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Regulatory Guidance for Permeable Reactive Barriers Designed to Remediate Inorganic and Radionuclide Contamination (PRB-3)

EXECUTIVE SUMMARY

The contamination of groundwater in the United States is a challenging problem. It has been estimated that 300,000-400,000 contaminated waste sites may account for 750 billion dollars of remediation over the next three decades (National Academy of Sciences, 1994). The successful treatment of contaminated groundwater is a further challenge. Conventional treatment methods, such as pump and treat systems, have been shown to be somewhat ineffective. Selection of a groundwater treatment technology is a crucial and often costly proposition. Emerging groundwater treatment technologies may provide effective, lower-cost alternatives. It is important to fully understand all aspects of any innovative technology. This guidance document was developed to address the regulatory requirements of permeable reactive barriers (PRB) and try to achieve a consensus on requirements. It should prove useful to regulators, stakeholders and technology implementers.

The document is divided into sections dealing with site characterization, modeling, permitting, construction, monitoring, waste management, maintenance, closure, health and safety and stakeholder concerns. From a regulatory perspective, the most important sections of the document are most likely the permitting, monitoring, and closure sections. Appendix B provides examples and current applications where PRBs have been, or will be, installed. Specifics regarding the design and installation of PRBs are not covered within this document, however the reference to documents that provide this information is included within the introduction.

Site characterization is a critical step in order to deploy a PRB. A complete understanding of the site geology, hydrogeology, and geochemistry, as well as the contaminant profile, is necessary. Specifics on field and laboratory analytical parameters are provided in Table 2-3. Once a complete understanding of the site has been accomplished, it is important to develop a conceptual site model in order to relate the data in three-dimension. Numerous hydrogeological and geochemical models are available to further evaluate site conditions.

Permitting issues associated with PRBs include the state or federal programs associated with Underground Injection Control, National Pollution Discharge Elimination System, Air Quality, and RCRA. Permitting will typically not be an extensive process in PRB deployment, as permits may not be required depending on the design of the technology. Construction related issues are briefly discussed in this document. The requirements are similar to a typical construction project.

Monitoring is a critical regulatory issue and is addressed in detail within the document. Monitoring of the groundwater upgradient, within and downgradient of the PRB is essential to determine both performance and effectiveness of the remedial system. The proper placement of monitoring wells is

essential. The document discusses some concerns in monitoring well placement and Figures 2 and 3 are provided for guidance purposes. The placement of monitoring wells must be a site-specific decision based on groundwater modeling. Monitoring frequency should also be determined on a site-specific basis taking into account concerns such as groundwater flow velocity and the contaminants of concern. Table 7-1 is provided as a guide in determining monitoring frequency.

Waste management issues surrounding PRBs include the proper classification and disposal of contaminated soil, groundwater, and reactive media. Because PRBs are an emerging technology, maintenance issues are somewhat undefined. The document urges the development and revision of an operation and maintenance plan prior to construction. Closure of the PRB is also undefined due to a lack of historical perspective. A critical issue for PRBs designed to treat inorganic and radionuclide contamination, is whether to retain a wall, or remove it following remediation. These treatment systems are designed to concentrate the contaminants within the PRB and therefore may present re-contamination issues. Furthermore, PRBs tend to lose porosity with age and can affect the groundwater flow vectors. It is important not to treat closure of the PRBs lightly, to develop a closure plan before installation and refine the plan, as needed, during operation.

Health and safety issues are standard for the industry and follow Occupation Safety and Health Administration Requirements. Stakeholder concerns should be addressed in detail. This may require holding public meetings, information sessions, distributing informative bulletins, or developing a neighborhood-canvassing program. The document provides detail on the many stakeholder concerns.