

FEDERAL REMEDIATION TECHNOLOGIES ROUNDTABLE

ANNUAL SUMMARY OF ACTIVITIES:

AUGUST 2011

FRTR HIGHLIGHTS

- ◆ Twenty new cost and performance case studies posted on the Federal Remediation Technologies Roundtable (FRTR) website.
- ◆ Summary and presentations from the FRTR meeting on Fractured Bedrock Media (November 2010) posted on the FRTR website.
- ◆ EPA's Office of Superfund Remediation and Technology Innovation (OSRTI) has developed a website – The Fractured Bedrock Focus Area – to provide information on efforts to identify and remediate contaminated fractured bedrock sites. For more information, visit www.cluin.org/products/fracrock. The website includes resources related to fractured bedrock media, including
 - Brief profiles of fractured bedrock sites that identify the nature and extent of contamination, the geology affecting assessment and remediation efforts, characterization and remediation actions taken or planned, and points of contact. The site allows browsing or searching of the profiles.
 - Online bibliographies and additional websites providing information on site remediation and characterization in fractured bedrock media.
- ◆ FRTR's "What's New" website contains a recent publication by the Naval Facilities Engineering Command (NAVFAC). The publication titled *Technology Transfer (T2) Five Year Program Plan for Environmental Restoration 2010-2014*, provides information on innovative technologies, lessons learned during field applications, and additional technical challenges faced by Navy Remedial Project Managers (RPMs). It provides a summary of the T2 process, including mechanisms, products, and future directions for the T2 program.

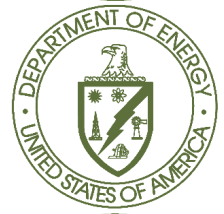
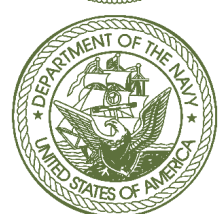
This fact sheet summarizes the activities of the Federal Remediation Technologies Roundtable (FRTR) over the last year. The FRTR is an interagency working group that encourages cooperation among member agencies to promote development and use of new technologies for improved remediation of hazardous waste sites. Primary members of the FRTR include the U.S. Department of Defense (DoD), the U.S. Department of Energy (DOE), the U.S. Department of the Interior (DOI), the U.S. National Aeronautics and Space Administration (NASA), and the U.S. Environmental Protection Agency (EPA).

The roundtable has met twice each year to share information since it was established in May 1990. Meeting summaries and presentations are available on the FRTR website at: www.frtr.gov. Recent meetings have focused on Vapor Intrusion (November 2009) and Low Cost Treatment Technologies for Soil and Groundwater (May 2010). The 41st FRTR meeting, held in November 2010, focused on Characterization of Contamination in Fractured Media; the objectives of the meeting were as follows:

- ◆ Improve communication and common understanding of characterization and remediation issues associated with fractured bedrock.
- ◆ Share experience and lessons learned in advancing best practices.
- ◆ Outline key issues and develop shared strategies to address them.

This fact sheet highlights ongoing efforts by the FRTR member agencies to better understand characterization and remediation in fractured media.

The complex geologic nature of fractured media impacts the



characterization of such media and the design, implementation, and success of remediation strategies. The complex distribution and connectivity of fractures, joints, conduits, and other discontinuities in the rock, coupled with the large range in their hydraulic properties, results in highly convoluted flow paths over large distances. Fractured rock and carbonate aquifers are also characterized by void space associated with the initial formation of the rock, which influences the long-term retention of contaminants. Recent advances in understanding physical and chemical processes and characterizing groundwater flow and chemical transport in fractured rock aquifers are leading to defensible conceptual site models (CSM) that can minimize the number of monitoring locations, while achieving long-term monitoring objectives. Several characterization and remediation technologies are currently being used both at pilot- and full-scale levels to improve the understanding of these sites. At the 41st FRTR meeting, several such innovative characterization and remediation technologies for use at sites with fractured media were highlighted. In addition, some speakers also recommended changes to management strategies at such sites.

Fractured Media-Related Efforts within DoD

A Navy site is being used to study characterization and remediation of contaminated fractured media. The presence of chlorinated solvents in fractured sedimentary bedrock at the former Naval Air Warfare Center (NAWC) site in West Trenton, New Jersey (<http://nj.usgs.gov/nawc>) has provided opportunities for studies of subsurface processes and new characterization and monitoring technologies. At a site where a pump and treat system was already in place, a study demonstrated the significance of aquifer testing and hydrogeologic characterization to design a cost-effective remediation strategy that involved injection of bioaugmentation amendments. The study also demonstrated the importance of monitoring at intermediate wells to help better interpret bioaugmentation results. Another study used rock coring to evaluate the effectiveness of a thermal conductive heating at NAWC and found that the method had removed nearly 70 percent of the trichloroethene (TCE) from the saturated rock samples. These studies demonstrated that good CSMs are critical for selecting remediation methods and interpreting results. Continuous characterization

of fractured rock sites is important, even during the remediation phase and is essential to achieve an iterative synthesis of multiple investigations.

Fractured Media-Related Efforts within the U.S. Geological Survey (USGS)

Under the Toxics Substances Hydrology Program, the USGS is conducting research on the fate, transport, and remediation of chloroethene contamination in fractured rocks at the NAWC site (http://toxics.usgs.gov/sites/nawc_page.html). The dipping sedimentary rocks at this site have highly variable hydraulic properties and convoluted groundwater flow and chemical transport pathways. A complex distribution of TCE and its daughter products exists in the fractures and the primary porosity (rock matrix). Research objectives include advancing the understanding of physical, chemical, and microbiological processes and properties affecting chloroethene fate and transport in fractured rocks and evaluating chloroethene remediation methods and monitoring strategies. Field investigations, laboratory analyses, and computer modeling are being used to address these objectives. Specific activities include testing hypotheses about CSMs, identifying contaminant transport pathways, and elucidating

TECHNOLOGY NEWS AND TRENDS (TNT) NEWSLETTER HIGHLIGHTS FRACTURED BEDROCK

The December 2010 issue of the TNT Newsletter, published by EPA's OSRTI, highlighted three pilot studies that involved characterization and remediation at fractured bedrock sites contaminated with volatile organic compounds. The three sites are Valmont TCE Superfund Site near Hazleton, Pennsylvania, Naval Air Warfare Center (NAWC) site in West Trenton, New Jersey, and Atlas E Missile Site No. 12 (Atlas 12) at the F.E. Warren Air Force Base in Windsor, Colorado. These sites demonstrated the use of remediation technologies such as subsurface injection of reactive amendments and in situ thermal conductive heating systems. They also tested the use of geophysical tools to interpret hydraulic fracture networks at sites. The December 2010 TNT Newsletter can be downloaded at www.clu-in.org/download/newsletters/tnandt1210.pdf

the processes controlling natural and enhanced biodegradation. Results are being disseminated to EPA, DoD, and other agencies, to provide a scientific foundation for decisions related to prevention, remediation, monitoring, and management of contaminant spills and releases in fractured rock aquifers.

Fractured Media-Related Efforts within EPA

EPA's Office of Superfund Remediation and Technology Innovation (OSRTI) has developed a website to provide information on efforts to identify and remediate contaminated fractured bedrock sites. Site profiles on this website provide information on the nature and extent of contamination problems

at a fractured bedrock site, geology affecting site assessment and remediation efforts, characterization and remediation actions taken or planned, and site contacts to facilitate open communication between individuals involved in applying these technologies. Information for the profiles is collected from technical journals and conference proceedings, as well as other published sources. As of March 2011, the website includes 229 profiles, addressing 8 remediation and 12 characterization technologies. As further information is obtained, EPA plans to update and expand this website with updated and new fractured bedrock profiles. For more information, visit www.cluin.org/products/fracrock.

Remediation Case Studies and Technology Assessment Reports

A major activity of the FRTR throughout the year is to collect and distribute information from federal and state agencies on the use of new technologies at their sites. Each year, the FRTR compiles reports and makes them available at the website – www.frtr.gov. The “What’s New” section is updated monthly and provides notices about meetings, conferences, and publications of relevance to FRTR stakeholders.

The FRTR website provides case studies and reports in four categories: Remediation Technology, Site Characterization and Monitoring, Long-Term

Monitoring and Optimization, and Remediation Technology Assessment. The case studies share data collected by member agencies and are based on real experiences and lessons learned in selecting and implementing site characterization and treatment technologies to delineate and remediate soil and groundwater contamination at hazardous waste sites. Remediation case study reports describe the performance and cost of technology applications for full-scale and large-scale demonstration projects.

FRACTURED MEDIA-RELATED RESOURCES

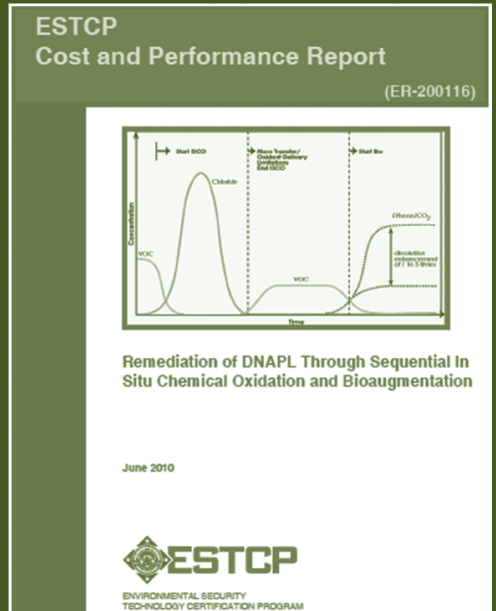
1. EPA's Fractured Bedrock Focus Area: This searchable website, developed by EPA OSRTI, provides brief profiles of fractured bedrock sites, including contaminants, site geology, characterization and remediation actions, and points of contact. www.cluin.org/products/fracrock/viewsites.cfm
2. Multifunction Bedrock Aquifer Transportable Testing Tool (BAT3): This tool, tested by the USGS, is designed to conduct tests that measure permeability of fractured bedrock and to collect water samples for geochemical analyses from short intervals of boreholes in fractured bedrock aquifers. The equipment can be readily transported from site to site, easily assembled, and adjusted to accommodate different borehole conditions, such as fracture density that may vary across locations. The BAT3 also includes data-acquisition equipment that allows the storage, display, and interpretation of hydraulic data as it is collected. Its compact and portable design keeps shipping costs manageable and it has been used at several sites throughout the eastern U.S. to characterize fractured bedrock aquifers. <http://toxics.usgs.gov/highlights/bat3>
3. The Bedrock Bioremediation Center (BBC) at the University of New Hampshire (UNH), specializes in multidisciplinary research using naturally occurring microbes that live along the fractures in bedrock to remediate organically contaminated bedrock aquifers. The BBC is comprised of a consortium of faculty from the University's Environmental Research Group (ERG), and the UNH Departments of Civil Engineering, Microbiology, Earth Sciences, and Natural Resources. www.unh.edu/erg/bbc/index.html

REMEDICATION OF DNAPL THROUGH SEQUENTIAL IN SITU CHEMICAL OXIDATION AND BIOAUGMENTATION

Highlight of New Remediation Technology Cost and Performance Report

This field demonstration was conducted at Launch Complex 34, an unused launch facility at the Kennedy Space Center (KSC) in Florida. Adjacent to the Engineering Support Building (ESB) at the demonstration sites, there is an extensive trichloroethene (TCE) dense non aqueous phase liquid (DNAPL) source present in groundwater. During an in situ chemical oxidation (ISCO) demonstration in 1999, 942,985 gallons of a potassium permanganate solution was injected into a 75 foot by 50 foot test plot to treat the DNAPL source. This demonstration was conducted to assess the technical feasibility of coupling the ISCO source treatment conducted in 1999 with in situ bioremediation (ISB) as a secondary remediation approach to address residual DNAPL at the site. The pilot test area for the 2003/2004 ISCO/ISB demonstration was located within the previous ISCO demonstration plot. A preliminary site investigation conducted in December 2002 indicated the presence of residual DNAPL at the site. Based on 2002 soil sampling results, concentrations of TCE in soil exceeded 10,800 milligrams per kilogram (mg/kg) at the pilot test area.

Construction of the ISB system began in 2003 and ISB system operated between June 2003 and August 2004. The demonstration was conducted in three operational phases: (1) baseline phase, using groundwater circulation alone, started on December 8, 2003; (2) biostimulation phase with the addition of the electron donor, started on March 1, 2004; and (3) bioaugmentation phase, where the test plot was bioaugmented with KB-1TM, a bacterial consortium containing *Dehalococcoides* species, on April 15, 2004. The demonstration was discontinued in August 2004 (sooner than anticipated) due to several hurricanes and biofouling issues. This resulted in several performance objectives not being met. Following the completion of the demonstration, a final round of groundwater samples was collected from the onsite monitoring wells in August 2005, 12 months after system shutdown. Over the duration of the demonstration, TCE concentrations decreased significantly to non-detect levels. The addition of electron donor resulted in the biodegradation of TCE to cis-dichloroethene (DCE) and additional dechlorination occurred flowing the bioaugmentation phase resulting in the formation of vinyl chloride and to a lesser extent ethane. Despite these results, the limited duration of the demonstration made it challenging to conclusively assess the DNAPL mass reduction using sequential ISCO and ISB.



Remediation Technology Cost and Performance Case Studies

More than 410 Remediation Technology Cost and Performance Case Studies (treatment or containment) are available on the FRTR website. Recently, nine new cost and performance case studies for remediation technologies have been added. These case studies address the use of *in situ* remediation technologies for contaminated soil and groundwater. Prepared by DoD's Environmental Security Technology Certification Program (ESTCP), these new case studies provide data on the cost and performance of various technologies including nanotechnology, bioremediation, in situ chemical oxidation, and monitored natural attenuation to treat a range

of contaminants such as chlorinated solvents, perchlorate and explosives.

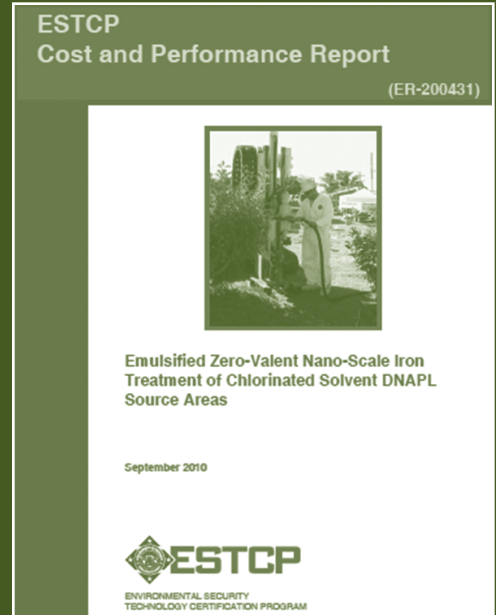
Site Characterization and Monitoring Reports

This focus area includes reports on field-based site characterization and monitoring technologies, and documents experiences and lessons learned in field demonstrations and full-scale applications; more than 195 reports are currently available. Two new reports, both addressing the characterization of organic chemicals, have been added, with one provided by the DoD ESTCP and the other by Interstate Technology and Regulatory Council (ITRC).

EMULSIFIED ZERO-VALENT NANO-SCALE IRON TREATMENT OF CHLORINATED SOLVENT DNAPL SOURCE AREAS

Highlight of New Remediation Technology Cost and Performance Report

This field demonstration was conducted at the Site 45 Dry Cleaning Facility, located in the Main Post area at Parris Island Marine Corps Recruit Depot (MCRD) in South Carolina. Following the removal of an underground storage tank system in 1988, four aboveground storage tanks were placed along the northern side the former dry cleaner facility (Building 193) at the site. In March 11, 1994, one of the tanks was overfilled with tetrachloroethene (PCE) and an unknown amount flowed into a concrete catch basin. This overflow was washed onto the surrounding soil during heavy rainfall at the site. Results of previous field investigations indicate that chlorinated volatile organic compounds (VOC) contamination in the surface and subsurface soil at the site has impacted groundwater from the upper boundaries of the unconfined aquifer to about 19 feet below ground surface (bgs). Results of a 2005 field investigation indicate the presence of a dense non aqueous phase liquid (DNAPL) source area consisting primarily of PCE. The DNAPL source area has been relatively well-characterized and was ideal for this demonstration. The purpose of the demonstration is to evaluate the ability of emulsified zero valent iron (EZVI) to remediate the chlorinated solvent DNAPL source zone at the site, achieve pre established radius of influence goals, and evaluate the ability of Pneumatic and Direct Injection techniques to evenly distribute EZVI in a controlled manner. EZVI was injected into the test plots at the site in October 2006. 576 gallons of EZVI was injected into 8 locations within the Pneumatic Injection test plot, and a total of 151 gallons of EZVI was injected into 4 locations within the Direct Injection test plot. There were some complications during the demonstration due to the shallow nature of the target injection areas and pre existing soil borings at the site. As a result, EZVI was not evenly distributed throughout the treatment areas of each test plot. However, all other performance objectives including reducing the DNAPL mass and mass flux of PCE and trichloroethene (TCE) were successfully met.



USE AND MEASUREMENT OF MASS FLUX AND MASS DISCHARGE

Highlight of New Characterization Report

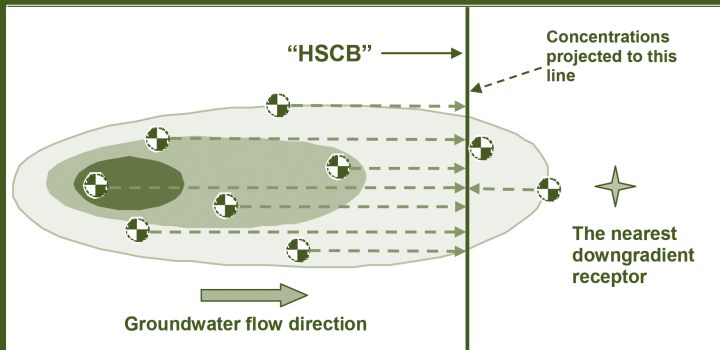


This Interstate Technology and Regulatory Council (ITRC) technology overview summarizes the concepts underlying mass discharge and flux, their potential application for site remediation, and methods of measurement. Potential applications described within the document include the use of mass flux and discharge in site characterization, remedy selection and design, performance monitoring and optimization, compliance monitoring, and site prioritization. In addition, the document presents several case studies and summarizes their general findings (including the impact of mass discharge and flux on decision-making and remediation costs). Several conceptual site models (CSMs) using mass flux and mass discharge are presented. Overall findings showed that mass discharge and flux estimates have been useful in achieving several site management objectives and that mass discharge and flux evaluation can improve CSMs and lead to more efficient remediation.

Potential applications of mass discharge and mass flux data for contaminated groundwater management.

GROUNDWATER MONITORING NETWORK OPTIMIZATION AT THE DELATTE METALS SUPERFUND SITE, PONCHATOULA, LOUISIANA

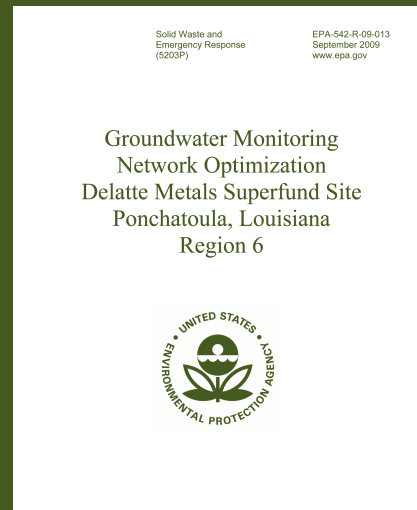
Highlight of New Long-Term Monitoring Program Evaluation Case Study Report



Use of a hypothetical statistical compliance boundary (HSCB) during application of the MAROS power analysis method to project contaminant concentrations in the monitoring network.

The site was deleted from the National Priorities List in August 2005. Analytical data collected at the site from January 2004 to August 2008 were evaluated using a formal qualitative approach and statistical tools found in the Monitoring and Remediation Optimization System (MAROS) software. The report describes the groundwater monitoring evaluations conducted at the site, findings, and recommendations. The report provides recommendations on specific sampling locations, sampling frequencies, analytes, and data management strategies to support the development of a long term site management plan. The report notes that current data are insufficient to determine whether the remedy has been successful and additional data should be collected to evaluate the status of site groundwater and potential exposure pathways.

This report reviews and provides recommendations for improving a groundwater monitoring network for the Delatte Metals Superfund Site, a former battery manufacturing facility. The primary goal of this groundwater long-term monitoring optimization (LTMO) evaluation was to improve the efficiency and accuracy of the monitoring network. This evaluation also served to assess the attainment of remedial action objectives. Several remedial actions have been completed at the site, including: removal of contaminated soil, decommissioning of buildings and tanks, installation of a bio barrier to treat contaminated groundwater, and implementation of institutional



Long-term Monitoring and Optimization Case Study Reports

This focus area includes reports that describe long-term monitoring and optimization efforts that involve techniques such as evaluations of groundwater monitoring programs and plume, and hydraulic optimization. More than 130 reports are currently available under this focus area. Seven new documents from EPA have been recently added. Two of the reports focus on evaluations of extraction systems used for remediation, while five reports describe evaluations of long-term monitoring programs.

Remediation Technology Assessment Reports

The reports in this focus area provide broad assessments of technologies based on results from field experience gained from multiple sites. Two new reports were added to this focus area, bringing the total to 94, with one each from DoD ESTCP and ITRC. The DoD ESTCP report describes a technology demonstration to study various approaches to determining loading rates and the impacts of substrate delivery during enhanced anaerobic bioremediation. The ITRC report provides information on the use of a decision framework for applying monitored natural attenuation processes at sites contaminated with metals and radionuclides.

TECHNICAL ASSISTANCE FOR THE SOMERSWORTH SANITARY LANDFILL SUPERFUND SITE, SOMERSWORTH, NEW HAMPSHIRE

Highlight of New Long-Term Monitoring Program Evaluation Case Study Report

This report summarizes the findings and recommendations from a long-term groundwater monitoring program evaluation conducted at the Somersworth Sanitary Landfill Site in Somersworth, New Hampshire. Groundwater remedies began operating at the site in 2001 and included a zero valent iron (ZVI) permeable reactive barrier installed at the downgradient edge of the waste management area of the landfill and a permeable landfill cover (PLC) over the waste management area. The site is currently in the long-term monitoring phase of operation and maintenance (O&M). In 2007, site monitoring data was evaluated using the Monitoring and Remediation Optimization System (MAROS) software. This report includes a review of the data inputs, assumptions, and subsequent MAROS analysis to evaluate the previously identified recommendations for the Somersworth site monitoring network. The data was assessed for sufficiency, quality, and consistency with site conditions. Based on a review of the data inputs, MAROS analysis results, and interpretation, it was determined that the recommendations for the Somersworth Site were appropriate and consistent with the groundwater monitoring objectives. The report describes additional recommendations to streamline future data analyses and prevent minor complications that may arise after making the proposed changes to the monitoring network.

Final Report:
Technical Assistance for
the Somersworth Sanitary
Landfill Superfund Site
Somersworth, New Hampshire
EPA Region 1

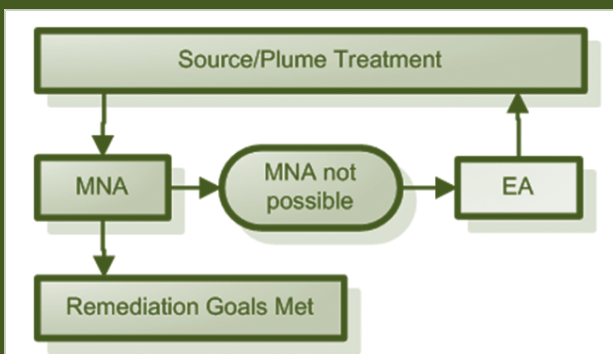


A DECISION FRAMEWORK FOR APPLYING MONITORED NATURAL ATTENUATION PROCESSES TO METALS AND RADIONUCLIDES IN GROUNDWATER

Highlight of Remediation Technology Assessment Report

The purpose of this Interstate Technology and Regulatory Council (ITRC) guidance is to facilitate acceptance of attenuation-based remedies including monitored natural attenuation (MNA) and enhanced attenuation (EA) for remediation of metals and radionuclides in groundwater, where appropriate. The guidance summarizes the results of a web based survey of site regulators

and stakeholders to determine the existing state of knowledge and acceptance of remedies based on MNA. It identifies issues from the survey and proposes solutions for these issues. It also includes a decision framework that allows users to evaluate the feasibility of MNA processes at contaminated sites and incorporates key aspects of the U.S. Environmental Protection Agency's (EPA) three volume, technical background series on MNA. In addition, the guidance identifies key issues and approaches associated with evaluating attenuation-based remedies for metal- and radionuclide contaminated sites with multiple contaminants. To illustrate the key messages of this guidance and demonstrate the application of attenuation-based remedies to real-world scenarios, the guidance presents several case studies.





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AUGUST 2011

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Federal Remediation Technologies Roundtable



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