Sandia National Laboratories

Environmental Program

Sandia Environmental Decision Support System (SEDSS)

Technology Need

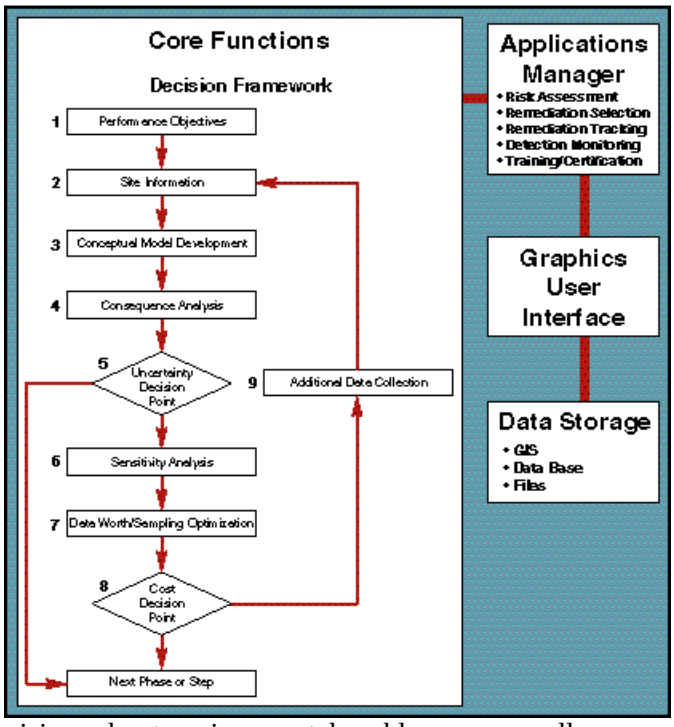
Needed is a decision support methodology and automated decision support tool for aiding environmental decision support makers in selecting appropriate characterization and remediation schemes. The Sandia Environmental Decision Support System (SEDSS) is designed for expansion to a very broad range of environmental restoration problems. It is a concise, widely applicable process or framework for formulating, addressing and solving environmental problems (i.e., the methodology).

Objective

SEDSS is designed to extend the application of risk-based performance assessment methodologies to environmental restoration activities. This problem-solving approach explicitly accommodates uncertainty while integrating risk analysis with data collection.

Project Description

The SEDSS is a user-friendly computer code that facilitates the decision-making process. The system provides: (1) access to site data through a geographic information system (GIS); (2) a set of analysis tools necessary to qualitatively and quantitatively evaluate the current site based on the available information; and (3) a platform for graphically displaying and documenting the results of these analyses for the analyst, site managers, regulators, and other stakeholders.



Probabilistic Modeling (Assessing Uncertainty): Decisions about environmental problems are usually based on incomplete site information. To address this uncertainty, SEDSS uses a probabilistic approach for the quantitative analysis of the problem. Techniques such as Monte Carlo simulation and geostatistical analysis provide a means to quantify and display the uncertainty in site conditions. Use of these techniques serve to establish confidence in decisions related to human health and environmental risk.

Conceptual Model Development: The SEDSS includes a Conceptual Model Manager (CMM) that assists users in defining and documenting the environmental problem. A series of interactive windows allows the user to step through the problem to identify assumptions about the site environment as well as sources of contamination, transport pathways, and human and environmental exposure routes. The user's response to the CMM queries provides the framework for the quantitative evaluation of risk. The documentation of the problem, provided by the CMM, will facilitate negotiations among site owners, regulators, and other stakeholders.

A prototype of the SEDSS exists that will: (1) optimize the location of a monitoring well network for detection of hazardous contaminants under the U.S. Environmental Protection Agency's RCRA regulations, and (2) perform risk analysis for the groundwater pathway.

Advantages

Some examples of decisions to which SEDSS applies include the following: How should resources (cost and time) be prioritized based on estimates of risk? Is a site safe? If the site is unsafe, what remedial action or containment is necessary and optimal? When is remediation complete and how can it be defended as adequate? Is a potential new waste-facility-design safe (i.e., can a permit application be defended)? Is a monitoring network adequate?
The second benefit is the creation of a foundation for a computer-based decision support tool. Automation of the approach listed above via a computer system (SEDSS itself) allows rapid and consistent application of the approach for evaluation of risk, cost, and consequently defensible decisions. Eventually, a user of this system will be:

- Guided in establishing performance objectives for a given site;
- Provided with immediate access to both data stored in numerical or graphical forms;
- Guided in the development of a conceptual model of the site conditions, including the types and condition of the waste, the pathways through which the waste migrates, the mechanisms by which human receptors can be exposed to the waste, and the human health risks associated with that exposure;
- Assisted in setting up and executing numerical analysis to evaluate the user's concept of contaminant movement, exposure, and risks that accommodate the users existing uncertainty in site characteristics;
- Provided with the ability to determine which additional data would be important in altering or substantiating a current decision on risk or remediation approach, and tools to evaluate the cost/benefit of acquiring that data; and
- Guided in on-site, real-time collection of additional data.

Development efforts have extended to the SEDSS's capabilities to include steps one to four above providing the ability to determine risk from radioactive or hazardous contaminants moving via the ground-water pathway.

The SEDSS automates much of the integration between analysis techniques and puts the entire decision analysis framework at the decision makers fingertips. This is currently a multi-year process that can potentially become a real time process. Currently the SEDSS only applies to the groundwater pathways for contaminants and uses the basic EPA risk calculations.

Incorporation of Other SNL Projects

Because the SEDSS provides a comprehensive environmental decision-making framework, several other research projects at Sandia National Laboratories (SNL) have been or are being considered for incorporation into the system. One of these is the Cost/Risk Performance Assessment which currently focuses on the application of geostatistical simulation and cost/benefit analysis to direct the cleanup of uranium contaminated soils at the Fernald, Ohio facility.

A Consortium for Environmental Decision-Making

Negotiations are underway to develop a consortium for effective, environmental decision-making. Along with the EDSP, these negotiations involve the following organizations: human health and ecological risk analysis, geographic information systems, an on-site environmental restoration group at Oak Ridge

National Laboratory; developers of the PLUME code (a graphical computer display system) at Argonne National Laboratory; Consolve, the developer of SitePlanner; ESRI, the developer of ARC/INFO and ArcView GIS software; and several other commercial organizations. Furthermore, discussions occurred with groups at Pacific Northwest National Laboratory responsible for environmental monitoring at DOE's Hanford site, the Remedial Action Assessment System (RAAS) family of codes, and Multimedia Environmental Assessment System (MEPAS) code.

Costs

A Sun workstation or server running the Unix operating system is required to use the SEDSS software. The start-up cost estimate is highly variable. Operation and maintenance costs include system administration of the workstation and software updates.

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