Alaskan Way Viaduct
REPLACEMENT
PROGRAM

Western Bridge Engineers' Seminar

Geotechnical Challenges of the S. Holgate to S. King Street Viaduct Replacement Project, Seattle, Washington

Jim Struthers, LEG,
WSDOT Geotechnical Branch

Monique Anderson, PE,
Shannon & Wilson, Inc.

WSDOT

SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

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SUMMARY

- **Project Background**
- **Geotechnical Information**
- **Earthquake Hazards**
- **Bridge Foundations**
  - Shafts vs. Piles
  - Ground Improvement
  - Vibrations
- **Bridge Approaches**

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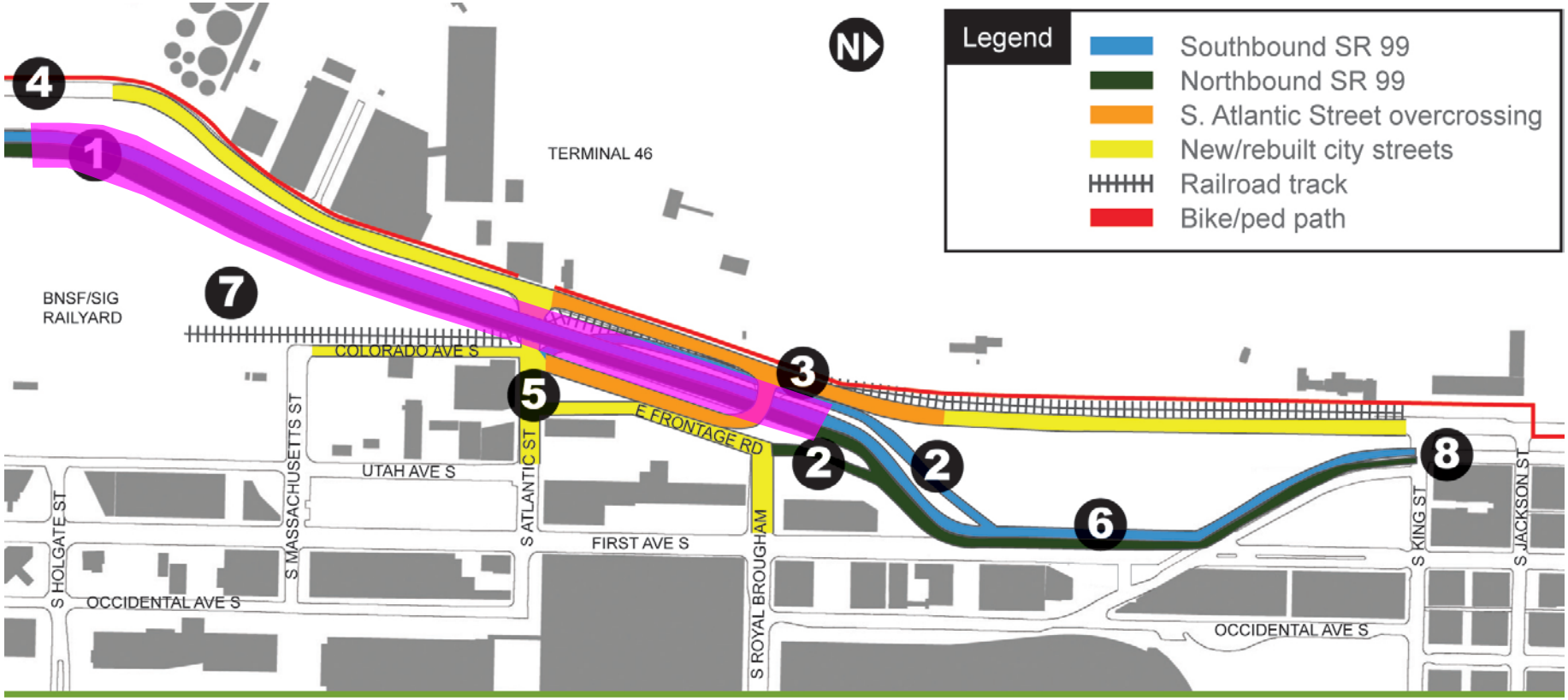
PROJECT BACKGROUND



1. Three lanes on SR 99 in each direction, with wider lanes and shoulders.
2. On- and off-ramp detours near the stadiums.
3. An overcrossing of the railroad tracks at S. Atlantic Street.
4. New bicycle and pedestrian paths.
5. New and rebuilt city streets.
6. SR 99 detour.
7. Relocated railroad track.
8. Connection to existing viaduct at S. King Street.

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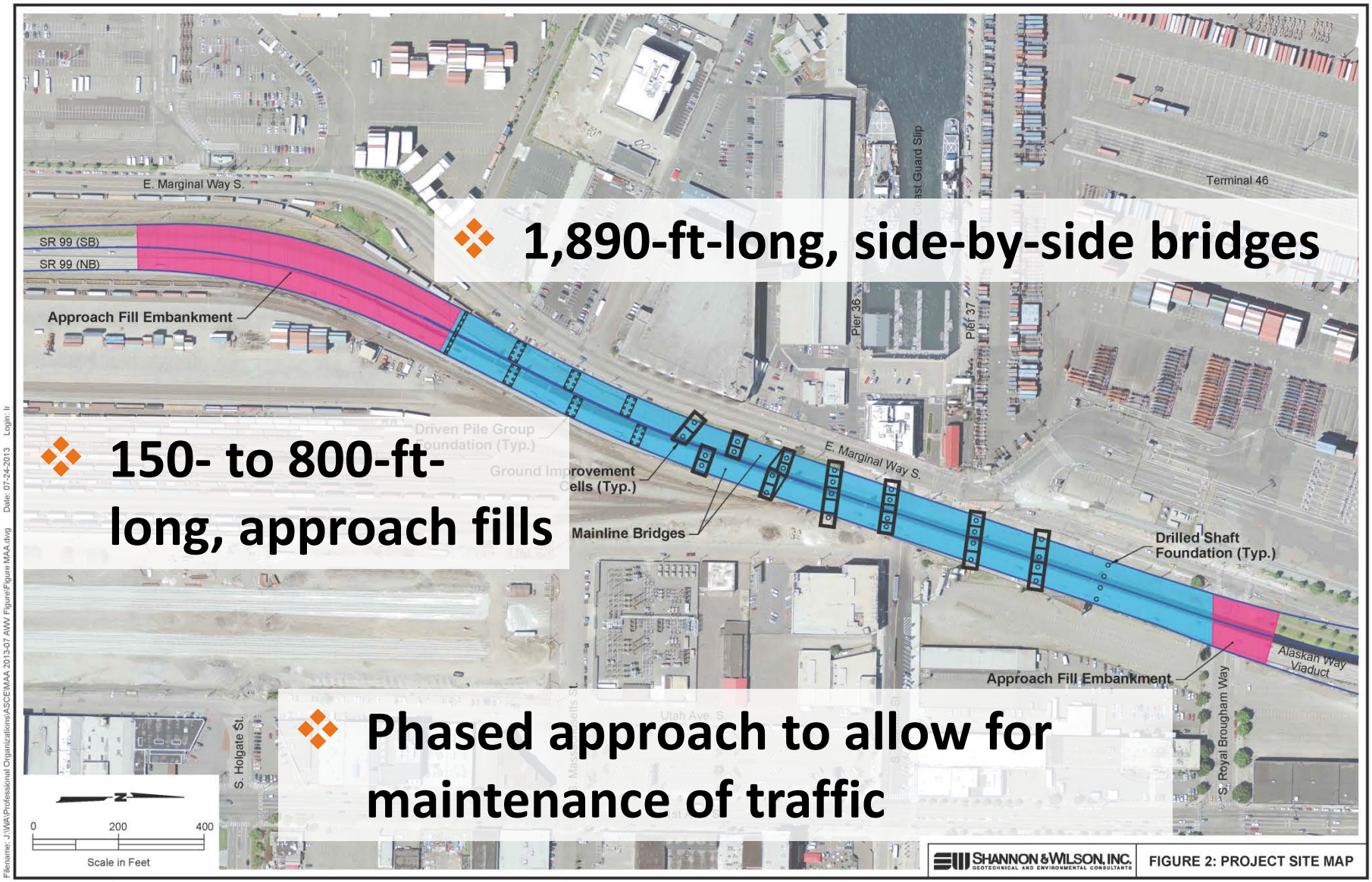

- 1,890-ft-long, side-by-side bridges
- 150- to 800-ft-long, approach fills
- Phased approach to allow for maintenance of traffic

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PROJECT BACKGROUND

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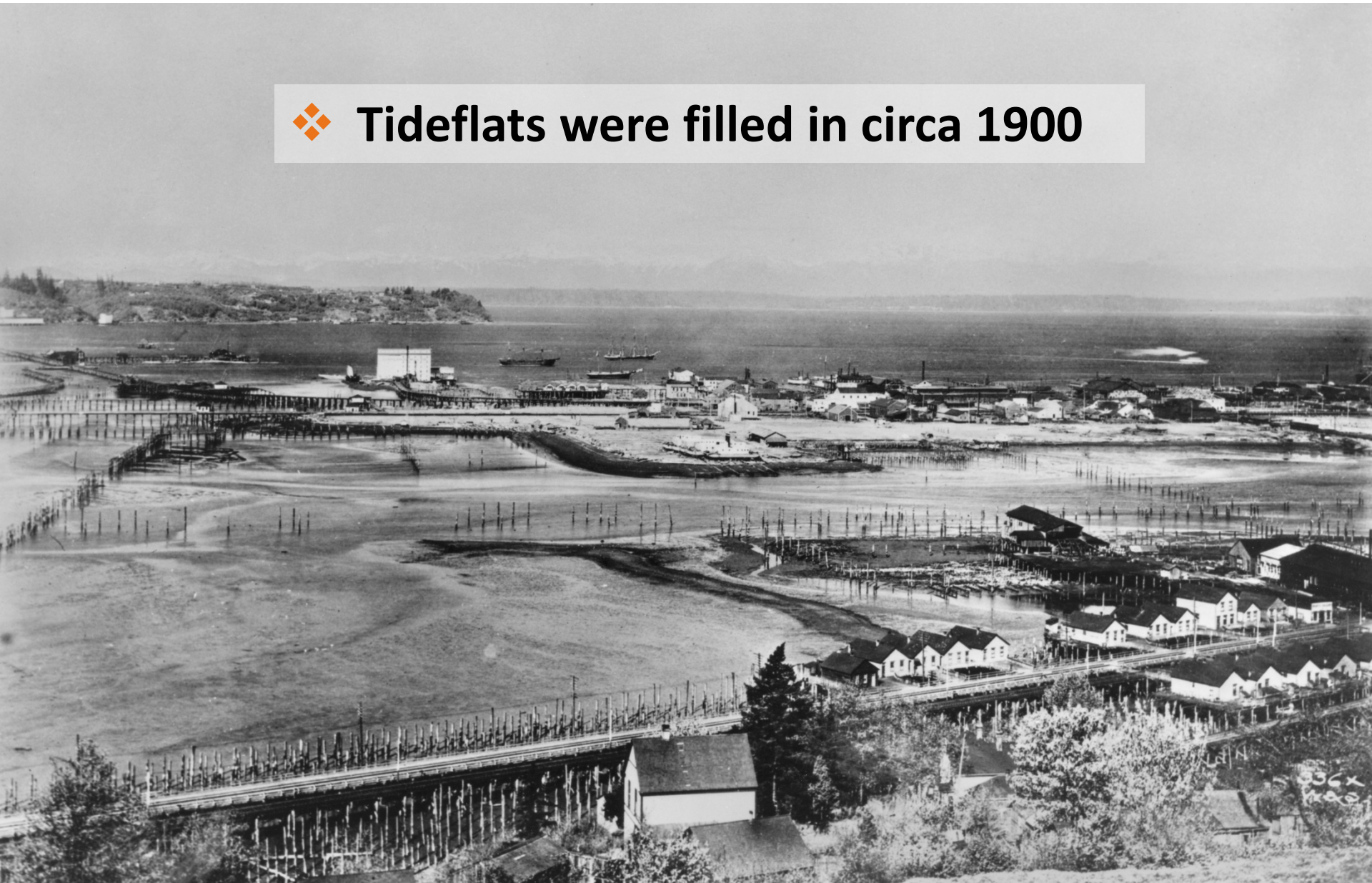
GEOTECHNICAL INFORMATION

- Tideflats were filled in circa 1900



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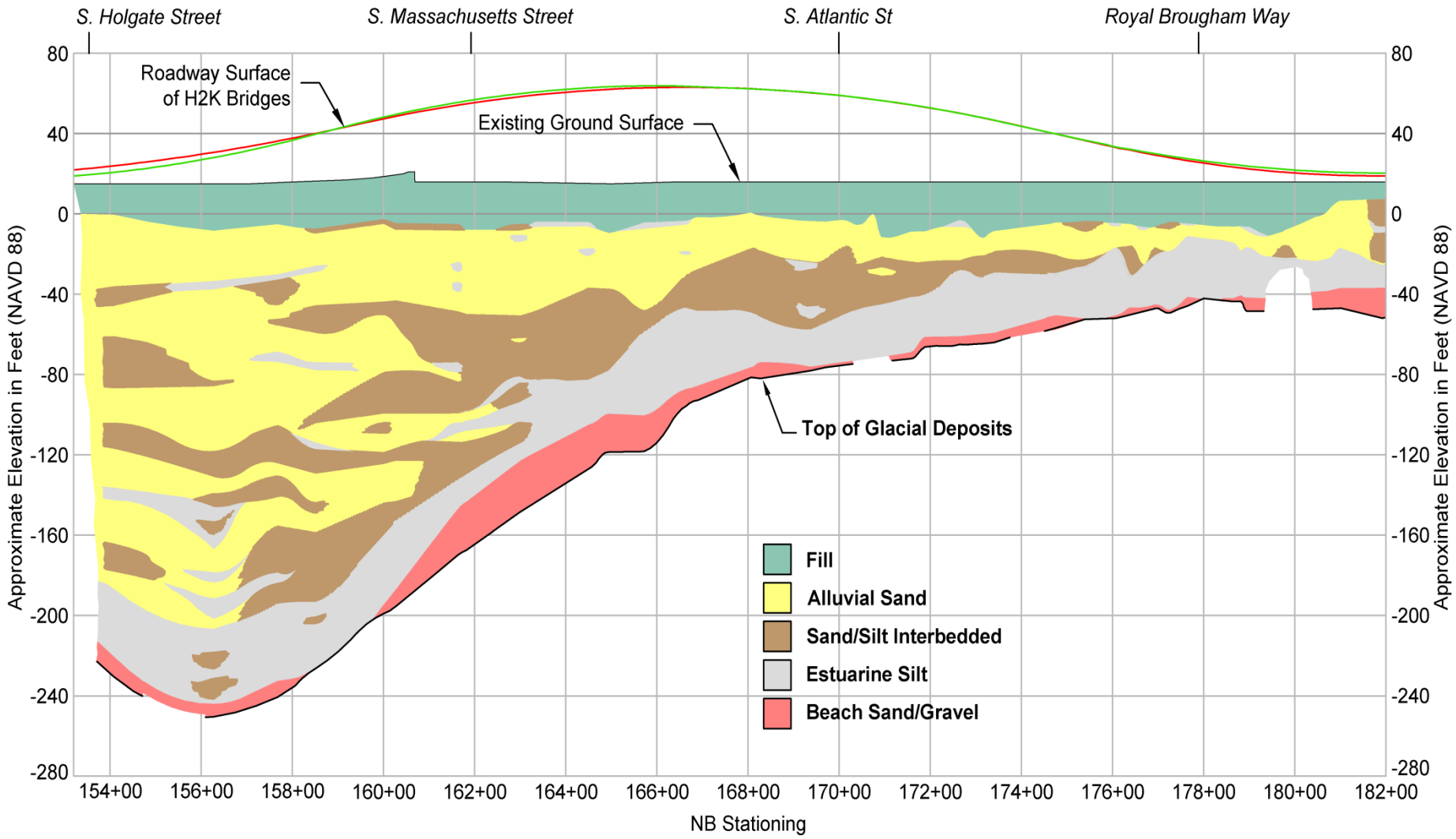
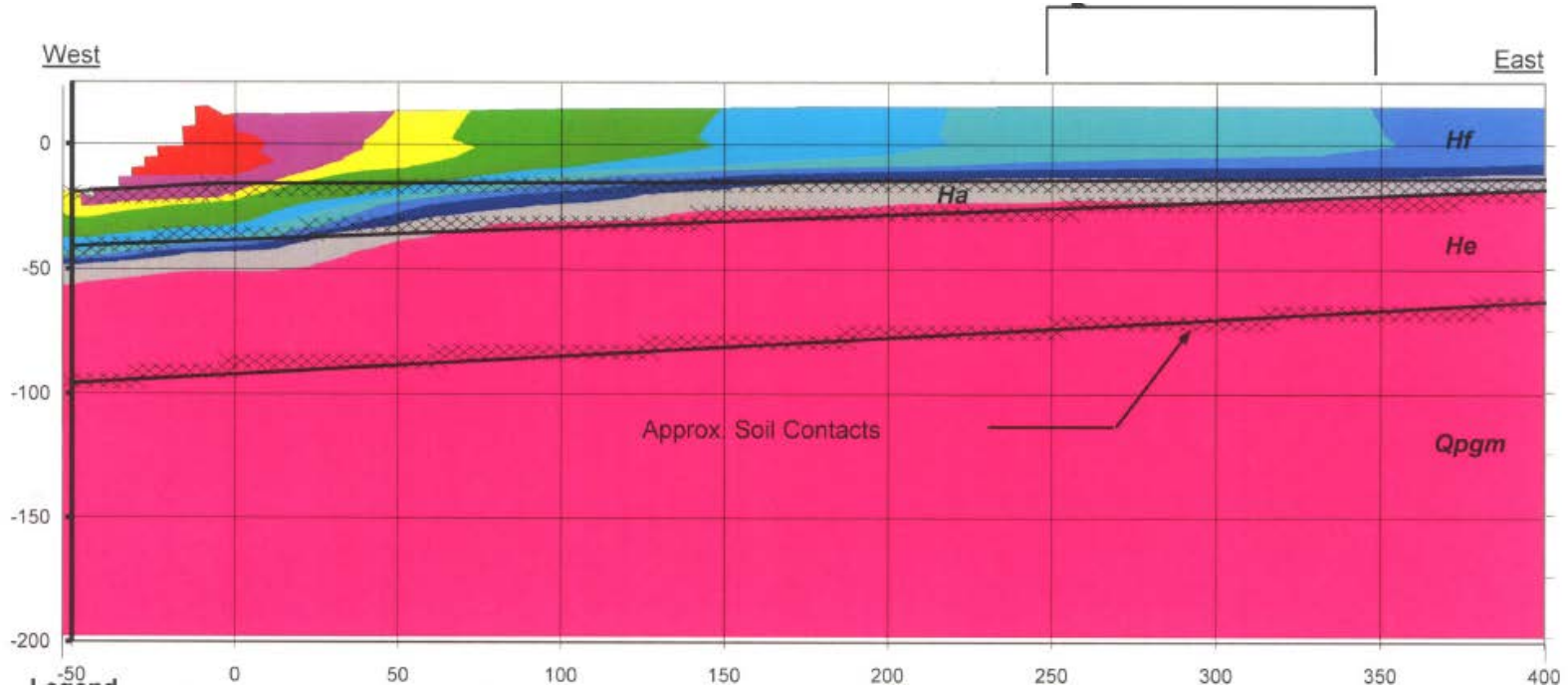
GEOTECHNICAL INFORMATION



EARTHQUAKE HAZARDS

1,000-year Design Earthquake (AASHTO)

- Liquefaction of Sand/Silt Alluvial Soils
- Strength Loss of Estuarine Soils
- Lateral Spreading toward Elliott Bay



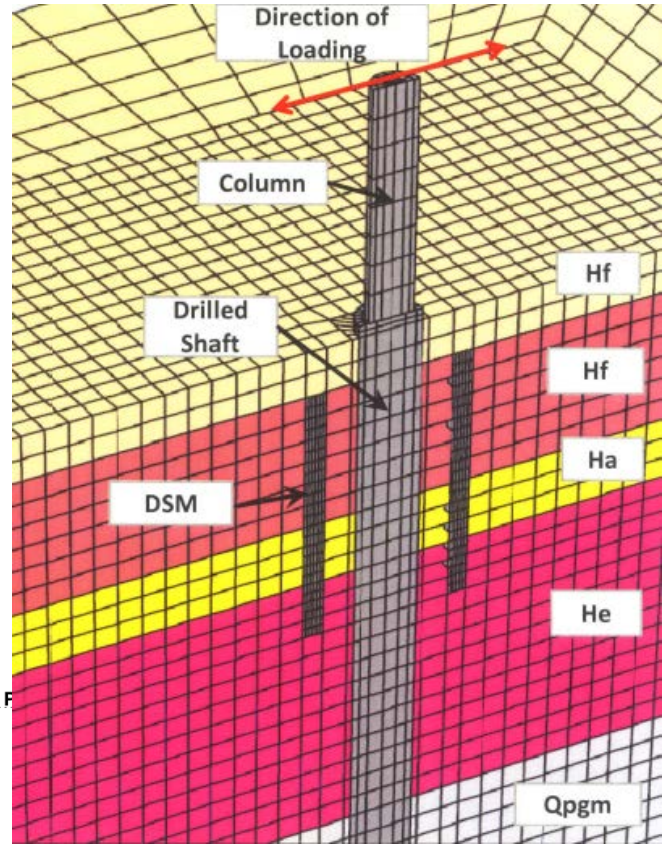
BRIDGE FOUNDATIONS

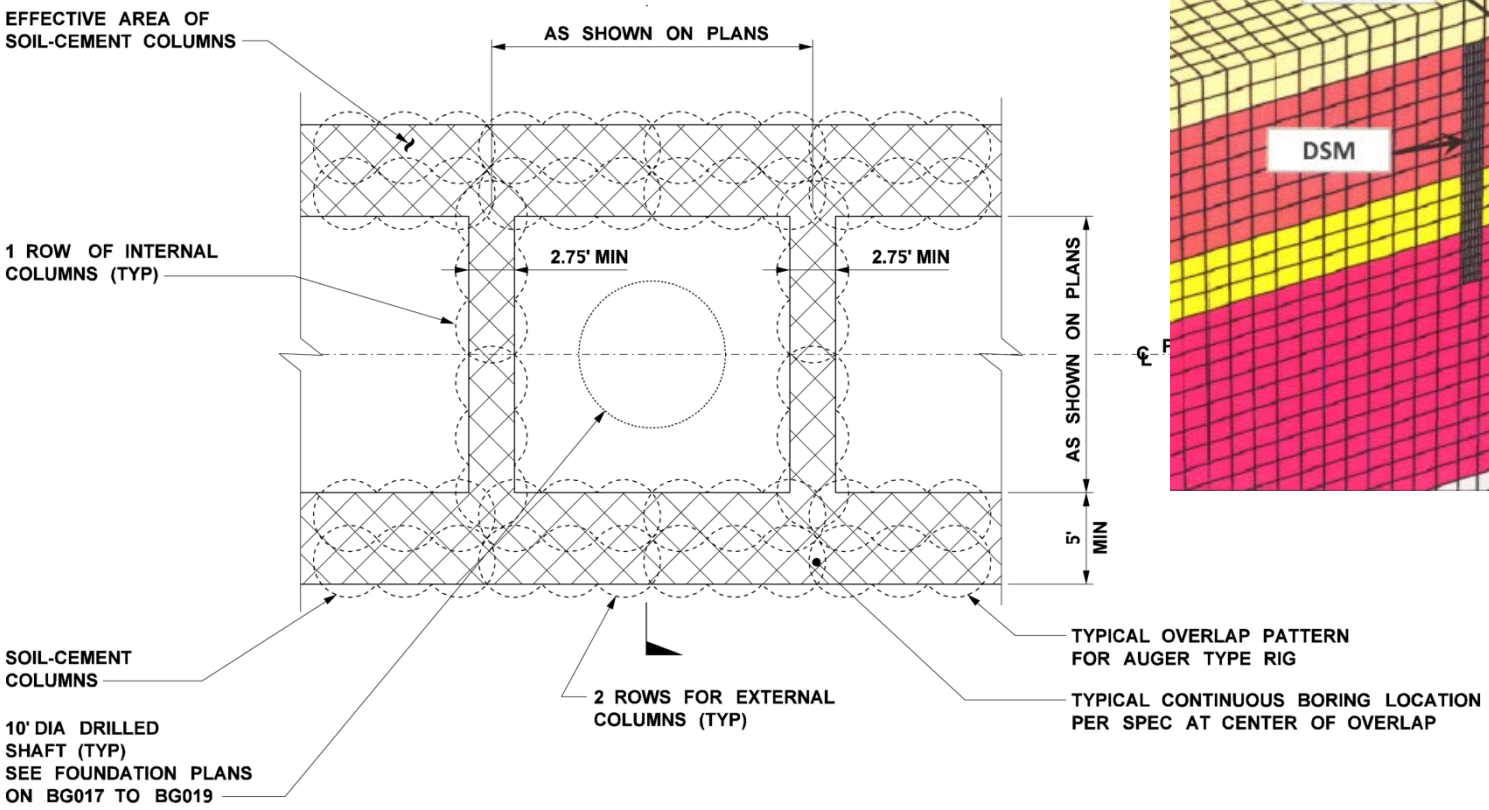
- **Foundation Type**
  - Glacial soil < 150’ deep: 10’-dia. Drilled Shafts
  - Glacial soil > 150’ deep: 5’-dia. Pipe Piles
- **Seismic Concerns**
  - Downdrag
  - Lateral Forces
- **Ground Improvement**
- **Pile Driving Concerns**
  - Penetration
  - Vibration

BRIDGE FOUNDATIONS

GROUND IMPROVEMENT

- Shield foundations from lateral spreading loads

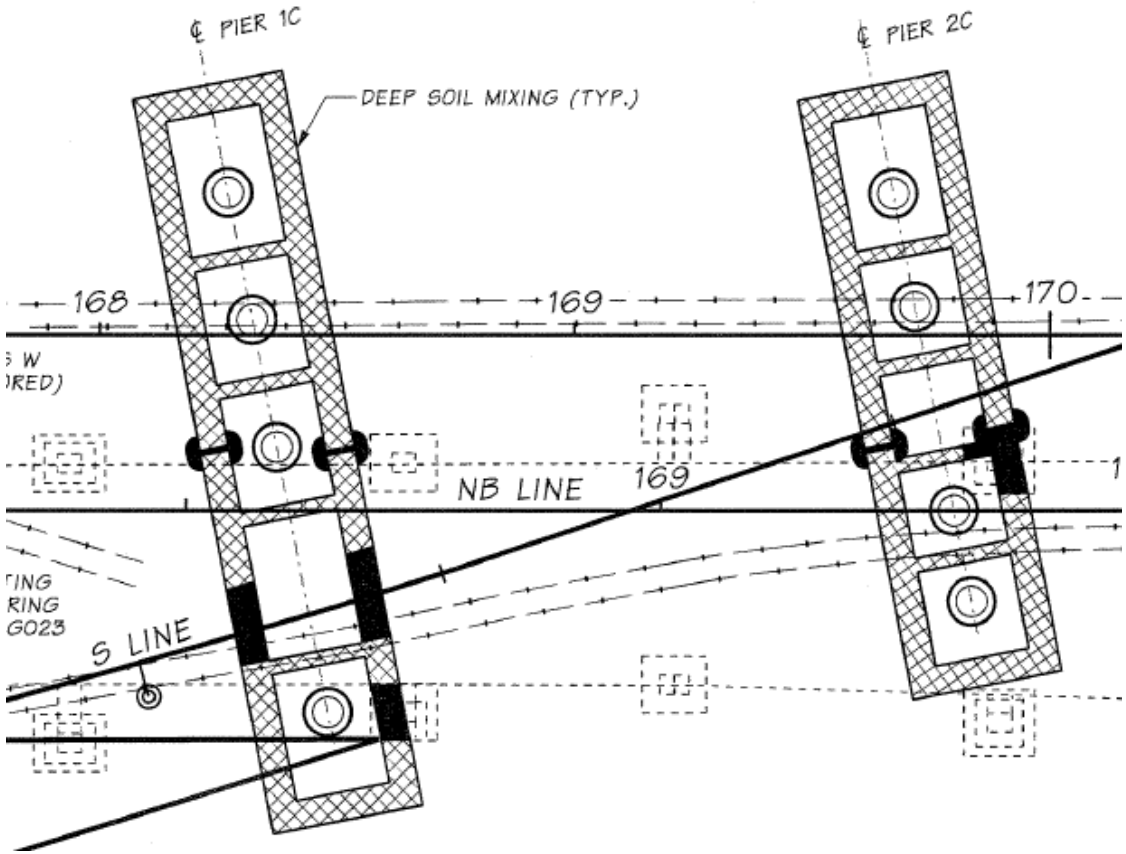




BRIDGE FOUNDATIONS

DEEP SOIL MIXING

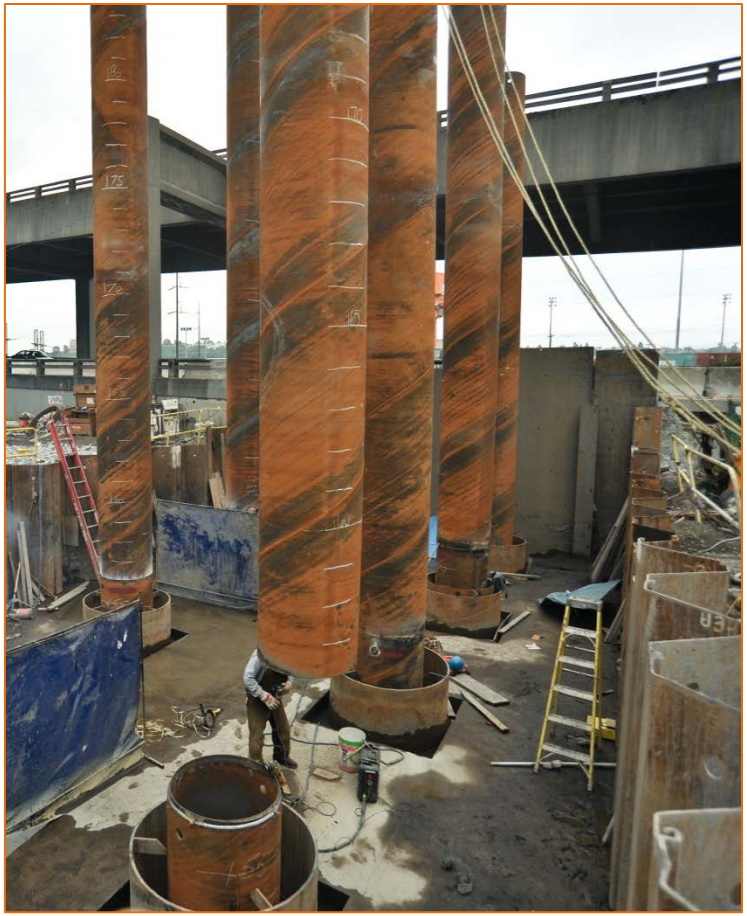
- Phased approach



BRIDGE FOUNDATIONS

OPEN-END PIPE PILES

- **Southbound (Phase 1)**
  - Composite Pile
  - 5’ Outer pile to top of glacial
  - 3’ Inner pile, 30’ into glacial
  - Shield vibrations
- **Northbound (Phase 2)**
  - After viaduct demo
  - 5’ pile – no composite
  - Penetrate up to 25’ into glacial



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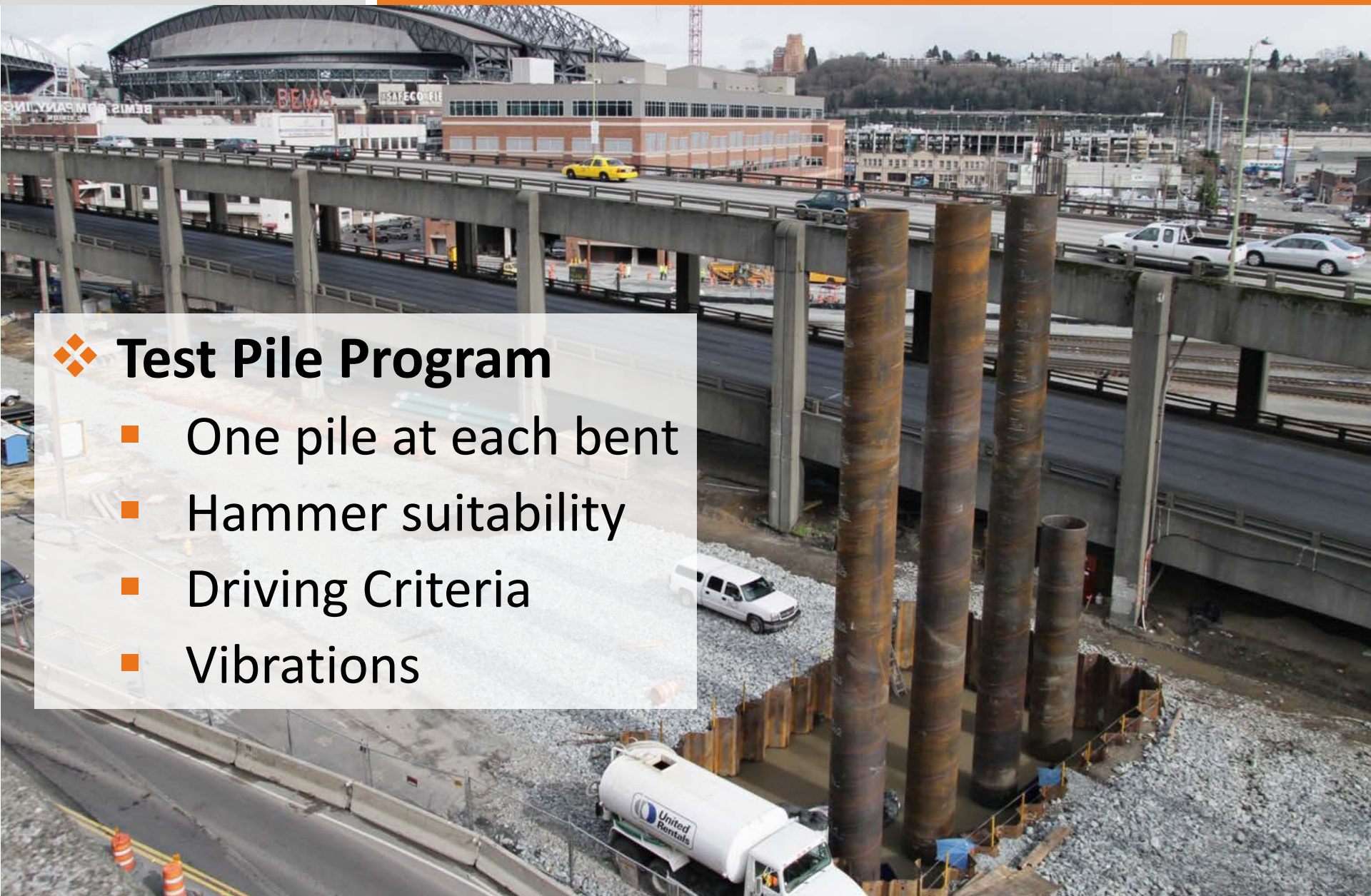
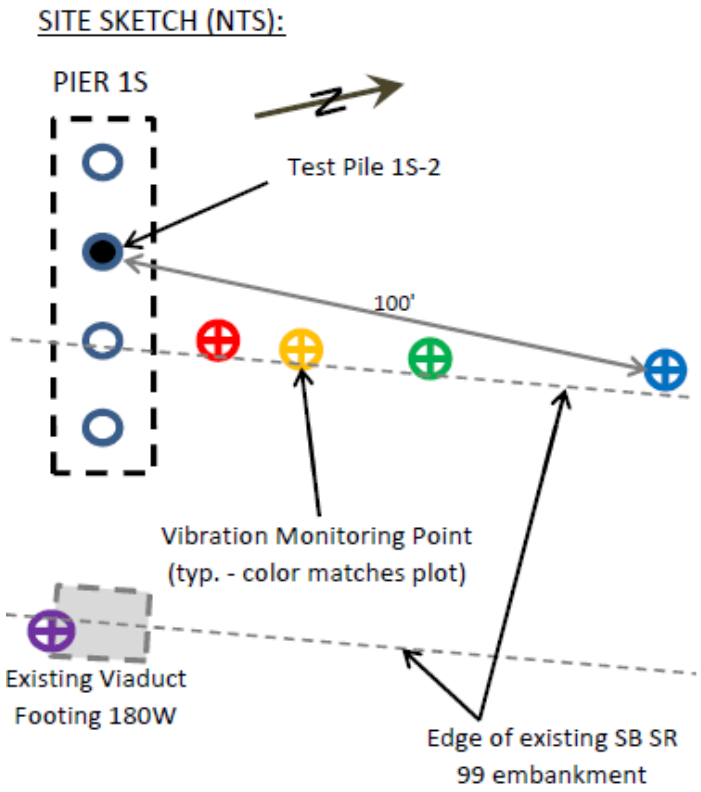


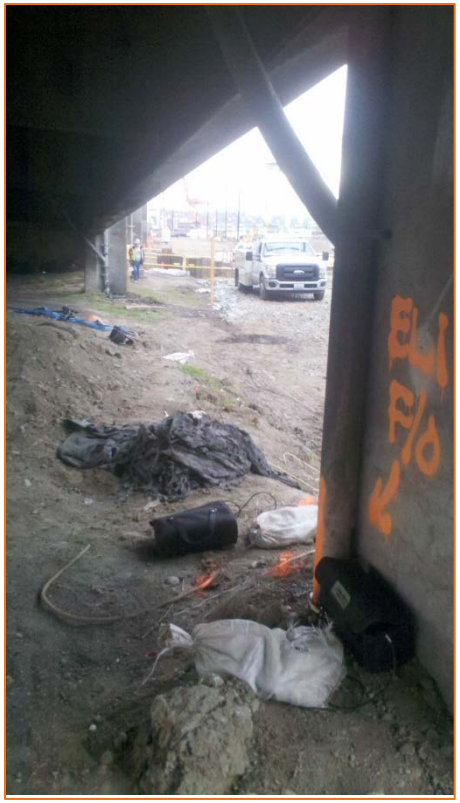
- **Test Pile Program**
  - One pile at each bent
  - Hammer suitability
  - Driving Criteria
  - Vibrations

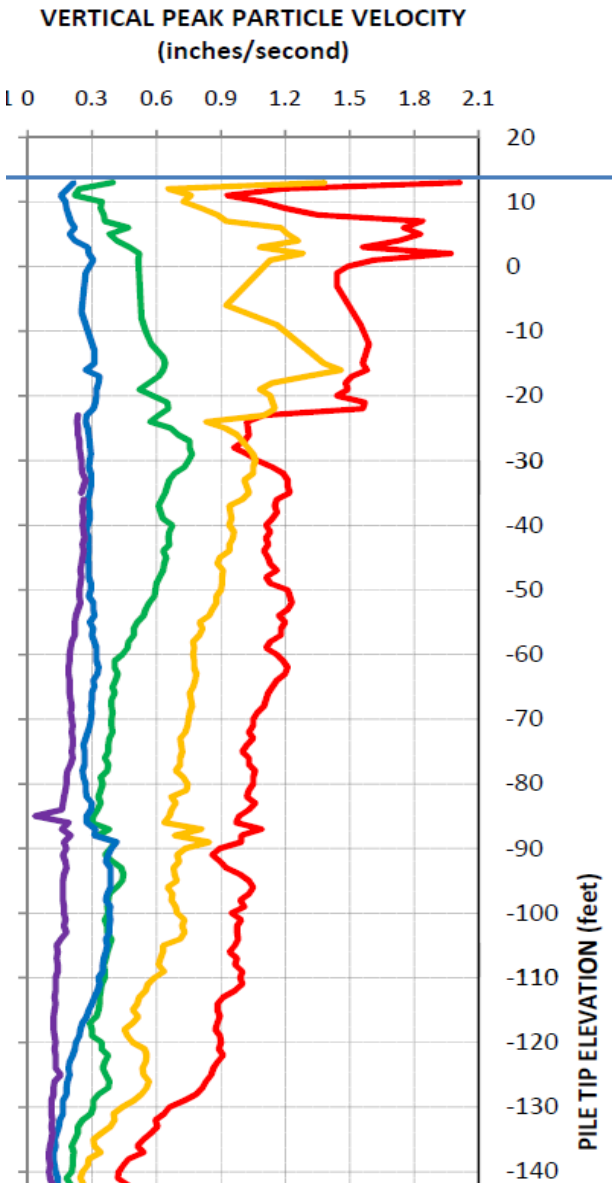
BRIDGE FOUNDATIONS

VIBRATION MONITORING

- 2 ips vibration limit on viaduct



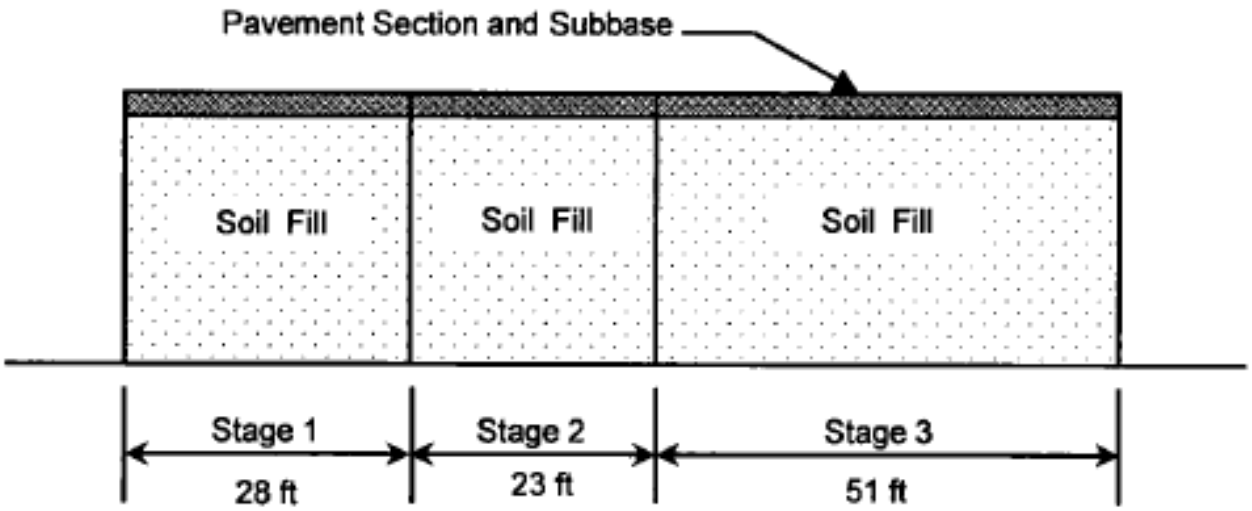




BRIDGE APPROACHES

SOIL FILL APPROACH

- Up to 28’ high
- Stability Issues – Max. stable height of 15’
- Settlement Issues
  - Underlying utilities
  - Phased Construction
  - Schedule

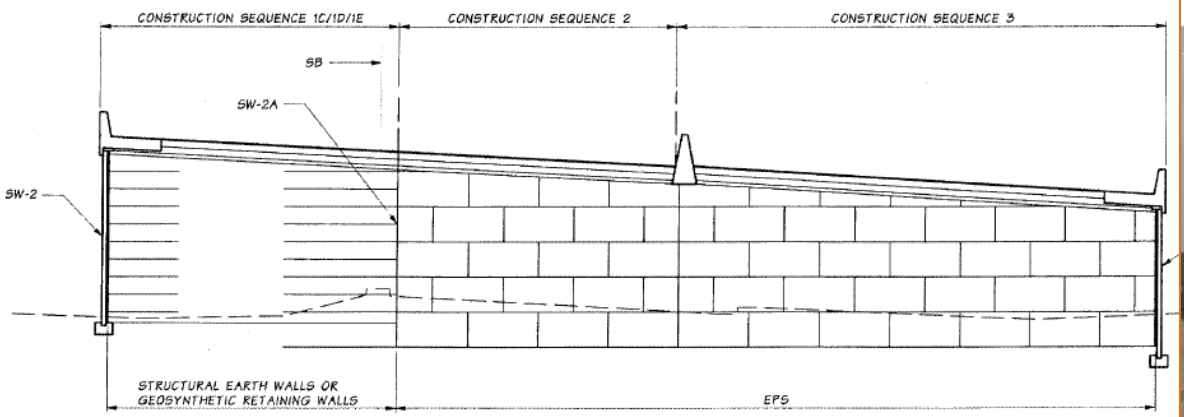


BRIDGE APPROACHES

SELECTION OF LIGHTWEIGHT FILL –

Expanded Polystyrene Geofoam

- No ground improvement
- Solves stability and settlement issues
- Place up to 1,000 cy/day



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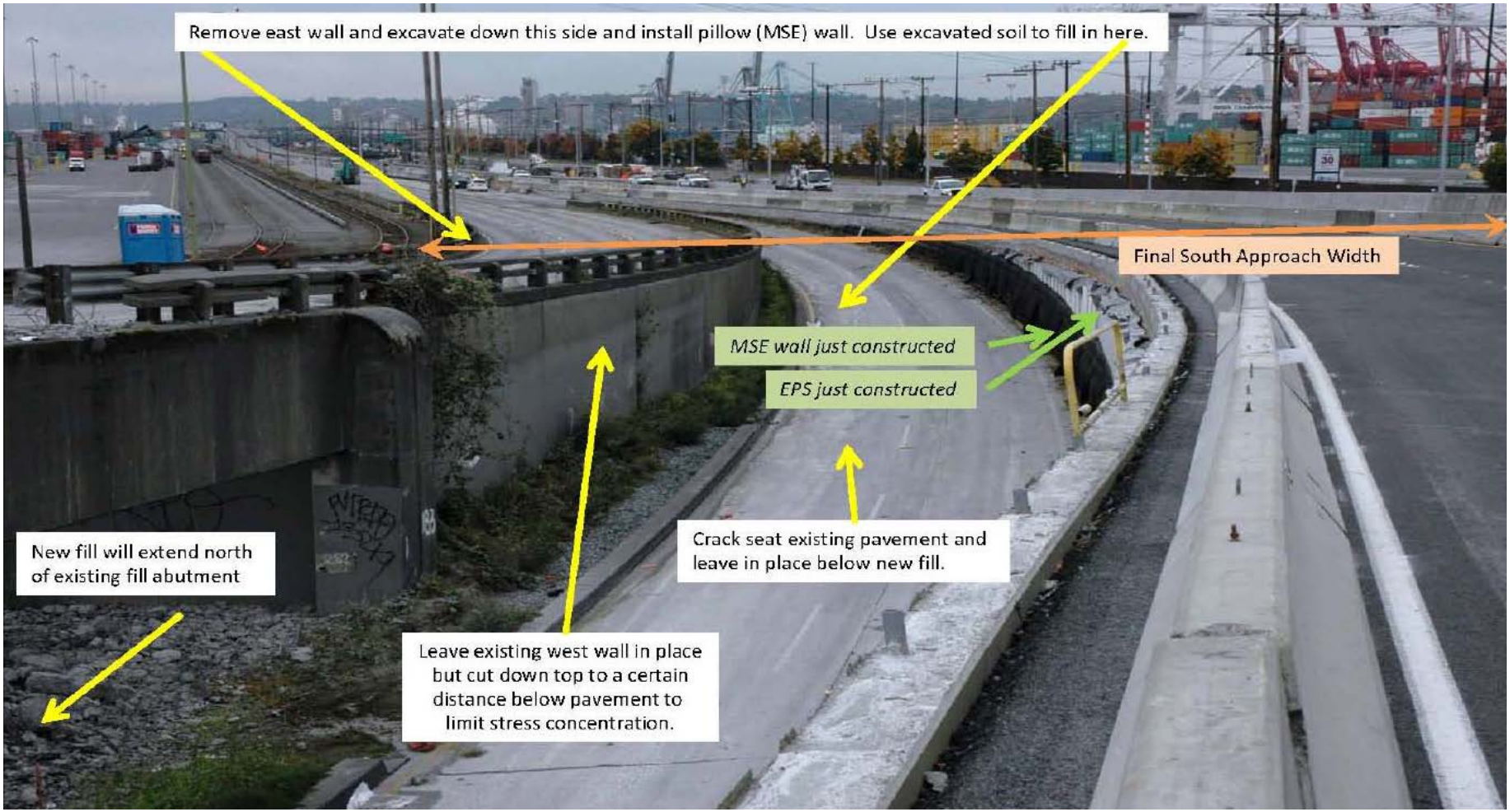
BRIDGE APPROACHES

OTHER SITUATIONS

❖ USE OF EXISTING APPROACH



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QUESTIONS?