High-Resolution Site Characterization of a Chlorinated Solvent Groundwater Plume beneath a Phytoremediation Site

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Background/Objectives. Naval Base Kitsap Keyport occupies 340 acres (including tidelands) on a small peninsula in the central portion of western Puget Sound in Kitsap County, Washington. The former base landfill comprises approximately 9 acres on the west side of the installation and was formerly part of a wetland that now borders the landfill to the west and south.
The landfill was the primary disposal area for domestic and industrial wastes generated by the base from the 1930s until it was closed in 1973. Plating waste, waste paint, thinners, and strippers from the plating, paint and stripper shops were disposed of in the southwest area of the landfill. The primary contaminants of concern (COCs) at the site are [trichloroethene, trichloroethane, and their daughter products. Two primary source areas were identified during the Remedial Investigation/Feasibility Study (RI/FS). The selected remedy for the two source areas (referred to as the North and South plantations) was phytoremediation in concert with natural attenuation, with capping and other controls across the remainder of the site. After more than 15 years of monitoring, it has been demonstrated that the north plantation has successfully been reducing contaminant concentrations, but the south plantation has not met remedial expectations. Re-characterization was performed to delineate contaminant hot spots beneath the south plantation and the central landfill in anticipation of future treatment.

Approach/Activities. The re-characterization progressed iteratively over three field seasons, from high-density screening level data collection to progressively more focused definitive data collection. Initial screening data collected in 2015 consisted of 267 tree core samples and geophysical surveying. Isoconcentration contours were developed using these initial data and overlaid with all current data from the site, including long-term monitoring data, natural attenuation monitoring data, and the geophysical survey data. The apparent hotspots identified through this data overlay were then investigated in 2016 using 61 membrane interface probe (MIP) direct-push borings to refine the understanding of lateral extent of contamination and assess vertical extent. Depth-specific isoconcentration contour maps generated based on the MIP data were used to select locations and depths for collection of grab soil and groundwater samples for laboratory analysis, collected in 2017 using direct-push continuous coring at 31 locations. The laboratory results of soil and groundwater samples were used to select locations for permanent groundwater monitoring wells in hotspot cores and at downgradient extents. During auger drilling of permanent monitoring wells, relatively undisturbed soil samples were collected for analysis of soil characteristics. Groundwater samples from the newly installed wells were analyzed for the target chlorinated volatile organic hydrocarbons (cVOCs) as well as conventional chemistry parameters and microbial populations to allow screening of remedial technologies that could be used to target hot spots and reduce restoration timeframe.

Results/Lessons Learned. The iterative investigation approach succeeded in focusing definitive data collection activities on high-value, data-rich locations. Isoconcentration contours generated from tree cores provided an overall lateral distribution of cVOC hotspots that was confirmed by the MIP probes. The MIP investigation revealed a much more complex vertical distribution of cVOCs than was surmised from the tree core data and the original conceptual site model. Field photoionization detector readings during direct-push continuous coring matched

well with the MIP response, allowing targeted grab sampling to provide a correlation between MIP response and laboratory-measured cVOC concentrations in soil and groundwater. The combined data set provided a high level of confidence for selecting optimal locations for permanent groundwater monitoring wells and collection of soil characteristics data representative of hot spot cores.