Improved conceptual site modeling for environmental remediation using a multi-stage geophysical approach

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Environmental remediation efforts traditionally rely on test borings to obtain the needed information for developing a conceptual site model (CSM). The efficacy of the remedial design largely depends on the accuracy of the CSM but, budgetary and site constraints often result in sparsely sampled sites with high levels of uncertainty, especially in areas with complex geologic conditions. By supplementing traditional boring and sampling techniques with surface and borehole geophysical data, the CSM can be refined to more accurately represent true conditions at the site, resulting in improved decision-making and potential cost savings. This work presents a case study of a site impacted by petroleum hydrocarbons that benefited from the completion of a preliminary (i.e., on-site) surface geophysical scope followed by a limited borehole logging scope and an expanded (i.e., off-site) surface geophysical scope. Surface geophysical methods included electromagnetic terrain conductivity (EM) mapping, two-dimensional electrical resistivity imaging (2-D ERI), and ground penetrating radar (GPR), and borehole wire-line methods were limited to caliper, natural gamma, and borehole camera. The combined geophysical approach led to the identification of a confining shale layer at depth that was controlling contaminant migration and causing flow in an unexpected direction beneath a surface ridge. The enhancement of the CSM from the addition of geophysical data resulted in improved decision-making to expedite moving the site toward achieving remediation goals.