Comparison of Laser-Induced Fluorescence Profiles following a Decade of LNAPL Recovery

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Background/Objectives. Light nonaqueous phase liquid (LNAPL) recovery operations using skimming and total fluid pumping methods have been occurring at an active petroleum refinery since the 1980s. An investigation of the extent and vertical distribution of LNAPL was performed adjacent to recovery wells in 2005 using laser-induced fluorescence (LIF) combined with cone penetration testing (CPT). Since 2005, the pumping operations have recovered a significant amount of LNAPL and thus resulted in significant decreases in LNAPL recovery rates at several wells. The objective of this work was to investigate changes in the LNAPL saturation profile adjacent to these active LNAPL recovery wells by advancing LIF/CPT borings. Comparison between historic and recent high-resolution borings and analysis of current and cumulative LNAPL recovery were utilized to assist in developing an understanding of progress towards a remediation endpoint of active LNAPL recovery operations.

Approach/Activities. LNAPL recovery began in the 1980s and is ongoing. The LIF borings advanced in 2005 which utilized the Rapid Optical Screening Tool (ROST™) were compared to 2017 borings utilized the Ultra-Violet Optical Screening Tool (UVOST®). Three locations were selected for comparison. The ROST™/UVOST® output was compared for both magnitude of fluorescent response and waveform characteristics to estimate changes in LNAPL saturation and composition, respectively.

Results/Lessons Learned. Comparison of the CPT data indicates that the recent boring locations were similar regarding vertical distribution of soil type to previous locations and similar LIF waveforms were seen, which suggests that output of the ROST and UVOST technologies is similar and the LNAPL has undergone minimal weathering since 2005. A reduction of florescence response was observed in proximity to the recovery wells. Certain zones of coarse-grained sediments, where higher transmissivity would be expected, showed little or no reduction in LIF response. Based on information available from the manufacturer, coarse-grained soil can magnify LIF response as much as 10 times compared with finer grained soil. Conversely, reductions in LIF response were seen in several fine-grained units within the screened interval. Overall the reductions in LIF response showed that skimming recovery was able to reduce the submerged LNAPL. Calculation of LNAPL transmissivity values and decline curve analysis at each recovery well suggests that LNAPL recovery operations have reached or are approaching an endpoint despite a lack of reduction in LIF response within the coarse-grained unit which may be already at residual saturation in 2005. The comparison indicated that as the recovery system matures and is approaching the end of recovery, recovery well performance history combined with system optimization may be more effective at evaluating recoverability of remaining LNAPL.