Leveraging PRISM^{TM} to Assess Contaminant Flow Pathways: Magothy Aquifer, New York

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Background/Objectives. Sound conceptual site models (CSMs) are essential for developing a comprehensive understanding of natural attenuation processes and preferential groundwater flow pathways at contaminated sites. However, as groundwater remediation projects are commonly challenged by inherent geologic complexity in the subsurface, the development of CSMs and a quantification of the associated uncertainties often yield results that are less accurate than desired. In this study, we use PRISM^{TM}, a holistic approach that leverages sequence stratigraphy, facies analysis, and subsurface geophysics, to better understand the subsurface geology and define preferential flow pathways within a complex groundwater remediation site. This information is then used to optimize remediation strategies at both the source and the dilute fringe of a trichloroethylene (TCE)-impacted groundwater plume.

Approach/Activities. We correlate depositional sequences from continuous geophysical data to trace strike and dip cross sections throughout the subject site (Long Island, New York). This information is then combined with detailed facies models, developed within the context of modern analogs, to develop a high resolution sequence stratigraphic framework for the Turonian Magothy Formation beneath the Site.

Results/Lessons Learned. Correlation of existing geophysical data and complementary well logs from the Site reveals two high-frequency, depositional sequences, consisting primarily of seaward-prograding deltaic and fluvial deposits topped by thick glacially-derived sediments. In light of this high resolution stratigraphic interpretation, re-examination of the subsurface heterogeneity and impacted groundwater data show significant stratigraphic constraints on the plume migration pathway. Contaminants appear to be primarily traveling through laterally continuous fluvial and deltaic mouth bar sands, however, in some locations major stratigraphic markers (i.e. “maximum flooding surfaces”) appear to exhibit stratigraphic control on TCE concentrations. This may be explained by the fact that the maximum flooding surfaces are the muddiest intervals of the site, rendering them as potential storage units of contamination, which could result in a statistically important first-order increasing trend via back-diffusion. Therefore, identifying stratigraphic markers and predicting the facies relationships of transmissive and storage zones using PRISM^{TM} is crucial to accurately predicting groundwater flow and developing robust remedial strategies at the Site.