3MRA TECHNOLOGY IMPROVES RISK ASSESSMENT OF HAZARDOUS WASTE STREAMS

Issue

Over the last decade, environmental risk assessments of hazardous waste at landfills and other waste-management facilities have become more complex. Risk assessments of contaminated land can be complicated because they usually involve:

- More than one environmental *medium* (air, land, water, soil, sediment, plants, and animals)

- Different pathways of *exposure* (inhalation, ingestion, and absorption)

- Several types of *receptors* (any person, plant, or animal that is potentially affected by a contaminant)

3MRA Model

To address the complexities of today's environmental risk assessments, EPA's Land Research Program in the Office of Research and Development has developed the Multimedia, Multipathway and Multireceptor Risk Assessment Modeling System (3MRA). The system was developed in partnership with EPA's Office of Solid Waste and with collaboration by the U.S. Department of Energy. It includes 17 science modules that collectively simulate the release of hazardous contaminants in waste management facilities, along with their fate and transport, foodweb dynamics, exposure, and risk.

3MRA is designed to provide risk information to safely manage liquid, solid, or semi-solid hazardous materials at landfills, waste piles, aerated tanks, or surface impoundments. The system is part of a Windows-based modeling infrastructure called FRAMES (Framework for Risk Analysis in Multimedia Environmental Systems), which supports model development and application.

3MRA Features

3MRA is unique due in part to its capacity to quantify cumulative, chronic exposures and risk for both human and ecological receptors; it provides detailed information for subpopulations within receptor groups.

3MRA evaluates multiple exposure routes, including food or water ingestion, soil ingestion, and air inhalation. It also evaluates exposures for multiple receptors such as a resident, a farmer, or an ecological habitat.

To assess risk, 3MRA helps evaluate exposure against available benchmarks for environmental and health effects. This process can be done across selected "exposure profiles." Each exposure profile consists of a combination of factors that describe a particular exposure scenario of interest to decision–makers (e.g., ingestion of pollutants due to contaminated

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well water). 3MRA can track over 21,000 exposure profiles, which can be further evaluated to determine the level of protection of the population at various waste concentrations.

A special feature of the system is its data-input component, which collects and processes data automatically. 3MRA facilitates access of Web-based databases, retrieves data, and processes the data for the modeled area of interest. Furthermore, 3MRA's problem-solving capabilities include estimating concentrations of pollutants below which treatment, storage, or disposal of hazardous waste would not be required based on acceptable risk.

Application and Impact
The 3MRA modeling system has undergone extensive quality-assurance testing throughout its development. The system, with its integrated set of science-based models, provides a flexible application for conducting site-specific, regional, or national risk assessment of land-based hazardous materials.

3MRA Versions

3MRA Version 1.0:
Site-based risk assessment technology with regional and national scale roll-up capabilities

3MRA Version 1.x:
A tool set extension that facilitates and enhances capabilities for:
• Post-processing exposure profiles
• Parallel processing of model runs
• Uncertainty and sensitivity analysis, and parameter estimation

3MRA Version 2.x (beta):
• Advances underlying FRAMES design
• Geared to site-based analysis, with roll-up options now being added
• Retains 3MRA science and data
• Easier to add/update science models and input data
• Drag-and-drop conceptual site model design for problem solving
• Co-development of FRAMES 2.0—a multi-agency collaboration effort.

REFERENCES

Download 3MRA Version 1.0:
http://www.epa.gov/ceampubl/mmedia/3mra/index.htm

SuperMUSE website at:
http://www.epa.gov/athens/research/modeling/supermuse/supermuse.html

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