Performance and Refresh of a Full-Scale Biowall System Designed to Treat Chlorinated Solvents in Groundwater

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Background/Objectives. The former Seneca Army Depot Activity is located in the Finger Lakes Region of New York near the town of Romulus. The Ash Landfill site is located in the former Depot and consists of 5 former solid waste management units related to the incineration of non-hazardous materials and disposal of the incinerator ash. Operations and disposal practices at this site have resulted in chlorinated solvent impacts to soil and the formation of a plume that extends approximately 1,100 feet to the south. Remedy was implemented at the Ash Landfill starting in the mid 1990s with a source removal excavation and the installation of a zero-valent iron (ZVI) permeable reactive barrier (PRB) at the plume toe near the property line in 1999.

Approach/Activities. After the installation of the ZVI PRB the Ash Landfill chlorinated solvent plume was assessed to determine how long the plume would likely be present and thus how long the ZVI PRB would be required. The resultant modeled predicted plume lifespan was unacceptably long and additional plume control measures were conceptualized to accelerate plume reduction and site closure. Enhanced bioremediation in the form of bark mulch PRBs was selected for plume control expansion after a pilot test was successfully completed onsite in 2005. 2,840 linear feet of trenched in bark mulch PRBs were installed in 4 separate biowall segments in 2006. The biowall segments were placed along the plume length, oriented perpendicular to groundwater flow and plume migration, approximately 200 feet or 3 years groundwater travel time apart. After approximately 10 years of highly successful performance, the biowalls were reaching depletion and remedy performance was stating to decline. In 2017, the Ash Landfill biowall system was refreshed with additional organic carbon and pH buffer mass to re-establish remedy performance. Biowall refresh was accomplished by installing injection wells in each biowall segment and directly injecting a mixture of emulsified vegetable oil mixed with pH buffer while extracting groundwater from adjacent biowall wells. Pairing extraction with coincident injection induced recirculation loops between extraction and injection wells improved distribution and accelerated the refresh process.

Results/Lessons Learned. During the original biowall pilot study and full scale design processes the lifespan of the biowall system was estimated to be 10 to 15 years. The biowall system achieved the lower end of the life expectancy range before carbon refresh was required to maintain system performance. Biowall depletion and need for refresh was identified through a multiple lines of evidence approach consisting of statistical analysis of geochemical shifts over time and reversals in parent (TCE) and daughter (cis-1,2-DCE, VC and ethene) product concentration trends. This lines of evidence approach is applicable to any enhanced bioremediation application to identify depletion and the need for refresh. Biowall performance data and the lines of evidence approach that was used to identify biowall depletion will be presented.

During biowall refresh, it was discovered that biowall backfill materials had lower permeability than expected due to material compaction over time and a greater percentage of fine sand than expected. This necessitated the installation of additional injection wells in the biowalls and a reduction of design radius of influence to ensure that adequate substrate distribution was achieved. One performance sampling event has been completed since biowall refresh was completed. This post-refresh dataset and lessons learned during refresh will be presented.