Applied NAPL Science Review (ANSR)

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Demystifying NAPL Science for the Remediation Manager

Introduction

Applied NAPL Science Review is a scientific ejournal that will provide insight into the science behind the characterization and remediation of Non-Aqueous Phase Liquids (NAPLs) using plain English.

With over 800 subscribers after the first issue, Applied NAPL Science Review is clearly filling a need for descriptions of NAPL technical concepts in non-technical language. If you know someone who is interested in this topic, please forward this issue to them using the "Forward" link at the bottom of the page.

We welcome feedback, suggestions for future topics, questions, and recommended links to NAPL resources. All submittals should be sent to Mike Hawthorne.

Announcements

NEW LNAPL WORKSHOP: *Advances in LNAPL Site Management*. March 14-17, 2011, San Diego, CA. 21st Annual Int'l Conference on Soil, Water, Energy, and Air, AEHS Foundation. Click Here for link to conference web page.

Coming Up

The next newsletter will explore Hydrostratigraphs as tools for an improved LCSM.

Related Links

API LNAPL Resources

ASTM LCSM Guide

Env Canada Oil Properties DB

EPA NAPL Guidance

ITRC LNAPL Resources

ITRC DNAPL Documents

RTDF NAPL Training

RTDF NAPL Publications

USGS LNAPL Facts

ANSR Archives

ANSR Online

Diagnostic Gauge Plots

Simple Yet Powerful LCSM Tools

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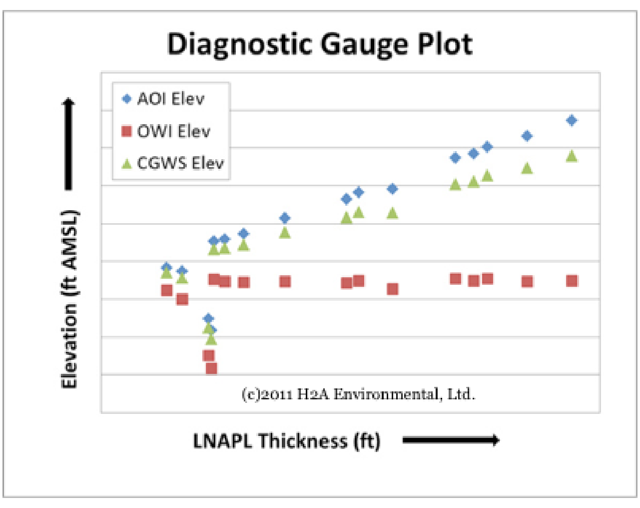
How do you know if the apparent LNAPL thickness gauged in a well is exaggerated? The answer can mean a substantial difference in predicted LNAPL volumes and associated cleanup costs.

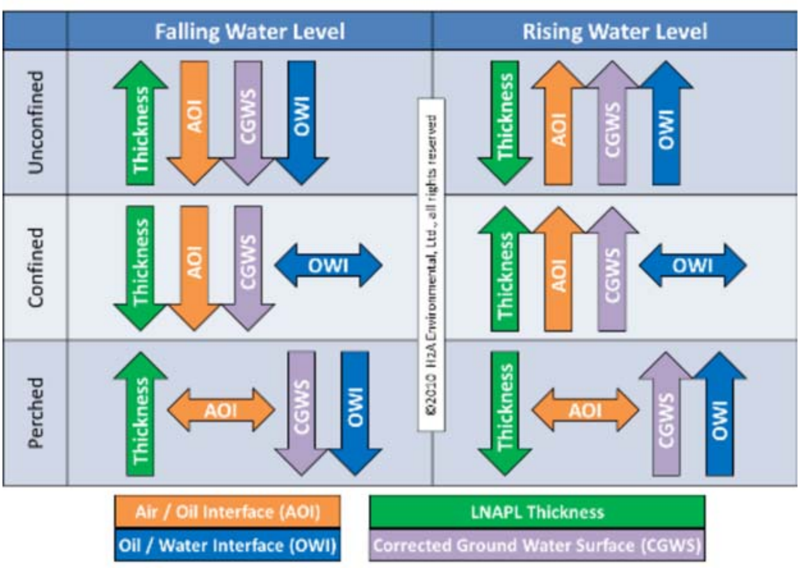
BACKGROUND: As discussed in the last issue ("LNAPL Thickness Revitalized"), LNAPL thickness is an important LNAPL Conceptual Site Model (LCSM) variable. However, the thickness used in multiphase LNAPL volume calculations must be the formation LNAPL thickness (saturation curve height). Under unconfined conditions, apparent LNAPL thickness gauged in wells is a good approximation of the formation LNAPL thickness (mobile LNAPL interval excluding the smear zone). However, confined or perched LNAPL typically results in a substantial exaggeration of apparent LNAPL thickness.

DEFINITION: Diagnostic Gauge Plots are one tool that can be used to determine if LNAPL is unconfined, confined or perched, and to estimate the formation LNAPL thickness. A Diagnostic Gauge Plot is a graph of the air/oil interface (AOI), oil/water interface (OWI) and corrected ground water surface (CGWS) elevations versus the thickness of LNAPL observed in a well over time.



TREND ANALYSIS: Fluctuating AOI, OWI and CGWS elevations in equilibrium will exhibit diagnostic trends when plotted against the associated apparent LNAPL thicknesses gauged in the well. These trends can be used to screen for periods of unconfined, confined or perched LNAPL conditions.

Theoretical Basis for Diagnostic Gauge Plot Trends



Unconfined LNAPL: During unconfined LNAPL conditions, all three interfaces and the LNAPL thickness will typically fluctuate. The apparent LNAPL thickness will fluctuate in the opposite direction of the three interfaces.

Confined LNAPL: During confined LNAPL conditions, the OWI elevation will typically be stable, and the other three measurements (AOI, CGWS and thickness) will fluctuate, all in the same direction.

Perched LNAPL: During perched LNAPL conditions, the AOI elevation is theoretically stable and the other three measurements (OWI, CGWS and thickness) fluctuate. The apparent LNAPL thickness trend will be opposite to the OWI and CGWS trends.

SUMMARY: Under unconfined conditions all three interfaces as well as apparent LNAPL thickness will fluctuate. Under both confined and perched conditions, one interface will be stable, but the other two interfaces and the apparent thickness will fluctuate. The key is to identify which interface is stable, and whether apparent thickness and the fluctuating interface elevations are moving together or in opposite directions.

Key to Diagnostic Gauge Plot Trend Analysis

Hydrogeology	Stable Surface	Key
Unconfined	None	Apparent NAPL thickness increases as AOI, OWI and CGWS elevations decrease, and vice versa
Confined	OWI is stable	Apparent NAPL thickness increases as AOI and CGWS elevations increase, and vice versa
Perched	AOI is stable	Apparent NAPL thickness decreases as OWI and CGWS elevations increase, and vice versa

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ADVANCED: If multiple hydrostatic conditions exist over time for a given well, then multiple trends will be observed in that well's Diagnostic Gauge Plot. In such cases, the points of inflection where trends change direction can be used to estimate LNAPL formation thickness.

REAL WORLD LIMITATIONS: A word of caution – non-equilibrium conditions, vertical gradients, and other factors can affect the results of a Diagnostic Gauge Plot analysis. For example, routine product removal events through bailing or other means can prevent the attainment of equilibrium conditions in wells with LNAPL. As a result, the non-equilibrium gauging data may not follow the ideal theoretical trends for Diagnostic Gauge Plots. Multiple lines of evidence should be used.

Next month's issue will explore Hydrostratigraphs, another diagnostic LNAPL Conceptual Site Model tool that can be used to confirm the results of a Diagnostic Gauge Plot analysis.

Until then, feel free to call or email with questions regarding the use of Diagnostic Gauge Plots in modern day LNAPL science to minimize your site remediation costs.

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