Utilizing Dye-Laser Induced Fluorescence Tooling with Soil Borings to Map Residual Free-Phase DNAPL at Former Solvent Disposal Trenches

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Background/Objective. Former industrial operations at Hill Air Force Base (HAFB) included the disposal of chlorinated degreasing solvents into two unlined disposal trenches. The quantities of released solvent are not known; however, approximately 44,500 gallons of free-phase dense nonaqueous phase liquid (DNAPL) have been recovered from the site since the early 1990s. The primary DNAPL constituents include trichloroethene with minor amounts of tetrachloroethene and 1,1,1-trichloroethane.

The former unlined disposal trenches were situated on top of a narrow channel of sand and gravel incised into a layer of underlying low-permeability clay deposits that form a barrier to the downward migration of DNAPL. The clay deposits are uneven, creating low areas for DNAPL accumulation. The historical solvent disposal resulted in the contamination of a shallow aquifer, primarily present as DNAPL pools within these low areas. Much of the pooled DNAPL at the site has been removed; however, DNAPL is still present in isolated areas in and around the clay deposits. An investigation was implemented with the goal to create a three-dimensional (3-D) conceptual site model to overlay the residual DNAPL onto the existing 3-D geological site model. This presentation discusses the results of the Dye-Enhanced, Laser-Induced Fluorescence (Dye-LIF) investigation.

Approach/Activities. The residual DNAPL has been evaluated using Dye-LIF with direct-push technology methods, followed by the advancement of soil borings to collect confirmatory dye "shake test," soil samples, and grab groundwater samples. As the Dye-LIF tool was advanced into the subsurface, a pump injected fluorescent, hydrophobic dye through a small injection port located approximately 8 inches below a laser; the injected dye dissolved into the DNAPL (when present) and fluoresced in the presence of the laser light source, providing a measure of DNAPL presence and thickness. Hydraulic properties of the formation were also estimated from the dye injection pressure and dye flow rate, which were recorded during probing.

Soil samples and grab groundwater samples were collected from soil borings in areas where DNAPL was not identified, to provide Dye-LIF method calibration data. At locations where DNAPL was indicated by the Dye-LIF tool, soil samples were collected for a dye shake test to confirm the presence of DNAPL.

Results/Lessons Learned. The Dye-LIF investigation was conducted in August 2022 with confirmation soil borings and sampling completed in October 2022. Preliminary data have successfully identified several areas of residual DNAPL (with analytical data pending). The collected Dye-LIF, soil, and groundwater data will be used to update the 3-D geological site model with the current DNAPL extent, ultimately to be used to assist in future remedy evaluation.