ARCADIS Design & Consultancy for natural and built assets

MANAGING UNKNOWN AND UNCERTAIN CHEMISTRY RESULTS WITH HIGH RESOLUTION INVESTIGATION

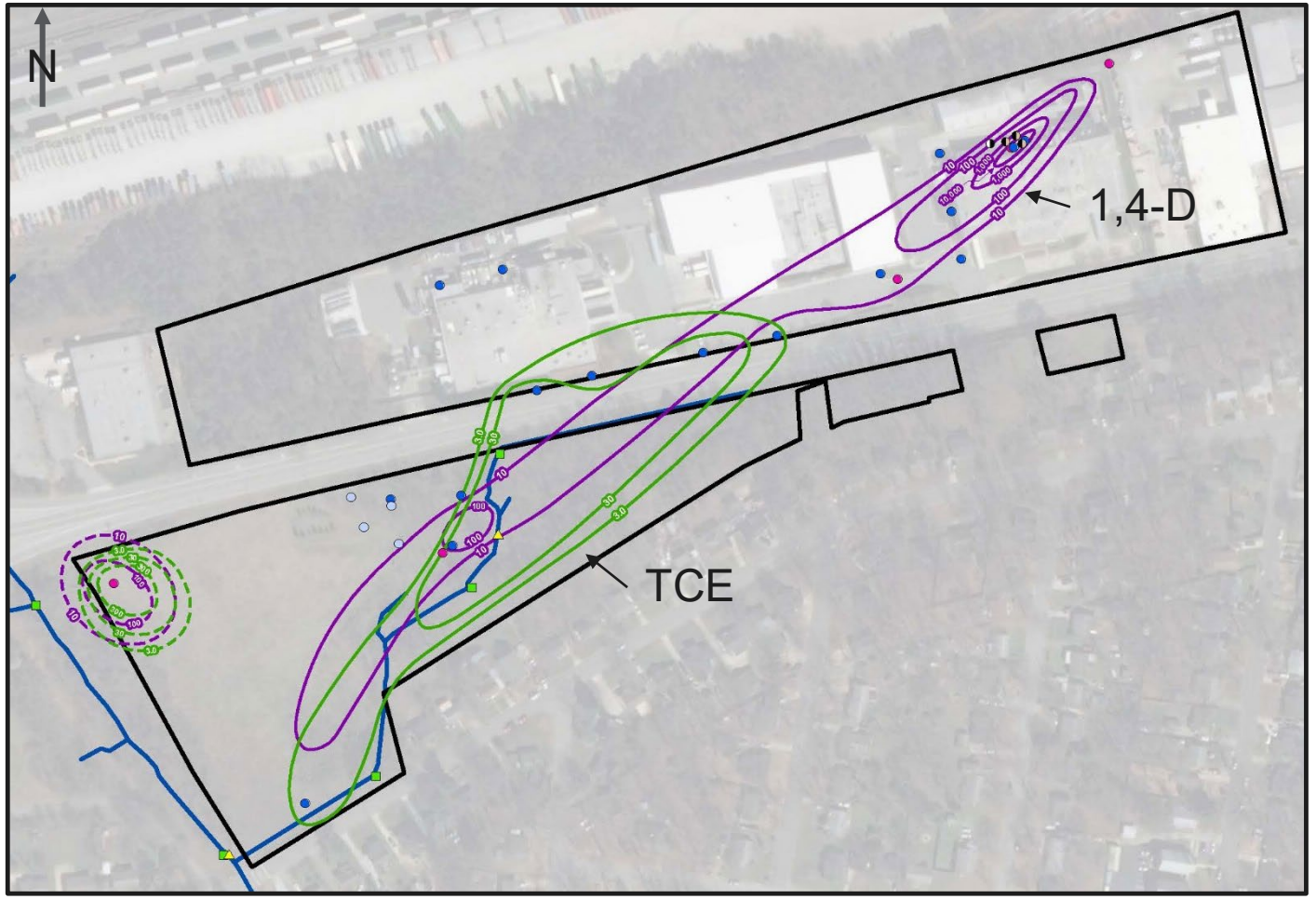
Fifth International Symposium on Bioremediation and Sustainable Environmental Technologies

April 2019

Outline

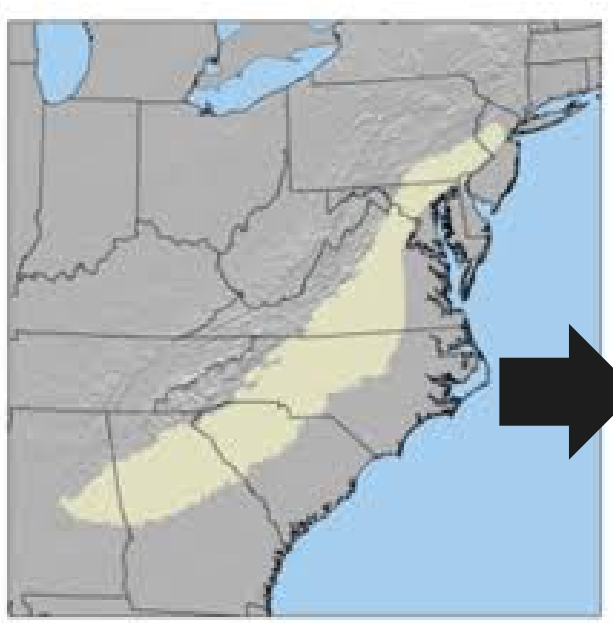
- Discontinuous plumes and multiple sources
- What we anticipated
- Getting out the microscope
- What did we learn
- Managing the uncertainty

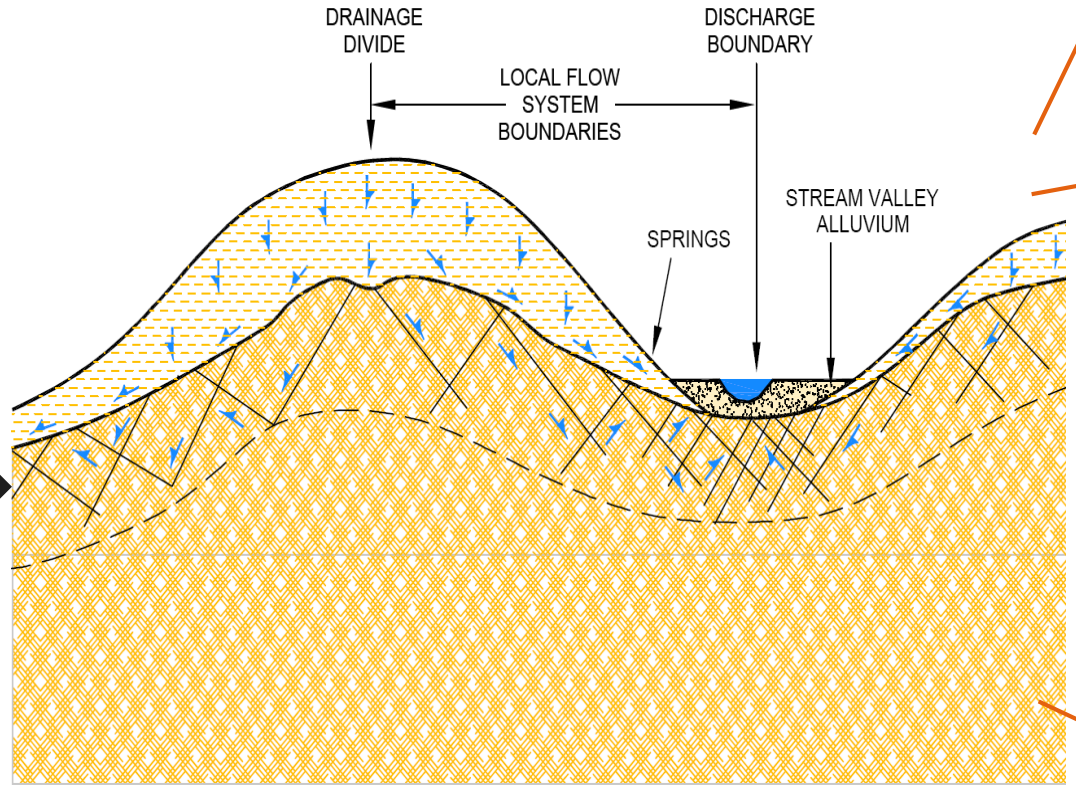
Pre-Investigation CSM



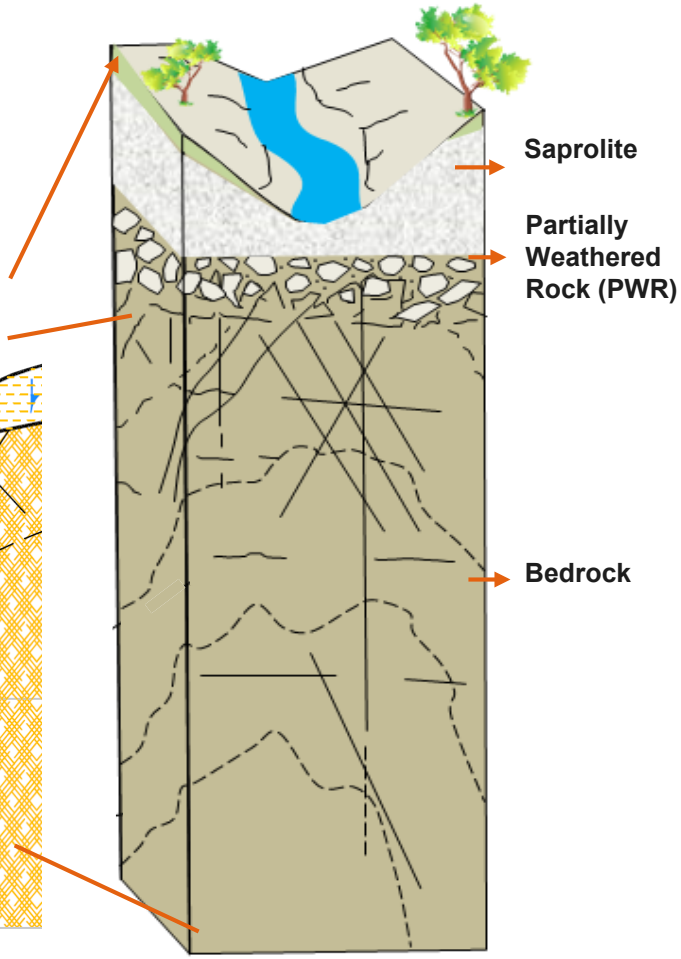
- The distribution of the chemistry didn't make sense
- Is separation of plumes real?
- Transport doesn't match with the expected geology
- Where's the risk?
- Existing remedial system seemed disconnected from overall issues

Regional Geology

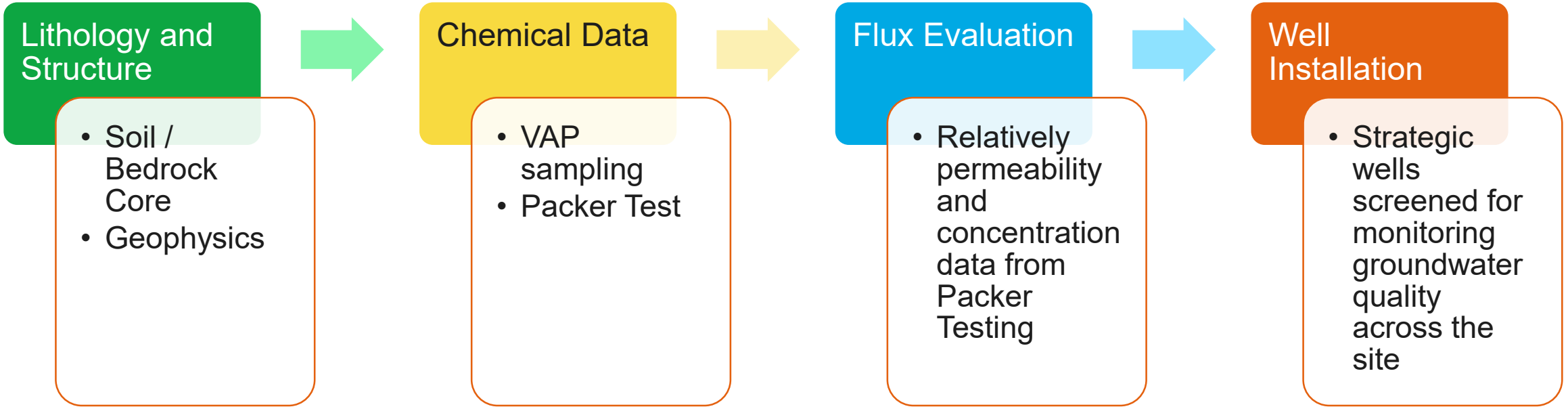




LeGrand, 2004

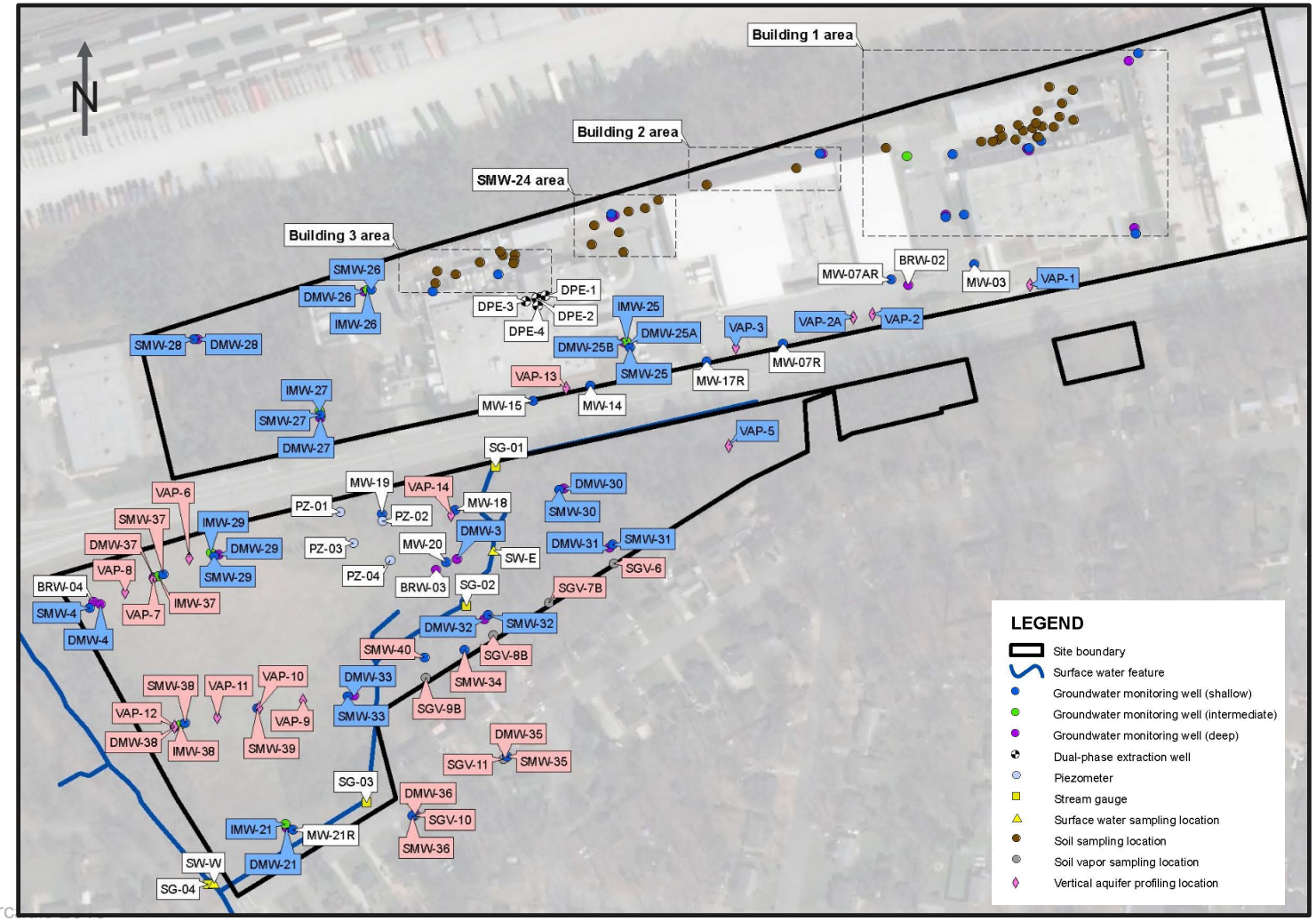


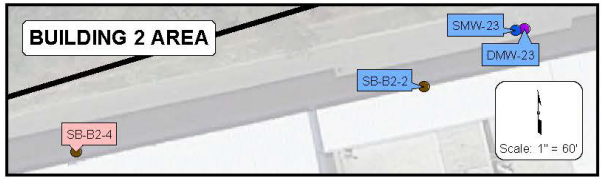
Investigation Approach

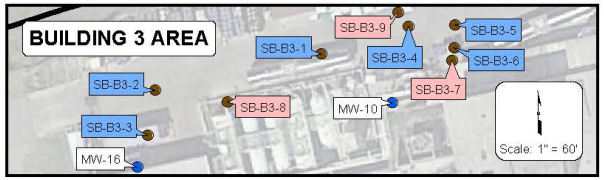


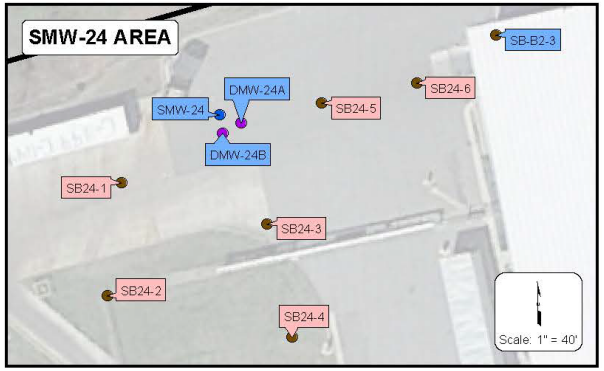
High Resolution Data Provided Basis for Understanding of Risk and Uncertainty

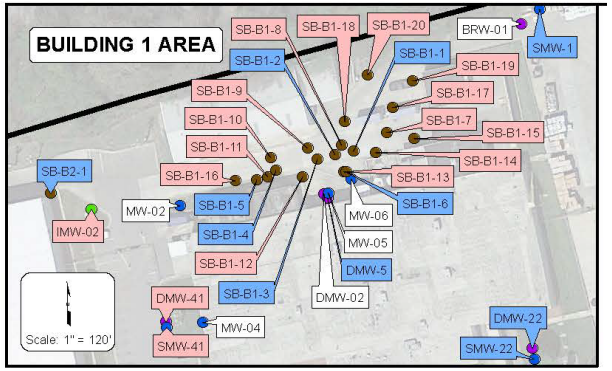
Site Layout



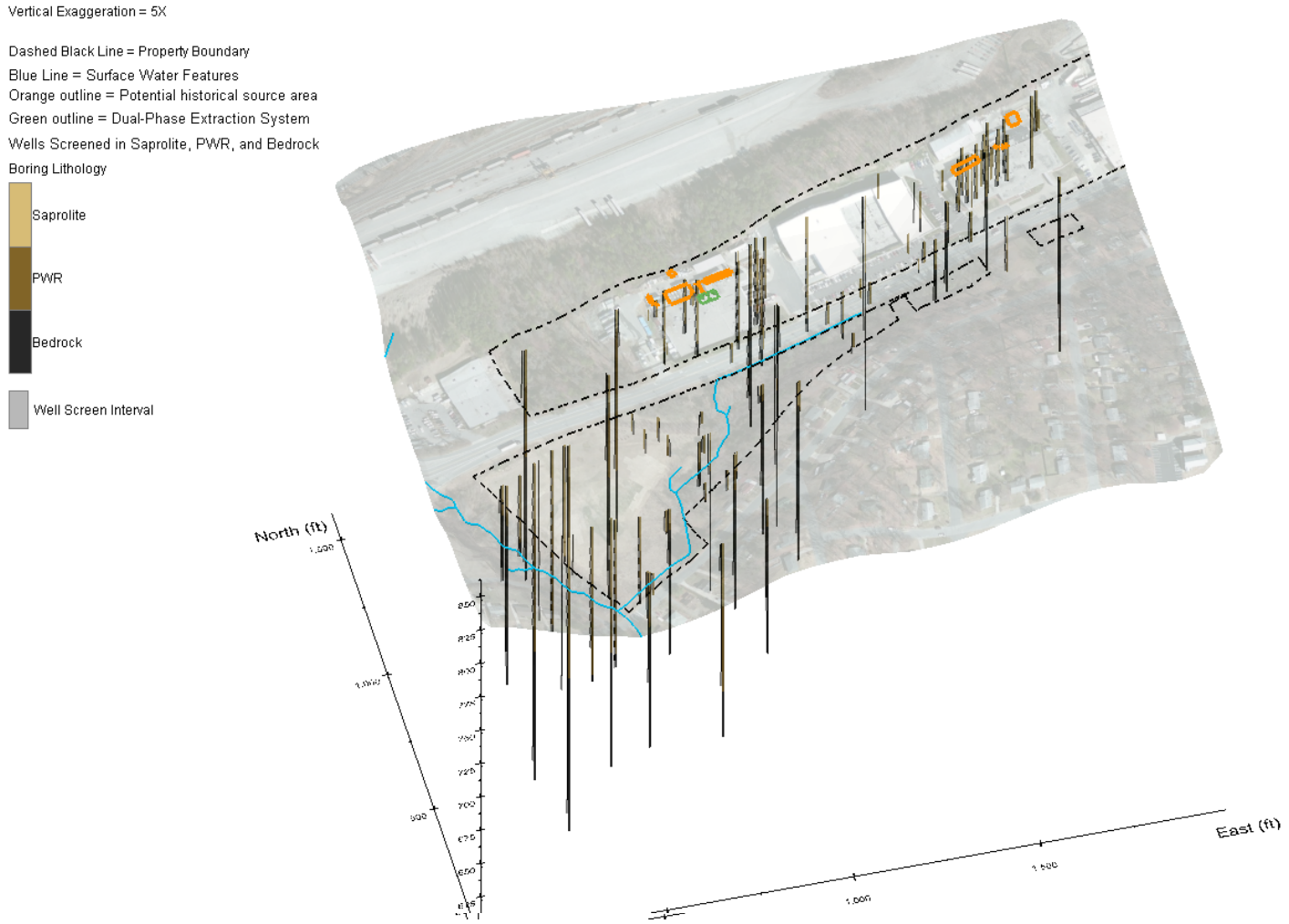








Implementation Sequence



Geology Overview

Saprolite

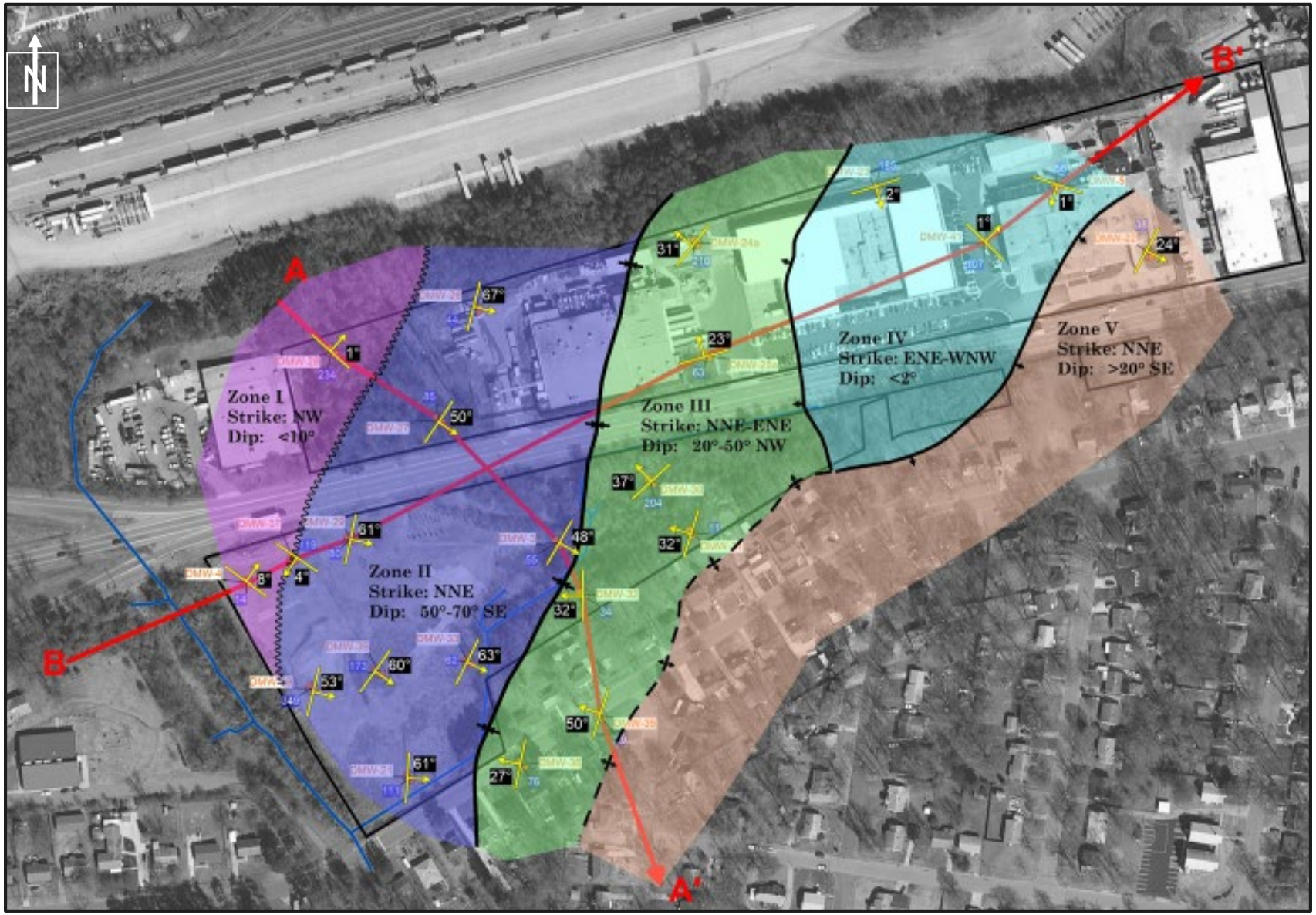
PWR

Typical Range of Bedrock

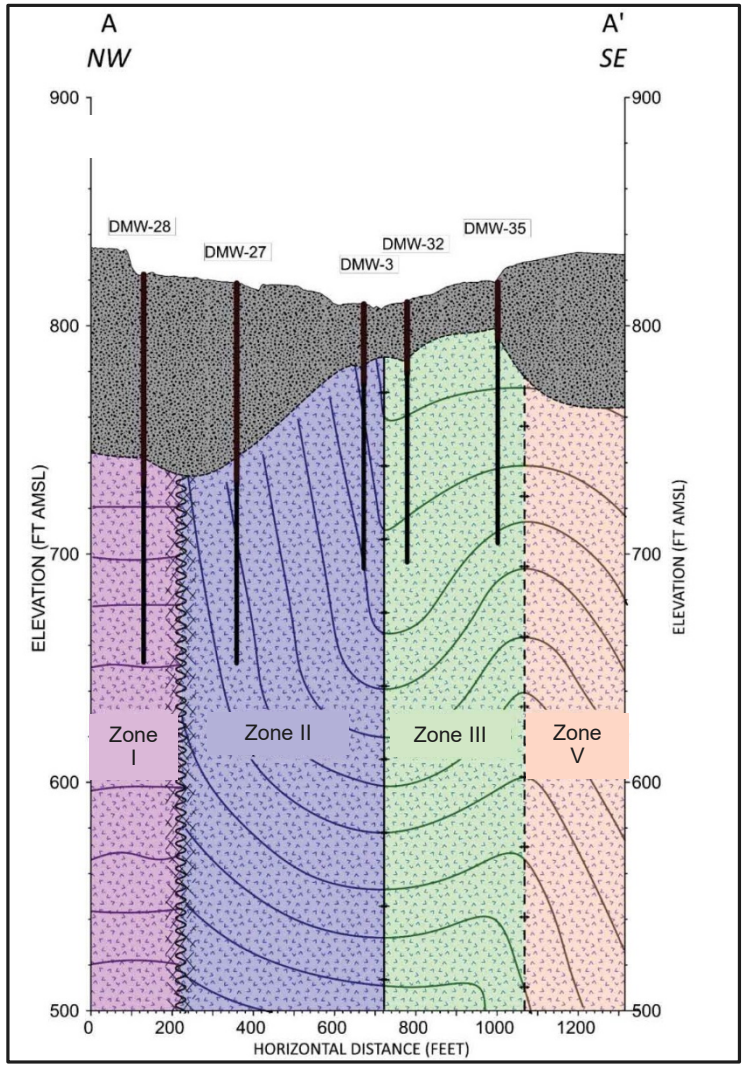
Bedrock along Shear Zone

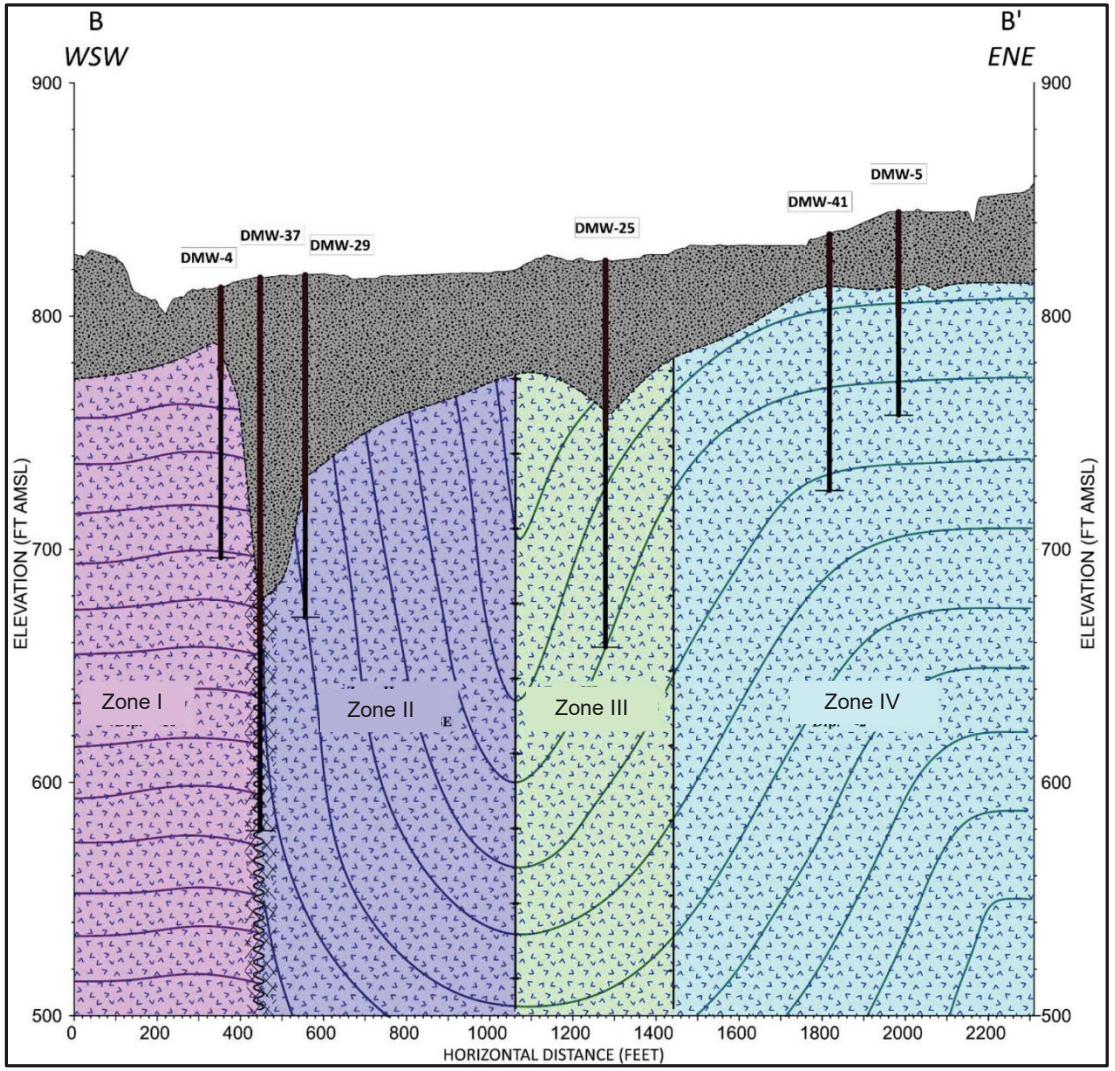
Shear Zone Core

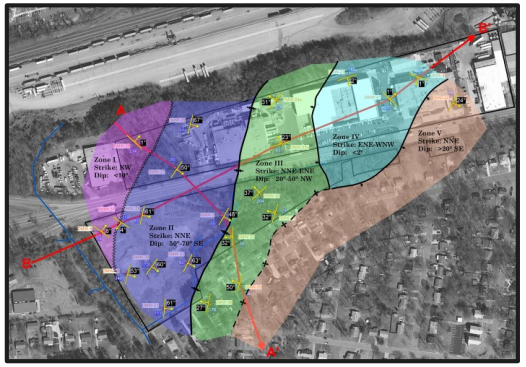
Borehole Geophysics Results



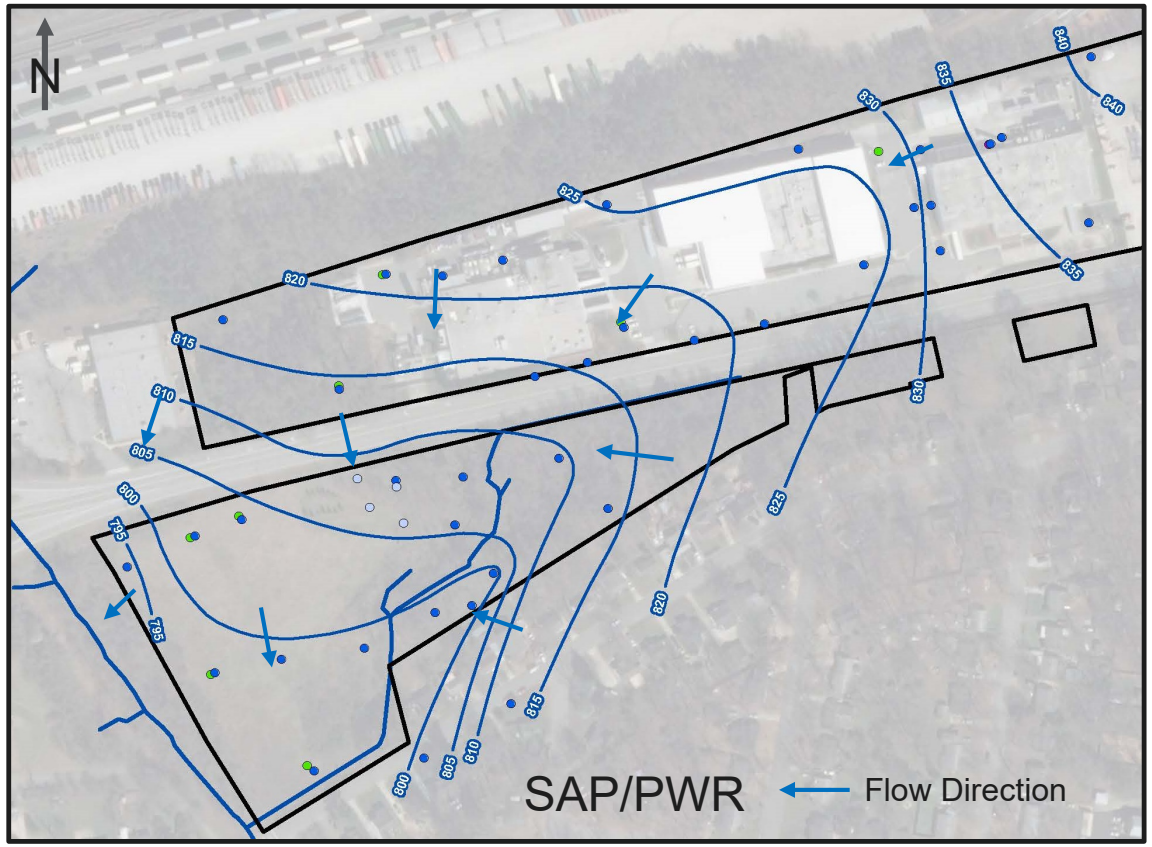
Bedrock Structure

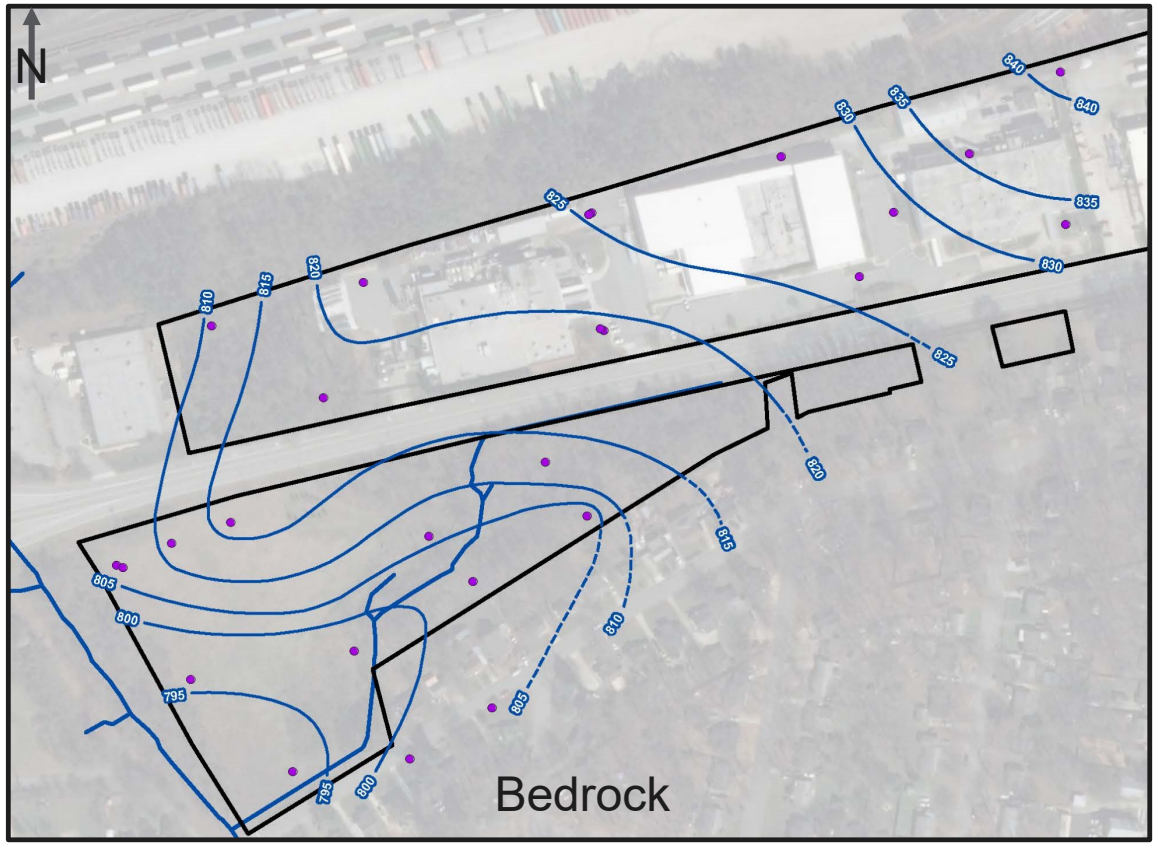




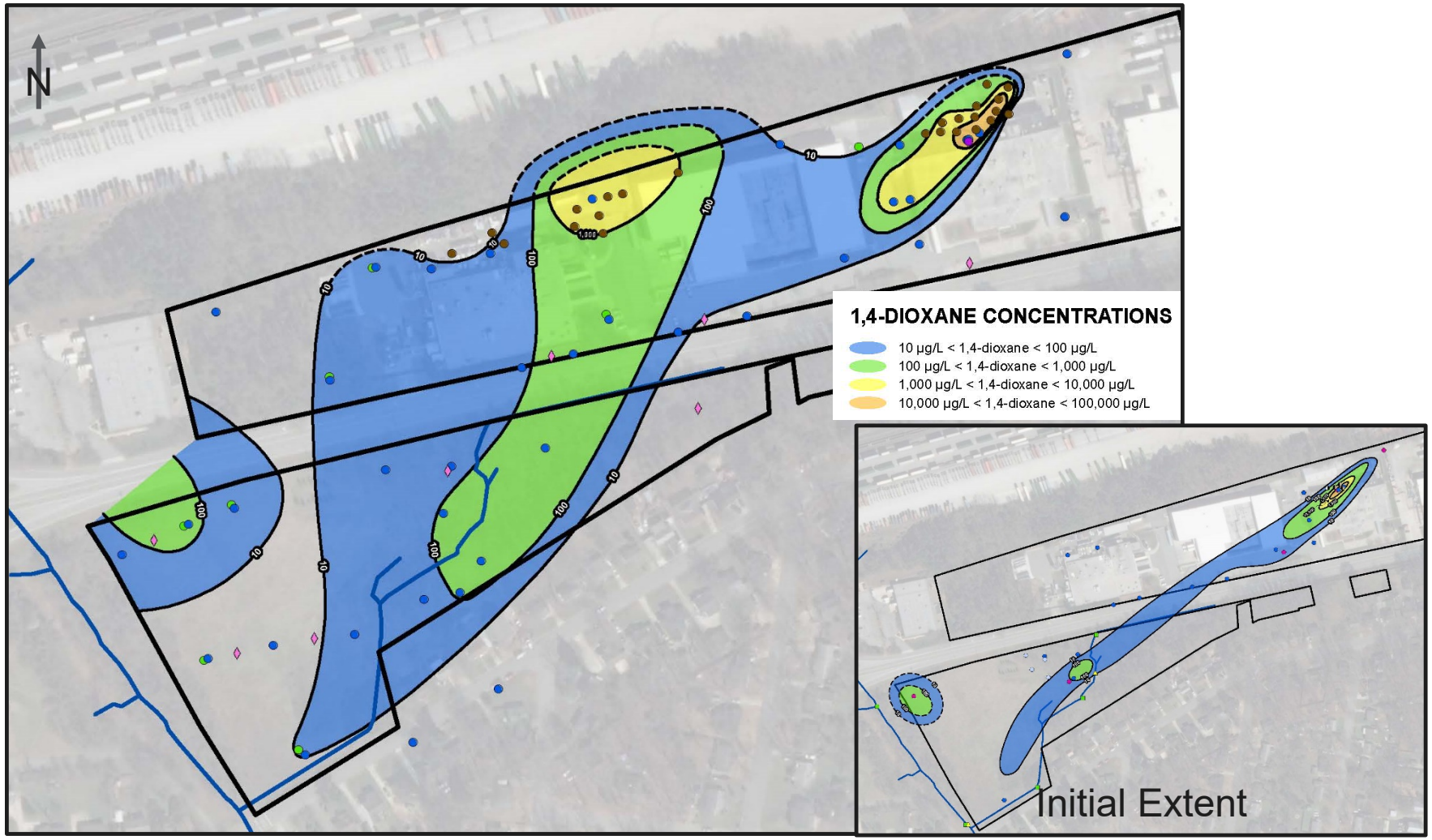


Potentiometric Surface Maps

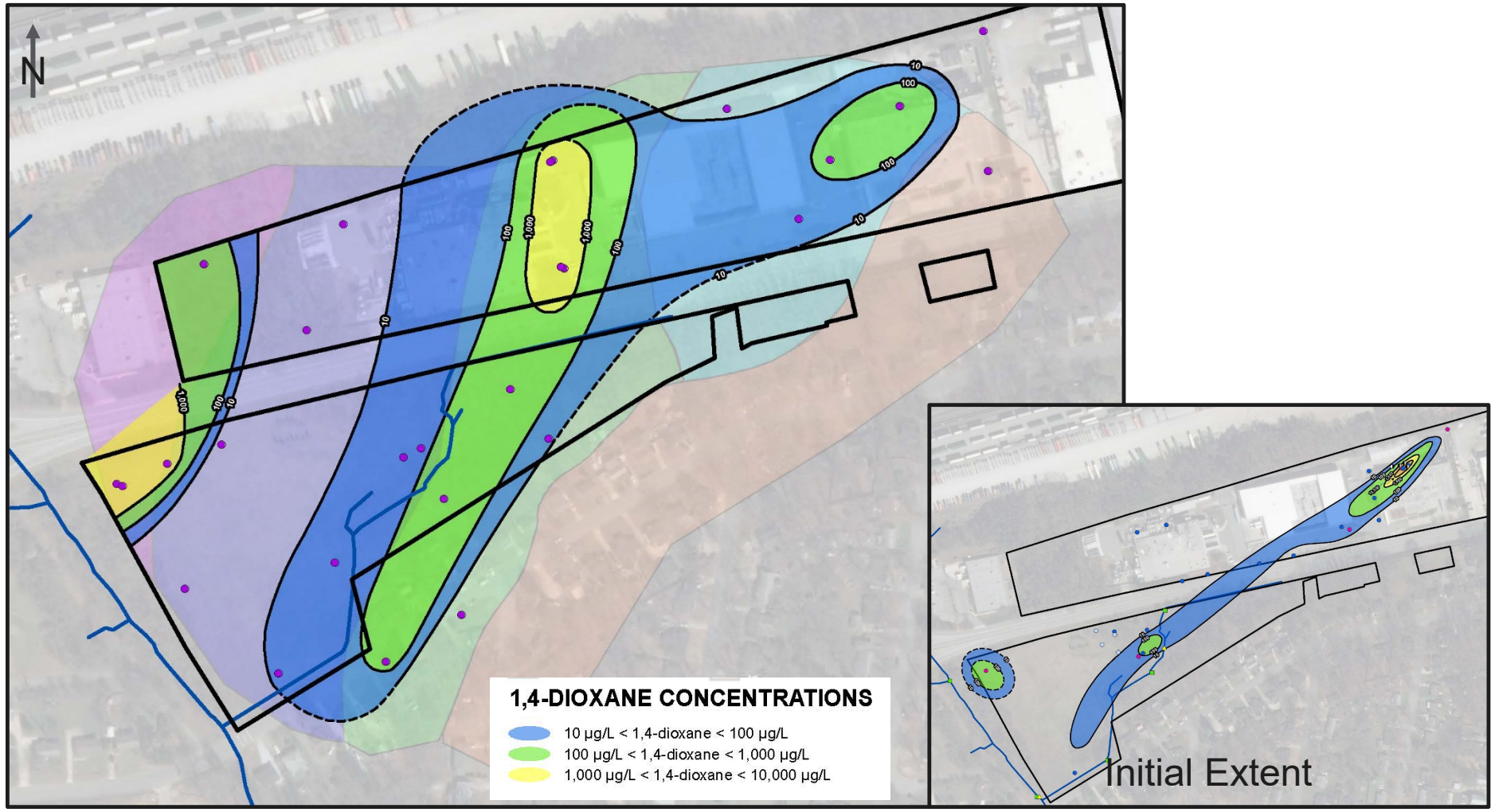




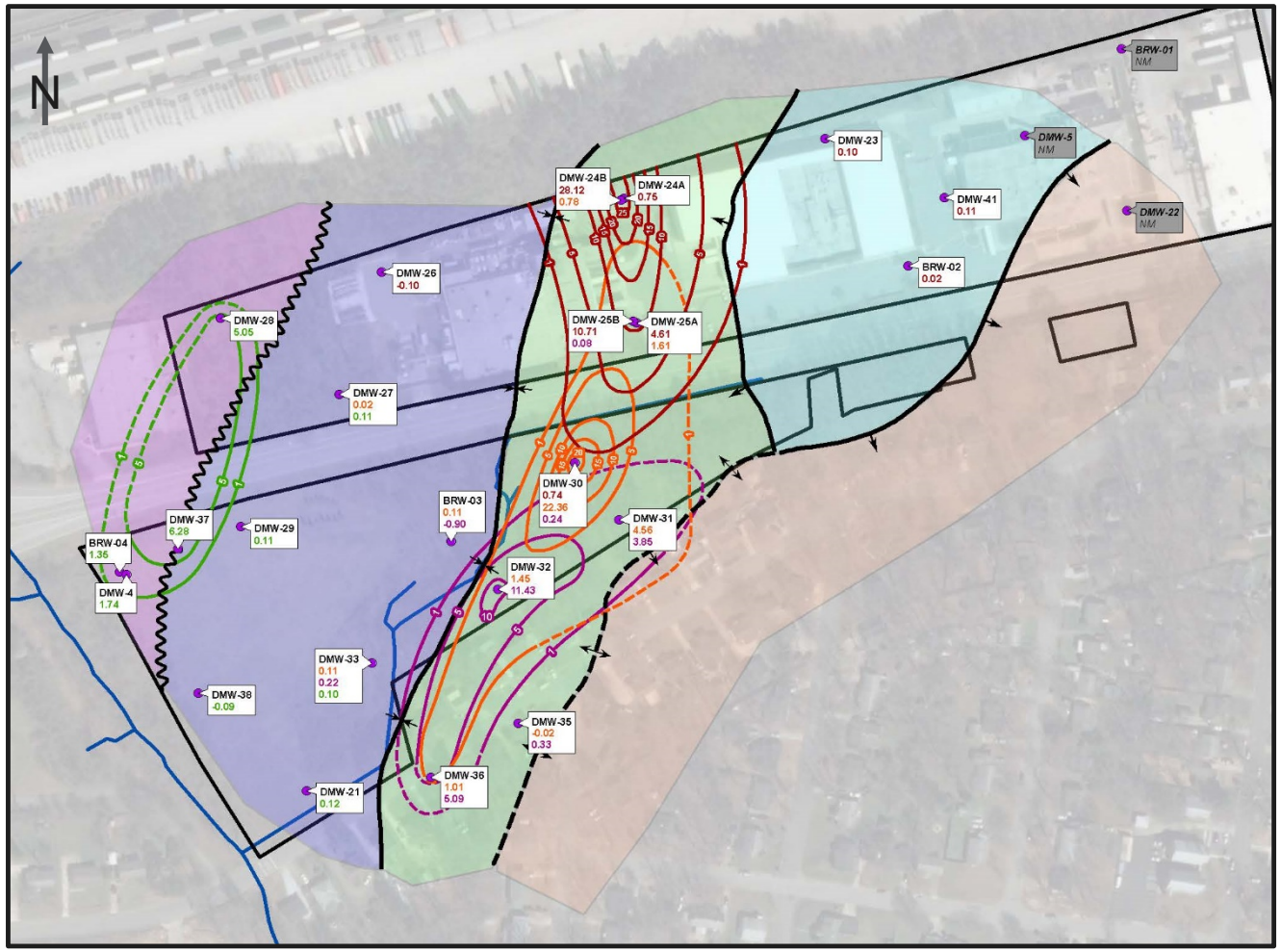
1,4-Dioxane in SAP/PWR



1,4-Dioxane and Bedrock Structure



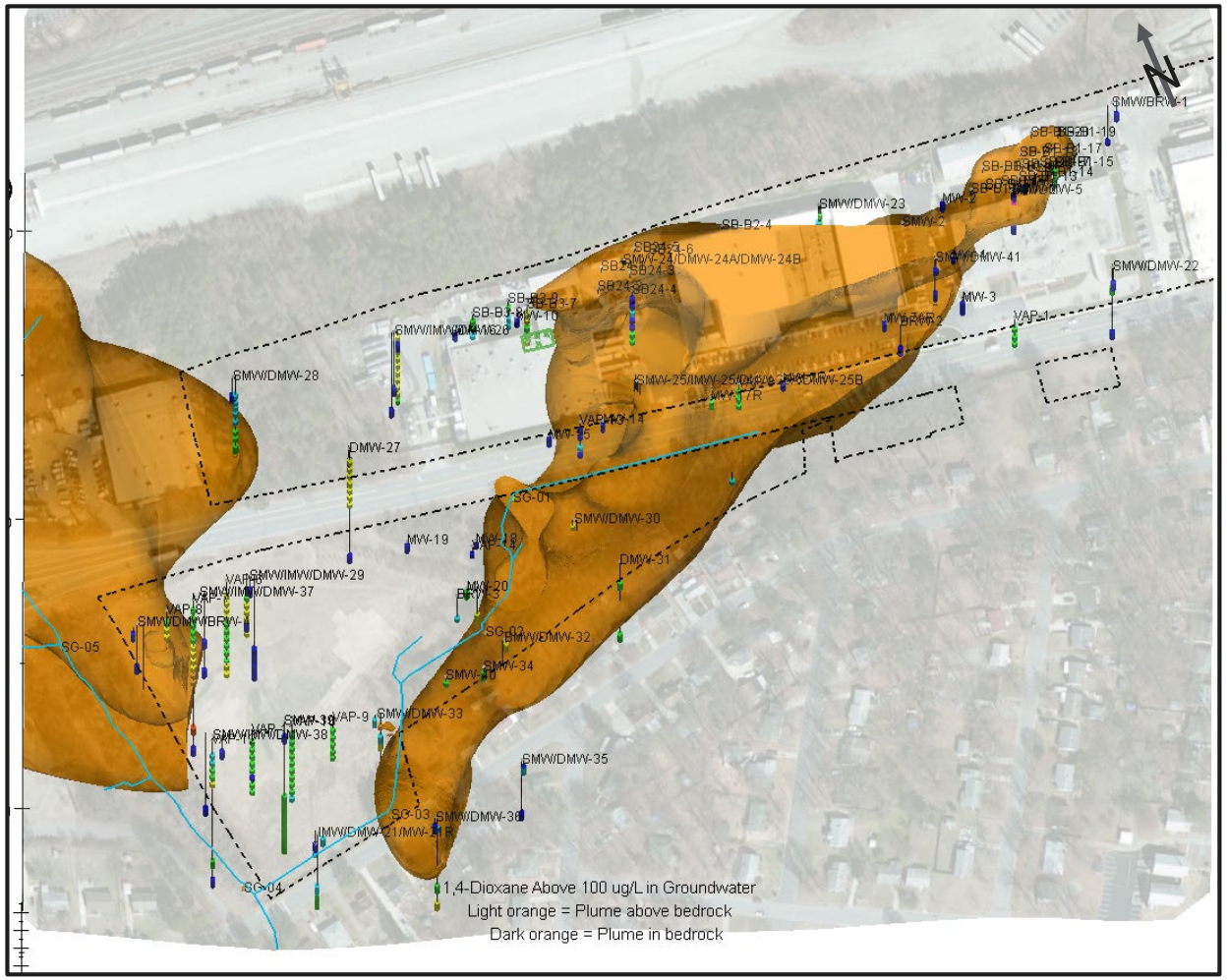
Aquifer Testing and Bedrock Structure

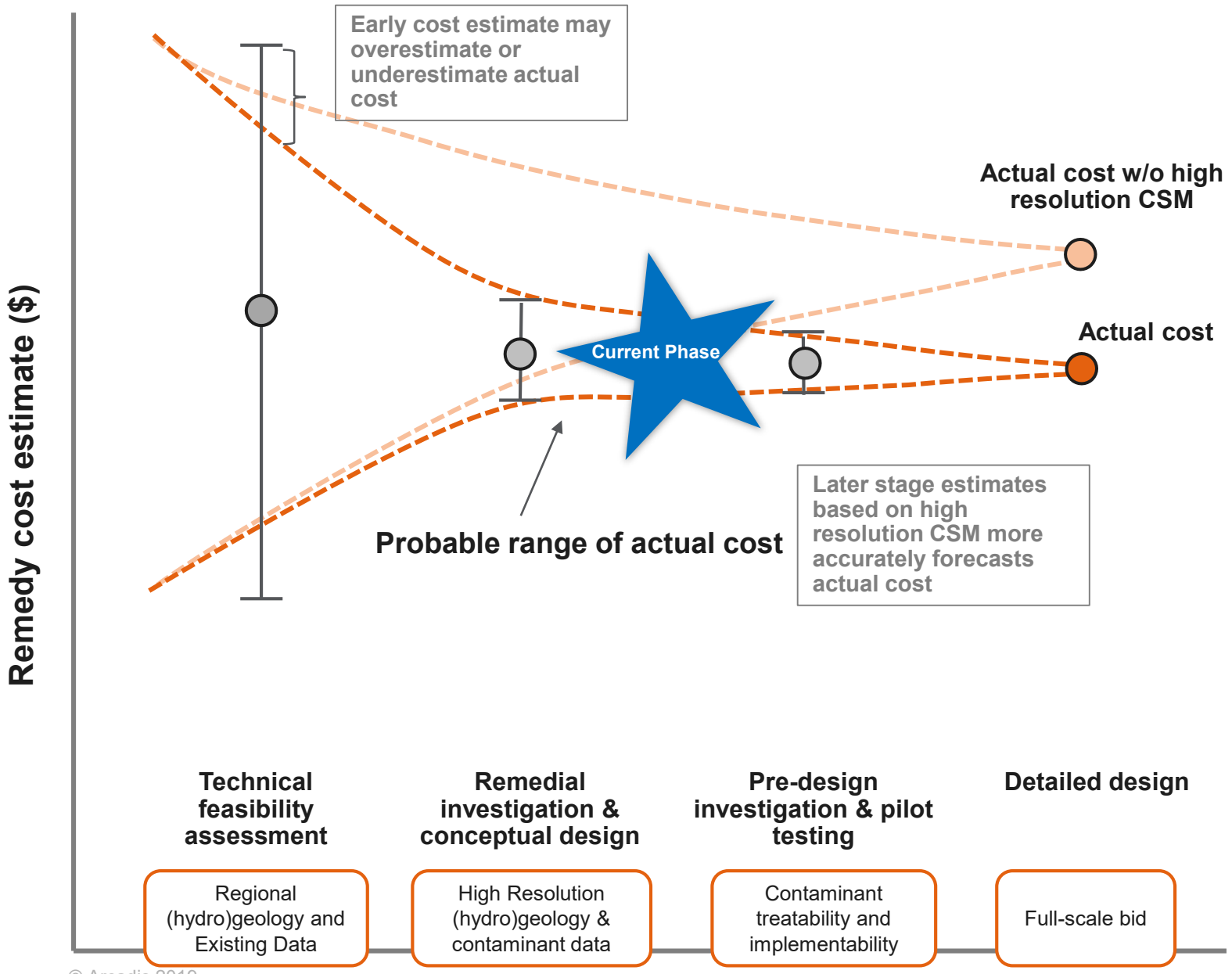


- Structure controls flow
- Chemistry bounded by structure
- Further confirmation of hydraulic segregation between plumes
- Provides long range order for remedial design basis

Conclusions

- High resolution investigation aligned chemical and geologic data to develop a robust CSM
- Reduced uncertainty related to the chemical distribution
- Potential risk pathways were evaluated and prioritized
- Expect high Return on Investigation™
  - Increased certainty in remediation targets
  - Focused area for implementation
  - Offsite impacts migrating on to the property have been segregated





- The resolution of the data reduces the uncertainty and leads to a more focused remedial strategy
- Lower density data at the subject site could have resulted in a larger scale focus for a remedial system
- Progression through investigation and remedy design phases clarifies basis for scope and costing
- Cost reduction not always guaranteed, but *cost estimate range should always narrow* as the CSM and remedy design is developed

Questions/Discussion

Thank you!

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