PRACTICAL AND INNOVATIVE APPROACHES TO EVALUATE SITES WITH LNAPL

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Overview

- LNAPL impacted sites and their challenges
- Risk-based solutions and plume stability
- Importance of site characterization
- An innovative investigation approach
What Is LNAPL?

- Light non-aqueous phase liquid
- Lighter than water with limited solubility
- Moves as a separate phase within the soil profile

*Representation of a LNAPL Release to the Subsurface from API Interactive LNAPL Guide Version 2.0*
Remediation Challenges

- Preferential migration through coarser pathways
- Becomes trapped and partially saturates soil pore space
- Is a source of contamination for dissolved and vapour phase

*Hydrocarbon Trapping in Pore Network* from API Interactive LNAPL Guide Version 2.0
What Solution Provides the Greatest Benefit?

- Site can be difficult to clean up and costly to recover LNAPL
- Regulatory standards challenging to achieve
- Are there benefits to partial remediation?
- Is remediation sustainable?
Using Risk-Based Solutions

- Clear objectives can be defined
- Measurable apparent thicknesses can remain in the ground
- Ensures that potential receptors and environment are protected
- Allows resources (i.e., $) to be allocated more efficiently
Plume Stability Is Key

- Is LNAPL stable or expanding?
- Trend interpretations require years of data
- Complicated by cyclical water level fluctuations and heterogeneity

Plume expansion or seasonal variation?
Two Reliable Stability Indicators

1) An adequately spaced sentry well network with no LNAPL detections
   - LNAPL plume is not expanding if sentry well network consistently clean
Two Reliable Stability Indicators

2) Dissolved phase stability

- An advancing source would also cause dissolved phase changes
How Well Do We Know the Plume?

- Adequacy of site characterization and delineation is commonly overlooked.
- Conceptual site model necessary to support data collection and interpretation.
- Heterogeneity leads to preferential LNAPL migration and non-uniformity.
How Well Do We Know the Plume?

Is 10 m spacing appropriate?

What if this was 50 m or 100 m spacing?
How Well Do We Know the Plume?

- Characterization of site stratigraphy important
- Investigation shouldn’t be limited to apparent downgradient areas

Comparison of LNAPL Migration for Different Contact Angles between Soil Types from API Interactive LNAPL Guide Version 2.0
How Well Do We Know the Plume?

- LNAPL migration occurs along pathways of least resistance
- Plume controlled by small scale variations in stratigraphy

*Plan View*

- Oil Plume
- Water Table
- Oil Impounded by Silty Soils
- Oil Flow Through More Permeable Sands

*Preferential LNAPL Flow through Heterogeneous Soils* from API Interactive LNAPL Guide Version 2.0
An Innovative Approach

Technology:
- Hydraulic Profiling Tool (HPT) from Geoprobe Systems was advanced in Main Gate area at 5 Wing Goose Bay

Objective:
- To improve understanding of soil conditions and identify higher permeability areas across smear zone
- Evaluate possible methods to increase system recovery
What Exactly is the HPT?

- A logging tool that measures the pressure required to inject water into the soil as it is advanced through the ground
- Resistance to injection is directly correlated to soil permeability
- Advanced at approximate rate of 2 cm/s
- Injection pressure log produced for each hole
Drilling Equipment
An Example HPT Log

Core #1: 15.5 – 16.7 m
Very fine (44%) and fine (43%) sand

Core #2: 17.1 – 18.3 m
medium (60%) sand, some fine (19%), some coarse (18%)
Soil Cores

Core #1: 15.5 – 16.7 m
very fine (44%) and fine (43%) sand

Core #2: 17.1 – 18.3 m
medium (60%) sand, some fine (19%),
some coarse (18%)
Chip Trays

Core #1

Core #2
Plan View Interpretation Example
Key Messages

- Maximizing the overall benefit of remediation efforts should be considered
- Representative site characterization and understanding is essential
- Effective practical and innovative methods are available to assist with these objectives
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