Observations following 10 years of Bioreactor Operations in a South-Central Texas Fractured Bedrock Aquifer

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Background/Objectives. Camp Stanley Storage Activity (CSSA) is a U.S. Army post located in south-central Texas. In the early 1990s, a chlorinated solvent plume containing tetrachloroethylene (PCE) and its degradation products was discovered in an old landfill area that was later designated Solid Waste Management Unit (SWMU) B-3. The trenches in the landfill range in depth from 5 to 15 feet and are approximately 350 to 400 feet long and 12 feet wide. Soil cover on the site is minimal with an underlying fractured, limestone environment with some karst development. Subsequent investigations at SWMU B-3 revealed a chlorinated solvent mass had migrated into formation members of the Middle Trinity Aquifer; including the shallow Glen Rose formation and deeper Cow Creek formation. Depth to groundwater on the site can range from 70 to 300 feet below ground surface depending on rainfall and recharge. In 2007, an in-situ pilot scale bioreactor was installed to begin remediation of contaminated groundwater by first removing waste in the disposal trenches and then backfilling with a gravel/mulch substrate.

Approach/Activities. The bioreactor was conceptualized and designed to remediate the affected groundwater and unsaturated zone underlying SWMU B-3. Construction included excavation, removal, and offsite disposal of affected soil, debris, and waste contained within six trenches. To stimulate biodegradation, a conveyance and distribution system was installed within the mulch/gravel backfilled trenches. Currently, the system is connected to seven extraction wells designed to pump VOC impacted groundwater to the trenches. Approximately, 100,000 gallons of contaminated groundwater is treated at the bioreactor each day. Groundwater from the extraction wells routinely include PCE and trichloroethene (TCE) concentrations exceeding 100 parts per billion (ppb). Since inception, the bioreactor has undergone several upgrade activities including the addition of extraction and injection wells, and the installation of an automated SCADA system. Several enhancements have also been implemented to promote anaerobic biodegradation. In 2008, microbial activity was augmented with the addition of the KB-1 *Dehalococcoides* culture. In 2012 and 2017, lactate was introduced into the bioreactor as an organic substrate to enhance the anaerobic environment needed for optimal microbial populations.

Results/Lessons Learned. Since 2007, samples collected at the bioreactor have included an analysis of several performance parameters used to track enhanced anaerobic bioremediation progress and understand site conditions within the treatment zone. These parameters provide information on contaminant concentrations, reductive dechlorination breakdown products, redox conditions, prevailing terminal electron accepting processes, and general water chemistry. Utilizing long-term data sets, we plan to evaluate the success of the bioreactor treatment system over a 10-year period (2007-2017). Moreover, we hope to examine performance parameter expectations to help determine the overall effectiveness of the bioreactor system in achieving remedial objectives and operational endpoints. This analysis may also help to determine if the current monitoring protocol should be revised to include data specific to multiple degradation mechanisms in order to more fully understand the active degradation reactions and thereby improve overall bioreactor system operations and performance.