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Ohio Administrative Code

Rule 3745-30-07 Industrial landfill and residual landfill facility construction.

Effective: May 28, 2021

This rule identifies the engineered components ofan industrial landfill or residual landfill facility, design specifications,and construction and reporting requirements.

(A) The owner or operator shall contact the licensing authority and Ohio EPA prior to commencing construction of each phase of the industrial landfill or residual landfill facility for the purpose of inspection.

(B) The owner or operator shall submit a certification report, signed and sealed by a professional engineer registered in Ohio, to Ohio EPA and the licensing authority upon completion of any of the construction activities conducted pursuant to paragraph (D) of this rule in each phase of the industrial landfill or residual landfill facility. The certification report shall include the following:

(1) A narrative section that identifies the engineered component that was constructed during the construction event and includes the following:

(a) A summary of the design and construction specifications given in the approved permit to install and a comparison with the component that was constructed during the construction event.

(b) A summary of how construction was impacted by weather and equipment limitations and other difficulties encountered.

(2) All alterations and other changes that relate to the installation of any of the components to be certified, presented as follows:

(a) A listing of all alterations previously concurred with by Ohio EPA.

(b) All alteration requests and supporting documentation that are proposed for concurrence.

(c) A list of any other changes made by the owner or operator that do not require Ohio EPA concurrence but which affect construction or the record drawings.

(3) Results of all testing required by this rule or by the approved permit to install.

[Comment: See also rule 3745-30-14 of the Administrative Code. All quality assurance/quality control tests that do not meet the specifications outlined in this rule or the approved permit to install are failed tests that are required to be investigated and assessed. An area with a verified failure requires reconstruction to meet specifications. Reconstructed areas are required to be reconstructed and to be retested at a frequency acceptable to Ohio EPA.]

(4) Results of all surveys required by this rule or the approved permit to install for the construction of any engineered component or group of components. Survey data shall be reported in a table with the northing and easting for each designated survey point established to be no more than one hundred feet apart. The northings and eastings shall be based on the grid system established in the permit in accordance with rule 3745-30-05 of the Administrative Code. If the permit to install does not establish a grid system, the owner or operator shall establish a grid system for the purposes of construction certification. Additional points shall be established at grade breaks and other critical locations. Results shall be reported as follows:

(a) For the purpose of confirming the constructed elevations of the liner system and its distance to the uppermost aquifer system, the bottom of the liner system elevations shall be compared to the elevations in the approved permit to install.

(b) The survey grid shall be used to demonstrate the thickness of the following constructed components with a comparison of the constructed thickness to the thickness specified in the approved permit to install:

(i) Added geologic material.

(ii) The recompacted soil liner.

(iii) The leachate collection layer.

(iv) The separatory soil barrier layer.

(v) The separatory leachate collection layer.

(vi) The cap drainage layer.

(vii) The cap protection layer.

(5) Record drawings showing the following:

(a) Plan views with topographic representation of the elevations of the top of recompacted soil liner and the location of any berms and leachate collection pipes with inverts noted. For a residual landfill facility using the geosynthetic clay liner option, the elevations of the top of the subbase shall be included.

(b) Plan views with topographic representation of the elevations of the top of the separatory soil barrier layer and the location of any berms and leachate collection pipes with inverts noted.

(c) Plan views with topographic representation of the horizontal limits of all existing IMW, the top elevations of the cap system, surface water control structures including ditches to control run on and run off, sedimentation ponds including the inlet and outlet, and any permanent ground water control structures.

(d) Plan views of the deployment of the flexible membrane liner panels, including the location and identification of the destructive tests and all repairs.

(e) If the certification report is submitted for the cap system, cross sections showing the top elevations of the existing IMW, top elevations of the cap system, and the elevations of the surface water management system. The cross sections shall be taken at the same locations and using the same scale as in the approved permit to install. If the permit to install does not include cross sections, the cross sections shall be taken at an interval no greater than every three hundred feet of length and width.

(f) The location and as-built detail drawings of all components to be certified using the same views as required in rule 3745-30-05 of the Administrative Code.

(6) After the initial construction and establishment of a survey mark at the industrial landfill or residual landfill facility, the following information summarizing the activities performed to construct and establish the survey mark:

(a) The geodetic survey datasheet of each control point used to establish the horizontal and vertical coordinates of the survey mark.

(b) A table listing the horizontal and vertical coordinates of each control point and survey mark.

(c) A summary of surveying activities performed in determining the coordinates of the survey mark.

(d) A plan sheet clearly identifying the location of the survey mark, the control points, and the limits of IMW placement on a road map with a scale of one inch equals no greater than one mile.

(e) A detailed drawing illustrating the design of the survey mark, as constructed.

(7) Documentation demonstrating that any oil or gas wells that have been identified within the limits of IMW placement have been properly plugged and abandoned in accordance with Chapter 1509. of the Revised Code prior to any construction in the area of the well.

(8) Qualifications of construction, testing, and construction quality assurance and control personnel. A description of the experience, training, responsibilities in decision making, and other qualifications of the personnel that provided construction oversight and conducted the testing on the engineered component for which the certification report is submitted.

(9) A notarized statement that to the best of the knowledge of the owner or operator, the certification report is true, accurate, and contains all information required by paragraph (B) of this rule.

(C) The owner or operator shall ensure that the following criteria are met:

(1) The design of the excavation of all engineered components and the waste mass considers configurations throughout the applicable development and post-closure care periods. The design for the stability of all engineered components and the waste mass shall meet the following:

(a) Have a factor of safety for hydrostatic uplift of not less than 1.40 at any location during the construction and operation of the facility.

(b) Have a factor of safety for bearing capacity of any vertical sump risers on the liner system of not less than 3.0.

(c) Have a factor of safety for static slope stability of not less than 1.50 using two dimensional limit equilibrium methods or another factor of safety using a method acceptable to Ohio EPA when assessed for any of the following failure modes and conditions:

(i) Deep-seated translational and deep-seated rotational failure mechanisms of internal slopes, interim slopes, and final slopes for drained conditions. For slopes containing geosynthetic interfaces placed at grades greater than 5.0 per cent, large displacement shear strength conditions shall be used for any soil to geosynthetic or geosynthetic to geosynthetic interfaces of the geosynthetic with the lowest peak shear strength. For geosynthetic to geosynthetic interfaces, use the large displacement shear strength of the geosynthetic with the lowest peak shear strength.

[Comment: Ohio EPA considers any failure that occurs through a material or along an interface that is loaded with more than one thousand four hundred forty pounds per square foot to be a deep seated failure mode.]

(ii) Shallow translational and shallow rotational failure mechanisms of internal slopes and final slopes for drained conditions.

[Comment: Peak shear strengths can be used for most shallow failure modes.]

(d) Have a factor of safety for static slope stability of not less than 1.30 using two dimensional limit equilibrium methods or another factor of safety using a method acceptable to Ohio EPA when

assessed for deep seated translational and deep seated rotational failure mechanisms of internal slopes, interim slopes, and final slopes for undrained conditions resulting from loading or unloading of the slopes. The analysis shall assume that the weight of the material is loaded or unloaded all at one time without time for pore pressure dissipation. Alternatively, if the facility is designed using staged loading calculations, then the analysis shall assume that the weight of the material is loaded or unloaded all at one time at the end of the time it takes to construct the stage.

(e) Assumptions used in the stability analyses shall be used to establish the minimum specifications and materials for construction.

(f) Include calculations for seismic slope stability that shall meet the following:

(i) Deep-seated translational and deep-seated rotational failure mechanisms of final slopes for drained conditions and as applicable conditions representing the presence of excess pore water pressure at the onset of loading or unloading shall comply with one of the following:

(a) The factor of safety shall not be less than 1.00 using two or three dimensional limit equilibrium methods. For slopes containing geosynthetic interfaces placed at grades greater than 5.0 per cent, large displacement shear strength conditions shall be used for any soil to geosynthetic or geosynthetic to geosynthetic interfaces of the geosynthetic with the lowest peak shear strength. For geosynthetic to geosynthetic interfaces, use the large displacement shear strength of the geosynthetic with the lowest peak shear strength.

(b) The calculated deformations are limited to fifteen centimeters. For slopes containing geosynthetic interfaces, large displacement shear strength conditions shall be used for any soil to geosynthetic or geosynthetic to geosynthetic interfaces of the geosynthetic with the lowest peak shear strength. For geosynthetic to geosynthetic interfaces, use the large displacement shear strength of the geosynthetic with the lowest peak shear strength.

(ii) Shallow translational and shallow rotational failure mechanisms of final slopes for drained conditions shall comply with one of the following:

(a) The factor of safety shall not be less than 1.00 using two or three dimensional limit equilibrium

methods.

(b) The calculated deformations are limited to thirty centimeters. For slopes containing geosynthetic interfaces, large displacement shear strength conditions shall be used for any soil to geosynthetic or geosynthetic to geosynthetic interfaces of the geosynthetic with the lowest peak shear strength.

(g) Have a factor of safety against liquefaction of not less than 1.00 for internal slopes, interim slopes and final slopes.

(h) Have a factor of safety for static slope stability of not less than 1.10 using two dimensional limit equilibrium methods or other methods acceptable to Ohio EPA when assessed for any of the following failure modes and conditions:

(i) If required by Ohio EPA, shallow translational and shallow rotational failure mechanisms of internal slopes in which the protective soils over the leachate collection layer have reached field capacity. Calculations shall use the maximum head predicted for the fifty year, one hour design storm.

(ii) Shallow translational and shallow rotational failure mechanisms of final slopes in which the cover soils over the drainage layer have reached field capacity. Calculations shall use the maximum head predicted for the one hundred year, one hour design storm.

(2) The design of the liner system complies with the following:

(a) For an industrial landfill facility, design (1)(a) or (1)(b) as identified in the appendix to this rule.

(b) For a residual landfill facility, design (1)(a), (1)(b), (2)(a), or (2)(b) as identified in the appendix to this rule.

(c) For a residual landfill facility for IMW with a chloride concentration determined in accordance with rule 3745-30-03 of the Administrative Code of no more than one thousand two hundred and fifty parts per million, design (1)(a), (1)(b), (2)(a), (2)(b), or (3) as identified in the appendix to this rule.

(3) The liner system is designed as follows:

(a) For new facilities or lateral expansions of existing facilities, the liner system shall have at least a 2.0 per cent slope in all areas, except along flow lines augmented by leachate collection pipes, after accounting for one hundred per cent of the primary consolidation settlement and the secondary consolidation settlement of the compressible materials beneath the facility. Compressible materials include, as applicable, in-situ soil, added geologic material, structural fill material, and recompacted soil liner. For the purposes of this paragraph, secondary settlement shall be calculated using a one hundred year time frame or another time frame acceptable to Ohio EPA.

(b) For existing facilities where an owner or operator proposes to vertically expand over a liner system that was constructed after December 31, 2003, the slope of the existing liner system located beneath the vertical expansion shall meet the design standard in paragraph (C)(3)(a) of this rule.

(c) For existing facilities where an owner or operator proposes to vertically expand over a liner system that was constructed before December 31, 2003, the owner or operator shall demonstrate that the existing liner system located beneath the vertical expansion at a minimum maintains positive drainage in the leachate collection system and has no more than one foot of head of leachate after accounting for the additional IMW, one hundred per cent of the primary consolidation settlement, and the secondary consolidation settlement of the compressible materials beneath the facility. Compressible materials include, as applicable, in-situ soil, added geologic material, structural fill material, and recompacted soil liner. For the purposes of this paragraph, secondary settlement shall be calculated using a one hundred year time frame or another time frame acceptable to Ohio EPA.

(4) The design of all geosynthetic materials specified as an engineered component including but not limited to flexible membrane liner, geosynthetic clay liner, and geocomposite drainage layer, does not rely on any of the tensile qualities of the geosynthetic component. This paragraph does not apply to geosynthetics used to mechanically stabilize embankments.

(D) The owner or operator shall use the following specifications in design and construction of the industrial landfill or residual landfill facility whenever the items in this paragraph are required by paragraph (C) of rule 3745-30-06 of the Administrative Code:

(1) The foundation, liner subbase, or added geologic material used to meet the isolation distance between the uppermost aquifer system and the bottom of the liner system shall comply with the following:

(a) Be free of debris, foreign material, deleterious material, and not contain large objects in such quantities as may interfere with the application and intended purpose.

(b) Not be comprised of solid waste.

(c) Be determined to have adequate strength to satisfy bearing capacity and slope stability strength requirements.

(d) Be resistant to internal erosion.

(e) If a geosynthetic clay liner or flexible membrane liner is a component of the liner system, not have any abrupt changes in grade that may result in damage to the geosynthetic clay liner or flexible membrane liner.

(f) For foundation, have quality control testing at a frequency of three tests per unit for resistance to internal erosion of any stratigraphic units that have not been anticipated and that are more susceptible to seepage piping failure than the stratigraphic units that were tested and reported in the permit to install in accordance with ASTM D4647. Units susceptible to seepage piping failure include those located within fifteen feet of the proposed depths of excavation and those located where the piezometric surface of an aquifer or a zone of significant saturation is above the depth of excavation.

(g) For added geologic material, be constructed in lifts to achieve uniform compaction. Each lift shall comply with the following:

(i) Be constructed in loose lifts of twelve inches or less.

(ii) Be constructed of a soil with a maximum clod size that does not exceed the lift thickness.

(iii) Be compacted to at least ninety-five per cent of the maximum dry density determined in

accordance with ASTM D698 or at least ninety per cent of the maximum dry density determined in accordance with ASTM D1557.

(iv) Be placed with a soil moisture content that shall not be less than two per cent below or more than four per cent above the optimum moisture content determined in accordance with ASTM D698 or ASTM D1557.

(v) For added geologic material not classified as low plasticity clay (CL), as silty clay (ML-CL), a high plasticity clay (CH), a clayey sand (SC), or a clayey gravel (GC) in the "Unified Soil Classification System" described in ASTM D2487, have a maximum permeability of 1 X 10-5 cm/sec.

(vi) If the piezometric surface of an underlying aquifer or a zone of significant saturation is above the top of the added geologic material, be classified as slightly dispersive (ND3) or nondispersive (ND2, ND1) determined in accordance with ASTM D4647.

(h) For added geologic material, have quality control testing of the constructed lifts performed to determine the density and moisture content in accordance with ASTM D6938, ASTM D1556, ASTM D2167 or other methods acceptable to Ohio EPA at a frequency of no less than five tests per acre per lift. The locations of the individual tests shall be adequately spaced to represent the constructed area. Any penetrations shall be repaired using bentonite.

(2) Structural fill, rock fill, or soil fill used as a structural berm or subbase shall comply with the following:

(a) For rock fill, be durable rock.

(b) Be free of debris, foreign material, and deleterious material.

(c) Not be comprised of solid waste.

(d) Not have any abrupt changes in grade that may result in damage to the liner system.

(e) For soil fill, have pre-construction testing of the borrow soils performed on representative samples to determine the maximum dry density and optimum moisture content in accordance with ASTM D698 or ASTM D1557 at a frequency of no less than once for every ten thousand cubic yards.

(f) Be constructed in lifts to achieve uniform compaction of soil fills. Each lift shall comply with the following:

(i) For structural berm, be constructed in loose lifts of twelve inches or less. For subbase under a geosynthetic clay liner, be constructed in loose lifts of eight inches or less.

(ii) Be compacted to at least ninety-five per cent of the maximum dry density determined in accordance with ASTM D698 or at least ninety per cent of the maximum dry density determined in accordance with ASTM D1557.

(g) Be determined to have adequate strength to satisfy bearing capacity and slope stability strength requirements.

(h) Have quality control testing of the soil fills on the constructed lifts performed to determine the density and moisture content in accordance with ASTM D6938, ASTM D1556, ASTM D2167 or other methods acceptable to Ohio EPA at a frequency of no less than five tests per acre per lift. The locations of the individual tests shall be adequately spaced to represent the constructed area.

(3) At a minimum, the recompacted soil liner shall comply with the following:

(a) Be constructed using loose lifts eight inches thick or less to achieve uniform compaction. Each lift shall have a maximum permeability of 1×10^{-7} cm/sec.

(b) Be constructed of a soil with a maximum clod size of three inches or half the lift thickness, whichever is less.

(c) Be constructed of a soil that meets the following:

(i) With one hundred per cent of the particles having a maximum dimension not greater than two

inches.

(ii) With not more than ten per cent of the particles by weight having a dimension greater than 0.75 inches.

(iii) If the piezometric surface of an underlying aquifer or a zone of significant saturation is above the top of the recompacted soil liner, with a classification of slightly dispersive (ND3) or nondispersive (ND2, ND1) determined in accordance with ASTM D4647.

(d) Be compacted to at least ninety-five per cent of the maximum "standard proctor density" in accordance with ASTM D698 or at least ninety per cent of the maximum "modified proctor density" in accordance with ASTM D1557.

(e) Be compacted at a moisture content at or wet of optimum.

(f) Alternatives for paragraphs (D)(3)(a) to (D)(3)(e) of this rule may be used if demonstrated to the satisfaction of Ohio EPA that the materials and techniques will result in each lift having a maximum permeability of 1 x 10^{-7} cm/sec.

(g) Not be comprised of solid waste.

(h) Be constructed using the number of passes and lift thickness, and the same or similar type and weight of compaction equipment established by testing required in paragraph (H) of this rule.

(i) Be placed on the bottom and exterior excavated sides of the landfill and have a minimum bottom slope of two per cent and a maximum slope based on the following:

(i) Compaction equipment limitations.

(ii) Slope stability.

(iii) Maximum friction angle between any soil-geosynthetic interface and between any geosynthetic-geosynthetic interface.

(iv) Resistance of geosynthetic and geosynthetic seams to tensile forces.

(j) Be constructed on a prepared surface that shall comply with the following:

(i) Be free of debris, foreign material, and deleterious material.

(ii) Be capable of bearing the weight of the landfill and its construction and operations without causing or allowing a failure of the liner to occur through settling.

(iii) Not have any abrupt changes in grade that may result in damage to geosynthetics.

(k) Have a factor of safety for hydrostatic uplift not less than 1.4.

(l) Be adequately protected from damage due to desiccation, freeze/thaw cycles, wet/dry cycles, and the intrusion of objects during construction and operation.

(4) A cap soil barrier layer shall comply with the following:

(a) Be constructed using loose lifts eight inches thick or less to achieve uniform compaction. Each lift shall have a maximum permeability of 1×10^{-6} cm/sec.

(b) Be constructed of a soil with a maximum clod size of three inches or half the lift thickness, whichever is less.

(c) Be free of debris, foreign material, and deleterious material.

(d) Not be comprised of solid waste.

(e) If a flexible membrane liner is a component of the cap system, not have any abrupt changes in grade that may result in damage to the flexible membrane liner.

(f) Have a maximum recompacted laboratory permeability of 1×10^{-6} cm/s.

(g) Be constructed of a soil with at least eighty per cent of the particles by weight passing through the number 4 standard mesh screen. Alternative soil specifications may be used provided that a demonstration to Ohio EPA shows that the materials and techniques will result in each lift having a maximum permeability of 1×10^{-6} cm/sec.

(h) Be compacted to a maximum dry density and minimum soil moisture content no less than that used in the recompacted laboratory permeability test in accordance with paragraph (E)(1) of this rule.

(i) Be adequately protected from damage due to desiccation, freeze/thaw cycles, wet/dry cycles, and the intrusion of objects during construction of the cap system.

(5) A geosynthetic clay liner shall comply with the following:

(a) Be negligibly permeable to fluid migration.

(b) Have a dry bentonite mass per unit area of at least 0.75 pounds per square foot at zero per cent moisture content.

(c) Be installed in the following manner:

(i) To allow no more than negligible amounts of leakage. A minimum overlap of six inches, or, for end-of-panel seams, a minimum overlap of twelve inches. Overlap shall be increased in accordance with manufacturer's specifications or to account for shrinkage due to weather conditions.

(ii) In accordance with the manufacturer's specifications in regards to handling and the use of granular or powdered bentonite to enhance bonding at the seams.

(iii) Above an engineered subbase or above a recompacted soil liner. Geosynthetic clay liners without internal reinforcement shall not be used in areas beneath leachate collection piping, in sump areas, or on any slope with a grade that is steeper than ten per cent.

(iv) On a surface that shall not have any sharp edged protrusions or any particles protruding more

than one quarter of one inch.

(v) Such that the geosynthetic clay liner is adequately protected from damage due to desiccation and erosion.

(6) A flexible membrane liner shall comply with the following:

(a) Be negligibly permeable to fluid migration.

(b) Be physically and chemically resistant to chemical attack by the IMW, leachate, or other materials which may come in contact with the flexible membrane liner.

(c) For facilities proposing to dispose of secondary aluminum waste, be able to retain its mechanical and physical properties when exposed to temperatures up to one hundred degrees centigrade.

(d) For installations exceeding ten thousand square feet, have present during the installation at least one welding technician having seamed a minimum of one million square feet of flexible membrane liner.

(e) Be seamed to allow no more than negligible amounts of leakage. The seaming material shall be physically and chemically resistant to chemical attack by the residual waste, leachate, or other materials that may come in contact with the seams.

(f) Be cleaned of deleterious materials in the seaming area immediately prior to seaming.

(g) Have properties for installation and use that are acceptable to Ohio EPA.

(7) A cushion layer to protect the flexible membrane liner if the potential exists for the flexible membrane liner to come in contact with any sharp edged protrusions or any particles protruding more than one quarter of one inch. The cushion layer shall be adequately protected from solar degradation. The liner cushion layer shall account for the weight of the overlying waste mass and have pre-construction interface testing performed according to paragraph (G) of this rule.

(8) A leachate management system shall comply with the following:

(a) Contain and collect leachate within the boundary of the industrial landfill or residual landfill flexible membrane liner or soil liner, consist of either a granular drainage layer or geocomposite drainage layer, and comply with the following:

(i) Limit the level of leachate in areas other than lift stations to a maximum of one foot. Any granular material used as a drainage medium shall have a permeability no less than 1×10^{-2} cm/sec.

(ii) Function without clogging. A filter layer may be required by Ohio EPA.

(iii) Have either a leachate collection layer that is comprised of materials capable of ensuring protection of the flexible membrane liner or include a liner cushion layer.

(iv) For a granular leachate collection layer, not be placed over wrinkles in the flexible membrane liner that are greater than four inches in height.

(v) Prevent crushing of or damage to any of its components. A protective layer to protect the leachate management system and the industrial landfill or residual landfill liner components from the intrusion of objects during construction and operation, which may consist of select IMW, may be required by Ohio EPA. For a geocomposite drainage layer, the protective layer shall not be placed over wrinkles in the flexible membrane liner that are greater than four inches in height.

(vi) For leachate collection pipes, be provided with access for clean-out devices, be protected from differential settling, and have lengths and configurations that shall not exceed the capabilities of clean-out devices. Leachate collection pipes shall have at least a 0.5 per cent grade after accounting for one hundred per cent of the primary consolidation settlement and ninety-five per cent of the secondary consolidation settlement of the compressible materials beneath the facility which includes, as applicable, in-situ soil, added geologic material, structural fill material, and recompacted soil liner. Secondary settlement shall be calculated using a one hundred year time frame or another time frame acceptable to Ohio EPA.

(vii) For sumps, be equipped with automatic high level alarms located no greater than one foot

above the top elevation of the sump.

(b) Be chemically resistant to attack by the IMW, leachate, or any other material it may contact.

(c) Automatically remove leachate from the industrial landfill or residual landfill to a leachate storage structure, a permitted discharge to a public sewer, or a permitted waste water treatment system.

(d) Conveyance and storage of leachate outside the limits of IMW placement shall comply with the following:

(i) Be no less protective of the environment than the industrial landfill or residual landfill, as determined by Ohio EPA.

(ii) Be monitored if required by Ohio EPA.

(iii) For storage tanks, be provided with spill containment.

(iv) For storage structures, have a minimum of one week of storage capacity, calculated using design assumptions which simulate a final cap system completed in accordance with rule 3745-30-09 of the Administrative Code.

(v) For a leachate pond, have primary and secondary liners with a leak detection system and defined action leakage rate.

(vi) For a leachate pond, have a layer capable of protecting the liner system from damage during pond cleanout.

(vii) For a leachate pond, have no less than three feet of freeboard above the basin capacity.

(e) Ensure leachate is treated and disposed in accordance with one of the following:

(i) At the industrial landfill or residual landfill facility.

(ii) Through on-site pretreatment and either transported or piped off-site for final treatment and disposal.

(iii) Through transportation or piping off-site for treatment and disposal.

(9) A cap drainage layer shall comply with either the following:

(a) Consist of granular drainage material a minimum of one foot thick with a permeability of 1×10^{-3} cm/s. The granular cap drainage layer shall not be placed over wrinkles in the flexible membrane liner that are greater than four inches in height.

(b) Consist of geocomposite drainage layer with a minimum transmissivity to ensure that the cap system meets the slope stability requirements of this rule. The transmissivity shall be adjusted for elastic deformation, creep deformation, biological clogging, and chemical clogging by using the appropriate reduction factors.

(10) A cap protection layer consisting of soil shall comply with the following:

(a) Have a maximum permeability in accordance with the final slope stability calculation.

(b) Have pre-construction testing of the borrow soils performed on representative samples to determine the recompacted laboratory permeability in accordance with ASTM D5084. Testing shall be at a frequency of no less than once for every ten thousand cubic yards and the soil shall be recompacted to no greater than ninety per cent of the maximum dry density determined in accordance with ASTM D698, with a moisture content within one per cent of optimum.

(c) If the cap protective layer is placed on a geocomposite drainage layer, not be placed over wrinkles in the flexible membrane liner that are greater than four inches in height.

(11) Final surfaces of the landfill consisting of soil shall meet the following:

(a) Have a maximum projected erosion rate of five tons per acre per year.

(b) Be constructed with best management practices for erosion control.

(c) Have sufficient fertility in the uppermost portion to support vegetation.

(d) Be constructed in a manner that healthy grasses or other vegetation can form a complete and dense vegetative cover not later than one year after placement.

(12) Surface water control structures shall be designed to minimize silting and scouring and as follows:

(a) For a permanent surface water control structure, to accommodate by non-mechanical means the peak flow from the twenty-five year, twenty-four hour storm event.

(b) For a temporary surface water control structure, to accommodate the peak flow from the twenty-five year, twenty-four hour storm event.

(c) For a sedimentation pond, in accordance with the following:

(i) With a minimum storage volume based on either the calculated runoff volume from a ten year, twenty-four hour storm event, or 0.125 acre-feet per year, for each acre of disturbed area within the upstream drainage area, multiplied by the scheduled frequency of pond clean-out (in years), whichever is greater.

(ii) To ensure the principal spillway safely discharges the flow from a ten year, twenty-four hour storm event. The inlet elevation of the emergency spillway shall be designed to provide flood storage, with no flow entering the emergency spillway, for a twenty-five year, twenty-four hour storm event, with allowance provided for the flow passed by the principal spillway during the event.

(iii) To ensure the combination of principal and emergency spillways safely discharges the flow from a one hundred year, twenty-four hour storm event. The embankment design shall provide for no less than one foot net freeboard when flow is at the design depth, after allowance for embankment settlement.

(13) Survey mark. At least one permanent survey mark shall be established prior to any construction and within easy access to the limits of IMW placement in accordance with the following:

(a) Be referenced horizontally to the North American datum, or state plane coordinate system and vertically to the North American vertical sea level datum as identified by the national geodetic survey.

(b) Be at least as stable as a poured concrete monument ten inches in diameter installed to a depth of forty-two inches below the ground surface including a corrosion resistant metallic disk that indicates horizontal and vertical coordinates of the survey mark and contains a magnet or ferromagnetic rod to allow identification through magnetic detection methods.

(c) Survey control standards for the survey mark shall be in accordance with the following:

(i) The minimum horizontal distance accuracy shall be one foot horizontal to two thousand five hundred feet horizontal.

(ii) The minimum vertical accuracy shall be one inch to five thousand feet horizontal.

(14) Grades of access roads shall not exceed twelve per cent. All access roads shall be designed to allow passage of loaded vehicles during all weather conditions with minimum erosion and dust generation and with adequate drainage.

(15) Ground water control structures.

(a) Permanent ground water control structures shall adequately control ground water infiltration through the use of non-mechanical means such as impermeable barriers or permeable drainage structures. No permanent ground water control structures may be used to dewater an aquifer system, except if the recharge and discharge zone of the aquifer system are located entirely within the boundary of the industrial landfill or residual landfill facility.

(b) For purposes of controlling ground water infiltration until sufficient load has been placed in all locations across the facility such that a 1.40 factor of safety for hydrostatic uplift is achieved, a

pumping system of a temporary ground water control structure shall include a high-level alarm set at an elevation no higher than the base of the recompacted soil liner being protected by the temporary ground water control structure.

(16) Any explosive gas monitoring systems shall be designed and constructed in accordance with rule 3745-27-12 of the Administrative Code.

(17) Any active or passive gas control structures shall be designed to prevent fires within the limits of IMW placement. Construction of the explosive gas control structures shall not compromise the integrity of the cap system, the leachate management system, or the recompacted soil liner. Any explosive gas control structures shall be designed so that explosive gas cannot travel laterally from the industrial landfill or residual landfill facility or accumulate in occupied structures.

(18) An industrial landfill or a residual landfill facility located within a geologically unstable area, other than in an area of potential subsidence resulting from underground mining, shall be designed to resist the earth movement at the site. Geologically unstable areas include any of the following:

(a) Where on-site or local soil conditions result in significant differential settling.

(b) Where the downslope movement of soil or rock due to gravitational influence occurs.

(c) Where the lowering or collapse of the land surface occurs either locally or over broad regional areas.

(19) A separatory liner/leachate collection system shall be designed to serve as a barrier to direct leachate from new IMW placement into the leachate collection system associated with the vertical expansion and to manage any explosive gas generated from the IMW placement below the barrier. The separatory liner/leachate collection system shall have a minimum slope of ten per cent or some alternative slope based on compaction equipment limitation and stability analyses. The amount of IMW filled beneath the separatory liner system needed to obtain the required minimum slope shall be minimized. The separatory liner/leachate collection system may include the following components:

(a) A gas collection layer.

(b) A recompacted soil liner.

(c) A flexible membrane liner.

(d) A leachate collection layer. The leachate collection layer shall be designed to limit the level of leachate to a maximum of one foot on the separatory liner throughout the operation and post-closure care period of the facility.

(e) Leachate collection pipes.

(f) A filter layer.

(g) A geosynthetic clay liner.

(20) Any oil wells and gas wells within the proposed limits of IMW placement shall be properly plugged and abandoned in accordance with Chapter 1509. of the Revised Code.

(E) The owner or operator shall submit the results of the following tests to the appropriate Ohio EPA district office not later than seven days prior to being used in construction of the industrial landfill or residual landfill facility:

(1) For the soil material used in construction of the recompacted soil liner and cap soil barrier layer, of the following tests performed on representative samples:

(a) For a recompacted soil liner, recompacted permeability at construction specifications at a frequency of no less than once for every ten thousand cubic yards.

(b) Moisture content and density in accordance with an approved ASTM method at a frequency of no less than once for every one thousand five hundred cubic yards.

(c) Grain size distribution in accordance with ASTM D6913 and ASTM D7928 at a frequency of no

less than once for every one thousand five hundred cubic yards on recompacted soil liner material and at a frequency of no less than once for every three thousand cubic yards on cap soil barrier layer.

(d) Atterberg limits in accordance with ASTM D4318 at a frequency of no less than once for every one thousand five hundred cubic yards on recompacted soil liner material and at a frequency of no less than once for every three thousand cubic yards on cap soil barrier layer.

(e) For a recompacted soil liner, if the piezometric surface of an underlying aquifer or a zone of significant saturation is above the top of the recompacted soil liner then determine the dispersive clay soils classification by pinhole test in accordance with ASTM D4647 at a frequency of no less than once for every fifty thousand cubic yards.

(f) For a cap soil barrier layer, the maximum dry density and optimum moisture content in accordance with ASTM D698 or ASTM D1557 at a frequency of no less than once for every one thousand five hundred cubic yards.

(2) For soil material used as cap protection layer and to be classified as a "CL" in accordance with ASTM D2487, the following:

(a) Grain size distribution in accordance with ASTM D6913 and ASTM D7928 at a frequency of no less than once for every three thousand cubic yards.

(b) Atterberg limits in accordance with ASTM D4318 at a frequency of no less than once for every three thousand cubic yards.

(3) For soil material used as added geologic material, the following:

(a) The maximum dry density and optimum moisture content in accordance with ASTM D698 or ASTM D1557 at a frequency of no less than once for every ten thousand cubic yards.

(b) The recompacted laboratory permeability in accordance with ASTM D5084 at a frequency of no less than once for every ten thousand cubic yards. This paragraph does not apply if the soil is classified as a low plasticity clay (CL), a silty clay (ML-CL), a high plasticity clay (CH), a clayey

sand (SC) or a clayey gravel (GC) in the "Unified Soil Classification System" described in ASTM D2487.

(c) If the piezometric surface of an underlying aquifer or a zone of significant saturation is above the top of the added geologic material, the dispersive clay soils classification by pinhole test in accordance with ASTM D4647 at a frequency of no less than once for every fifty thousand cubic yards.

(d) Atterberg limits in accordance with ASTM D4318 at a frequency of no less than once for every three thousand cubic yards.

(e) The grain size distribution according to ASTM D6913 and D7928 at a frequency of no less than once for every three thousand cubic yards.

(4) For soil material used as fill, the maximum dry density and optimum moisture content in accordance with ASTM D698 or ASTM D1557 at a frequency of no less than once for every ten thousand cubic yards.

(5) For geosynthetic clay liner, the following:

(a) If the internal drained shear strength is at higher risk of slope failure than the interfaces tested in accordance with paragraph (G) of this rule, the internal drained shear strength in accordance with ASTM D6243 at least twice for the initial use and at least once for each subsequent construction event. Tests involving geosynthetic clay liner material shall be conducted with hydrated samples.

[Comment: If a shear stress point plots below the Mohr-Coulomb shear strength failure envelope defined by the required factor of safety, the test will be considered failed.]

(b) The bentonite mass, at zero per cent moisture content, per square foot of geosynthetic clay liners in accordance with ASTM D5993 at a frequency of no less than once per fifty thousand square feet.

(6) For any granular drainage material used as a drainage medium, to be tested at least once for every three thousand cubic yards of material for the following:

(a) Permeability in accordance with ASTM D2434.

(b) Grain size distribution in accordance with ASTM C136.

(7) For any geocomposite drainage layer, to be tested for transmissivity in accordance with ASTM D4716 at the maximum projected load and a frequency of once per five hundred thousand square feet. The testing shall be performed in a manner representing field conditions.

(8) Chemical compatibility testing as required by the director. At the request of the licensing authority or Ohio EPA results of testing required in this paragraph shall be made available for inspection.

(F) Prior to the installation of the geosynthetics, other synthetic materials, and joint sealing compounds used in the construction of the flexible membrane liner or any other component of the industrial landfill or residual landfill, the owner or operator shall use materials that comply with the following:

(1) Be shown to be physically and chemically resistant to attack by the IMW, leachate, or other materials that the geosynthetic or synthetic material may come in contact with in accordance with USEPA method 9090 or other documented data. Chemical compatibility testing may be required by the director.

(2) Be shown to have properties acceptable for installation and use.

(G) Pre-construction interface testing and reporting. The owner or operator shall test the specific soils and representative samples of the geosynthetic materials that will be used at the site for interface shear strength over the entire range of normal stresses that will develop at the facility. Prior to the initial use of each specific geosynthetic material in the construction of engineered components at a facility, the appropriate shear strengths for all soil to geosynthetic and geosynthetic to geosynthetic interfaces that include the material shall be determined at least twice in accordance with ASTM D5321 or ASTM D6243 and at least once for each subsequent construction event using samples of the materials identified by the initial two tests to be at the highest risk for slope failure.

Tests involving the flexible membrane liner interface shall be conducted with a recompacted soil that has the highest moisture content and the lowest density specified for construction of the recompacted soil liner. Tests involving geosynthetic clay liner material shall be conducted with hydrated samples. The owner or operator shall ensure the results of pre-construction testing pursuant to this rule meet all applicable specifications in this rule and the set of approved parameters in the permit to install application that were established by the geotechnical analysis, be evaluated and signed and sealed by a professional engineer registered in the state of Ohio, and be submitted to the appropriate Ohio EPA district office not later than seven days prior to the intended use of the materials.

(H) The owner or operator shall perform the following activities to ensure that the appropriate components of the industrial landfill or residual landfill facility are constructed to meet the specifications of this rule:

(1) Prior to construction of the recompacted soil liner and whenever there is a significant change in the soil material properties, construct a test pad to model the recompacted soil liner. Test pad construction shall comply with the following unless an alternative capable of ensuring the recompacted soil liner meets the specifications in paragraph (D) of this rule is demonstrated to the satisfaction of Ohio EPA:

(a) Be designed such that the proposed tests are appropriate and their results are valid.

(b) Be constructed to establish the construction details that are necessary to obtain sufficient compaction to satisfy the permeability requirement. The construction details include such items as the lift thickness, the water content necessary to achieve the desired compaction, and the type, weight, and number of passes of construction equipment.

(c) Have a minimum width three times the width of compaction equipment, and a minimum length two times the length of compaction equipment, including power equipment and any attachments.

(d) Be comprised of at least four lifts.

(e) Be tested for field permeability, following the completion of test pad construction, using methods

acceptable to Ohio EPA. For each lift, a minimum of three tests for moisture content and density shall be performed.

(f) Be reconstructed as many times as necessary to meet the permeability requirement. Any amended construction details shall be noted for future soil liner construction.

(2) Describe the recompacted soil liner test pad in a certification report, signed and sealed by a professional engineer registered in the state of Ohio, containing a narrative that proposes the construction details, the range of soil properties that will be used to construct the recompacted soil liner, and the results of the testing required by this paragraph. The report shall be submitted to the appropriate Ohio EPA district office for written concurrence not later than fourteen days prior to the intended construction of the recompacted soil liner that will be modeled by the test pad.

(3) Moisture content and density testing of the recompacted soil liner and recompacted soil barrier in the cap system in accordance with ASTM D6938, ASTM D1556, ASTM D2167, or other methods acceptable to Ohio EPA at a frequency of no less than five tests per acre per lift. Any penetrations shall be repaired using bentonite or using methods acceptable to Ohio EPA.

(4) Test the flexible membrane liner using methods acceptable to Ohio EPA as follows:

(a) For the purpose of testing every seaming apparatus in use each day, peel and shear tests shall be performed on scrap pieces of flexible membrane liner at the beginning of the seaming period and every four hours thereafter.

(b) Nondestructive testing shall be performed on one hundred per cent of the flexible membrane liner seams.

(c) Destructive testing for peel and shear shall be performed at least once for every one thousand feet of seam length. An alternative means may be used if it is demonstrated to Ohio EPA that the alternative means meets the requirements of this paragraph.

(d) Electrical leak location testing in accordance with ASTM D7007 or ASTM D8265 shall be performed following placement of drainage layer or the protective layer over a geocomposite

drainage layer. If testing in accordance with ASTM D7007 or ASTM D8265 is unable to be performed, electrical leak location testing shall be performed in accordance with ASTM D7002, ASTM D7703, ASTM D7240, or ASTM D7953 on the exposed flexible membrane liner. This paragraph does not apply to repairs that are made after the initial electrical leak location testing.

[Comment: Examples of when ASTM D7007 or ASTM D8265 is deemed unable to be performed are conditions with isolation limitations, construction sequencing issues, and due to unique properties of materials used for the drainage layer or protective layer over a geocomposite drainage layer.]

(I) Failed tests. The owner or operator shall investigate all quality assurance/quality control tests failing to meet the specifications outlined in this rule. The owner or operator shall reconstruct an area with a verified failure to meet the specifications contained in this rule and retest the reconstructed areas at a frequency acceptable to Ohio EPA.