In Situ Enhanced Bioremediation to Reduce Large TCE/PCE Plumes and Government's Life Cycle Costs

Praveen Srivastav (praveen.srivastav@aptim.com) and William A. Foss (APTIM, Houston, TX, USA)
Robert E. Mayer, Jr. (APTIM, Knoxville, TN, USA)

Background/Objectives. At a former Air Force base in San Antonio, Texas, large plumes of trichloroethylene and tetrachloroethylene existed in the shallow aquifer under the industrial parts of the base and adjacent residential/commercial areas of the city. The plumes extended for several miles under the off-base residential/commercial areas. Previous groundwater remedies consisted of groundwater extraction and treatment, permeable reactive barriers, treatment of hotspots using in situ bioremediation (ISEB), electrical resistance heating, and groundwater use restrictions in off-base residential areas. The operation and maintenance of the groundwater treatment plants was a substantial ongoing cost to the government. The presence of plumes under private residences posed a continuing liability to the government due to potential exposure to contaminants in groundwater. Under a fixed price performance-based remediation contract, APTIM proposed optimization of the existing remedies to reduce life cycle cost and liability to the government. The purpose of the optimization was to reduce concentrations in source areas and reduce the aerial footprint of the plumes.

Approach/Activities. Despite implementation of a variety of remedial actions, the PCE/TCE plumes had not shown a significant reduction in size in years prior to APTIM's work. We also determined that inadequate dosage of carbon was used in previous ISEB injections by other contractors, causing remedy failure. APTIM designed ISEB strategies using a combination of hotspot treatment and biowalls throughout the on-base and off-base parts of the plumes. Groundwater modeling was performed to select locations for hotspot treatments and biowalls that would result in largest reductions in the plume footprint in the shortest possible timeframe. Hotspot treatments were performed primarily using ISEB; however, in situ chemical oxidation (ISCO) was also implemented in certain areas to quickly degrade high contaminant concentrations. Challenges encountered during the implementation of the remedies in on-base areas included working in high security on-base areas and performing work without interrupting ongoing operations. Implementation of ISEB in off-base residential/commercial areas included negotiating access to private properties, working on busy city streets, traffic control, difficult geology, and moving equipment and materials on a daily basis from the on-base storage area and center of operations.

Results/Lessons Learned. APTIM's optimization/remediation strategy achieved percentage reductions in the aerial extent of on-base and off-base plumes that far exceeded proposed percentage reductions in the project objectives. Groundwater modeling played a critical role in the selection of hotspot and biowall locations. Adequate dosing of carbon and bioaugmentation were critical in creating and sustaining a reducing environment for ISEB. Due to reductions in plume footprint and source area concentrations, groundwater extraction and treatment was no longer necessary. Working with the Air Force client, APTIM proposed and received approval of monitored natural attenuation as a replacement remedy for the off-base plume. The groundwater treatment plant was decommissioned and dismantled. Project goals of remedy optimization were achieved ahead of the schedule and resulted in life cycle cost savings for the government.