Ohio Administrative Code

Rule 3745-27-08 Sanitary landfill facility construction.

Effective: January 1, 2021

(A) Applicability. The construction requirements for a sanitary landfill facility specified in this rule are applicable to a sanitary landfill facility or permit to install application as specified in rules 3745-27-06, 3745-27-07, 3745-27-11, 3745-27-19, and 3745-27-20 of the Administrative Code.

(B) Engineered components for a sanitary landfill facility. The owner or operator shall incorporate the following engineered components in the design and construction of a sanitary landfill facility:

(1) At a minimum, a sanitary landfill facility shall include the following:

(a) A survey mark.

(b) A prepared in-situ foundation.

(c) A composite liner system that includes the following:

(i) A recompacted soil liner or a recompacted soil liner below a geosynthetic clay liner.

(ii) A flexible membrane liner.

(d) A leachate collection and management system that includes the following:

(i) A leachate collection layer.

(ii) Leachate collection pipes.

(iii) A filter layer.

(iv) A sump.

(v) Leachate conveyance apparatus.

(vi) Alternative components to those identified in paragraphs (B)(1)(d)(i) to (B)(1)(d)(v) of this rule if the owner or operator demonstrates to the satisfaction of Ohio EPA that the leachate collection and management system meets the requirements of paragraph (C)(3) of this rule.

(e) Surface water control structures including sedimentation ponds.

(f) A composite cap system that includes the following:

(i) A soil barrier layer or a geosynthetic clay liner above a subbase.

(ii) A flexible membrane liner.

(iii) A drainage layer.

(iv) A cap protection layer.

(v) Alternative components to those identified in paragraphs (B)(1)(f)(i) to (B)(1)(f)(iv) of this rule if the owner or operator demonstrates to the satisfaction of Ohio EPA that the cap system meets the requirements of paragraph (C)(4) of this rule.

(g) An explosive gas control system.

(h) Access roads.

(2) Supplemental engineered components that may be necessary to address site specific conditions including but not limited to the following:

(a) Permanent ground water control structures to control the impact of ground waters on other engineered components.

(b) Structural fill for berms and subbase.

(c) Added geologic material to meet the isolation distance requirement of rule 3745-27-07 of the Administrative Code.

(d) Liner cushion layer.

(e) Leachate storage structures, if there is no permitted discharge to a public sewer system or a permitted waste water treatment system.

(f) Separatory liner/leachate collection systems that may include the following components:

(i) A gas collection layer.

(ii) A recompacted soil liner.

(iii) A flexible membrane liner.

(iv) A leachate collection layer.

(v) Leachate collection pipes.

(vi) A filter layer.

(vii) A geosynthetic clay liner.

(g) Monocell or monofill separatory structures.

(h) A gas collection system.

(3) Optional engineered components that an owner or operator may propose for use in a sanitary landfill facility including but not limited to transitional cover.

(C) General design criteria. The objective of the design for any engineered component or system of components shall be to meet or exceed the specifications for design, construction and quality assurance testing pursuant to paragraph (D) of this rule along with the following general design criteria:

(1) The composite liner system shall be designed to do the following:

(a) Serve as a barrier to prevent the discharge of any leachate to ground or surface waters.

(b) For new facilities or lateral expansions of existing facilities, the composite 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 material includes, 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 100-year time frame or another time frame acceptable to the director.

(c) For existing facilities where an owner or operator proposes to vertically expand over a composite liner system that was constructed after December 31, 2003, the slope of the existing composite liner system located beneath the vertical expansion shall meet the design standard in paragraph (C)(1)(b) of this rule.

[Comment: When initially designing and constructing a composite liner system, a conservative approach may be necessary to account for further settlement of the underlying materials caused by any potential vertical expansion above the initial design.]

[Comment: An owner or operator may revise the applicable authorizing document or modify the facility, with Ohio EPA approval, to meet the design standard in paragraph (C)(1)(b) of this rule.]

(d) For existing facilities where an owner or operator proposes to vertically expand over a composite liner system that was constructed before December 31, 2003, the owner or operator shall demonstrate to the director that the existing composite liner system located beneath the vertical expansion maintains at a minimum positive drainage in the leachate collection system and has no more than one

foot of head of leachate after accounting for the additional waste and one hundred per cent of the primary consolidation settlement and the secondary consolidation settlement of the compressible materials beneath the facility. Compressible material includes, 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 100-year time frame or another time frame acceptable to the director.

(e) Have a maximum slope based on the following:

(i) Compaction equipment limitations.

(ii) Slope stability.

(2) The separatory liner/leachate collection system shall be designed to do the following:

(a) Serve as a barrier to direct leachate from new waste placement into the leachate collection system associated with the vertical expansion and to manage any explosive gas generated from the waste placement below the barrier.

(b) Have at least a 10.0 per cent constructed grade in all areas except along flow lines augmented by leachate collection pipes, or have some other minimum slope based on a design acceptable to the director.

(c) Have a maximum slope based on the following:

(i) Compaction equipment limitations.

(ii) Slope stability.

(d) The leachate collection and management system portion of the separatory liner 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 of the facility.

(e) Include a combination of engineered components as listed in paragraph (B)(2)(f) of this rule that will function throughout the operational life and post closure period of the landfill. Alternative specifications to those included in paragraph (D) of this rule may be proposed in any new permit or permit modification.

(f) Minimize the amount of waste filled beneath the separatory liner system needed to obtain the necessary minimum slope.

(3) The leachate collection and management system shall be designed to do the following:

(a) Incorporate adequate measures that will automatically remove leachate from the landfill to a leachate storage structure, a permitted discharge to a public sewer, or a permitted waste water treatment system, and to facilitate the treatment or transfer of leachate from any storage structure for the purpose of disposal.

(b) Ensure any components located outside of the limits of solid waste placement are no less protective of the environment than the sanitary landfill facility.

(c) Ensure either the selection and specifications for the materials that will make up the leachate collection layer are protective of the flexible membrane liner, or include a liner cushion layer.

(d) Ensure the composite liner system is protected from the intrusion of objects during construction and operation.

(e) Ensure any geosynthetic materials have pre-construction interface testing performed in accordance with paragraph (G) of this rule.

(f) Ensure components of the leachate collection system are designed not to crush or deform under expected maximum loads and settlement to an extent where the crushing or deformation negatively impacts the performance of the leachate collection system.

(g) Ensure the leachate collection system is designed to minimize clogging.

(h) Ensure the selected materials are physically and chemically resistant to attack by the solid waste, leachate, or other materials with which they may come into contact.

(i) Limit the level of leachate in areas other than sumps to a maximum of one foot throughout the operation and post closure of the facility. For the purposes of this rule, a sump is an excavated depression of limited size that serves as a collection and transfer point for leachate.

(j) Have at least a 0.5 per cent grade for the 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 which includes, 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 100-year time frame or another time frame acceptable to the director.

(4) The composite cap system shall be designed to do the following:

(a) Minimize infiltration of surface water.

(b) Serve as a barrier to prevent leachate outbreaks.

(c) Have at least a 5.0 per cent grade in all areas except where surface water control structures are located.

(d) Have a maximum slope based on the following:

(i) Compaction and maintenance equipment limitations.

(ii) Slope stability.

(e) Provide protection for all composite cap system components from the effects of the formation of landfill gas.

(5) 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 such that healthy grasses or other vegetation can form a complete and dense vegetative cover not later than one year after placement.

(6) If applicable, the design of the explosive gas control system may use a passive venting system or an active extraction system to satisfy air pollution control requirements and shall be designed to maintain explosive gas concentrations outside the limits of waste placement below the explosive gas threshold limits identified in rule 3745-27-12 of the Administrative Code.

(7) The design of all geosynthetic materials specified in the engineered components including but not limited to flexible membrane liners, geosynthetic clay liners, and geocomposite drainage layers, shall not rely on any of the tensile qualities of these geosynthetic components. This paragraph does not apply to geosynthetics used to mechanically stabilize embankments.

(8) The design of the excavation, engineered components, and the waste mass shall consider all configurations throughout the applicable developmental and post closure care periods and meet the following:

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

(b) The factor of safety for bearing capacity of any vertical sump risers on the composite liner system shall not be less than 3.0.

(c) The factor of safety for static slope stability shall not be less than 1.50 using two dimensional limit equilibrium methods or another factor of safety using a method acceptable to the director 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. 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) The factor of safety for static slope stability shall not be less than 1.30 using two dimensional limit equilibrium methods or another factor of safety using a method acceptable to the director 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, the analysis shall assume that the weight of the material is loaded or unloaded all at one time at the end of stage construction.

(e) The factor of safety for seismic slope stability 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) Have a factor of safety of not 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. 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. 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 for 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.

(f) The factor of safety against liquefaction shall not be less than 1.00 for internal slopes, interim slopes, and final slopes.

(g) The factor of safety for static slope stability shall not be less than 1.10 using two dimensional limit equilibrium methods or other methods acceptable to the director when assessed for any of the following failure modes and conditions:

(i) If required by the director, 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.

[Comment: The number of digits after the decimal point indicates that rounding can only occur to establish the last digit. For example, 1.485 can be rounded to 1.49, but not 1.5 or 1.50.]

(9) Assumptions used in the performance analyses in paragraph (C)(8) of this rule shall be used to establish the minimum specifications and materials for construction of the sanitary landfill facility.

(D) Design, construction and testing specifications. The owner or operator shall meet or exceed the following specifications in the design, construction, and quality assurance testing of all engineered components of a sanitary landfill facility.

[Comment: The order of the engineered components in this paragraph reflects a logical bottom to top or a typical construction sequencing approach. Reporting requirements will be dependent on which engineered components are being certified. In general, a test pad certification report submitted to Ohio EPA for written concurrence may be used repeatedly in future construction certifications provided the soil properties of the borrow soil remain the same. Pre-construction testing results for borrow soils or shear strength testing results for geosynthetic components may be submitted as often as necessary during the construction process to allow for their continued use. A single construction certification report for each construction project shall be submitted in accordance with rule 3745-27-19 of the Administrative Code to Ohio EPA for written concurrence with all quality assurance testing and for approval of all alterations that are included in the certification report.]

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

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

(b) To 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 marks shall have a minimum horizontal distance accuracy of one foot horizontal to two thousand five hundred feet horizontal and a minimum vertical accuracy of one inch to five thousand feet horizontal.

(2) Surface water control structures. Surface water run-on and run-off control structures shall comply with the following:

(a) Accommodate the peak flow from the twenty-five year, twenty-four hour storm event.

(b) Minimize silting and scouring.

(c) Use non-mechanical means for all permanent structures.

(3) Sedimentation ponds. Sedimentation ponds shall comply with the following:

(a) Have a minimum storage volume, excluding sediment volume, based on the larger of the following:

(i) The calculated run-off volume from a ten year, twenty-four hour storm event.

(ii) The scheduled frequency of pond clean-out, which shall be no more often than once per year, multiplied by 0.125 acre-feet per year for each acre of disturbed area within the upstream drainage area.

(b) Have a principal spillway that safely discharges the flow from a ten year, twenty-four hour storm event using non-mechanical means.

(c) Have an inlet elevation of the emergency spillway to provide flood storage, with no flow entering the emergency spillway while allowing flow through the principal spillway during a twenty-five year,

twenty-four hour storm event.

(d) Have the combination of principal and emergency spillways to safely discharge the flow from a one hundred year, twenty-four hour storm event using non-mechanical means.

(e) Have an embankment design that provides for no less than one foot net freeboard when flow is at the design depth, after allowance for embankment settlement.

(4) 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 shall 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 sanitary 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.

(5) In-situ foundation. The unconsolidated or consolidated stratigraphic units that make up the in-situ foundation shall comply with the following:

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

(b) Not be comprised of solid waste.

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

(d) Be proof rolled, if applicable.

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

(f) Be resistant to internal erosion.

(g) Have quality control testing of any stratigraphic units that have not been anticipated and that are more susceptible to slope failure or seepage piping failure than the stratigraphic units that were tested and reported in the permit to install. This testing shall be at a frequency of three tests per unit and in accordance with the following:

(i) For the effective shear strength of each unconsolidated stratigraphic unit that may be susceptible to slope failure and the recompacted soil liner, determined in accordance with ASTM D3080, ASTM D4767, or ASTM D6467.

(ii) For the undrained shear strength of all applicable unconsolidated stratigraphic units using fully saturated samples, determined in accordance with ASTM D2850 or ASTM D4767.

(iii) For the resistance to internal erosion of each unconsolidated stratigraphic unit that may be susceptible to seepage piping failure, determined 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.

(6) Structural fill. Rock fills or soil fills used in structural berms or subbase shall comply with the following:

(a) Be durable rock for rock fills only.

(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 composite liner system.

(e) For soil fills, 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) Be constructed in loose lifts of twelve 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.

(7) Added geologic material. Added geologic material shall comply with the following:

(a) Provide at least fifteen feet of isolation distance between the uppermost aquifer system and the bottom of the recompacted soil liner.

(b) 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.

(c) Not be comprised of solid waste.

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

(e) Have pre-construction testing of the borrow soils performed on representative samples to determine the following:

(i) 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.

(ii) The recompacted laboratory permeability is a maximum of 1.0 X 10^{-5} cm/sec in accordance with ASTM D5084 tested 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" as described in ASTM D2487.

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

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

(v) 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.

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

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

(h) Have quality control testing of the constructed lifts performed to determine the density and moisture content in accordance with ASTM D6938, ASTM D1556M, 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.

(8) Recompacted soil liner. The recompacted soil liner shall comply with the following:

(a) Have a minimum thickness as follows:

(i) Three feet.

(ii) Two feet when used in conjunction with a geosynthetic clay liner that meets the specifications in paragraph (D)(9) of this rule.

(iii) Two feet for the recompacted soil liner component of a separatory liner/leachate collection system.

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

(c) Not be comprised of solid waste.

(d) Be placed beneath all areas of waste placement.

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

(f) Have pre-construction testing of the borrow soils performed on representative samples and the results submitted to the appropriate Ohio EPA district office not later than seven days prior to the intended use of the material in the construction of the recompacted soil liner. The pre-construction testing shall determine the following:

(i) 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.

(ii) The 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.

(iii) The atterberg limits in accordance with ASTM D4318 at a frequency of no less than once for every one thousand five hundred cubic yards.

(iv) The recompacted laboratory permeability in accordance with ASTM D5084 at a frequency of no less than once for every ten thousand cubic yards.

(v) If the piezometric surface of an underlying aquifer or a zone of significant saturation is above the top of the recompacted soil liner, 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.

(g) Be constructed in lifts to achieve uniform compaction. Each lift shall include the following:

(i) Be constructed with qualified soils and the corresponding construction details established by written concurrence from Ohio EPA with the test pad certification report pursuant to paragraph (E) of this rule, or an alternative to qualifying soils with a test pad if it is demonstrated to the satisfaction of Ohio EPA that the materials and techniques will result in each lift having a maximum

permeability of 1.0 X 10^{-7} cm/sec, and the following specifications:

(a) With loose lifts of eight inches or less.

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

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

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

(ii) Be compacted to at least ninety-five per cent of the maximum dry density determined in accordance with ASTM D698, at least ninety per cent of the maximum dry density determined in accordance with ASTM D1557, or an alternative compaction specification acceptable to Ohio EPA.

(iii) Be placed with a minimum soil moisture content that is not be less than the optimum moisture content determined in accordance with ASTM D698, ASTM D1557, or an alternative soil moisture content specification acceptable to Ohio EPA.

(iv) Have a maximum permeability of 1.0 X 10^{-7} cm/sec.

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

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

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

(j) Have quality control testing of the constructed lifts performed to determine the density and moisture content in accordance with ASTM D6938, ASTM D1556M, ASTM D2167, or other methods acceptable to Ohio EPA at a frequency of no less than five times 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.

(9) Geosynthetic clay liner. A geosynthetic clay liner used as part of the recompacted soil liner or as part of the composite cap system 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) Have pre-construction testing of the geosynthetic clay liner material performed on representative samples and the results submitted to the appropriate Ohio EPA district office not later than seven days prior to the intended use of the material. The pre-construction testing shall determine the following:

(i) 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 shear strength failure envelope defined by the necessary factor of safety, it will be considered a failed test.]

(ii) The dry 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.

(iii) The interface shear strength in accordance with paragraph (G) of this rule.

(d) Be installed in the following manner:

(i) To allow no more than negligible amounts of leakage, maintain 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 the recompacted soil liner when used in liner systems or above an engineered subbase pursuant to paragraph (D)(22) of this rule when used in composite cap systems. 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.

(e) Be adequately protected from damage due to desiccation and erosion.

(10) Flexible membrane liner. The flexible membrane liner shall comply with the following:

(a) Be a sixty mil high density polyethylene (HDPE) geomembrane for composite liner systems or a forty mil geomembrane for composite cap systems or another material or thicknesses acceptable to Ohio EPA.

(b) Be physically and chemically resistant to attack by the solid waste, leachate, or other materials that may come in contact with the flexible membrane liner using SW-846 method 9090 or other documented data.

(c) Have pre-construction interface testing performed according to paragraph (G) of this rule.

(d) Be placed above and in direct and uniform contact with the recompacted soil liner or the recompacted soil barrier layer or the geosynthetic clay liner.

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

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

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

(h) Have quality control testing in accordance with the following, unless the manufacturer's specifications for testing are more stringent, in which case the manufacturer's specifications shall be used:

(i) For the purpose of testing every seaming apparatus in use each day, perform peel tests according to an appropriate method on scrap pieces of flexible membrane liner when an apparatus is started, operators change, an apparatus is restarted, or at the beginning of each seaming period.

(ii) Perform nondestructive testing on one hundred per cent of the flexible membrane liner seams.

(iii) Perform destructive testing for peel according to the appropriate ASTM method on randomly selected samples at a frequency of no less than once per one thousand feet of seam completed by a particular seaming apparatus. An alternate means may be used if it is demonstrated to the satisfaction of Ohio EPA that the alternate means meets the requirements of this paragraph.

(iv) Perform electrical leak location testing in accordance with ASTM D7007 or ASTM D8265 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 include 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.]

(11) Liner cushion layer. The liner cushion layer shall be placed above the flexible membrane liner, protect the flexible membrane liner from damage that may be caused by construction materials and activities, account for the weight of the overlying waste mass, and have pre-construction interface testing performed according to paragraph (G) of this rule. The liner cushion layer shall be adequately protected from solar degradation.

(12) Leachate collection layer. The leachate collection layer shall be placed above the composite liner system, which may be protected by the cushion layer, and shall comply with the following:

(a) Be comprised of granular materials that meet the following requirements:

(i) Have a minimum thickness of one foot.

(ii) Have no more than five per cent of the particles by weight passing through the 200-mesh sieve.

(iii) Have no more than five per cent carbonate content by weight.

(iv) Have a minimum permeability of 1.0×10^{-2} cm/sec.

(v) Have quality control testing in accordance with the following:

(a) Permeability in accordance with ASTM D2434 at a frequency of no less than once for every three thousand cubic yards of material.

(b) Grain size distribution in accordance with ASTM C136 at a frequency of no less than once for every three thousand cubic yards of material.

(c) Carbonate content in accordance with ASTM D3042 at a pH of 4.0 and at a frequency of no less

than once for every ten thousand cubic yards of material.

(vi) An alternate material or thickness may be used provided that it is demonstrated to the satisfaction of Ohio EPA that the material meets the requirements of this paragraph and the appropriate quality control testing and frequency of testing are approved by Ohio EPA prior to use.

(vii) The granular leachate collection layer shall not be placed over wrinkles in the flexible membrane liner that are greater than four inches in height.

(b) For a geocomposite drainage layer used in lieu of a granular drainage layer, the following requirements:

(i) Have a minimum transmissivity to ensure that the leachate collection system meets the one foot of head of leachate requirement of this rule. The transmissivity shall be adjusted for elastic deformation, creep deformation, biological clogging, and chemical clogging by using the appropriate reduction factors.

(ii) To protect the composite liner system from the intrusion of objects during construction and operation, include a minimum of twelve inches of permeable material acceptable to Ohio EPA. The permeable material shall not be placed over wrinkles in the flexible membrane liner that are greater than four inches in height.

(iii) Have quality control testing 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.

(13) Leachate collection pipes. The leachate collection pipes shall comply with the following:

(a) Be embedded in the drainage layer.

(b) Be provided with access for clean-out devices that shall be protected from differential settling.

(c) Have lengths and configurations that shall not exceed the capabilities of clean-out devices.

(d) Have joints sealed to prevent separation.

(e) Sealing material and means of access for cleanout devices shall be resistant to physical and chemical attack by the solid waste, leachate, or other materials with which they may come into contact.

(14) Filter layer. The filter layer of the leachate collection and management system shall comply with the following:

(a) Be placed above the leachate collection layer and leachate collection pipes.

(b) Be designed to minimize clogging of the leachate collection layer, leachate collection pipes, and sumps.

(15) Sumps. The leachate collection and management system shall incorporate an adequate number of sumps that comply with the following:

(a) Be protected from adverse effects from leachate and differential settling.

(b) Be equipped with automatic high level alarms located no greater than one foot above the top elevation of the sump.

(16) Leachate conveyance apparatus. Any leachate conveyance apparatus located outside of the limits of solid waste placement shall comply with the following:

(a) Be monitored as required by the director.

(b) Be protected from the effects of freezing temperatures, crushing, or excess deflection.

(17) Leachate storage structures. Leachate storage structures shall have adequate storage capacity to receive the anticipated amount of leachate removed during normal operations from the leachate sumps to maintain a maximum one foot of head and at a minimum have at least one week of storage

capacity using design assumptions simulating final closure completed in accordance with rule 3745-27-11 of the Administrative Code. Any leachate storage structures located outside of the limits of solid waste placement shall be monitored as required by Ohio EPA and include the following:

(a) For an above ground leachate storage tank, spill containment no less than one hundred ten per cent of the tank volume.

(b) For an underground leachate storage tank, be double cased with a witness zone.

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

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

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

(18) Access roads. All access roads used for waste hauling that are constructed within the horizontal limits of waste placement shall comply with the following:

(a) Not have grades in excess of twelve per cent.

(b) Be designed to be stable and to prevent damage to the liner or composite cap systems caused by the effects of traffic loading and braking or any other action.

(19) Transitional cover. Not later than one hundred twenty days after a portion of the facility reaches final elevations, transitional cover, as specified in rule 3745-27-19 of the Administrative Code, shall be installed that complies with the following:

(a) Consists of a twenty-four inch thick layer of soil with a minimum twelve per cent particles by weight passing through the number 200 sieve. Testing for grain size shall be performed on representative samples of the soil at a frequency of no less than once for every three thousand cubic yards in accordance with ASTM D1140 or ASTM D6913, as appropriate.

(b) Consists of soil that does not contain large objects in such quantities as may interfere with the soil's application and intended purpose, be of sufficient thickness and fertility to support vegetation, and be seeded as soon as practicable. Healthy grasses or other vegetation shall form a complete and dense vegetative cover within one year of soil placement.

(c) An alternative to paragraphs (D)(19)(a) and (D)(19)(b) of this rule may be used if the owner or operator demonstrates to the satisfaction of Ohio EPA that the material will minimize infiltration of surface water and be installed in such a manner to minimize maintenance.

(20) Gas collection system. The gas collection system shall be installed prior to the composite cap system and comply with the following:

(a) Collect and transport gas and condensate without adversely impacting the composite cap system.

(b) Facilitate maintenance to portions of the component without requiring the entire system to be closed down.

[Comment: Condensate may be allowed to remain in the waste mass provided that there is a composite liner and leachate collection system.]

(21) Cap soil barrier layer. Design and construction of a recompacted soil barrier layer in the composite cap system shall comply with the following:

(a) Be at least eighteen inches thick.

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

(c) Not be comprised of solid waste.

(d) Be placed above all areas of waste placement.

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

(f) Have pre-construction testing of the borrow soils performed on representative samples and the results submitted to the appropriate Ohio EPA district office not later than seven days prior to the intended use of the material in the construction of the cap soil barrier layer. The pre-construction testing shall determine the following:

(i) 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.

(ii) The grain size distribution in accordance with ASTM D6913 at a frequency of no less than once for every one thousand five hundred cubic yards.

(iii) The recompacted laboratory permeability in accordance with ASTM D5084 at a frequency of no less than once for every ten thousand cubic yards. If the maximum dry density and optimum moisture content was determined in accordance with ASTM D698, the soil shall be recompacted to at least ninety-five per cent. If the maximum dry density and optimum moisture content was determined in accordance with ASTM D1557, the soil shall be recompacted to at least ninety per cent. The recompacted soil moisture content shall not be less than the optimum moisture content from the prescribed proctor test.

(g) Have a minimum recompacted laboratory permeability of $1.0 \text{ X } 10^{-6}$ cm/s.

(h) Be constructed in lifts to achieve uniform compaction. Each lift shall conform to the following:

(i) Be constructed of soil in accordance with the following:

(a) With loose lifts of eight inches or less.

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

(c) With at least eighty per cent of the particles by weight passing through the number 4 standard mesh screen.

(d) Alternative soil specifications may be used provided that it is demonstrated to the satisfaction of Ohio EPA that the materials and techniques will result in each lift having a maximum permeability of 1.0 X 10^{-6} cm/sec.

(ii) Be compacted to a maximum dry density and minimum soil moisture content not less than that used in the recompacted laboratory permeability test in accordance with paragraph (D)(21)(g) 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 composite cap system.

(j) Have quality control testing of the constructed lifts performed to determine the density and moisture content in accordance with ASTM D6938, ASTM D1556M, 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.

(22) Subbase below a geosynthetic clay liner used in the composite cap system. Design and construction of the subbase shall comply with the following:

(a) The thickness of the subbase shall be sufficient to achieve an evenly graded surface and be a minimum of twelve inches thick.

(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 geosynthetics.

(e) Not have any sharp edged protrusions or any particles protruding more than one quarter of one inch.

(f) 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.

(g) Be constructed in lifts to achieve uniform compaction. Each lift shall include the following:

(i) Soil constructed as follows:

(a) In loose lifts of eight inches or less.

(b) With a maximum clod size that does not exceed the lift thickness.

(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.

(h) Have quality control testing of the constructed lifts performed to determine the density and moisture content in accordance with ASTM D2922 and ASTM D3017, 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.

(23) Cap flexible membrane liner. A flexible membrane liner meeting the requirements of paragraph (D)(10) of this rule with the exception of paragraph (D)(10)(h)(iv) of this rule shall be placed above the recompacted soil barrier layer or the geosynthetic clay liner in the composite cap system.

(24) Cap drainage layer. The drainage layer for the composite cap system shall comply with the following:

(a) Be comprised of granular materials that meet the following requirements:

(i) Have a minimum thickness of one foot.

(ii) Will not clog or freeze.

(iii) Will not damage the underlying flexible membrane liner.

(iv) Have no more than five per cent of the particles by weight passing through the 200-mesh sieve.

(v) Have no greater than ten per cent carbonate content by weight.

(vi) Have a minimum permeability of 1.0×10^{-3} cm/sec.

(vii) Have quality control testing in accordance with the following:

(a) Permeability in accordance with ASTM D2434 at a frequency of no less than once for every three thousand cubic yards of material.

(b) Grain size distribution in accordance with ASTM C136 at a frequency of no less than once for every three thousand cubic yards of material.

(c) Carbonate content in accordance with ASTM D3042 at a pH of 4.0 at a frequency of no less than once for every ten thousand cubic yards of material.

(viii) An alternative material or thickness may be used provided it is demonstrated to the satisfaction of Ohio EPA prior to use that the material meets the requirements of this paragraph.

(ix) Not be placed over wrinkles in the flexible membrane liner that are greater than four inches in height.

(b) A geocomposite drainage layer used in lieu of a granular drainage layer shall meet the following requirements:

(i) Have a minimum transmissivity to ensure that the composite 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.

(ii) Ensure the composite liner system is protected from the intrusion of objects during construction.

(iii) Have quality control testing 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.

(iv) Be comprised of geosynthetic materials that have pre-construction interface testing performed according to paragraph (G) of this rule.

(25) Cap protection layer. A cap protection layer consisting of soil shall comply with the following:

(a) Be placed above the cap drainage layer.

(b) Be a minimum of thirty-six inches thick for facilities located in the northern tier of counties in Ohio (Williams, Fulton, Lucas, Ottawa, Erie, Lorain, Cuyahoga, Lake, Geauga, and Ashtabula counties) and thirty inches thick for facilities located elsewhere in Ohio. The thickness of the drainage layer may be used to satisfy the thickness requirement of the cap protection layer.

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

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

(e) 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. The borrow soil being tested 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.

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

(26) Explosive gas control system. An explosive gas control system shall not compromise the integrity of the composite cap system, the leachate management system, or the composite liner

system, and shall comply with the following:

(a) Accommodate waste settlement.

(b) Provide for the removal of condensate.

(c) Prevent lateral movement of explosive gas from the sanitary landfill facility.

(d) Prevent fires within the limits of solid waste placement.

(E) Test pad construction and certification. The construction of the recompacted soil liner shall be modeled by an approved test pad. The purpose of the test pad is to determine construction details necessary to achieve the permeability standard for recompacted soil liners and to establish a set of parameters for certification of the soils to be used in the construction of the recompacted soil liner. Test pad construction and certification shall comply with the following:

(1) Be designed such that the proposed tests are appropriate and the results of each test are valid.

(2) Have an area large enough to perform valid field permeability testing with 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.

(3) Have a thickness of no less than thirty inches.

(4) Have the following pre-construction testing performed on representative samples of the test pad construction soils at a minimum frequency of twice per lift:

(a) The maximum dry density and optimum moisture content in accordance with ASTM D698, or ASTM D1557.

(b) Grain size distribution in accordance with ASTM D6913 and ASTM D7928.

(c) Atterberg limits in accordance with ASTM D4318.

(5) Be constructed prior to the construction of the recompacted soil liner that the test pad will model.

(6) Include the following construction details:

(a) The maximum loose lift thickness.

(b) The minimum soil moisture content that is not less than the optimum moisture content determined in accordance with ASTM D698 or ASTM D1557.

(c) The minimum soil dry density that is not less than ninety-five per cent of the maximum "Standard Proctor Density" determined in accordance with ASTM D698 or at least ninety per cent of the maximum "Modified Proctor Density" determined in accordance with ASTM D1557.

(d) The specific type and weight of compaction equipment manufactured for the purpose of compacting cohesive soils.

(e) The minimum number of passes of the compaction equipment. For the purposes of this rule, one pass is defined as a single contact of the compactor over an area.

(7) Be reconstructed as follows:

(a) With new borrow soil as many times as necessary to meet the permeability requirement.

(b) Whenever there is a significant change in soil material properties.

(c) Whenever the owner or operator would like to amend the construction details.

(8) 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 three tests per lift. The locations of the individual tests shall be adequately spaced to represent the constructed area. Any penetrations shall be repaired using bentonite.

(9) Have post-construction testing performed for field permeability in accordance with ASTM D6931, ASTM D3385, ASTM D5093, or other methods acceptable to Ohio EPA.

(10) Be described 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 all testing pursuant to 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.

(11) An alternative to test pads may be used if it is demonstrated to the satisfaction of Ohio EPA that the alternative meets the permeability requirements in this rule.

(F) [Reserved.]

(G) Pre-construction interface testing and reporting. The specific soils and representative samples of the geosynthetic materials that will be used at the site shall be tested 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 results of pre-construction testing pursuant to this rule shall meet all applicable specifications in this rule and the set of approved parameters in the permit to install application that were established by the slope stability 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.

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

[Comment: In order to initially test a soil to geosynthetic interface, one should run two tests over the entire range of normal stress to determine the shear strength failure envelope of that interface. Each test should consist of a representative sample of soil and geosynthetic.]

(H) Construction certification report. Pursuant to rule 3745-27-19 of the Administrative Code, a construction certification report shall be prepared and signed and sealed by a professional engineer registered in the state of Ohio and other professionals skilled in the appropriate disciplines, and submitted to Ohio EPA and to the approved board of health. Copies of the daily construction activity logs shall be kept at the facility and be made available to Ohio EPA upon request. The construction certification report shall include the following:

(1) A narrative section that identifies the engineering components that were 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 components that were 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. The alteration request shall be equivalent or more protective than the approved permit to install.

[Comment: Rule 3745-27-19 of the Administrative Code requires that the owner or operator obtain Ohio EPA's written concurrence with the certification report prior to placing waste in the phase. If an

alteration will be submitted within a certification report, it is highly recommended that the appropriate district office of Ohio EPA be notified prior to construction. Ohio EPA may not concur with alterations submitted after they are constructed. If this occurs, reconstruction or amendment of the altered component is necessary prior to waste placement.]

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

[Comment: The listing of these changes is for Ohio EPA's informational purposes only.]

(3) Results of all testing conducted pursuant to this rule and the quality assurance/quality control plan for the construction of any engineered component or group of components. If the results of pre-construction testing of borrow soils were submitted in a format that is acceptable to Ohio EPA, only summary tables of data need to be included in the construction certification report. If a quality assurance/quality control plan is not a requirement of the applicable authorizing document including an approved permit to install, plan approval, operational report, or approved closure plan, the owner or operator shall include at a minimum the results of testing performed, testing procedures, sampling frequency and location, and parameters tested to certify compliance with this rule.

[Comment: 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 need to be investigated and assessed. An area with a verified failure requires reconstruction to meet specifications. Reconstructed areas need to be retested at a frequency acceptable to Ohio EPA. Reconstruction and retesting need to be performed in accordance with rule 3745-27-19 of the Administrative Code.]

(4) Results of all surveys conducted pursuant to this rule, the quality assurance/quality control plan, 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 3745-27-06 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. Survey results shall be reported as

follows:

(a) For the purpose of confirming the constructed elevations of the composite liner system and its distance to the uppermost aquifer system, the bottom of recompacted soil liner 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 of the constructed facility components 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.

(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 waste, the top

elevations of the composite cap system, surface water control structures including ditches to control run on and run off; and 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) The location and as-built detail drawings of all components to be certified using the same views pursuant to rule 3745-27-06 of the Administrative Code.

(f) If the certification report is submitted for the composite cap system, cross sections showing the top elevations of the existing waste, top elevations of the composite 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.

(6) After the initial construction and establishment of facility survey marks, the following information summarizing the activities performed to construct and establish the facility survey marks:

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

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

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

(d) A plan sheet clearly identifying each control point, the facility survey marks, and the limits of solid waste 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 facility survey marks, as constructed.

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

(8) Documentation demonstrating that any oil or gas wells that have been identified within the limits of solid waste 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.

(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 in accordance with this rule and the quality assurance/quality control plan.