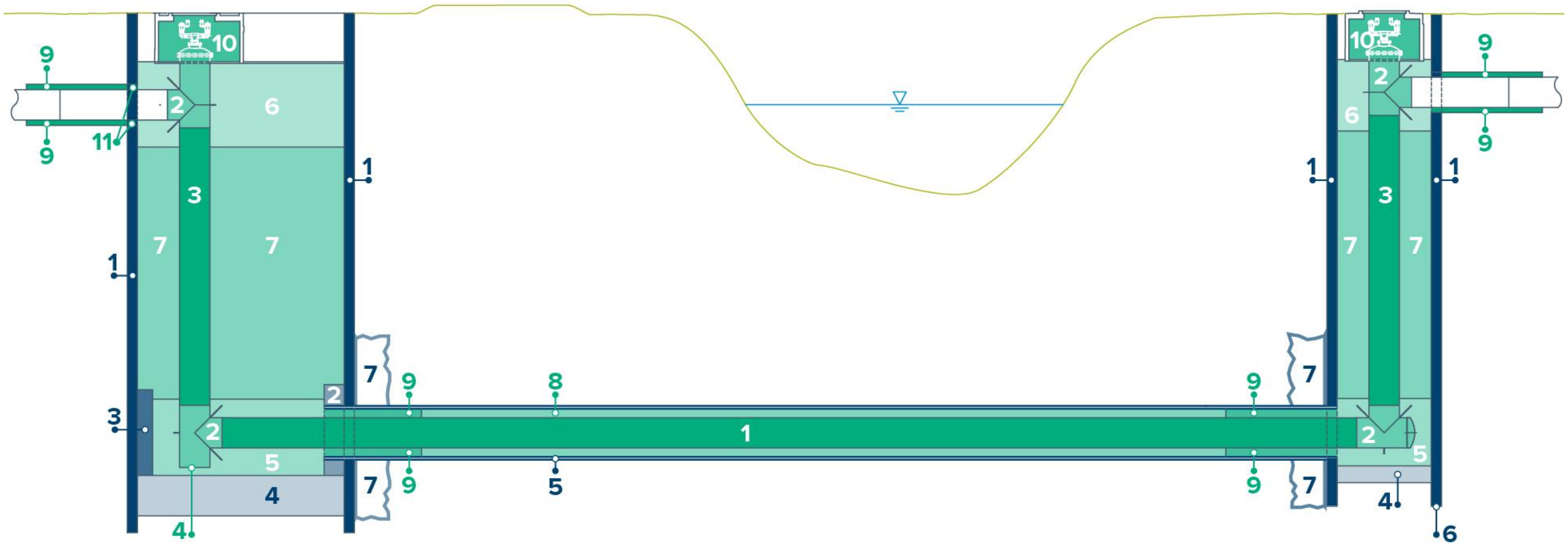






Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface
Sandy Lean Clay		120	Mohr-Coulomb	1500	0	Water Surface
Sand with Silt - Liquifiable		125	Mohr-Coulomb	300	0	Water Surface
Sandy Lean Clay #2		120	Mohr-Coulomb	1000	0	Water Surface
Fill		125	Mohr-Coulomb	50	34	None
Flood Deposits		120	Mohr-Coulomb	0	30	Water Surface

TRENCHLESS CROSSING CONFIGURATION
Tualatin River Profile



Construction Elements	
1	Shoring Wall System
2	Shaft Wall Seal
3	Tunnel Thrust Block
4	Shaft Base Slab/Seal
5	Tunnel Casing
6	Shaft Groundwater Cutoff
7	Ground Improvement

Permanent Elements			
1	Tunnel Pipeline	8	Annular Space Backfill
2	Pipeline Elbow/Tee	9	Concrete Pipe Encasement
3	Pipeline Riser	10	Access/Air Vac Structure
4	Low Point Sump	11	Pipe Wall Penetration
5	Lower Shaft Pipe Encasement		
6	Upper Shaft Pipe Encasement		
7	Shaft Backfill		

TRENCHLESS CROSSING – MITIGATED CONFIGURATION

Tualatin River

Slurry microtunneling with watertight shafts

Launch Shaft:

- 30-ft ID
- located on the north
- 80 ft deep

Receiving Shaft:

- 20-ft ID,
- Located south in wider ROW

Microtunnel Length:

- 500 ft to 2,100 ft

- *Incremental cost increase is potentially lower than open cut in road embankment*

NEXT STEPS

- Move from planning to design!

Design level geotechnical exploration program and seismic hazards analysis for each trenchless segment

→

Identification of specific permanent deformation profiles, constructability issues and develop trenchless configurations

Questions?