FEDERAL REMEDIATION TECHNOLOGIES ROUNDTABLE MEETING

Arlington, Virginia
June 5, 2008

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ACTION ITEMS

- ► Comments on the draft FRTR fact sheet—Annual Summary of Activities: June 2008—are due by July 5, 2008.
- ► Todd Bridges will send Tom Nicholson information about a case study involving effluent discharges containing cobalt-60.
- ► Amy Walker will send links to Navy guidance documents on optimizing remedial operations, remedy selection, and long-term monitoring to Norm Niedergang.
- ► Todd Bridges will send Jake Phillip a link to the Corps capping guidance.

WELCOME/OPENING REMARKS

Norm Niedergang, Director of the Technology Innovation and Field Services Division (TIFSD) in the U.S. Environmental Protection Agency (EPA) Office of Superfund Remediation and Technology Innovation (OSRTI), welcomed the attendees to the 36th meeting of the Federal Remediation Technologies Roundtable (FRTR) and provided a brief overview of the agenda. He indicated that all member agencies present would be asked to cast ballots to select a topic for the technical session at the Fall 2008 roundtable, with the results to be announced at the end of the meeting.

Niedergang said that FRTR continues to demonstrate its value as a venue for cooperative ventures among government agencies. "How are you leveraging working together with other federal agencies?" is one of the key questions asked by EPA's Office of the Chief Financial Officer. OSRTI is pleased to be able to point to FRTR as an example of relevant collaboration across government agencies.

Niedergang also informed the group that member agencies other than EPA are welcome to host the next meeting if any would like to do so.

Tom Nicholson (Nuclear Regulatory Commission) announced the availability of a two-part document entitled Integrated Ground-Water Monitoring Strategy for NRC-Licensed Facilities and Sites (www.nrc.gov/reading-rm/doc-collections/nuregs/contract/cr6948/). This document presents a logical framework for assessing what, how, where and when to monitor underground water to ensure that a facility is behaving within the expected limits as described by the performance assessment. The strategy is implemented as an iterative process, beginning with analysis of any existing site and facility characterization and monitoring data, any existing conceptual site model, and any existing risk assessment or PA model. Application of this systematic approach can reduce uncertainty associated with site analysis and aid decision making. Volume 1 presents a discussion of the logic and strategic approach, and Volume 2 contains case studies of six test sites where the strategy was applied.

Attendees introduced themselves

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FRTR ACTIVITIES UPDATE

John Kingscott (EPA/OSRTI) discussed the redesign of the FRTR Web site (www.frtr.gov), which has been undertaken to update and expand the resources, improve functionality and relevance, and simplify navigation to make the site more user friendly (Attachment A). New tabs are proposed for the navigation sidebar to highlight areas of particular interest.

- A "What's New?" tab, updated monthly, will provide the opportunity for members to contribute notices about meetings, conferences, publications, and other news relevant to FRTR interests.
- The "Technology Cost and Performance" tab will be renamed "Cost and Performance Case Studies." Reorganization of that page will make these popular databases more directly accessible, and a link to Remediation Optimization Case Studies will be added. Entries within each resource area will be arranged by date, with the most recent first. EPA will discontinue publishing annual abstracts of the remediation case studies.
- A "Current Publications" tab leads to a page that lists FRTR member agency publications and showcases landmark agency reports. These resources will be listed by date (most recent first) and retained on the page for one year. A new tab will lead to archived material.

The site redesign is scheduled to "go live" by the end of June 2008. A "Comments" button has been added at the bottom of the left-hand navigation bar, and Kingscott urged FRTR members to review the site and use the button to provide feedback. He encouraged all members to participate in keeping the Web site up to date by contributing items for the “What's New?” and “Current Publications” pages, reporting changes to the Web links, and identifying old publications that have been replaced.

Kingscott also reported the addition of 34 new case studies to the databases: eight under Treatment, five under Technology Assessments, four under Site Characterization, and 17 under Optimization of Long-Term Monitoring. He reminded members that information for developing new cost and performance case studies is always appreciated. In conclusion, he requested comments on the draft FRTR fact sheet included among the meeting handouts. The fact sheet summarizes the updates to the FRTR Web site and highlights additions to the case studies. Comments on the draft fact sheet are due by July 5, 2008. EPA will distribute the final fact sheet to member agencies.

Audience members contributed the following additional suggestions for updating the FRTR site:

- Add a glossary of terms and a list of acronyms.
- Include a section for regulatory guidance on how technologies can be used, such as the new documents on monitored natural attenuation of metals; alternatively, provide links to agency pages that discuss the guidance to ensure that up-to-date information is available.
- Expand vendor information.
- Include a solicitation venue for research grants and cleanup opportunities.
- Provide real-time information updates via a listserv and/or an RSS feed.
- Have each agency review the resources it has suggested for FRTR in the past, indicate outdated material that should be removed, propose the most appropriate and useful links currently used by its members, and provide a paragraph describing the value of each site.

STATUS OF SEDIMENT REMEDIATION WORK AND/OR POLICY: EPA, NAVY, ARMY, ARMY CORPS, SERDP/ESTCP, USGS, STATES

Norm Niedergang introduced Carol Dona (U.S. Army Corps of Engineers [USACE]) and thanked her for serving as the chair for the meeting's technical presentations on contaminated sediments. Dona introduced the five representatives from member agencies and the Interstate Technology and Regulatory Council (ITRC) assembled to present overviews of a variety of program activities during the first segment of the technical program.

Update on Superfund HQ Sediment Remediation Activities

Steve Ells (EPA/OSRTI) reported on activities, resources, and opportunities within Superfund associated with sediment remediation (Attachment B).

- The Contaminated Sediments Technical Advisory Group (CSTAG) was created to monitor progress and provide advice for a small number of large, complex, or controversial contaminated sediment Superfund sites. CSTAG has visited 13 sites to date. The site reviews are available on the CSTAG Web site at www.epa.gov/superfund/health/conmedia/sediment/cstag_sites.htm.
- The Superfund Sediments Resource Center (SSRC) was developed in EPA Headquarters to provide quick responses to remedial project managers (RPMs) on site-specific technical issues. So far, 20 responses have been prepared.
- Superfund Assessment and Monitoring Sheets (SAMS) have been developed that use fish tissue data to monitor remedy effectiveness. The first SAMS is due to be released in July 2008.
- On April 10, 2007, EPA, the Navy's Space and Naval Warfare Systems Command, and the Army Corps of Engineers Engineer Research and Development Center (ERDC) signed a memorandum of understanding (MOU) for collaboration on contaminated sediments research. Ells said that the most important area in this undertaking involves identifying topics and projects for active collaboration and discussing potential mechanisms for executing collaborative projects, such as field demonstrations. EPA also has worked with the Corps in sponsoring the development of technical documents on sediment dredging and capping.
- Ells also identified research questions in the areas of sediment remediation, characterization, and modeling that might provide FRTR members with topics for collaborative projects.

Navy Overview – Contaminated Sediments: Policy, Issues and Technology Needs

Wanda Holmes (Naval Facilities Engineering Command [NAVFAC]) substituted for Kim Parker Brown in a discussion of contaminated sediment issues relevant to the Department of the Navy (Attachment C). Sediment sites currently comprise approximately 30 percent of the Navy's environmental cleanup budget. More than 200 potentially contaminated sediment sites have been identified. Investigation and cleanup of sediment is more complex than for media such as soil, surface water, and ground water because Navy installations often are adjacent to water bodies that exhibit complex hydrological and sediment dynamic processes. Source identification is difficult due both to commingling of contaminants and to contribution from both Navy and non-Navy sources. Many of the Navy's shore-side support facilities are affected by urban water systems, which can complicate cleanups due to recontamination issues. The Navy's sediment

cleanup goals are based on site-specific risk, as unrestricted use generally is not financially feasible.

Determining approaches to sediment sites where the water body is owned by the Navy is an issue the Navy is still working to address. In 2002, the Navy developed a sediments policy and implementation guidance to aid RPMs in cleaning up sediment sites. Some of the characterization and remediation issues are unique to the Navy, while others are similar to those encountered by the regulatory community and other potentially responsible parties. Selection of appropriate remediation tools is key in approaching the solution of cleaning up sediment sites, but the uses of these sites can limit technology selection as it is of paramount importance to avoid compromising the military mission of the facility. Innovative investigation and remediation approaches for sediments often are in development stages or have not been proven in the field. Many of these areas warrant further research and demonstration, but it is necessary to prioritize them to address relevant data gaps in the most cost-efficient way. Research and development (R&D) focus areas of importance to the Navy include source identification and characterization technology tools, understanding of sediment stability/transport, *ex situ* treatment of excavated contaminated sediment, *in situ* treatment and containment, long-term monitoring, and development of total maximum daily loads to help solve water quality issues.

Army Overview

Todd Bridges (U.S. Army Engineer Research and Development Center [ERDC]) provided background on work performed under the Dredging Operations and Environmental Research (DOER) Program at the ERDC, which is located in Vicksburg, Mississippi. DOER is the largest continuing Corps R&D program, and it provides direct support to the $1 billion navigation program. R&D is conducted in four major areas: (1) operations technologies; (2) dredged materials management; (3) environmental resource protection; and (4) tools for risk analysis of the environmental and economic costs/benefits associated with the full range of available dredged material management options.

The U.S. Army Corps of Engineers maintains about 20,000 miles of navigated waterways each year. Of the 250 million cubic yards of sediment dredged annually, only about 10 percent is contaminated. The Corps has no preference for any particular technology for remediating contaminated sediments; its standard practice is simply to choose the least costly and most environmentally acceptable alternative. Cost is a major consideration given that addressing contaminated sediment can exceed $100 per cubic yard. Technologies that allow sediments to be reclaimed and used for other purposes are particularly desirable.

The Corps has an active interest in capping, sediment transport processes and modeling, resuspension and residuals, and sediment treatment technologies. These interests are strongly qualified by economics. Bridges referred the audience to a recent report, The Four Rs of Environmental Dredging: Resuspension, Release, Residual, and Risk (ERDC/EL TR-08-4, 2008, http://el.erdc.usace.army.mil/elpubs/pdf/trel08-4.pdf). The "four Rs" are factors that complicate an evaluation of the effectiveness of dredging to achieve environmental objectives. Another publication—a two-part technical and cost evaluation of sediment cleanup technologies—will be issued later in 2008.

SERDP and ESTCP Sediments Research Program

Andrea Leeson described the sediments research goals of the Strategic Environmental Research and Development Program (SERDP) and the Environmental Security Technology Certification Program (ESTCP) as supported by the U.S. Department of Defense (DoD) (Attachment D). SERDP invests in environmental technologies from basic research through bench-scale proof of principle. ESTCP demonstrates and validates promising innovative environmental technologies that address DoD's highest priority environmental requirements.

SERDP has 22 ongoing sediments projects (www.serdp.org/Research/er-sediments.cfm) and ESTCP has 15 (www.estcp.org/technology/ER-Sediments.cfm). Current sediment needs areas were identified by a panel of experts at a workshop in 2004 and published in a report—SERDP and ESTCP Expert Panel Workshop on Research and Development Needs for the *In Situ* Management of Contaminated Sediments (www.estcp.org/Technology/upload/SedimentsFinalReport.pdf). The needs encompass the development of tools for investigation and analysis, an examination of the effectiveness of capping, development of guidance on monitored natural recovery (MNR), establishment of standardized test sites, research into fixed and mobile technologies for delivery of *in situ* amendments, and "data mining" (i.e., review of existing applications of capping technologies and MNR).

SERDP releases its annual Core and SERDP Exploratory Development (SEED) solicitations every November. The Core solicitation provides funding in varying amounts for multi-year projects. SEED proposals are limited to a maximum of $150K and a period of performance of one year. Proposals are due in January, and awards are issued in March. ESTCP posts a request for proposals in January, with pre-proposals due in March. After review by the ESTCP Technical Committees, successful offerors are requested to submit full proposals. A DoD partner will be selected to aid in identifying an appropriate demonstration site and understanding DoD needs. Project funding is released in March of the following year.

A Bioavailability Workshop will be held August 20-21, 2008, in Annapolis, Maryland. The meeting has three primary objectives: (1) examine the current state of the science and technology for understanding and assessing bioavailability processes in soils and sediments that impact risk-based remedial action decisions; (2) evaluate current and potential future applications of bioavailability concepts and assess barriers to their implementation; and (3) identify and prioritize R&D opportunities that can facilitate regulatory acceptance and field implementation of bioavailability concepts to support risk assessments at DoD sites. The summary report of the workshop should be posted in November 2008 at the same time the SERDP statements of need are released. Although programmatic meetings are not publicized, interest from other agencies is welcomed; however, experience has shown that better results are obtained from smaller rather than larger groups. Attendance at the Bioavailability Workshop is by invitation only, but if any of the member agencies has an interest in the topic, Leeson invites them to contact her concerning this or any other SERDP or ESTCP meeting.

ITRC: Who We Are & What We Do

Kim Ward (New Jersey Department of Environmental Protection) leads the Contaminated Sediments Team for the ITRC (Attachment E). ITRC is a state-led coalition working together

with industry and stakeholders to achieve regulatory acceptance of environmental technologies. ITRC consists of 50 states, the District of Columbia, multiple federal partners, industry participants, and other stakeholders cooperating to break down barriers and reduce compliance costs, making it easier to use new technologies and helping states maximize resources. ITRC brings together a diverse mix of environmental experts and stakeholders from both the public and private sectors to broaden and deepen technical knowledge and streamline the regulation of new environmental technologies. ITRC accomplishes its mission in two ways: it develops guidance documents and training courses to meet the needs of both regulators and environmental consultants, and it works with state representatives to ensure that ITRC products and services have maximum impact among state environmental agencies and technology users.

ITRC's Contaminated Sediments Team was funded in February 2008 to respond to concerns expressed by industry and regulators, such as "How can we effectively manage and limit exposure to contaminated sediments?" The characterization of sediment contamination in freshwater, estuarine, and marine settings should emphasize assessing the bioavailability of these contaminants to humans and ecological receptors using valid and acceptable measurement tools; however, guidance is lacking in measuring exposures and determining the risks of contaminated sediments sites. Characterizing potentially contaminated sediments accurately (i.e., developing a site conceptual model) and understanding bioavailability of chemical constituents in sediments can aid in the selection of a remedial process and the development of a management plan that minimizes exposure. The team intends to develop a technical regulatory guidance document that describes contaminated sediment investigative processes, including the three-dimensional delineation of source term, characterization of exposure term using tools to evaluate bioavailability, and a tool to assess the optimal remedial alternative for the site relative to the exposure threat. The project currently is in data collection mode.

General Panel Question/Answer Session

Q. Tom Nicholson noted that radionuclides can appear to be sequestered in sediments that receive effluent releases from nuclear power plants, but remobilization is possible during flooding events. How should the risks be evaluated, and what is an appropriate remedial approach?

A. Todd Bridges responded that only limited guidance is available, and few laboratories are set up to determine levels of radioactive elements; however, he has seen this issue addressed before, and will send Tom information about a case study involving discharges of cobalt-60.

Q. Are other government agencies dealing with the assessment and stability of contaminated sediments in a complex hydrologic environment similar to that of the Columbia River—i.e., very large water bodies with deep, fast-moving water?

A. About 10 miles of the upper Columbia River near the Canadian border is basically a Superfund site now. Multiple agencies are involved: Department of the Interior (through an interagency agreement and MOU), Fish and Wildlife, Bureau of Land Management, and the National Park Service are involved in the remedial investigation and in providing support to EPA.

Q. Norm Niedergang asked if anyone is aware of any federally funded sediment projects

conducted in an optimization context.

A. Amy Walker (NAVFAC) responded that she is in charge of the Navy's optimization workgroup. The Navy has a policy for optimizing remedial and removal actions under the Environmental Restoration programs: optimization is required in every phase of the remediation process. She volunteered to send links for Navy guidance documents on optimizing remedy selection, remedial operations, and long-term ground-water monitoring to Niedergang.

Q. Jake Phillip (Nuclear Regulatory Commission) asked for more information about a capping guidance from the Corps of Engineers. Also, what progress has been made on evaluation studies of caps and erosion protection? Is the work coordinated with that of DOE's Environmental Management group?

A. Todd Bridges said that considerable progress has been made over the last 20 years in improving capping techniques and assessing the results of capping projects. Bridges will send Jake Phillip a link to the Corps capping guidance. The Corps work has not been coordinated with DOE because few of DOE's caps lie underwater. Beth Moore interjected that DOE has recently had external technical reviews conducted of cap performance on six landfill sites and plans to issue new guidance on landfill caps for containment of mixed wastes. She will send the details to FRTR for the Web site update and share information about the reports with anyone who indicates an interest.

Q. Is anyone studying the land/water interface? Are there any paired studies that consider sediments as well as the land?

A. Steve Ells said there is interest in looking at banks and floodplain soils from which contaminants move into sediments. This movement can exacerbate the problem of contamination reaching the sediments from other sources. Marc Greenberg currently is working on a project through ESTCP and SERDP that will evaluate ground-water/surface-water interactions to assess the effect on sediments and determine whether risk is being increased. Superfund also has a draft Technical Support Project document on this topic entitled Evaluating Ground-Water/Surface-Water Transition Zones in Ecological Risk Assessment; it is due to be finalized roughly in July 2008.

REMEDY OPTIMIZATION AND ADAPTIVE MANAGEMENT

Todd Bridges discussed how risk management principles and methods are increasingly being used to support decision-making within contaminated sediment projects (Attachment F). He introduced the concept of "wicked problems" to describe sediment cleanup projects—i.e., problems with no definitive formulation, many diverse inputs, no right or wrong solutions (only better or worse solutions), and no ultimate test of the solution. Decisions made by project managers must balance the risks posed by action/inaction against the benefits resulting from their action/inaction. In seeking to manage risks associated with their projects, project managers must be able to justify, using quantitative information, the selection of specific risk management actions in terms of risk reduction benefits. Related objectives include reducing controversy, conflict, and project delays while simultaneously increasing the credibility of the decision-making process. Effective management of risk requires methods for distinguishing and integrating technical (science, engineering, and economics) and social information relevant to a decision in a structured, transparent, and quantitative manner. Risk-informed decision making

can be supported through the use of formal optimization methods and decision analysis techniques that provide the means for quantitatively distinguishing alternative remedial strategies in terms of overall benefit.

Example problems were provided to show how to assemble the problem/solution factors and use numerical layouts for comparison to achieve a final analytical result. In adaptive planning and engineering, uncertainty is inherent to planning, design, construction, and operation and management activities. Adaptive management requires a framework for collecting and using information that results from implementing a plan, monitoring the performance of the plan, and learning. Operations research and multi-criteria decision analysis provide suitable approaches. Bridges concluded with the following observations: sediment remedial projects should be addressed as decision problems rather than as technology problems; deliberation is essential to the successful resolution of risk-decision problems; and transforming practice requires commitment to change, experimentation, and learning.

IMPROVED RECORD OF DECISION AND BASELINE ECOLOGICAL RISK ASSESSMENTS

Donna Caldwell (CH2M Hill) described the development and application of the improved Record of Decision (iROD) format (Attachment G). Most regulation-driven reports are required to provide comprehensive information that is both highly technical and legally/scientifically defensible while remaining accessible to a broad-based and often non-technical audience. These potentially conflicting objectives sometimes result in technical documents that are cumbersome, redundant, and difficult to interpret by the audience they are intended to reach; however, streamlining tools and information technology can be combined with a tiered presentation approach to produce documents that are easier to use. Consistent with the President's Management Agenda, this approach is intended to create an improved technical document that complies with regulatory requirements and guidance, reduces redundancy, can be understood more easily by a broad audience, and presents supporting data in a detailed but intuitive and user-friendly format. The tools applied to these documents were developed as a result of the joint initiative between U.S. EPA and DoD's Streamlining Task Force. Applied appropriately, the tools are expected to produce a document of higher quality, reduce the document size significantly, and minimize regulatory review time, thus leading to a potentially more cost-effective deliverable.

An iROD document is a hard-copy document with an electronic deliverable on CD-ROM. This self-launching document is designed to be interactive, graphically oriented, and easily navigable. The technology is based on commonly used freeware. The iROD is a traditional ROD that focuses on the use of streamlined text, figures, and tables, with appropriate references to supporting documentation in the Administrative Record. The iROD must comply with CERCLA and the NCP and follow EPA guidance. The purpose of the iROD is to provide the full rationale for a remedy decision in a concise document. The goals of the iROD are to facilitate quick access to referenced information, shorten review times, improve readability, and enhance public understanding.

A case study application of this concept to the completion of a Navy environmental restoration site ROD for Marine Corps Air Station Cherry Point and a baseline ecological risk assessment

(BERA) for the Blows Creek Watershed, St. Julien's Creek Annex, was demonstrated as part of the presentation. New and improved versions of RODs and BERAs have been developed and signed in various formats by the regulatory community. These innovative approaches to the organization of information can be applied successfully to a broad range of documents and adapted to differing objectives and scopes. The Assistant Secretary of the Navy issued the streamlined ROD strategy on August 31, 2007. The goal is to make the iROD the standard format for documenting a remedy, aiming for a 50 percent implementation rate in FY2009 and 100 percent application in FY2010 and beyond for all active and Base Realignment and Closure environmental restoration sites developing RODs. An iRod Web portal is under development, and portions of this resource are available through the Navy's Environmental Restoration Technology Transfer Web page (www.ert2.org/). Sections for example iRods, references, and outreach resources are currently available, with success stories/lessons learned, templates, and an overview yet to come.

INTERACTIVE SEDIMENT REMEDY ASSESSMENT PORTAL (ISRAP): A TOOL TO FACILITATE DESIGN OF LONG-TERM REMEDIAL MONITORING STRATEGIES

Victoria J. Kirtay (Space and Naval Warfare Systems Center San Diego) discussed the development of tools to support a uniform approach for the design and implementation of long-term sediment monitoring programs at contaminated sediment sites (Attachment H). Although several resources identify general monitoring needs and approaches for sediment sites and specific details concerning monitoring tools, no framework is currently available to link remedy-specific and goal-specific monitoring needs with appropriate monitoring tools and approaches. To fill this need, a guidance document and a Web-based tool, the Interactive Sediment Remedy Assessment Portal (ISRAP), are under development.

The contaminated sediment monitoring guidance document is being prepared to provide an optimized, cost-effective framework to bridge the gap between detailed monitoring tool descriptions and general guidelines that identify monitoring needs for sediment sites that undergo remediation. The guidance includes remedy-specific validation and monitoring matrices that relate monitoring tools to specific monitoring needs for dredging, capping, and MNR to help RPMs focus on key issues associated with site-specific monitoring needs and tools and to facilitate the design of cost-effective and meaningful monitoring plans. The guidance is designed to be useful to RPMs at a variety of stages in the remedial investigation/feasibility study process, but will be particularly useful in understanding and planning for monitoring needs following remedy implementation at contaminated sediment sites. A uniform approach should ensure that long-term monitoring is clearly tied to remedial action objectives and that clear exit criteria are established to facilitate timely and cost-effective site closure while protecting human health and the environment.

The guidance document serves as a detailed reference companion for the Web-based resource, ISRAP. A key component of ISRAP is an online, interactive matrix that will help RPMs focus on key issues associated with site-specific monitoring needs. The matrix also facilitates a comparison of effective monitoring tools by providing information on the uses and limitations of each tool to enable a user to rank their potential utility. The Web-based nature of the tool will enable the matrix content to be adapted and updated to keep pace with the evolving nature of sediment remediation practices and sediment monitoring approaches, and will enable a technical

peer-review by members of the sediment monitoring community. The tools presently are under internal peer review; external peer review is anticipated this summer.

DREDGING IN SEDIMENT CONTAINING MUNITIONS AND EXPLOSIVES OF CONCERN (MEC)

George Follett (USACE, Baltimore District) explained basic dredging techniques, discussed techniques useful in reducing the inherent risks of dredging in sediments containing MEC, and told of lessons learned during various dredging/MEC projects (Attachment I). MEC can consist of unexploded ordnance, discarded military munitions, and explosive munitions constituents (e.g., TNT, RDX) present in concentrations high enough to pose an explosives hazard. These materials can be discarded, excess, or obsolete munitions that have been disposed legally and otherwise, whether buried, dumped at sea, or abandoned. MEC may be found near active installations or formerly used defense sites. There is no safe procedure for handling and disposing MEC, merely a procedure that is considered least dangerous. No MEC are considered "safe to move"; the decision to move MEC is based on acceptance of increased risk to the worker and public.

The Corps of Engineers excavates, transports, and disposes sediment while constructing new waterways; maintaining existing waterway dimensions; obtaining fill for land reclamation, beach renourishment, and dike and levee construction; creating wetlands and marshes; obtaining materials from borrow areas; and other beneficial uses. A number of dredging projects have unknowingly and unfortunately encountered MEC. MEC have been discovered during these projects on dredges (i.e., in dragheads, cutterheads, pump casings, or turtle screens) and at the dredged material placement site. Detonations have occurred that either have damaged the dredge plant or even sunk the dredging vessel.

Although many beach replenishments place up to eight feet of sand on the shore (and up to 22 feet in protective dunes), the best metal-detecting equipment available can detect MEC only to a depth of approximately three feet of beach sand. Additionally, many MEC are quite small; a 37mm projectile is less than 1.5 inches in size. Even if MEC are carefully removed from the upper three feet of beach, the sand is continually worn down in the surf zones to reveal yet undiscovered MEC. To illustrate the problem, Follett described his introduction in 2002 to a cleanup at Buckroe Beach in Hampton, Virginia. During documented beach replenishments in 1989 and 1997, sand replenishments placed MEC on the beach. No screening mechanism was employed. Between 1991 and 2003, six time-critical removal actions were conducted at the beach. The last two averaged $500K each. Local agencies performed a large number of additional removal actions. Follett learned that it is virtually impossible to remove 100 percent of MEC.

Recent dredging projects have addressed MEC issues proactively before the start of construction, thereby greatly reducing overall risk and MEC cleanup costs. Comparison of the cost of post-dredging MEC cleanup to the cost of MEC avoidance during dredging operations indicates that it is far less expensive to prevent the introduction of MEC than to conduct a post-dredging MEC removal. A new guidance document—Dredging in Sediment Containing MEC—is currently undergoing a draft final rewrite. Follett also drew attention to a 20-page guidance issued in the

UK in 2006—Dealing with Munitions in Marine Aggregates (www.thecrownestate.co.uk/1402_latest_munitions_guidance_note.pdf).

SEDIMENT DREDGING AT SUPERFUND MEGASITES: ASSESSING THE EFFECTIVENESS

Karl Gustavson (Army ERDC) summarized the findings of the National Research Council committee that assessed the effectiveness of sediment dredging at large Superfund sites (Attachment J). The committee's findings were published in 2007 in a 316-page report. The report is available for purchase through the National Academies Press (www.nap.edu/catalog.php?record_id=11968) and also is available in pdf format on the EPA Web site (www.epa.gov/superfund/health/conmedia/sediment/pdfs/dredging.pdf).

Decisions about whether or not to dredge contaminated sediments have proven to be among the most controversial at Superfund sites. The scientific and technical difficulties associated with accurately characterizing a site and selecting a remedy are augmented by the uncertainty in estimating the ultimate effect of remedial actions on human and ecologic risk. In response to controversies regarding the efficacy of dredging at reducing risk at contaminated sediment sites, the Committee on Sediment Dredging at Superfund megasites was convened by the National Research Council of the National Academies. In brief, the committee was charged with evaluating the effectiveness of dredging of contaminated sediments at Superfund megasites, including short-term and long-term changes in contaminant transport and ecologic effects. Overall, the committee was charged to strive to develop recommendations that would facilitate scientifically based and timely decision making for megasites in the future.

The committee concluded that sediment dredging can be implemented effectively to remove contaminants from aquatic systems, but technical limitations often constrain its ability to achieve expected outcomes. Dredging has had systematic difficulties in achieving short-term surface sediment cleanup levels; however, under some conditions dredging can achieve cleanup levels and aid recovery of biota at contaminated sediment sites. Occasionally, site conditions can limit complete removal of contaminated sediments. The result is residual contamination that hinders the ability to achieve risk reduction. For example, when the results from two sites dredged within the same time frame were examined, good results were obtained from deep dredging of contaminated sediments at the site underlain by deep, clean, sandy material, whereas poor results, including increased levels of contaminants in the water column, were observed after dredging at a site underlain by bedrock.

The committee emphasized the need for monitoring to establish whether or not the remedial action was having its intended effect, but determined that monitoring at most Superfund sites has been inadequate to determine whether dredging has been effective in achieving remedial action objectives. The report provides recommendations for improving future decision making:

- Remedies should be designed to meet long-term risk-reduction goals (as opposed to metrics not strictly related to risk, such as mass-removal targets).
- Environmental conditions that limit or favor the effectiveness of dredging should be given major consideration in deciding whether to dredge at a site.
- Resuspension, release, and residuals will occur if dredging is performed. Decision-makers should explicitly consider those processes in expectations of risk reduction.

- To reduce adverse effects, best-management practices that limit resuspension and residual contamination should be used during dredging. The ability of combination remedies to lessen the adverse effect of residuals should be considered.
- EPA should ensure that monitoring is conducted at all contaminated sediment megasites to evaluate remedy effectiveness.
- Descriptions of risk reduction require a pre-remedial baseline data set for comparison to post-remediation data, appropriate controls and reference sites, and consistent sampling and appropriate statistical power.
- Monitoring data should be compiled and made publicly available such that evaluations of remedial efficacy can be verified independently.

IN SITU TECHNOLOGIES FOR THE REMEDIATION OF CONTAMINATED SEDIMENTS

Kelly Madalinski (EPA/OSRTI) provided a brief overview on the current state of the art for *in situ* treatment and reactive caps to address contaminated sediments, including recent site-specific applications (Attachment K). Although there is no single perfect approach for treating contaminated sediments, the practical treatment options currently are limited to capping, dredging/excavation, and MNR. The utility of these options can be limited by their potential to achieve desired risk reduction goals, be implemented in a cost-effective manner, or address site-specific issues adequately (e.g., presence of nonaqueous-phase liquid [NAPL]). Development and improvement of *in situ* technologies aims to address some of these limitations as well as expand the available remedial options.

In situ treatment is gaining renewed interest as a potential remedial option. Traditionally, *in situ* treatment technologies have maintained high levels of interest among sediment practitioners and researchers. This level of interest stems from the tremendous potential advantages, such as permanent risk reduction and lower cost to implement; however, *in situ* technologies must meet significant technical challenges to deliver and retain treatment amendments in sediments in an aquatic environment. Recent field demonstrations and ongoing research on *in situ* treatment are beginning to show promise in addressing these challenges.

"Active" or "reactive" capping currently is generating significant interest and activity among sediment practitioners and researchers. Reactive capping enhances traditional capping approaches by the presence of reactive (treatment) material within the cap that further controls contaminant migration. Reactive caps potentially can address site-specific issues, including the presence of NAPL in the sediments or concerns over consolidation effects. In addition, innovative installation techniques (e.g., geotextile mats) allow for placement of the reactive material in a controlled manner. The caps are designed to deal with ground-water seepage, but they are not a substitute for source control. A growing number of full- and demonstration-scale sediment projects are implementing reactive caps, including several Superfund sites. Madalinski noted that fact sheets for several active capping projects are currently in development.

ACTIVE CAPS FOR REMEDIATION OF MIXTURES OF CONTAMINANTS AND RESISTANCE TO EROSION (SERDP, ER-1501)

Anna Sophia Knox (Savannah River National Laboratory) is working to design *in situ* treatments for sediments by combining chemical and biological amendments to develop an active capping technology that can contain and stabilize a large range of contaminants in both marine and fresh waters (Attachment L). Current technologies for remediating contaminated sediments include removal followed by treatment and disposal, *in situ* isolation of the sediments by covering them with a sand or gravel cap (i.e., passive capping), and MNR, which involves monitoring natural processes that isolate, degrade, transform, and immobilize contaminated sediments. These remedial alternatives offer only temporary solutions, address only a limited number of contaminants, may not be applicable in both marine and fresh waters, and may be destructive to the benthic environment. An acute need exists for remedial technologies that address a variety of contaminants in a broad range of aquatic environments, provide more permanent solutions by reducing contaminant toxicity, and have minimal impact on benthic habitats.

The system Knox is developing under SERDP project ER-1501will reduce contaminant toxicity and/or bioavailability while simultaneously creating a barrier that is resistant to mechanical disturbance, thus combining many of the advantages of active and passive methods. The project has identified amendments that sequester and retain mixtures of contaminants under a broad range of environmental conditions. Apatite, organoclays, and biopolymers removed metals effectively from both fresh and salt water and exhibited high retention (80% or more) of most metals, indicating reduced potential for metal remobilization. Biopolymer products suitable for inclusion in active caps include chitosan/guar gum cross-linked with borax and xanthan/chitosan cross-linked with calcium chloride. Slurries of sand coated with these biopolymers can produce a barrier that resists mechanical disturbance. Modeling studies showed that active caps composed of apatite or organoclay have the potential to delay contaminant breakthrough via diffusion by hundreds of years or more compared with passive caps composed of sand. This research has identified the best active cap materials; determined the effects of active cap components on metal bioavailability, retention, and toxicity; and identified biopolymer products that impart erosion resistance to active caps.

Knox also is helping to organize a special symposium on sediments planned for 2009. The 10th International Conference on the Biogeochemistry of Trace Elements is scheduled for July 13-16, 2009, in Chihuahua, Mexico. The special symposium—Fate and Transport of Metals in Contaminated Sediments: New Approaches in Remediation—aims to bring together professionals from disciplines related to metal bioavailability to aquatic organisms, metal fate and transport in contaminated sediments, remediation technology for contaminated sediments, and risk assessment. Selected papers will be published in an edited book. More information is available at the conference Web site (http://icobte2009.cimav.edu.mx/index.php/contents/en).

Q. It appears that little work was done using phytic acid (a sugar derivative) as a sequestering agent. Was it recalcitrant to biodegradation?

A. The natural product phytic acid (myo-inosiltolhexaphosphate), a simple sugar derivative containing six ionizable phosphate groups, is not biodegradable. This material can immobilize inorganic contaminants such as actinides and other divalent elements through the formation of insoluble contaminant-phosphate precipitates in a manner similar to the

addition of apatite or hydroxyapatite (HA) to metal contaminated sediment/soil. However, this material is produced mainly in China and is less cost effective than rock phosphate, the main source for apatite.

MEETING WRAP-UP/NEXT STEPS/NEXT MEETING AGENDA

Norm Niedergang thanked everyone for attending.

Balloting for the next FRTR meeting topic indicated green remediation as the topic of greatest interest to member agencies. One of the ballots also suggested hydrology and erosion control for landfill caps as a potential future meeting topic. A date for the Fall 2008 FRTR meeting was not finalized, and scheduling will be considered carefully due to the potential for conflicting with larger meetings, such as the SERDP/ESTCP Partners in Environmental Technology Symposium on December 2-4.

The meeting was adjourned.

ATTACHMENTS

A. FRTR Activities Update
B. Update on Superfund HQ Sediment Remediation Activities
C. Navy Overview – Contaminated Sediments: Policy, Issues and Technology Needs
D. SERDP and ESTCP Sediments Research Program
E. ITRC: Who We Are & What We Do
F. Remedy Optimization and Adaptive Management
G. Improved Record of Decision and Baseline Ecological Risk Assessments
H. Interactive Sediment Remedy Assessment Portal (ISRAP): A Tool to Facilitate Design of Long-Term Remedial Monitoring Strategies
I. Dredging in Sediment Containing Munitions and Explosives of Concern (MEC)
J. Sediment Dredging at Superfund Megasites: Assessing the Effectiveness
K. *In Situ* Technologies for the Remediation of Contaminated Sediments
L. Active Caps for Remediation of Mixtures of Contaminants and Resistance to Erosion (SERDP, ER-1501)