

## TCE CONTAMINATION IN FRACTURED BEDROCK

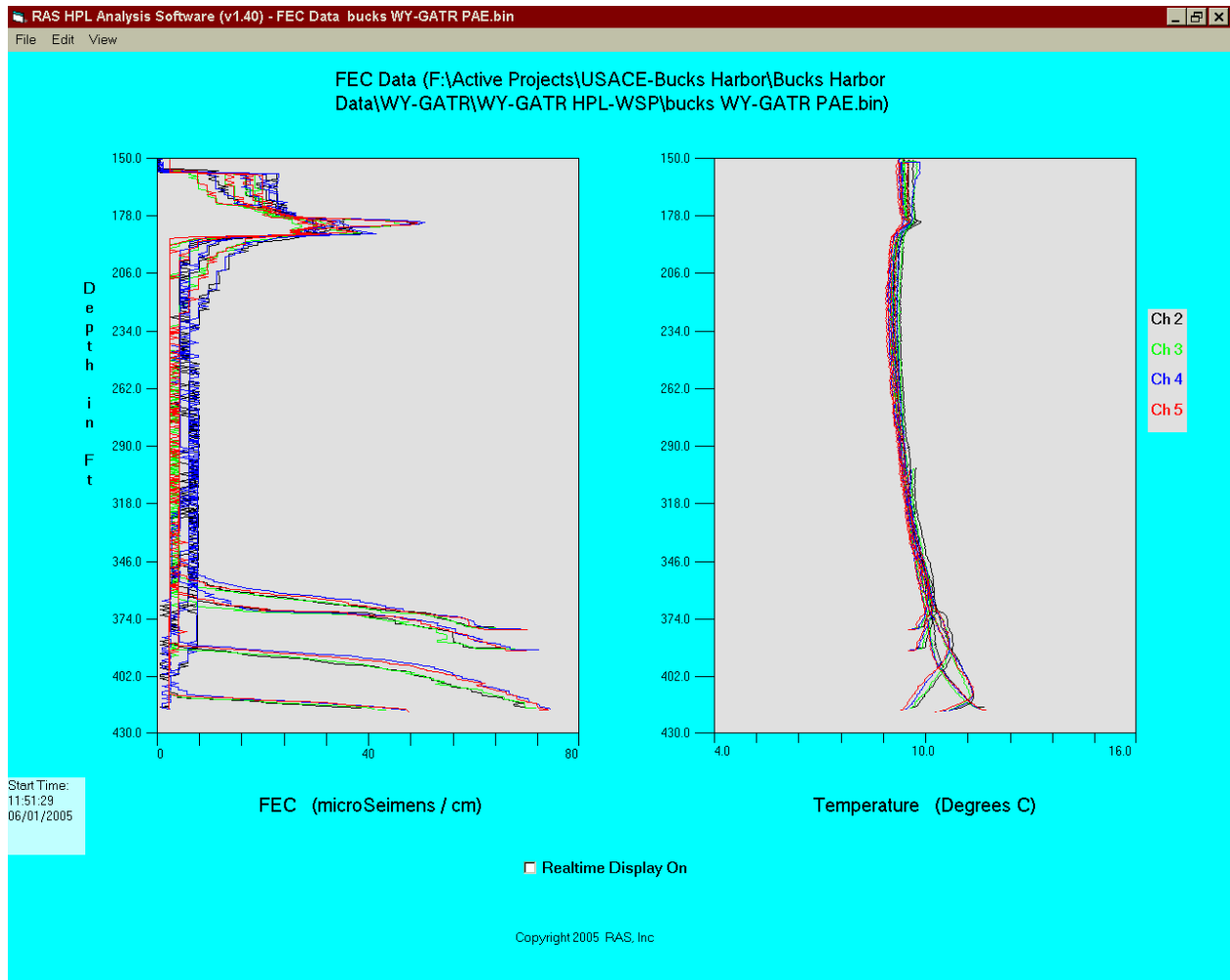
Identification and recovery or remediation of TCE in groundwater systems is complicated when the geology is fractured hard rock. Evaluation of the specific depths of the contaminants and the flow regime is necessary for effective remediation; however, in this type of geology, where fractures and fissures typically make up the porosity, accurate characterization of groundwater and contaminant flow is very difficult.

At two US DERP FUD sites, hydrophysical and geophysical logging methods were employed to determine the depths to individual fractures and fracture zones in each well. Geophysical logging methods included caliper, resistivity, and televiwer logs. These methods provided data regarding the bedrock characteristics. Then, hydrophysical logging was applied to define the specific flow zones which contained contamination, so that the remediation system design could be successful.

Hydrophysical logging is a highly sensitive ground water flow measuring technique which evaluates both horizontal and vertical flow. The approach involves logging the wells with a high resolution multi-sensor tool while at the same time injecting the well with environmentally-safe deionized water. As the formation fluids will contrast electrically with the deionized water, highly accurate identification of the location and velocity of flow is achieved, in near real time. In addition, characterization of the system of flow is possible since inflow and outflowing zones are identified, along with identification of which fractures are contaminated, and to what extent the contamination is present.

In this example, following the hydrophysics - which was used both to characterize the flow system and to provide a screening method for more specific assessment of target zones - wireline straddle packer testing was also conducted. At these sites, the wireline packer testing provided additional hydrogeologic and hydraulic test information and was used for interval specific sampling.

*Reference: The Corps Environment, US Army Corps of Engineers, January 2006, Vol. 7, No. 1, Robert Leitch and Drew Clemens, New England District, "Efficient approach determines nature. Extent of TCE in a bedrock aquifer."*



Hydrophysical logging was used to evaluate the specific fracture zones as a screening method for subsequent wireline straddle packer testing. Using the specific locations identified by the HPL, where the high FEC spikes occurred, allowed for targeted placement of the wireline straddle packer system for acquisition of samples. The samples were acquired and analyzed for contamination and specific and isolated fracture zones were shown to be contaminated. These results allowed for much better remedial design. – needs Bill’s review!