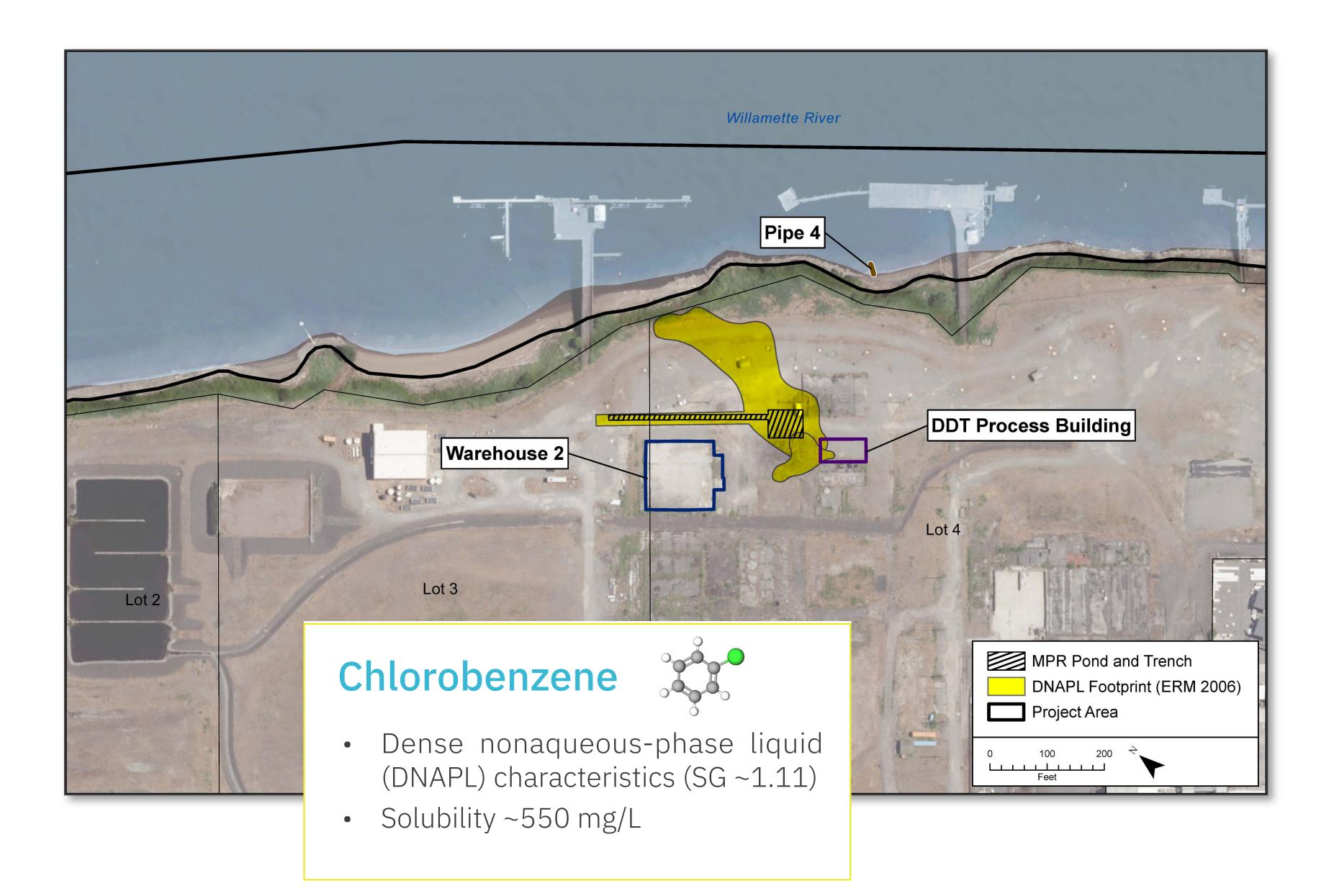
Novel Approaches for Chlorobenzene Plume Delineation at a Nearshore Sediment-Bedrock Interface to Support Conceptual Site Model Development

David Livermore, Eron Dodak, Integral Consulting Inc.; Mike Pinto, RETIA USA LLC

Legacy manufacturing creates modern cleanup challenge

Site History and Background

The site's complex history as a chlor-alkali manufacturing facility created a challenging environmental legacy. Historical DDT manufacturing from 1947–1954 used chlorobenzene as a key process chemical, shaping the distribution of contamination today.



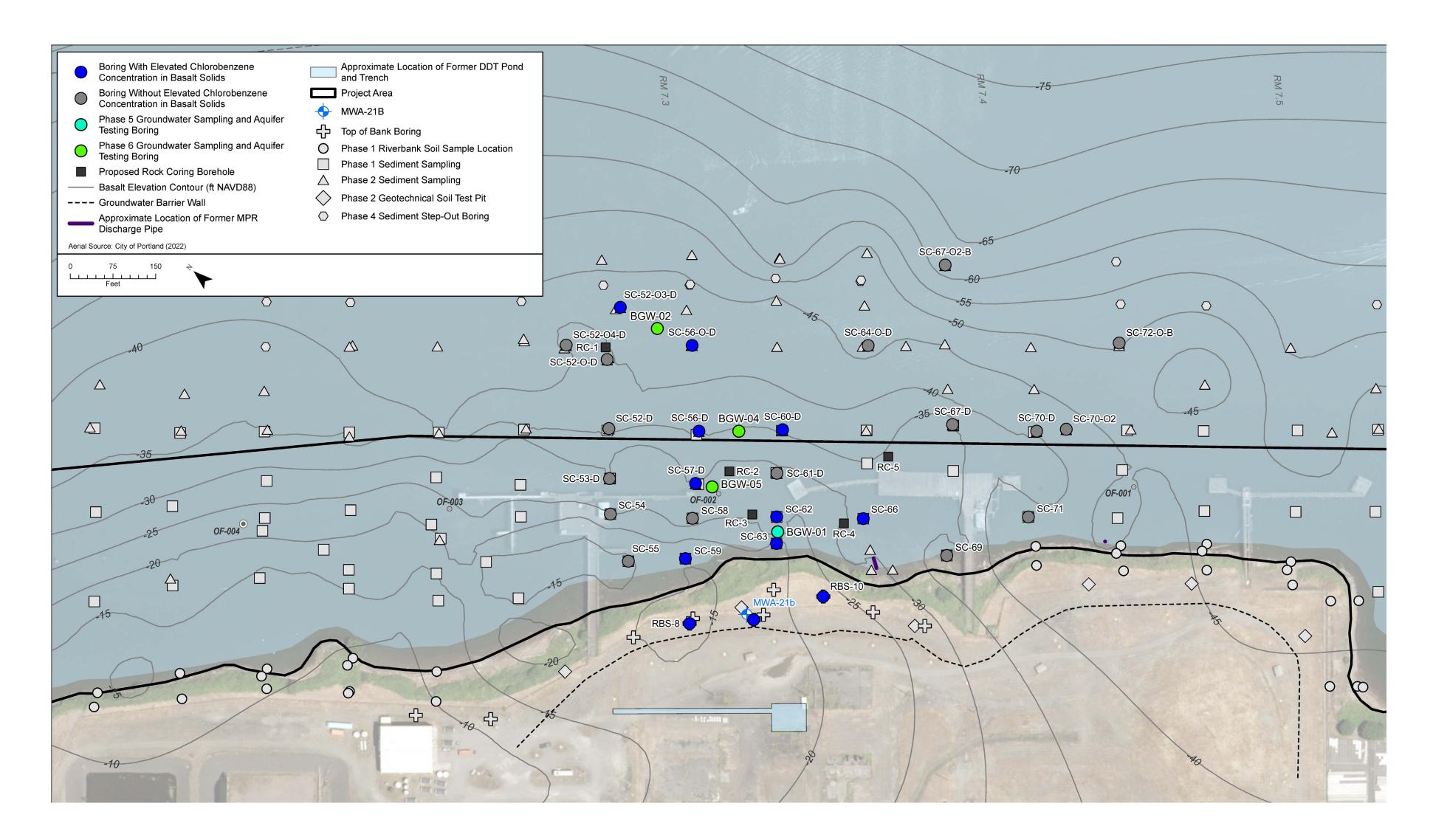
Initial Conceptual Model

Original Assumptions

- Dilute chlorobenzene plume
- Simple groundwater-to-sediment migration
- Limited vertical migration
- Focus on shallow contamination

Additional investigation revealed in some areas, penetration of dissolved-phase chlorobenzene into weathered or fractured bedrock near the sediment-basalt bedrock interface.

River setting forces innovation in investigation methods



The investigation faced multiple intersecting challenges that demanded innovative investigation solutions.

Regulatory Constraints

- No permanent river wells allowed in the river
- Limited investigation window

Operational Challenges

- Overwater drilling and well installation complexity
- 12-hour completion for temporary wells for safety compliance
- No circulation water use during drilling for sample integrity
- Bentonite seal installation challenges





Rapid testing protocol reveals unique migration patterns

Innovative Investigation Methods

The team developed a sophisticated approach combining conventional technologies with innovative implementation strategies.

Monitoring Well Installation and Development

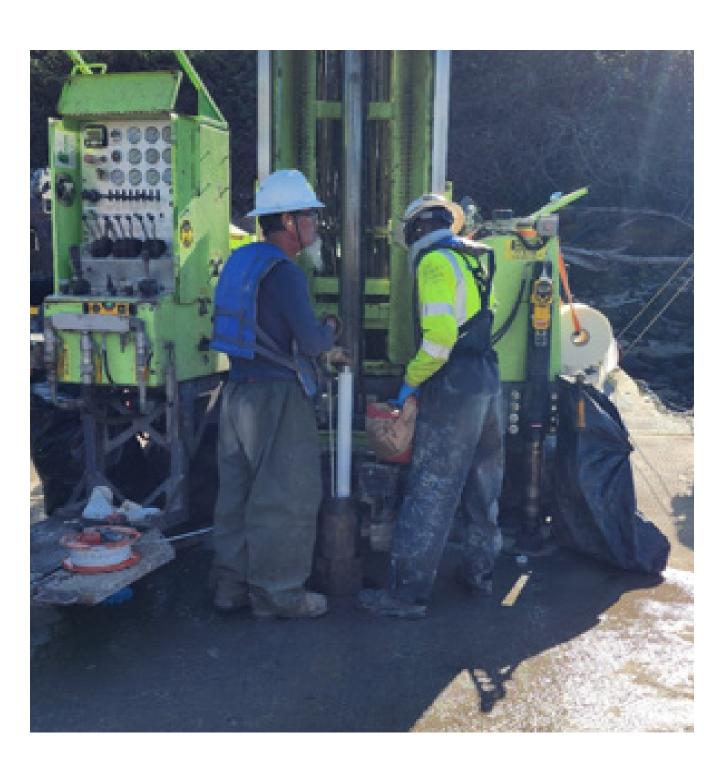
- Barge-mounted sonic drilling
- 2-inch diameter prepacked screens
- Time release TR30 bentonite pellets to seal the well and prevent bridging during placement
- 15-minute mechanical surging
- 45-minute overpumping and mechanical surging
- Continuous parameter monitoring throughout development

Sample Collection

- Low-flow sampling (100–300 mL/minute)
- Field parameter stabilization monitoring

Aquifer Testing

- Multiple slug-in and slug-out tests with 0.25-second data collection
- Analysis using Bouwer and Rice (1976) and Bouwer (1989) methods







Lessons Learned—Rock Coring Recommendation

Use potable water during pilot-boring with a sonic drill rig to reduce pulverized basalt in the core and enable accurate rock core logging. Reoccupy the station to core and install temporary well with the screen interval based on pilot boring results.

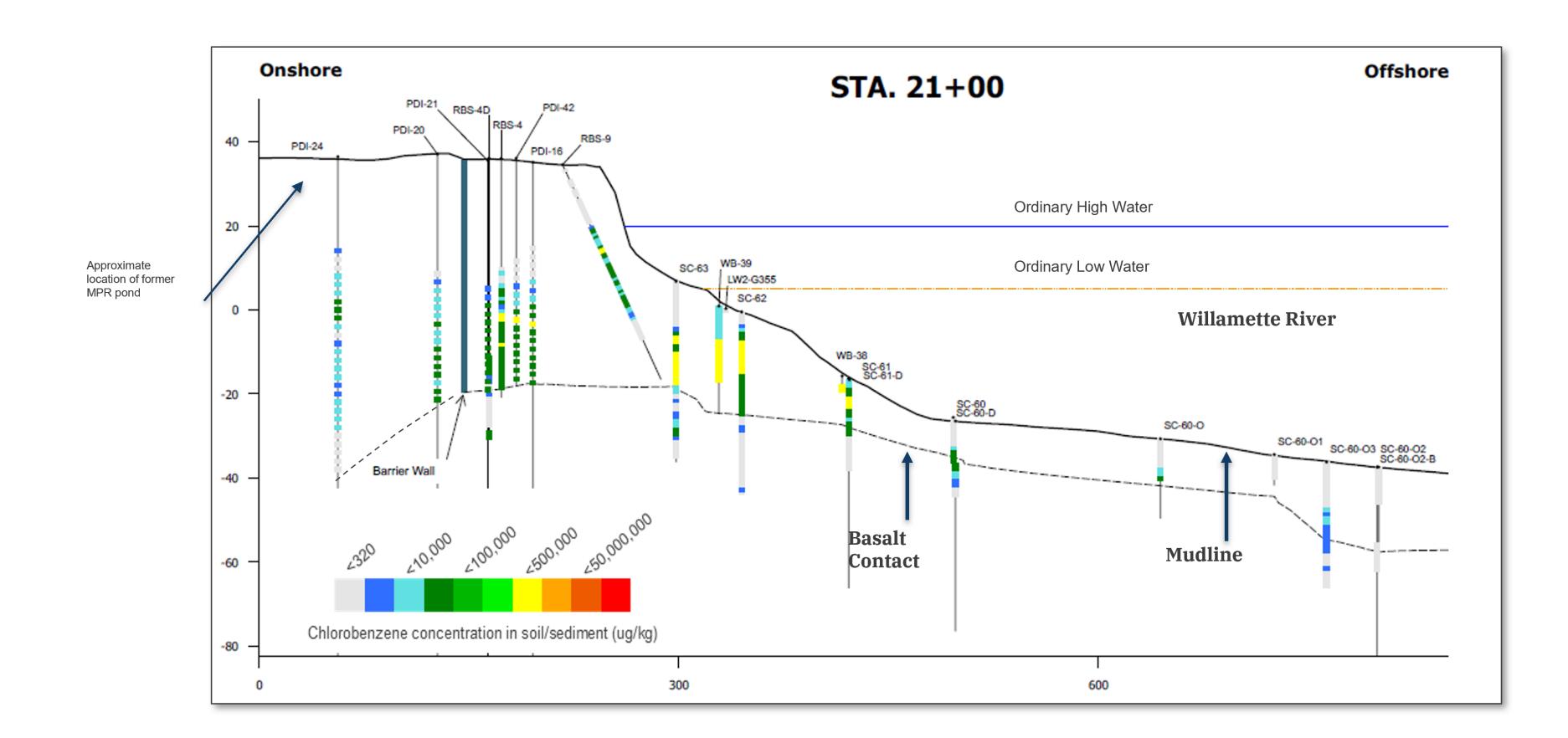
Left: Comparison photos of the same interval (1) sonic core without circulation water (2) sonic core with circulation water

High conductivity zones enable rapid contaminant movement

Investigation of the basalt groundwater system revealed contaminant transport potential.

Key Findings:

- Basalt groundwater chlorobenzene concentrations from 6–40 mg/L
- Basalt hydraulic conductivity:
- Fractured, massive basalt 19 ft/day
- Vesicular, weathered basalt 9–39 ft/day



Conclusion: Understanding Complex Pathways Enables Effective Remediation

Implementation Strategy Elements:

- Targeted source control focusing on basalt groundwater containment and treatment
- Sediment dredging
- Assessment of reactive capping during design

David Livermore

Senior Principal 503.806.4665 dlivermore@integral-corp.con



