

Attenuation-Based Remedies for Chlorinated Solvents in Groundwater and the Vadose Zone

How and When Will We Impact Site Milestones?

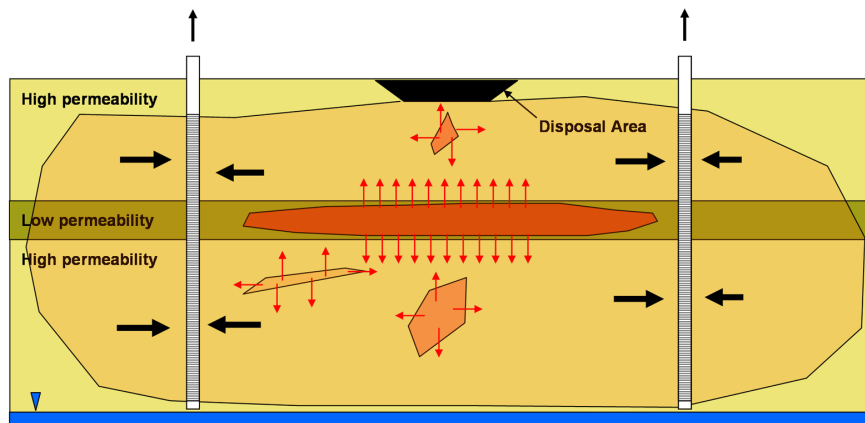
- ▶ FY10-11: Demonstrate methods to quantify contaminant flux and to define achievable remedial action objectives for sites with persistent contamination.
- ▶ FY10-12: Provide transition technologies to enable sites to discontinue source treatment and to turn off other “active” treatments (i.e., soil vapor extraction [SVE] and pump-and-treat [P&T]).
- ▶ FY11-12: Demonstrate remediation technologies to accelerate transition from source treatment to attenuation-based remedies (ABRs), such as enhanced remediation (EA) and monitored natural attenuation (MNA).

Milestone

- ▶ Savannah River—(FY2010) Dismantle pump-and-treat in T-Area.
- ▶ Paducah Gaseous Diffusion Plant—(FY2011) Provide a technical basis for monitored natural attenuation via aerobic cometabolism.
- ▶ Hanford—(FY2010-2012) Provide a technical basis to support remedy selection/implementation at 200-PW-1/200-ZP-1.

How Is Chlorinated Solvent Contamination Impeding Site Closure?

Much progress has been made toward the remediation of chlorinated solvents in soil and groundwater. Technologies have been developed to treat groundwater source zones effectively where the bulk of the solvent is present at high concentrations in small areas. Unfortunately, these methods leave large areas of contamination in the groundwater at concentrations that are projected to exceed remedial objectives for decades or even centuries. Existing vadose zone technologies effectively treat high permeability zones, but leave persistent contamination in low permeability zones that remains problematic over long time frames. Sites are faced with continued long-term operation of costly source treatments, P&T, or SVE.



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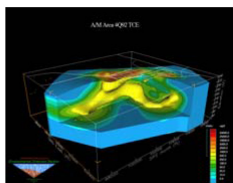
safety ♦ performance ♦ cleanup ♦ closure

For more information:

[www.em.doe.gov/
Pages/GroundwaterSoilCleanup.aspx](http://www.em.doe.gov/Pages/GroundwaterSoilCleanup.aspx)

What Did the National Academy of Sciences Identify as the Key Technical Challenges?

- ▶ *Residual contaminants in low permeability zones continue to produce long-term, low-concentration secondary contaminant sources.*
- ▶ *Anaerobic groundwater settings are most favorable for natural attenuation of chlorinated solvents. The largest chlorinated solvent plumes are in aerobic settings, leading to very slow attenuation.*
- ▶ *Approaches and tools that provide a sound technical basis for transitioning from source and plume treatments to MNA are needed—these approaches and tools must be recognized and accepted by regulators and stakeholders.*
- ▶ *Long-term monitoring strategies resulting in lower costs and providing data to ensure a high level of protection are needed.*



How Will this Research Meet the Technical Challenges?

A key initial milestone was the acceptance by regulators and stakeholders of the concept of EA and the technical framework that allows for integration into the existing regulatory process. The work in this action area will provide products that can be directly applied or provide the technical information needed to reach closure. Specifically, this work will:

- ▶ *Provide practical approaches and tools to aid sites in obtaining regulator and stakeholder acceptance of criteria for the shutdown of “active” treatments.*

- ▶ *Develop and demonstrate transition technologies that will enhance attenuation rates and reduce fluxes from secondary contaminant sources.*

What Are the Transformational Concepts ?

Site cleanup will be based on meeting maximum concentration limits at receptors. However, criteria for transitioning from “active” to more passive treatments may be better quantified by another metric, mass flux. This metric supports the consideration of the long-term impact to the groundwater. Enhanced Attenuation is a strategy based on a mass flux-based mass balance and relies on manipulation of biological, chemical and hydrological processes to control solvent fluxes.

Within this action area two applied research projects will address the identified transformation concepts.

Enhanced Attenuation for Chlorinated Solvents

This project is focused on providing the technologies that will allow site owners to transition from “active” treatments to more passive approaches and ultimately achieve site remediation. This will be accomplished via two areas of research and development. The first area is developing and demonstrating technologies associated with two of the key challenges, aerobic sites and long-term, low concentration secondary contaminant sources. Technologies are lacking in these two challenge areas. The goal is technologies that require low energy use, minimize use of manpower, and yield sustainable attenuation rates to support contaminant plume shrinkage and site closure in an acceptable time-frame. The second area focuses on providing the technical basis for using key types of remediation technologies for EA to transition sites into MNA and demonstrating these technologies in partnership with EM remediation project personnel. The products of this area of the project will provide metrics for evaluating when to transition and key design factors needed to be

considered as an EA technology. This information will be provided in a series of technology-specific user guides.

Methods for Addressing Persistent Organic Contamination in the Vadose Zone

This project is focused on providing the tools and technologies to implement a mass flux-based approach to remediation in the vadose zone.

Mass flux-based solutions provide the ability to evaluate links effectively between vadose zone and groundwater contamination and identify when to transition from active to passive remedies or closure. Remedial approaches using flux control are ABRs that manage and reduce the release of solvents from vadose zone sources into the groundwater and are targeted at persistent contamination that cannot be effectively addressed by active mass removal technologies.



INITIATIVE IMPACT TO SITE MILESTONES

- For the first time, provide a viable path to end pump-and-treat, for Savannah River, Paducah Gaseous Diffusion Plant, Richland Operations, and other sites.
- Provide a technical basis for transition to passive approaches.
- Ability to integrate vadose zone remedies with groundwater goals.

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