Compartmentalized Approach to Bedrock and Overburden Remediation at a Legacy Petroleum Site

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Background/Objectives. The site was formerly a general store with two 1,000-gallon UST's with primary constituents of concern being benzene, toluene, ethylbenzene, and xylenes (BTEX). Historic monitoring wells already installed at the site were screened at various depths in the overburden, bedrock, and across the overburden/bedrock interface. The shallow, highly fractured schist bedrock is approximately 10 feet (ft) below ground surface (bgs) with groundwater observed within the overburden and bedrock wells. The conceptual model theorized that hydrocarbon mass resided at the overburden/bedrock interface and was contributing to groundwater exceedances in bedrock.

Approach/Activities. Based on the limited historical soil and groundwater data, and the multiple zones that were represented in the monitoring well network, additional investigation was warranted to characterize the mass present in the overburden and the bedrock. The characterization of the bedrock consisted of identification of fractures/weathered zones within the bedrock using a downhole camera, discrete groundwater sampling from identified fractures/bedding planes using a custom designed straddle packer assembly with an eighteen-inch sample interval, and high resolution water level monitoring of the surrounding well network during groundwater sampling using pressure transducers to define the horizontal connectivity between existing monitoring wells and the vertical connection between formations. To investigate the overburden, five overburden soil borings were completed with soil samples collected every 2 feet to quantify the saturated soil mass contributing to groundwater impacts in the overburden and bedrock. The soil borings were converted to temporary piezometers to obtain groundwater samples and to evaluate the connection of the overburden with the bedrock during the bedrock injections. The piezometers confirmed that the overburden was contributing to the impacts identified in the bedrock monitoring wells.

Based on the data collected from the RDC, a clear picture of the subsurface lithology and hydrological connectivity between the overburden and bedrock was confirmed. The data collected from the discrete groundwater sampling, provided information to assist in injection location and remediation product loading. Injections began in the bedrock and targeted four fractures identified in the RDC sampling event. Injections were completed using a truck mounted custom injection system containing a 165 HP triplex positive displacement pump and a custom straddle packer allowing precise product placement in the formation. During injections, groundwater levels were constantly monitored to determine well connection and radius of influence. Approximately six months after the bedrock injections were completed, the overburden was treated via a similar high pressure/high flow injection system.

Results/Lessons Learned. After the first injection event, the compliance bedrock well achieved cleanup standards and 75% reduction of BTEX concentrations was demonstrated in the wells screened across the soil/bedrock interface. Upon completion of the second injection event (overburden only), all compliance wells achieved cleanup standards. Quarterly sampling events confirmed the initial post injection results and a No Further Action letter was issued to the site owner.