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Comparing Shear-Thinning Fluid with Traditional Injection Techniques for Treatment into Low-Permeability Source PCE and TCE

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Background/Objectives. A pilot study was performed to evaluate the effectiveness of in situ bioremediation to treat source PCE and TCE in a low permeability aquifer with significant high permeability sand stringers. Previous high-resolution characterization showed that the majority of source mass is bound up in the low permeability. Mass flux calculations indicated that although the majority of the mass is in the low permeability silty clay, mass discharge is overwhelmingly through the sand units above and below the silty clay. Traditional injection techniques such as injection wells and direct-push injections (DPI) would likely treat the high permeability units preferentially, leaving significant source mass in the low permeability unit untreated. By adding a shear-thinning fluid to amendments during injections, greater contact with the lower permeability unit is possible.

Approach/Activities. Three independent injection scenarios were performed in the source area. Area A included only DPI without shear thinning fluid. Area B included pressurized amendment injections via standard wells. Area C included pressurized amendment with shear thinning fluid via standard wells. Different tracers were used in each area to differentiate amendment distribution independently. Monitoring was performed during injections and for two years following injections in wells within each treatment area and further downgradient. Soil samples were also collected to evaluate amendment distribution.

Results/Lessons Learned. Results of this comparison test quickly showed that DPI would not perform effectively in the subsurface environment at this site, as low volumes and frequent surfacing were encountered during injections. Comparing the standard and shear-thinning fluid injection approaches showed that the shear-thinning fluid injections were distributed more evenly through areas of varying permeabilities and significant impacts were apparent at a greater radius. Although tracer was observed further downgradient from the standard injection, this was likely due to delivery in higher permeability sand units and was the result of uneven distribution. Results of the bioremediation effectiveness will also be presented, including apparent complete dechlorination despite the absence of ethane.