Hydrogeologic Requirements for Permitting Landfills in Minnesota

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Hydrogeologic Requirements

Depend on Type of Landfill

- Mixed Municipal Landfill (MSW)
- Industrial Landfill
- MSW Combustor Ash Landfill
- Demolition Landfill
General Principles for all MN Landfills

- Must adequately characterize prospective sites
- Engineered design may have to change to reflect site hydrogeologic conditions
- Groundwater monitoring must be considered
Technical Requirements for Industrial Landfills

- **MR 7035.1590**
  Design approval based on waste characteristics, fill size, topography, soils, hydrogeologic setting, and potential for harm.

- **MR 7035.1700 Subp. S.**
  Typically same monitoring requirements as for MSW landfills *(and 5’ separation to SHWT)*.
MPCA policy: Because industrial rules are not entirely “prescriptive” industrial landfills may held to the same hydrogeologic and engineering requirements as for MSW landfills.

Strict MSW rule adherence depends on waste type
Technical Requirements for MSW Combustor Ash Landfills

MR 7035.2885 Subp. 7
- Must complete the same hydrogeologic evaluation as a MSW landfill

MR 7035.2885 Subp. 9
- Must meet the same engineering requirements as a MSW landfill
For Higher Strength Industrial Wastes

--Ind. LFs Held to MSW Rules--

MSW Rules: MR 7035.2815 Subp. 2. A.

Location:

- Must be located only where topography, geology, and groundwater conditions minimize* environmental impacts

- Soil, bedrock and groundwater flow has been determined

- A groundwater monitoring system is feasible

- In the event of a release corrective actions can be taken

* Minimize does not have a well-defined meaning in this context
MSW Rules: MR 7035.2815 Subp. 2. B.

(MSW-Ind) landfills *cannot* be located where

- Hydrologic or topographic conditions would allow rapid or unpredictable pollutant migration
- Impair long term integrity of the facility
- Preclude reliable monitoring

Practically speaking this is usually only taken into account with karst
MSW-Ind. Hydrogeologic Permitting Process

Preliminary Application

MR 7001.3200

Use existing information to summarize:

- site geology
- ground water occurrence, horizontal and vertical directions and rates of movement,
- ground water quality
Detailed Site Evaluation Report

MR 7035.2815 Subp. 3.G.

Must conduct four-phase in-depth Hydrogeologic Investigation (sequence of MPCA-approved workplans and reports)
Required, Intensive 4-Phase Geotechnical Study

P-I: Collate, summarize existing soils, geologic and hydrogeologic information

P-II: Intensive site soils, ground water investigation

P-III: Installation of monitoring wells

P-IV: Baseline sample wells
   (3 rounds of sampling)

Result: Geotechnical information for engineering and monitoring considerations but not directly for siting decisions.
PHASE II REPORT
DETAILED SITE INVESTIGATION REPORT

The completeness checklists are a series of checklists prepared by the hydrogeologists of the Solid Waste Section, Ground Water and Solid Waste Division, Minnesota Pollution Control Agency in August 1991.

The purpose of the checklists is to ensure that the requirements of the Solid Waste Management Rules (Minn. Rules pt. 7035.2015, subp. 3 and other subparts cited within subp. 2) are addressed in the preparation of the four phases of the hydrogeologic evaluation work plans and reports. When preparing work plans and reports, users should refer to the specific rule requirements cited in the checklists. When varying from any rule requirement, a technical rationale to support the change must be presented.

Following the Commissioner's approval of the Detailed Site Investigation Work Plan and completion of the approved work, the Detailed Site Investigation Report is submitted. A person with expertise in hydrogeology must sign the report and certify the quality of the work.

In the blanks provided the page(s) of the document where the specific rule requirement is addressed.

Minn. Rules pt. 7035.2015, subp. 3, Item C., pages 114-118; 5000FR pages 349-355

1. Description of soil/bedrock units 

This is included in the discussion for each unit.

MPCA Use Page
--- --- --- ---
1. texture and classification
   particle size distribution
   mineral composition, cementation and soil structure
   geologic structures (faults, dikes, folding, jointing, etc. where applicable)
   permeability, field and lab
   porosity
   any heterogeneity encountered: the type, scale and frequency
   describe the model, its capabilities and limitations
   include all assumptions or approximations used
   identify quantifiable values derived from the model that are not
   local, intermediate and regional flow systems
   identify groundwater recharge and discharge areas, other
   intersections of ground water with surrounding surface water
   the effect of heterogeneity/irregularities on ground water movement
   directions of ground water movement, included
   vertical and axial components
   specific discharge rates
   average linear velocities
   seasonal or other temporal fluctuations in hydraulic head
   projected paths and rates of movement of both water-soluble and
   low-solubility components of leachate
   determine existing and future
   plans for the project and sections oriented in directions parallel to and perpendicular to
   the probable flow directions of ground water flow
   illustrate the model and vertical extent of soil/bedrock units, measured
   values of hydraulic head, equipotential lines and internal
   ground water streamlines
   locations of soil and bedrock boundaries
   locations and construction of piezometers and monitoring points
   locations of any geophysical measurements used to prepare the cross sections

3. Description and evaluation of the ground water flow system (specifically
discuss the following with respect to their impact on ground water and
pollutant movement):

4. Use of ground water models (mathematical or analog), if applicable:

5. Environmental and public health impact analysis includes:

6. Plan-view maps and cross sections

--- --- --- ---
sections spaced no more than 500 feet apart
sections oriented in directions parallel to and perpendicular to
the probable flow directions of ground water flow
illustrate the model and vertical extent of soil/bedrock units, measured
values of hydraulic head, equipotential lines and internal
ground water streamlines
locations of soil and bedrock boundaries
locations and construction of piezometers and monitoring points
locations of any geophysical measurements used to prepare the cross sections

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7. Logs for borings and piezometers. Include, at a minimum, the following for each log:

<table>
<thead>
<tr>
<th>MPCA Use</th>
<th>Page</th>
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</thead>
<tbody>
<tr>
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</tbody>
</table>

- Date of boring
- Name and address of the driller and testing firm
- Drilling and sampling methods
- Surveys: elevation of the ground surface (M.S.L.)
- Surveyed location referenced to permanent benchmarks
- Soil and rock classifications & narrative descriptions
- Contacts between strata/units, sample depth, blow counts, test data
- Observations during drilling
- Water level measurements
- Sampling procedure
- Any geophysical logs
- Signed by a person responsible for logging the boreholes

Borehole records of piezometers as required by Minn. Rules pt. 7035.2012, subp. 10.

8. Items specific to facility:

- All work plan objectives/items included
- Justification for deviation from work plan

9. Appendices:

- Raw geotechnical data
- Sample calculations
- Water elevations

Definitions:

- MPCA: Minnesota Pollution Control Agency
- Statement of Need and Reasonableness (SQR): This document is the justification for the MPCA Solid Waste Management Rules.
- MSL: Mean Sea Level
Also Must Consider Generalized EAW/EIS Criteria
(must have adequate geotechnical information for EAW/EIS)

**EAW**
- New: < 100,000 cyds/yr
- Existing: > 25% more capacity

**EIS**
- New: > 100,000 cyds/yr
  - soluble bedrock
  - “Potential for significant environmental effects that are reasonably expected to occur.”

If an EIS is required then the process takes longer, and potentially more geotechnical information may be required.
Demolition Landfill Guidance

- A collaborative effort by landfill owners, counties, MPCA staff, consultants.

- Undertaken to normalize demolition landfill permit requirements.
Demolition Landfill Guidance

Contents

- Background information
- Facility classification (Class I-III)
- Waste classification (Class I-III)
- Waste screening
- ISWMPs
- Groundwater and liner criteria

Demolition Landfill Guidance

Background

The State Solid Waste Rules allow the Minnesota Pollution Control Agency (MPCA) Commissioner considerable discretion to set site evaluation, design, monitoring, and operational requirements for demolition landfills. The exercise of this discretion has resulted in a lack of consistency in the way that the MPCA has applied these requirements to demolition landfills throughout the state.

Purpose

This guidance is intended to provide improved consistency and predictability in how the MPCA, counties, facility owners, and facility operators manage demolition landfills under the existing solid waste management rules in the following areas:

- Locating the facility;
- Developing initial site evaluation information;
- Determining facility classification;
- Identification of an acceptable waste list;
- Appropriate waste-screening procedures;
- Contents of an Industrial Solid Waste Management Plan;
- Need for ground water monitoring;
- Other liner requirement.

Location Standards

The single most effective action that owners/operators of demolition landfills can take is to locate demolition landfills in areas that will inherently protect ground water and surface water from the...
Acceptable C&D Waste List (Class I)

- Bituminous concrete (includes asphalt pavement and blacktop)
- Concrete (including rerod) and masonry (bricks, stucco and plaster)
- Stone and uncontaminated soil
- Untreated wood (including painted, stained and/or varnished dimensional lumber, pallets, tree stumps, grubbing, root balls, particle board, plywood, fencing, docks)
- Siding (Includes vinyl, masonite, untreated wood, aluminum and steel.)
- Wall coverings
- Electrical wiring and components
- Roofing materials
- Duct work
- Wall board, sheet rock
- Built-in cabinetry
- Plumbing fixtures
- Affixed carpet and padding
- Ceramic items
- Conduit and pipes
- Glass (limited to window and door glass from buildings and structures)
- Insulation (Includes fiberglass, mineral wool, cellulose, polystyrene, newspaper.)
- Plastic building parts
Acceptable C&D Waste List (Class I) cont.

- Sheathing
- Molded fiberglass
- Rubber
- Drain tile
- Recognizable portions of burned structures
- Metal
- Ceiling tile
- Wood and vinyl flooring
- Asbestos-containing materials (pursuant to an approved ISWMP)

Class II demolition landfills may take the C&D wastes listed above, incidental nonrecyclable packaging consisting of paper, cardboard and plastic, and limited demo-like industrial waste. Demo-like industrial waste accepted by Class II demolition landfills is limited in composition to wood, concrete, porcelain fixtures, shingles or window glass. These additional waste types need to be identified in the facility’s ISWMP.

Class III essentially industrial waste
What else goes into un-lined Demolition Landfills?

--Even conscientious operators can miss unacceptable wastes--
Hydrogeologic Requirements for Demolition Landfills

- MR 7035.2825 Subp. 7, Subp. 10, and guidance
- Monitoring and liner requirements depend on waste types, soil and groundwater conditions

http://www.pca.state.mn.us/publications/w-sw5-05.doc
### Table 1: Class I Groundwater Monitoring Decision Matrix (for demolition landfills)

<table>
<thead>
<tr>
<th>Is GW monitoring required?</th>
<th>Depth to water table</th>
<th>Soil Texture</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Clay</td>
</tr>
<tr>
<td></td>
<td>5 feet or more</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>At least 10 feet</td>
<td>No</td>
</tr>
</tbody>
</table>

In terms of risk this criteria has not been fully validated
Demolition Landfill Monitoring and Liner Decisions

**Sand**
(feels gritty)
(2.00 - 0.05 mm, USDA)
(2.00 - 0.02 mm, ISSS)

**Silt**
(feels floury)
(0.05 - 0.002 mm, USDA)
(0.02 - 0.002 mm, ISSS)

**Clay**
(feels sticky)
(< 0.002 mm, USDA)
(< 0.002 mm, ISSS)
Seasonal High Water Table

The minimum depth of routine anaerobic saturation due to the water table

Mottling
Contaminant Attenuation

- Dilution
- Diffusion
- Adsorption
- Inorganic degradation
- Biodegradation

- Contaminants may or may not be attenuated
- Contaminant transport rate may be slower than groundwater flow rate depending on contaminant properties, soil, subsoil, and aquifer characteristics.
Simplified Soil Texture, Groundwater Flow Rates, and Attenuation Potential
### Table 2: Class II Liner Decision Matrix (for demolition landfills)

<table>
<thead>
<tr>
<th>Depth to Water Table</th>
<th>Soil Texture</th>
<th>Is a liner necessary?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Clay</td>
<td>Silt</td>
</tr>
<tr>
<td>5 feet or more</td>
<td>No</td>
<td>Run model</td>
</tr>
<tr>
<td>At least 10 feet</td>
<td>No</td>
<td>Run model</td>
</tr>
</tbody>
</table>

In terms of risk this criteria has not been fully validated.
Site Modeling Example:

Industrial Waste Management Evaluation Model (IWEM)

- Uses EPA’s Composite Model for Leachate Migration with Transportation Products (EPACMTP) for contaminant fate and transport
- Evaluates human health and groundwater impact using liner systems, hydrogeologic data, and leaching results

**Inputs:** Contaminant types and properties, soil properties, aquifer characteristics, area and thickness of waste

**Output:** Is a liner needed and if so what type
Hydrogeologic Summary

- The hydrogeologic investigation results in information to be used for engineering and monitoring considerations.

- Except in karst most landfill siting has not been limited based on geologic conditions (texture) but some may have been limited based on shallow water table.
Questions?