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GROUP 1
AECOM

Success in Optimized AAB Using High Resolution Site Characterization at Source Area WP21, Dover Air Force Base

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Background

Site WP21—two former waste lagoons and oil/water separators—is a major source of chlorinated solvents that feeds the mile-long Area 6 groundwater plume at Dover Air Force Base (DAFB) in Dover, Delaware (**Figures 1 and 2**). The primary contaminants of concern (COCs) are the solvents tetrachloroethene, trichloroethene, and 1,1,1-trichloroethane.

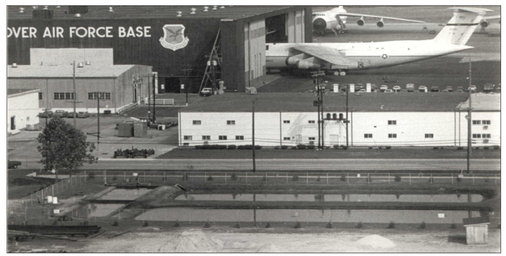

Figure 1: Waste lagoons and oil/water separators seen in foreground of photograph (circa 1960s)

As part of the overall Area 6 remediation strategy, accelerated anaerobic bioremediation (AAB) was implemented in the shallow aquifer at WP21 in 2006 and again in 2010. Boosting the total organic carbon (TOC) levels resulted in concentrations of daughter products increasing by one to two orders of magnitude, indicating successful degradation of chlorinated solvents in the general area of WP21.

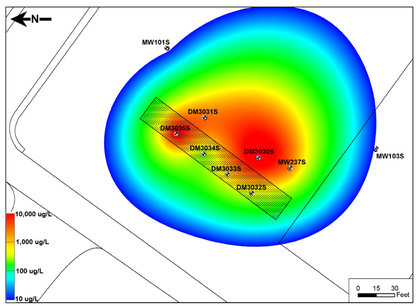

Figure 2: Total chlorinated ethenes and ethanes in groundwater at source area (2015)

However, after 10 years of treatment, localized elevated COC concentrations remained, suggesting that parent material remains adsorbed onto the soil within the source area. To optimize the AAB remedy and address residual source material, a high resolution site characterization was conducted.

Source Characterization

A Membrane Interface Probe-Hydraulic Profiling Tool (MiHPT) survey was conducted in 2016 (**Figure 3**). Residual contamination was detected in a thin silty zone (**Figure 4**) within the upper portion of the aquifer (10 and 14 feet below ground surface [bgs]) in the footprint of the former concrete basins and directly upgradient of the monitoring wells with the highest COC concentrations.

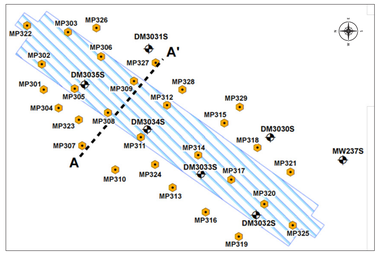

Figure 3: Source area MiHPT locations at site WP21

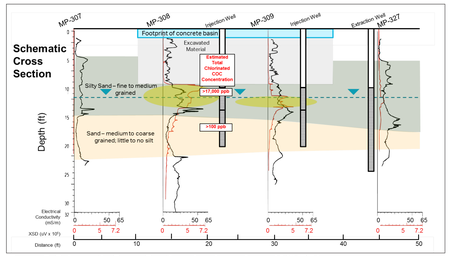

Figure 5: Schematic Cross Section showing selected MiHPT logs

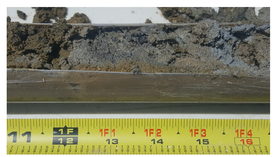

Figure 4: Soil Cores from WP21 source area showing contaminant staining and NAPL

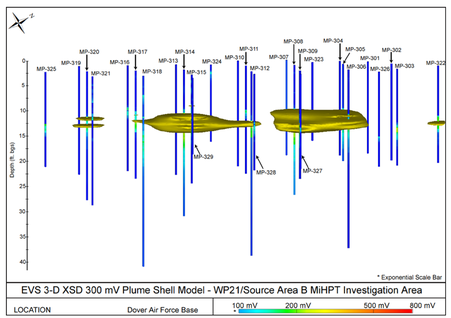

Figure 6: Earth Volumetric Studio plume map of WP21 showing the XSD 300 mV plume shell

EVS was used to illustrate the thin silty zone where solvent source material is being trapped in the subsurface thereby acting as a continuing source area slowly releasing mass (**Figure 5**). The trapped contamination was the focus of the remedy optimization.

Source Treatment Optimization

Using the MiHPT survey data in conjunction with hydraulic modeling, a groundwater recirculation system of eight injection wells and two extraction wells was installed to focus AAB treatment on the silty contaminated layer (**Figure 7**).

The groundwater recirculation system was installed and screened at optimal locations to flush water through the silty contaminated layer, thereby enhancing COC dissolution into the groundwater. Carbon substrate was injected into the flow stream using a mobile treatment trailer (**Figure 8**) to boost TOC levels in the area.

Figure 8: Mobile treatment trailer and injection locations

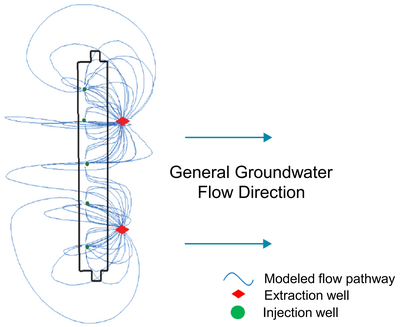

Figure 7: Groundwater recirculation system modeling

To overcome hydraulic conductivity variations within the silty layer, injections were pulsed from one side to the other. Sodium lactate is added periodically to maintain TOC concentrations and establish a robust anaerobic environment.

Recirculation started in May 2017 with initial results showing the expected increase in all COCs. The largest increase was in cis-1,2-DCE (from 9,500 to over 81,000 micrograms per liter [µg/L]) and chloroethane (from 3,000 to over 16,000 µg/L) during the initial injection phase (**Figures 9 and 10**, respectively). This indicates that the parent material desorbs off of the soil matrix and quickly degrades within a few feet of the source area.

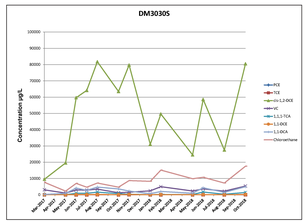

Figure 9: Cis-1,2-DCE concentration vs. time graph

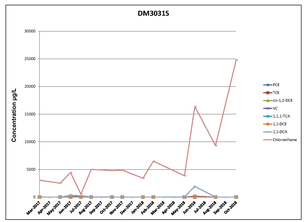

Figure 10: Chloroethane concentration vs. time graph

Conclusion

The MiHPT survey allowed for the optimization of the AAB system to focus a recirculation system directly into the zone of residual contamination. This will ultimately halt the continued mass flux of contaminants and greatly shorten the active remedial efforts of the larger Area 6 groundwater plume.