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EVO/Bioaugmentation for Treatment of Trichloroethene by Biobarrier and Source Injection Approach

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Background/Objectives. Enhanced in situ bioremediation (EISB) using emulsified vegetable oil (EVO) was selected to treat chlorinated VOCs (primarily trichloroethene [TCE], >10 mg/L) in groundwater in a glacial till aquifer beneath an urban setting in the northeastern U.S. to remove the source and provide for monitored natural attenuation (MNA). The 900 ft long plume originates in an on-site source area in the upper portion of the aquifer and follows a downward gradient to the lower portion of the aquifer off-site. A lense of more uniform clean sand occurs in the till at depth and represents a preferential flow pathway. The 100 ft thick impacted glacial till aquifer resides over less impacted Triassic basin bedrock aquifer. Two microcosms and a pilot test demonstrated that addition of electron donor and bioaugmentation can achieve complete reductive dechlorination of TCE in Site groundwater. EVO was selected given its longevity to provide a more passive approach in this difficult urban setting. Injection through permanent monitoring wells (installed by rotosonic drilling) was selected given the difficult drilling environment (tight till with gravel and cobbles). Treatment is focused in the upper aquifer in the source area (where residual DNAPL is present) and in the lower aquifer at off-site "biobarriers" to intercept the dissolved VOC plume.

Approach/Activities. Injection wells were installed in the source area and along the 400 ft barrier during the first quarter 2014 for a total of 33 injection wells. 14 Injection wells are spaced roughly 10 ft in the source area and 20 ft in the barrier. Advection/dispersion is expected to provide overlap of the resultant hydrogen plumes originating from the injected electron donor based on 2-D finite difference fate and transport modeling. Baseline groundwater sampling was conducted in May 2014 and the data were used to evaluate the amount of donor to inject. Over a period of thirteen days in September/October 2014, a total of 3,810 pounds of Newman Zone™ prepared at a target 10% concentration by volume (31,438 gallons in solution), were injected into the source area and barrier. In the months following, parameters including electron acceptors, pH, ORP, and DO were carefully monitored to evaluate the need to buffer the aquifer (to adjust pH). Evidence of conditions suitable for the establishment of a microbial consortium were observed and the addition of buffer was deemed unnecessary. In May 2015, O'Brien & Gere injected 336 L of the TSI-DC Bioaugmentation Culture® (TSI-DC) containing (Dehalococcoides [Dhc] mccartyii) into the biologically active treatment zones. Groundwater performance monitoring is being conducted on a dynamic basis to assess the performance of the electron donor and culture, and the EISB technology.

Results/Lessons Learned. Presentation will include: an evaluation of post-bioaugmentation performance monitoring data collected to assess EISB effectiveness such as field parameters, standard analytical and specialty microbial analyses; strategy used to measure and control methane produced as a by-product of the reductive dechlorination process; and, dynamic assessment of the path forward after the first peak phase of EISB (including a maintenance plan to control fouling at injection wells in order to preserve functionality for potential future use).