Michigan Department of Environmental Quality
Groundwater Modeling Program

Documentation of Groundwater Flow and Fate and Transport Models

A groundwater model developed for a site, whether an analytical or numerical model, should be described in sufficient detail so that the model reviewer may determine the appropriateness of the model for the site or problem that is simulated. Submittal of a model documentation report and model datasets (in digital format) is required.

Report

Groundwater modeling documentation must detail the process by which the model was selected, developed, calibrated, verified and utilized. The model documentation report must include the following information:

- A description of the purpose and scope of the model application.
- Presentation of the hydrogeologic data used to characterize the site.
- Documentation of the source of all data used in the model, whether derived from published sources or measured or calculated from field or laboratory tests.
- Description of the model conceptualization.
- Identify the model selected to perform the task, it's applicability and limitations.
- A discussion of the modeling approach.
- Documentation of all calculations.
- Summary of all model calibration, history matching and sensitivity analysis results.
- Present all model predictive simulation results as a range of probable results given the range of uncertainty in values of model parameters.

The organization of the report should include the following sections:

- Title Page
- Table of Contents
- List of Figures
- List of Tables
- Introduction
- Objectives
- Hydrogeologic Characterization
- Model Conceptualization
- Modeling Software Selection
- Model Calibration
- History matching
- Sensitivity Analysis
- Predictive Simulations or Use of Model for Evaluation of Remedation Alternatives
- Recommendations and Conclusions

- References
- Tables
- Figures
- Appendices

Tables

The following is a list of tables that should appear within the body of the model documentation report or in attached appendices:

- Well and boring log data including:
- Name of all wells or borings,
- Top of casing elevation,
- Well coordinate data,
- Well screen interval,
- Hydraulic head data,
- Elevation of bottom of model,
- Hydraulic conductivity or transmissivity, and
- Groundwater quality chemical analyses (if appropriate).
- Aquifer test or slug test data.
- Model calibration and verification result showing a comparison of measured and simulated calibration targets and residuals.
- Results of sensitivity analysis showing the range of adjustment of model parameters and resulting change in hydraulic heads or groundwater flow rates.

Other data, not listed above, may lend itself to presentation in tabular format. Where appropriate, the aquifer for which the data apply should be clearly identified in each table.

Figures

The following is a list of the types of figures (maps or cross sections) which should be included in the model documentation report:

- Regional location map with topography.
- Site map showing soil boring and well locations, and site topography.
- Geologic cross sections.
- Map showing the measured hydraulic-head distribution.
- Maps of top and/or bottom elevations of aquifers and confining units.
- Areal distribution of hydraulic conductivity/transmissivity .
- Map of areal recharge (if appropriate).
- Model grid with location of different boundary conditions used in the model.
- Simulated hydraulic-head maps.
- Contaminant distribution map(s) and/or cross sections showing vertical distribution of contaminants (if appropriate).

- Map showing simulated contaminant plume distribution (if appropriate).

Other types of information, not listed above, may be presented in graphic format. Figures that are used to illustrate derived or interpreted surfaces such as layer bottom elevations and hydraulic-head maps should have the data used for the interpolation also posted upon the figure. As an example, measured hydraulic-head maps should identify the observation points and the measured hydraulic-head elevation. Similarly, the simulated hydraulic-head maps should locate the calibration target points and the residual between the measured and modeled data.

All figures should provide the following information:

- North Arrow
- Date of figure preparation and data collection
- Title Bar
- Scale Bar
- Legend

All maps or cross sections should be drawn to scale with an accurate scale clearly displayed on each figure. When feasible, all figures should be the same scale. Figures that apply to specific aquifers should be clearly labeled.

Additional Data

Additional data may be required to be presented in the model documentation report. Examples of additional data are as follows:

- Additional studies work plans providing for the collection of additional data where model simulations show data deficiencies, and
- Groundwater monitoring plans/proposals/recommendations to collect data needed to verify model predictions.

Other data may be required, depending on the conditions at the site. These additional subjects should be addressed within the body of the report. This may include additional figures and tables, or report sections.