Groundwater Plume Analytics® Tools for Improved Conceptual Site Models at Bioremediation Sites

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Background/Objectives. According to USEPA guidance, a conceptual site model (CSM) "uses a concise combination of written and graphical work products to portray both known and hypothesized site information." While hypothesized information may be useful in the beginning stages of a project, more mature sites should focus on known data for updating the CSM. Groundwater Plume Analytics® is an innovative evaluation technique that uses known (i.e., empirical) data to reliably and effectively communicate meaningful patterns in groundwater plume behavior. Groundwater Plume Analytics® tools allow for improved CSM updates as a site matures by demonstrating plume behavior and stability resulting from remedial actions conducted at a site.

Approach/Activities. The Ricker Method® for plume stability analysis is a unique public-domain method of evaluating plume stability that overcomes limitations posed by conventional well-by-well analysis techniques. Outputs from the Ricker Method® can be used to further dissect and evaluate dissolved plume behavior. This can be especially helpful when evaluating biodegradation of chlorinated solvents. For example, as parent compounds (e.g., trichloroethene) degrade biologically to daughter compounds (e.g., cis-1,2-dichloroethene and vinyl chloride), the plume-wide rate of attenuation for each constituent can be determined. One can also easily observe biodegradation patterns throughout the plume. For example, during biodegradation, the molar fraction of a parent compound decreases as molar fractions of daughter compounds increase. These plume-wide attenuation and molar fraction rates provide powerful insight into the remedy effectiveness and informing a CSM as to data gaps.

Outputs from the Ricker Method® can be used as a basis for primary analysis and other plume diagnostic tools that allow for further evaluation and communication of groundwater plume dynamics. One of these innovative tools includes the Spatial Change Indicator™ (SCI) analysis. This powerful tool provides detailed insight into specific parts of a plume. It can demonstrate remediation effectiveness, inform remediation strategy optimization, identify potential sources, and illustrate how the plume is reacting to natural and engineered environmental conditions at a remediation site.

This session presents the use of Groundwater Plume Analytics® tools to update CSMs for multiple large-scale and mature bioremediation sites.

Results/Lessons Learned. Using Groundwater Plume Analytics® tools to update CSMs at several mature remediation sites resulted in many beneficial outcomes, including cessation or optimization of active remediation systems and moving to natural remediation systems, optimized monitoring programs, quantification of remedial progress (e.g., demonstrated reductions in plume area, average concentration, and mass) and calculation of attenuation rates to quantify natural attenuation. Additional qualitative beneficial outcomes have also been realized, including focused attention from site managers and effective communication with project stakeholders. Many examples of the beneficial results will be presented.