DECISION SUPPORT FOR ADAPTIVE SAMPLING AND ANALYSIS PROGRAMS (ASAPs)

EAD has developed methods to make hazardous waste site characterization projects more efficient by using real-time data collection technologies, Web-based data management support, and sophisticated sampling optimization software.

PROBLEM/OPPORTUNITY

Traditional site characterization methods rely on preplanned sampling programs and sample analyses by off-site laboratories to determine the extent and level of contamination at hazardous waste sites. This process is costly and time consuming. ASAPs can significantly reduce characterization costs because they rely on field methods for rapid, on-site sample analysis and real-time decision support that modifies the sampling program as it progresses to reflect sampling results. This form of data collection not only improves standard waste characterization projects but can also transform remedial designs by facilitating the use of approaches such as precision excavation, in which remediation is guided by integrated ASAP data collection.

APPROACH

EAD provides both qualitative and quantitative support for ASAPs. First, EAD recognizes that good decisions are based on an accurate, qualitative understanding of all the data available from a hazardous waste site. Collections of ASAP-based data can contain enormous amounts of information that has come in different formats from various sources. This information must be integrated, managed, and visualized quickly. EAD uses a variety of software tools to facilitate this process, including commercial databases, standard geographical information system (GIS) packages, customized data visualization software, and Web technologies for data dissemination. An example of the latter is EAD's Maps and Data (MaD) browser. MaD is a Java applet developed by EAD for publishing dynamic maps and data tables over the Internet, thus making them available within common browsers such as Navigator or Internet Explorer. The MaD browser requires no additional software purchases or plug-ins by users and includes built-in database connections and log-in/password security.

Second, EAD provides quantitative support for ASAPs. The challenges are to quantitatively fuse soft data (such as historical records, aerial photographs, and nonintrusive geophysical data) with hard sampling results to estimate contaminant extent; measure the uncertainty associated with these estimates; determine the benefits of collecting additional information; and help find locations where additional sampling would yield the most benefits. With funding from the U.S. Department of Energy's (DOE's) Office of Science and Technology Development, EAD has developed a software package called Plume™ to address some of these challenges. Plume uses a unique combination of Bayesian analysis and geostatistics.

RESULTS

The benefits of ASAPs can be significant. EAD has designed and implemented ASAP data collection efforts at Sandia National Laboratories and Kirtland Air Force Base in New Mexico; Brookhaven National Laboratory in New York; Argonne National Laboratory and Joliet Army

Ammunition Plant in Illinois; and several Formerly Utilized Sites Remedial Action Program (FUSRAP) sites. In addition to providing better characterizations than traditional approaches, these programs cost 30% to 70% less. ASAP data collection efforts are particularly effective when integrated within remedial designs. For example, recent work at the Fernald site as part of its soils excavation program has shown that the use of real-time data collection technologies and decision support techniques will save the site more than $20 million over the life of the project. A precision excavation project at the FUSRAP Ashland 2 site that used ASAP techniques resulted in an estimated $10 million savings. Both MaD and Plume have been commercialized.

Future

The development of these technologies has opened many doors for additional EAD research and development activities. The advantage of leveraging private sector expertise to solve practical problems at DOE sites has been amply demonstrated. Spin-off activites include research on environmental restoration data management issues, design of in situ hazardous waste monitoring systems, application of virtual reality techniques to the analysis of environmental restoration data, development of sampling strategies for specialized sampling program requirements, and use of ASAP techniques within integrated remediation designs.

Communication of Results

Results from EAD's ASAP work have been disseminated in a number of ways over the life of the program. These have included presentations at many conferences and workshops, as well as the publication of Argonne technical reports and journal articles.

Use of a gross gamma screen and global positioning system provides real-time data for an adaptive sampling and analysis program.

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