INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

Use of High Resolution Site Characterization Tools

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Notice

IDEM Technology Evaluation Group (TEG) completed this evaluation of *High Resolution Site Characterization* (HRSC) based on review of items listed in the “References” section of this document.

This evaluation does not approve this technology nor verify the technology’s effectiveness in conditions not identified here. Mention of trade names or commercial products does not constitute endorsement or recommendation by IDEM for use.

Background

As a preliminary conceptual site model (CSM) is developed using existing data analysis and interpretation across the spectrum of IDEM programs, uncertainties are often identified. The scale of variation in the subsurface can necessitate the use of HRSC to resolve these uncertainties. With lateral variations in subsurface conditions, correlating even closely spaced borings is highly speculative. HRSC data can rapidly and efficiently improve a CSM and guide the project with further characterization, risk evaluation and, where necessary, remedy selection and implementation. Through integration of all of the HRSC data types (geological, hydrological, and chemical), collaborative data sets (USEPA 2010) can be generated and acted upon in real-time processes. HRSC data obtained while onsite provide a better understanding of contaminant concentration, mass, and distribution in the subsurface and the stratigraphy, geology, and hydrogeology. Using the HRSC data, properly placed soil borings and monitoring wells collect suitable samples for the potential delineation and closure of a site.

Use HRSC applications to address CSM data gaps by:

- Delineating the extents of contaminants of concern (COC).
- Identifying the presence and extent of both light and dense non-aqueous phase liquids (NAPL).
- Identifying the site lithology.
- Estimating the site hydraulic conductivities.

Many tools could be considered under the HRSC definition. However, this document focuses on direct sensing tools described in *Implementing Advanced Site Characterization Tools (ASCT),* (ITRC 2019). The ASCT Tool Selection Matrix (ITRC 2019), using the COCs, site conditions, and type of data collected chooses the correct tools to optimally characterize a site. IDEM encourages utilizing these tools to optimize the characterization of a release that results in an unknown area of NAPL or is likely to require additional work to characterize or remediate the site.

Advantages

Using HRSC tools at the beginning of an investigation to gather critical release and site information can achieve the project goal of characterizing the release in a much shorter time than when using traditional methods. Use HRSC tools to:

- Collect the Initial Site Characterization hydrogeological data and collaboration with COC data make an informed decision on the need and location of monitoring wells.
- Accurately collect environmental measurements at the same scale as the heterogeneities that control contaminant distribution and transport. These heterogeneities often occur at scales that are too small for conventional investigation strategies and technologies to characterize optimally.
- Obtain detailed geologic, hydrogeologic and contaminant information necessary to guide target remediation (when needed) and select an appropriate closure strategy.
- Identify both the contaminant mass and phase(s) that are present (for example, non-aqueous phase liquid, dissolved, sorbed and vapor) and evaluate the permeability of contaminated soil zones.

Technologies commonly associated with HRSC include real-time, direct sensing equipment and other field-based data generation technologies that provide larger quantities of data, which form the basis for evaluating a site. HRSC strategies can be implemented adaptively using various sampling approaches including, but not limited to, discrete sample intervals (USEPA 2017), vertical profile borings, transect-based, and media-sequenced characterization strategies (USEPA 2018).

HRSC strategies and technologies result in a scale-appropriate understanding of the site contaminant distribution that efficiently and reliably supports the evaluation, and implementation of an effective closure strategy. HRSC tools support a reduced time to site closure by characterizing subsurface conditions critical to successful remedy design at a scale that conventional investigation methods are unable to attain.

Limitations

Multiple barriers inhibit support of the general adoption of HRSC tools. These barriers include the perception that the tools are not readily available, they are too expensive, and the data are perplexing or too subjective. Moreover, some environmental practitioners are unsure of how to select among the tools and integrate their use to best meet characterization and remedy objectives.

While collecting real-time data can be efficient, it is equally important to determine the correct resolution of data and not collect unnecessary data. Data resolution is commensurate with the scale to ensure that the distribution of contaminants is sufficiently delineated and that an effective remedial strategy, if necessary, can be developed.

Practical Considerations

The use of HRSC tools is promoted by IDEM in the initial investigation to efficiently take advantage of the speed and coverage of real-time reconnaissance tools like membrane interface probe (MIP), laser induced fluorescence (LIF), and Optical Image Profiler (OIP) to target areas of contamination for higher resolution (EPA 2010). Other HRSC tools that efficiently provide geologic and hydrogeologic information include electrical conductivity system (EC), hydraulic profiling tool (HPT), and Waterloo Advanced Profiling System (APS).

Selecting the proper LIF tool to target specific NAPL is essential. Some LIF systems are blind to certain NAPLs. For example, UVOST® characterizes light-fuel LNAPL and is unresponsive to many coal tars, which are DNAPLs with potentially hundreds of times more toxicity and recalcitrance than diesel. The Tar-specific Green Optical Screening Tool (TarGOST®) system delineates coal tar but cannot detect gasoline. Selecting the inappropriate LIF tool may result in overlooking contaminants and wasting money, effort, and remediation efficacy. Dye-enhanced LIF system detects chlorinated solvents and similar compounds that do not naturally fluoresce.

The density of data varies depending on site-specific data collection objectives for each of the data types (geology, hydrogeology, and chemical). The EC measurements provide relative grain size analysis while the HPT provides an estimate of the hydraulic conductivity and saturation of the pore space. The HPT and APS are probes with a screened injection port on the side of the tool injecting water into unconsolidated formations advancing at a consistent rate through virgin materials. A pressure sensor located in the probe assembly measures the pressure required to inject water into the formation at a flow rate of 200–300 mL/minute. By performing a dissipation tests the HPT can evaluate hydrostatic pressure at multiple intervals and determine water levels. The HPT pressure log and EC log provide detailed information about lithology and hydrogeology. The APS and HPT probes use their screened injection ports also to collect groundwater grab samples at specified depths (McCall, W., et al., 2017).

If an active remedy is necessary, a focused analysis using HRSC tools may be necessary for appropriately designing corrective action and remediation work plans. Integration of efficient remediation practices during site characterization and site cleanup can help reduce the project's cumulative environmental footprint. USEPA recommends the use of direct-push rigs with direct sensing tools such as MIP, LIF, or OIP to collect real-time measurements and minimize separate mobilization of field crews (USEPA, 2019).

Conclusion

Because HRSC tools can collect large quantities of data in a small amount of time, HRSC tools are very efficient to fill identified data gaps and uncertainties in the CSM. Using the information obtained from the HRSC tools, the project team can optimize the remedy design and accelerate the closure process. Upon review of existing information, the project team should identify the scale of variation and the area of uncertainty in the CSM. The HRSC tools assist in verifying the source zone distribution in the impacted soils (Columbia Technologies, March 19, 2018). Once the distribution of the NAPL mass is known, measure the NAPL transmissivity to identify the potential for the NAPL to migrate (ITRC 2018 and API 2016). Additionally with most volatile organic compounds, the HRSC tools are useful to estimate the boundaries of the dissolved contaminant plume.

Further Information

If you have any additional information regarding this technology or any questions about the evaluation, please contact the Office of Land Quality, Science Services Branch at (317) 232-3215. IDEM will update this technical guidance document periodically or on receipt of new information.

References

API (American Petroleum Institute) 2016. API Publication 4762 API LNAPL Transmissivity Workbook: A Tool for Baildown Test Analysis. API Publishing Services, Washington, DC

ASTM (American Society for Testing and Materials) 2017. D7352 Standard Practice for Direct Push Technology for Volatile Contaminant Logging with the Membrane Interface Probe (MIP). ASTM International, West Conshohocken, PA. www.astm.org

ITRC (Interstate Technology & Regulatory Council). 2018. *LNAPL Site Management: LCSM Evolution, Decision Process, and Remedial Technologies. LNAPL-3*. Washington, D.C.: Interstate Technology & Regulatory Council. LNAPL Update Team. https://lnapl-3.itrcweb.org/

ITRC (Interstate Technology & Regulatory Council). *2019. Implementing the Use of Advanced Site Characterization Tools*. (ASCT). Washington, D.C.: Interstate Technology & Regulatory Council, Advanced Site Characterization Tools Team. https://asct-1.itrcweb.org

McCall, W., T. M. Christy, and M. K. Evald, 2017. Applying the HPT-GWS for Hydrostratigraphy, Water Quality and Aquifer Recharge Investigations. Groundwater Mon. & Rem. Vol. 37, no. 1. Pages 78-91.

Personal Communication John Sohl, Columbia Technologies, March 19, 2018

USEPA. 2010. "Best Management Practices: Use of Systematic Project Planning Under Triad Approach for Site Assessment."

USEPA. 2017. "Brownfields Road Map to Understanding Options for Site Investigation and Cleanup", Sixth Edition, 542-R-17-003.

USEPA, 2018. Course manual for Groundwater High-Resolution Site Characterization USEPA June 2018 pages 4-107 thru 4-112

USEPA, 2019. "Green Remediation Best Management Practices: Sites with Leaking Underground Storage Tanks, Office of Land and Emergency Management" EPA 542-F-19-001 August 2019 Update