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DEPARTMENT OF ENVIRONMENTAL CONSERVATION
WASTE MANAGEMENT DIVISION
SOLID WASTE MANAGEMENT PROGRAM

PROCEDURE ADDRESSING REQUIREMENTS FOR MUNICIPAL SOLID WASTE LANDFILLS TO DEMONSTRATE COMPLIANCE OF THE LANDFILL DESIGN WITH WATER QUALITY STANDARDS

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I. INTRODUCTION

On October 9, 1993, the RCRA Subtitle D Regulations, 40 CFR Part 258, Solid Waste Disposal Criteria, went into effect. The effective date was delayed to April 9, 1994 for any existing municipal solid waste landfill ("MSWLF") that disposed of 100 tons or less of solid waste per day. Section 258.40(a)(1) requires new MSWLF units and lateral expansions to be constructed in accordance with a design approved by the Director of an EPA-approved State which ensures that concentration values of Table 1 substances will not be exceeded in the uppermost aquifer at the relevant point of compliance. Table 1 is a listing of 24 chemicals and there respective maximum contaminant levels ("MCL"). Part 258 requires that the relevant point of compliance be no more than 150 meters from the waste management unit boundary and must be on land owned by the owner of the MSWLF unit.

Section 6-303(d) of the current Vermont Solid Waste Management Rules ("Rules") states that except for facilities which qualify for a categorical certification under Section 6-309, the Secretary may not certify a discrete disposal landfill unless it is in compliance with rules promulgated by the Secretary pursuant to 10 V.S.A. Chapter 48, Ground Water Protection; 10 V.S.A. Chapter 47, Vermont Water Quality Standards, and the laws of Vermont. The November 15, 1997, Ground Water Protection Rule and Strategy ("GWPR") prohibits construction and use of new solid waste landfills in any Class I and Class II ground water areas. For Class III ground water areas, Section 12-503(2)(a) of the GWPR states, in part, that a regulated activity must not: (a) cause a violation of the primary enforcement standards at a compliance point, or (b) must not cause a violation of the secondary enforcement standards or 110% of the secondary background groundwater quality, whichever is greater, at a compliance point.

The Rules require that, as part of the application for solid waste facility certification, a site characterization be performed to determine all mechanisms of discharges and to allow modeling to determine compliance with all applicable environmental quality standards. In order for the applicant for disposal facility certification to address this requirement, the Solid Waste Management Program has been requiring a predictive demonstration of compliance with the ground water enforcement standards for specific chemicals. This predictive demonstration has also included an evaluation of compliance with surface water quality criteria in the Vermont Water Quality Standards if Waters of the State are located within the study area.

This procedure identifies the steps to follow when preparing a predictive demonstration of compliance with water quality standards for the design of any new MSWLF unit or lateral expansion of any existing MSWLF unit.

This revised procedure supersedes the January 25, 1995, Procedure Addressing

Requirements for Municipal Solid Waste Landfills to Demonstrate Compliance of the Landfill Design With Water Quality Standards. The revisions bring the Procedure into conformance with the November 15, 1997, Groundwater Rules.

II. DEFINITIONS

Ground water quality standards for demonstrating compliance with this procedure are ground water enforcement standards listed in the GWPR, or Vermont Health Advisories if a ground water enforcement standard has not been established. Maximum contaminant levels (established for drinking water) supersede ground water enforcement standards or Vermont Health Advisories if the maximum contaminant level became effective after the adoption of the GWPR on November 15, 1997, and if the maximum contaminant level is more stringent than the GWPR ground water enforcement standard. All chemicals listed in 40 CFR 258.40 - Table 1 are included as *ground water quality standards*.

Surface water quality standards for chemicals in surface water are listed in Appendix C and/or D of the Vermont Water Quality Standards.

Sources for water quality standards information are contained in the bibliography of this procedure.

III. REQUIREMENTS

This procedure applies to any new MSWLF unit or a lateral expansion of an existing lined or unlined MSWLF for which the site characterization, as required under §6-603 of the current Rules, is undertaken. Any application for certification for applicable MSWLF units which is submitted after the effective date of this procedure shall demonstrate that the design of the solid waste unit ensures compliance with the ground water quality standards as defined in this procedure at the Design Management Zone ("DMZ") boundary. The procedure for establishing the DMZ is contained in Section 12-802 of the GWPR and Step 3 of this procedure.

The design must also ensure compliance with the surface water quality criteria in the Vermont Water Quality Standards if there is a potential for "Waters of the State" to be adversely impacted from the MSWLF.

For new landfills, an applicant is required to demonstrate that the cell(s) to be constructed and operated during the initial certification period shall be designed in compliance with this procedure. Alternatively, applicants are urged, but not required, to demonstrate compliance with this procedure based on the conceptual maximum area, waste volume, and lifespan of the facility. If the applicant chooses to demonstrate compliance for only the immediate certification period then additional demonstration(s) would be necessary in support of subsequent lateral expansion(s).

The steps addressed below are to be followed for both lined and unlined landfills, unless specifically noted.

Step 1. Leachate Characterization: An assessment and demonstration of the quantity of leachate anticipated throughout the life of the MSWLF unit, including the post-closure period, is required. Estimates of leachate production rates must take into account rainfall, run-on, run-off, evapotranspiration, and the in-place moisture content of the waste. The most recent version of the computer model entitled "Hydrologic Evaluation of Landfill Performance (HELP) Model", or other methods of estimating site specific leachate production can be used to estimate leachate quantity.

Leachate characterization must include an assessment of leachate quality. If leachate data that are representative of the facility are not available then data from similar existing facilities, preferably located in Vermont, should be consulted. Additional factors influencing MSWLF leachate quality to be considered in the characterization include: infiltration and leaching rates, the composition of the waste anticipated, and the age and biological maturity of the landfill in question.

Step 2. Assessment of Leakage Through Liners: The applicant must determine the estimated amount of leachate leaking through the liner system and into the subsurface environment. For unlined landfills, applicants should assume that the leachate generation calculated in Step 1 is the volume discharged to the subsurface environment. An assessment of leachate leakage through the proposed liner system should take into account the following assumptions:

a) Leachate leakage through synthetic liner components is flow through structural failures, including scattered pinholes, tears, and penetrations. Leachate leakage through a natural soil liner is flow through cracks produced by desiccation or by diffusion.

b) Poor contact between the natural material and synthetic material of a composite liner;

c) 12 inches of leachate on the primary liner;

d) For tear and penetration scenarios leakage is assumed to occur at the lowest point of the liner; for a pinhole scenario leakage is assumed to begin at the edge of the landfill base liner.

e) Leachate has the physical properties of water.

Step 3. Establishment Of The Design Management Zone Boundary And Upgradient Water Quality: A proposed DMZ shall be delineated on a site plan and submitted for Agency approval, along with a written narrative which justifies the location of the DMZ boundary. When establishing the DMZ boundary, at where ground water quality standards are applied, the factors listed below are considered:

a) Site topography;

b) Nature, thickness, and permeability of unconsolidated materials;

c) Nature and permeability of bedrock;

d) Groundwater depth, flow direction and velocity;

e) Waste volume, waste type and characteristics, including waste loading;

f) Contaminant mobility, based on the physical and chemical characteristics of the leachate;

g) Distances to property boundary and surface waters;

h) Engineering design of the activity;

I) Life span of the activity;

j) Present and anticipated use of land and ground water, including the proximity and number of ground waters users and the availability of alternative drinking water supplies;

k) Technical scope, costs, and timeframes of potential abatement options if a ground water quality standard is violated;

l) Public health, safety, and welfare effects; and

m) Ground water classification.

In addition to the criteria contained in the GWPR, the DMZ boundary shall be no more than 150 meters from the waste management unit boundary and shall be located on land owned by the owner of the MSWLF unit.

Up gradient ground water quality must be determined prior to ascertaining the potential for leachate migration in the subsurface. Anticipated hydrogeologic conditions must be considered on a case by case basis.

When a separate pollution source (such as an unlined landfill) is located up gradient of a municipal solid waste landfill unit for which this demonstration is required, ground water quality data from between the two units (i.e., down gradient of the pollution source) shall be used as up gradient ground water quality data in any contaminant transport modeling effort.

Step 4. Surface Waters: The applicant must demonstrate that the proposed facility will comply with the Vermont Water Quality Standards. In order of increasing complexity, the demonstration shall be in one of the following forms:

a) A determination that, based on the location of surface water and site specific hydrogeology and hydrology, surface water is not threatened from any discharge from the proposed MSWLF; or

b) A determination that, based on in-stream dilution alone, surface water is not threatened from the quantity and quality of leachate leakage determined in Step 1 and Step 2 above; or

c) A determination that, based on the modeling performed in Step 5 and Step 6, any ground water discharge to surface water will not violate surface water standards; or

d) A determination that, based on the modelling performed in Step 5 and Step 6 and the flow value of the particular surface water body, the discharge will not violate surface water standards.

Failure to make this demonstration is considered to be non-compliance with this procedure, the Vermont Water Quality Standards, and the current Solid Waste Management Rules, and is therefore grounds for application denial.

Step 5. Leachate Migration in the Subsurface: The migration of leachate to the subsurface is dependent on factors such as the moisture content of the waste, the chemical and physical properties of the leachate constituents, climate, the loading rate, and physical and chemical properties of the subsurface. In addition, the following physical, chemical and biological processes may influence subsurface migration and should be considered in the assessment:

Physical Processes - Advection, hydrodynamic dispersion, mechanical filtration, physical

sorption, multiphase fluid flow, hydraulic conductivity, variable hydraulic conductivity, and secondary porosity.

Chemical Processes - Precipitation/dissolution, chemical adsorption/desorption, oxidation and reduction, hydrolysis, ion exchange, and complexation.

Biological Processes - Biodegradation.

Step 6a. Leachate Migration Modeling - (Exemptions): Based on the results from Steps 1 through 5, the applicant may provide evidence that modeling of chemical concentrations within the saturated zone to and beyond the DMZ boundary is not required to demonstrate that ground water quality standards will not be exceeded at the Design Management Zone boundary. This demonstration may be acceptable if:

A. it is demonstrated that ground water quality standards will not be exceeded within the DMZ at the unsaturated/saturated zone interface; or

B. As-built design features of the lined MSWLF unit, other than the double liner system, which when coupled with the site hydrogeology preclude any flow of leachate into the upper-most aquifer.

The conclusion of either demonstration (A) or (B) above must include the finding that "ground water quality standards will not be exceeded at the Design Management Zone boundary" to be deemed in compliance with this procedure.

Step 6b. Leachate Migration Modeling - (Requirements): After reviewing the hydrogeologic characteristics of the site, the nature of liner leakage, and the leachate characteristics, it may be appropriate to use a analytical model to simulate the expected fate and transport of the chemicals present in leachate both vertically to ground water and horizontally to and beyond the DMZ boundary. Ground water flow and transport models range from simple analytical calculations to sophisticated computer programs that use numerical solutions to solve mathematical equations. The results of the model selected must confirm that the landfill design will not result in concentrations of chemicals which exceed ground water quality standards at the DMZ boundary at any point in time. For the base condition of the model, concentrations through time until peak concentrations are attained must be reported for each input chemical selected.

Model input parameters must be based on the results of the leachate characterization (Steps 1 and 2) and the migration assessment Step 6. Established from actual Vermont MSWLF leachate data, Table "A" contains the minimum list of chemicals which must be evaluated in a

contaminant transport model. Additionally, for expansions of existing facilities, modeling must be performed for any chemical in leachate which has been consistently reported at a concentration which exceeds the appropriate ground water quality standard as defined in this procedure, unless otherwise approved by the Agency. Approval of the list of chemicals and corresponding concentrations by the Agency is required before performing contaminant transport modeling.

A sensitivity analysis must be performed. Each input must be varied by 20% or by a factor related to the particular parameter. More conservative and less conservative scenarios must be performed for one organic and one inorganic compound.

Step 7. Demonstration of Compliance: A base condition that indicates that there will be no violations of any ground water quality standard at the DMZ boundary at any point in time is considered to be a demonstration of compliance with this procedure. Failure to make this demonstration is considered to be non-compliance with this procedure, the Ground Water Protection Rule and Strategy, and the current Solid Waste Management Rules, and is therefore grounds for application denial.

Alternatively, siting and design modifications to the proposed MSWLF unit may be undertaken and the evaluation outlined above may be performed again.

TABLE A

CONTAMINANT TRANSPORT MODELING
MINIMUM CHEMICAL INPUT PARAMETERS

CHEMICAL	LEACHATE CONCENTRATION	WATER QUALITY STANDARD
Iron	390,000 ug/l	300 ug/l (ES)
Manganese	90,000 ug/l	50 ug/l (ES)
1,1-dichloroethane	173 ug/l	5 ug/l (VHA)
2-Butanone	4600 ug/l	170 ug/l (ES)
Methylene Chloride	654 ug/l	5 ug/l (MCL)
Trichloroethylene	30 ug/l	3 ug/l (VHA)

ES: Ground Water Enforcement Standard
VHA: Vermont Health Advisory
MCL: Maximum Contaminant Level

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U.S. EPA, 1988. The hydrologic evaluation of landfill performance (HELP) model, Vol.III. User's guide for Version 2. Internal working document EL-92-1, Report 1. U.S. Army Engineers Waterways Experiment Station, Vicksburg, MS.

U.S. EPA, 1988. The hydrologic evaluation of landfill performance (HELP) model, Vol.IV. Documentation for Version 2. Internal working document EL-92-1, Report 2. U.S. Army Engineers Waterways Experiment Station, Vicksburg, MS.

U.S. EPA, 1993. The hydrologic evaluation of landfill performance (HELP) model. Documentation for Version 3. EPA/600/1-94/xxx. Cincinnati, OH.

State of Vermont - Groundwater Protection Rule and Strategy, effective date: November 15, 1997, Vermont Department of Environmental Conservation, Water Supply Division, 103 So. Main Street,

Waterbury, VT 05671-0403. *(Source for ground water enforcement standards.)*

State of Vermont - Vermont Health Advisory Reference Guide. Vermont Department of Health, Division of Environmental Health, 108 Cherry Street, Burlington, Vermont, 05402. *(Source for maximum contaminant levels and Vermont Health Advisories.)*

State of Vermont - Vermont Water Quality Standards. Vermont Water Resources Board, 58 East State Street, Montpelier, Vermont, 05602-3201. *(Source for surface water quality standards.)*

Effective date

This Procedure is effective upon date of Signature.

Signature

Signature 2/8/99

Canute Dalmasse, Commissioner Date
Department of Environmental Conservation