Comparison of UVOST-CPT Profiling, LNAPL Transmissivity Testing, and Skimming Recovery and Implications for Plume Management

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Background/Objectives. Lighter than water non-aqueous phase liquids (LNAPL) comprised of petroleum hydrocarbon (PHC) jet fuel of variable grades and weathering are present in the subsurface at a Department of Defense fuel storage-transportation facility in Southern California (Site). LNAPL and associated adsorbed and dissolved-phase PHC mass resides in sandy fluvial sediment at a depth below grade of 30 to 40 feet. Efforts have accelerated to define the current extent and volume of LNAPL, determine LNAPL and PHC constituent migration potential, degree of LNAPL recoverability via conventional and enhanced recovery approaches, natural attenuation capacity, overall risks and appropriate actions to take. A range of different types of data have been collected as a result and, despite apparent disparities, a concerted effort at synthesis might yield important insights on LNAPL presence, mobility, and basic recoverability.

Approach/Activities. Continuous cone penetrometer and ultraviolet optical screening tool (CPT-UVOST) profiling has refined three-dimensional understanding of lithology and presence/absence of LNAPL. A total of 54 CPT-UVOST soundings have been performed with 45 percent inferring presence of LNAPL. These supplement some 130 borings (most completed as wells) with documented information on LNAPL presence/characteristics for some 90 wells (and 40 of these documenting presence of LNAPL). Total volume of LNAPL was estimated from these data, primarily using a semi-quantitative analysis of the CPT-UVOST profile data, producing estimates of LNAPL smear zone thickness and saturation values.

LNAPL skimming operations over the past two years have focused on six recovery wells in a test plot with areal dimensions of 200 feet by 80 feet. A standardized bail-down method was followed to estimate LNAPL transmissivity (Tn) at the recovery wells. Tn estimates for the LNAPL recovery wells were paired with nearby CPT-UVOST profiles. One of these pairs, near the center of the well pattern and with the highest relative data quality, was selected for normalization of all the pairings. A predictive algorithm was developed for early stage conventional LNAPL recovery within the test plot. An analytical groundwater flow model was used to correlate Tn values to rates of simple LNAPL recovery and the predictive algorithm output was compared to this.

Results/Lessons Learned. Total volume of LNAPL within the 30 to 40 feet depth interval (sandy fluvial sediment) is estimated to significantly exceed 100,000 gallons. Per well LNAPL recovery initially generally ranged from less than one gallon per day (gpd) to 5 gpd, Estimated average Tn values for early in recovery operations ranged from 0.3 to 15.1 ft^2/day. After a series of months of operation, a significant rainy season caused groundwater to rise and thereafter LNAPL extraction rates declined. More recently, extraction rates have recovering somewhat as precipitation infiltration declined and the groundwater potentiometric surface dropped. Comparisons of predicted recovery values to actual data, identification of sources of error, and recommendations for further action applicable to the subject site and other sites were developed.