Re-evaluation of LNAPL Conceptual Site Model throughout the Project Life Cycle

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Background/Objectives. This case study presents the importance of re-evaluating and updating the conceptual site model (CSM) throughout the project life cycle of a remediation site. As remedial technologies evolve and advance it is prudent to reconsider alternative remedial strategies that may have previously been deemed impractical or not implementable due to previous regulatory requirements that have since been updated. The subject property of this case study is a former manufacturing facility located within the Maryland Coastal Plain Physiographic Province and site sediments consist predominantly of sand and silty sand with discontinuous layers of silts and clays. Light non-aqueous phase liquids (LNAPL) including #2 fuel oil and gasoline were first encountered during 1995; environmental investigation and remedial activities subsequently ensued and continued until regulatory closure was achieved in 2016 based on the results of a LNAPL mobility study.

Approach/Activities. A remediation system using vacuum-enhanced groundwater extraction (VEGE) and soil vapor extraction (SVE) operated for 13 years (1998-2011) which was followed by 5 additional years of remediation that included enhanced fluid recovery (EFR) events, manual recovery using sorbent socks/bailers and the use of automated LNAPL skimming devices in several of the on-site monitoring wells to maximize LNAPL recovery. Although LNAPL thicknesses had reduced significantly from 1998 to 2016, measurable quantities were still detected in the on-site monitoring wells. In accordance with the corrective action plan (CAP) developed for the site through the Maryland Department of the Environment (MDE) Oil Control Program (OCP), LNAPL must be removed to the maximum extent possible, which has historically been interpreted by MDE as a non-measurable sheen. In order to achieve case closure, a comprehensive LNAPL mobility study was conducted to update the CSM and to provide quantitative evidence that LNAPL has been removed from the site to the maximum extent practicable despite the current and expected long-term presence of measurable LNAPL. The LNAPL mobility study included soil boring advancement, transmissivity testing, analysis of the LNAPL fluid properties, and evaluation of long-term fluid gauging data and volume of LNAPL recovered via the various remedial techniques utilized. Methods for evaluating LNAPL mobility and transmissivity included skimming tests and analysis of the soil physical properties to determine the capillary pressure, pore fluid saturation and mobile fraction of LNAPL remaining in the soil.

Results/Lessons Learned. The results of the mobility study show that LNAPL transmissivity values are well below the practical recovery range of 0.1 to 0.8 ft^2/day (ITRC, 2009) and that the potential for LNAPL migration is very low. Based on the merit of these observations, MDE approved a CAP addendum allowing LNAPL to remain in place and case closure has been achieved. The outcome of this project shows the importance of updating the CSM as site conditions change over time. While there are costs associated with re-evaluating the CSM, that should not be a deterrent because the overall life cycle project cost savings can be significant.