Overcoming Challenges and Closure-Strategy Development at a Long-Term, Large-Scale CVOC Bioremediation/Thermal Project

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Background/Objectives. Historical releases of chlorinated solvents occurred from a former manufacturing facility in Connecticut resulting in concentrations of chlorinated volatile organic compounds (CVOCs) in source zone groundwater of up to 780 ppm and concentrations of over 20 ppm in the resulting 15-acre downgradient groundwater plume. Source area residual dense non-aqueous phase liquid (DNAPL) and CVOCs were situated in tight soils (till) and weathered bedrock. The majority of the off-site CVOC groundwater plume is located within a forested wetland where the soils are more permeable than in the source area. The primary contaminant of concern was trichloroethylene (TCE) although other CVOCs persisted in groundwater. The final multi-faceted remedial solution was a large-scale project incorporating limited source zone excavation followed by source zone in-situ electrical resistance heating (ERH), and extensive plume-wide in-situ bioremediation utilizing enhanced reductive dechlorination (ERD) and bioaugmentation. Remediation has been ongoing since 2009.

Approach/Activities. In situ thermal treatment of the saturated zone was proposed as the remedy for the source area combined with in-situ bioremediation via ERD and bioaugmentation, followed by monitored natural attenuation to address the migrating groundwater plume. The bioremediation system consisted of approximately 600 injection wells installed across multiple biobarriers installed to a maximum depth of 40-feet. Approximately 20,000 gallons of emulsified vegetable oil substrate (EVO) were injected between June 2010 and October 2015. Bioaugmentation followed the 2010 injections. Beginning in Spring 2017, approximately seven years following the initial phase of treatment, targeted injections were undertaken at approximately 200 locations spread across several areas within the original biobarriers. Approximately 3,500 gallons of EVO were injected with the goal of reducing recalcitrant pockets of CVOCs and accelerating remedial completion. The 2017 injections are expected to be the final round of injections at the site. The ERH system operated from October 2010 through July 2011 and was comprised of 89 electrodes installed in the source area overburden and weathered bedrock. Approximately seven years of remediation performance monitoring data has been collected and evaluated. The monitoring well network has been evaluated for locations where compliance has been attained and where pockets of recalcitrant CVOCs remain.

Results/Lessons Learned. After seven years following initial substrate injections, the combined ERD/ERH remedial approach is progressing well despite challenges encountered at each injection event. It is anticipated that the 2017 targeted substrate injections will be the last. The exact locations for substrate addition were chosen based on past performance data and biogeochemical parameters collected through December 2016. Data analytics were used to target injection locations and maximize injection efficiency. This abstract focuses on the evaluation, design, and implementation of year-seven supplemental substrate injections and will highlight the basis for the design approach, challenges encountered, lessons learned, and deviations from the initial three injection programs. This abstract will also discuss the closure-strategy development following this last round of injections and how regulatory compliance will be achieved.