Chlorinated Solvent Plume Reduced >95% via In Situ Combined Remedy Leading to Long-Term VI Risk Reduction at State-Led Project

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Background/Objectives. A former dry cleaner presented vapor intrusion (VI) risk to nearby residents in Temperance, Michigan. Several anthropogenic and hydrogeologic factors led to a bifurcated groundwater plume of tetrachloroethene (PCE) and related daughter products that intruded the basements of two residences, which complicated both near-term vapor mitigation and long-term vapor source reduction. PCE was discovered in saturated soil at several locations at concentrations above the soil saturation limit, presenting a long-term source for VI. The objective of this State-led project was to significantly reduce source mass and related VI risk, ultimately achieving VI screening levels for groundwater in contact with the structure at the compliance point, the basement sump basin(s).

After a significant remedial investigation/feasibility study (RI/FS) and several interim remedial measures, an in situ remediation pilot study was designed and implemented in two phases. In situ chemical reduction (ISCR) via sulfidated zero-valent iron and enhanced reductive dechlorination (ERD) via addition of electron donor and halorespiring bacteria were selected as the destructive mechanisms for PCE and related daughter products. At some of the locations these technologies were coupled with colloidal activated carbon to expedite the reduction in volatile organic compounds. These technologies were implemented in source areas and in barrier-type configurations at mid-plume and distal plume locations.

Groundwater monitoring at source – transport route – and receptor flow paths have demonstrated significant reduction in PCE, trichloroethene (TCE), and cis-1,2-dichloroethene (cis-1,2-DCE) without accumulation of vinyl chloride. PCE and TCE mass reduction have been estimated at greater than 95% after only 12 to 15 months. Daughter product mass reduction of cis-1,2-DCE has also been observed, and, most importantly, all chlorinated ethenes are below stringent VI screening levels at the compliance point (the basement sump crocks).

Approach/Activities. RI/FS and interim remedial actions (e.g., spent solvent tank removal) were completed in April 2020, while two phases of pilot study in situ remediation delivery events were completed in August 2020 and May 2021. Quarterly performance monitoring of groundwater and soil vapor have demonstrated significant (greater than 95%) reduction in the aqueous plume(s) and the related vapor plume.

Results/Lessons Learned. Results achieved and the field application/approaches will be presented. Remedial injectant and implementation logistics will be discussed. Verification of remediation results, performance metrics and their impact on vapor intrusion risks will be presented and discussed in detail, including groundwater and soil vapor results along the source-transport route-receptor flow path.