Site Characterization and Remedial Planning for TCE-Impacted Groundwater in Saprolite and Crystalline Bedrock

Jeff Zoeckler (jeff.zoeckler@hanaengineers.com) and
Christina Jettie (christina.jettie@hanaengineers.com)
(Hana Engineers & Consultants, LLC, Richmond, VA, USA)

Background/Objectives. The Former Manassas Air Force Communication Facility (MAFCF), located in Independent Hill, Virginia, is currently owned and operated by Prince William County Schools and used as an administration, maintenance, and school complex. MAFCF was operational as an aircraft control and warning station from 1952 to 1959. Currently, the United States Army Corps of Engineers is conducting ongoing environmental restoration activities at MAFCF in accordance with the Formerly Used Defense Site Program. A Remedial Investigation (RI) was finalized for the site in 2014, indicating concentrations of chlorinated solvents (primarily TCE) in groundwater that could trigger unacceptable risks for hypothetical future site use. Therefore, a Feasibility Study (FS) is being completed to address the TCE-impacted groundwater. Additional focused site characterization activities including an in-situ microcosm study were completed in early 2017 to address data gaps and support the development of remedial alternatives in the FS.

The site lies in the Piedmont Physiographic Province, characterized by saprolitic deposits overlying hard igneous and metamorphic rock. Locally, saprolitic material of both phyllite and the gneiss-like units occur before transitioning to highly weathered, more competent units at depth. Groundwater at MAFCF occurs in three zones: shallow, intermediate, and deep. Packer testing indicates that all three aquifer zones appear to be connected through fractures.

Approach/Activities. Several advanced techniques were incorporated into the investigative approach. Both membrane interface probe (MIP) and a mobile analytical laboratory were used during the RI to obtain real-time plume concentration data and estimate the plume dimensions in the shallow aquifer. Packer testing and down-hole geophysics were utilized during supplemental site characterization to identify fracture zones and preferential flow paths. An in-situ microcosm study was completed to determine if microorganisms capable of degrading TCE and other chlorinated VOCs are present under natural, biostimulated and bio-augmented conditions. Currently, a three-dimensional groundwater model is being completed to simulate groundwater flow, solute transport, and biodegradation at the site. The model and sensitivity analysis are being used to estimate remediation timeframes for alternatives in the FS.

Results/Lessons Learned. Real-time groundwater analysis was successful in determining the overall shape of the chlorinated VOC plume and identifying focused areas for future investigation. Packer testing and borehole geophysics were successful in identifying fractures and flow zones in bedrock. An initial biological study indicated no detective levels of *Dehalococcoides*, *tceA* gene, *bvcA* gene, or *vcrA* gene. However, biostimulation and bioaugmentation microcosms showed measurable levels of *Dehalococcoides, tceA* gene and *vcrA* gene, indicating the presence of the enzyme responsible for reductive dichlorination of TCE to cis-DCE and from cis-DCE and VC to ethene. Modeling results including prediction of remediation time frames will be available for discussion at the time of the presentation in April 2018.