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NEWBERRY & TRIBBLE, INC.

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October 2, 2012

Mr. Edward F. Mussler III, P.E.
Permitting Branch Head
North Carolina Dept. of Env. & Natural Resources
1646 Mail Service Center
Raleigh, NC 27699-1646

**Re: East Carolina Regional Landfill
Permit No. 08-03
Bertie County
HHNT Project No. 6703-260-01**

Dear Mr. Mussler:

On behalf of Republic Services of North Carolina, LLC, and the East Carolina Regional Landfill, we request that the protective cover system over the base liner be changed from the currently permitted 24 inch thick system to a 12 inch thick protective system. This 12 inch thick protective system will include a 12 ounce per square yard (osy) geosynthetic cushion installed on top of the FML and then a 12 inch thick layer of permeable media of either sand or gravel. By utilizing the geosynthetic cushion fabric, the protection of the base liner FML will be equal to or more protective than the 24 inch thick protective cover system. Listed below are the principal concerns and the methods these will address for utilization of this system.

Protection of the FML During Construction

1. The protective cover system will include a 12 osy cushion geotextile which will be fully sewn or welded together over the FML. This cushion geotextile exceeds the need for simple cushioning for the protective cover media. This thicker than usual geotextile will fully replace the protective value of the 12 inches of permeable media being eliminated from the protective cover system.
2. The CQA Plan will be revised to require extra care of the FML during construction. Additionally, when more than one low ground pressure dozer is operating on the FML and geotextile cushion fabric spreading permeable media, an additional CQA technician will be on-site to witness the work and assure the FML is protected. (see attached Red Line version of the revised CQA Plan and the Technical Specifications which include enhancements to better protect the FML)
3. The CQA Plan will be revised to require full photo coverage of the protective cover system during and after installation. These photographs will be made part of the CQA report for the respective cell under construction.
4. The gravel leachate collection column will remain 24 inches thick and will have a minimum width of 10 feet at the top of the column. This will protect the leachate collection pipes under

the eventual full waste loading to prevent excessive stress in the pipe and will insure continued leachate collection off the liner.

Protection During Initial Waste Placement

1. Prior to spreading or placement of any waste in the cell area over the alternative protective cover system, the Project Engineer will provide training to the facility operators on placement of waste in the fluff layer to assure the protective cover system is properly maintained. A record of this training will be placed in the facility operating record. This training will take place on every cell with the alternative protective cover system as it is opened for waste disposal. (See attached training program outline)
2. Photos showing the initial waste placement will be taken demonstrating the installation of the fluff lift placement with dozers and not steel wheel compactors.
3. CAES will be utilized to monitor equipment location, including height above lines during the initial fluff layer placement.

Effectiveness of Leachate Collection System

1. A demonstration by Republic Services that the leachate collection system will maintain head on the liner of less than 12 inches in depth shall be provided for each cell, either in the Permit to Construct Application or at the time of Cell Construction. This demonstration will utilize the HELP Model with the specifications of the site's actual protective cover media used for that cell. This will assure that on a cell-by-cell basis, the effectiveness of the leachate collection system is demonstrated.

Appropriateness of the Operator Training and Demonstration of Training

1. The Operation Plan for the facility will be revised to include the minimum training requirements for the initial waste placement training. This training will be accomplished during waste being placed in each cell (see Training Program Outline).
2. The Project Engineer will provide a summary report of the training and this report will be placed in the facility operating record as a demonstration of the training prior to waste placement (see attached Red Line version of the revised Operation Plan).

Appropriateness of CQA

1. The CQA Plan and Technical Specifications have been revised to account for this revised protective cover system. Red Line copies of the revised documents have been included with this request and it is our professional opinion these are appropriate to assure proper performance of the system.

We appreciate your consideration of this request and we look forward to your review for approval. Should you have any questions, please call.

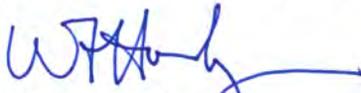
Mr. Edward Mussler, P.E.

October 2, 2012

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Sincerely,

HODGES, HARBIN, NEWBERRY & TRIBBLE, INC.



William F. Hodges, P.E.
Professional Engineer

WFH/dk

cc: Ray Hoffman, P.E.
Matt Einsmann, P.E.

TECHNICAL SPECIFICATIONS REVISIONS

SECTION 02253

PROTECTIVE COVER - ON LINER - NATIVE SANDY SOIL (ALTERNATE BID)

PART 1 GENERAL

1.01 SCOPE OF WORK

This section covers the material and placement of the protective cover system for the base liner system.

1.02 QUALITY ASSURANCE

- A. Quality assurance shall be in accordance with the requirements of Section 01400 Quality Control and the testing program requirements of this section.
- B. A representative of the CQA ENGINEER shall be present at all times during soil cover construction activities.

1.03 RELATED WORK

- A. Section 02747 - Leachate Collection System
- B. Section 02757 – Cushion and Separation Geotextile

1.04 MEASUREMENT AND PAYMENT

- A. Measurement shall be made by survey or field measurement and computed by the DESIGN ENGINEER in cubic yards with the quantity for payment being the produce of the surface area as provided by the Confirmation Surveyor and the required thickness (24") of the protective cover.
- B. Protective cover placed beyond the limits of the lines and grades as shown on the Construction Drawings will not be accepted and must be removed, if directed by the DESIGN ENGINEER, at the Contractor's expense.
- C. The entire Protective Cover must meet or exceed the specified thickness requirements prior to payment.
- D. Payment for work shall be made on the unit price bid in the Proposal.

PART 2 PRODUCTS

2.01 SOIL COVER MATERIAL

- A. Soil that meets all of the following requirements shall be classified as select protective cover native sandy soils for use in construction of the liner protective

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cover.

1. Soil shall be classified according to the United Soil Classification System (USCS) as SW, SP, SM, or SC (ASTM D2487-83). Liquid limit, plasticity index (PI), and percent passing the No. 200 sieve will be considered for proper classification.

Construction Quality Assurance shall meet the following minimum requirements:

<u>Test</u>	<u>Minimum Frequency</u>	<u>Criteria</u>
Permeability (ASTM D2434)	3,000 yd ³	k\$1x10 ⁻³ cm/sec

2. Soil materials shall be reasonably free of gypsum, ferrous, and/or calcareous concretions and nodules, refuse, roots, or other deleterious substances.
3. Continuous and repeated visual inspection of the materials being used will be performed by the CQA ENGINEER to ensure proper soils are being used. In addition, the CQA ENGINEER shall make frequent inspections of the placement operations and materials, and will consult with the site personnel on suitable materials and locations of such. All material shall be taken from select sources or stockpiles.
4. The protective cover native sandy soils shall be uniform, smooth, and reasonably free of debris, rock, plant materials, and other foreign material larger than 3/4 inch in diameter. The material should contain no sharp edges.

PART 3 EXECUTION

3.01 CONSTRUCTION OF PROTECTIVE COVER

- A. Soil for the cover shall be placed and spread with light weight rubber-tired or tracked equipment. All tracked equipment used in placement of the protective soil cover shall be low ground pressure equipment having a ground contact pressure less than 6 psi. Tracked equipment must be operated in such a manner that sharp turns that cause dragging of the tracks over the protective cover are minimized. Haul trucks delivering sand or stone to the cell shall operate over a minimum thickness of 4 feet of protective cover while in the cell. When spreading, the soil shall be stockpiled at depths of a minimum four feet and thence spread to the thickness indicated utilizing light weight rubber-tired or track equipment, so as not to damage the low permeability soil liner, geomembrane, geotextile, or leachate collection system piping.
- B. The soil cover on the floor and side slopes shall be 12 inches thick. The thickness shall be measured perpendicular to the slope of face. Payment quantity shall be equal to the quantity of the underlying geomembrane times 12" thick.
- C. After completion of the protective cover, the protective cover system shall be surveyed to ensure the specified thickness has been achieved.

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- D. Any damage to the geomembrane shall be repaired in accordance with Section 02750 - HDPE Geomembrane Liner and under the direction of the CQA ENGINEER.

--END OF SECTION--

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SECTION 02255

PROTECTIVE COVER - ON LINER - SANDY SOILS

PART 1 GENERAL

1.01 SCOPE OF WORK

This section covers the material and placement of the protective cover system for liner systems utilizing a sandy soil drainage blanket with a permeability of $k \leq 1 \times 10^{-2}$ cm/sec.

1.02 QUALITY ASSURANCE

- A. Quality assurance shall be in accordance with the requirements of Section 01400 – Quality Control and the testing program requirements of this section.
- B. A representative of the CQA ENGINEER shall be present at all times during protective cover construction activities.

1.03 RELATED WORK

- A. Section 02747 – Leachate Collection System
- B. Section 02757 – Cushion and Separation Geotextile

1.04 MEASUREMENT AND PAYMENT

- A. Measurement shall be made by survey or field measurement and computed by the DESIGN ENGINEER in cubic yards with the quantity for payment being the produce of the surface area as provided by the Confirmation Surveyor and the required thickness (12") of the protective cover.
- B. Protective cover placed beyond the limits of the lines and grades as shown on the Construction Drawings will not be accepted and must be removed, if directed by the DESIGN ENGINEER, at the Contractor's expense.
- C. The entire Protective Cover must meet or exceed the specified thickness requirements prior to payment.
- D. Payment for work shall be made on the unit price bid in the Proposal.

PART 2 PRODUCTS

2.01 SANDY SOIL COVER MATERIAL

Material for the sandy soil (protective cover) shall be a loose granular material resulting from the disintegration of rocks, shall be capable of 98% passage through a 1/2" screen and shall have no more than 5% by weight passing the No. 200 sieve. The protective cover material

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shall contain no aggregate rocks, debris, plant material, material with sharp edges, lignite, coal, ash, or carbonaceous material. By-products of industrial processes, with the exception of quarry grinding operations, shall not be accepted. The sandy soil (protective cover) material shall have a permeability of not less than 1×10^{-2} cm/sec.

Construction Quality Assurance shall meet the minimum requirements for the Granular Drainage Media as follows:

<u>Test</u>	<u>Minimum Frequency</u>	<u>Criteria</u>
Grain size to No. 200 sieve (ASTM D 422)	1,500 yd ³	98% < ½" and < 5% passing 200 sieve
Permeability (ASTM D 2434)	3,000 yd ³	k $\geq 1 \times 10^{-2}$ cm/sec

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PART 3 EXECUTION

3.01 CONSTRUCTION OF PROTECTIVE COVER

- A. The CONTRACTOR shall maintain the sand and stone stockpiles from the time he mobilizes to the job site.
- B. Sandy soils for the protective cover shall be placed and spread with light weight rubber-tired or tracked equipment. All tracked equipment used in placement of the protective cover shall be low ground pressure equipment having a ground contact pressure less than six (6) psi. Tracked equipment must be operated in such a manner that sharp turns that cause dragging of the tracks over the protective cover are minimized. Haul trucks delivering sand or stone to the cell shall operate over a minimum thickness of 4 feet of protective cover while in the cell. The delivered material shall be stockpiled at depths of a minimum four feet and thence spread to the thickness indicated utilizing light weight rubber- tired or track equipment so as not to damage the geomembrane liner, geotextile, or leachate collection system piping. Material inadvertently tracked into the cell by the haul trucks which does not meet Section 2.01 above, must be removed.
- C. The sandy soils on the floor and side slopes shall be .12 inches thick. The thickness shall be measured perpendicular to the slope of face. Payment quantity shall be equal to the quantity of underlying geomembrane times .12 inches.
- D. After completion of the protective cover, the protective cover system shall be surveyed to ensure the specified thickness has been achieved.
- E. Any damage to the geomembrane shall be repaired in accordance with Section 02750 HDPE Geomembrane Liner and under the direction of the CQA ENGINEER.

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--END OF SECTION--

2.03 TRANSITION FILTER

Crushed aggregate or river gravel for the transition filter shall be a clean, washed, hard, non-carbonaceous mineral such as quartz. Gravel size shall be No. 89 in accordance with ASTM D448-86 or NC DOT size No. 89 or No. 78M.

2.04 CUSHION GEOTEXTILE FABRIC

Geotextile shall be a total of 12 oz./s.y. non-woven geotextile of polypropylene fibers or polyester yarns which is intended to be and shall be suitable for cushion and separation. This geotextile shall be installed in 2 separate 12 osy layers under the gravel leachate collection column, only. Other areas of the cell will have one layer of this 12 osy material.

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2.05 GEOTEXTILE FABRIC WRAP

Geotextile shall be a 6.0 oz./s.y. non-woven geotextile of polypropylene fibers or polyester yarns which is intended to be and shall be suitable for filtration and separation.

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2.06 SACRIFICIAL SEPARATION GEOTEXTILE FABRIC

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Sacrificial Separation Geotextile Fabric shall be non-woven geotextile of polypropylene fibers or polyester yarns which are intended to be and shall be suitable for separation. Geotextile shall be minimum 6 ounce per square yard fabric in accordance with Section 02757 – Cushion and Separation Geotextile.

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PART 3 EXECUTION

3.01 INSTALLATION

- A. The leachate collection system shall be installed in accordance with the construction details in the Construction Drawings. The leachate pipe shall be embedded in gravel (the gravel leachate collection column) with the gravel providing separation of the pipe from the protective cover. This gravel leachate collection column will be covered with the sacrificial separation geotextile fabric to be removed immediately prior to waste placement.
- B. The OWNER shall provide the services of a Registered Land Surveyor to certify that the thickness of the material required by the plans and specifications is actually in place. This Surveyor shall also prepare an "As-Built" drawing of the site which shows the in-place location of the collection system.
- C. Perforations in leachate collection piping shall be clear during installation. If required, Contractor shall use pressure washer to clean perforations after installation inside cell. This work will be monitored and verified by the CQA tech.

--END OF SECTION--

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SECTION 02757

CUSHION **AND SEPARATION** GEOTEXTILE (NOT IN THIS CONTRACT)

PART 1 DESCRIPTION

1.01 SCOPE OF WORK

- A. The CONTRACTOR shall furnish all labor, materials, tools, supervision, transportation, and installation equipment necessary for the installation of the geotextile layer, as specified herein, as shown on the Construction Drawings, and in accordance with the Construction Quality Assurance (CQA) Manual.
- B. The CONTRACTOR shall be prepared to install the geotextile in conjunction with the earthwork, FML and other components of the liner system.

1.02 REFERENCES

(Note: For geotextile test standards please refer to the current ASTM Annual Book of ASTM Standards, Volume 04.08 Section 4 for the Latest version of the American Society for Testing and Materials (ASTM) Standards.)

1.03 MEASUREMENT AND PAYMENT

- A. Cell Floor Cushion Geotextile
 - 1. Measurement shall be by the square foot as measured by the confirmation surveyor in the geomembrane survey. Measurement shall be the 3-D area on the area lined and shall extend to the top inside edge of the anchor trench.
 - 2. Payment shall be at the unit price in the Proposal.
- B. Leachate Collection Pipe Cushion Geotextile
 - 1. No separate measurement shall be made.
 - 2. Payment shall be considered incidental to the leachate pipe installation.

C. Leachate Collection System Sacrificial Separation Geotextile

- 1. No separate measurement shall be made.
- 2. Payment shall be considered incidental to the leachate pipe installation.

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PART 2 PRODUCTS

2.01 MATERIALS

- A. This section sets forth the requirements for geotextiles.
- B. Physical Properties

The geotextile shall be manufactured using a spunbonded process in which continuous polypropylene filaments are mechanically needled to produce a non-woven geotextile. Manufacturer's certification shall be required stating the geotextile has been inspected for broken needles. This inspection shall be via metal detectors permanently installed on-line at the production facility.

The geotextile shall meet or exceed the properties listed in Table 1. Unless noted otherwise, all numerical values indicate minimum average roll values (i.e., test results from any sampled roll in the lot, when tested in accordance with ASTM D 4759-88 shall meet or exceed the minimum average roll value listed). All strength values are for the weaker principle direction.

TABLE 1

<u>Physical Property</u>	<u>Test Method</u>	<u>Unit Value</u>	<u>Minimum</u>
Mass Per Unit Area	<u>Cushion Geotextile</u> ASTM D 3776	oz/sy	12.0
Puncture Resistance	ASTM D4833	lbs.	95.00
	<u>Separation Geotextile</u>		
<u>Mass Per Unit Area</u>	<u>ASTU D 3776</u>	<u>oz/sy</u>	<u>6.0</u>

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ASTM - American Society for Testing and Materials

- C. Submittals

Prior to bid, the CONTRACTOR shall submit the geotextile manufacturer's specification sheet(s) which indicate the property values of the product(s) that are submitted for use on the project. A swatch (12" x 12") of each geotextile shall be submitted along with the specification sheets.

Prior to arrival of the geotextile(s) on site, upon request the geotextile manufacturer shall supply quality control/quality assurance documents to the OWNER's representative.

Quality control/quality assurance sampling and testing shall be conducted in accordance with ASTM D 4354 and applicable test standards as found in Table 1. Recommended tests and test frequencies are found in Table 2.

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TABLE 2

Property	Minimum Frequency
Mass Per Unit Area	every 100,000 ft ²
Puncture Resistance	every 400,000 ft ²

Additional Supporting Documentation: SUPPLIER shall supply additional documentation which shall include: supporting test data and EPA 9090 test data which will assist the DESIGN ENGINEER in determining the suitability of the geotextile for the intended application.

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D. Plant Inspection

A representative of the OWNER may visit the manufacturing plant at any time during the project to observe and inspect the manufacturing process and quality control monitoring, sampling and testing. The OWNER will notify the SUPPLIER at least forty-eight (48) hours in advance of the intended visit. The SUPPLIER shall be responsible for making all necessary arrangements for the visit with the manufacturer. All costs of travel, lodging and meals incurred by the OWNER's representative will be borne by the OWNER.

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2.02 SHIPPING, STORAGE AND HANDLING

A. General

Geotextile shall be shipped, stored and handled in accordance with ASTM D 4873, and as specified herein. CONTRACTOR shall be completely responsible for storage and handling of all geotextiles.

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B. Roll Identification

Each roll shall be labeled (by printing directly on the geotextile) or tagged with roll identification number, lot identification number, name of manufacturer, product type and grade, and physical dimensions. The label or tag information shall be affixed or attached to the roll at all times during deployment of the roll. The roll identification number and manufacturer name shall also be marked on the protective covering.

C. Shipping

Geotextile shall be shipped and stored in opaque protective covering. LINER OWNER or Supplier CONTRACTOR shall notify the CQA ENGINEER at least 24 hours prior to schedule delivery. No materials shall be unloaded without the presence of the OWNER's representative. Geotextile(s) delivered to the site shall be inspected for damage, unloaded and stored with minimal handling. CONTRACTOR shall assist the OWNER's representative in conducting inventory, handling and sampling of geotextile at no additional cost to the OWNER.

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D. Handling

No hooks, tongs or other sharp tools or instruments shall be used for handling geotextile roll(s). EARTH CONTRACTOR OR LINER CONTRACTOR shall use slings or a pole which extends a minimum of 1 foot beyond each end to unload or handle individual rolls. Geotextile shall not be dragged along the ground.

E. Site Storage

Geotextile roll(s) whose protective covering has been damaged during handling shall be protected from ultraviolet light exposure, precipitation or other inundation, soil, mud, dirt, debris, puncture, cutting or other damaging or deleterious conditions. Geotextile shall not be stored directly on the ground.

2.03 CONFORMANCE TESTING

A. Sampling Procedures

Upon delivery to the site, samples of the geotextile(s) shall be removed and sent to a laboratory, chosen by the OWNER, for testing to ensure conformance to these specifications. Samples shall be selected by the OWNER's representative in accordance with these specifications. Conformance testing, as detailed, in subparagraph 1.05 C, Table 2 shall be performed.

B. Interpretation of Conformance Test Results

Test specimens will be obtained from each conformance sample. The minimum number of specimens tested per conformance sample for each tested geotextile property will be determined in accordance with the respective ASTM Standard. The average value will be calculated from the specimen test values of each conformance sample and compared to the minimum average roll value of the tested geotextile property. A conformance sample that yields an average number which is less than the specified minimum average roll property, will be recorded as a failure. If two conformance samples fail, all rolls within the sampled 100,000 square feet or lot will be rejected for use on the project unless the manufacturer would like to have additional testing performed at no cost to the OWNER. If only one (1) conformance test fails, the roll that yielded the failure will be rejected and a subsequent conformance sample from the same 100,000 square feet or lot will be tested. All rolls within the sampled 100,000 square feet or lot will be rejected for use on the project if the subsequent conformance test fails. Only the roll which yielded a failure will be rejected from use on the project if the subsequent conformance test passes.

2.04 GEOTEXTILE INSPECTION

A. Material Inspection

The CONTRACTOR shall visually inspect all geotextile rolls for imperfections, faulty areas and possible damage prior to installation. All defective rolls shall be marked and repaired in accordance with approved methods.

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PART 3 EXECUTION

3.01 INSTALLATION

A. Placement

Geotextile(s) shall be installed as shown on the Construction Drawings, approved installation drawings, and as specified herein or in accordance with the approved installation procedures. No geotextile roll shall be installed without approval of the CQA ENGINEER. Geotextile rolls shall be placed in such a manner as to minimize field sewing.

Geotextile shall be cut only with an approved geotextile cutter.

All changes to approved installation drawings and procedures shall be approved by the CQA ENGINEER prior to implementation.

The CONTRACTOR shall exercise extreme care during geotextile installation to prevent damage to the prepared supporting subgrade surface or to other installed geosynthetics. The CONTRACTOR shall exercise care to prevent the entrapment of rocks, clods of earth or other matter which could damage the geotextile or other geosynthetic, clog the geotextile or hamper seaming. Any geotextile surface showing damage to penetration by foreign objects or distress shall be replaced or repaired.

No foot traffic shall be allowed on the geotextile except with approved smooth - sole shoes. No vehicular traffic shall be allowed on the geotextile. The CONTRACTOR shall not use the geotextile as a work area or storage area for tools and supplies.

The CQA ENGINEER shall have the authority to order the immediate stoppage of work as a result of improper installation procedures or for any reason which may result in defective and improper installation.

Cleanup within the work area shall be an ongoing responsibility of the CONTRACTOR. Particular care shall be taken to ensure that no trash, tools or other materials are trapped beneath the geotextile.

B. Repairs

Geotextile repairs shall be made with patches of the same geotextile material, using approved sewing systems, equipment and techniques. The patch size shall be 24 inches larger in all directions than the area to be repaired. All corners shall be rounded. All stitches shall be located no closer than 1 inch from the edge of the patch.

C. Joining Methods

Thread used to sew panels of geotextiles together shall be UV stabilized polypropylene. The thread color shall contrast with the geotextile color to assist in inspection of the seam.

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Geotextile seams shall be prayer or flat seams for non-woven geotextiles. All seams shall be formed by mating the edges of the geotextile panels, and sewn together with continuous stitches located a minimum of 3 inches from the mated edges. A two - thread, type 401k double - locked stitch shall be used for all sewing work. Sewing procedures shall conform to the latest procedures recommended by the geotextile manufacturer.

Thermal welding can also be performed on geotextiles with mass per unit area greater than 7.9 ounces per square yard. For both forms of seaming the CONTRACTOR shall demonstrate that the seam efficiency meets requirements found in Table 1.

D. Cover

All geotextile should be covered within 14 days. If the geotextile will be left exposed for more than 14 days, the manufacturer, prior to shipping, shall provide field U.V. test data and written recommendations for the maximum time of U.V. exposure. Geotextiles which will be left exposed for more than 14 days shall be routinely sampled and tested for tensile strengths every 4 weeks. Samples should be taken from the exposed geotextile and these areas properly repaired. If within the time frame of recommended exposure the tensile strength of the geotextile falls below 80% of the original values, the manufacturer shall replace the detective material assuming all cost for removal of the detective material and installation of the replacement material.

E. Socks

Geotextile fabric socks for wrapping pipe shall be constructed with the fabric specified in this section. The sock shall be constructed by forming a cylinder and stitching the seam in accordance with the joining methods specified in this section. The sock diameter shall be sufficient size to slip easily over the pipe and connecting sleeve.

-- END OF SECTION --

CQA PLAN REVISIONS

CONSTRUCTION QUALITY ASSURANCE (CQA) PLAN

CONSTRUCTION OF CELL NO. 13
EAST CAROLINA REGIONAL LANDFILL
BERTIE COUNTY, NORTH CAROLINA
PERMIT NO. 08-03

FOR

REPUBLIC SERVICES OF NORTH CAROLINA, LLC

JUNE 2012



— HODGES, HARBIN, —
NEWBERRY & TRIBBLE, INC.

Consulting Engineers

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I. GENERAL

- A. Republic Services of North Carolina, LLC, (the OWNER) will retain an engineering consulting firm (CQA Firm) to assure that proper construction techniques and procedures are used and to verify that the materials used meet the Contract Specifications. The CQA Firm must employ engineers licensed to practice engineering in the State of North Carolina and experienced in the field of solid waste management and sanitary landfill construction. At the completion of the work, the program requires certification reports indicating that the facility has been constructed in accordance with the Construction Specifications and approved design. It is the responsibility of the certifying Engineer(s) to prepare these reports.
- B. To implement the construction project, a CONTRACTOR, familiar with earthwork and geomembrane construction, will serve as a general contractor (CONTRACTOR) providing construction services. In addition, a CQA ENGINEER will be retained to serve as an independent third party to ensure project conformance of all construction activities to established CQA standards. In most instances, the CONTRACTOR will perform all earthwork activities, and may retain a geomembrane contractor for installation of geosynthetic materials. Republic may, at their discretion, directly contract with a geomembrane contractor for installation of geosynthetic materials. The CQA Plan provides guidance information and procedures that should be undertaken by Republic, the DESIGN ENGINEER, and the CONTRACTOR so the work will be of the quality necessary to meet the project objectives and will be responsive to the requirements of Republic Services of North Carolina, LLC.
- C. This CQA Plan is a supplemental document to the Construction Plans and Specifications for each project. Where a conflict arises, the Contract Documents will govern.
- D. The activities addressed under this CQA Plan include the following activities:
- Grading
 - Clay liner construction
 - Installation of a HDPE geomembrane liner and leachate collection system
 - Placement of soil protective cover
- E. Definitions
- Quality Control: A planned system of activities, or the use of such a system, whose purpose is to provide a level of quality that meets the needs of users. The objective of quality control is to provide construction quality control that is safe, adequate, dependable, and economical. The overall system involves integrating the quality factors of several related steps including: the proper specification of what is wanted, production to meet the full intent of the specification, inspection to determine whether the resulting material, product, service, etc. is in accordance with the Construction Specifications, and review of usage to determine necessary revisions of the Construction Specifications.

In practice, Quality Control refers to those procedures, criteria, and tests employed and paid for by the CONTRACTOR(s) to confirm that the work satisfies the CONTRACTOR's standards and is in compliance with the Construction Plans and Specifications. This plan does not address quality control procedures, criteria, and/or tests employed by the CONTRACTOR.

- Quality Assurance: A planned system of activities whose purpose is to provide assurance that the overall quality control program is in fact being effectively implemented. The system involves a continuing evaluation of the adequacy and effectiveness of the overall quality control program with the ability to have corrective measures initiated where necessary. For a specific material, product, service, etc., this involves verifications, audits, and the evaluation of the quality factors that affect the specification, production, inspection, and use of the product, service, system, or environment.

In practice, Quality Assurance refers to those procedures, criteria, and tests required and paid for by the OWNER to confirm that the work performed by the CONTRACTOR(s) is in compliance with the approved Construction Plans and Specifications and any additional requirements of this Plan.

- Lot: A quantity of resin (usually the capacity of one rail car) used in the manufacture of polyethylene geomembrane rolls. The finished roll will be identified by a roll number traceable to the resin lot used.
- Panel: The unit area of geomembrane that will be seamed in the field. A panel is identified as a roll or portion of a roll that is larger than 100 square feet.
- Subgrade Surface: The soil layer surface which immediately underlies the structural fill, compacted clay liner/cap, or geomembrane liner/cap.

F. Parties referenced in this CQA Plan shall consist of the following:

1. DESIGN ENGINEER: The DESIGN ENGINEER is the official representative of the OWNER. The DESIGN ENGINEER is responsible for the preparation of the construction plans and specifications of the project and for the preparation of the CQA Plan. The DESIGN ENGINEER is also responsible for the interpretation of these documents and for resolution of construction matters that arise during construction. The DESIGN ENGINEER shall review and approve shop drawings, authorize minor variations in the work from the contract documents and reject defective work (duties and responsibilities are described in the General Conditions as "ENGINEER"). The DESIGN ENGINEER shall be a registered professional engineer licensed in North Carolina.

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2. **CQA ENGINEER:** Responsible for defining quality assurance, requirements compatible with the project objectives, verifying basic data as reasonable and complete, outlining procedures to process data, development of statistical procedures for the analysis of test data and preparing quality assurance memoranda and quality control reports. The CQA ENGINEER shall report to the DESIGN ENGINEER. The CQA ENGINEER shall be a registered professional engineer licensed in North Carolina. Reference to the CQA ENGINEER, for the purpose of this document, shall include the CQA ENGINEER or his representative.
3. **Engineering Technicians:** Responsible for field observations, testing and inspection. Technicians will be assigned to the project as deemed necessary by the CQA ENGINEER and will be responsible to the CQA ENGINEER. The CQA ENGINEER, Technician or the CQA ENGINEER's representative shall be on-site during all construction activities, except clearing and grubbing and initial cell excavation. A daily log of all field technicians, testing and inspection shall be maintained by the Technician.
4. **OWNER:** The OWNER is the individual, entity, public body, or authority with whom the CONTRACTOR has entered into the Agreement and for whom the Work is performed. For this project, the OWNER is Republic Services of North Carolina, LLC.
5. **CONTRACTOR:** The CONTRACTOR has the primary responsibility for ensuring that the landfill cell is constructed in accordance with the Construction Plans and Specifications developed by the ENGINEER and approved by the permitting agency. Other responsibilities include the performance of all construction activities at the site including site facilities, administration, material purchasing, procurement, supervision, construction quality control, installation, and subcontracting. The CONTRACTOR is responsible for the protection of completed work until it is accepted by the OWNER. The CONTRACTOR is also responsible for informing the OWNER and CQA Consultants of the scheduling and occurrence of all construction activities.
6. **Geomembrane Manufacturer (Manufacturer):** The party responsible for manufacturing the geomembrane rolls.
7. **Geosynthetic CQA Laboratory (Testing Laboratory):** Party, independent from the OWNER, Manufacturer and Installer, responsible for completing laboratory tests on samples of geosynthetics obtained at the site or during manufacturing usually under the direction of the OWNER.
8. **Geotechnical CQA Laboratory:** Party, independent from the OWNER or CONTRACTOR, responsible for completing laboratory tests on soil samples obtained at the site or source usually under the direction of the OWNER.
9. **Geomembrane Installer (Installer):** The Installer is responsible for field handling, sorting, placing, seaming, loading (against wind), and other aspects of the geosynthetics installation, including geomembranes,

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geotextiles, geocomposites, geosynthetic clay liners, and geocomposite composites.

II. GRADING

A. GENERAL

The CQA ENGINEER shall test the grading, placement, and compaction of in-situ materials and structural fill. The CQA ENGINEER shall certify the materials and construction were in accordance with the plans, specifications, and this CQA Plan.

B. RELATED WORK

The CQA ENGINEER should reference the grading section of the technical specifications for pertinent soil materials, physical properties and construction requirements.

C. SUBGRADES

During construction, conformance and performance testing of the subgrade soil materials shall be performed by the CQA ENGINEER. The CQA ENGINEER shall monitor proofrolling of areas that are cut to achieve grade. Material placed to achieve grades indicated on the plans shall be tested by the CQA ENGINEER in accordance with the test methods and frequencies listed herein to verify that the compacted fill materials used by the CONTRACTOR complies with the technical specifications. Areas of proofrolling or compacted fill that do not conform to the technical specifications will be delineated and reported to the CONTRACTOR. These areas will be re-worked by the CONTRACTOR and re-tested until passing results are achieved.

The CQA ENGINEER shall monitor the repair and re-work of subgrade which is damaged by excess moisture (causing softening) and insufficient moisture (causing desiccation and shrinkage) or by freezing. If such conditions are found to exist, the CQA ENGINEER shall evaluate by the suitability of the subgrade by the following methods as applicable:

- moisture / density testing;
- continuous visual inspection during proof-rolling;
- other test methods identified herein.

D. CONFORMANCE TESTING

It will be necessary for the CQA ENGINEER to observe and test the structural fill soils to ensure they are uniform and conform to the requirements of the technical specifications. For soil materials obtained from on-site or off-site borrow areas, visual inspections and conformance tests shall be performed by the CQA ENGINEER prior to the materials being used. Borrow area inspections may also be utilized by the CQA ENGINEER to ensure that only suitable soil materials are transported to the site. For both on-site and off-site borrow areas containing non-

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uniform materials, it shall be necessary for the CONTRACTOR and the CQA ENGINEER to coordinate excavation and monitoring of the segregation of substandard materials. All materials failing to comply with conformance standards shall be rejected for use.

Initial evaluation of various soil types by the CQA personnel during construction shall be largely visual; therefore, the CQA personnel must be experienced with visual-manual soil classification procedures. CQA personnel shall observe soils for deleterious materials (e.g., roots, stumps, rocks, and large objects). When necessary, the visual-manual procedure for the description and identification of soils shall be conducted by the CQA ENGINEER and the description shall be in accordance with test method ASTM D2488.

E. TEST METHODS AND FREQUENCY

All testing shall be conducted in accordance with the technical specifications or as directed by the DESIGN ENGINEER. The field testing methods, used to evaluate the suitability of soils during their installation, shall be performed by the CQA ENGINEER in accordance with current ASTM test procedures indicated in the table below. Documentation and reporting of the test results shall be the responsibility of the CQA ENGINEER.

The Standard Proctor Test (ASTM D698) shall be used for the determination of moisture / density relationships unless otherwise indicated. In-place surface moisture / density nuclear test method ASTM D2922 or drive cylinder test method ASTM D2937 shall be used for in-situ field testing. The sand cone test method ASTM D1556 or drive cylinder test method ASTM D2937 shall be used to establish correlations of moisture and density in cases of uncertainty, and as a check of the nuclear surface moisture / density gauge calibration. Any conflict regarding acceptance of test results shall be resolved by the DESIGN ENGINEER.

Testing shall be conducted during the course of the work. The minimum construction testing frequencies are presented in the table below. The frequency may be increased at the discretion of the CQA ENGINEER or if variability of the materials is observed by the CQA ENGINEER. Sampling locations shall be selected by the CQA ENGINEER. If necessary, the location of routine in-place density tests shall be determined using a non-biased sampling approach.

A special testing frequency shall be used at the discretion of the CQA ENGINEER when visual observations of construction performance indicate a potential problem.

MINIMUM TESTING REQUIREMENTS FOR STRUCTURAL FILL	
<u>TEST</u>	<u>FREQUENCY</u>
Laboratory Moisture-Density / ASTM D698	1 test for each type of soil encountered
Liquid Limit, Plastic Limit, Plasticity Index / ASTM D4318	1 test for each type of soil encountered
Sieve Analysis / ASTM D422	1 test for each type of soil encountered

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Field Density and Moisture Content / Sand Cone, ASTM D1556 Drive Cylinder, ASTM D2937 Nuclear, ASTM D2922	1 test per 1,000 c.y. of structural fill
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F. COMPACTION

The CQA ENGINEER shall confirm that structural fill conforms to compaction requirements as follows:

<u>Description</u>	<u>General Compaction</u>	<u>Top 12"</u>
Sediment Pond Embankments	95%	95%
Roadways	95%	98%
Shoulders and Embankments	95%	95%
Utilities Under Structures	95%	98%
Other Areas	95%	95%

G. PROTECTION OF SUBGRADES AND FILL SURFACES

The CQA ENGINEER shall monitor newly graded areas to verify the CONTRACTOR is protecting these areas from traffic and erosion until construction is complete.

III. COMPACTED CLAY LINER

A. GENERAL

1. The CQA ENGINEER shall certify the materials and installation are in accordance with the plans, specifications, and this CQA Plan.

B. MATERIAL

1. The clay liner material shall consist of on-site cohesive soils, synthetically improved soils, or imported cohesive soils meeting the permeability criteria of $k \leq 1.0 \times 10^{-7}$ cm/sec. Soils used in compacted clay liners shall consist of clean, select material free of debris, excessive coarse particles or other deleterious matter. Liner material shall be clayey soil, classified according to the United Soil Classification System as SC, CL, CH, ML, or MH (ASTM D2487).

C. STOCKPILING AND MATERIAL APPROVAL

1. All material to be used as the clay liner shall be approved in advance by the CQA ENGINEER. Approval is based upon successful completion of CQA testing outlined herein. Such testing can be performed either during excavation and stockpiling or from existing stockpiles prior to use.

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2. The procedure for testing during excavation and stockpiling is outlined below.
 - a. Each load of soil will be examined either at the borrow source or the stockpile area. Any unsuitable material will be rejected or routed to separate stockpiles consistent with its end use.
 - b. During stockpiling operations, one bulk sample of material placed will be collected. The following tests will be performed prior to placement of any compacted clay liner material:
 1. Method for Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures, ASTM D2216.
 2. Method for Particle - Size Analysis of Soils, ASTM D422.
 3. Test Method for Liquid Limit, and Plasticity Index of Soils, ASTM D4318.
 - c. One (1) sample for every 10,000 cubic yards of material stockpiled will be selected for moisture – density relationship (ASTM D698) and corresponding permeability testing (ASTM D 5084-90 Measurement of Hydraulic Conductivity of Saturated Porous Materials using a Flexible Wall Parameter).
3. Reports for clay liner will be prepared by the CQA ENGINEER and shall include:
 - a. Summary of laboratory test data,
 - b. A summary of construction, sampling and testing method, and recommendations.

D. TEST PAD

1. A test pad will be constructed using the same construction methods, equipment, and material to be used for the clay liner component. The test pad construction will be conducted prior to or coincide with the beginning of construction of clay liner component.
2. Construction equipment and methods shall be reviewed by the CQA ENGINEER prior to test fill placement.
3. Construction methods, sampling, and testing, including permeability testing, shall be specified by the CQA ENGINEER.

E. SUBGRADE

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1. The CQA ENGINEER shall verify that the clay liner subgrade is constructed in accordance with the grading specifications.
2. The landfill cell shall be excavated to the lines and grades as indicated on the drawings. The subgrade shall be scarified to a depth of 6" and compacted to 95% as determined by the Standard Proctor Test, ASTM-D698.
3. The subgrade shall be reasonably free of large rocks, roots, stumps and other debris.
4. Existing and future drainage channels shall be cleaned so that all sediment, vegetation, and deleterious material is removed prior to placement of the compacted clay liner in these areas.

F. CONSTRUCTION

1. Clay Liner shall be placed to conform to the $k \leq 1.0 \times 10^{-7}$ cm/sec permeability criteria.
2. Only soil previously approved by the CQA ENGINEER shall be used in construction of the clay liner. Unsuitable material will be removed prior to acceptance by the CQA ENGINEER.
3. All required field density and moisture content tests shall be completed before the overlying lift of soil is placed. The surface preparation (e.g. wetting, drying, scarification, etc.) shall be completed before the CQA ENGINEER will allow placement of subsequent lifts.
4. Moisture content will be monitored by the CQA ENGINEER or his representative prior to compaction. If the soil is drier than the specified minimum moisture content, water will be added and the lift will be mixed to distribute the moisture evenly.

The surface of each lift shall be scarified prior to placement of subsequent lifts.

5. The thickness of the loose lift shall be measured at random locations after spreading and leveling is completed. Loose lift thickness should not exceed 10" for a final 6" compacted lift thickness.

Each lift shall be checked visually for rocks, debris, plant materials, and other foreign material. The upper 6" of clay liner shall be reasonably free of material which will not pass through a 1" screen. The remaining 18" of compacted clay liner (below the top 6") shall be free of material which will not pass through a 3" screen. This may require mechanical pulverizing of these soils.

6. The exposed surface of the clay liner shall be rolled with a smooth drum roller or equivalent at the end of each work day or when required to protect the compacted clay from adverse weather conditions.

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7. The finished clay liner shall be reasonably free of all rock or rock fragments within 6" of the surface. Rock or rock fragments are defined as the material retained by a standard 1" screen. Protrusions shall be removed and all cracks and voids shall be filled and the surface made uniform. Rock or other material protruding more than 1/2" shall not be allowed. This shall be accomplished by final dressing of the soil liner with smooth drum rollers and hand raking.
8. The surface on which the geomembrane is to be placed shall be maintained in a firm, clean, dry and smooth condition before and during the liner installation.
9. The CQA ENGINEER shall inspect the clay liner and certify that it is in accordance with the specifications and approved plans and receive concurrence of the state prior to the CONTRACTOR beginning installation of geomembrane. This may require separate certifications of liner sections. If this is required, surveys of each section shall be provided by the CONTRACTOR to define the limits of these sections. Placement of geomembrane on any portion of the soil liner surface by the geomembrane installer will constitute his acceptance of the surface.

G. SAMPLING AND TESTING

1. The CQA ENGINEER or his representative will perform field density tests to assure that the soil density and moisture content are within the prescribed limits. The frequency of testing is noted below.
2. Bottom and Sidewall of Cell
 - a. Field density tests shall be performed at the rate of one per 10,000 square feet of lined area for each lift of the clay liner base and the subgrade.
 - b. The field density tests will be performed using a nuclear density gauge or drive tube method. The location of each test will be randomly determined by the CQA ENGINEER or his representative. All holes shall be repaired as described below.
 - c. Perforations in the clay liner resulting from sampling or testing procedures, survey stakes or other activities shall be identified and backfilled by the CQA ENGINEER. The perforations shall be filled with a soil-bentonite mix consisting of 10% minimum by weight bentonite powder or granules mixed with clay liner material. The perforations shall be backfilled with the soil-bentonite mixture in 3-inch loose lifts and thoroughly compacted by hand tamping by the CQA ENGINEER.
 - d. Two bulk samples of the clay liner for each lift will be collected during placement or compaction. The following tests will be performed:

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1. Method for Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures, ASTM D2216.
 2. Method for particle-Size Analysis of Soils, ASTM D422.
 3. Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils, ASTM D4318.
 4. Moisture - Density Relationship, ASTM D 698.
- e. One sample per acre per each lift of clay liner component will be selected by the CQA ENGINEER for permeability testing (ASTM D5084-90).
- f. A one square foot section of clay liner for every 20,000 square feet of liner shall be screened with acceptance of the liner will be based on the following criteria:

UPPER 6" CLAY LINER	
Percentage of Material Passing (by weight)	Screen Size
95% (all tests)	1"
100% (avg. of all tests)	3"

UPPER 18" CLAY LINER	
Percentage of Material Passing (by weight)	Screen Size
100% (avg. of all tests)	3"

Should any sample fail the 95% or 100% passing requirement of the upper 6", then four (4) additional test areas within the 20,000 square foot test area shall be selected by the CQA ENGINEER and tested in like manner. If the four (4) areas pass, then all test areas shall be repaired and the 20,000 square foot area accepted. If any one (1) of the four (4) areas fails, then the 20,000 square foot area shall be reworked and retested. Alternatively, should any sample fail the 95% or 100% passing requirement, the entire area represented by the test (20,000 square feet) may be reworked and resampled by a single test sample. Rocks or roots remaining on or protruding through the surface shall be removed and the surface repaired. These rocks or roots will not be cause for rejection.

- g. The following procedure shall be used in the event of density or permeability test failure. If density tests do not meet minimum requirements of the specifications, recompaction of the failed area

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(minimum 100' x 100') shall be performed and retested until the area meets or exceeds requirements outlined in the specifications. If a permeability sample fails to meet the minimum hydraulic conductivity requirements outlined in the specifications, at least five (5) replicate samples shall be obtained in the immediate vicinity of the failed test. Should the replicate samples confirm the failure of the soil to meet specifications, the area of failure shall be localized and reconstructed in accordance with the specifications. This area shall be retested as outlined within the plan. Alternatively, the entire 40,000 square foot area representing the failing permeability sample shall be reworked and retested for density, moisture and permeability.

IV. HDPE GEOMEMBRANE LINER

A. GENERAL

Stringent quality assurance and careful documentation are required in the production and installation of all geosynthetic materials. The work addressed under this section shall facilitate proper construction of all geosynthetic components of the liner for the landfill. All work shall be constructed to the lines, grades, and dimensions indicated on the project plans, in accordance with the Construction Specifications, or as required by the OWNER or DESIGN ENGINEER.

The CQA ENGINEER shall issue a written daily report of activities to the DESIGN ENGINEER. These reports shall include, at a minimum, observations and test results as well as problems encountered and solutions achieved. Construction reports summarizing significant events, as well as addressing all problems encountered and their solutions, shall be issued to the DESIGN ENGINEER. The format of these reports and frequency shall be established at the pre-construction meeting.

The CQA ENGINEER shall certify the materials and installation are in accordance with the plans, specifications, and this CQA Plan.

B. MATERIAL

1. The geomembrane will be 60 mil High Density Polyethylene (HDPE) supplied and installed by firms approved by the OWNER.
2. Seams for providing watertight joints will be extrusion or double hot wedge fusion seams using techniques approved by the CQA ENGINEER.
3. Construction Quality Assurance shall confirm the material meets the minimum physical properties and test frequencies of the Geosynthetic Research Institute GRI Test Method GM-13, as latest revised, for 60 mil High Density Polyethylene (HDPE) Geomembrane. The minimum

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thickness requirement shall be for the lowest individual measurement, not the average.

4. The CQA ENGINEER or his representative will sample two (2) rolls from each shipment of geomembrane at the manufacturing plant prior to shipment to the site.
5. The random samples must be representative of the material supplied and exclude the outer wrap of geomembrane if signs of scuffing or other damage is observed. Samples should be full roll width and at least 2 feet long.
6. The laboratory testing of the samples selected by the CQA representative shall be directed by the CQA ENGINEER and shall confirm conformance with the following properties:
 - a. Thickness (ASTM D5199 for smooth sheet
ASTM D5994 for textured sheet)
 - b. Density (ASTM D1505)
 - c. Melt Index (ASTM D1238)
 - d. Carbon Black Content (ASTM D1603)
 - e. Tensile Properties (ASTM D6693 or GRI GM-13)
 - f. Tear Resistance (ASTM D1004, DIE C)
 - g. Asperity Height (GRI GM-12)
7. The CQA ENGINEER or his representative will measure geomembrane thickness of each roll made for the project at the manufacturing plant prior to shipment. Material that does not fall within acceptable thickness criteria will be rejected.

C. GEOMEMBRANE MANUFACTURER AND INSTALLER

1. The Geomembrane Installer will submit the following as obtained from the Geomembrane Manufacturer to the CQA ENGINEER:
 - a. Production Certification including project references
 - b. Testing Program of Compound Ingredients
 - c. Material Certification
 - d. Test Data for Material and Resin
 - e. All of the above submittals will be reviewed and retained by the CQA ENGINEER
2. The Geomembrane Installer will submit the following to the CQA ENGINEER prior to the installation:

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- a. Qualifications of Geomembrane Installer Superintendent and Foreman
- b. Resumes of Geomembrane CONTRACTOR field crew
- c. Six (6) sets of geomembrane panel layout drawings

D. DELIVERY AND STORAGE

1. Upon delivery at the site, the CQA ENGINEER shall inventory all rolls and conduct a surface observation of each roll or factory panel for defects or damage. The inspection will be performed without unrolling rolls or unfolding factory panels unless defects or damages are found or suspected. The CQA ENGINEER will indicate those rolls with severe flaws that should be removed from the site and those rolls with minor flaws.
2. The CONTRACTOR will be responsible for the storage of the geomembrane on-site upon arriving at the site. The OWNER will provide storage space in a location (or several locations) such that on-site transportation and handling are minimized. Storage space should be protected from theft, vandalism, passage of vehicles, etc.
3. The CQA ENGINEER will verify that storage space selected is in a well-drained area and that cribbing techniques have been used as needed to ensure that the materials will not be sitting in ponded water in the event of rainfall.

E. GEOMEMBRANE INSTALLATION

1. An initial CQA meeting will be held prior to installation (pre-deployment meeting). The Geomembrane Installer, CQA ENGINEER or his representative, and a representative of the OWNER will be in attendance. The following issues will be discussed and agreed upon by all parties and shall be included in a report in the CQA documentation.
 - a. Testing of welds
 - b. Characteristics of "good" weld, and
 - c. Repair procedures
2. The CQA ENGINEER or his representative will mark all areas where grinding is considered to be excessive. The location and repair method for the excessive grinding will be recorded in the daily field reports. The method or repair will be determined by the CQA ENGINEER.
3. Overheating of the geomembrane will be monitored by the CQA ENGINEER or his representative. At the discretion of the CQA ENGINEER, coupons will be cut from the end of the extrusion seams and the bottom side of the seam will be observed for visible warping or deformation. The location and repair method of overheated areas will be recorded in the daily field reports. The method of repair will be determined in the field by the CQA ENGINEER.

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4. During seaming, the CQA ENGINEER or his representative will observe the seams for the following:
 - a. proper preparation
 - b. grinding technique, where applicable, and
 - c. overheating
5. The CQA ENGINEER or his representative will observe the geomembrane during the coolest part of the day to check for slack. Any areas where excessive "trampolining" occurs will be marked by the CQA ENGINEER for repair by the Geomembrane Installer.
6. The CQA ENGINEER or his representative will mark all areas where the geomembrane indicates a protrusion from the compacted clay liner. The method of repair will be determined in the field by the CQA ENGINEER.

F. TEST SEAMS

1. Test seams shall be made each day prior to commencing field seaming. The seams shall be made on fragment pieces of geomembrane under the same surface and environmental conditions as the production seams to verify that seaming conditions are adequate. The test seams shall be made at the beginning of each seaming period; at changes of equipment, equipment settings, operator, weather, or sheet temperature; at the CQA ENGINEER's discretion, and at least once every four to six hours during continuous operation of each welding machine; or at change in material type (i.e., smooth-to-smooth seam versus smooth-to-textured seam).
2. The test seam sample shall be at least five feet long by one foot wide with the seam centered lengthwise. For dual track fusion welds nine, one-inch wide by six-inch long test strips shall be cut from the test seam. Quantitatively test three specimens for inside peel adhesion (peel), three for outside peel, and then three specimens for bonded seam strength (shear). For extrusion welds six, one-inch wide by six-inch long test strips shall be cut from the trial seam. Quantitatively test three specimens for peel and three specimens for bonded seam strength (shear).
3. A test seam sample shall pass when the results of the tests shown below are achieved in both peel and shear test and when the break can be described as a film tear bond. A film tear bond is defined as a failure in the ductile mode of one of the bonded sheets by tearing prior to complete separation to the bonded area.
 - Peel strength (fusion) – ASTM D6392
 - Peel strength (extrusion) – ASTM D6392
 - Shear strength (fusion & extrusion) – ASTM D6392
4. Test seams shall be repeated, in its entirety, when any of the test seam samples fail in either peel or shear. If additional test seams fail, the seaming apparatus or seamer shall not be accepted and shall not be

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used for seaming until the deficiencies are corrected and two consecutive successful full test seams are achieved. No welding equipment or welder shall be allowed to begin production welds until equipment and welders have a successfully completed test seam. Seaming shall not proceed when ambient air temperature or adverse weather conditions jeopardize the integrity of the liner installation. Installer shall demonstrate that acceptable seaming can be achieved by completing passing trial seams.

5. The remainder of the successful test seam shall be assigned a number and marked accordingly by the CQA ENGINEER, who shall also log the date, hour, ambient temperature, number of seaming apparatus, name of seamer, and pass or fail description. The sample itself should be archived until project completion.

G. FIELD DESTRUCTIVE TESTING

1. The Geomembrane Installer will obtain 12" x 60" samples of field seams, suitable for testing, at an average frequency of one sample per 500 linear feet of weld. The date, time and equipment, seam number, and seaming parameters will be marked on each sample and recorded by the CQA ENGINEER.
2. Samples retained will be tested in the field by the Geomembrane Installer. A minimum of five specimens from each sample will be tested in peel and shear (ASTM D6392) for the properties in the Seam Strength Table in this section.

SEAM STRENGTH AND RELATED PROPERTIES OF THERMALLY BONDED SMOOTH AND TEXTURED HIGH DENSITY POLYETHYLENE (HDPE) GEOMEMBRANE 60 MIL SHEET		
Property	Units	Value
Hot Wedge Seams		
shear strength (1)	lb/in	120
shear elongation at break (2)	%	50
peel strength (1)	lb/in	91
peel separation	%	25
Extrusion Fillet Seams		
shear strength (1)	lb/in	120
shear elongation at break (2)	%	50
peel strength (1)	lb/in	78
peel separation	%	25
(1) Value listed for shear and peel strengths are for 4 out of 5 test specimens; the 5th specimen can be as low as 80% of the listed values. Average of all 5 must meet minimum specified value (2) Elongation measurements should be omitted for field testing (3) A maximum of one non-film tear bond failure out of a set of 5 tests is acceptable provided the non-film tear specimen meets strength requirements		

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If unresolved discrepancies exist between the CQA ENGINEER's and CONTRACTOR's test results, the archived sample may be tested by the CQA ENGINEER. Samples which do not pass the shear and peel tests will be resampled from locations at least 10 feet on each side of the original location. These two re-test samples must pass both shear and peel testing. If these two samples do not pass, then additional samples will continue to be obtained until the questionable seam area is defined.

3. The CQA ENGINEER or the OWNER may require additional random samples to be taken for testing in areas which visually appear defective and not in accordance with the project requirements.

At the end of each double wedge welded field seam of 100' or more in length, a 1" wide coupon is to be cut from near the end of the seam. This coupon is to be tested in peel using a field tensiometer. The CQA ENGINEER will observe this test and FTB type failures will be the criteria for preliminary acceptance of the production seam. (Final seam acceptance is contingent on air and destructive testing).

H. NON-DESTRUCTIVE TESTING

1. The CQA ENGINEER shall confirm that the geomembrane installer has conducted non-destructible testing of the entire length of all field seams in accordance with Section 02750 of the Technical Specifications. The testing method shall be approved by the CQA ENGINEER in advance.
2. Non-destructive testing will be observed by the CQA ENGINEER or his representative on a full-time basis.

I. DESTRUCTIVE LABORATORY TESTING

1. Destructive seam samples will be laboratory tested by the CQA ENGINEER. Testing frequency shall average one sample per 500 linear feet of field seam.
 - a. Test samples will be at least 12" x 36". A minimum of five peel specimens will be tested for each sample in accordance with ASTM D6392 for the properties in the Seam Strength table in this section. At least five specimens from each sample will be tested for bonded shear strength (shear) in accordance with ASTM D6392. These test samples shall be taken at the same locations as the CONTRACTOR's destructive testing samples.
 - b. All laboratory specimens will be conditioned for a minimum of one hour prior to testing at the Standard Atmosphere for Testing Geosynthetics, that is, air maintained at a relative humidity of 65 \pm 5% and a temperature of 21 \pm 2°C (70 \pm 4°F).

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2. The load and elongation at failure will be measured for each specimen. FTB is the qualifying criterion.
 - a. The CQA ENGINEER will describe the type of failure for each specimen and record the presence of any disbonding, delamination, foreign material in the bond area, etc.
 - b. The criteria for determining passing welded seam shall be as stated in the "Seam Strength" table in this section.
 - c. If unresolved discrepancies exist between the CQA ENGINEER's and CONTRACTOR's test results, the archived sample may be tested by the CQA ENGINEER. Samples which do not pass the shear and peel tests will be resampled from locations at least 10 feet on each side of the original location. These two re-test samples must pass both shear and peel testing. If these two samples do not pass, then additional samples will continue to be obtained until the questionable seam area is defined.

SEAM STRENGTH AND RELATED PROPERTIES OF THERMALLY BONDED SMOOTH AND TEXTURED HIGH DENSITY POLYETHYLENE (HDPE) GEOMEMBRANE 60 MIL SHEET		
Property	Units	Value
Hot Wedge Seams		
shear strength (1)	lb/in	120
shear elongation at break (2)	%	50
peel strength (1)	lb/in	91
peel separation	%	25
Extrusion Fillet Seams		
shear strength (1)	lb/in	120
shear elongation at break (2)	%	50
peel strength (1)	lb/in	78
peel separation	%	25
(1) Value listed for shear and peel strengths are for 4 out of 5 test specimens; the 5 th specimen can be as low as 80% of the listed values. Average of all 5 must meet minimum specified value (2) Elongation measurements should be omitted for field testing (3) A maximum of one non-film tear bond failure out of a set of 5 tests is acceptable provided the non-film tear specimen meets strength requirements		

J. REPAIRS

Any portion of unsatisfactory geomembrane or seam area failing a destructive or non-destructive test shall be repaired. Damaged geomembrane shall be removed and replaced with acceptable geomembrane materials if damage cannot be satisfactorily repaired. Installer shall be responsible for repair of

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damaged or defective areas. Agreement upon the appropriate repair method shall be decided between the CQA ENGINEER and the Installer. Procedures available include the following:

- Patching - Used to repair large holes, tears, undispersed raw materials and contamination by foreign matter;
- Spot Welding - Used to repair localized flaws (minor) or where geomembrane thickness has been reduced;
- Capping - Used to repair large lengths of failed seams; and
- Replacement - Used to remove the unacceptable seam and replace with new material.

In addition, surfaces of the geomembrane which are to be repaired by extrusion welds shall be lightly abraded with disc grinder or equivalent to assure cleanliness. All geomembrane surfaces shall be clean and dry at the time of repair. Patches or caps shall be extended at least six inches for extrusion weld and four inches for wedge weld beyond the edge of the defect. All corners of patch material shall be rounded.

The CQA ENGINEER shall number and log each patch repair, and the Installer shall non-destructively test each repair using methods specified in this plan.

K. FINAL INSPECTION

A final inspection shall be completed by the Installer, DESIGN ENGINEER, CQA ENGINEER and OWNER prior to the Installer demobilizing from the site. All identified problem areas shall be repaired by the Installer and accepted by the CQA ENGINEER prior to the Installer demobilizing from the site.

V. GEOTEXTILE

A. MATERIAL

1. The geotextile shall be a non-woven geotextile of polypropylene fibers or polyester yarns which is intended to be and shall be suitable for separation and cushioning. The cushion geotextile shall be a 12 ounce per square yard fabric and the separation geotextile shall be 6 ounce per square yard fabric.
2. During shipment and storage, the geotextile shall be protected from ultraviolet light exposure, precipitation, contamination or other damaging conditions. Geotextile rolls shall be shipped and stored in relatively opaque and watertight wrappings. The CQA ENGINEER shall verify that rolls of geotextile have been shipped and are stored in accordance with the specifications.
3. All handling on-site is the responsibility of the CONTRACTOR or Installer. The CONTRACTOR or Installer is responsible for the submittal of shipping manifests and all other relevant documents to the CQA

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4. The CQA ENGINEER shall random sample from each shipment of geotextile delivered to the site, sampling a minimum of 10% of each shipment. The 3' x 3' samples shall be retained as part of the project records. Should visual inspection by the CQA ENGINEER reveal any apparent deficiencies in the material, the CQA ENGINEER shall at the OWNER's expense, take a minimum of two samples and have them tested for the properties listed in Section 02757 of the Technical Specifications.

B. GEOTEXTILE MANUFACTURER AND INSTALLER

1. The CONTRACTOR shall submit the following as obtained from the Geotextile Manufacturer to the CQA ENGINEER to review:
 - a. Production Certification
 - b. Material Certification
 - c. Test Data for Material
2. The CONTRACTOR shall submit the following to the CQA ENGINEER prior to installation:
 - a. Qualifications of installer superintendent, foreman and field crew.
 - b. Six sets of field installation drawings.

C. INSTALLATION

1. The CQA ENGINEER will allow installation of the cushion geotextile to proceed after he has provided certification of the geomembrane liner or a section thereof.
2. The CQA ENGINEER shall monitor the installation of the cushion geotextile to verify there is no damage to the geomembrane liner. Should the liner be damaged the CQA ENGINEER shall require the necessary repairs to be completed at the CONTRACTOR'S expense.
3. The CQA ENGINEER or his representative shall be present during all placement operations and shall verify that all work is in accordance with the plans and specifications.
- ~~4. The CQA ENGINEER shall make a photographic record of all areas of the cushion geotextile and this shall be made part of the CQA Report.~~
- ~~5. The CQA ENGINEER shall make a photographic record of all areas of the sacrificial separation geotextile and this shall be made part of the CQA Report.~~
- ~~6. At the conclusion of this activity, the CQA ENGINEER shall provide a written certification that the work has been installed according to plans and specifications.~~

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VI. LEACHATE COLLECTION SYSTEM

A. GENERAL

The CQA ENGINEER shall certify the materials and installation are in accordance with the plans, specifications, and this CQA Plan.

B. MATERIALS

1. Leachate collection piping shall be in accordance with Section 02745 - Leachate Piping of the Technical Specifications.
2. Crushed aggregate or river gravel for encasing leachate pipe and penetration assembly shall be clean washed gravel composed of a hard mineral such as quartz. Crushed aggregate or river gravel size shall be No. 57 in accordance with ASTM D448-86.
3. The cushion geotextile shall be a non-woven geotextile of polypropylene fibers or polyester yarns which are intended to be and shall be suitable for separation and cushioning. Geotextile shall be 12 ounce per square yard cushioning fabric. The area under the leachate collection gravel column shall have 2 layers of this 12 ounce per square yard material.

The sacrificial separation geotextile over the gravel leachate collection column shall be non-woven geotextile of polypropylene fibers or polyester yarns which are intended to be and shall be suitable for separation and shall be minimum 6 ounce per yard.
4. The transition media shall be crushed aggregate or river gravel of a clean washed, hard, non-carbonaceous mineral such as quartz. The gravel size shall be ASTM No. 89 and in accordance with ASTM D448-86, NC DOT size No. 89, or NC DOT size No. 78M.
5. The CQA ENGINEER or his representative shall verify that all materials provided are those specified or are equal and are in accordance with the approved plans, specifications and this CQA Plan.

C. INSTALLATION

1. The CQA ENGINEER will allow installation of the leachate collection system to proceed after he has received all of the destructive test results of the FML and has reviewed and approved the FML as built survey.
2. The CQA ENGINEER shall verify there is no damage to the geomembrane during the installation of the leachate collection system. Should damage occur the CQA ENGINEER shall direct the CONTRACTOR to make the required repairs.

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3. The CQA ENGINEER or his representative shall be present during all phases of the leachate collection system construction and shall verify that all work is in accordance with the approved plans, specifications and this CQA Plan.

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D. QUALITY ASSURANCE

The CQA ENGINEER or his representative shall verify that the following are provided and installed in accordance with the approved plans, specifications and this CQA Plan. This shall include:

1. High Density Polyethylene Pipe
 - a. Receipt of CONTRACTOR's submittals on materials
 - b. Review of submittals for pipe
 1. compliance with applicable ASTM standard
 2. unit weight
 3. diameter and SDR
 4. physical dimensions
 5. method of jointing with instructions
 6. nominal pipe joint lengths
 7. re-ended bedding and installation details
 8. instructions and tables or information on strength of each pipe type versus bury
 9. conditions of depth and traffic loadings
 10. certification by manufacturer that material properties meet the values listed in the material properties sheet
 - c. Secure certification that pipe supplied is represented by the quality assurance data.
 - d. Reject pipe which does not meet appropriate ASTM Standards.
 - e. Results of any samples taken by the CQA ENGINEER for testing.
 - f. Witness and verify that jointing and installation is in accordance with manufacturer's re-endations and the specifications.
 - g. Leachate conduits external to the collection system are tested and demonstrated to be leakproof.
2. Crushed aggregate or river gravel
 - a. Receipt of CONTRACTOR's submittals on crushed aggregate or river gravel.
 - b. Review of submittals for conformity to specifications including quarry's certification of gradation.

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- c. Reject material which does not meet specifications.
 - d. Results of any samples taken by the CQA ENGINEER for testing.
 - e. Verify that crushed aggregate or river gravel encasement is in accordance with the approved plans, specifications and this CQA Plan.
3. Geotextile
- a. Receipt of CONTRACTOR's submittals on geotextile and review for conformity to specifications.
 - b. Reject material which does not meet specifications.
 - c. Verify that geotextile is in accordance with the approved plans, specifications and this CQA Plan.
 - d. Results of any samples taken by the CQA ENGINEER for testing.

VII. PROTECTIVE COVER - ON LINER - NATIVE SANDY SOILS

A. GENERAL

The CQA ENGINEER shall certify the materials and installation are in accordance with the plans, specifications, and this CQA Plan.

B. MATERIAL

- 1. Soil for protective cover - native soils - on liner shall be classified according to the United Soil Classification System (USCS) (ASTM D2487-93). Liquid limit, plasticity index (PI), and percent passing the No. 200 sieve will be considered for proper classification. Construction Quality Assurance shall confirm the following minimum requirements:

<u>Test</u>	<u>Minimum Frequency</u>	<u>Criteria</u>
Permeability (ASTM D2434)	3,000 c.y.	k\$1x10 ⁻³ cm/sec

- 2. Soil materials shall be reasonably free of gypsum, ferrous, and/or calcareous concretions and nodules, refuse, roots, or other deleterious substances.
- 3. Continuous and repeated visual inspection of the materials being used will be performed by the CQA ENGINEER to ensure proper soils are being used. In addition, the CQA ENGINEER shall make frequent inspections of the placement operations and materials, and will consult with the site personnel on suitable materials and locations of such. All material shall be taken from select sources or stockpiles.

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4. The protective cover native soils shall be uniform, smooth, and reasonably free of debris, rock, plant materials, and other foreign material larger than 3/4 inch in diameter. The material should contain no sharp edges.

C. STOCKPILING AND MATERIAL APPROVAL

1. All material to be used as protective cover gravel and geotextile shall be approved in advance by the CQA ENGINEER. The CQA ENGINEER must verify the gravel meets all the material requirements.
2. Verification can be accomplished at source and during stockpiling or prior to use at existing stockpiles.
3. The CQA ENGINEER shall prepare reports of all testing, analysis, and verification.

D. CONSTRUCTION

1. The CQA ENGINEER shall provide verification of the following:
 - a. Approved material was used to construct the cover.
 - b. The protective cover was constructed in accordance with the approved plans, specifications, and this CQA Plan, which thickness shall be 12 inches.
 - c. The required cover thickness was achieved.
 - d. The geomembrane and geotextiles were not damaged during the construction of the protective cover.
2. Any time more than one dozer or loader is operating in the cell to spread protective cover, a second CQA technician shall be present in the cell to observe this work and to assure there is no damage to the FML.

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VIII. PROTECTIVE COVER - ON LINER - SANDY SOILS

A. GENERAL

The CQA ENGINEER shall certify the materials and installation are in accordance with the plans, specifications, and this CQA Plan.

B. MATERIAL

Material for the sandy soil (protective cover) shall be a loose granular material resulting from the disintegration of rocks, shall be capable of 98% passage through a 1/2" screen and shall have no more than 5% by weight passing the No. 200 sieve. The protective cover material shall contain no aggregate rocks,

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debris, plant material, material with sharp edges, lignite, coal, ash, or carbonaceous material. By-products of industrial processes, with the exception of quarry grinding operations, shall not be accepted. The sandy soil (protective cover) material shall have a permeability of $k \geq 1 \times 10^{-2}$ cm/sec.

Construction Quality Assurance shall meet the minimum requirements for the Granular Drainage Blanket as follows:

<u>Test</u>	<u>Minimum Frequency</u>	<u>Criteria</u>
Grain size to No. 200 sieve (ASTM D 422)	1,500 yd ³	98% < 1/2" and < 5% passing 200 sieve
Permeability (ASTM D 2434)	3,000 yd ³	$k \geq 1 \times 10^{-2}$ cm/sec

C. STOCKPILING AND MATERIAL APPROVAL

1. All material to be used as protective cover sandy soils shall be approved in advance by the CQA ENGINEER. The CQA ENGINEER must verify the sand meets all the material requirements.
2. Verification can be accomplished during excavation and stockpiling or prior to use at existing stockpiles.
3. The CQA ENGINEER shall prepare reports of all testing, analysis, and verification.

D. CONSTRUCTION

1. The CQA ENGINEER shall provide verification of the following:
 - a. Approved material was used to construct the cover.
 - b. The protective cover was constructed in accordance with the approved plans, specifications, and this CQA Plan, which thickness shall be 12 inches.
 - c. The geomembrane was not damaged during the construction of the cover.
 - d. The required cover thickness was achieved.
2. Any time more than one dozer or loader is operating in the cell to spread protective cover, a second CQA technician shall be present in the cell to observe this work and to assure there is no damage to the FML.

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3. The CQA ENGINEER shall make a photographic record of all areas of the cushion geotextile and this shall be made part of the CQA Report.
4. The CQA ENGINEER shall make a photographic record of all areas of the sacrificial separation geotextile over the gravel leachate collection column and this shall be made part of the CQA Report.

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IX. CERTIFICATION

- A. The CQA ENGINEER will provide certification that the construction of the liner, leachate collection system, and other associated ancillary facilities for the particular landfill area are constructed according to the approved plans, specifications, and this CQA Plan. Said certification shall have the CQA ENGINEER's seal as a professional engineer registered in the State of North Carolina. The report shall be submitted as each cell or section is constructed and within 30 days of completion of a cell or section.
- B. The Certification Report shall include assessments of the CONTRACTOR's compliance with the Construction Plans and Specifications and physical sampling and testing. The Certification Report shall also include statements summarizing the extent of construction, with special attention given to changes from the design plans. The report will certify the results of the various field tests and laboratory tests performed, and assess whether or not the constructed project is in compliance with the Construction Plans and Specifications the report shall include a copy of all test reports and field notes..
- C. The project will not be deemed complete and acceptable until the North Carolina Department of Environment and Natural Resources Solid Waste Section has accepted the construction certification and all supplement reports and data as completed.

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OPERATIONS PLAN REVISIONS

G. Training

Republic Services of North Carolina, LLC will utilize both internal company training and outside continuing education for the landfill operations personnel. The operations personnel operating the site will be supervised and trained by certified landfill operators. These personnel will receive internal company training in operations, reporting, monitoring, environmental compliance, and facility maintenance.

This internal training will be repeated and updated on a periodic basis.

Off-site outside training will be scheduled as course offerings are announced.

Operation of the site will include specialized training in the operation and maintenance of the following:

1. Leachate pump stations / sideslope riser pumps / gravity leachate sewer collection systems.
2. Leachate storage tanks/secondary containment system.
3. Stormwater management.
4. Hazardous waste identification.
5. Prohibited waste identification.
6. Leachate recirculation
7. Waste solidification
8. Tipper operation
9. Landfill gas operations
10. Installation of initial (fluff) lift in the cell.

Records of personnel training shall be maintained in the facility operating record.

V. METHOD OF OPERATION - MSW LANDFILL

A. Landfilling/Operations

The landfilling operation will be comprised of solid waste being deposited on the working face of the landfill. Steel wheel compactors will be used to obtain maximum compaction of the waste by compacting at two to six foot depths of waste at a time, and by confining the area to be compacted daily.

The exception to this is the first lift which will be installed approximately eight feet deep with limited steel wheel compaction. This initial eight foot lift (known as a fluff lift) will generally be placed with dozers since this greatly reduces the risk to the liner system, **especially with a 12 inch thick protective cover over the liner**. Once fill reaches approximately eight feet, steel wheel compactors will be used to place and compact the waste. If the working face is confined to a minimum area on a daily basis, this will economize the amount of daily cover or alternative daily cover (ADC) required. Per North Carolina State Regulations, a daily cover of six inches of compacted soil or an alternative daily cover must be placed on top of the daily landfill operation to protect the landfilled garbage from exposure to rain and becoming windborne, and to prevent rodent and insect propagation or infestation. Once an area of the landfill is complete, that is, achieves final grades, a cover system (cap) will be placed as final cover and this will be seeded and stabilized. A sequence or phasing of the filling operations and final cover (cap) cross-sections are indicated in the Engineering Plans. Compost materials may be included in the final cover top layer if first demonstrated to the Section, then approved by the Section.

B. Daily Operations

1. Placement of solid waste will begin in the initial fill area of the landfill.
Extreme care should be used with the installation of the fluff lift and prior to

any waste going in the cell, a training session will be conducted with all “in cell” personnel to discuss care of the protective cover system and the FML liner.

2. A photographic record should be maintained during the fluff lift installation to demonstrate there was no degradation of the protective cover, the leachate collection gravel column or the FML.

3. Wastes should be kept to the minimum surface area possible and compacted via numerous passes of the steel-wheel compactor. Surface area (active landfill area) should be kept to a minimum for two reasons: (1) to minimize the amount of daily cover soils or ADC needed and, (2) to maximize the amount of garbage (not soils) being placed; thereby, increasing the life of the landfill.

Waste placed against the outer berms along the permanent outer edge of the cell shall be no closer than 15' to this edge of liner. By stopping at the inside edge of this berm, the operator will be placing waste no closer than 15' from the permanent edge. Waste placed against the interior berms between cells, shall be no closer than 10' to this edge. This will allow ample room for new liner to be tied to existing liner in the future cells.

After the first lift is in place, compaction berms may be installed at the outer edge. Trucks will unload their waste at the working face. The waste will be compacted against the compaction berm and up the working face. These outside compaction berms will serve several purposes:

a. The small berms give the operator guidance on where to place waste to ensure that the outside slope can be constructed quickly and accurately and,

traps. These materials should be stockpiled, allowed to drain and utilized for daily cover.

C. Cell Filling/Stormwater Management

The landfill cells will be typically filled from the lower elevations toward the upper elevations in initial lift, (fluff lift) of approximately eight feet. No steel wheel compaction equipment shall be placed in the landfill cell until there is an eight foot (plus or minus) mat of waste in that portion of the cell. Care shall be used to assure that the material placed in this initial lift will not be capable of penetrating the 12 inches of protective cover over the liner. Penetration of waste through this protective cover could damage the FML liner.

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The operator must use extreme care in managing the initial cell filling. In the area of the cell above the waste being placed in an initial lift, the operator shall have installed stormwater rain flaps to prevent stormwater from flowing onto the cell area being filled.

As the fluff lift is placed, the sacrificial geotextile over the 24 inch thick gravel leachate collection column shall be removed to expose the gravel. The operator must use care to assure the gravel is not disturbed by the installation of the fluff lift. A photographic record demonstrating the fluff lift installation shall be made part of the facility operating record.

The stormwater rain flaps should be placed so no area larger than two acres can drain directly into the leachate collection system. Based on a 5 inch storm event, up to 272,000 gallons could enter the leachate collection and storage system. It is unlikely that this full amount of rainfall would enter the system since any open cell will have some waste in it and even limited amounts of waste and sand will retain a percentage of the rainfall event.

and a 162,000 gallon tank are provided. These tanks have separate secondary containment structures capable of holding 110% of the tank volume. This is a sealed containment so it will be the operator's responsibility to pump off uncontaminated stormwater from the secondary containment. These tanks have been designed so that leachate may be transferred from one tank to the other to aid in leachate management.

The chemical composition of untreated leachate generated will be analyzed, at a minimum, semi-annually. The leachate samples will be collected from the leachate storage tank sampling port and shall be analyzed for the Detection Monitoring constituents (EPA Appendix I list for Detection Monitoring as incorporated by reference in Rule.1633), as well as pH, specific conductance, BOD, COD, TSS, phosphate, nitrate, sulfate. Test results will be submitted to the Section.

The leachate management system is sized based on the "Hydraulic Evaluation of Landfill Performance Model" (HELP Model), developed by the U.S. Army Corp of Engineers for the Environmental Protection Agency. The HELP Model cases, runs, and results are included with the leachate system design calculations.

In addition to using the HELP Model to size the leachate management systems, the following design standards, which exceed the North Carolina minimum design standards, shall be incorporated.

1. All leachate collection lines shall be a minimum of 8" diameter instead of the North Carolina minimum of 6" diameter.
2. All leachate lines shall have a minimum 8' wide leachate collection column of ASTM #57 stone to serve as both a filter for the leachate pipe and as a redundant flow path for leachate in the event the leachate pipe somehow becomes clogged. This column shall extend from the base liner upward for at least 24 inches. It should be noted that the adjacent protective cover is 12

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inches thick and the gravel leachate collection column is 24 inches thick.

This gravel redundant flow area is roughly 50 percent void space of the 16 square foot gravel column for an 8 square foot flow area, which is many times the area of the 8” diameter leachate pipe and an even greater ratio when compared to the North Carolina standard 6” diameter leachate collection pipe.

3. Where a 12 inch thick protective cover system which utilizes natural sand, manufactured sand, or native soils is used, there shall be a 2 foot wide by 12” thickness of ASTM #78 or #89 stone filter media to assure fines in the protective cover system do not enter the ASTM #57 gravel column.
4. All sideslope riser sumps shall have a double layer of Geosynthetic-Clay Liner (GCL) above the clay or low permeability soil liner and below the Flexible Membrane Liner (FML).
5. All sideslope riser pumps shall have a flow meter which shall be monitored no less than weekly, with the results to be placed in a tabular chart in the Facility Operating Record.
6. Leachate collection lines shall be cleaned with jet action within 12 months of permit issuance and then once every five years thereafter. If a blockage is encountered, camera monitoring of the line shall be done.
7. If at any time North Carolina Department of Environmental and Natural Resources – Solid Waste Section has evidence of a line blockage, based on their observations and review of the records, the landfill will upon receipt of a written request for a camera inspection, conduct same within 90 days of such written request, with the tape/disk of the inspection made available to the

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5. On a weekly basis, inspect the secondary containment systems and the tanks for any leaks. If none are present, record the inspection, and then pump off any accumulated stormwater. Place the inspection reports in the operating record.

6. Records shall be maintained by the landfill operator of the following:
 - a. Daily volume of leachate generated
 - b. Daily volume of leachate recirculated into the waste mass
 - c. Analytical records of leachate quality
 - d. Records of days when stormwater is pumped from the secondary containment systems
 - e. Weekly inspections of the leachate tanks
 - f. Daily inspections of the leachate pump stations or sideslope riser pumps
 - g. Weekly volume of leachate in the tank
 - h. Records of any equipment breakdowns
 - i. Maintenance records
 - j. [Removal of the sacrificial geotextile over the top of the 24" thick gravel leachate collection column.](#)

Special attention should be given to managing rainfall events to reduce, as much as possible, the surge volumes caused by these events. A major part of this leachate management is discussed in item C - Cell Filling/Stormwater Management. In that discussion, it is recognized that it is possible that a 5 inch rainfall event (over a 2 acre subcell) could create a surge of up to approximately 272,000 gallons of stormwater (initial lift only) that would require treatment as leachate. This event could be handled by all components of the leachate management system including the storage tanks if leachate is removed from the tanks during and immediately following the rainfall event.

TRAINING PROGRAM OUTLINE

TRAINING PROGRAM OUTLINE

CQA Training

This training will be provided by the Project Engineer and will include the CQA Technician and the Contractors working on the liner and Protective Cover.

Outline of Items to be Covered:

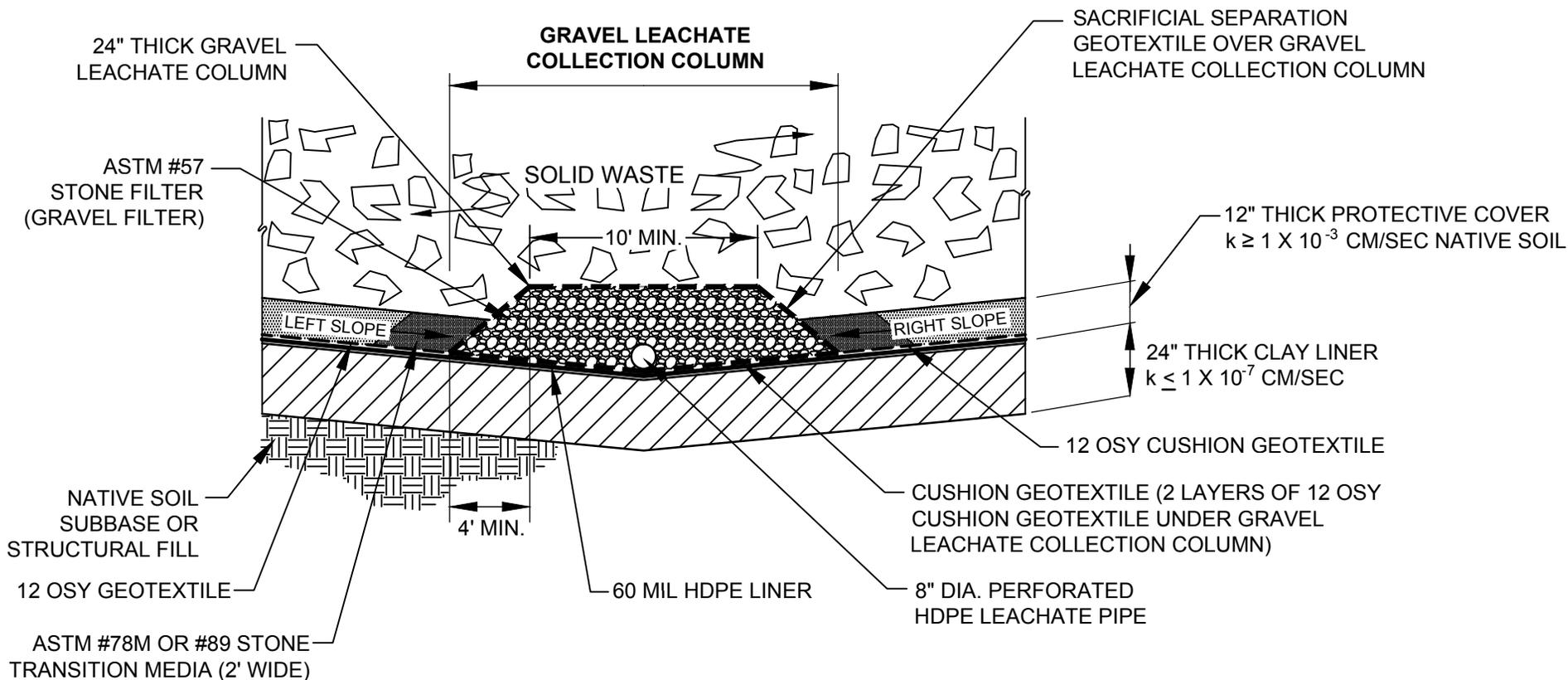
1. Discussion of the 12 inch thick protective cover and how this is to be installed, including the cushion geotextile fabric over the FML.
2. Discussion of how the CQA technicians will observe this work and demonstrate with photographs how the system was properly installed.
3. Discussion of spreading the protective cover including the need for a second technician when more than one dozer or loader is operating in the cell spreading protective cover.
4. Discussion of the gravel leachate collection column and the transition media, if required. This will also cover the sacrificial separation geotextile over the gravel leachate collection column.
5. Discussion of what the final CQA report will include.

Fluff Lift Installation Training

This training will be performed by the Project Engineer and will include all site personnel who will work in the cell during the installation of the fluff lift of waste.

1. Discussion of the 12 inch thick protective cover system and the 24 inch thick leachate collection system.
2. Discussion of the removal of the sacrificial separation geotextile over the gravel leachate protection column.
3. Discussion of photographic record required.
4. Discussion of pushing the waste into the cell so as not to damage the protective cover or leachate collection system.
5. Discussion of tipper or truck dumping in the initial lift.
6. Discussion of reporting anything out of the ordinary or anything that could affect the liner or protective cover system.

PROTECTIVE COVER DETAILS

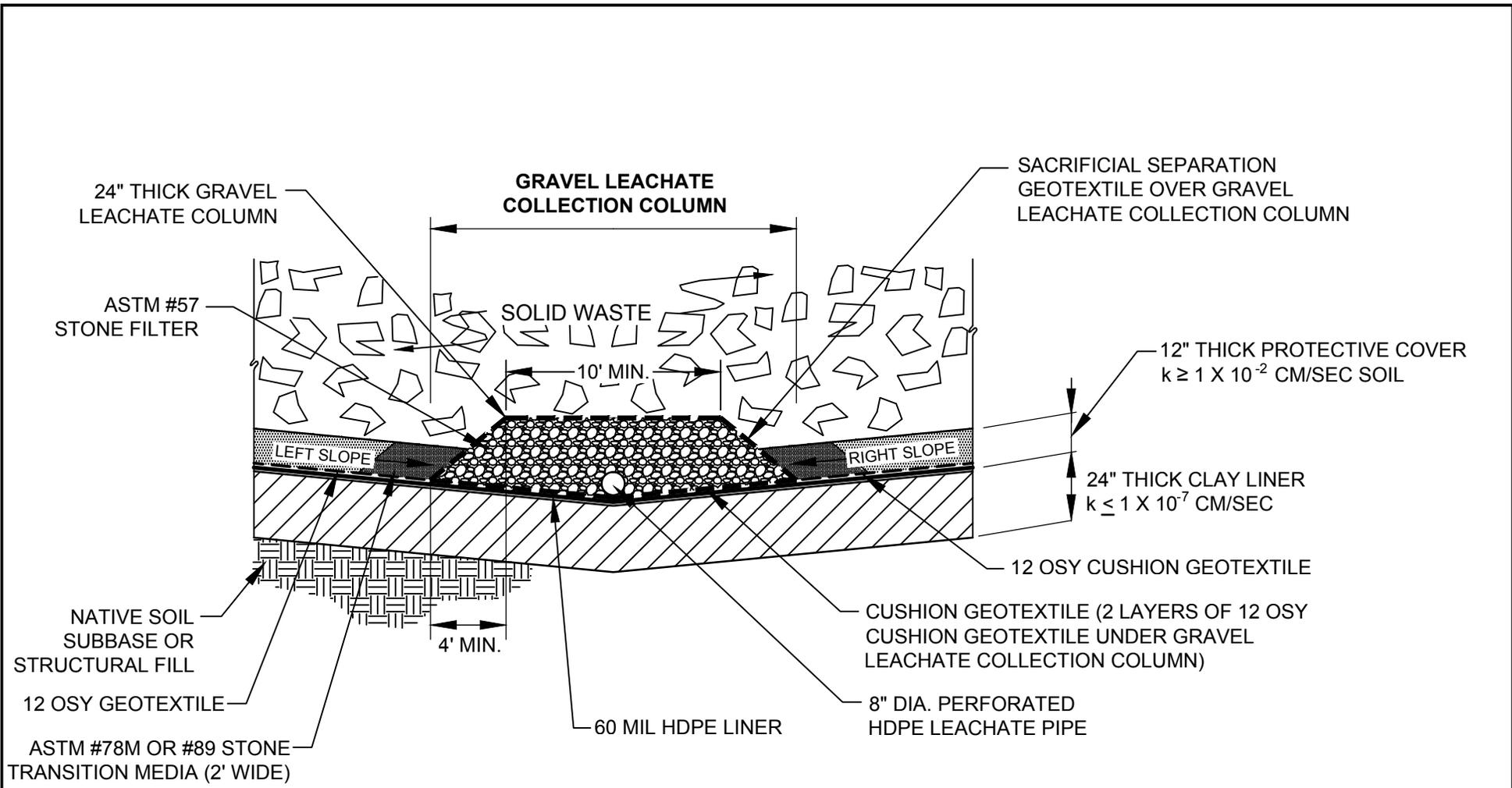


NOTES:

1. PERFORATED 4" DIA. SUPPLEMENTAL LEACHATE COLLECTION PIPES SHALL BE INSTALLED IN THE PLANE WITH THE GEOTEXTILE GEOCOMPOSITE ON 50' CENTERS PERPENDICULAR TO THE 8" PERFORATED LEACHATE COLLECTION PIPE IN THE CENTERLINE OF THE CELL.
2. 60 MIL HDPE LINER COMPONENT SHALL BE COVERED WITH A MIN. 6 OZ PER SQ. YARD GEOTEXTILE FABRIC (EXCEPT ON SIDE SLOPES).

MINIMUM SLOPE		
CELL NO.	LEFT	RIGHT
11	2.00%	2.30%
12S	2.00%	2.60%
12N	2.00%	2.10%

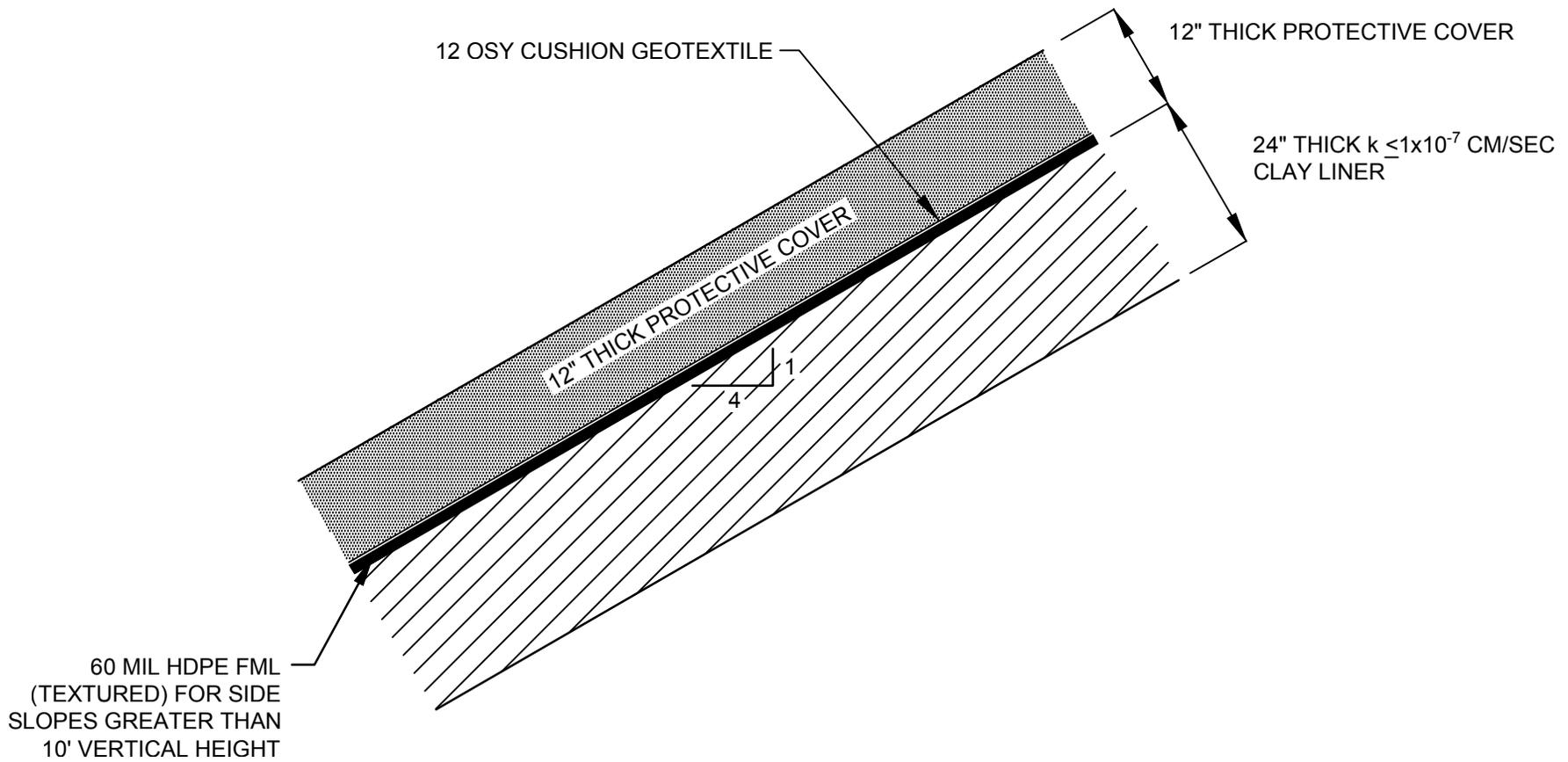
EAST CAROLINA BOTTOM LINER SYSTEM "A"



NOTE:
 60 MIL HDPE LINER COMPONENT SHALL BE COVERED
 WITH A MIN 6 OZ. PER SQ. YARD GEOTEXTILE FABRIC,
 EXCEPT ON SIDE SLOPES.

MINIMUM SLOPE		
CELL NO.	LEFT	RIGHT
11	2.00%	2.30%
12S	2.00%	2.60%
12N	2.00%	2.10%

EAST CAROLINA BOTTOM LINER SYSTEM "B"



EAST CAROLINA SIDE SLOPE LINER SYSTEM "A" OR "B"