

DEPOT: A Database of Environmental Parameters, Organizations and Tools

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ABSTRACT

The Database of Environmental Parameters, Organizations, and Tools (DEPOT) has been developed by the Department of Energy (DOE) as a central warehouse for access to data essential for environmental risk assessment analyses. Initial efforts have concentrated on groundwater and vadose zone transport data and bioaccumulation factors. DEPOT seeks to provide a source of referenced data that, wherever possible, includes the level of uncertainty associated with these parameters. Based on the amount of data available for a particular parameter, uncertainty is expressed as a standard deviation or a distribution function.

DEPOT also provides DOE site-specific performance assessment data, pathway-specific transport data, and links to environmental regulations, disposal site waste acceptance criteria, other environmental parameter databases, and environmental risk assessment models. The web site address is <http://www.prod.sandia.gov/depot>.

INTRODUCTION

The process of data discovery, validation, and justification is repeated at the program level every time an environmental assessment or environmental impact statement must be conducted. Effort is often duplicated simply because the essential data are not readily available or known to the analyst. Since multiple risk assessment parameter databases already exist, a central data warehouse that links to existing databases and also contains uncertainty-based data is an asset that seeks to provide minimum duplication of data discovery, significant reduction in the tedious process of data validation and verification, and greater risk assessment accuracy.

The Database of Environmental Parameters, Organizations and Tools (DEPOT) is currently under development through a joint effort of Sandia National Laboratories (SNL) and Oregon State University. The project's primary goal is to provide a source of referenced data that includes the level of uncertainty associated with parameters required for environmental risk assessments. Initial efforts have concentrated on groundwater and vadose zone transport data and

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bioaccumulation factors. The database currently contains bioaccumulation factor uncertainty data for 29 elements and distribution coefficient data with the associated uncertainty for cesium, strontium, technetium and uranium. Histograms and probability density functions have been calculated for the distribution coefficient data; wherever possible, uncertainty in the bioaccumulation factor data has been expressed as a standard deviation. The web site also provides DOE site-specific transport data, toxicity and carcinogenicity data, and extensive links to other risk assessment databases, models, and environmental regulations.

DATABASE STRUCTURE

The major DEPOT sections are shown in Fig. 1, which is adapted from the web site front page. Fig. 2 is the DEPOT Site Map, which shows the links between sections. All blue site map titles are currently active database links.

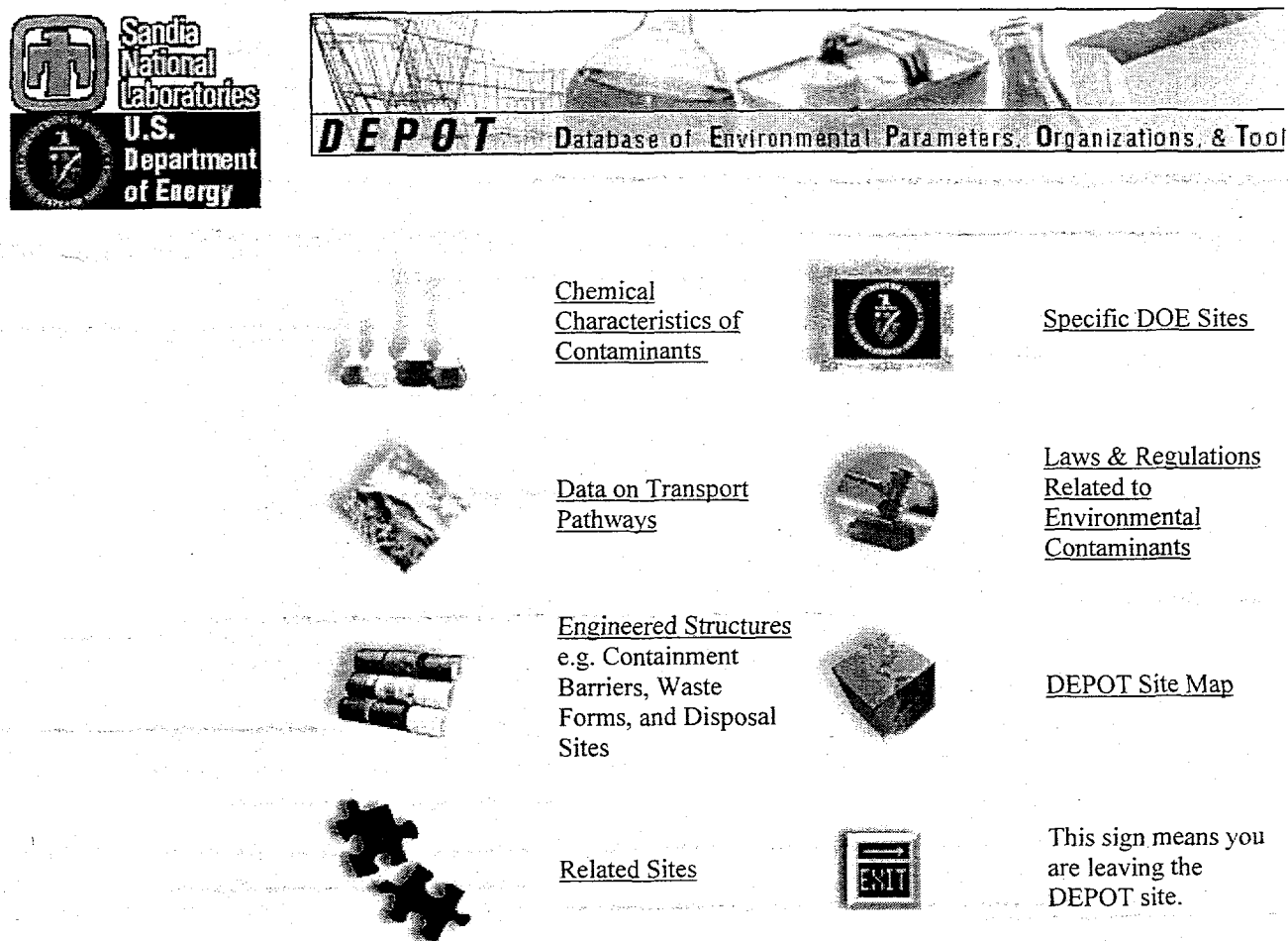


Fig. 1. DEPOT Web Site Front Page.

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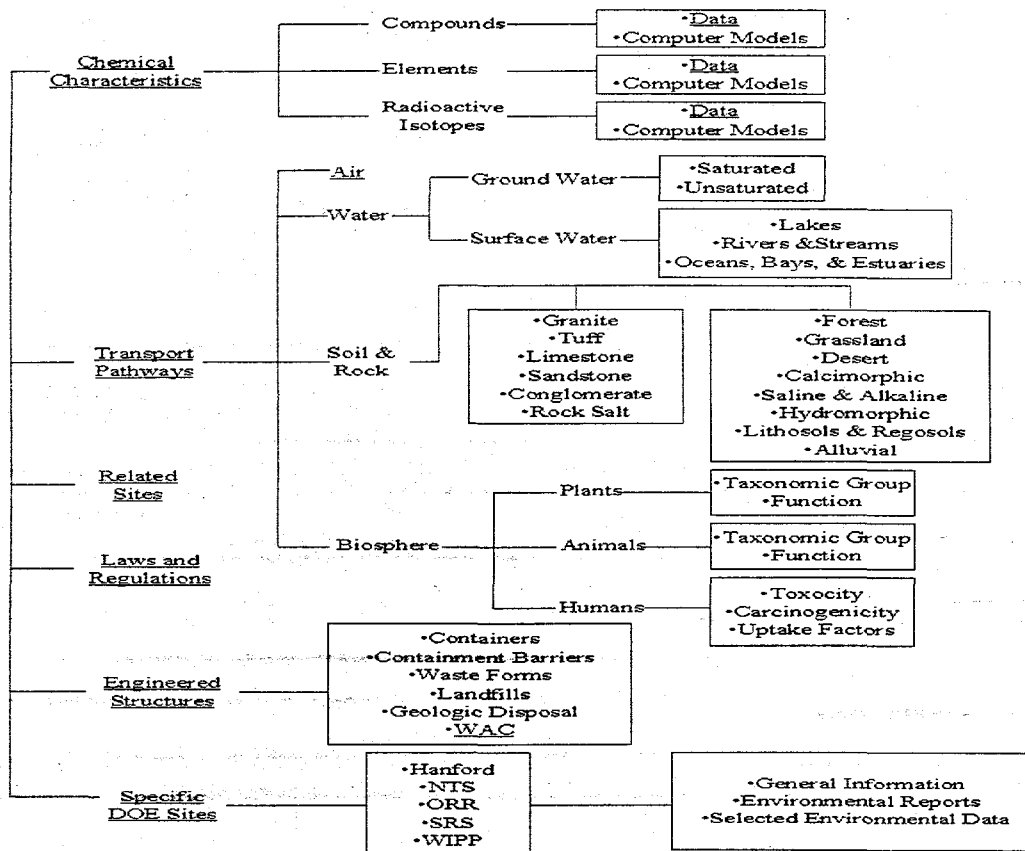


Fig. 2. DEPOT Site Map.

Chemical Characteristics of Contaminants

The heart of DEPOT is the data contained in the "Chemical Characteristics of Contaminants" section. In addition to the distribution coefficient and bioaccumulation factor data discussed above, this section currently contains general parametric data for 65 chemical compounds (the volatile and semi-volatile organics that are analyzed in EPA Methods 8260 and 8270, respectively), 110 elements and 267 isotopes. These data are presented in the tabular formats shown below:

DEPOT Chemical Compound Data

Compound	Chemical Formula	Density (g/cc)	Molecular Weight	Diffusion Coeff. in Air	Human Carcinogenicity	Human Toxicity	Solubility
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The carcinogenicity and toxicity data are taken from Material Safety Data Sheets for the listed compounds. Clicking on "Solubility" takes the user to another table that provides solubilities in water, common acids and bases, and common organic solvents.

DEPOT Element Data

Element	At. No. (At. Wt.)	Element Phase	Element Group	Shell	Human Carcino- genicity	Human Toxicity	Dist. Coeff.	Bioaccum. Factor
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The "Element Phase" column lists room temperature physical states (solid, liquid, gas), "Element Group" is a listing of periodic table groups, and the "Shell" column provides electronic structures. Clicking on "Dist. Coeff." produces a table with the following format:

Distribution Coefficient (K_d) Data

Element	Dist. Coeff.	Soil Type	Soil Texture	Ref. ID
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The database currently has 28 K_d values for cesium, 87 values for strontium, 10 values for technetium and 18 values for uranium. These data have been used to calculate a mean value and standard deviation, histogram and probability density function (pdf) for each of the four elements. Representative histogram and pdf data are shown in Fig. 3.

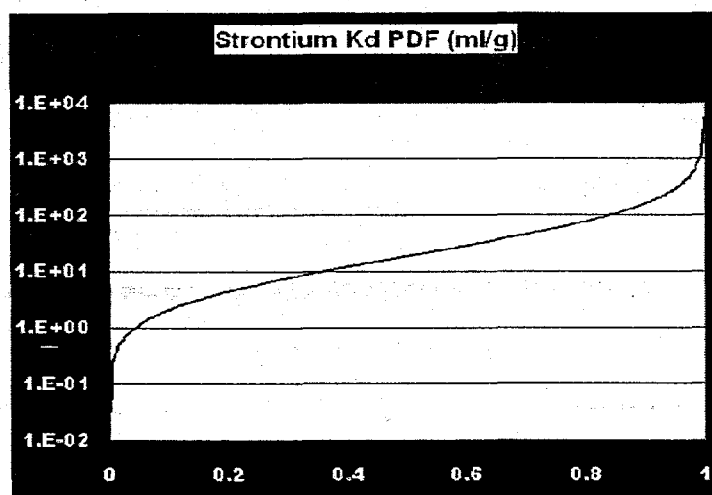
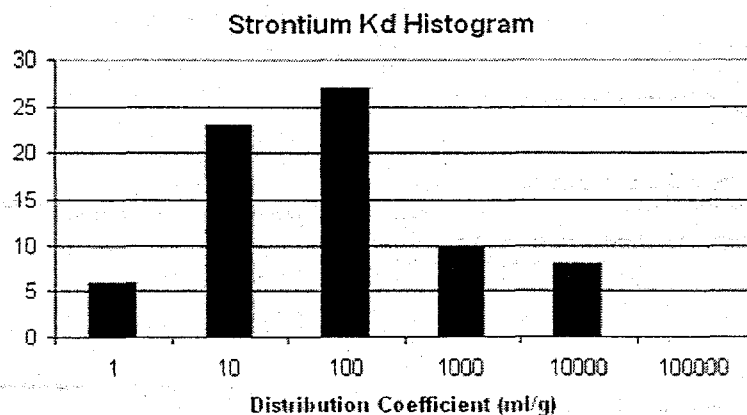


Fig. 3. K_d Distribution Data for Strontium.

Clicking on "Bioaccum. Factor" in the "Elements" data table takes the user to the bioaccumulation factor data for the particular element.

Bioaccumulation Factor Data

Element	Bio-accum. Factor	Min	Max	Mean	Std Dev	Dist.	Category	Species	Common Name	Media	Wet or Dry	Comments	Ref ID	Pages
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The wide variety of ways bioaccumulation factor data are presented in the literature necessitates the large number of elements in this data table. "Min, Max, Mean and Std Dev" data are provided whenever they were present in the original reference. "Dist." is a placeholder for pdfs that will be determined as part of future database improvements. "Category" is either "plant" or "animal". This column is necessary because some values only have this level of specificity. Latin names are provided under "Species" when they were given in the original reference; examples of data found in the "Common Name" columns are "mushroom" and "Zebra fish". Examples of "Media" include fresh water, salt water and soil. The "Comments" column is used to specify the conditions under which the data were collected.

Both the K_d and bioaccumulation factor tables have a "Ref ID" column. This column has a unique number for each reference that has been used to develop the database. Clicking on this number provides the user with the data reference.

The remaining category under "Chemical Characteristics of Contaminants" is "Radioactive Isotopes". This table contains the following data:

DEPOT Data for Radioactive Isotopes

Isotope	Weight % in Naturally Occurring Material	Half Life	Specific Activity (Ci/g)	Primary Decay Mode	Particle Energy (MeV)
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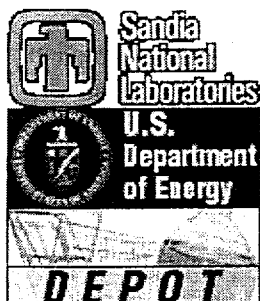
Specific DOE Sites

DEPOT currently provides access to site-specific Performance Assessment (PA) and well monitoring data for Hanford, the Nevada Test Site, Oak Ridge, Savannah River and the Waste Isolation Pilot Plan (WIPP). Available data are listed in Fig. 4. Since there is no groundwater pathway for contaminant transport at the Nevada Test Site, only air transport data are available.

Clicking on "General Information" will take the user to the web site for that DOE facility and "Environmental Reports" provides a list of site-specific environmental documents that are web-accessible. This section of DEPOT has been provided as a convenient shortcut for risk assessment analysts who may wish to use site-specific DOE data.

Data on Transport Pathways

DEPOT will eventually allow the user to access distribution coefficient and bioaccumulation factor data via the primary transport pathways (air, soil, water, biosphere) and the more specific subset pathways shown in Fig. 2. The only link currently active is "Air", which takes the user to



Specific DOE Sites



All General Information and Environmental Reports links leave the DEPOT Website

Sites

Hanford Site:	General Information	Environmental Reports	Selected Environmental Data • Data from PA Analyses • Well Location Data
Nevada Test Site:	General Information	Environmental Reports	Selected Environmental Data • Air Transport Data
Oak Ridge Reservation:	General Information	Environmental Reports	Selected Environmental Data • Data from PA Analyses • Well Characteristics • Well Monitoring Data
Savannah River Site:	General Information	Environmental Reports	Selected Environmental Data • Groundwater Transport Data
Waste Isolation Pilot Plant:	General Information	Environmental Reports	Click on preceding links for environmental data.

Fig. 4. DOE Site Data Available Through DEPOT.

the Nevada Test Site data. The other links will be brought on line as database expansion continues.

Laws and Regulations Related to Environmental Contaminants

DEPOT provides links to relevant web sites for the following environmental regulations:

- Clean Air Act
- Comprehensive Environmental Response, Compensation, and Liability Act
- Clean Water Act
- Federal Insecticide, Fungicide, and Rodenticide Act
- Federal Water Pollution Control Act
- Low-Level Radioactive Waste Policy Act
- National Environmental Policy Act of 1969
- National Emission Standards for Hazardous Air Pollutants
- Nuclear Waste Policy Act
- Resource Conservation and Recovery Act
- Safe Drinking Water Act
- Solid Waste Disposal Act
- Toxic Substance Control Act
- Uranium Mill Tailings Recovery Act

These links will be updated as environmental legislation evolves.

Engineered Structures

The "Engineered Structures" section of DEPOT will eventually provide links to information on the various types of waste containers, waste barriers, waste forms, waste treatment companies and waste disposal sites. Links are in place to the Waste Acceptance Criteria of the following DOE and commercial sites:

Hanford
Lawrence Livermore National Laboratory
Nevada Test Site
WIPP
Waste Control Specialists
Perma-Fix Environmental Services, Inc.
Chem-Nuclear Consolidation Facility
Barnwell Waste Management Facility
Envirocare of Utah, Inc.

A link has also been provided to the document, "A Comparison and Cross-Reference of Commercial Low-Level Radioactive Waste Acceptance Criteria."

Related Sites

DEPOT links to web sites dealing with such topics as groundwater contamination and remediation, DOE radioactive waste, EPA risk assessment guidance, geographical information system (GIS) data, exposure factors, and risk assessment tools. The complete list of existing links is provided in Table I. Current plans call for this list to be updated quarterly.

DATABASE EXPANSION

DEPOT is a work in progress. During the current fiscal year, we hope to achieve the following site expansions and improvements:

- Expand K_d data to include the Toxicity Characteristic Leaching Procedure (TCLP) metals and organics listed in 40 CFR 261.24, Table 1.
- Expand bioaccumulation factor data to include the 65 organic compounds currently in the database.
- Begin development of pdfs for existing bioaccumulation factor data.
- Add a statistics engine that would enable users to perform their own statistical analyses.
- Upgrade the data input system to allow simultaneous, real-time data input by multiple data analysts. Data input is currently not real-time and is limited to a single entry port.
- Begin construction of the "Engineered Structures" section.

Table I. DEPOT Related Site Links

Web Site	Site Description
OASIS: Parameter Estimation System for Aquifer Restoration	Graphical decision support system for groundwater modeling with a collection of tools to assess and analyze groundwater contamination problems and potential remediation techniques.
Central Internet Database	DOE site with Toxics Release Inventory data and information on radioactive waste, hazardous materials and facilities across the DOE complex.
Environmental Data Registry	Reference information about environmental data.
EPA Risk Guidance	Links to exposure factor data; guidelines for ecological, toxicity and carcinogenic risk assessments.
EPA Preliminary Remediation Goals	EPA Region 9 risk guidance with toxicity values, chemical data, and transport pathways information.
EPA Spatial Data Library System	Various geospatial data sets for GIS applications.
Exposure Factors Handbook	On-line text provides a summary of statistical data on various factors used in assessing human exposure to toxic chemicals, such as drinking water consumption, soil ingestion, inhalation rates, and dietary intake.
Federal Highway Administration's Automated Geotechnical Information and Design System	A discussion of a database that the Federal Highway Administration is planning to develop.
Hanford Resource Center	Links to all Hanford Site environmental documentation.
Geotechnical and Geoenvironmental Software Directory	Includes the SoilVision database, with textural, volume-mass and soil-water characteristic data for over 5000 soils. Also includes estimation capabilities.
Illinois EPA's Bureau of Land	Risk assessment tool designed for contaminated soil and groundwater in the State of Illinois.
Integrated Risk Information System (IRIS)	Database produced by EPA's Office of Research and Development and the National Center for Environmental Assessment. Includes brief discussion of confidence in the data, uncertainty, and modifying factors. Updated quarterly.
International Toxicity Estimates for Risk	Includes database of toxicity risk factors for over 500 chemicals.
Isotope Explorer	Freeware Windows application to access and display nuclear data and search for literature references. Program can retrieve Internet data or uses data stored locally.
Multimedia Modeling Environmental Database (MMEDE)	A companion to the Multimedia Environmental Pollutant Assessment System (MEPAS). Both MEPAS and MMEDE must be purchased.
National Nuclear Data Center	DOE site that provides information on neutron, charged-particle and photonuclear reactions; nuclear structure, and decay data.
National Geotechnical Experimentation Sites Database	Records from geotechnical field tests.
Oak Ridge National Laboratory Distributed Active Archive Center	Site contains data related to biogeochemical dynamics which are the result of the interactions between biological, geological and chemical components of the earth's environment. Data range from site-specific to global, with durations from days to years.
Pacific Northwest National Laboratory Ecology Group	Information on aquatic and terrestrial ecosystems research activities.
Prediction of Radiological Effects from Shallow Trench Operations (PRESTO)	EPA family of risk assessment models designed to calculate the maximum individual dose to a critical population group and the cumulative genetic and somatic health effects to the general population that result from the disposal of low-level radioactive waste in shallow trenches.
Risk Assessment Information System (RAIS)	DOE site that contains risk assessment tools and information. Tools are designed for use with DOE site-specific data.
Spatial Analysis and Decision Assistance	Uncertainty analyses freeware developed by the University of Tennessee.
Superfund Soil Screening Guidance	Soil screening levels information.
Exposure Analysis Modeling System (EXAMSII)	USEPA modeling system to assess the probable aquatic fate, transport, and exposure concentrations of synthetic organic chemicals, pesticides, industrial materials and leachates from disposal sites.

SUMMARY

DEPOT was conceived as a resource for risk assessment analyses that would provide referenced data with a mathematical assessment of data uncertainty. While the site has evolved into a comprehensive resource for the entire spectrum of environmental restoration and waste management activities, providing environmental parametric data with an associated uncertainty remains the primary goal. Continued development of the DEPOT web site will provide the risk assessment community with ready access to real, referenced transport and uptake data collected under a wide variety of conditions. Use of data with an established uncertainty will:

- Reduce the need for excessive conservatism in risk analyses.
- Increase the level of confidence that assessment results realistically portray the projected risks.
- Result in more efficient use of cleanup resources.