

## Determining Applicable Cleanup Criteria when None Exist: Back Diffusion from Soil to Groundwater

Mark Klemmer & Scott Potter – ARCADIS, U.S., Inc.

William Parry – CSX Transportation, Inc

Groundwater impacts including chlorinated solvents (trichloroethene [TCE], cis-1,2-dichloroethene [cDCE], and vinyl chloride [VC]) at the site of a former rail yard required cleanup to stringent State of Massachusetts GW-2 criteria, which are based on risk of vapor intrusion (VI) to buildings. Vapor intrusion-based soil criteria are available, but only apply to vadose-zone soils that have the potential to contribute to VI impacts. The soil concentrations listed are not intended to correlate to groundwater impacts if in contact with that soil. In this scenario, the impacts to the groundwater aquifer are caused by back-diffusion of mass stored in the underlying clay aquitard. Consistent with the site conceptual model, much of the original plume had degraded, leaving behind high concentration soil and pore water impacts in the clay that continue to back-diffuse to the overlying sand aquifer. Remediation of the groundwater aquifer itself may be temporarily successful, but the concentration of CVOCs in the underlying clay is likely to continue diffusing out of clay and potentially re-impact the aquifer. Although the clay soils themselves don't exceed the regulatory criteria, the potential for back-diffusion above the GW-2 standard in groundwater was still a concern and represented a VI regulatory driver. While plenty of remedial options could be used to clean the groundwater aquifer, a remedy was required for the underlying clay that would prevent continued back-diffusion.

Multiple analyses were conducted at the site to determine appropriate criteria that should be met in order to prevent back diffusion, meet groundwater criteria, and prepare the site for sale. This presentation will walk through multiple methods used in an attempt to determine appropriate clean-up criteria for the clay, meet the VI-based groundwater criteria, and allow final sale of the property. The initial method used consisted of a judgment-based approach that utilized spatial correlation between the distribution of total VOCs in groundwater and the more limited area exceeding the VI-based GW-2 standards. A simple mathematical method was conducted that uses a simple equilibrium calculation at the clay/sand interface and incorporates dilution by groundwater transport in the sand zone; allowing a simple and straightforward determination of allowable clay soil concentrations that will not contribute to groundwater impacts above the GW-2 standards.

After the methods were complete, exceedances of the final proposed criteria were compared against the available site data. The result showed a distinct area that mimicked a former rail spur, indicating a likely source for the overall plume, and indicated that the proposed remedy for the clay soils could be reduced by approximately 50% from the original concept. The soil/groundwater remediation system is currently operating and some areas should be partially complete by Fall 2015.

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