Title: **Evaluation Techniques for Groundwater Contaminant Transport Models (Study No. 8)**

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Objectives: To compare analytic, groundwater contaminant models with numerical model results and determine the uncertainty of parameter values using sensitivity analysis.

Background/Need: The Wisconsin Department of Natural Resources (DNR) may grant a variance to landfill design if the developer can show from a model study that the alternative design will not significantly impact the groundwater. Different models are appropriate to a site depending on its conditions. The DNR needs efficient ways to validate models.

Methods: An analytical, solute transport model AT123D represented regional flow with mixing and transformation, while two advective transport models, FLOW and TRAVEL, represented the interaction of landfill leachate with the regional flow near the source. Sensitivity analysis was conducted using both factorial analysis and Monte Carlo analysis.

Results: The AT123D Model calculated spatial and temporal concentration distributions for various waste loadings, geometry and regional flow conditions. FLOW provided a reasonable estimate of plume geometry and penetration depth, though it could not account for mixing of contaminated water with the groundwater. TRAVEL predicted plume location geometry at a specified distance downstream from the source. Monte Carlo gave the most significant information when all parameters were allowed to vary at once.

Conclusions: Analytical models are good tools for preliminary screening in site selection and in evaluating probable environmental impacts, even though physical situations may not be an exact fit to the model's assumptions. Monte Carlo analysis cannot determine the relative parameter impacts. Factorial analysis is useful with reasonable parameter ranges.

Recommendations/ Implications: Each model study by a developer should be tested with AT123D to get an initial estimate of resulting concentrations. AT123D should then be run using the volume source with penetration depth calculated by FLOW and high and low parameter values. Rather than an evaluation tool for incoming models, TRAVEL should be used to evaluate the amount of degradation of a non-conservative substance at a given distance downgradient of a proposed site or to calculate where a plume might exist

after a given amount of time.

Several steps are recommended for sensitivity analysis. Parameters to be tested should be examined for accuracy. A single measure should be selected for output of the model. Probable ranges and distributions need to be targeted for parameters. A Monte Carlo analysis should be done varying the parameters over their probable distributions followed by a resolution III factorial analysis. The analytic results should be used to determine the relative sensitivity of the parameters. The full model should then be rerun with refined parameter estimates and assessed for acceptance.

Availability of Report: This report is available for viewing and loan at:

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Related Publications: Trussell, Howard and Hoopes, John, 1987. Flow User's Guide. University of Wisconsin-Madison, Madison, Wisconsin.

Yeh, G.T., 1981. AT123D: Analytical Transient One-, Two- and Three-Dimensional Simulation of Waste Transport in the Aquifer System, User's Guide. Oak Ridge National Laboratory, Env. Sci Div., Publ. 1439. Modified by Howard Trussell and John Hoopes, 1987.

Key Words: Landfill, landfill design, models

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