

SUBCHAPTER H: LINER SYSTEM DESIGN AND OPERATION
§§330.331, 330.333, 330.335, 330.337, 330.339, 330.341
Effective March 27, 2006

§330.331. Design Criteria.

(a) New permits for Type I landfill units, lateral expansions, vertical expansions of Type I landfills over landfills that do not meet the design criteria under paragraph (1) or (2) of this subsection and expansions of existing Type IAE landfills that subsequently no longer satisfy the conditions specified in §330.5(b)(1) of this title (relating to Classification of Municipal Solid Waste Facilities) must be constructed in accordance with one of the following provisions approved by the executive director:

(1) a design that ensures that the concentration values listed in Table 1 of this paragraph will not be exceeded in the uppermost aquifer at the point of compliance, as determined in §330.403 of this title (relating to Groundwater Monitoring Systems); or

TABLE 1	
Chemical	MCL (mg/l)
Arsenic	0.05
Barium	1.0
Benzene	0.005
Cadmium	0.01
Carbon tetrachloride	0.005
Chromium (hexavalent)	0.05
2,4-Dichlorophenoxy acetic acid	0.1
1,4-Dichlorobenzene	0.075
1,2-Dichloroethane	0.005
1,1-Dichloroethylene	0.007
Endrin	0.0002
Fluoride	4
Lindane	0.004
Lead	0.05
Mercury	0.002
Methoxychlor	0.1
Nitrate	10
Selenium	0.01
Silver	0.05
Toxaphene	0.005
1,1,1-Trichloroethane	0.2
Trichloroethylene	0.005
2,4,5-Trichlorophenoxy acetic acid	0.01
Vinyl chloride	0.002

(2) a composite liner, as defined in subsection (b) of this section, and a leachate collection system that is designed and constructed to maintain less than a 30-centimeter depth of leachate over the liner.

(b) For purposes of this section, "composite liner" means a system consisting of two components; the upper component must consist of a minimum 30-mil geomembrane liner and the lower component must consist of at least a two-foot layer of re-compacted soil with a hydraulic conductivity of no more than 1×10^{-7} centimeters per second (cm/sec). Geomembrane liner components consisting of high density polyethylene (HDPE) must be at least 60-mil thick. The geomembrane liner component must be installed in direct and uniform contact with the compacted soil component.

(c) When approving a design that complies with subsection (a)(1) of this section, the executive director may consider, but is not limited to, the following factors:

- (1) the hydrogeologic characteristics of the facility and surrounding land;
- (2) the climatic factors of the area;
- (3) the volume and physical and chemical characteristics of the leachate;
- (4) the quantity, quality, and direction of flow of groundwater;
- (5) the proximity and withdrawal rate of the groundwater users;
- (6) the availability of alternative drinking water supplies;
- (7) the existing quality of the groundwater, including other sources of contamination and their cumulative impacts on the groundwater and whether groundwater is currently used or reasonably expected to be used for drinking water;
- (8) public health, safety, and welfare effects; and
- (9) practicable capability of the owner or operator.

(d) Type IV landfills must meet one of the following groundwater protection requirements:

- (1) there must exist at least four feet of in-situ soil between the deposited waste and groundwater. This in-situ soil must constitute an in-situ liner and must meet all the physical properties for a constructed liner as detailed in §330.339(c)(5) of this title (relating to Liner Quality Control Plan). In-situ liners must not exhibit primary or secondary physical features such as jointing, fractures, bedding planes, solution cavities, root holes, desiccation shrinkage cracks etc., that have a coefficient of permeability greater than 1×10^{-7} cm/sec;

(2) there must be at least a three-foot thick re-compacted clay liner between the deposited waste and groundwater. The constructed liner must meet all the criteria detailed in §330.339 of this title and must at a minimum have one foot of protective cover overlying the re-compacted liner after all quality control testing and final thickness determinations are complete; or

(3) an alternative liner design, in accordance with §330.335 of this title (relating to Alternative Liner Design).

(e) Municipal solid waste landfill facilities that accept Class 1 industrial solid wastes, other than asbestos-containing material, must have dedicated cells that meet the following requirements.

(1) The cells designated for Class 1 industrial solid wastes must have a composite liner system consisting of two components. The upper component must consist of a minimum of a 30-mil geomembrane liner and the lower component must consist of at least a three-foot layer of re-compacted soil with a hydraulic conductivity of no more than 1×10^{-7} cm/sec. Geomembrane liner components consisting of HDPE must be at least 60-mil thick. The geomembrane liner component must be installed in direct and uniform contact with the compacted soil component. The liner system installed for Class 1 industrial solid waste cells is subject to the requirements of §330.339 of this title. These cells must be designated on facility layout maps.

(2) The cells designated for Class 1 industrial solid wastes must have a leachate-collection system designed and constructed to maintain less than a 30-cm depth of leachate over the liner. The leachate-collection and leachate-removal system must be:

(A) constructed of materials that are chemically resistant to the leachate expected to be generated;

(B) of sufficient strength and thickness to prevent collapse under the pressures exerted by overlying wastes, waste cover materials, and by any equipment used at the landfill; and

(C) designed and operated to function through the scheduled closure and post-closure period of the landfill.

(3) Unless the executive director approves an engineered design that the applicant has demonstrated will provide equal or greater protection to human health and the environment, a new landfill cell or an areal expansion of an existing landfill cell must be located in areas allowed by §335.584(b)(1) and (2) of this title (relating to Location Restrictions).

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§330.333. Leachate Collection System.

Leachate-collection and associated leachate-removal systems shall be:

(1) constructed of materials that are chemically resistant to the leachate expected to be generated;

(2) of sufficient strength and thickness to prevent collapse under the pressures exerted by overlying wastes, waste cover materials, and by any equipment used at the landfill; and

(3) designed and operated to function through the scheduled closure and post-closure care period of the landfill considering the following factors:

- (A) estimated rate of leachate removal;
- (B) capacity of sumps;
- (C) pipe material and strength, if used;
- (D) pipe network spacing and grading, if used;
- (E) collection sump materials and strength;
- (F) drainage media specifications and performance; and

(G) demonstration that pipes and perforations will be resistant to clogging and can be cleaned.

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§330.335. Alternative Liner Design.

Alternative liner designs, which for Type I landfills must include a leachate management system, may be authorized by the executive director if the owner or operator provides a demonstration by computerized design modeling that the maximum contaminant levels detailed in §330.331 of this title (relating to Design Criteria), Table 1 will not be exceeded at the point of compliance. At the discretion of the executive director, a field demonstration may be required to prove the practicality and performance capabilities of an alternative liner design.

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§330.337. Special Liner Design Constraints.

(a) At the discretion of the executive director, owners or operators of Type IV landfill excavations that extend below the seasonal high water table may be required to meet one or more provisions in this section.

(b) The owner or operator of a Type I landfill shall demonstrate that the liner system will not undergo uplift from hydrostatic forces during its construction by using one or more of the following methods:

(1) providing calculations satisfactory to the executive director that the weight of the liner systems, including any ballast, is sufficient to offset by a factor of 1.2 any otherwise unbalanced upward or inward hydrostatic forces on the liner;

(2) incorporating an active or passive dewatering system in the design to reduce upward or inward hydrostatic forces on the liner by a factor of 1.2 and by providing calculations satisfactory to the executive director that the dewatering system will perform to adequately reduce those forces;

(3) providing evidence satisfactory to the executive director that the soil surrounding the landfill is so poorly permeable that groundwater cannot move sufficiently to exert force that would damage the liner; or

(4) providing evidence that the seasonal high water table is below the deepest planned excavation.

(c) The owner or operator shall ensure that the liner is stable during the filling and operation of the landfill through a suitable combination of dewatering and/or ballast, if determined to be required in subsection (b) of this section. These methods shall not be used without prior approval of the executive director.

(d) Any required leachate collection system shall be designed to handle both the leachate generated and the groundwater inflow from materials beneath and lateral to the liner system. The maximum volume of groundwater inflow shall be calculated based on determination of the permeability and potentiometric conditions of the liner system and of the materials surrounding the liner system.

(e) Prior to excavating any unit below the seasonal high water table, the owner or operator shall perform a preliminary foundation evaluation satisfactory to the executive director. The foundation evaluation shall consider stability, settlement, and constructability.

(f) The liner quality control plan as required in §330.339 of this title (relating to Liner Quality Control Plan) shall include the following information for landfills to which subsection (b) of this section is applicable:

(1) the methods and tests to be used to verify that the liner will not undergo uplift during construction and until ballast placement, if required, is complete; and

(2) the measures and tests that will be used to verify that any required ballast meets the criteria established, including, but not limited to, inspections, compaction, weight and density of material, thickness, and top elevations.

(g) Any dewatering systems used to ensure liner stability during construction and filling shall be operated until the executive director determines that such systems are no longer required.

(h) The executive director may determine on a site-specific basis that waste can be used as ballast. If so, the facility operating plan for the landfill shall contain the following requirements.

(1) The first five feet or the total thickness of the ballast, whichever is less, placed on the liner system shall be free of brush and large bulky items, which would damage the underlying parts of the liner system or which cannot be compacted to the required density.

(2) If waste is used for ballast, a wheeled compactor having a minimum weight of 40,000 pounds, or equivalent equipment, shall be properly utilized to reach a compaction density of at least 1,200 pounds per cubic yard. For purposes of determining the required ballast thickness, a density of compacted waste of 1,200 pounds per cubic yard shall be used. The weight of the liner system, including any ballast, must be sufficient to offset any unbalanced upward or inward hydrostatic forces on the liner by a factor of 1.5 when waste is used for ballast.

(3) The liner quality control plan shall also include the method(s) to be used to verify that compaction of waste used for ballast is to a density of not less than 1,200 pounds per cubic yard. If a compactor having a minimum weight of 40,000 pounds is used, no compaction density verification will be required.

(4) If waste is used for ballast, the ballast evaluation report shall also include verification that a compactor having a minimum weight of 40,000 pounds was used or, if not, that compaction was at least 1,200 pounds per cubic yard.

(i) The seasonal high water table shall be adjusted upward, if necessary, as additional data become available after a permit is issued.

(j) If ballasting or dewatering is used, the owner or operator shall submit a ballast evaluation report in a format specified by the executive director in duplicate to the executive director when the owner or operator determines that ballasting or dewatering is no longer necessary. If the executive director provides no response within 14 days of the date of receipt, the owner or operator may discontinue dewatering or ballasting operations. The ballast evaluation report shall include:

(1) verification that the liner did not undergo uplift during construction, using the method identified in the liner quality control plan;

(2) certification that ballast met the criteria established in this section and in the liner quality control plan; and

(3) signature and seal of an independent licensed professional engineer performing the evaluation and signature of the facility operator or his authorized representative.

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§330.339. Liner Quality Control Plan.

(a) A landfill must have an approved liner quality control plan prepared under the direction of a licensed professional engineer, and it shall be the basis for the type and rate of quality control testing performance and reported in the soil liner evaluation report as required in §330.341 of this title (relating

to Soil Liner Evaluation Report and Geomembrane Liner Evaluation Report). The plan must be included in the site development plan to provide operating personnel adequate procedural guidance for assuring continuous compliance with groundwater protection requirements. The plan must specify construction methods employing good engineering practices for compaction of clay soils to form a liner. Unless alternative construction procedures are approved in writing by the executive director, all constructed liners shall be keyed into an underlying formation of sufficient strength to ensure stability of the constructed lining. The plan shall address the installation and testing of a geomembrane liner, if used. Proposed dewatering plans shall be included. The plan shall include the following information:

(1) constructed liner details, where applicable, shall be depicted on cross-sections of a typical cell showing the slope, widths, and thicknesses for compaction lifts. The amount of compaction shall be expressed as a percentage of a predetermined laboratory density; and

(2) soil and liner quality-control testing procedures, to include sampling frequency, shall be included in the plan. All field sampling and testing, both during construction and after completion, shall be performed by a person acting in compliance with the provisions of the Texas Engineering Practice Act and other applicable state laws and regulations. The professional of record who signs the soil liner evaluation report or his representative should be on site during all liner construction. Quality control of construction and quality assurance of sampling and testing procedures should follow the latest technical guidelines of the executive director.

(b) The liner quality control plan shall also:

(1) provide guidance needed for testing and reporting evaluation procedures to the professional who will prepare the soil liner evaluation reports for the facility;

(2) specify materials, equipment, and construction methods for the compaction of clay soils to form impermeable liners for the conditions to include the following information:

(A) details for the overexcavation and recompaction of the in-situ soils, or the compaction of soils from a borrow source, shall be depicted on cross-sections of a typical cell showing the slope, widths, and thicknesses for compaction lifts; and

(B) procedures to be followed when excavations, cells, or disposal areas extend into or have the potential to extend into the groundwater shall be in accordance with the provisions provided in §330.337 of this title (relating to Special Liner Design Constraints); and

(3) describe installation methods and quality control testing and reporting following placement for any geomembrane liner that may be required or authorized by the executive director.

(c) Soil liner quality control testing frequencies and procedures shall be in accordance with the executive director's most recent guidelines and the following.

(1) All field sampling and testing, both during construction and after completion of the lining, shall be performed by a qualified professional experienced in geotechnical engineering and/or engineering geology, or under his direct supervision.

(2) All liners should have continuous on-site inspection during construction by the professional of record or his designated representative.

(3) The amount of compaction of clay liners shall be expressed as a percentage of a maximum dry density based on a compaction test specified by a licensed professional engineer. The compaction of the clay liner shall have been proven by soils laboratory testing to provide a coefficient of permeability of 1×10^{-7} centimeters per second (cm/sec) or less.

(4) The liner quality control plan shall define the frequency of testing for each of the test procedures listed in subparagraphs (A) - (F) of this paragraph. These frequencies shall be expressed in numbers of tests per specific area of liner per lift or specific thickness of liner, unless an alternative frequency is approved by the executive director. In addition, unless otherwise approved by the executive director, all soil tests performed on any in-situ or constructed soil liners shall be in accordance with the standards in subparagraphs (A) - (E) of this paragraph:

(A) laboratory permeability tests. Permeability tests shall be run using tap water or .05 Normal (N) solution of calcium sulfate (CaSO_4) and not distilled water. All test data must be submitted on permeability tests regardless of test method used. At a minimum, the calculations of the last data set reported for each sample and the resultant coefficient of permeability shall be reported as supporting data. Tests shall be either constant head with back pressure (Appendix VII of Corps of Engineers Manual, EM 1110-2-1906; American Society of Testing and Materials (ASTM) D5084, "Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter,") or falling head (Appendix VII of Corps of Engineers Manual, EM1110-2-1906);

(B) sieve analysis +1, 200, -200 sieves; (ASTM D422 or ASTM D1140, as applicable);

(C) Atterberg limits (ASTM D4318);

(D) moisture-density relationships (ASTM D698 or any executive director approved modified test whose compactive effort matches the on site-construction equipment);

(E) moisture content (ASTM D2216); and

(F) thickness verification.

(5) All soils used as constructed liners must have the following minimum values verified by testing in a soils laboratory:

(A) plasticity index - equal to or greater than 15;

(B) liquid limit - equal to or greater than 30;

(C) percent passing 200 mesh sieve (-200) equal to or greater than 30%;

(D) percent passing one-inch screen - 100%; and

(E) coefficient of permeability less than or equal to 1×10^{-7} cm/sec.

(6) Permeability tests for proving the suitability of soils to be used in constructing clay liners shall be performed in the laboratory using the procedures and guidance of paragraph (4)(A) of this subsection. Field quality control must be provided by field density tests based on predetermined moisture-density compaction curves, Atterberg limits, and laboratory permeabilities of undisturbed field samples of compacted liner soils, unless an alternative plan is approved by the executive director.

(7) Field permeability testing of in-situ soils or constructed soil liners shall be in accordance with ASTM D5093 for those soil liners that are in the floor of the excavation and a variation of the Boutwell STEI field permeability test approved by the executive director for the sidewalls, or in accordance with guidance furnished by the executive director.

(8) All quality control testing of soil liners shall be performed during the construction of the liner. In no instance shall any quality control field or laboratory testing be undertaken after completion of liner construction, except for that testing which is required of the final constructed lift, confirmation of liner thickness, or cover material thickness.

(9) All soil testing and evaluation of either in-situ soil or constructed soil liners shall be complete prior to installing the leachate collection system or, if no leachate collection system is required, prior to adding the one foot of protective cover on the area under evaluation.

(d) Soil and liner density shall be expressed as a percentage of the maximum dry density and at the corresponding optimum moisture content specified as appropriate by a licensed professional engineer experienced in geotechnical engineering. These soils so compacted must upon testing either in the laboratory or as a test pad in the field demonstrate a coefficient of permeability no greater than 1×10^{-7} cm/sec.

(e) Unless alternative construction procedures have prior written approval by the executive director, all constructed soil liners shall be keyed into an underlying formation of sufficient strength to ensure stability of the constructed lining.

(f) Each soil liner evaluation report shall be prepared in accordance with the approved liner quality control plan. Any deviation from the approved plan must have prior written approval from the executive director.

(g) Soil liners shall not be compacted with a bulldozer or any track-mobilized equipment unless it is used to pull a pad-footed roller. All soil liners shall be compacted with a pad-footed or prong-footed roller only. The maximum clod size of the compacted liner soils shall be approximately one inch in diameter. In all cases soil clods shall be reduced to the smallest size necessary to achieve the coefficient of permeability reported by the testing laboratory and to destroy any macrostructure evidenced after the compaction of the clods under density-controlled conditions.

(h) The liner soil material shall contain no rocks or stones larger than one inch in diameter or that total more than 10% by weight. Rock content shall not be a detriment to the integrity of the overlying geomembrane.

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§330.341. Soil Liner Evaluation Report and Geomembrane Liner Evaluation Report.

(a) Prior to the disposal of solid waste in any cell, or on any area, excavation, or unprotected surface, a soil liner evaluation report and a geomembrane liner evaluation report shall be submitted to the executive director. If the approved design does not require a synthetic liner, a geomembrane liner evaluation report is not required.

(b) Each soil liner evaluation report and geomembrane liner evaluation report shall be submitted in triplicate (including all attachments) to the executive director and shall be prepared in accordance with the methods and procedures contained in the approved liner quality control plan. If the executive director provides no response, either written or verbal, within 14 days of receipt, the owner or operator may continue facility construction or operation.

(c) If the executive director determines that a report is incomplete or that the test data provided are insufficient to support the evaluation conclusions, additional test data or other information may be required, and use of the cell or disposal area will not be allowed until such additional data are received, reviewed, and accepted. Each report must be signed and, where applicable, sealed by the individual performing the evaluation and counter-signed by the facility operator or an authorized representative.

(d) The surface of a constructed soil liner should be covered or otherwise protected within a period of six months to mitigate the effects of dessication, surface erosion, and rutting due to traffic. Liner surfaces not covered within six months shall be checked by the soil liner evaluation report evaluator, who shall then submit a letter report on the findings to the executive director. Any required repairs shall be performed promptly. A new report shall be submitted on the new construction for all liners that need repair due to damage.

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