



Natural Attenuation Monitor

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Issue 2

This publication is published by the US DOE Monitored Natural Attenuation and Enhanced Attenuation for Chlorinated Solvents Technology Alternative Project to provide to all interested parties the latest information on this project.



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Note to Readers: You will notice several changes in team names and terminology in this edition of the newsletter. The changes are discussed in several articles in this edition of the Monitor.

Comments and Questions on the MNA/EA Project may be e-mailed to Karen Vangelas at karen.vangelas@srs.gov or she may be reached at (803)-725-5223.

Overview of MNA-EA Project

Several months have passed since we completed the first issue of the *Natural Attenuation Monitor*. It's now time to write the second issue of the *Monitor*, which will describe our accomplishments, actions, and progress over the last five months.

First, I must acknowledge the kind words and compliments our readers provided on the first issue. Stakeholders across the sites appreciated getting the information, its brevity, and timeliness. Our management was impressed with how economically we were informing interested participants, as well as the quantity of material we packed into the issue. On behalf of the project management team, I thank the Savannah River Site (SRS) Citizens Advisory Board (CAB) for its recommendation to provide information on our successes to stakeholders across the DOE complex. As the project advances, we'll do our best to provide timely updates.

Our biggest news is that the suite of applied research projects and field studies was negotiated successfully and in place before the end of July, 2004. Kick-off discussions with the principal investigators were held with all meetings being completed by mid-August. Awards are in place with 4 university, 5 industry, 2 U.S. Geological Survey, and 4 DOE national laboratory participants.

The Interstate Technology and Regulatory Council, Enhanced Attenuation: Chlorinated Organics (EACO) team, is in place with representatives participating from 8 state regulatory agencies, industry, academia, stakeholders, and other federal agencies. Co-chairs for the EACO Team are state regulators from South Carolina and Florida. The EACO Team is intended to jointly develop, with the DOE team, updated regulatory guidance for MNA of chlorinated organics. We meet face-to-face quarterly and have monthly conference calls.

In late May 2004 at the Battelle Conference on Remediation of Chlorinated and Recalcitrant Compounds:

Fourth International Conference, we presented four papers in a dedicated session on the project and presented a poster session on the results of a survey on the uses of MNA for chlorinated solvents. The session attracted over 250 attendees; 150 CDs of the papers were distributed; and the questions were excellent. We are pleased with the technical communities' response.

We held a program review on the project at the Savannah River Site in mid-July. The Technical Working Group and Interactive Working Group reported on actions and accomplishments, to date. The EACO Co-Team Leader, Kimberly Wilson of DHEC talked about the activities of the regulatory team; Ken Lovelace, EPA/HQ, talked about EPA's view of the project and indicated there were no major gaps in what the project is doing versus what is needed. The review went well with Mark Frei, Director, Office of Cleanup Technologies, complimenting the team on how successful the project is at integrating all participants into one organizational team.

Karen Adams, our SRS Operations oversight manager, just gave an update on the project to the Savannah River CAB Facility Disposition and Site Remediation Committee. They appreciated the information and asked good questions. On September 27, we are invited to update the full Savannah River CAB; the next day, we participate in a DOE Headquarters progress review on all Alternative Projects. We thank the CAB for its interest and support. We will be contacting the stakeholders and regulators at Savannah River, Oak Ridge and Hanford sites to schedule presentations to update these groups on the project's progress.

Claire H. Sink, Project Manager
U.S. Department of Energy



Goodbye to Enhanced Passive Remediation, Hello to Enhanced Attenuation

The first meeting of the MNA/EPR project team with the Interstate Technology and Regulatory Council (ITRC) Enhanced Attenuation: Chlorinated Organics (EACO) Team resulted in a change in terminology for a key concept of this project. The term “enhanced passive remediation (EPR)” was discussed at length. The EACO Team supports the concept of taking an action that will give the natural processes the boost needed to meet the established remedial goals of the plume to be cleaned up. The difficulty lay with the term “enhanced passive”. The consensus was that these are conflicting terms. Kimberly Wilson, EACO Team co-chair, summarized the discussion of the term, “If a process is passive it works without human input, therefore once you take an action to enhance it, it is no longer passive.” The EACO and MNA/EPR Teams came to agreement with the term “enhanced attenuation (EA)”. This term reflects the end goal and does not prejudice, define and/or limit the process. (See article titled **Enhanced Attenuation: Filling the Void** for definition of enhanced attenuation.)

The MNA/EPR Project Team has been renamed to reflect this terminology change and is now the MNA/EA Project Team. Documents and papers written after April 2004 are using the term/name “enhanced attenuation.”

~~EPR - ENHANCED
PASSIVE REMEDIATION~~

Enhanced Attenuation (EA)

Meeting the Technical Targets: Work Underway

Two major initiatives began this year. First, the Technical Working Group (TWG) has formed three subteams to develop the mass balance concept, the enhanced attenuation (EA) concept (see article titled **Enhanced Attenuation: Filling the Void**), and the characterization and monitoring to support MNA and EA. The subteams are drafting documents that will be developed throughout the project life. The subteam documents will be the basis for the technical guidance document to be the final technical deliverable of the project. The first drafts are scheduled for completion at the end of September 2004.

The second major initiative is conducting the research studies that will support the technical targets identified in the *Natural and Passive Remediation of Chlorinated Solvents: Critical Evaluation of Science and Technology Targets*. The research studies were identified by topic and organization in the article titled **New Science, New Technologies: Meeting the Technical Targets**, published in the March 2004 issue of the *Monitor*. The 14 research studies were negotiated and initiated during the period of April through July 2004.

Each researcher has 22 months to conduct and document his or her research. Karen Vangelas, MNA/EA Operations Lead, Brian Looney, MNA/EA TWG Chair, and Karen Adams, MNA/EA DOE-SR Project Lead, have held kickoff meetings with each of the research teams. Each research study is linked with one or more of the three TWG sub-teams. Communication between the research teams and the TWG



Researchers will take advantage of existing wells for testing new characterization tools.

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Enhanced Attenuation: Filling the Void

Environmental remediation techniques come in all sizes, shapes and levels of complexity. If we put all these techniques on a continuum from the very aggressive on one end to those that require “no human intervention” on the other, many in the technical and regulatory communities identify a void. That void, as shown in the figure below, lies between the engineered but passive systems, such as permeable reactive barriers, and monitored natural attenuation, that by US EPA definition states involves “no human intervention”.

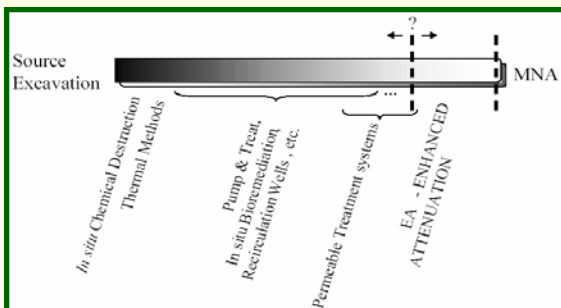


Figure 1. Enhanced Attenuation is a class of technologies between engineered technologies and those that have no intervention by humans.

Tom Early, TWG member from Oak Ridge National Laboratory, is leading a subteam of the TWG in exploring how to fill that void. The term coined by the TWG and the EACO teams is “Enhanced Attenuation (EA)”. Remediation techniques considered to fit into this category of Enhanced Attenuation are those that can show the property of sustainability. By our definition, which is continuing to be refined as the teams continue their work, *a sustainable enhancement is an intervention that continues to operate until such time that the enhancement is no longer required to reduce contaminant concentrations or fluxes*. The subteam is examining enhancements in all three zones of a contaminant plume, the source, the dissolved phase and the discharge zone, as shown in the three figures below.

They are looking at case studies of techniques already in practice to determine potential for sustainable performance, as well as looking at new enhancement ideas. One class of remediation being examined as a possible enhanced attenuation process is the use of injected vegetable oils (e.g., EOS™ / Solutions IES) or other extended release organic reagents (e.g., HRCx™ / Regensis). Results from several case studies of the EOS (Edible Oil Substrate) process, for example, are quite promising. Bob Borden, North Carolina State University, and a member of the ITRC EACO team, is a leader in this field and is assisting in evaluating enhancement opportunities. The EA subteam will be drafting a document that explores the case studies of a variety of remediation processes to determine if they fit into EA and to examine potential modifications to enhance and document sustainability.

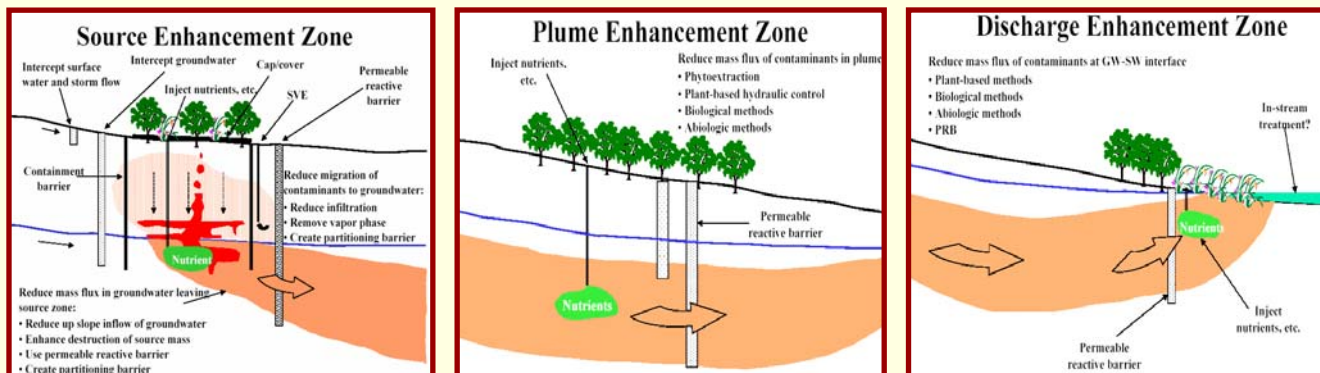


Figure 2a, 2b, and 2c. These 3 figures present some of the enhancement options being examined for source, plume and discharge areas of a plume for applicability as sustainable enhancements.

(Continued from page 4) Meeting the Technical Targets

sub-teams is being encouraged and coordinated to promote cross-fertilization of ideas as well as discussions at key decision points in the researcher's and TWG's work.

Ten of the 14 research teams will either require samples from the four testbeds located at the Savannah River Site or will conduct testing on these same testbeds. The MNA/EA Operations and Technical leads are coordinating with the researchers and with the SRS operating department responsible for the testbeds in selecting sampling or testing locations to meet the needs of the researchers and to provide benefit to the operating department. The final reports of each research study will be provided to the operating department for their use in decision making, as appropriate.



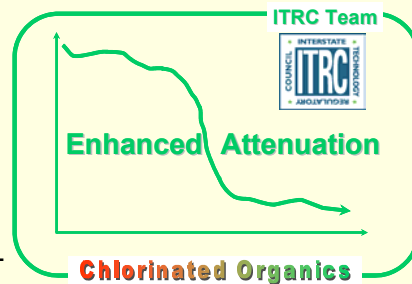
USGS researchers collect sediment samples from a wetland for a study on oxidative and reductive processes.

One of the four remaining research studies will develop a decision support system that will help answer the questions of "what to measure" and "when/where to measure" for natural attenuation applications. A major portion of this work will be using neural networks to evaluate relationships between standard and non-standard data. Some of the data included in this evaluation will be historical data from the SRS testbeds. Two of the four remaining research studies will update publicly available models used in decision-making associated with chlorinated solvent remediations. The final research study will develop a scenario based decision-tree, much like a taxonomic key in biology. This decision-tree will be a guidance tool for regulators and technical professionals on how to proceed in an efficient manner with characterization, modeling and monitoring of a waste site for MNA.

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Natural Attenuation and Passive Bioremediation Team Changes Name and Begins Work

The Interstate Technology and Regulatory Council's Natural Attenuation and Passive Bioremediation



Team, under the leadership of Judie Kean and Kimberly Wilson, held its organizational meeting during the ITRC's spring meeting in March 2004. Approximately 30 members and interested parties attended this meeting that set the path forward for this team. Team members represent: 8 state regulatory agencies, the US EPA, the US Department of Defense, the US Department of Energy, academia, industry and stakeholders. The eight state regulatory agencies represented are Washington, Tennessee, South Carolina, Florida, New Jersey, Delaware, Montana, and Virginia.

This team's mission is to develop, in collaboration with the DOE's MNA/EA Team, the "next generation" regulatory and technical guidance to address enhanced attenuation and advances in the understanding of monitored natural attenuation. To reflect this mission, the team elected to change their name to the Enhanced Attenuation: Chlorinated Organics Team. Working with the MNA/EA Technical Working Group, the EACO Team's first activity is the development of a survey to examine regulatory practices and successes, and regulatory hurdles to implementing either MNA or MNA with EA concepts, as appropriate. This survey will be distributed to the ITRC's 43 partner states for completion.

The ITRC Team is developing an electronic database that will contain case studies and regulatory documents of MNA and EA actions. The EACO and MNA/EA Teams will collaborate to author the guidance document identified in the previous paragraph and to develop and provide training on the technical and regulatory issues associated with that document.

Key Concepts Presented at Battelle Sponsored Conference on Chlorinated and Recalcitrant Compounds

The Fourth International Conference for the Remediation of Chlorinated and Recalcitrant Compounds was the venue for the MNA/EA Team to present key concepts of the project. Four oral presentations and one poster session were presented during this widely attended technical conference held in May 2004. This conference is attended by scientists, engineers, regulators, remediation site owners, and other environmental professionals representing universities, government site management and regulatory agencies, and R&D and manufacturing firms. The session titled, Streamlining the MNA Process, was chaired by Claire Sink, DOE HQ MNA/EA Project Manager, and showcased our project. This session was attended by over 250 of the conference attendees and was well received with thoughtful and supportive comments from the attendees.

Brian B. Looney, chair of the Technical Working Group (TWG) and from the Savannah River National Laboratory, opened the session with an overview presentation of the goals, history and central technical concepts of the project. He was followed by Frank Chapelle, TWG member from the US Geological Survey, who presented the mass balance concept and the theoretical basis for this concept. The mass balance concept was presented in the March 2004 edition of the *Monitor* in an article titled **Balancing Contaminant Loading with Contaminant Attenuation**. John Wilson, US EPA, when commenting on Frank's presentation expressed the clear challenge faced by the TWG, "Frank, you have been promoting the idea of the mass balance for probably the last 10 years, the challenge is to work out the math that supports this idea." Tyler Gilmore, TWG member from Pacific Northwest National Laboratory, presented the four-phased approach to characterization and monitoring for MNA. Simply stated the four phases are designed to: 1) screen whether MNA is viable, 2) determine the predominant attenuation

mechanisms and decide if an enhancement is needed and what it should be, 3) verify that MNA is working, develop the operating window and select the long-term monitoring methods that will provide a measure that you are within the operating window, and 4) conduct long-term monitoring to ensure you are operating within the accepted envelope where MNA is viable. David Major, TWG member from GeoSyntec Consultants, presented the advancements being made in molecular (genetic) technologies that show promise in enabling the technical community to directly measure the impact of microbiological activity in the natural attenuation processes.

Successful development of these methods have the potential to shift the balance from collecting indirect measures of attenuating processes to direct measures of the same processes, resulting in greater reliability/accuracy in determining the biological attenuation mechanisms at work. Chuck Newell and Travis McGuire, of Groundwater Services, Inc., presented a poster session displaying the results and interpretations of the historical survey of MNA practices they conducted for the TWG. The emphasis of this survey was to document the successes and failures of implementing MNA, from a technical perspective.

Information on obtaining copies of the abstracts and papers associated with these presentations is located at the end of this newsletter in the article titled **Published MNA/EA Project Documents**.

MNA/EA Team Presents a Program Review for DOE Management

A program review of the MNA/EA project was held on July 14, 2004 for DOE management at the Savannah River Site. Mark Frei, HQ/DOE, Director, Office of Cleanup Technologies, Office of Environmental Management and John Lankford, HQ/DOE, Office of Cleanup Technologies, and Patrick Jackson, DOE-SR, Cleanup Projects Integration Team represented the Department of Energy.

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Mark Frei and Mac Lankford (at table, center and right), discuss progress of MNA/EA Project team with Claire Sink (at table) and other team members.

Also in attendance was management of the Savannah River National Laboratory (SRNL), the host organization for this project.

Claire Sink, DOE Office of Cleanup Technologies, MNA/EA Project Manager, Karen Adams, DOE-SR, Soils and Groundwater Project, MNA/EA Project Lead, and Paul Deason, SRNL, Deputy Director, welcomed the attendees to the review. Team members gave presentations representing the key technical concepts being developed through the project, the research efforts being undertaken to support the key technical concepts, and summarized interactions with participating groups. Brian Looney, Frank Chapelle, Tom Early and Tyler Gilmore, representing the Technical Working Group, presented the technical concepts. Karen Vangelas reported on the research efforts (see article titled **Meeting the Technical Targets: Work Underway** for more information on the research efforts). Mike Shotton, Deputy Project Manager, Soils and Groundwater Closure Project at SRS represented the end users, Kimberly Wilson, South Carolina Department of Health and Environmental Control and EACO co-chair, spoke for the regulators; and Karen Vangelas reported on the project team's interactions with stakeholder organizations and the publishing of the *Monitor*.

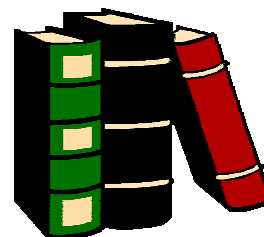
After the presentations, Ken Lovelace, US EPA Headquarters, provided the perspective of HQ/EPA Science and Policy Office on the progress and direction of the project to meet ongoing needs with the regulatory community. Ken's

comments were supportive and indicated the project is moving in a needed direction to incorporate the new science that has and is continuing to be developed since the 1998 technical guidance was published by US EPA.

Mark Frei concluded the meeting providing the DOE HQs perspective on the project's progress and direction. Mark reflected this is a complex project and the team is doing a good job managing the project. The complexity comes from integrating the regulators, stakeholders, end users needs and issues into the science, which is the driving force of the project. He is very supportive of the project's culture of integrating the regulators, stakeholders and end users into the project team. The team was commended on publishing and disseminating the *Monitor* as an effective communication tool for providing project information.

Published MNA/EA Project Documents

A running list of all documents that are a product of this project will be presented here. Documents will be added to the list once they have been approved for public release.



Most documents will be available from the Office of Scientific and Technical Information's website (www.osti.gov). Each listing will include the document title, hot link, and short description. Those documents that were presented in previous issues will not include a description.

Scientific Basis for Monitored Natural Attenuation and Enhanced Passive Remedation for Chlorinated Solvents – DOE Alternative Project for Technology Acceleration Implementation Plan (www.osti.gov/bridge/product.biblio.jsp?osti_id=810006&queryId=1&start=0), WSRC-

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RP-2003-00286, Department of Energy, Office of Scientific and Technical Information, Oak Ridge TN, February 20, 2003.

Historical and Retrospective Survey of Monitored Natural Attenuation: A Line of Inquiry Supporting Monitored Natural Attenuation and Enhanced Passive Remediation of Chlorinated Solvents (www.osti.gov/bridge/product.biblio.jsp?osti_id=820972&queryId=1&start=0), WSRC-TR-2003-00333, Department of Energy, Office of Scientific and Technical Information, Oak Ridge TN, October 20, 2003.

Summary Document of Workshops for Hanford, Oak Ridge and Savannah River Site as part of the Monitored Natural Attenuation and Enhanced Passive Remediation for Chlorinated Solvents - DOE Alternative Project for Technology Acceleration (www.osti.gov/bridge/product.biblio.jsp?osti_id=820971&queryId=1&start=0), WSRC-RP-2003-1044, Department of Energy, Office of Scientific and Technical Information, Oak Ridge TN, October 20, 2003.

Natural and Passive Remediation of Chlorinated Solvents: Critical Evaluation of Science and Technology Targets (www.osti.gov/bridge/product.biblio.jsp?osti_id=822824&queryId=2&start=0), WSRC-TR-2003-00328, Department of Energy, Office of Scientific and Technical Information, Oak Ridge TN, February 2004. This document identifies the key technical concepts this project will develop. There is an evaluation of potential technical/scientific areas that have the potential for development and an identification of 16 technical targets that will be pursued during this project.

Baseline Natural Attenuation Processes: Lines of Inquiry Supporting Monitored Natural Attenuation of Chlorinated Solvents (www.osti.gov/bridge/product.biblio.jsp?osti_id=828468&queryId=1&start=0), WSRC-TR-2003-00329, Department of Energy, Office of Scientific and Technical Information, Oak Ridge TN, May 18, 2004. This document pro-

vides a review of the mechanisms that contribute to the class of remediation identified as natural attenuation. The concept of using a mass balance as a method to mathematically represent these mechanisms is introduced.

Five papers were presented at the Battelle sponsored Remediation of Chlorinated and Recalcitrant Compounds, The Fourth International Conference, held May 24—27, 2004 in Monterey California. Battelle press publishes the proceedings in which all five papers will be published. The titles of the papers and authors are as follows:

A Mass Balance Approach to Monitored Natural Attenuation, Frank Chapelle, C. Journey (USGS) B. B. Looney, M. Heitkamp, Robin Brigmon (SRTC), D. Major (GeoSyntec Consultants), T. Early (ORNL), T.H. Wiedemeier (T.H. Wiedemeier & Assoc.), T. Gilmore (PNNL), G. Wein (BSRI), C. Sink (US DOE).

Facilitating MNA and Enhanced Passive Remediation (EPR) of Chlorinated Solvents, Brian B. Looney, K. M. Vangelas (SRTC), C. Sink (US DOE).

Trends in Monitored Natural Attenuation Application at Chlorinated Solvent Sites, Charles J. Newell, T.M. McGuire (Groundwater Services, Inc.), B.B. Looney, K.M. Vangelas (SRTC), C. Sink (US DOE).

Putting the Third Line of Evidence First—Advances in Molecular Technologies, David W. Major (GeoSyntec), M. Heitkamp (SRTC), C. Sink (US DOE).

Characterization and Monitoring Strategy for Monitored Natural Attenuation, Tyler Gilmore (PNNL), B. B. Looney, B. Riha (SRTC), J. Waugh (S.M. Stoller), C. Sink (US DOE).