Attenuation of a chlorinated solvent plume expedited by underground construction

Owen Miles
Haley & Aldrich, Inc.

John R. Kastrinos, P.G. (PA), LSP
Haley & Aldrich, Inc.

Jacob Chu, P.Eng.
Haley & Aldrich, Inc.

Introduction

• Tetrachloroethene (PCE) was released from a former dry cleaner to a glaciofluvial aquifer in an urban watershed in New England.
• During remedial investigation work, a new building was built with underground space that employed a concrete slurry wall that spanned the full width and depth of the plume (Figure 1).
• Recovery wells were installed upgradient of the building to contain the plume and prevent potential lateral displacement of the plume by the slurry wall.
• Downgradient of the wall and containment system, PCE declined to below the state regulatory limit within one to three years. The rapid decline was driven primarily by the low organic carbon content of the aquifer matrix (0.5% or less), combined with containment by the groundwater containment and treatment system (GCTS), and dilution by groundwater entering the plume from areas to the north and south.
• A marine clay aquitard underlies the glaciofluvial deposits.
• The authors evaluated the influence of downward vertical gradients on potential back-diffusion from the underlying glaciomarine aquitard.

Post-construction fate and transport

• The GCTS was installed upgradient of the slurry wall to prevent plume displacement.
• Quarterly monitoring indicated PCE was not being displaced by the slurry wall, and that the GCTS system was effective.
• Downgradient of the slurry wall, PCE concentrations declined from part-per-million levels to below the 50 µg/L regulatory limit (the state standard protective of vapor intrusion) one to three years after constructing the slurry wall (Figure 2).

Matrix diffusion modeling

• PCE concentrations were higher in deep wells, indicating the plume was largely confined to the deepest section of the aquifer.
• Downgradient of the slurry wall, downward vertical gradients varied between 0.2 and 0.8, with an average of 0.4.
• 2-dimensional modeling was used to assess potential for back-diffusion of CVOCs from the aquitard under site gradients.
• Different gradients were tested, based on observed downward gradients at the site. The modeling approach is shown in Figure 5.

Summary and conclusions

• PCE concentrations in the downgradient area of the plume decreased to below the regulatory limit one to three years after completing the wall.
• The low organic carbon content of the aquifer matrix (0.5% or less), combined with containment by the GCTS and the barrier effect of the slurry wall led to rapid declines in PCE concentrations.
• Although CVOCs were detected at the base of the aquifer, which is underlain by a glaciomarine aquitard, there has been no evidence of back-diffusion from the aquitard.
• Based on matrix-diffusion modeling, the local downward vertical gradients are sufficient to prevent back-diffusion from causing PCE to rebound in the overlying aquifer to levels above the regulatory limit (Figure 6).