Emerging Technologies for Enhanced *In Situ* Biodenitrification (EISBD) of Nitrate-Contaminated Ground Water

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EXECUTIVE SUMMARY

Enhanced *in situ* biodenitrification (EISBD) is a developing technology for *in situ* reduction of nitrate in contaminated ground water. One of the most pervasive ground water contaminants in the U.S. is nitrate. This document focuses on issues related to environmental concerns about nitrate and current remediation techniques.

Traditional technologies for the remediation of nitrate-contaminated ground water are generally costly, lengthy, and often only partly effective. Of the emerging technologies for nitrate remediation, EISBD technologies offer a more cost-effective, timely, and more efficient means of reducing nitrate contamination to acceptable levels. This document describes two such EISBD technologies, their applicability to contaminated sites, and the results of the laboratory and field-testing done to date. Regulatory and stakeholder concerns related to both nitrate contamination and these two EISBD technologies are also presented.

Since methemoglobinemia (Blue Baby Syndrome) has been reported in several states and is associated with elevated levels of nitrate in drinking water, nitrate is a federally regulated compound. Nitrate contamination is also alleged to cause spontaneous, early-term abortions in humans and animals and may be related to certain types of cancer and thyroid dysfunction. Because of these issues, nitrate contamination is of concern to public health officials.

Sources of nitrate contamination include fertilizers, human and animal waste, and explosives. The presence of excess nitrate and other nutrients in streams, lakes, and estuaries has devastated fisheries and caused diminished recreational potential of the resource. One source of nitrate contamination in surface waters is nitrate-contaminated ground water.

Membership on this work team was open to all ITRC members. Participants with expertise or interest in nitrate treatment technologies in their states elected to join the team and contribute to the development of this work product. Professors from the University of New Mexico and University of Nebraska-Lincoln also participated and provided research information. ITRC public stakeholder representatives provided input regarding public and community concerns on the issues and remedial technologies.

The EISBD technology being developed at the University of New Mexico involves the injection of an amendment, usually acetate, through injection wells. These amendments are nontoxic, self-limiting, and promote the conditions optimal for anaerobic, microbial denitrification to occur. By amendment injection, the rate of denitrification is greatly accelerated, and nitrate is converted to nitrogen gas in a biochemical process. This technology has the potential of remediating sizable nitrate plumes in ground water systems.

The EISBD technology under development at the University of Nebraska-Lincoln is geared toward the reduction of nitrate contamination around public and/or domestic well fields dedicated to the production of drinking water. Injection of carbon amendments carefully calculated at controlled rates produce an environment where nonharmful anaerobic, nitrate-reducing microbes proliferate at a safe distance from the wellhead. Microbial denitrification reduces the nitrate concentrations, again through conversion to nitrogen gas.