Upscaling of Chlorinated Solvent and 1,4-Dioxane Degradation Data from Detailed Fluvial/Alluvial Stratigraphy to a Site Conceptual Model for Monitored Natural Attenuation

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Background/Objectives. Recent advances in borehole logging and software combined with concepts such as sequence stratigraphy (e.g., Shultz et al., 2017) have made sophisticated subsurface interpretation and models accessible to the environmental consulting industry. However, in practice, conceptual site models are still very often based on generalized and often arbitrarily subdivided stratigraphy. This can be problematic in evaluating natural attenuation, as biological and abiotic degradation pathways can depend on subtle variations in factors such as nutrient availability and mineral content of soils.

Approach/Activities. A subsurface investigation was performed at a complex site with unconsolidated alluvial/fluvial stratigraphy. The site is located in an industrial area with aging comingled groundwater plumes of various chlorinated solvents and 1,4-dioxane. Concentration trends have been obscured by off-site sources and large fluctuations in the water table. A detailed stratigraphic interpretation was first performed to define the finest scale flow units. Natural attenuation was characterized at this level of detail, then “upscaled” to a coarser, larger scale that can be described using data from the existing network of monitoring wells. The effect of this scale-dependent analysis on predicted and measured compound specific isotope ratios is examined.

Results/Lessons Learned. Resolving the fine-scale detail of naturally-attenuating groundwater plumes can provide context for unexpected observations encountered during a monitored natural attenuation program. However, an understanding of the maximum level of detail that can be resolved is critical to quantifying the significance of these data. This is particularly important when large fluctuations in water levels may lead to changes in sampling biases. These insights can help minimize the scope and cost of any active remediation that may be required by a regulator and/or promote a remedy change to an existing monitored natural attenuation program.