

## **15A NCAC 13B .1624 CONSTRUCTION REQUIREMENTS FOR MSWLF FACILITIES**

(a) This Rule establishes the performance standards and minimum criteria for designing and constructing a new MSWLF unit or lateral expansion of existing MSWLF units. Additional standards for the cap system are described in Rule .1627 of this Section.

(b) New MSWLF units and lateral expansions shall comply with the following design and construction criteria:

- (1) Base liner system description. The base liner system is constructed on the landfill subgrade and shall be designed to efficiently contain, collect and remove leachate generated by the MSWLF unit. At a minimum, the components of the liner system shall consist of the following.
  - (A) A Base Liner. The base liner shall consist of one of the following designs. The design described in Subpart (b)(1)(A)(i) of this Rule is the standard composite liner. If a landfill owner or operator proposes to utilize one of the alternative composite liner designs described in Subparts (b)(1)(A)(ii) and (iii) of this Rule, the owner or operator shall demonstrate through a model that the proposed design will ensure that maximum concentration levels (MCLs) listed in Table 1 will not be exceeded in the uppermost aquifer at the relevant point of compliance as established in Rule .1631(a)(2) of this Section. For these two designs, the Division may waive the site-specific modeling requirement if it can be demonstrated that a previous site for which a model was approved had similar hydrogeologic characteristics, climatic factors and volume and physical and chemical leachate characteristics. If an alternative liner design other than Subparts (b)(1)(A)(ii) and (iii) of this Rule is proposed, the Division shall require site-specific, two-phase modeling as described in Subpart (b)(1)(A)(iv) of this Rule.
    - (i) A composite liner utilizing a compacted clay liner (CCL). The composite liner is one liner that consists of two components; a geomembrane liner installed above and in direct and uniform contact with a compacted clay liner with a minimum thickness of 24 inches (0.61 m) and a permeability of no more than  $1.0 \times 10^{-7}$  cm/sec. The composite liner shall be designed and constructed in accordance with Subparagraphs (b)(8) and (10) of this Rule.
    - (ii) A composite liner utilizing a geosynthetic clay liner (GCL). The composite liner is one liner that consists of three components: a geomembrane liner installed above and in uniform contact with a GCL overlying a compacted clay liner with a minimum thickness of 18 inches (0.46 m) and a permeability of no more than  $1.0 \times 10^{-5}$  cm/sec. The composite liner shall be designed and constructed in accordance with Subparagraphs (b)(8), (9), and (10) of this Rule.
    - (iii) A composite liner utilizing two geomembrane liners. The composite liner consists of three components; two geomembrane liners each with an overlying leachate drainage system designed to reduce the maximum predicted head acting on the lower membrane liner to less than one inch. The lower membrane liner shall overlie a compacted clay liner with a minimum thickness of 12 inches (0.31 m) and a permeability of no more than  $1.0 \times 10^{-5}$  cm/sec. The composite liner system shall be designed and constructed in accordance with Subparagraphs (b)(8) and (10) of this Rule.
    - (iv) An alternative base liner. An alternative base liner system may be approved by the Division if the owner or operator demonstrates through a two-phase modeling approach that the alternative liner design meets the following criteria:
      - (I) the rate of leakage through the alternative liner system will be less than or equal to the composite liner system defined in Subparts (b)(1)(A)(i) of this Rule; and
      - (II) the design will ensure that concentration values listed in Table 1 will not be exceeded in the uppermost aquifer at the relevant point of compliance as established in Rule .1631(a)(2) of this Section.
  - (B) A leachate collection system (LCS). The LCS is constructed directly above the base liner and shall be designed to effectively collect and remove leachate from the MSWLF unit. The secondary function of the LCS is to establish a zone of protection between the base liner and the waste. The LCS shall be designed and constructed in accordance with Subparagraphs (b)(2), (11), (12) and (13) of this Rule.
- (2) Leachate collection system design and operation.

- (A) The leachate collection system shall be hydraulically designed to remove leachate from the landfill and ensure that the leachate head on the composite liner does not exceed one foot. A means of quantitatively assessing the performance of the leachate collection system must be provided in the engineering plan. The performance analysis must evaluate the flow capacities of the drainage network necessary to convey leachate to the storage facility or off-site transport location. The engineering evaluation shall incorporate the following criteria:
    - (i) At a minimum, the geometry of the landfill and the leachate collection system shall be designed to control and contain the volume of leachate generated by the 24-hour, 25-year storm.
    - (ii) The performance analysis shall evaluate the leachate collection system for the flow capacities during conditions when the maximum impingement rate occurs on the LCS. The LCS flow capacity shall be designed to reduce the head on the liner system generated by the 24-hour, 25-year storm to less than one foot within 72 hours after the storm event.
  - (B) The leachate collection system shall be designed to provide a zone of protection at least 24 inches separating the composite liner from landfilling activities, or shall be subject to approval from the division upon a demonstration of equivalent protection for the liner system.
  - (C) The leachate collection system shall be designed to resist clogging and promote leachate collection and removal from the landfill.
  - (D) The leachate collection system shall be operated to remove leachate from the landfill in such a way as to ensure that the leachate head on the composite liner does not exceed one foot under normal operating conditions.
- (3) Horizontal separation requirements.
- (A) Property line buffer. New MSWLF units at a new facility shall establish a minimum 300-foot buffer between the MSWLF unit and all property lines.
  - (B) Private residences and wells. All MSWLF units at a new facility shall establish a minimum 500-foot buffer between the MSWLF unit and existing private residences and wells.
  - (C) Surface waters. All MSWLF units at new facilities shall establish a minimum 50-foot buffer between the MSWLF unit and any stream, river, or lake, unless the owner or operator can demonstrate:
    - (i) To the Division that the alternative management of the water and any discharge will adequately protect the public health and environment; and
    - (ii) That the construction activities will conform to the requirements of Sections 404 and 401 of the Clean Water Act.
  - (D) Existing landfill units. An adequate buffer distance shall be established between a new MSWLF unit and any existing landfill units to establish a ground-water monitoring system as set forth in Rule .1631 of this Section.
  - (E) Existing facility buffers. At a minimum, a lateral expansion or new MSWLF unit at an existing facility shall conform to the requirements of the effective permit.
- (4) Vertical separation requirements. A MSWLF unit shall be constructed so that the post settlement bottom elevation of the base liner system is a minimum of four feet above the seasonal high ground-water table and bedrock datum plane contours established in the Design Hydrogeological Report prepared in accordance with Rule .1623(b) of this Section.
- (5) Survey control. One permanent benchmark of known elevation measured from a U.S. Geological Survey benchmark shall be established and maintained for each 50 acres of developed landfill, or part thereof, at the landfill facility. This benchmark shall be the reference point for establishing vertical elevation control.
- (6) Location coordinates. The North Carolina State Plane (NCSP) coordinates shall be established and one of its points shall be the benchmark of known NCSP coordinates.
- (7) Landfill subgrade. The landfill subgrade is the in-situ soil layer(s), constructed embankments, and select fill providing the foundation for construction of the unit. A foundation analysis shall be performed to determine the structural integrity of the subgrade to support the loads and stresses imposed by the weight of the landfill and to support overlying facility components and maintain their integrity of the components. Minimum post-settlement slope for the subgrade shall be two percent. Safety factors shall be specified for facilities located in a Seismic Impact Zones.

- (A) Materials required. The landfill subgrade shall be adequately free of organic material and consist of in-situ soils or a select fill approved by the Division in accordance with the performance standards contained in Subparagraph (b)(7) of this Rule.
  - (B) Construction requirements.
    - (i) The landfill subgrade shall be graded in accordance with the approved plans and specifications, which are incorporated into the permit to construct in accordance with Rule .1604(b) of this Section.
    - (ii) The owner or operator of the MSWLF units may be required by the permit to notify the Division's hydrogeologist and inspect the subgrade when excavation is completed or if bedrock or other unpredicted subsurface conditions are encountered during excavation.
  - (C) Certification requirements. At a minimum, the subgrade surface shall be inspected in accordance with the following requirements:
    - (i) Before beginning construction of the base liner system, the project engineer shall visually inspect the exposed surface to evaluate the suitability of the subgrade and document that the surface is properly prepared and that the elevations are consistent with the approved engineering plans incorporated into the permit to construct in accordance with Rule .1604(b) of this Section;
    - (ii) The subgrade shall be proof-rolled using procedures and equipment specified by the design or project engineer; and
    - (iii) The subgrade shall be tested for density and moisture content at a minimum frequency as specified in the plans incorporated into the permit to construct in accordance with Rule .1604(b) of this Section.
- (8) Compacted clay liners. Compacted clay liners are low permeability barriers designed to control fluid migration in a cap liner system or base liner system.
- (A) Materials required. The soil materials used in constructing a compacted clay liner may consist of on-site or off-site sources, or a combination of sources; sources may possess adequate native properties or may require bentonite conditioning to meet the permeability requirement. The soil material shall be free of particles greater than three inches in any dimension.
  - (B) Construction requirements. Construction methods for the compacted clay liner shall be based upon the type and quality of the borrow source and shall be verified in the field by constructing test pad(s). The project engineer shall ensure that the compacted clay liner installation conforms with the Division approved plans including the following minimum requirements:
    - (i) A test pad shall be constructed prior to beginning installation of the compacted clay liner and whenever there is a significant change in soil material properties. The area and equipment, liner thickness, and subgrade slope and conditions shall be representative of full scale construction. Acceptance and rejection criteria shall be verified for the tests specified in accordance with Part (C) of this Subparagraph. For each lift, a minimum of three test locations shall be established for testing moisture content, density, and a composite sample for recompacted lab permeability. At least one Shelby tube sample for lab permeability testing, or another in-situ test that is approved by the Division as equivalent for permeability determination shall be obtained per lift.
    - (ii) Soil conditioning, placement, and compaction shall be maintained within the range identified in the moisture-density-permeability relation developed in accordance with Subparagraph (C) of this Paragraph.
    - (iii) The final compacted thickness of each lift shall be a maximum of six inches.
    - (iv) Prior to placement of successive lifts, the surface of the lift in place shall be scarified or otherwise conditioned to eliminate lift interfaces.
    - (v) The final lift shall be protected from environmental degradation.
  - (C) Certification requirements. The project engineer shall include in the construction quality assurance report a discussion of all quality assurance and quality control testing required in this Subparagraph. The testing procedures and protocols shall be submitted in accordance with Rule .1621 of this Section and approved by the Division. The results of all testing shall be included in the construction quality assurance report including documentation of any failed test results, descriptions of the procedures used to correct the improperly installed material, and statements of

all retesting performed in accordance with the Division approved plans including the following requirements:

- (i) At a minimum, the quality control testing for accepting materials prior to and during construction of a compacted clay liner shall include: particle size distribution analysis, Atterberg limits, triaxial cell laboratory permeability, moisture content, percent bentonite admixed with soil, and the moisture-density-permeability relation. The project engineer shall certify that the materials used in construction were tested according to the Division approved plans.
  - (ii) At a minimum, the quality assurance testing for evaluating each lift of the compacted clay liner shall include: moisture content and density, and permeability testing. For each location the moisture content and density shall be compared to the appropriate moisture-density-permeability relation. The project engineer shall certify that the liner was constructed using the methods and acceptance criteria consistent with test pad construction and tested in accordance with the plans incorporated into the permit to construct in accordance with Rule .1604(b) of this Section.
  - (iii) Any tests resulting in the penetration of the compacted clay liner shall be repaired using bentonite or as approved by the Division.
- (9) Geosynthetic Clay liners. Geosynthetic clay liners are geosynthetic hydraulic barriers manufactured in sheets and installed by field seaming techniques.
- (A) Materials required. Geosynthetic clay liners shall consist of natural sodium bentonite clay or equivalent, encapsulated between two geotextiles or adhered to a geomembrane. The liner material and any seaming materials shall have chemical and physical resistance not adversely affected by environmental exposure, waste placement, leachate generation and subgrade moisture composition. Accessory bentonite, used for seaming, repairs and penetration seaming shall be made from the same sodium bentonite as used in the geosynthetic clay liner or as recommended by the manufacturer. The type of geosynthetic clay liner shall be approved by the Division according to the criteria set forth in this Part.
    - (i) Reinforced geosynthetic clay liners shall be used on all slopes greater than 10H:IV.
    - (ii) The geosynthetic clay liner material shall have a demonstrated hydraulic conductivity of not more than  $5 \times 10^{-9}$  cm/sec under the anticipated confining pressure.
  - (B) Design and Construction requirements. The design engineer shall ensure that the design of the geosynthetic clay liner installation conforms to the requirements of the manufacturer's recommendations and the Division approved plans. The Division approved plans shall provide for and include the following provisions:
    - (i) The surface of the supporting soil upon which the geosynthetic clay liner will be installed shall be reasonably free of stones, organic matter, protrusions, loose soil, and any abrupt changes in grade that could damage the geosynthetic clay liner;
    - (ii) Materials placed on top of the GCL shall be placed in accordance with the plans incorporated into the permit to construct in accordance with Rule .1604(b) of this Section. Equipment used to install additional geosynthetics shall be specified by the design engineer and as recommended by the manufacturer. A minimum of 12 inches of separation between the application equipment and the geosynthetic clay liner shall be provided when applying soil materials;
    - (iii) Materials that become prematurely hydrated shall be removed, repaired, or replaced, as specified by the project engineer and in accordance with the plans incorporated into the permit to construct prepared in accordance with Rule .1604(b) of this Section;
    - (iv) Field seaming preparation and methods, general orientation criteria, and restrictive weather conditions;
    - (v) Anchor trench design;
    - (vi) Critical tensile forces and slope stability, including seismic design;
    - (vii) Protection from environmental damage; and
    - (viii) Physical protection from the materials installed directly above the geosynthetic clay liner.
  - (C) Certification requirements.

- (i) Before beginning installation of the geosynthetic clay liner, the project engineer shall visually inspect the exposed surface to evaluate the suitability of the subgrade and document that the surface is properly prepared and that the elevations are consistent with the approved engineering plans incorporated into the permit to construct in accordance with Rule .1604 (b) of this Section.
  - (ii) The project engineer shall ensure that the geosynthetic clay installation conforms to the requirements of the manufacturer's recommendations and the plans incorporated into the permit to construct in accordance with Rule .1604 (b) of this Section.
  - (iii) The project engineer shall include in the construction quality assurance report a discussion of quality assurance and quality control testing to document that material is placed in accordance with plans incorporated into the permit to construct in accordance with Rule .1604(b) of this Section.
  - (iv) The project engineer shall include in the construction quality assurance report a discussion of the approved data resulting from the quality assurance and quality control testing required in this Subparagraph.
  - (v) The testing procedures and protocols for field installation shall be submitted in accordance with Rule .1621 of this Section and approved by the Division.
  - (vi) The results of all testing shall be included in the construction quality assurance report, including documentation of any failed test results, descriptions of the procedures used to correct the improperly installed material, and performance documentation of all retesting, in accordance with the plans incorporated into the permit to construct in accordance with Rule .1604 (b) of this Section, including the following:
    - (I) Quality control testing of the raw materials and manufactured product;
    - (II) Field and independent laboratory destructive testing of geosynthetic clay liner samples;
    - (III) Documentation prepared by the project engineer in accordance with Subpart (b)(9)(C)(i) of this Rule.
- (10) Geomembrane liners. Geomembrane liners are geosynthetic hydraulic barriers manufactured in sheets and installed by field seaming techniques.
- (A) Materials required. The liner material and any seaming materials shall have chemical and physical resistance not adversely affected by environmental exposure, waste placement and leachate generation. The type of geomembrane shall be approved by the Division according to the criteria set forth in this Part.
    - (i) High density polyethylene geomembrane liners shall have a minimum thickness of 60 mils.
    - (ii) The minimum thickness of any geomembrane approved by the Division shall be greater than 30 mils.
  - (B) Construction requirements. The project engineer shall ensure that the geomembrane installation conforms to the requirements of the manufacturer's recommendations and the Division approved plans including the following:
    - (i) The surface of the supporting soil upon which the geomembrane will be installed shall be reasonably free of stones, organic matter, protrusions, loose soil, and any abrupt changes in grade that could damage the geomembrane;
    - (ii) Field seaming preparation and methods, general orientation criteria, and restrictive weather conditions;
    - (iii) Anchor trench design;
    - (iv) Critical tensile forces and slope stability;
    - (v) Protection from environmental damage; and
    - (vi) Physical protection from the materials installed directly above the geomembrane.
  - (C) Certification requirements. The project engineer shall include in the construction quality assurance report a discussion of the approved data resulting from the quality assurance and quality control testing required in this Subparagraph. The testing procedures and protocols for field installation shall be submitted in accordance with Rule .1621 of this Section and approved by the Division. The results of all testing shall be included in the construction quality assurance report including documentation of any failed test results, descriptions of the procedures used to correct

the improperly installed material, and statements of all retesting performed in accordance with the plans incorporated into the permit to construct in accordance with Rule .1604(b) of this Section, including the following:

- (i) Quality control testing of the raw materials and manufactured product;
  - (ii) At a minimum, test seams shall be made upon each start of work for each seaming crew, upon every four hours of continuous seaming, every time seaming equipment is changed or if significant changes in geomembrane temperature and weather conditions are observed;
  - (iii) Nondestructive testing of all seams; and
  - (iv) Field and independent laboratory destructive testing of seam samples.
- (11) Leachate collection pipes. A leachate collection pipe network shall be a component of the leachate collection system and shall be hydraulically designed to convey leachate from the MSWLF unit to an appropriately sized leachate storage or treatment facility or a point of off-site transport. Leachate collection piping shall comply with the following:
- (A) Materials required.
    - (i) The leachate collection piping shall have a minimum nominal diameter of six inches.
    - (ii) The chemical properties of the pipe and any materials used in installation shall not be adversely affected by waste placement or leachate generated by the landfill.
    - (iii) The physical properties of the pipe shall provide adequate structural strength to support the maximum static and dynamic loads and stresses imposed by the overlying materials and any equipment used in construction and operation of the landfill. Specifications for the pipe shall be submitted in the engineering report.
  - (B) Construction requirements.
    - (i) Leachate collection piping shall be installed according to the plans incorporated into the permit to construct in accordance with Rule .1604(b) of this Section.
    - (ii) The location and grade of the piping network shall provide access for periodic cleaning.
    - (iii) The bedding material for the leachate collection pipe shall consist of a coarse aggregate installed in direct contact with the pipe. The aggregate shall be chemically compatible with the leachate generated and shall be placed to provide adequate support to the pipe. The bedding material for main collector lines shall be extended to and in direct contact with the waste layer or a graded soil or granular filter.
  - (C) Certification requirements. The project engineer shall include in the construction quality assurance report a discussion of the quality assurance and quality control testing to ensure that the material is placed according to the approved plans. The testing procedures and protocols for field installation shall be submitted in accordance with Rule .1621 of this Section and approved by the Division. The results of all testing shall be included in the construction quality assurance report including documentation of any failed test results, descriptions of the procedures used to correct the improperly installed material, and statements of all retesting performed in accordance with plans incorporated into the permit to construct in accordance with Rule .1604(b) of this Section, including the following:
    - (i) All leachate piping installed from the MSWLF unit to the leachate storage or treatment facility shall be watertight.
    - (ii) The seal where the piping system penetrates the geomembrane shall be inspected and non-destructively tested for leakage.
- (12) Drainage layers. Any soil, granular, or geosynthetic drainage nets used in the leachate collection system shall conform to the following requirements:
- (A) Materials required.
    - (i) The chemical properties of the drainage layer materials shall not be adversely affected by waste placement or leachate generated by the landfill.
    - (ii) The physical and hydraulic properties of the drainage layer materials shall promote lateral drainage of leachate through a zone of relatively high permeability or transmissivity under the predicted loads imposed by overlying materials.
  - (B) Construction requirements.

- (i) The drainage layer materials shall be placed in accordance with the approved plans prepared in accordance with Rule .1604(b) of this Section and in a manner that prevents equipment from working directly on the geomembrane.
      - (ii) The drainage layer materials shall be stable on the slopes specified on the engineering drawings.
    - (C) Certification requirements. The project engineer shall include in the construction quality assurance report a discussion of the quality assurance and quality control testing to ensure that the drainage layer material is placed according to the approved plans. The testing procedures and protocols for field installation shall be submitted in accordance with of Rule .1621 of this Section and approved by the Division. The results of all testing shall be included in the construction quality assurance report including documentation of any failed test results, descriptions of the procedures used to correct the improperly installed material, and statements of all retesting performed in accordance with the approved plans prepared in accordance with Rule .1604(b) of this Section.
- (13) Filter layer criteria. All filter collection layers used in the leachate collection system shall be designed to prevent the migration of fine soil particles into a courser grained material, and permit water or gases to freely enter a drainage medium (pipe or drainage layer) without clogging.
- (A) Materials required.
    - (i) Graded cohesionless soil filters. The granular soil material used as a filter shall have no more than five percent by weight passing the No. 200 sieve and no soil particles larger than three inches in any dimension.
    - (ii) Geosynthetic filters. Geosynthetic filter materials shall demonstrate adequate permeability and soil particle retention, and chemical and physical resistance which is not adversely affected by waste placement, any overlying material or leachate generated by the landfill.
  - (B) Construction requirements. All filter layers shall be installed in accordance with the engineering plan and specifications incorporated into the permit to construct prepared in accordance with Rule .1604(b) of this Section. Geosynthetic filter materials shall not be wrapped directly around leachate collection piping.
  - (C) Certification requirements. The project engineer shall include in the construction quality assurance report a discussion of the quality assurance and quality control testing to ensure that the filter layer material is placed according to the approved plans. The testing procedures and protocols for field installation shall be submitted in accordance with Rule .1621 of this Section and approved by the Division. The results of all testing shall be included in the construction quality assurance report including documentation of any failed test results, descriptions of the procedures used to correct the improperly installed material, and statements of all retesting performed in accordance with the approved plans prepared in accordance with Rule .1604(b) of this Section.
- (14) Special engineering structures. Engineering structures incorporated in the design and necessary to comply with the requirements of this Section shall be specified in the engineering plan. Material, construction, and certification requirements necessary to ensure that the structure is constructed according to the design and acceptable engineering practices shall be included in the Division approved plan.
- (15) Sedimentation and erosion control. Adequate structures and measures shall be designed and maintained to manage the run-off generated by the 24-hour, 25-year storm event, and conform to the requirements of the Sedimentation Pollution Control Law (15A NCAC 4).
- (16) Construction quality assurance (CQA) report.
- (A) A CQA report shall be submitted:
    - (i) After completing landfill construction in order to qualify the constructed MSWLF unit for a permit to operate;
    - (ii) After completing construction of the cap system in accordance with the requirements of Rule .1629; and
    - (iii) According to the reporting schedule developed in accordance with Rule .1621 of this Section.
  - (B) The CQA report shall include, at a minimum, the information prepared in accordance with the requirements of Rule .1621 of this Section containing results of all construction quality assurance

and construction quality control testing required in this Rule including documentation of any failed test results, descriptions of procedures used to correct the improperly installed material and results of all retesting performed. The CQA report shall contain as-built drawings noting any deviation from the approved engineering plans and shall also contain a comprehensive narrative including but not limited to daily reports from the project engineer and a series of color photographs of major project features.

- (C) The CQA report shall bear the seal of the project engineer and a certification that construction was completed in accordance with:
  - (i) The CQA plan;
  - (ii) The conditions of the permit to construct;
  - (iii) The requirements of this Rule; and
  - (iv) Acceptable engineering practices.
- (D) The Division shall review the CQA report within 30 days of a complete submittal to ensure that the report meets the requirements of this Subparagraph.

Table 1

CHEMICAL	MCL(mg/l)
Arsenic	0.05
Barium	1.0
Benzene	0.005
Cadmium	0.01
Carbon Tetrachloride	0.005
Chromium (hexavalent)	0.05
2,4-Dichlorophenoxy acetic acid	0.1
1,4-Dichlorobenzene	0.075
1,2-Dichloroethane	0.005
1,1-Dichloroethylene	0.007
Endrin	0.0002
Fluoride	4
Lindane	0.004
Lead	0.05
Mercury	0.002
Methoxychlor	0.1
Nitrate	10.0
Selenium	0.01
Silver	0.05
Toxaphene	0.005
1,1,1-Trichloromethane	0.2
Trichloroethylene	0.005
2,4,5-Trichlorophenoxy acetic acid	0.01
Vinyl Chloride	0.002

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