

ODNR DEPARTMENT OF NATURAL RESOURCES  
Division of Mineral Resources Management  
Industrial Minerals

## Checklist to Submit a Ground-Water Modeling Report for ODNR to Review

This checklist is intended to assist in the submission of a ground-water model report as required by the Ohio Administrative Code 1501: 14-5-01 (A) and (B). The checklist reflects what is required for ODNR, Division of Mineral Resources Management (DMRM) and ODNR, Division of Water Resources (DWR) in a review. Please review your report carefully with the checklist to insure that all required materials are included. The report may not exactly match this checklist, because additional text and/or figures might be necessary to fully detail the process of modeling.

Submissions are reviewed in the order received. The report must provide sufficient information for the reviewing hydrogeologist to evaluate how the model was constructed, how the parameters and data used in the model relate to existing geologic and hydrologic conditions within the model domain, and how accurately the model calibrated. Failure to include required items will result in a delayed approval and multiple rounds of reviews. After the initial review is complete, comments are sent to the operator and the consultant. When all comments are addressed, the report is approved, and the hydrology review portion of the application is approved.

Operators and consultants new to the ground-water model hydrology application process are encouraged to schedule a premodeling meeting with the Industrial Minerals geologist, Kelly Barrett. (Kelly.Barrett@dnr.state.oh.us or 614-265-6502) Suggested topics for the meeting include conceptual model design, model boundary conditions, sources of data, reporting requirements, and any other topic the modeler wishes to discuss. Mail three copies of the ground-water model report and the Request for Hydrology Modeling Review form to Kelly Barrett, ODNR Division of Mineral Resources Management, 2045 Morse Road, Building H-3, Columbus, OH 43229-6693.

### *General Requirements for Maps Included in Report*

These requirements must be included on every map in the report:

- Title with Figure or Plate number that is referenced in text
- North arrow
- Legible labels, basemap, and proposed quarry extent
- Scale of 1:24,000 (1 inch = 2,000 feet) or other scale at which data are legible
- Appropriate units that are labeled
- Legend that includes all items depicted on the map (boundary conditions, different quarry extents, contour lines, water wells, sump location, etc.)
- Uniform contour interval on all potentiometric surface maps
- Data Source(s)

*Introduction*

The introduction of the report must describe what change(s) is requested in the application to require ground-water modeling or why a new application requires ground-water modeling. Description of the quarry setting and a summary of mining history must also be included in this section.

For an existing permit, detail the following in text and show on a site map:

Describe if the expansion of the quarry is vertical, lateral, or both:

- If vertical, indicate change in elevation
- If lateral, indicate change in acreage

Describe and show current:

- Quarry dimensions                       Sump elevation
- Quarry floor elevation                       Sump location

Indicate and map proposed:

- Quarry dimensions                       Sump elevation
- Quarry floor elevation                       Sump location
- One or multiple quarry expansions

Indicate:

- Industrial Minerals permit number                       Operator

Summarize history of mining at the quarry including:

- Start of mining date and when operator obtained permit
- Date and extent of any significant deepening and expansion
- Date and elevation changes in quarry floor and in sump
- Start date of previous dewatering

On site map also indicate:

- Municipalities     Major roads
- Bodies of water     Streams

For a new application, describe the following in text and show on a site map:

Describe the following for proposed quarry extent:

- Sump elevation     Quarry floor elevation
- Acreage
- One step or multi-step expansions

Indicate:

- Operator

On site map also indicate:

- Municipalities     Major roads
- Bodies of water     Streams

*Hydrogeologic Setting*

The model report must include a description of the physical characteristics of the quarry and of the region included in the model domain. Model design should reflect the conditions described in this section.

Describe the following in text and show on map:

Geologic framework

Glacial Geology

- |   |  |
|---|--|
| <input type="checkbox"/> Map unit(s)            | <input type="checkbox"/> Composition         |
| <input type="checkbox"/> Age                    | <input type="checkbox"/> Thickness (feet)    |
| <input type="checkbox"/> Physiographic province | <input type="checkbox"/> Topographic relief  |
| <input type="checkbox"/> Glacial geology map    | <input type="checkbox"/> Drift thickness map |

Bedrock Geology

- |  |   |
|--|---|
| <input type="checkbox"/> Map unit(s)                       | <input type="checkbox"/> Thicknesses (feet)         |
| <input type="checkbox"/> Lithology                         | <input type="checkbox"/> Strike and dip             |
| <input type="checkbox"/> Structure (Fault, fractures, etc) | <input type="checkbox"/> Solution or karst features |
| <input type="checkbox"/> Hydraulic properties              | <input type="checkbox"/> Bedrock geology map        |
| <input type="checkbox"/> Bedrock topography map            |   |

Include a generalized stratigraphic section that indicates:

- |  |   |
|--|---|
| <input type="checkbox"/> Map unit(s) (Formation Name)    | <input type="checkbox"/> Period (i.e. Devonian) |
| <input type="checkbox"/> Approximate unit thickness (ft) | <input type="checkbox"/> Reference(s)           |

Surface water

- Significant streams and bodies of water

Ground Water

Describe aquifers

- Identify aquifers by map unit and lithology
- Type of aquifer (confined, unconfined, etc.)
- Hydraulic properties
- Aquifer thickness (feet)
- Principal aquifer and alternative aquifers

ODNR DWR Water Wells

*Visit the DWR website or contact DWR to obtain well data.*

- Show water well locations on map
  - Label each well location with unique identifier such as the DWR well log number
  - Explain if any large area is lacking wells
- Include well table that lists:
  - Unique well identifier
  - DWR water well log number
  - Township (and county if needed)
  - Completion date (month/day/year)
  - XY coordinates (specify coordinate system)
  - Surface elevation at well (feet above mean sea level)
  - Total depth of well (feet below land surface)
  - Depth to bedrock (feet)
  - Geology of screened or open borehole
  - Static water level (feet below land surface)
  - Casing length (feet)
  - Length of screen (feet)
  - Test rate (gallons per minute)
  - Test duration (hours)
  - Drawdown (feet)

- Static water level elevation (feet above mean sea level)
- Specific capacity (gpm/ft)

*Additional information that is requested in Description of Model Calibration Section can be included in this table such as residual value.*

- Indicate if water wells correspond to calibration points or only a subset of the wells are calibration points
- Summarize well characteristics in text to describe aquifer(s)

#### Ohio Water Withdrawal Program Facilities

*Facilities are not included with ODNR DWR water well logs.*

*Contact DWR to request Water Withdrawal Facility data.*

For each Water Withdrawal Facility in study area, list:

- Facility name
- Annual withdrawal with year indicated
- Location (Coordinate system indicated)
- Include existing permit if dewatering
- Indicate if not all facilities are included in model and why
- Locate facilities on well location map
  - Indicate with different color or symbol from DWR water wells

#### Potentiometric Surface Map

*The potentiometric surface map should have the same contour interval and map scale as the potentiometric surface maps produced from model calibration for comparison.*

- Map includes entire model domain
- Refer to potentiometric surface map in text to describe:
  - Regional flow
  - Timeframe map represents (current, pre-mining, etc.)

Indicate if the map was:

- Constructed from well data
  - Include map in report
  - List and cite well data used including:
    - Unique ID
    - Static water elevation
  - Label each well

If potentiometric surface contour elevations match surface water feature elevations (ex. where contours cross streams), map should indicate this.

- Published
  - Enclose copy of map
  - Reference map source

### *Description of Model Design*

Indicate how the model was conceptualized and built.

Indicate software used to complete model

Describe model extent:

- Lateral distance from quarry
  - Model domain should not be constrained to prevent boundary conditions from affecting the cone of depression.
- Vertical distance from ground surface to base of model
- Model grid cells
  - Number of rows
  - Number of columns
  - Grid cell size(s)
- Provide map of model grid
  - Topographic base
  - Quarry extent shown that corresponds to calibration timeframe

Identify and describe the following characteristics of hydrogeologic units:

- Number of layers
- How unconsolidated and/or bedrock units are included
  - Indicate if any or all units are combined based on properties
- Thickness of each layer
- Changes in hydrogeologic properties between layers
- Description of criteria used to select base of model
- Provide cross section of model hydrostratigraphic layers that indicates:
  - Map units that intersect quarry
  - Scale
  - Vertical exaggeration

Boundary Conditions

- List boundary conditions applied
  - Explain:
    - Assignment of each boundary condition
    - How boundary conditions reflect hydrogeologic setting
  - For specific boundary condition types, indicate:
    - Head values assigned to constant head and/or drain cells
    - Values assigned to the following for stream or river cells
      - Stream width
      - Stream depth
      - Streambed permeability
      - Streambed thickness
      - Streambed conductivity
      - Stage or head values with source (ex. USGS topo map)
  - Flux for specified flow boundaries
- Show all model boundary conditions on a map for entire model domain  
*Include multiple maps if boundary conditions vary between model layers*  
Indicate:

- Each boundary type and no-flow boundaries by a distinct color or pattern
- River and stream cells
- Type and extent of cell(s) used to simulate quarry and expansion(s)
- Pumping well cells (ex. Water Withdrawal facilities)

#### Model Parameters

##### Hydraulic conductivity

List source of values:

- Published values
  - Cite reference(s)
  - Include transmissivity and storativity if available
- Derived from well or pumping data
  - Cite source or describe measurements

Hydraulic Conductivity Map(s) that indicates:

*Include multiple maps if hydraulic conductivity varies between model layers*

- Hydraulic conductivity (designate unit)
- Boundary of model domain

##### Recharge

- All recharge values are greater than 0 (zero)
- List published values with reference
- Explain how value(s) relates to hydrogeological setting
- Recharge Map that shows:
  - Recharge values (inches per year)
  - Boundary of model domain

#### *Description of Model Calibration*

Describe calibration process and show calibrated map results.

Indicate data used to evaluate when model was calibrated

- Well data
- Pumping rate at the quarry

Specify the timeframe of calibration

- Year, range of years, or general time frame (ex. pre-mining)

List criteria used to evaluate calibration

- Statistics (Absolute error, RMSE, etc.)
- Graph of measured versus simulated points
- Comparison of potentiometric surfaces

Indicate final values for each of the following variables and how those values vary from what were originally assigned:

- Hydraulic conductivity
- Recharge
- Conductance or streambed permeability

Provide Calibration Points Map that includes:

- All points used in calibration
- Unique label for each point to refer to calibration points table

- Points evenly spaced throughout model domain as data are available
  - Address any data gaps or unusual features
- Current and proposed quarry extents  
*Can designate residual values on this map or a separate map (see requirements below)*

- Table with the following data for each calibration point that includes:
 

<input type="checkbox"/> Unique Well ID	<input type="checkbox"/> Location (Coordinate system noted)
<input type="checkbox"/> Measured Head	<input type="checkbox"/> Simulated Head
<input type="checkbox"/> Residual Value	

- Residual values map  
 Indicates:
  - Residual value for each calibration point
    - Positive and negative residual values represented with different colors or symbols
  - Unique well ID for each point to refer to calibration points table
  - Quarry extent that corresponds to time of calibration

- Measured vs. Simulated Heads Graph  
 Includes:
  - Residuals from calibration shown on graph
  - RMS error
  - Minimum residual
  - Maximum residual
  - Number of points

*Model Results*

Describe simulation(s) results created with calibrated model. Include maps to show calibrated and simulated potentiometric surfaces and cones of depression.

For calibrated model and simulation(s), list and describe:

- Final quarry floor elevation
- Final quarry extent
- Cone of depression
  - How it was determined
  - Describe extent

Include the following maps that depict:

- Simulated Potentiometric Surface Map for Calibrated Model:
  - Potentiometric surface contours with labels
  - Quarry extent during calibration timeframe
- Simulated Potentiometric Surface Map(s) for each expansion scenario:
  - Potentiometric surface contours with labels for expanded quarry dewatering
  - Proposed quarry extent for applicable scenario
- Simulated Drawdown Map(s):
  - Drawdown contours at 10-foot intervals

- USGS topographic basemap
- Proposed quarry extent

Mass Balance or Water Budget

- Graph or table
- Indicates estimated input and output of water in the model
  - Specified by type (storage, constant heads, wells, etc.)
- Indicate units

Report conclusion

- Summarize findings
- Describe area of impact and plan for impacted wells possibly impacted

*References*

Please consult the document ‘References & Data Sources for Data or Model Submissions’ for references that are commonly used in existing reports or data submissions and for sources of data that are required to be included. Only include references cited in the text of for data shown on maps. Use a consistent style to list references that is based on a widely used format.

**For questions and concerns about these guidelines or the model report review process, contact Kelly Barrett at (614) 265-6502 or [Kelly.Barrett@dnr.state.oh.us](mailto:Kelly.Barrett@dnr.state.oh.us).**