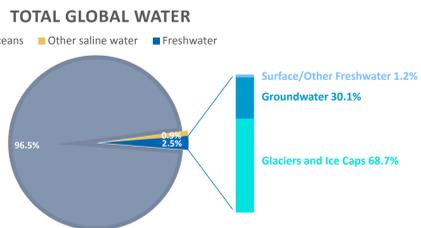




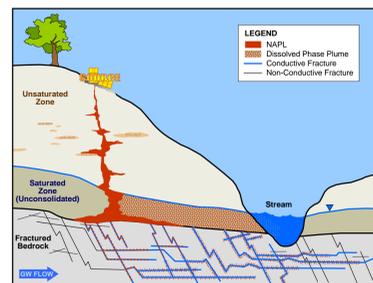
Problem Summary

Groundwater is an important resource.



Source: "Water in Crisis: A Guide to the World's Fresh Water Resources", Gleick, P.H., (editor), 1993.

- Groundwater provides ~40% of the public water supply.
- Groundwater supplies >98% of self-supplied domestic water demands.



- Contaminated groundwater may directly impact and limit both public and private water supplies.
- Contaminated groundwater may also impact other routes of exposure, with linkages to vapor intrusion and surface water bodies.



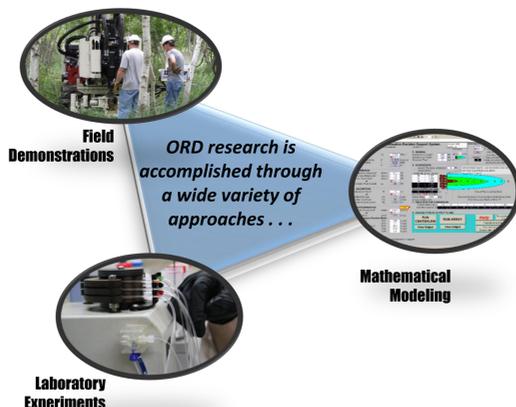
- Contaminated groundwater is found at 80% of Superfund sites.

- EPA seeks to ensure that groundwater quality meets federal and state drinking water standards to prevent human exposure to contaminants.
- Research under this task supports the Agency's mission to protect groundwater resources, and restore impacted groundwater resources.
- Activities within the task were shaped by EPA Program and Regional Office research needs. External guidance will continue to be received through the research coordination team. (Contact: Diana Cutt, cutt.diana@epa.gov)



Task Overview

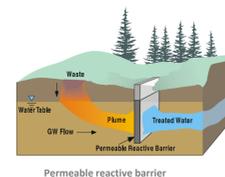
Task-Specific Research Activities



Inorganic Groundwater Contaminants

Research on inorganic groundwater contaminants will focus on: long-term performance review of a permeable reactive barrier for the treatment of arsenic in groundwater, mobilization of inorganic contaminants as an unintended consequence of in-situ reduction technologies, and an analysis of the co-contaminant behavior of arsenic and selenium in groundwater.

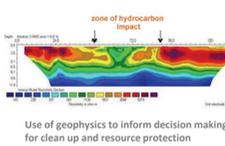
Contact: Rick Wilkin, wilkin.rick@epa.gov



Geophysics for Groundwater Characterization

The overall goal of this work is to advance the educated and effective adoption of geophysical technology for management of contaminated groundwater. To achieve this goal, it is proposed to develop, demonstrate, and disseminate a Geophysical Toolbox Decision Support System (GTDSS) aimed at both geophysicists users and end users.

Contact: Dale Werkema, werkema.d@epa.gov



Flux Based Site Management

Flux-based site management entails the use of contaminant flux and mass discharge for site management purposes. Example products planned under this activity include a summary report on effective field-scale approaches based on flux measurements to better link characterization, prediction, and decision making; and another to modify a current technology for flux measurements to a field-based analysis method to promote high resolution sampling.

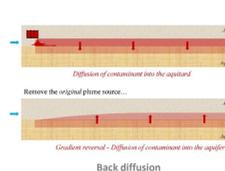
Contact: Michael C. Brooks, brooks.michael@epa.gov



Back Diffusion

Back diffusion may impair the effectiveness of treatment systems and therefore hinder the development of effective exit strategies for site cleanups. A better understanding of the role that diffusion plays in plume persistence is essential for effective and protective cleanup of Superfund sites.

Contact: Junqi Huang, huang.junqi@epa.gov



In Situ Chemical Oxidation

Three products are proposed related to contaminant groundwater treatment using in-situ chemical oxidation (ISCO): a critical analysis of ISCO design factors used in estimating the delivery of oxidant volume/dosage, aquifer characteristics (in particular permeability) following ISCO permanganate treatment at a contaminated case study site, and an evaluation of the influence of ISCO on volatile organic rebound (back diffusion).

Contact: Scott Huling, huling.scott@epa.gov



Emulsified Zerovalent Iron

Work will be conducted to summarize a six-year study of source zone treatment of dense non-aqueous phase liquid contaminants at a Superfund site using emulsified zerovalent iron. This work will include soil core analysis from the field site to evaluate mineralogical and chemical changes of injected nanoscale zerovalent iron over the six year period.

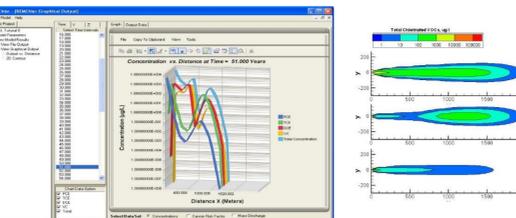
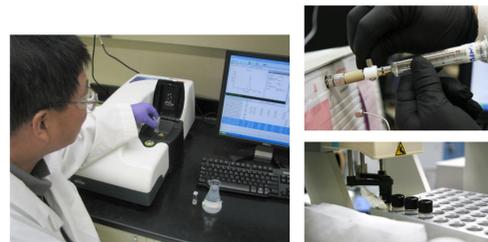
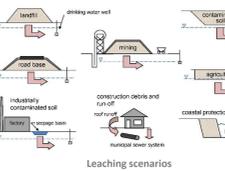
Contact: Chunming Su, su.chunming@epa.gov



Organic Constituent Leaching Methodologies

Understanding the ability of organic contaminants to be leached from waste material and transported into ground water is an issue impacting ill communities. The focus of this research activity is to evaluate leaching assessment methodologies and approaches that are currently available and to determine what would be necessary to develop a leaching assessment framework for organic contaminants.

Contact: Susan Thorneloe, thorneloe.susan@epa.gov



Selected Accomplishments



- FY16 Milestone – A focused workshop was held for OLEM on the feasibility of developing a framework for evaluating leaching potential of semi- and non-volatile organic contaminants. The workshop was held in Washington DC and was attended by 21 people, including researchers from EPA (ORD, OSRTI, ORCR, Region III), academia, and environmental consultants. Results from the workshop are being used to guide subsequent development of the framework.
- Contact: Susan Thorneloe, thorneloe.susan@epa.gov



- FY16 Product – A journal article was published titled *Critical Assessment of Oxidant Volume Design and post-ISCO CVOC Rebound and Changes in Aquifer Permeability*. The manuscript provides important clarification in the parameters and methods used to estimate oxidant volume, and provides guidelines that improve effective and efficient technology deployment.
- Contact: Scott Huling, huling.scott@epa.gov



- FY16 Milestone – A book chapter was completed that reviewed application of additives used in bioremediation of chlorinated solvents and fuels for groundwater and soil remediation. These additives include soluble carbon substrates, slow-release and solid substrates, microbes, oxygen gas, nutrients, and pH modifiers. Potential issues with additive use include biofouling, stalling, short circuiting, displacement, reduced hydraulic conductivity, and secondary water quality deterioration. Methods and techniques to deal with these issues are provided and future research needs are identified.
- Contact: Chunming Su, su.chunming@epa.gov

Future Directions

Products proposed under Task 3.61.2 for the FY16 to FY19 planning cycle

Product Name	ORD Research Activity	Proposed Product Type	Proposed Delivery Date	OSWER Priorities							Product Key		
				HRT&Ms	BD	PRB's	CoBio	IG&E	MSR	OL			
1. Flux-based site management summary report	FBSM	R	FY17	●									
2. A High Resolution Passive Flux Meter Approach Based on Colarimetric Responses	FBSM	A, R, or F	FY18	●									
3. Modeling NAPL dissolution from pendular rings in idealized porous media	FBSM	A	FY18					●					
4. Strategies for managing risk due to back diffusion	Back Diffusion	R, F, or I	FY19		●								
5. A critical analysis of ISCO design factors used in estimating the delivery of oxidant volume/dosage	ISCO	R or A	FY16					●					
6. Aquifer characteristics following ISCO permanganate treatment at a contaminated case study site	ISCO	R, A, or W	FY17					●					
7. Influences of ISCO on VOC rebound (back diffusion)	ISCO	R, A, or W	FY18		●			●					
8. Natural attenuation and co-contaminant behavior of arsenic and selenium	Inorganics	A	FY17					●	●				
9. Predicting the mobilization of arsenic in reducing environments	Inorganics	A	FY19					●	●	●			
10. Long-term performance of permeable reactive barriers for treating contaminated groundwater	PRBs	A	FY18		●					●			
11. A decision support system to guide the use of geophysical characterization and monitoring technologies for environmental investigations: geophysical tool decision support system (GTDSS)	Geophysics	S	FY18	●									
12. Geophysical methods to characterize and monitor groundwater-surface water interactions	Geophysics	A	FY19		●								
13. Draft framework for evaluating leaching potential of semi-volatile and non-volatile organic contaminants	Organics Leaching	R	FY19										●

Products to support EPA program managers, EPA remedial project managers, and other site management personnel, who then engage communities to protect public health and natural resources, and restore contaminated groundwater for beneficial use.