## C31 Forensic Characterization of Co-Mingled Groundwater Plumes Using Detailed Profiling Techniques for the Purpose of Liability Separation and Remedial Design

*Scott MacFabe, HBSc*, Managing Principal/Senior Hydrogeologist, and James Mueller, Director of Industrial Remedial Technologies, Malcolm Pirnie, Inc., 10 North Martingale Road, Schaumburg, IL; and Seth Pitkin, Remediation Group Leader, Stone Environmental, Inc., 58 East State Street, Montpelier, VT*

The goals of this presentation are to discuss a novel method and case study performing detailed groundwater plume characterization using the Waterloo Profiler for the purposes of liability separation and remedial design.

Standard methods for conducting subsurface investigations often lead to oversimplification of the environmental setting and misinterpretation of the nature and extent of groundwater impacts. Inaccurate problem definition resulting from coarse site characterization often leads to the application of ineffective remedial measures and complicated dispute resolution. A device has been developed that has the capability to rapidly collect detailed subsurface information for the purpose of problem definition, liability separation and remedial design. This vertical profiling method was developed at the University of Waterloo incorporating a direct push probe that allows measurement of both physical and chemical properties in porous media without the need for well installation. The Waterloo Profiler is known as a continuous point sample profiler because it collects samples from a very short interval in the aquifer at any desired spacing without withdrawing the device between samples. The short sampling interval eliminates depth-integrated, flow weighted averaging of key variables, such as solute concentration inherent in conventional sampling programs. The Profiler has been modified to obtain real-time hydrostratigraphic data to allow the investigator to select sampling depths on the basis of changes in hydraulic conductivity.

Application of the Waterloo Profiler coupled with an on-site mobile laboratory utilizing solid phase microextraction and gas chromatography allowed the investigators to adjust the assessment in progress at an industrial site in New Jersey. These techniques resulted in identification of a second, off-site source area and provided detailed definition of the nature and extent of two distinctly different plumes with a confluence at a local water supply well. Despite the complicated geologic setting, the results of the assessment produced detailed 3-dimensional definition of the plume geometry and chemistry.

The subject industrial client historically used trichlorethene (TCE) as a cleaning solvent during annual reconditioning of heavy manufacturing equipment. Minor releases of TCE to the subsurface had produced a narrow groundwater plume that had migrated from the original source area. A local high capacity water supply well located approximately 1-mile downgradient had measured low levels of chlorinated solvents during routine monitoring events. Chemical signatures in the well indicated a second contaminant source. Allegations were made indicating that our client was the sole source of chlorinated solvents in the well, consequently proving nexus required detailed investigation. Downgradient investigation of our client's plume required access and testing in a sensitive wetland and subsurface investigation in complicated outwash deposits. Application of the Profiler provided detailed vertical definition of the narrow plume emanating from the industrial site and co-mingling with a second, more prominent and vertically extensive plume. Upgradient tracking of the second plume resulted in confirmation of a second, much larger contaminant source with a chemical signature similar to impacts measured in the local municipal water supply well. The results of the investigation provided the client with the necessary confidence and details to develop a scientifically based conflict resolution strategy consistent with the findings and to redirect the initial allegations.

Accurate definition and separation of the measured impacts led the responsible parties to develop consensus related to the management of groundwater contamination and implementation of a focused remedial strategy. In the absence of the investigation, the client would have unnecessarily accepted liabilities remotely related to minor impacts associated with their property and principally caused by a previously unknown source.

**Groundwater Plume, Waterloo Profiler, Liability Separation**

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