

In Situ Bioremediation of Chlorinated Ethene DNAPL Source Zones: Case Studies

April 2007

**Prepared by
The Interstate Technology & Regulatory Council
Bioremediation of DNAPLs Team**

**Copyright 2007 Interstate Technology & Regulatory Council
444 North Capitol Street, NW, Suite 445, Washington, DC 20001**

EXECUTIVE SUMMARY

The Interstate Technology & Regulatory Council's Bioremediation of DNAPLs (BioDNAPLs) Team was formed in 2004 with the aim of developing the technical and regulatory requirements needed to support the use of bioremediation as a treatment option for subsurface dense, nonaqueous-phase liquids (DNAPLs) contamination, particularly that associated with chlorinated ethenes. Chlorinated solvents were once widely used throughout a number of industries, leading to numerous environmental contamination problems. Both the U.S. Department of Defense and the U.S. Department of Energy face DNAPL contamination problems at many of their facilities similar to those of industry. DNAPLs, primarily those containing chlorinated solvents, pose one of the most widespread and prominent types of contamination associated with Superfund sites. Current DNAPL remediation technologies require the use of energy, fluids, or oxidants to mobilize DNAPL for subsequent recovery or to destroy it. A potential advantage of bioremediation is that microorganisms—which can proliferate and attack the contaminant at or near the DNAPL interface without mobilization—may provide a far more efficient, effective, and economical remediation.

As part of its strategic approach, the BioDNAPLs Team determined that an independent evaluation of the status of bioremediation was needed, that review of a “data rich” set of case studies would be the best evaluation approach, and that a forum would be an appropriate setting for the process. The team gathered and evaluated a number of proposed case studies and selected a group of six that would demonstrate bioremediation of DNAPLs in a wide range of conditions. The selected case studies can be classified as demonstrations, pilot-scale tests, those in design, and full-scale cleanups.

For each case study, background information was compiled into a 10–15 page summary, together with data reports and other information. This information was sent to a panel of experts from industry, academia, and the regulatory community who were recognized experts in the field of groundwater remediation—but not necessarily in bioremediation—and who could thus provide an independent review. The review included evaluation of technical approaches and performance of each case study, as well as its regulatory aspects, remediation goals, and applicability to other sites. Reviewer comments were provided to the sponsors of the case studies, who then incorporated responses into the presentations made at the Long Beach, California Case Studies Forum, held in late March 2006 and including the expert reviewers and members of the BioDNAPLs Team. At the forum, reviewers were able to ask questions stimulated by the presentation, as well as questions generated during preworkshop review of the case study data. Further, there was an extended, in-depth discussion, led by the panel of experts but including all forum participants, that explored the totality of the information presented. The goal was not to compare the case studies, but rather to distill a general understanding from the collective information.

The primary question posed to the expert panel was “Do we have credible evidence that bioremediation of chlorinated ethene source zones is a viable remediation option?” The conclusion of the panel was a unanimous “Yes.” Panel members indicated that the weight of

evidence was “impressive” and that the potential for this technology was “exciting,” particularly the potential for effective use in difficult environments such as fractured media.

Within this context some caveats were recognized. The technology is still early in its development, with its niche not yet fully defined. There are concerns about the potential for mobilizing DNAPL during electron donor injections, and much of the “credible evidence” is based on measurements of aqueous-phase concentrations, which have inherent technical limitations. In addition, the overall impact that bioremediation of source zones can have on the restoration time frame is not clear. These caveats were not regarded as restrictions; rather they show the direction in which future developments and exploration must be made. The promise of bioremediation remains great, and its full realization is now closer.

This report has two purposes. First, for the record, it presents the six case histories from the Long Beach forum and the proceedings of the forum. Second, it provides state and federal regulatory agencies charged to oversee the cleanup of sites with DNAPL contamination with a thorough set of case studies presenting the best evidence supporting in situ bioremediation as a viable cleanup strategy. A companion CD contains this document, eight presentations made at the Case Studies Forum, and supporting material. It is the hope of the ITRC BioDNAPLs Team that the document will accelerate technology transfer to and among the states, saving regulators valuable time and money during selection and approval of remedial technologies.