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LNAPL Management: Strategy Development through Investigation, LCSM and NSZD

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Background/Objectives. Operation of a fuel bulk storage and distribution terminal in the Piedmont region of northwestern South Carolina from the 1940s through the late 1980s resulted in a large LNAPL plume, consisting primarily of kerosene/jet fuel, existing at depths of approximately 30 to 40 feet below ground surface. Investigation and remediation efforts have been undertaken in numerous phases for over 25 years, resulting in the installation of over 100 monitoring wells, recovery wells, and piezometers. Remediation via total fluids extraction (pump and treat) from as many as 16 extraction wells was managed continuously from 1992 through late 2014, recovering over 163,000 gallons of fuel. Recovery rates demonstrate a clear decline over time, and the LNAPL plume has correspondingly reduced in areal extent. However, conditions still do not meet state standards for cessation of remediation.
More recent efforts to evaluate risk scenarios for this site, clarify regulatory drivers and evaluate site strategy have led to a revised LNAPL Conceptual Site Model (LCSM) which incorporates quantitative metrics unknown earlier in the project lifecycle. Reappraisal of the LNAPL plume behavior and evaluation of practical means to effect LNAPL removal have been completed. These efforts were geared towards determination of a site management strategy that can incorporate exposure risks and practical LNAPL recovery and removal endpoints combined with establishing a dialogue with the regulatory agency that can address practical realities.

Approach/Activities. Discussion of investigative techniques to evaluate LNAPL plume behavior will address review of historical recovery data, well-specific yield testing, laser-induced fluorescence (LIF) analysis, core collection and lab analysis, baildown testing at select locations and completion of a natural source zone depletion (NSZD) study. Results will be presented with commentary of their applicability to this site and overall contribution to the LCSM and site strategy. The practical application of these tools and results contributing to better quantitative understanding of LNAPL recovery and management options will also be discussed.

Results/Lessons Learned. An evaluation of the various data sets assembled via investigation and historical records review and their contribution to LCSM preparation will be provided. This will include gross changes in LNAPL plume footprint and recovered fuel volumes over time, LIF response, baildown test results, and lab results derived from core analyses and CO_2 eflux from shallow soil gas. Trends and possible correlations amongst these data sets will be discussed and evaluated in the context of development of a practical site management strategy and development of technically defensible remedial endpoints.
Findings from this body of work mirror many key lessons identified from recent advances in LNAPL science: namely, in-well LNAPL thickness is a poor indicator of mobility or recoverability, oil transmissivity (T_o) has proven to be a meaningful basis for gauging relative LNAPL recoverability, and natural destruction mechanisms appear to outpace mechanical extraction techniques in LNAPL removal for mature plumes. In addition, absent extreme efforts unsupported by existing risk or market conditions, mandates for complete LNAPL removal are certain to meet with frustration and failure in any near-term time period.