Industrial Landfill Guidance

June 2009

Minnesota Pollution Control Agency

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Cover: Synthetic liner material being placed at an ash landfill in Southern Minnesota.

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I. Introduction

A. Background

During its 2008 session, the Minnesota Legislature directed the Minnesota Pollution Control Agency (MPCA) to facilitate a work group to report to the Legislature on the management of construction and demolition (C&D) and industrial wastes. The Construction and Demolition and Industrial Solid Waste Landfill Work Group (Work Group) submitted its *Report to Minnesota Legislature on Management of Industrial Solid Waste and Construction and Demolition Debris in Land Disposal Facilities* (report) to the Legislature on January 15, 2009. Appendix A provides a link to this document, and to other useful industrial landfill guidance documents.

As described in the report, "The Work Group feels the current mix of statutes, rules, and policies with respect to industrial landfills are disjointed. The MPCA should develop a comprehensive risk-based policy addressing industrial waste management. Such a policy would ensure that regulations pertaining to the permitting and design of facilities accepting industrial waste will be clear, easily identifiable, and—most importantly—environmentally protective."

B. Purpose

The Work Group recommended that the MPCA develop an industrial landfill guidance document (guidance) that sets forth a comprehensive risk-based approach to industrial waste management. The report also suggested clarification on post-closure care regulations, and established regulations for terminating post-closure care obligations for all landfills, including C&D and industrial landfills. Based on these recommendations, the MPCA formed a Landfill Advisory Group (LAG) to work on these issues, and to develop an industrial landfill guidance.

The purpose of this guidance is to provide improved consistency and predictability in how the MPCA, counties, facility owners, and facility operators manage industrial landfills under the existing solid waste management rules. This guidance will be applied to all new and existing industrial landfills in accordance with the implementation plan included in Appendix B.

C. Scope

Facilities accepting a wide variety of industrial waste from outside customers (i.e., merchant industrial landfills, mixed municipal solid waste [MSW] landfills, and Class III demolition landfills) are not covered by the guidance until a separate stakeholder process highlighting mixed industrial waste is completed. MPCA anticipates this process will begin after the statutorily required rulemaking on landfill siting and financial assurance (FA) is complete. The reason these landfills are not covered by this guidance document is that these three types of facilities all compete for mixed industrial wastes, and if this guidance is only applied to merchant industrial landfills this could create an unintended economic advantage for the MSW landfills and Class III demolition landfills.

The proposed separate stakeholder process will attempt to honor relevant recommendations, including those made by the LAG and the Work Group. The process will invite participation from representatives from merchant industrial landfills, MSW landfills, demolition landfills accepting industrial wastes, local governments, waste haulers, and environmental groups. When that dialogue and the rule processes are completed, the MPCA will revise this June 2009 edition of the guidance.

D. Risk-based approach to landfill siting, operation, and design

The report recommended that permitting and regulation of industrial landfills should be based around three key factors (i.e., "the three legged-stool" for landfill siting):

- Hydrogeologic setting
- Waste types accepted (using a risk-based evaluation of waste toxicity characteristics)
- Engineered controls (e.g., landfill liners and caps)

Development and subsequent integration of these interrelated criteria is currently underway. One of the three factors, hydrogeologic setting (i.e. hydrogeologic sensitivity) needs to go through the rule-making process before specific applications to the other two factors can be integrated more fully into the landfill siting process.

E. Beneficial use

Minn. Stat. § 115A.02 describes a hierarchy for various solid waste management practices. To the extent practicable, solid waste is to be managed as high on the hierarchy as possible. The waste management hierarchy practices are listed in order of preference below:

1. waste reduction and reuse
2. waste recycling
3. composting of yard waste and food waste
4. resource recovery through composting or incineration
5. land disposal

In 2004, the MPCA promulgated Minn. R. 7035.2860, which outlined the requirements for the beneficial use of solid waste. The rule provides a means for obtaining approval to utilize waste materials that can provide a beneficial service in either engineering or construction applications, or agronomic applications. Currently, there are 17 pre-approved standing beneficial use determinations for industrial by-products (see http://www.pca.state.mn.us/waste/swutil-sbud.html).

In accordance with the legislative directive described above, new applications for an industrial monofill permit (see definition below) and for each permit re-issuance, must include an overview of the permittee's attempt to beneficially use industrial waste accepted at the landfill. In cooperation with waste generators, a description of ongoing efforts toward beneficial use must also be included in the facility's annual report.

II. Facility Classification and Landfill Types

A. Facility classification

Industrial waste is defined in Minn. R. 7035.0300 as follows:

> Subp. 45. **Industrial solid waste.** "Industrial solid waste" means all solid waste generated from an industrial or manufacturing process and solid waste generated from nonmanufacturing activities such as service and commercial establishments. Industrial solid waste does not include office materials, restaurant and food preparation waste, discarded machinery, demolition debris, municipal solid waste combustor ash, or household refuse.

In Minnesota, there are currently 20 industrial solid waste landfills. Each of these industrial landfill types may accept different waste types with differing physical and chemical characteristics that need to be accounted for in terms of siting and engineered controls.

B. Types of industrial landfills

For purposes of this guidance, the following definitions of industrial landfill types will be used:

- **An industrial monofill** is a land disposal facility permitted and designed to receive a uniform and well-defined non-hazardous solid waste stream. Examples may include coal ash, mining debris, or industrial manufacture process wastes.
- **A private on-site demo-like industrial landfill** is a land disposal facility that is owned and operated for the sole purpose of the disposal of non-process solid wastes generated by the owner or owner's affiliate.
- **A merchant landfill** is a land disposal facility that accepts solid waste for disposal from any entity that is willing to pay its tipping fee, and has wastes that meet its acceptance criteria. Examples include C&D, industrial, and MSW landfills.

These definitions are useful for addressing requirements that are specific to the landfill type but it should be noted that a facility may change designation from one category to another.

III. Landfill Siting Standards

A. Groundwater sensitivity and landfill siting

In the 2008 budget bill, the Minnesota Legislature provided the following language regarding landfill siting: "The rules for the disposal of solid waste shall include site-specific criteria to prohibit solid waste disposal based on the area's sensitivity to groundwater contamination, including site-specific testing."

The MPCA cannot issue permits for most new landfills until it modifies its solid waste rules as directed by the Legislature (see Appendix C). The MPCA started this rulemaking process in conjunction with developing this guidance.

B. Industrial landfill siting rules

The following Minnesota Rules currently apply to siting industrial waste landfills:

7035.1590 INDUSTRIAL SOLID WASTE LAND DISPOSAL FACILITY DESIGN.
The owner or operator of an industrial solid waste land disposal facility must design, construct, and operate the facility in accordance with parts 7035.1590 to 7035.2500, and an agency-issued permit. If the owner or operator determines that the requirements of parts 7035.1590 to 7035.2500 do not apply, the owner or operator shall submit to the agency for approval documentation supporting the owner's or operator's determination. The agency's approval or disapproval of the owner's or operator's determination will be based on the hydrogeologic setting, waste characteristics, fill size, soil conditions, operating practices, and the potential for harm to human health or the environment.

7035.1600 PROHIBITED AREAS FOR INDUSTRIAL SOLID WASTE LAND DISPOSAL FACILITIES.
The fill and trench areas of industrial solid waste land disposal facilities are prohibited within the following areas:
A. 1,000 feet from the normal high water mark of a lake, pond, or flowage;
B. 300 feet from a stream;
C. a regional floodplain;
D. wetlands;
E. within 1,000 feet of the nearest edge of the right-of-way of any state, federal, or interstate highway or of the boundary of a public park or of an occupied dwelling. Permission may be granted under this item, without these distance requirements, at the discretion of the commissioner, taking into consideration such factors as noise, dust, litter, and other aesthetic and environmental considerations;
F. locations considered hazardous because of the proximity of airports; and
G. an area which is unsuitable because of topography, geology, hydrology, or soils.

7035.1700 REQUIRED PRACTICES FOR MAINTENANCE AND OPERATION OF INDUSTRIAL SOLID WASTE LAND DISPOSAL FACILITIES.
[…]
B. Industrial solid waste must not be deposited in a manner that allows material or leachings therefrom to cause pollution of ground water or surface water. Proposed separation between the lowest portion of the facility and the high water table elevation must be a minimum of five feet. This requirement does not render inoperative any other requirements specified herein and additional ground water protection must be provided.
[…]

C. Other siting rules applied by policy

In lieu of more prescriptive rules for industrial facilities, the MPCA also applies the following rules to help supplement ("fill in") the more general industrial rules listed above.

MR 7035.2815, subp. 2. A.
A facility must be located only in an area where:
(1) the topography, geology, and ground water conditions allow the facility to be designed, operated, constructed, and maintained in a manner that minimizes environmental impacts;
(2) ground water flow paths and variations in soil or bedrock conditions are known in sufficient detail to enable reliable tracking of pollutant movement in the event of a release from the facility;
(3) it is feasible to construct a monitoring system with sufficient monitoring points to assure that pollutants can be detected and tracked in the event of a release from the facility; and
(4) in the event of a release from a facility, pollutants can be contained and corrective actions taken to prevent adverse impacts on water supplies and to return the facility to compliance with ground water and surface water quality standards.

MR 7035.2815, subp. 2. B.
Unless the owner or operator provides an engineered secondary containment system, a facility cannot be located in an area where the hydrologic or topographic conditions would allow rapid or unpredictable pollutant migration, impair the long-term integrity of the facility, or preclude reliable monitoring. The additional engineering must be approved by the commissioner and must consist of at least:
(1) a second liner with a collection system between the two liners;
(2) an in-place, operational ground water containment and treatment or disposal system that can be activated immediately if ground water pollution is detected; or
(3) another method of secondary containment backing up the liner providing additional protection equivalent to subitem (1) or (2) and backing up the cover system.

MR 7035.2815, subp. 2. C.
A land disposal facility must not be located on a site where:
(1) there are karst features, such as sinkholes, solution channels, disappearing streams, and caves, which may cause failures of the leachate management system or prevent effective monitoring or containment of a release of leachate;
(2) there are other unstable soil or bedrock conditions that may cause failures of the leachate management system.

IV. Industrial Solid Waste Management Plans

A. Purpose

The purpose of an Industrial Solid Waste Management Plan (ISWMP) is to provide an up-front, standardized approach to waste characterization and waste acceptance compatible with the design of a particular landfill. The ISWMP must be specific enough to describe how individual wastes will be adequately characterized, and provide enough flexibility to reflect the range of waste types proposed for disposal at a specific industrial landfill. The ISWMP waste acceptance criteria may be tailored to manage a single waste stream, more complex waste disposal streams, or waste streams that change or become more complex over time.

B. Waste characterization

It is the permittee's responsibility to ensure that adequate information exists to allow waste to be accepted at its facility in accordance with the terms of its permit. To adequately characterize a specific waste, the permittee

must provide a waste profile. This starts with compiling existing information about the waste, and then "filling in the information gaps" with additional testing. The permittee must discuss waste variability and testing frequency in the ISWMP. Even relatively inert, uniform wastes must be adequately characterized and the results reported to the MPCA at least once per permit cycle.

The following requirements need to be addressed in an MPCA-approved ISWMP:

1. Each permit application for an industrial solid waste landfill needs to include a list of waste types being accepted at the facility. The permittee needs to describe waste types both generically and, as appropriate, must include known or determined chemical characteristics of the waste.
2. As determined by applying Minn. R. pts. 7045.0131 and 7045.0135, the waste must be non-hazardous. If the waste is hazardous (see Figures 1 and 2 below), it cannot be disposed of within an industrial solid waste disposal facility. The U.S. Environmental Protection Agency (EPA) has determined that coal combustion wastes generated at electric utilities and independent power producing facilities do not warrant regulation as hazardous waste under subtitle C of the Resource Conservation and Recovery Act (RCRA), and RCRA section 3001 (b)(3)(C) provides an exemption that applies to these waste types.
3. For landfills with liner systems greater than or equal to an MSW liner design, either analysis for "totals/20," or the toxicity characteristic leachate procedure (TCLP) may be used to determine if the waste is hazardous (see Figure 1 below).
4. For landfills with a liner design less protective than that of an MSW, the permittee must conduct a total composition analysis to determine which constituents are present in the waste stream and if the waste may be hazardous (see Figure 2 below). The permittee may use these results to estimate maximum leachable concentrations (i.e., 20-fold dilution used by TCLP) and to determine the appropriate constituents to evaluate the waste stream for using the Synthetic Precipitation Leach Procedure (SPLP). If conclusive evidence exists that the waste is not hazardous (i.e., as indicated by the steps in Figure 2), then the SPLP may be used in lieu of the TCLP (see discussion at the end of Appendix D). For waste acceptance, the SPLP results are compared against a percentage of the Minnesota Department of Health's Health Risk Levels (HRLs), the EPA's Maximum Containment Levels (MCLs), the MPCA's Soil Reference Values (SRVs) or Soil Leach Values (SLVs), liner design, and hydrogeologic setting. In addition to characterizing the waste and providing for waste acceptance criteria results from the SPLP test are also useful for establishing leachate and groundwater monitoring parameters.
5. Appendix D provides analytes that may be suggested for waste characterization. Additional testing that may be necessary to properly characterize the waste may include physical appearance, pH, reactivity, bulk density, radioactivity, odor, organic vapor generation in headspaces, volatile organic compounds, herbicides, pesticides, poly-nuclear aromatic hydrocarbons, halogenated organics, ignitability, and corrosivity. This list is not considered to be an inclusive list, so additional analysis may need to be done based on what information is available for the processes that generate the waste and the known physical and chemical nature of the waste.

The ISWMP must include a detailed Sampling and Analysis Plan (SAP) that includes at minimum the following elements:

- title page
- contact persons
- sampling equipment
- description of sampling protocol
- parameters
- sampling frequency
- description of how the samples are to be transported to the laboratory
- chain of custody (if needed)
- analytic methods and reporting limits
- quality assurance/quality control (QA/QC)

Appendix D provides lists of typical analytes, analytic methods, and method detection limits that may be useful when determining a more complete waste profile. These lists may not be complete, and it's the permittee's responsibility to propose a list to the MPCA of the parameters and test methods necessary to adequately characterize the wastes.

C. Waste acceptance

ISWMPs need to propose waste acceptance criteria based on the landfill liner design and waste characteristics that it proposes to accept. Unless otherwise restricted by local rules and ordinances, if an industrial landfill design is as protective as an MSW design, the landfill may accept waste below the hazardous waste limits (see Figure 1).

For industrial landfills that are not built to MSW standards (see Figure 2) when proposing waste acceptance limits, the applicant needs to consider liner type, hydrogeologic conditions, and test results in relation to the HRLs, MCLs, SRVs and SLVs.

All wastes that are accepted at the landfill must be compatible with the landfill facility design during the construction, operation, post-closure, and closure period for the landfill. The applicant must include information in the waste acceptance plan that demonstrates this compatibility.

The MPCA may reasonably establish more stringent waste acceptance criteria as is necessary to protect the environment and public health and safety. The applicant must obtain approval of the waste acceptance plan prior to disposal of the waste.

Figure 1: Waste evaluation for landfills with liner systems greater than or equal to Municipal Solid Waste landfill design

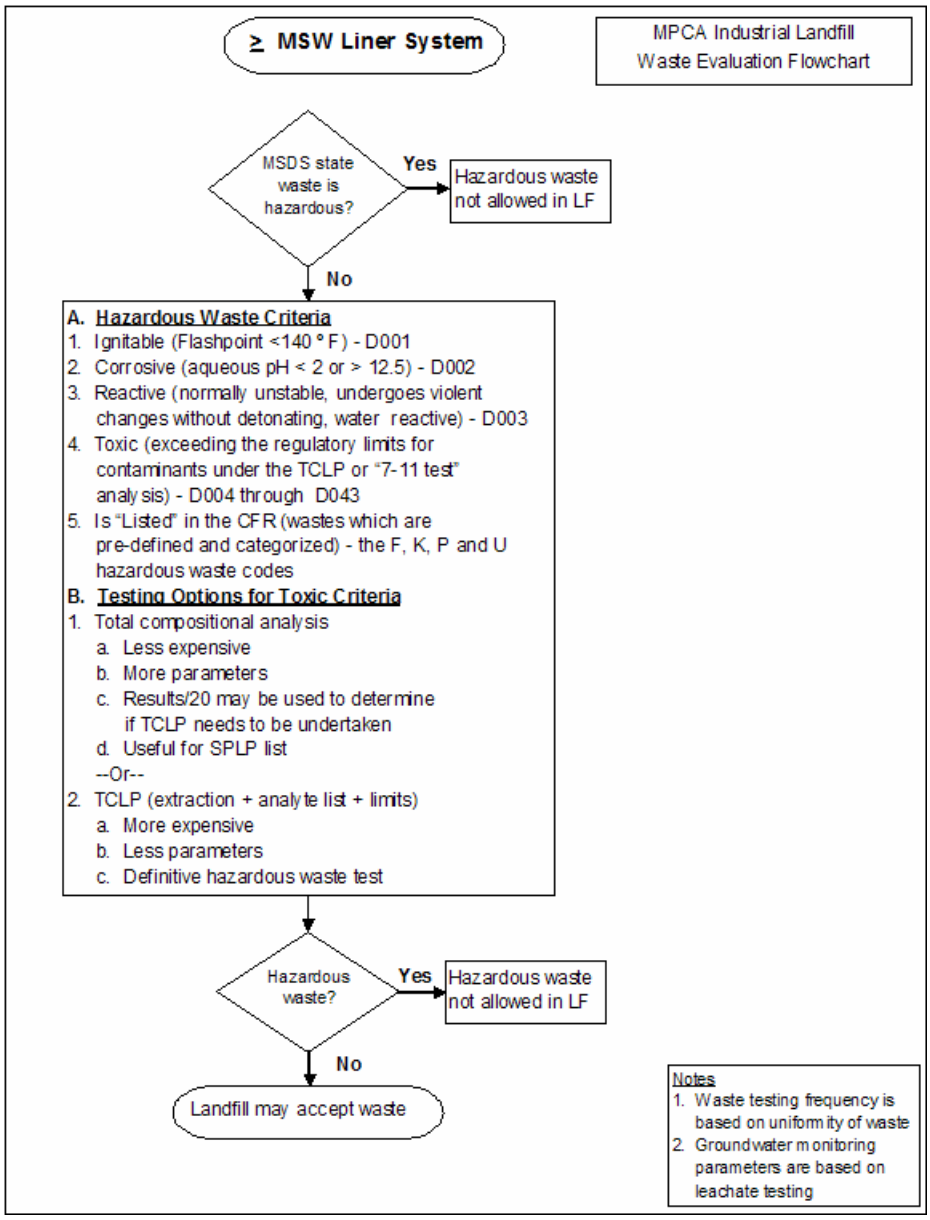
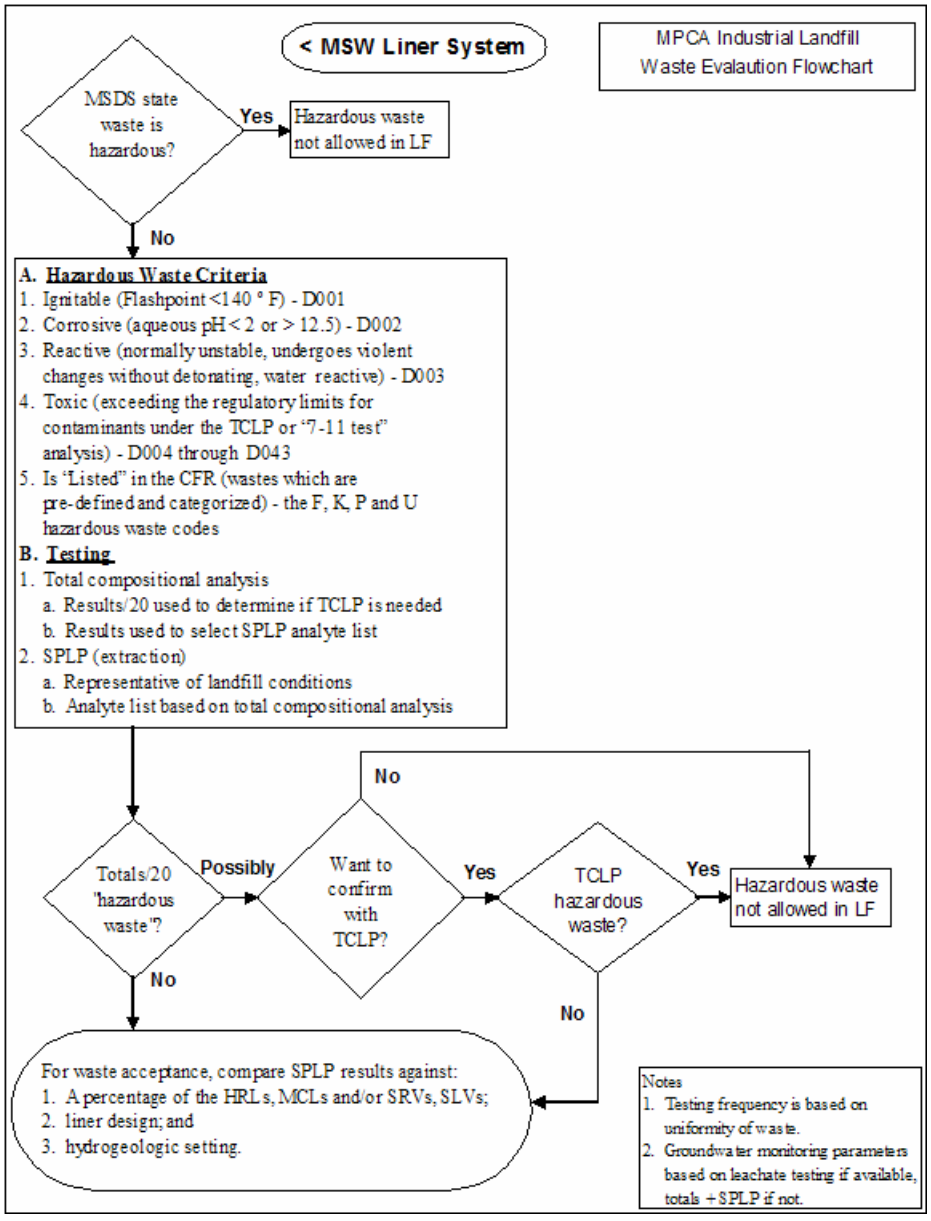


Figure 2: Waste evaluation for landfills with liner systems less than Municipal Solid Waste landfill design



V. Hydrogeologic Requirements for Industrial Landfills

The following Minnesota Rules currently apply to hydrogeologic requirements for industrial waste landfills:

> **7035.1700 REQUIRED PRACTICES FOR MAINTENANCE AND OPERATION OF INDUSTRIAL SOLID WASTE LAND DISPOSAL FACILITIES.**
> […]
> S. A water monitoring program must be constructed and operated to determine whether industrial solid waste or leachate therefrom is causing pollution of ground water or surface water. The drilling and construction of all site wells, including those used for monitoring purposes, must be done in compliance with chapter 4725.
> […]
>
> **7035.1800 A.2. PERMIT APPLICATION AND REQUIRED PLANS FOR AN INDUSTRIAL SOLID WASTE LAND DISPOSAL FACILITIES**
>
> The submitted plans must include the following: Site analysis including consideration of each item in part 7035.1600 along with data and supplementary reports, including soil boring data and a hydrogeologic study. Attention to this requirement must include consideration of surface features, underground formations, soil boring data from soil borings of which at least one is to a minimum depth of 50 feet below proposed excavation and lowest elevation of the facility, water table profile, direction of ground water flow, initial quality of water resources in the potential zone of influence of the facility, use of water resources in the potential zone of influence of the facility.

To reduce subjectivity, MPCA policy requires a formal Phase I through Phase IV Hydrogeologic Investigation for all new industrial waste landfills as is required for MSW landfills (Minn. R. 7035.2815, subps. 3 and 4). The required checklists for the work plans and reports are included in Appendix E below. During re-permitting of existing facilities, a formal Phase I through Phase IV investigation may be required depending on extent of the new fill area, and how much previous hydrogeologic work was undertaken at the facility.

Applied by policy and as described in Minn. R. 7035.2815, subp. 4, a groundwater compliance boundary must be established at the facility. As per Minn. R. 7035.2815, subp. 5, item C, the compliance boundary must be on the facility property, must completely surround the landfill, and cannot be more than 200 feet from the 10-year fill footprint. To facilitate monitoring and any potential future corrective actions unless otherwise approved by the commissioner, the permittee must maintain a minimum 200-foot setback from the fill and the property boundary.

VI. Engineered Controls

Engineered landfill control systems must be designed to reduce the risk of contaminant releases to the environment. Engineered landfill control systems include the following:

- Liner with leachate collection
- Liner leak detection
- Final cover
- Groundwater monitoring
- Gas collection

The MPCA considers factors such as waste type and leachate quality, hydrogeologic characteristics, and other site characteristics to determine the type of control systems required.

The design and construction of engineered controls are performed under the direction of licensed professional engineers, who must certify their design and construction. The engineered controls available to engineers are not static, but change over time as new technologies and products are developed and as knowledge improves concerning how liquid and contaminants move through these natural and engineered structures.

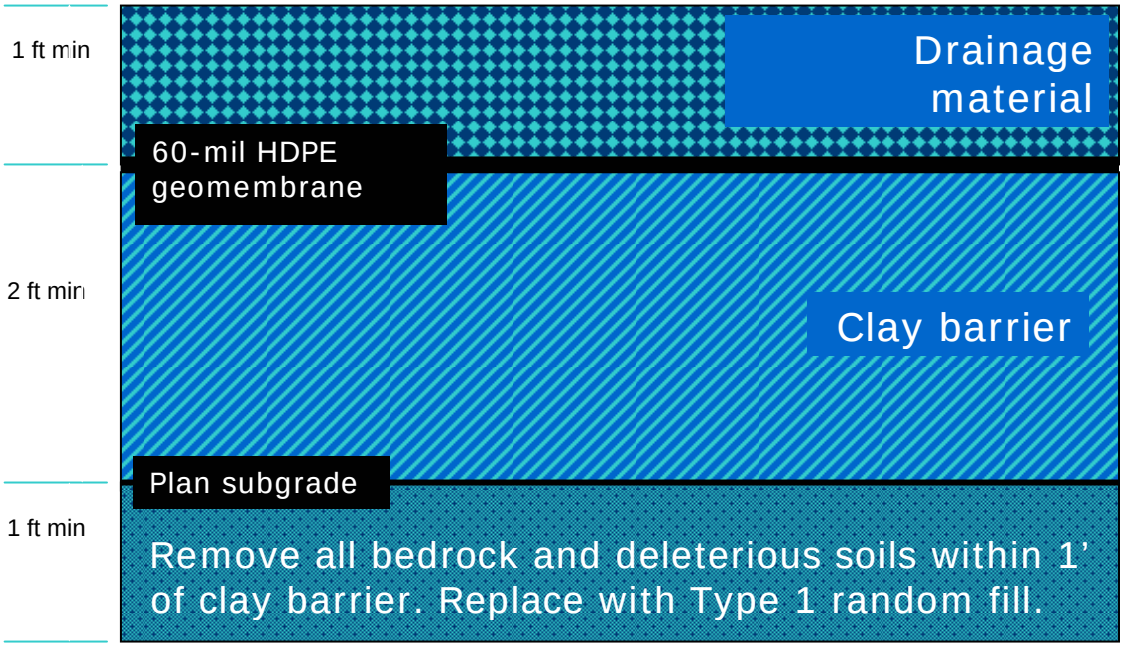
A. Liner systems

Industrial landfills accept a variety of waste types, and so the MPCA has approved a variety of liner designs (e.g., a single synthetic membrane, a composite MSW equivalent liner, and a double composite liner).

Unlike the MSW landfill rules, the industrial landfill rules (Minn. R. 7035.1700) do not prescribe the type of liner system needed for industrial landfills. In the absence of prescriptive industrial landfill liner design rules, the MPCA applies its MSW liner design criteria as a starting point for determining the appropriate engineering design for industrial landfill liners. The MPCA may however allow liner designs that are less protective than the MSW design, or may require a liner design that is more protective than the MSW design.

The two MSW landfill liners allowed by Minn. R. 7035.2815, subp. 7, item E are: 1) four feet of compacted clay, or 2) two feet of compacted clay with a 60-mil thick synthetic membrane (composite liner). See Figure 3 for the engineering detail drawing of a composite MSW liner design.

Figure 3: Typical Landfill Composite Liner System



Of the 17 current industrial landfills with engineered liners, 14 of them have liners that are equivalent in design or function to the MSW liner design prescribed by Minn. R. 7035.2815, subp. 7. The lime waste from sugar beet processing was permitted for disposal in former lime slurry ponds that were constructed with a compacted clay liner. The MPCA found this acceptable due to the nature of the fairly inert lime material, native soil types, depth to groundwater, and nearby receptors. Three demo-like industrial landfills have not been required to have engineered liners based on a case-by-case evaluation of site location, depth to groundwater, nearby receptors, soil types, and types of waste received.

The coal ash landfills and paper mill landfills have generally installed MSW-equivalent liners. In some cases, the MPCA has allowed geosynthetic clay liners (GCL) as an acceptable replacement for up to two feet of compacted clay due to the homogenous nature of the coal ash and of the paper mill sludge and due to the associated minimal risk of puncturing the geomembrane and the GCL during waste placement. In addition, the GCL may provide a lower permeability than the compacted clay and has been demonstrated to be compatible with coal ash and paper mill sludge leachate.

When the MPCA has allowed GCL in lieu of two feet of clay, the MPCA has required the electro-resistivity test (ASTM Method 6747-04) on the installed liner system following the placement of the sand drainage layer. This test method has proven effective for locating construction-related holes in geomembranes. In some cases, the MPCA may require a two-foot sand drainage layer to protect the integrity of the GCL composite liner when the sand drainage layer is put in place.

The MPCA has posted several fact sheets on its web page (www.pca.state.mn.us/waste/pubs/solidwaste.html) as a means of providing guidance on industrial landfill design (see also Appendix A). The following links contain documents that provide more information on the design and construction of industrial landfills:

- Guidance for Liner Design for Demolition Debris or Industrial Solid Waste Landfills (www.pca.state.mn.us/publications/w-sw5-02.pdf)
- Guidance for Soil Construction Standards and Testing Frequencies – Landfill Cell Construction (www.pca.state.mn.us/publications/swguidance-finalcoverconstruction.pdf)
- Guidance for Industrial Waste Management Evaluation Model (IWEM) (www.pca.state.mn.us/publications/w-sw5-03.pdf).

B. Leachate management systems

Engineered liners at industrial landfills are sloped to a low point where the leachate is removed from the liner system via gravity or pumps. It may be possible to manage landfill leachate by conveying it to a permitted sanitary sewer, or by on-site management that includes land application, recirculation, spraying it back over the working face for dust control, or possibly even a permitted surface water discharge.

The method selected for leachate treatment is usually based on the chemistry of the leachate, economics, and personal choice. Some industrial landfills discharge leachate directly to the city sanitary sewer system where it is piped to the local wastewater treatment facility. Other industrial landfills pump their leachate to a storage tank or holding pond prior to trucking the leachate to a nearby wastewater treatment facility and/or spray irrigating the leachate back onto the waste for dust control. Spraying for dust control has been employed at coal ash disposal facilities throughout the state.

A distinction may be made on leachate recirculation, where leachate collected from the base of the landfill is re-injected back into the waste through perforated pipes buried within the waste, or sprayed on top of wastes for dust control. There may be benefits to leachate recirculation at landfills including accelerated biodegradation of wastes which leads to increased gas generation, waste compaction, and faster reduction/stabilization of leachate strength during open life/early stages of closure.

Land application and recirculation has been used at MSW landfills, but has not yet been used at industrial landfills. On-site leachate management may be preferable to other methods of managing leachate and so should be considered. On-site leachate treatment including recirculation must be formally evaluated when permitting or re-permitting an industrial landfill.

Carefully spraying leachate on top of wastes (well within the footprint, considering wind direction and speed) for dust control especially for coal ash may be an acceptable leachate management practice, but as with all these methods requires MPCA approval.

More detail on the leachate collection system design can be found by referencing the MSW landfill liner design requirements and by referring to the guidance documents mentioned above. Guidance documents and/or Program Management Decisions are available on the MPCA web site (see below) for managing landfill leachate.

- Land Treatment of Landfill Leachate: www.pca.state.mn.us/waste/pubs/solidwaste.html
- Alternative Leachate Management: www.pca.state.mn.us/waste/pubs/solidwaste.html

C. Liner leak detection systems

Industrial landfill liner leak detection systems consist of lysimeters constructed under the lowest elevation of an area of a cell or a fill phase (below the leachate collection sump) and groundwater monitoring systems. A lysimeter constructed under the sump serves to monitor the area of the landfill with the highest leachate head, for any leaks through the liner system. The bottom liner of a dual liner system also serves as a leak detection system for the upper liner. Groundwater monitoring systems are used to detect leachate migration from the lined area.

D. Caps/cover systems

Final cover systems for industrial landfills are not prescribed in the Minnesota industrial landfill rules. As such, the MSW landfill standards are also used as a starting point for designing industrial landfill cover systems (see Minn. R. 7035.2815, subp. 6). The majority of the final cover designs at industrial landfills utilize a geomembrane in the barrier layer. Depending on the landfill, elements of demolition debris landfill cover systems may also be considered for industrial landfills.

The following link contains several documents that should be referenced for more information on industrial landfill covers: www.pca.state.mn.us/waste/pubs/solidwaste.html. The documents of interest on this page are the following:

- Guidance for Final Cover for Demolition Debris Landfills, www.pca.state.mn.us/publications/w-sw5-08.pdf
- Guidance for Soil Construction Standards and Testing Frequencies – Final Cover Construction, www.pca.state.mn.us/publications/swguidance-finalcoverconstruction.pdf
- Landfill Slope Guidance, www.pca.state.mn.us/publications/reports/solidwaste-pmd-landfillslope.pdf

E. Gas management systems

The generation of landfill gas is an issue at industrial landfills that dispose of wastes that contain organic material. For example, gas collection systems have been installed at paper mill sludge landfills. When permitting or re-permitting an industrial landfill, the MPCA requires the applicant to submit an estimation of gas generation rates. If the MPCA determines that significant levels of gas will be generated, proper gas management (monitoring and mitigation) must be incorporated into the landfill design.

F. Construction quality assurance/quality control

The MPCA requires proper QA/QC that includes thorough, independent construction oversight during all phases of landfill construction and after construction. A section detailing proposed QA/QC needs to be included with the permit application documents. The MPCA requires testing to confirm that the materials used for construction meet the design specifications.

Liner leak location testing is advised for all geomembrane liner systems, and must be performed via electro-resistivity testing on landfills having single membrane or membrane/GCL composites (see ASTM Method 6747-04). Electro-resistively testing is needed because it has been proven effective for locating construction-related holes in liners. Due to current method limitations the upper liner of a double liner system is exempt from this requirement. For liner testing, see http://www.pca.state.mn.us/publications/w-sw5-07.pdf.

VII. Other Permits

In addition to obtaining a solid waste management permit from the MPCA, other permits may be required for industrial landfill projects. Examples of other permits that may be required include:

- MPCA stormwater permits (industrial stormwater permits and/or construction stormwater permits)
- MPCA air emissions permits
- MPCA water quality permits for leachate treatment and disposal (if chosen)
- Wetlands permits from the U.S. Army Corps of Engineers, the Department of Natural Resources, local soil and water conservation districts, counties, etc.
- Other local unit of government land use permits

Part of the permitting process typically includes MPCA providing some measure of technical assistance to local units of government. To the greatest extent possible, the MPCA waits until local approvals are complete, prior to issuing or re-issuing landfill permits.

VIII. Operational Practices

A. Operations Manual

The MPCA requires each industrial landfill to include an operations manual (OM) with its permitting documents. There are many benefits to be gained from a properly operated and maintained landfill. The potential benefits include reduced potential impact on air, land, and water; reduced impact on adjacent property; reduced operational costs; extended site life; reduced claims and liabilities; reduced conflict with regulatory agencies; good public relations; and customers that return for business.

Waste disposal and operational practices at different industrial landfills may vary considerably. Operational practices for industrial landfills are prescribed in Minn. R. 7035.1700. If not otherwise prescribed in the rules, the following items must also be included in the OM: facility description, site access, site preparation and development, hours of operation, site security, waste screening/inspection of wastes, waste handling and placement, size of the working face, compaction, cover material, phase development, surface water management, dust control, equipment maintenance, operation training, annual survey, self inspections, operating record, household hazardous waste, and an emergency plan.

B. Monitoring

The MPCA requires applicants to submit for approval sampling and analysis plans that encompass groundwater, leachate, and potentially landfill gas.

The applicant must install monitoring wells at the facility in locations based on the groundwater flow direction established in the hydrogeologic investigation. Down-gradient wells should be placed within the property boundary, but not more than 200 feet from the edge of the waste fill area. Monitoring wells need to be horizontally and vertically located based on site-specific conditions.

Required routine groundwater sampling typically consists of Spring, Summer, and Fall events. This sampling is in addition to the initially required baseline sampling. Monitoring parameters include a parameter list based on typical groundwater analyte lists, and/or parameters that are more specific to the waste type(s).

The MPCA typically requires quarterly leachate sampling for usual leachate parameters and/or parameters that are more specific to the waste type(s). Gas sampling is dictated by waste types when required.

IX. Financial Assurance

A. Introduction to financial assurance

In the Minnesota budget bill passed in May 2008, the following sentence was included: "The rules for the disposal of solid waste...shall also include modifications to financial assurance requirements under subdivision 4h that ensure the state is protected from financial responsibility for future groundwater contamination."

More prescriptive financial assurance (FA) rules were being developed at the time this guidance was written and when the FA rule revision has been completed, this section of the guidance will be revised accordingly.

"Financial assurance" is essentially establishing, maintaining, and using various financial mechanisms to cover the costs of landfill closure, post closure, and contingency actions. The MPCA uses FA as a tool to ensure that money is available for landfill work required to protect the environment and public health in the event that a landfill owner fails to undertake necessary actions.

Current industrial solid waste land disposal rules are not explicit regarding FA requirements. However, the industrial rules under Minn. R. 7035.1800 do require compliance with permit conditions. The MPCA uses its authority under Minn. R. 7001.0150 to issue permits that require FA. Currently, only facilities that have liners, active gas management, or other design features necessary to protect the environment have been required to have FA as a special permit condition.

To ensure that adequate funds are set aside to address future problems, all industrial landfills must evaluate, and establish some form of MPCA-approved FA for closure, post closure, and contingency actions. This is because even for the more benign industrial wastes, contingencies such as large-scale landfill slumping has occurred.

B. Financial assurance mechanisms

Minnesota Rules provide several mechanisms to meet the FA permit requirements. They are trust funds, surety bonds guaranteeing payment into a trust fund, self-insurance, and letters of credit. For the self-insurance option, the company operating the landfill must submit a detailed financial statement that proves that there is sufficient cash on hand to cover contingency and closure costs.

According to MPCA data, currently there are 20 industrial landfills in Minnesota. Of those, the MPCA has required 12 to have FA. The 12 facilities have a total of $47.7 million in MPCA-approved FA. The range in FA is from $1.1 million to $7 million. Industrial landfills with trust funds have cash in interest-bearing accounts. This form of FA is clearly more secure in protecting the state's future liability, since the funding is already allocated and would not be impacted by bankruptcies, etc. Initially, the FA might be in the form of bonds, but as deposits are made into the trust fund, the facility would draw down the amount bonded for.

C. Closure requirements

The requirements for estimating the level of FA needed for closed solid waste facilities are found in Minn. R. 7035.2685. Accurate FA calculations and funds must be up-to-date when the permittee closes the facility. For closure, the cost estimate is usually based on an itemized breakdown for closure of the most costly closure phase (typically the largest open area).

D. Post-closure requirements

Minn. Stat. 116.07, subd. 4h requires industrial facilities to establish FA for closure, and a 20-year post-closure care (PCC) period. During the PCC period, money can be drawn down from the account to pay for on-going maintenance activities, or larger scale problems, such as groundwater contamination. This money, however, is not directly replaced.

As such, at the end of the PCC period, no money may be left for any activities beyond the PCC period. Moreover, if any FA money remains after the PCC period ends, landfill owners would like to recover it. If groundwater monitoring is discontinued past the 20-year PCC period, groundwater contamination may occur that is undetected and uncorrected, human health and the environment may be imperiled, and there may not be any funds set aside to address the problem. The legislatively-mandated FA rule making process will address these issues, and this guidance will be then be revised accordingly.

E. Financial assurance and contingency actions

Estimates need to be provided for various contingencies that include the following:

- Leachate and/or waste spills;
- Structural, subsurface, and/or grass fires;
- Vandalism;
- Leachate seeps;
- Erosion of surface drainage system or soil cover;
- Major final cover damage;
- Major liner damage;
- Gas migration, mitigation;
- Exceedance of groundwater standards;
- Exceedance of leachate standards; and
- Unintended acceptance of hazardous waste.

Depending on the landfill design, operations, and the time scale being considered, the probability of incurring a major contingency action may or may not decline over time. If the company is viable when a contingency happens, the company needs to fund it out of pocket and not out of the contingency fund, but the company may ask for a reimbursement.

F. Administration of financial assurance

Realistic cost estimates need to be proposed by the permittee, and are then reviewed by the MPCA. Cost estimates need to be based on the work being conducted by a third party. These FA estimates must be included in the permit application, and must be updated with the annual report to account for inflation and cost of money.

PCC FA money is set aside specifically to address future problems with a facility that generated money from the waste to begin with. If a contingency action draws down an account subsequent to closure, the permittee will need to re-fund the account. There is no release of FA obligations, and under the state/federal superfund programs (joint and several liability) everyone is liable (parent corporations and potentially all contributors).

X. Post-Closure Care

"Post closure" and "post-closure care" mean actions taken for the care, maintenance, and monitoring of a facility after closure that will prevent, mitigate, or minimize the threat to public health and environment posed by the closed facility (see Minn. R. 7035.0300, subp. 82.). The requirements for post closure of a solid waste facility are found in Minn. R. 7035.2645.

In 1993, the MPCA adopted the EPA's 30-year PCC period for MSW landfills that are regulated under 40 CFR pt. 258. Prior to this requirement, all landfills were required to undergo a 20-year PCC period. Minnesota landfills that are not subject to regulation under 40 CFR pt. 258 (including industrial landfills) are still subject to the 20-year PCC period.

Permitted solid waste landfills in Minnesota must prepare a PCC plan, and may also need to set aside adequate FA money for future cover repair, groundwater and gas monitoring and mitigation, and leachate collection and treatment.

When a solid waste facility closes, a certification that the facility has been properly closed in accordance with the rule requirements must be submitted to the MPCA for review and approval. At the end of the PCC period, some or all of the requirements included in the closure document may be increased, decreased, or terminated.

Several Minnesota Rules relate to the PCC period, and the following summarizes what must be undertaken during the PCC period of landfills:

- restrict access to the facility
- make repairs to the final cover
- operate, maintain, and monitor the gas and groundwater systems
- continue to operate the leachate collection and removal system
- prevent run-on and run-off from damaging the final cover
- protect and maintain surveyed benchmarks
- survey the facility at least annually to determine the extent of settling or other events
- submit an annual report to the commissioner
- complete repair work within 30 days of discovery

The MPCA currently has no set criteria for terminating PCC requirements, and needs to further consider these issues, including what controlling documents should be used, and refining the decision-making criteria. Similarly to other states, it is suggested at minimum that at the end of the PCC period a certified PCC termination report be submitted to the MPCA that addresses all of the issues relating to the facility.

XI. Summary and Conclusions

This guidance document is intended to provide clarification and reduce subjectivity with respect to the industrial solid waste landfill rules. More prescriptive rules on hydrogeologic sensitivity and FA are being developed as of the publication of this document. Once these rules are promulgated, this guidance document will be revised accordingly.

Appendix A

Table of suggested references

- The U.S. EPA industrial waste landfill guide: http://www.epa.gov/epawaste/nonhaz/industrial/guide/index.htm
- MPCA main page of guidance: http://www.pca.state.mn.us/waste/pubs/solidwaste.html
- *Report to Minnesota Legislature on Management of Industrial Solid Waste and Construction and Demolition Debris in Land Disposal Facilities* http://www.pca.state.mn.us/publications/lrw-sw-1sy09.pdf
- Financial assurance fact sheet: http://www.pca.state.mn.us/publications/w-sw3-25.pdf
- Financial assurance management decision: http://www.pca.state.mn.us/publications/reports/solidwaste-pmd-financialassurance.pdf
- Liner design guidance for industrial landfills: http://www.pca.state.mn.us/publications/w-sw5-02.pdf
- Liner soil construction standards and testing frequencies: http://www.pca.state.mn.us/publications/w-sw5-07.pdf
- Cover soil construction standards and testing frequencies: http://www.pca.state.mn.us/publications/swguidance-finalcoverconstruction.pdf
- Guidance for the use of the IWEM model which is related to the link for the EPA: industrial waste manual http://www.pca.state.mn.us/publications/w-sw5-03.pdf
- Slope guidelines (mostly apply to industrial landfills): http://www.pca.state.mn.us/publications/reports/solidwaste-pmd-landfillslope.pdf
- Industrial Solid Waste Management Plan guidance: http://www.pca.state.mn.us/publications/w-sw3-36.doc
- U.S. Congress General Accounting (now "Accountability") Office (GAO, 1990), in the Executive Summary of its report, "Funding of Post-closure Liabilities Remains Uncertain," under a section labeled "Funding Mechanisms Questionable"

Appendix B

Industrial Landfill Guidance Implementation Plan

Introduction

This appendix serves as the implementation plan (plan) for the guidance. The plan explains that the guidance applies to proposed, new facilities as well as to existing facilities. This document will be used to guide the MPCA decision-making process. Occasionally, decisions will be made that fall outside of the general guidelines described in this guidance. This level of flexibility is necessary to effectively make decisions for the wide variety of situations that exist across the state.

Proposed facilities – Initially, for new, proposed facilities, a site evaluation will be done to determine the overall hydrogeologic characteristics. For most industrial landfills, the extent of the overall hydrogeologic investigation will be the same as required for mixed municipal landfills. These requirements are found in Minn. R. 7035.2815, subps. 3 and 4.

Existing facilities – Existing facilities will be reviewed per the guidance as current permits expire. Similar to what is done for proposed facilities, existing facilities will be evaluated in terms of location standards, depth to groundwater, soil types, types of waste received, FA, nearby receptors, etc., as described above.

For facilities that may wish to change their operations or provide for changing waste types before their current permit expiration date, a major or minor modification permit modification may be done after receipt of the new ISWMP, which, if approved, would allow the facilities to receive other waste types.

MPCA hydrologist and engineering forums – Proposed and existing sites may be peer reviewed at MPCA hydrologist forums. The purpose of the forums will be to discuss site conditions, facility classification, and unique site features that may create special concerns, past decisions on similar sites, etc. The forum process will help ensure that evaluations are done in a more consistent manner. The engineering staff hold similar forums at which technical issues related to solid waste permits are discussed, in order to help set more consistent permit conditions on a statewide basis.

Electronic data – Groundwater monitoring data must be submitted electronically. The MPCA intends to make these data available to owners and operators through the MPCA's web site at a future date. This will enable owners and operators to easily track and view the data.

Training – The MPCA will incorporate the relevant portions of this guidance into the Demolition Landfill Operator Certification Training.

Appendix C

Groundwater Sensitivity: Minnesota Statute Section 116.07, Subdivision 4, as amended (extract of pertinent language, 2008)

The rules for the disposal of solid waste shall include site-specific criteria to prohibit solid waste disposal based on the area's sensitivity to groundwater contamination, including site-specific testing. The rules shall also include modifications to financial assurance requirements under subdivision 4h that ensure the state is protected from financial responsibility for future groundwater contamination. Until the rules are modified to include site-specific criteria to prohibit areas from solid waste disposal due to groundwater contamination sensitivity, as required under this section, the agency shall not issue a permit for a new solid waste disposal facility, except for:

(1) the re-issuance of a permit for a land disposal facility operating as of March 1, 2008;

(2) a permit to expand a land disposal facility operating as of March 1, 2008, beyond its permitted boundaries, including expansion on land that is not contiguous to, but is located within 600 yards of, the land disposal facility's permitted boundaries;

(3) a permit to modify the type of waste accepted at a land disposal facility operating as of March 1, 2008;

(4) a permit to locate a disposal facility that accepts only construction debris as defined in section 115A.03, subdivision 7;

(5) a permit to locate a disposal facility that:

(i) accepts boiler ash from an electric energy power plant that has wet scrubbed units or has units that have been converted from wet scrubbed units to dry scrubbed units as those terms are defined in section 216B.68;

(ii) is on land that was owned on May 1, 2008, by the utility operating the electric energy power plant; and

(iii) is located within three miles of the existing ash disposal facility for the power plant; or

(6) a permit to locate a new solid waste disposal facility for ferrous metallic minerals regulated under Minnesota Rules, chapter 6130, or for nonferrous metallic minerals regulated under Minnesota Rules, chapter 6132.

Appendix D

Selected Analytical Parameters, Method Numbers and Reporting Limits, and Comparison of Total Constituent Analysis Instead of TCLP Analysis

The following tables list current analytical methods and associated reporting limits (RLs) in milligrams per kilogram (unless stated otherwise) for various analytical parameters.

Methods and reporting limits shown below are current as of date of guidance publication (source EPA SW-846). The reporting limits provided below should be met, but alternative (equivalent) methods and detection limits may be approved by the MPCA.

Method Reference Abbreviations	Method Reference
SW 846	Test Methods for Evaluating Solid Waste; U.S. EPA SW-846, use the most current version certified by the Minnesota Department of Health.
MDH	Minnesota Department of Health; Method 465D
Other Abbreviations and Flags EPA	Definition includes Environmental Protection Agency Methods from 40 CFR 136, NPDES, 500 Series, SDWA, or SW-846
PQL	Practical Quantitation Limit
RL	Reporting Limit (estimated)
NLPQL	Not Listed in the method reference document(s) Practical Quantitation Limit
?RL	PQL unknown Reporting Limit (estimated)
{ }NLOther Abbreviations and Flags	Parameters shown between these brackets are not specifically addressed in the Example Sampling Protocol and/or may require a separate container or different preservation requirements than other parameters in its group. Not Listed in the method reference document(s)
N/A?	Not applicable PQL unknown
mV{ }	millivolts Parameters shown between these brackets are not specifically addressed in the Example Sampling Protocol and/or may require a separate container or different preservation requirements than other parameters in its group.
NTUN/APQL	Nephelometric Turbidity Units Not applicable Practical Quantitation Limit
Deg. CmVRL	Degrees Celsius millivolts Reporting Limits (estimated)
Deg. C?	Degrees Celsius PQL unknown
{ }	Parameters shown between these brackets are not specifically addressed in the Example Sampling Protocol and/or may require a separate container or different preservation requirements than other parameters in its group
NTU	Nephelometric Turbidity Units
Deg. C	Degrees Celsius
Asterisk *	An asterisk "*" denotes a method detection limit (MDL) or an estimated detection limit.
Last revised: 12 May 2009	
Units in milligrams per kilogram unless otherwise stated	

TRACE METALS	ICP		ICP-MS	
	SW-846	RL*	SW-846	RL*
Aluminum	6010	15	6020	
Antimony	6010	7.5	6020	0.50
Arsenic (1)	6010	5.0	6020	1.8
Barium (1)	6010	2.0	6020	
Beryllium	6010	0.75	6020	0.25
Boron	6010	2.5		
Cadmium (1)	6010	5.0	6020	0.25
Chromium, total (Cr+4 and Cr+6) (1)	6010	5.0	6020	1.3
Chromium VI: see below				
Cobalt	6010	1.3	6020	
Copper	6010	2.5	6020	
Iron	6010	5.0	6020	
Lead (1)	6010	5.0	6020	0.50
Magnesium	6010	2.5	6020	
Manganese	6010	5.0	6020	
Mercury(1) (SW-846 Method 7471A), PQL = 0.2				
Molybdenum	6010	13		
Nickel	6010	2.5	6020	
Selenium (1)	6010	5.0	6020	2.3
Silver (1)	6010	2.5	6020	0.25
Strontium	6010	2.5	6020	0.25
Thallium	6010	13	6020	0.25
Tin	6010	2.5		
Titanium	6010	5.0		
Vanadium	6010	2.5	6020	
Zinc	6010	12	6020	
(1) Denotes TCLP metals				

* RLs at time guidance was developed, subject to change (source EPA SW-846)

VOLATILE ORGANICS	GC/MS SW-846	RL
Acetone	8260	1.0
Allyl Chloride	8260	0.50
Benzene (2)	8260	0.25
Bromobenzene	8260	0.25
Bromochloromethane	8260	0.25
Bromodichloromethane	8260	0.25
Bromoform	8260	0.25
Bromomethane (Methyl bromide)	8260	0.25
2-Butanone (MEK) (2)	8260	1.0
n-Butylbenzene	8260	0.25
sec-Butylbenzene	8260	0.25
t-Butylbenzene	8260	0.25
Carbon Tetrachloride (2)	8260	0.50
Chlorobenzene (2)	8260	0.25
Chloroethane	8260	0.50
Chloroform (2)	8260	0.25
Chloromethane (Methyl Chloride)	8260	0.25
2-Chlorotoluene	8260	0.25
4-Chlorotoluene	8260	0.25
Dibromochloromethane	8260	0.25
1,2-Dibromo3-chloropropane (DBCP)	8260	0.25
Dibromomethane (Methylene bromide)	8260	0.25
1,2-Dichlorobenzene	8260	0.25
1,3-Dichlorobenzene	8260	0.25
1,4-Dichlorobenzene (2)	8260	0.25
1,2-Dibromoethane (EDB)	8260	0.25
1,1-Dichloroethane	8260	0.25
1,2-Dichloroethane (2)	8260	0.25
1,1-Dichloroethene (2)	8260	0.25
cis-1,2-Dichloroethene	8260	0.25
trans-1,2-Dichloroethene	8260	0.25
Dichlorodifluoromethane (CFC-12)	8260	0.25
Dichlorofluoromethane	8260	0.25
Dichloromethane (Methylene chloride)	8260	0.25
1,2-Dichloropropane	8260	0.25
1,3-Dichloropropane	8260	0.25
2,2-Dichloropropane	8260	0.25
1,1-Dichloropropene	8260	0.25
cis-1,3-Dichloropropene	8260	0.25
trans-1,3-Dichloropropene	8260	0.25
Ethylbenzene	8260	0.25
Ethyl Ether	8260	0.25
Hexachlorobutadiene	8260	0.25
Isopropyl Benzene	8260	0.25
p-Isopropyltoluene	8260	0.25
Methyl tert-Butyl ether (MTBE)	8260	0.25
4-Methyl-2-pentanone (MIBK)	8260	0.25
Naphthalene (also see Semi-volatiles)	8260	0.25
n-Propyl Benzene	8260	0.25
Styrene	8260	0.25

VOLATILE ORGANICS	GC/MS SW-846	RL
1,1,1,2-Tetrachloroethane	8260	0.25
1,1,2,2-Tetrachloroethane	8260	0.25
Tetrachloroethene (PCE) (2)	8260	0.25
Tetrahydrofuran (THF)	8260	1.0
Toluene	8260	0.25
1,2,3-Trichlorobenzene	8260	0.25
1,2,4-Trichlorobenzene	8260	0.25
1,1,1-Trichloroethane	8260	0.25
1,1,2-Trichloroethane	8260	0.25
Trichloroethene (TCE) (2)	8260	0.25
Trichlorofluoromethane CFC-11	8260	0.25
1,2,4-Trimethylbenzene	8260	0.25
1,3,5-Trimethylbenzene	8260	0.25
1,2,3-Trichloropropane	8260	0.25
Trichlorotrifluoroethane	8260	0.25
Vinyl chloride (2)	8260	0.25
m-Xylene	8260	0.25
o-Xylene	8260	0.25
p-Xylene	8260	0.25
(2) Denotes TCLP volatiles		

SEMI- VOLATILE ORGANICS	GC/MS SW-846	RL
Acenaphthene	8270	0.33
Acenapthylene	8270	0.33
Aniline	8270	0.33
Anthracene	8270	0.33
Benzidine	8270	1.6
Benzo[a]anthracene	8270	0.33
Benzo[b]fluoranthene	8270	0.33
Benzo[k]fluoranthene	8270	0.33
Benzoic Acid	8270	1.6
Benzo[g,h,i]perylene	8270	0.33
Benzo[a]pyrene	8270	0.33
Benzyl Alcohol	8270	0.67
Butyl benzyl phthalate	8270	0.33
Bis(2-chloroethyl)ether	8270	0.33
Bis(2-chloroethoxy)methane	8270	0.33
Bis(2-chloroisopropyl)ether	8270	0.33
Bis(2-ethylhexyl)phthalate	8270	0.33
4-Bromophenyl phenyl ether	8270	0.33
Carbazole	8270	0.33
4-Chloroaniline	8270	0.67
4-Chloro-3-methylphenol	8270	0.67
2-Chlorophenol	8270	0.33
2-Chloronaphthalene	8270	0.33
4-Chlorophenyl phenyl ether	8270	0.33
Chrysene	8270	0.33

SEMI- VOLATILE ORGANICS	GC/MS SW-846	RL
Dibenzo[a,h]anthracene	8270	0.33
Dibenzofuran	8270	0.33
Di-n-butyl phthalate	8270	0.33
1,2-Dichlorobenzene	8270	0.33
1,3-Dichlorobenzene	8270	0.33
1,4-Dichlorobenzene (3)	8270	0.33
3,3'-Dichlorobenzidine	8270	0.67
2,4-Dichlorophenol	8270	0.33
2,6-Dichlorophenol	8270	0.33
Diethylphthalate	8270	0.33
2,4-Dimethylphenol	8270	0.33
Dimethyl phthalate	8270	0.33
4,6-Dinitro-2-methylphenol	8270	0.67
2,4-Dinitrophenol	8270	0.67
2,4-Dinitrotoluene (3)	8270	0.33
2,6-Dinitrotoluene	8270	0.33
Di-n-octyl phthalate	8270	0.33
1,2-Diphenylhydrazine (as Azobenzene)	8270	0.33
Fluoranthene	8270	0.33
Fluorene	8270	0.33
Hexachlorobenzene (3)	8270	0.33
Hexachlorobutadiene (3)	8270	0.33
Hexachlorocyclopentadiene	8270	0.33
Hexachloroethane (3)	8270	0.33
Indeno(1,2,3-cd)pyrene	8270	0.33
Isophorone	8270	0.33
2-Methylnaphthalene	8270	0.33
2-Methylphenol (3)	8270	0.33
3-Methylphenol (3)	8270	0.33
4-Methylphenol (3)	8270	0.33
Naphthalene (also see Volatile list)	8270	0.33
2-Nitroaniline	8270	0.67
3-Nitroaniline	8270	0.67
4-Nitroaniline	8270	0.67
Nitrobenzene (3)	8270	0.33
2-Nitrophenol	8270	0.33
4-Nitrophenol	8270	0.67
N-Nitrosodimethylamine	8270	0.33
N-Nitrosodi-n-propylamine	8270	0.33
N-Nitrosodiphenylamine	8270	0.33
Pentachlorophenol (3)	8270	0.67
Phenanthrene	8270	0.33
Phenol	8270	0.33
Pyrene	8270	0.33
Pyridine (3)	8270	0.67
2,3,4,6-Tetrachlorophenol	8270	0.33
1,2,4-Trichlorobenzene (also see Volatiles)	8270	0.33
2,4,5-Trichlorophenol (3)	8270	0.33
2,4,6-Trichlorophenol (3)	8270	0.33

(3) Denotes TCLP semi-volatiles

Organochlorine Pesticides

Aldrin	8081	0.04
Chlordane, alpha (4)	8081	0.04
Chlordane. Gamma (4)	8081	0.04
Chlordane, technical (4)	8081	1.0
4,4'-DDD	8081	0.04
4,4'-DDE	8081	0.04
4,4'-DDT	8081	0.04
Dieldrin	8081	0.04
Endosulfan I	8081	0.04
Endosulfan II	8081	0.04
Endosulfan sulfate	8081	0.04
Endrin (4)	8081	0.04
Endrin aldehyde	8081	0.04
Endrin ketone	8081	0.04
a-BHC	8081	0.04
b-BHC	8081	0.04
d-BHC	8081	0.04
g-BHC (Lindane) (4)	8081	0.04
Heptachlor (4)	8081	0.04
Heptachlor epoxide (4)	8081	0.04
Methoxychlor (4)	8081	0.08
Toxaphene (4)	8081	1.0

(4) Denotes TCLP pesticide

Acid Herbicides

2,4-D (2,4-Dichlorophenoxyacetic acid) (5)	8151	0.0011
Chloramben (Amiben)	8151	0.040
MCPA	8151	0.43
MCPP (Mecoprop)	8151	0.66
Pentachlorophenol	8151	0.0016
2,4,5-TP (Silvex) (5)	8151	0.0028

(5) Denotes TCLP acid herbicide

Comparison of Total Constituent Analysis Instead of TCLP Analysis

From U.S. EPA: http://www.epa.gov/osw/hazard/testmethods/faq/faq_tclp.htm

Question: Is it acceptable to perform a total constituent analysis instead of a TCLP analysis and then divide the total concentration by 20 to determine if a waste is non-hazardous, as is implied in Section 1.2 of Method 1311, TCLP?

Answer: Section 1.2 of the TCLP *does* allow for a total constituent analysis in lieu of the TCLP extraction. If a waste is 100% solid, as defined by the TCLP method, then the results of the total constituent analysis may be divided by 20 to convert the total results into the maximum leachable concentration. This factor is derived from the 20:1 liquid-to-solid ratio employed in the TCLP. If a waste has filterable liquid, then the concentration of the analyte in each phase (liquid and solid) must be determined. The following equation may be used to calculate this value:

$$\frac{[A \times B] + [C \times D]}{B + [20\ (L/kg) \times D]} = E$$

Where:

A = Concentration of the analyte in liquid portion of the sample (mg/L)
B = Volume of the liquid portion of the sample (L).
C = Concentration of the analyte in solid portion of the sample (mg/kg)
D = Weight of the solid portion of the sample (kg)
E = Maximum theoretical concentration in leachate (mg/L)

The value obtained (E) can be used to show that the maximum theoretical concentration in a leachate from the waste could not exceed the concentration specified in the toxicity characteristic (TC) (40 CFR Section 261.24).

In addition, if the total constituent analysis results themselves are below the TC limits without dividing by 20, then the same argument holds true, i.e., the maximum theoretical concentration in the leachate could not exceed the TC limits.

Appendix E

Hydrogeologic Evaluation Completeness Checklists for Solid Waste Land Disposal Facilities from the Minnesota Pollution Control Agency, August 1991

Hydrogeologic Evaluation
Completeness Checklist
Minnesota Pollution Control Agency
Solid Waste Program

PHASE I
PRELIMINARY 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. R. pt. 7035.2815, subp. 3 and other subparts cited within subp. 3) 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.

A person with expertise in hydrogeology must sign the Phase I Report and certify the quality of the work.

Indicate on the blanks provided the page(s) of the document where the specified rule requirement is addressed.

Minn. R. pt. 7035.2815, subp. 3, item E; SONAR pages 334-338

1. Evaluation of previous investigations for the facility

MPCA Use	Page No.	
____	____	detailed description of the purpose and results of previous investigations
____	____	evaluation of the results and conclusions of previous investigations
____	____	evaluation of the quality, reliability and accuracy of previous investigative work
____	____	supportive maps and data
____	____	if applicable, history of waste acceptance and location of filled areas

2. Description of regional information

____	____	description of published sources of information used to describe the regional setting
____	____	regional description of the following areas:
____	____	* geologic history
____	____	* stratigraphic sequence
____	____	* soils
____	____	* topography
____	____	* vegetation

MPCA Use	Page No.	
____	____	* climate
____	____	* surface water hydrology
____	____	* area water use
____	____	* regional hydrogeologic setting
____	____	* groundwater occurrence at the site
____	____	* aquifers and aquitards
____	____	* hydrogeologic parameters
____	____	* recharge and discharge areas
____	____	* rates and directions of groundwater movement
____	____	* water quality
____	____	preparation of geologic columns or sections
____	____	development of cross sections oriented along and perpendicular to the direction of groundwater flow
____	____	supportive maps and data

3. Well inventory

____	____	identification of all residential wells within one mile of the site
____	____	identification of all high-capacity wells and community water supply wells within three miles of the site
____	____	well inventory including the following:
____	____	* survey of active, unused, and abandoned wells
____	____	* well logs and other information regarding well construction
____	____	* water levels and well usage
____	____	* review of state and local collections of water well records

4. Existing monitoring system

____	____	For existing facilities, evaluation of the existing monitoring system:
____	____	* adequacy of existing monitoring system
____	____	* compliance with chapter 4725, Minnesota Department of Health Water Well Construction Code
____	____	* water quality data

Definitions:

SONAR: MPCA Statement of Need and Reasonableness (1988). This document is the justification for the MPCA Solid Waste Management Rules.

Hydrogeologic Evaluation
Completeness Checklist
Minnesota Pollution Control Agency
Solid Waste Program

PHASE II
DETAILED SITE INVESTIGATION WORK PLAN

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. R. pt. 7035.2815, subp. 3 and other subparts cited within subp. 3) 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.

The previous phase report must be submitted before the subsequent phase work plan is reviewed. Before implementing the work plan, the previous phase report and the current phase work plan must be approved by the MPCA. For example, before the Phase II work plan is reviewed, the Phase I report must be submitted. The Phase II work plan cannot be approved until the Phase I report has been approved. A person with expertise in hydrogeology must sign each document and certify the quality of the work.

Indicate on the blanks provided the page(s) of the document where the specified rule requirement is addressed.

Minn. R. pt. 7035.2815, subp. 3, item F and subp. 10; SONAR pages 338-349 and 493-503.

1. Number, distribution, and depth of soil borings

MPCA Use	Page No.	
____	____	specific subsurface conditions likely to be encountered
____	____	borings distributed to define soil and groundwater conditions within at least the following areas:
____	____	* beneath proposed waste fill area and leachate management system
____	____	* sufficient distance beyond the waste fill and leachate management system to define hydrogeologic conditions that would control pollutant migration away from the facility
____	____	* areas in which potential corrective action would be implemented
____	____	* justification for chosen distribution
____	____	minimum required number of borings, or justification for fewer or more borings
____	____	estimated depth of soil borings
____	____	justification for chosen depths relative to Minn. R. pt. 7035.2815, subp. 3, item C(4)
____	____	delineation of perched saturated zones
____	____	sequence of drilling

2. Soil sampling, analysis, and classification

MPCA Use	Page No.	
____	____	Field Protocol
____	____	* sample collection: max 5' intervals and changes in soil type
____	____	* at least one boring continuously sampled for every 10 acres of proposed fill area
____	____	* sample collection ASTM method (or equivalent)
____	____	* sample preservation and transportation
____	____	* field classification by a person with expertise in hydrogeology
____	____	* boring log form
____	____	Laboratory Protocol
____	____	* rationale for selecting soil samples for laboratory testing
____	____	* laboratory classification
____	____	* particle size distribution
____	____	* porosity
____	____	* vertical permeability
____	____	* clay mineral content or cation exchange capacity

3. Piezometers

____	____	proposed locations and screened intervals, and supporting rationale
____	____	construction specifications/design diagrams
____	____	cleaning of well construction materials
____	____	development procedure
____	____	proposal for stabilization or recovery rate tests
____	____	survey for horizontal and vertical control
____	____	proposal to characterize fluctuations in hydraulic heads and vertical gradients
____	____	program to determine in-situ hydraulic conductivity
____	____	evaluation of the effects of pumping from nearby high-capacity wells
____	____	obtain appropriate permits from MDH
____	____	compliance with Minn. R. pt. 7035.2815, subp. 10, item R

4. Drilling and abandonment procedures

____	____	proposed drilling method(s)
____	____	cleaning of drilling tools and cables
____	____	method of abandonment for monitoring wells, piezometers, and borings

5. Well inventory

____	____	proposal to field-check the accuracy of the Phase I Well Inventory, and update the well inventory, if necessary

6. Other, if applicable

MPCA Use	Page No.	
____	____	proposed borehole or surface geophysical methods
____	____	proposed test pits
____	____	surface water investigation (elevation, flow rates, etc...)
____	____	spring and seep survey

7. Implementation of Work Plan

____	____	proposed schedule for field work

8. Phase II Detailed Site Investigation Report

____	____	description of items to be included in the Phase II report
____	____	estimated submittal date for the Phase II report

9. Maps, Tables, Figures

____	____	Base Map
____	____	* topography (2' contours)
____	____	* property boundary and facility boundary
____	____	* waste fill boundary (existing and/or proposed)
____	____	* on-site water supply wells, buildings, and other pertinent features
____	____	* existing and abandoned monitoring wells, piezometers, and soil borings
____	____	* proposed piezometers and soil borings
____	____	* surface water features within the facility boundary, including intermittent streams and wetlands
____	____	* existing surface water monitoring locations
____	____	* date the map was prepared
____	____	* accurate map scale (1"=200' or larger scale)
____	____	* north arrow
____	____	* legend
____	____	Map showing surface water features, including intermittent streams and wetlands, within ¼ mile of the facility
____	____	Soil Boring Table
____	____	* boring number
____	____	* proposed depth
____	____	* sequence of drilling
____	____	* purpose
____	____	Boring Log Form
____	____	Well Construction Diagram
____	____	Others as appropriate to illustrate ASTM procedures

Definitions:

SONAR: MPCA Statement of Need and Reasonableness (1988). This document is the justification for the MPCA Solid Waste Management Rules.

Hydrogeologic Evaluation
Completeness Checklist
Minnesota Pollution Control Agency
Solid Waste Program

PHASE II
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. R. pt. 7035.2815, subp. 3 and other subparts cited within subp. 3) 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.

Indicate on the blanks provided the page(s) of the document where the specified rule requirement is addressed.

Minn. R. pt. 7035.2815, subp. 3, item G, pages 117-118; SONAR pages 349-355

1. Description of soil/bedrock units & properties influencing water flow. Include in the discussion for each unit:

MPCA Use	Page No.	
____	____	texture and classification
____	____	particle size distribution
____	____	mineral composition, cementation, and soil structure
____	____	geologic structures (strike, dip, folding, jointing, etc. where applicable)
____	____	permeabilities, field and lab
____	____	porosity
____	____	any heterogeneity encountered: the type, scale, and frequency (i.e., lenses, voids, solution channels, fractures, layering)

2. Description of hydrologic units

____	____	thicknesses
____	____	hydraulic properties
____	____	role and effect of each as an aquifer, aquitard, perched saturated zone
____	____	actual or potential use as a water supply

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

MPCA Use	Page No.	
____	____	local, intermediate, and regional flow systems
____	____	identify groundwater recharge and discharge areas, other interactions of groundwater with surrounding surface waters (perennial or intermittent), facility impacts on recharge areas
____	____	existing or proposed groundwater and surface water withdrawals
____	____	the effect of heterogeneity/fractures on groundwater movement
____	____	directions of groundwater movement, include
____	____	* vertical and areal components
____	____	* specific discharge rates
____	____	* average linear velocities
____	____	seasonal or other temporal fluctuations in hydraulic head

4. Use of groundwater models (mathematical or analog), if applicable

____	____	describe the model, its capabilities and limitations
____	____	state all assumptions or approximations made
____	____	identify quantities/values derived from the model that are not confirmed by direct measurement (i.e., dispersivity, recharge)
____	____	evaluate the reliability and accuracy of the results (i.e., sensitivity analysis)

5. Environmental and public health impact analysis include:

____	____	potential and actual releases
____	____	projected paths and rates of movement of both water-soluble and low-solubility components of leachate
____	____	determine monitoring needs

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 predominant directions of groundwater flow
____	____	illustrate: the areal and vertical extent of soil/bedrock units, measured values of hydraulic head, equipotential lines and inferred groundwater streamlines
____	____	locations of soil and bedrock borings
____	____	locations and construction of piezometers and monitoring points
____	____	locations of any geophysical measurements used to prepare the cross sections

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

MPCA Use	Page No.	
____	____	date of boring
____	____	name and address of the driller and testing firms
____	____	drilling and sampling methods
____	____	surveyed elevation of the ground surface (MSL)
____	____	surveyed location referenced to permanent benchmarks
____	____	soil and rock classifications & narrative descriptions
____	____	contacts between strata/units, sample depths, blow counts, test data
____	____	observations during drilling
____	____	water level measurements
____	____	sealing procedures
____	____	any geophysical logs
____	____	signed by a person responsible for logging the boreholes
____	____	construction record of piezometers as required by Minn. R. pt. 7035.2815, 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:

SONAR: MPCA Statement of Need and Reasonableness (1988). This document is the justification for the MPCA Solid Waste Management Rules.

MSL: Mean Sea Level

Hydrogeologic Evaluation
Completeness Checklist
Minnesota Pollution Control Agency
Solid Waste Program

PHASE III
WATER MONITORING SYSTEM WORK PLAN

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. R. pt. 7035.2815, subp. 3 and other subparts cited within subp. 3) 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.

The previous phase report must be submitted before the subsequent phase work plan is reviewed. Before implementing the work plan, the previous phase report and the current phase work plan must be approved by the MPCA. For example, before the Phase III work plan is reviewed, the Phase II report must be submitted. The Phase III work plan cannot be approved until the Phase II report has been approved. A person with expertise in hydrogeology must sign each document and certify the quality of the work.

Indicate on the blanks provided the page(s) of the document where the specified rule requirement is addressed.

Minn. R. pt. 7035.2815, subp. 3, item H(1); SONAR pages 355-356

1. Proposed monitoring system

MPCA Use	Page No.	
____	____	Description of the proposed monitoring system
____	____	Monitoring point locations shown on a base map
____	____	Thorough evaluation of suitability of any monitoring points proposed for inclusion in the monitoring system:
____	____	* compliance with Minn. R. pt. 7035.2815, subp. 10
____	____	* yield representative water quality samples
____	____	* distinguish effects of leachate on the groundwater versus background quality
____	____	* allow early detection of contaminant release
____	____	* capable of determining composition, areal and vertical extent, concentration distribution, and highest concentrations of pollutants

MPCA Use	Page No.	
____	____	* capable of determining compliance with groundwater performance standards in Minn. R. pt. 7035.2815, subp. 4
____	____	* compliance with Minnesota Department of Health Water Well Construction Code
____	____	Monitoring well design and installation procedures
____	____	* proposed locations and screened intervals, and supporting rationale
____	____	* construction specifications/design diagrams
____	____	* cleaning of well construction materials
____	____	* development procedure
____	____	* proposal for stabilization or recovery-rate tests
____	____	* survey for horizontal and vertical control
____	____	* proposal for soil sampling (Minn. R. pt. 7035.2815, subp. 10, item Q)
____	____	* obtain appropriate permits from Minnesota Department of Health
____	____	* compliance with Minn. R. pt. 7035.2815, subp. 10, item C
____	____	Newly proposed surface water monitoring point construction
____	____	* proposed method for stage or flow measurements

2. Explanation of how the water monitoring system addresses the hydrogeologic conditions identified in previous investigations, including but not limited to:

____	____	The Phase I Preliminary Investigation Report
____	____	The Phase II Detailed Site Investigation Report

3. Preliminary version of the monitoring protocol (See also Phase IV Work Plan)

____	____	Determination of initial water quality (baseline)
____	____	Qualifications of samplers
____	____	Laboratory analytical methods to be used
____	____	Preliminary field protocol
____	____	* monitoring point locations, elevations, and order of sampling
____	____	* all tests, measurements, and procedures needed at each monitoring point and order to be carried out
____	____	* measurement of water elevation prior to sampling or evacuation
____	____	* procedures for evacuation before sampling
____	____	* procedures for field filtration of samples
____	____	* procedures for sample preservation
____	____	* equipment and containers to be used and cleaning between samples

MPCA Use	Page No.	
____	____	* use of blanks, standards, and other quality control procedures
____	____	* quality control procedures to identify sources of contamination during transport and handling
____	____	* chain of custody procedures
____	____	* record of procedures, measurements, and condition of monitoring point
____	____	* procedures for sampling surface water monitoring points and leachate if required, including locations and depths

4. Implementation of Work Plan

____	____	Proposed schedule for field work

5. Phase III Water Monitoring System Report

____	____	Description of items to be included in the Phase III report
____	____	Estimated submittal date for Phase III report

Definitions:

SONAR: MPCA Statement of Need and Reasonableness (1988). This document is the justification for the MPCA Solid Waste Management Rules.

Hydrogeologic Evaluation
Completeness Checklist
Minnesota Pollution Control Agency
Solid Waste Program

PHASE III
WATER MONITORING SYSTEM 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. R. pt. 7035.2815, subp. 3 and other subparts cited within subp. 3) 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 Water Monitoring System Work Plan and completion of the approved work, the Water Monitoring System Report is submitted. A person with expertise in hydrogeology must sign the report and certify the quality of the work.

Indicate on the blanks provided the page(s) of the document where the specified rule requirement is addressed.

Minn. R. pt. 7035.2815, subp. 3, item H(2) and subp. 10; SONAR pages 355-356 and 487-504

1. Monitoring point construction and installation records

MPCA Use	Page No.	
____	____	Accurate and detailed record of soil or rock types encountered while installing a monitoring point. The record must be logged and completed by a person with expertise in hydrogeology (refer to Phase II work plan checklist, Item 3: Soil sampling, analysis, and classification).
____	____	Construction Record which includes:
____	____	* copy of the "Water Well Record" (the unique well number on this form must be legible and complete)
____	____	* well development record
____	____	* stabilization or recovery rate testing data
____	____	* suspended solids analysis
____	____	* other well production tests (if applicable)
____	____	** pumping
____	____	** drawdown
____	____	** yield
____	____	** flow direction tests

MPCA Use	Page No.	
____	____	* logs from geophysical testing completed on the well
____	____	* dated, signed, revised landfill plan sheet showing the surveyed location coordinates of the monitoring well to the nearest foot
____	____	* statement of accuracy and completeness of the construction records must be verified and signed by a licensed well contractor
____	____	Well construction log
____	____	* methods of drilling and installation
____	____	** type of drilling rig
____	____	** how casing, screen, filter pack, and grout were installed
____	____	** description of drilling fluid used
____	____	** procedure for cleaning materials or equipment
____	____	* observations during drilling and installation
____	____	** problems encountered and how solved
____	____	** conditions which may affect performance of the monitoring well
____	____	* drawing of the well in vertical cross-section
____	____	* elevations (Mean Sea Level or National Geodetic Vertical Datum)
____	____	** top of each casing (inner and protective), surveyed to the nearest 0.01 foot
____	____	** ground surface
____	____	** protective concrete slab or plug
____	____	** bottom of drill hole
____	____	** top and bottom of any dedicated pump, or sampling or measuring device
____	____	** top and bottom of the screen or intake interval and of each different size or type of casing
____	____	** each change in diameter of the drilled hole
____	____	** each change in filter pack
____	____	** each change in annular seal
____	____	* identification and location of the well
____	____	* well casing material type, inside diameter, and casing schedule number, standard dimension ratio, or wall thickness
____	____	* well screen material type, product name and description; type and direction of alignment of openings (horizontal or vertical); opening or slot width, type of screen bottom
____	____	* methods and materials used to join sections of casing and screen, casing to screen, and well bottom to screen
____	____	* granular filter pack
____	____	** manufacturer
____	____	** product name or number
____	____	** mineral composition
____	____	** gradations
____	____	** quantity of filter pack material used
____	____	* annular seal material (grout)
____	____	** manufacturer and product name
____	____	** proportions of water and solids in the grout mix

MPCA Use	Page No.	
____	____	** quantity used
____	____	** bentonite seal above filter pack, if applicable
____	____	*** method of placement
____	____	*** type and source of bentonite
____	____	* if applicable, type of dedicated pump, sampling device, or measuring device
____	____	** manufacturer and model number
____	____	** pumping capacity
____	____	** dimensions
____	____	** location of intake area
____	____	** how secured at the desired elevation
____	____	** type of material used for connected lines or hoses
____	____	** type and location of power source
____	____	Surface water monitoring points
____	____	* if on permitted property
____	____	** permanently marked
____	____	* if off of permitted property
____	____	** alternative method of marking location if permission to install marker is denied
____	____	* river or stream
____	____	** upstream of groundwater discharge area
____	____	** downstream where the discharge has mixed with stream flow
____	____	** within area of maximum projected pollutant concentrations in the discharging ground water
____	____	Submit to Commissioner a revised landfill plan sheet showing location and identification of all groundwater and surface water monitoring points

2. A description of changes from the work plan

____	____	Locations
____	____	Design
____	____	Installation procedures

3. Evaluation of differences from previously reported hydrogeologic data

____	____	Soil and bedrock conditions
____	____	Water levels
____	____	Groundwater flow conditions
____	____	How the above three conditions complicate the ability to assess impacts at the facility

Definitions:

SONAR: MPCA Statement of Need and Reasonableness (1988). This document is the justification for the MPCA Solid Waste Management Rules.

Hydrogeologic Evaluation
Completeness Checklist
Minnesota Pollution Control Agency
Solid Waste Program

PHASE IV
WATER QUALITY MONITORING WORK PLAN

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. R. pt. 7035.2815, subp. 3 and other subparts cited within subp. 3) 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.

The previous phase report must be submitted before the subsequent phase work plan is reviewed. Before implementing the work plan, the previous phase report and the current phase work plan must be approved by the MPCA. For example, before the Phase IV work plan is reviewed, the Phase III report must be submitted. The Phase IV work plan cannot be approved until the Phase III report has been approved. A person with expertise in hydrogeology must sign each document and certify the quality of the work.

Indicate on the blanks provided the page(s) of the document where the specified rule requirement is addressed.

Minn. R. pt. 7035.2815, subps. 3 and 14; SONAR pages 356-357 and 561-571

1. Field Portion of Monitoring Protocol must contain:

MPCA Use	Page No.	
____	____	Monitoring point locations and elevations.
____	____	Order in which monitoring points are to be sampled.
____	____	List all tests, measurements, and procedures needed at each monitoring point and order for conducting procedures.
____	____	List equipment and containers to be used and procedures and precautions for their use.
____	____	Procedures for evacuating well before sampling (also see Minn. R. pt. 7035.2815, subp. 10, item N).
____	____	If surface water sampling, the procedures for establishing exact sampling location and depth.
____	____	If leachate sampling, the procedures for establishing exact sampling location and depth.
____	____	Description of quality control procedures for field activities and sample transport to identify outside sources of error.

MPCA Use	Page No.	
____	____	Procedures for field filtration of samples.
____	____	Description of procedures for sample preservation, including preservatives and temperature control.
____	____	Procedures for sample labeling, handling, and storage.
____	____	Chain of custody procedures.
____	____	List procedures, measurements, and observations that the sampling personnel are to record.
____	____	Describe how procedures, equipment, and materials minimize sample disturbances.
____	____	The monitoring protocol must describe the method for measuring the water surface to 0.01 feet.
____	____	Does the monitoring protocol include descriptions of sample filtration to provide for sediment-free samples.
____	____	Procedures for assuring that sampling personnel record procedures, measurements, and conditions of monitoring points.

Water quality analyses must be performed using methods acceptable to the Commissioner based on their performance records, reliability, sensitivity, precision, and accuracy.

2. The monitoring protocol must contain this laboratory information:

____	____	Responsibilities of laboratory personnel.
____	____	Sample containers, preservatives, cleaning of containers and equipment, sample shipment and storage, and sample holding times.
____	____	Analytical methods and equipment used (include detection limits).
____	____	Laboratory's measurements of precision and accuracy for constituents.
____	____	Methods used to identify and prevent contamination of samples in laboratory and transport.
____	____	List of analytical quality control procedures used to assess the reliability of results.
____	____	Description of methods for reviewing and assessing all data for completeness and accuracy.
____	____	Establish sample retention times after analysis is completed.
____	____	List inspection, testing, and preventive maintenance programs for equipment.
____	____	Chain of custody procedures.
____	____	Procedures for the documentation and retention of quality control results.
____	____	Continuing education requirements for analytical procedures.

3. The work plan must also include:

____	____	Schedule for background or initial sampling dates
____	____	Proposed analytical constituents based upon factors in Minn. R. pt. 7035.2815, subp. 14, item B, subitems 1 and 2.

MPCA Use	Page No.	
____	____	Describe methods for data analysis and interpretation to be used in fulfilling water quality monitoring requirements.
____	____	Recognition of the requirement to revise, as appropriate, and review at least annually, the protocol.

4. Implementation of Work Plan

____	____	Proposed schedule for field work.

5. Phase IV Water Quality Monitoring Report

____	____	Description of items to be included in the Phase IV report.
____	____	Estimated submittal date for the Phase IV report.

Definitions:

SONAR: MPCA Statement of Need and Reasonableness (1988). This document is the justification for the MPCA Solid Waste Management Rules.

Hydrogeologic Evaluation
Completeness Checklist
Minnesota Pollution Control Agency
Solid Waste Program

PHASE IV
WATER QUALITY MONITORING 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. R. pt. 7035.2815, subp. 3 and other subparts cited within subp. 3) 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 Water Quality Monitoring Work Plan and the completion of the approved work, the Water Quality Monitoring Report is submitted. A person with expertise in hydrogeology must sign the report and certify the quality of the work.

Indicate on the blanks provided the page(s) of the document where the specified rule requirement is addressed.

Minn. R. pt. 7035.2815, subps. 3 and 14; SONAR pages 356-357 and 561-571

1. The report must contain:

MPCA Use	Page No.	
____	____	Monitoring and quality assurance data.
____	____	Analysis of water quality trends.
____	____	Identification of constituents that exceed groundwater performance standards of Minn. R. pt. 7035-2815, subp. 4, intervention limits.
____	____	Comparison to the current Minnesota Department of Health Recommended Allowable Limits.
____	____	Comparison to surface water quality standards, if appropriate.

2. The method for data analysis and interpretation used in this report should be consistent with those described in the approved Water Quality Monitoring Work Plan.

____ ____

3. Deviations from the monitoring protocol must be identified and explained.

____ ____

MPCA Solid Waste Management Rules Requiring Commissioner Approval
Minn. R. pt. 7035.2815, subp. 3

The following is a list of areas in the Minn. Solid Waste Management Rules where it is necessary to get the appropriate agency commissioner's approval to deviate from the minimum standards or requirements of Minn. R. pt. 7035.2815, subp. 3 if something is to be proposed which is less than these minimum standards. These rule citations are only for hydrogeologic concerns in the solid waste permitting process. NOTE: There are numerous other areas in the rules where commissioner approval is needed for alternatives to standards:

1) Minn. R. pt. 7035.2815, subp. 3., item A. – Commissioner approval needed if existing information is to substitute for rule required work items;

2) Minn. R. pt. 7035.2815, subp. 3., item C. – Commissioner approval needed if a shallower depth of investigation other than that specified in this item is proposed;

3) Minn. R. pt. 7035.2815, subp. 3., item D. – Commissioner may approve or require changes to the requirements of Minn. R. pt. 7035.2815, subp. 3, items E. thru I. if conditions in Minn. R. pt. 7035.2815, subp. 3.D. (1) – (4) are met;

4) Minn. R. pt. 7035.2815, subp. 3., item F, sub-item (4) – Commissioner of Minnesota Department of Health approval needed if borings and/or wells are not to be sealed in strict compliance with the Minnesota Water Well Construction Code;

5) Minn. R. pt. 7035.2815, subp. 3., item F, sub-item (5) – Commissioner approval is needed if sampling methods other than those specified in this subitem are proposed;

6) Minn. R. pt. 7035.2815, subp. 3., item F, sub-item (10) – Commissioner approval is needed if an alternative method to estimate the importance of head fluctuation over time is proposed.

Appendix F

Table of Acronyms

C&D	Construction and Demolition
CFR	U.S. Code of Federal Regulations
EPA	U.S. Environmental Protection Agency
FA	Financial Assurance
GCL	Geosynthetic Clay Liners
HRLs	Minnesota Health Risk Levels
ISWMP	Industrial Solid Waste Management Plan
IWEM	Industrial Waste Management Evaluation Model
LGU	Local Governmental Unit
MCLs	EPA Maximum Contaminant Levels
MSW	Municipal Solid Waste
MPCA	Minnesota Pollution Control Agency
PCC	Post-Closure Care
QA/QC	Quality Assurance/Quality Control
RCRA	Resource Conservation and Recovery Act
SRVs	Minnesota Soil Reference Levels
SLVs	Soil Leach Values
SPLP	Synthetic Precipitation Leach Procedure
TCLP	Toxic Characteristics Leach Procedure