ATTACHMENT D - FINAL COVER QUALITY CONTROL PLAN

TABLES

1.0 INTRODUCTION

This Final Cover Quality Control Plan (FCQCP) has been prepared to provide the Owner, Design Engineer, Construction Quality Assurance Professional of Record, and the Contractor the means to govern the construction quality of the prescriptive final cover and the alternate soil final cover system and to satisfy the environmental protection requirements under New Mexico Administrative Code (NMAC) regulations. Final cover design consists of a prescriptive cover with a geocomposite replacing the gravel drainage layer along the crown of the landfill as well as an alternate cover design to be used on the 4:1 side slopes on the landfill cap. The covers are designed to prevent the "bathtub effect" which occurs when a more permeable cover is placed over a less permeable bottom liner. NMAC 19.15.36.14(C) allows the operator to propose a performance-based landfill design system using geosynthetics, including geocomposites and geosynthetic clay liners, when supported by EPA's "hydrologic evaluation of landfill performance" (HELP) model or other division-approved model preventing the "bathtub effect." Demonstrations of both liner system performances are included in Attachment E – HELP Model.

1.1. Definitions

This section provides the definitions for terms used in this FCQCP.

A. ASTM

American Society for Testing and Materials.

B. Contract Documents

These are the official set of documents issued by the Owner. The documents include bidding requirements, contract forms, contract conditions, specifications, contract drawings, addenda, and contract modifications.

C. Contract Specifications

Qualitative requirements for products, materials, and workmanship upon which the contract is based.

D. Contractor

Person(s), firm, partnership, corporation, or any combination, private or public, who, as an independent contractor, has entered into a contract with the Owner, and who is referred to throughout the contract documents by singular number and masculine gender.

E. Construction Quality Assurance (CQA)

A planned system of activities providing the Owner and permitting agency assurance the facility was constructed as specified in the design (EPA, 1986). Construction quality assurance includes observations and evaluations of materials as well as workmanship necessary to determine and document the quality of the constructed facility. CQA refers to measures taken by the CQA Organization to assess if the installer or contractor is in compliance with the plans and specifications for a project.

F. Construction Quality Assurance (CQA) Monitors

CQA monitors are representatives of the Professional of Record (POR) who work under direct supervision of the POR. The CQA monitor is responsible for quality assurance monitoring and performing onsite tests and observations. The CQA monitor is onsite full-time during construction and reports directly to the POR. The CQA monitor performing daily quality assurance/quality control (QA/QC) observation and testing shall have a minimum of four (4) years of directly related experience or a graduate engineer or geologist with one (1) year of directly related experience. Field observations, testing, or other activities associated with CQA may be performed by the CQA monitor(s) on behalf of the POR. Additional CQA monitors may be used. If working under the direction of a CQA monitor, the second CQA monitor shall have a minimum of one (1) year of directly related experience.

G. Construction Quality Assurance (CQA) Professional of Record (POR)

The POR is an authorized representative of the Owner and has overall responsibility for construction quality assurance to confirm the facility was constructed in general accordance with plans and specifications approved by the permitting agency. The POR must be licensed as a Professional Engineer or Geologist in New Mexico and experienced in geotechnical testing and interpretations. Experience and/or education may include geotechnical engineering, engineering geology, soil mechanics, geotechnical laboratory testing, construction quality assurance, quality control testing, and hydrogeology. The credentials of the POR must meet or exceed the minimum requirements of the permitting agency. Any references to monitoring, testing, or observations to be performed by the POR should be interpreted to mean the POR or CQA monitors working under POR direction. The POR may also be known in applicable regulations as the CQA Engineer or Resident Project Representative.

H. Final Cover Evaluation Report (FCER)

Upon completion of closure activities, the certification will be in the form of the FCER, signed by the POR and include all documentation necessary for certification of closure.

2.0 CONSTRUCTION QUALITY ASSURANCE FOR ALTERNATIVE COVER SYSTEM

2.1. Introduction

This section of the FCQCP Plan addresses the construction of the soil components of the alternative cover system and outlines the program to be implemented with regard to materials selection and evaluation, laboratory test requirements, field test requirements and treatment of problems. The alternative cover system will be used on the sideslopes of the final cap. The scope of earthwork and related construction quality assurance includes the following elements (from bottom to top):

- 6-inch Daily Cover and 6-inch Intermediate Cover Layer
- 24-inch Infiltration Layer
- 12-inch Soil Erosion Layer

The Owner/Operator shall notify the division a minimum of 72-hours before construction of any final cover system installation, to allow the division to witness installation.

2.2. Earthwork Construction

The following paragraphs describe soil properties, general construction procedures, and QA/QC methods used in construction of the various layers of the final cover system.

A. Final and Intermediate Cover Layer

After the landfill reaches the maximum permitted grade of waste, soil will be placed according to the Site Operating Plan. The layer will consist of soil from the landfill site currently used as daily cover. A minimum of two (2) 6-inch layers of soil will be placed over the waste, prior to commencing work on the Final Cover System. The contractor will re-work the soil to provide a smooth surface, free of rocks and material larger than 2-inches in diameter with soils compacted to a minimum 80% Standard Proctor Density. The soils will be graded to an elevation 36-inches below the proposed final contours. QA/QC for preparation of this layer will be performed under the supervision of the CQA POR. Upon completion of grading, the POR will determine that the layer is prepared to provide a uniform surface and that it will adequately serve as the foundation for the overlying infiltration layer. Once the intermediate soil is placed, graded, and approved, a survey will be performed to verify the final and intermediate cover is a minimum 12-inches thick. The layer will be probed every 100-feet in each direction to verify a thickness of 12-inches.

B. Infiltration Layer

The infiltration layer will consist of a 24-inch thick minimum soil layer (measured perpendicular to the final and intermediate cover layer surface) placed on the side slope of the landfill. Material used for this layer will be obtained from the landfill site. It will be placed as two (2) 12-inch lifts, and will be compacted to approximately 85% of standard proctor (ASTM D698) density (+5%), at a moisture content within +/-2% of optimum. The material may be classified as SM, SP, SW or SC according to the Unified

Soil Classification System (USCS). Testing will be completed, as needed, to classify the soil according to the USCS. Over compacted soil in the infiltration layer will be disked or ripped (or any method approved by the POR) and recompacted to a density within the acceptable limits. If a density test fails, additional tests may be performed to define the over compacted area. The area to be reworked, then, will be the area between passing density tests. The infiltration layer construction will be conducted in a systematic and timely fashion. Delays will be avoided in completing the infiltration layer. Placement of the infiltration layer will cease during rainfall events to prevent over-compaction. Before proceeding with construction after a rainfall event greater than 0.5-inches, the Contractor will complete, at a minimum, a 10-foot by 10-foot test pad to verify that over-compaction will not occur as construction continues. A minimum of two (2) field density tests are required per test pad area. Test pad results will be reported in the Final Cover Evaluation Report.

C. Soil Erosion Layer

The soil erosion layer will be placed on top of the infiltration layer over the entire surface of the final cover. The soil will have a minimum thickness of 12-inches and capable of sustaining vegetation. The soil will be placed in 6-inch lifts, at 85% standard proctor (ASTM D698) density and within +/-5% of optimum moisture content. The material may be classified as SM, SP, SW, or SC according to the Unified Soil Classification System (USCS). Testing will be completed, as needed, to classify the soil according to the USCS. Over-compacted soil in the soil erosion layer will be disked, ripped, (or any method approved by the POR), and recompacted to a density within the acceptable limits. If a density test fails, additional tests may be performed to define the over-compacted area. The area to be re-worked, then, will be the area between passing density tests. The surface of the soil cover should be graded to the final grades as shown in Attachment B - Engineered Design Plans, and disked parallel to the proposed contours in preparation for seeding and to prevent excessive erosion after rainfall. The erosion control layer should be placed under the continuous QA/QC observation to ensure a minimum thickness of 12-inches is applied and existing structures are protected. Placement of the erosion control layer will be stopped during rainfall events to prevent over-compaction of the soil. Construction will continue once CQA personnel determine the soil can be effectively disked. Structural Best Management Practices (BMP) and an effective vegetation plan will aid in erosion prevention. Surveying will be performed to verify that the vegetative cover layer has been installed to the minimum thickness of 12-inches.

D. Establishment of Vegetation

Permanent vegetation will be established using appropriate seasonal seeding mixtures. Seeding or sodding shall be performed immediately following application of the final cover.

2.3. Survey and Final Topography

Upon completion of the final cover construction, a topographic survey will be performed by a land surveyor licensed in the state of New Mexico. The final contour map should include

all final contours, location of gas vents, gas monitoring wells, groundwater monitoring wells, drainage structures, fences, gages, access roads, and all other pertinent site features.

2.4. Sampling and Testing

As construction progresses, CQA monitors will conduct field and laboratory tests using standards set forth in the technical specifications. Standard operating procedures for soil testing will be prepared for site testing personnel that follow ASTM Test methods. These procedures will be for the following tests: Soil classification, moisture density relationship, field density and moisture, and thickness verification.

A. Soil Classification

Soil samples for analysis will be collected for the purpose of classifying the soil using the USCS. One (1) sample is required per soil type. The test procedure to follow in the laboratory will be ASTM D2487 and 2488 for soil classification. Extra testing must be performed whenever work or materials are suspect, marginal, or of poor quality. Extra testing may be conducted to provide additional data for engineering. Tests that do not meet minimum requirements will not contribute to the total number of tests performed in meeting the required test frequency.

B. Moisture Density Relationship of Soils

Soil samples will be collected for analysis to determine the Atterberg Limits, the percent passing the No. 200 sieve, and permeability. One (1) sample per soil type is required. The test procedure to follow in the laboratory will be ASTM D698. Extra testing must be performed whenever work or materials are suspect, marginal, or of poor quality. Extra testing may be conducted to provide additional data for engineering. Tests that do not meet minimum requirements will not contribute to the total number of tests performed in meeting the required test frequency.

C. Field Density and Moisture

Soil testing will be performed in situ or on undisturbed samples for the purpose of determining field density and moisture content. Three (3) tests are required per soil layer per acre. The test procedure to be followed for soil density will be ASTM D2922, performed in the field. The test procedure to follow for moisture content is either ASTM D2216 (laboratory) or ASTM D3017 (in situ). Extra testing must be performed whenever work or materials are suspect, marginal, or of poor quality. Extra testing may be conducted to provide additional data for engineering. Tests that do not meet minimum requirements will not contribute to the total number of tests performed in meeting the required test frequency.

D. Thickness Verification

Testing or surveying will be performed to ensure the constructed layer thicknesses meet minimum requirements. This verification will be performed at the top of the foundation layer, top of the vegetative support layer, and top of the vegetative cover layer. The work will be performed every 100-feet in each direction on a grid established by a land surveyor licensed in the State of New Mexico.

3.0 CONSTRUCTION QUALITY ASSURANCE FOR THE PRESCRIPTIVE COVER SYSTEM WITH GEOCOMPOSITE

3.1. Introduction

This section of the FCQCP Plan addresses the construction of the components in the prescriptive system and outlines the program to implement regarding materials selection and evaluation, laboratory test requirements, field test requirements, and treatment of problems. The scope of earthwork and related construction quality assurance includes the following elements (from bottom to top):

- 6-inch Daily Cover and 6-inch Intermediate Cover Layer
- 60-mil High Density Polyethylene (HDPE) Liner
- Geocomposite Liner
- 24-inch Infiltration Layer
- 12-inch Soil Erosion Layer

The Owner/Operator shall notify the division a minimum of 72-hours prior to construction and installation of any final cover system, to allow the division to witness installation.

3.2. Earthwork Construction

The following paragraphs describe soil properties, general construction procedures, and QA/QC methods to use in construction of the various layers of the final cover system.

A. Final and Intermediate Cover Layer

After the landfill reaches the maximum permitted grade of waste, final and intermediate cover soil will be placed according to the Site Operating Plan. The layer will consist of soil from the landfill site currently used as daily cover. A minimum of two (2) 6-inch layers of soil will be placed over the waste prior to commencing work on the Final Cover System. The contractor will rework the soil to provide a smooth surface, free of rocks and material larger than 2-inches in diameter, with soils compacted to a minimum 80% Standard Proctor Density. The soils will be graded to an elevation 36-inches below the proposed final contours. QA/QC for preparation of the layer will be performed under the supervision of the CQA POR. Upon completion of grading, the POR will determine the final and intermediate cover layer has been prepared to provide a uniform surface and will adequately serve as the foundation for the overlying base layer. Once soil is placed, graded, and approved, a survey will be performed to verify the final and intermediate cover is a minimum 12-inches thick. The layer will be probed every 100-feet in each direction to verify a thickness of 12-inches.

B. 60-mil High Density Polyethylene (HDPE) Liner

i. General

This Section covers the work necessary to construct and test the geomembrane lining (GML) system, which will consist of 60-mil high density polyethylene (HDPE) material. The objective is to provide an effective lining system at the completion of the work. The geomembrane liner shall generally conform to the testing requirements

of GRI Standard GM13 – Test Properties, Testing Frequency and Recommended Warrant for High Density Polyethylene (HDPE) Smooth Textured Geomembranes, (Geosynthetic Research Institute; Folsom, PA; November 2014), except as modified herein.

ii. Submittals

a. Manufacturer's Certification of SLQCP Conformance

The Contractor shall submit written certification by the Manufacturer that the lining materials conform to the requirements of the SLQCP in Attachment C, are similar and of the same formulation as the certification submitted, and demonstrated by actual usage to be satisfactory for the intended application.

b. Contractor's and Manufacturer's QC Program

The Manufacturer and the Contractor shall each submit a complete description of the quality control program as applicable for manufacturing, handling, installing, testing, repairing, and providing a completed lining in accordance with requirements of the SLQCP in Attachment C. The description shall include but not be limited to polymer resin supplier, product identification, acceptance testing, fabrication and production testing, installation testing, documentation of changes, alterations and repairs, retests, and acceptance. Each shall present documented evidence of its ability and capacity to perform this Work.

c. Contractor's Installation Plan

The Contractor shall submit installation drawings, descriptions of installation procedures, and a schedule for performing/completing the Work. Installation drawings shall show a lining sheet layout with proposed size, number, position, and sequence of sheets placing and indicating the location of all field seams. Installation drawings shall also show complete details and/or methods for anchoring the lining at the perimeter, making field seams, and making anchors/seals to pipes and structures.

The Contractor shall submit a complete description of welding procedures for making field seams and repairs. The welding procedures shall conform to the latest procedures recommended by the lining Manufacturer and to the SLQCP.

The Contractor shall also submit for approval that the surface(s) on which the lining will be placed is acceptable by the Geotechnical Professional certification. Installation of the lining shall not commence until certification is furnished to the Geotechnical Professional.

d. Manufacturer's Warranty

The lining Manufacturer shall furnish a written lining material warranty as described in GRI GM13. The warranty shall be against manufacturing defects or

workmanship and against deterioration due to ozone, ultraviolet, or other normal weather aging. The warranty shall be limited to replacement of material only and shall not cover installation of said material. It shall not cover damage due to vandalism, acts of animals, or supernatural acts of God. The warranty shall be for a period of 5 years from the date of GML installation.

e. Contractor's Warranty

The Contractor shall furnish a written guarantee that the entire lining work constructed by him to be free of defects in material and workmanship and installed pursuant to the SLQCP for a period of two (2) years following the date of acceptance of the work by the Geotechnical Professional. During the 23rd month, a pre-guarantee expiration inspection will be conducted to identify any necessary repair work covered by the guarantee. The Contractor shall agree to make any repairs or replacements made necessary by defects in materials or workmanship in the Work which become evident within said guarantee period. The Contractor shall make repairs and/or replacements promptly, the Owner may do so, and the Contractor shall be liable to the Owner for the cost of such repairs and/or replacements.

iii. Quality Assurance

Prior to start of work, the lining Manufacturer and the Contractor shall each submit for approval by the Geotechnical Professional documented evidence of the ability and capacity to perform this Work. Each shall have successfully manufactured and/or installed a minimum of 2-million sq.ft. of similar lining material in waste and/or liquid processing containment structures. The Contractor can meet these criteria by teaming with a subcontractor who is identified in the bid along with the firm's experience.

The Contractor shall submit the name and qualifications of the project superintendent assigned to the project whenever lining materials are handled/installed, as well as the names and qualifications of senior installation personnel on the project.

The Quality Control Plan(s) to implement for the Work by the lining Manufacturer and the Contractor shall be in accordance with applicable paragraphs of the SLQCP.

The Manufacturer shall provide onsite technical supervision and assistance at all times during installations of the lining system. The Manufacturer and Contractor, as applicable to each, shall submit for approval by the Geotechnical Professional written certification that the lining system was installed in accordance with the Manufacturer's recommendation, the SLQCP, project specification and drawings, and approved submittals.

The Geotechnical Professional will initiate a pre-installation meeting with the Manufacturer and Contractor before installing the lining system. Topics for review/discussion shall include, as a minimum, project plans and specifications, approved submittals, training and qualification procedures for Contractor personnel, and demonstration of making field-welded seam(s)-included peel and shear tests.

Prior to installation of the lining system, the Contractor shall instruct the workmen of the hazards of installation such as handling sheets of lining material in high winds, use of equipment, application of solvents, adhesives and caulks, and walking on lining surfaces. Work gloves, safety glasses, hard hats, and smooth-soled shoes are minimum safety wear requirements when working on the GML. Safety shoes must be worn when handling heavy objects.

The Geotechnical Professional shall have authority to order an immediate stoppage of work because of improper installation procedures, safety infractions, or for any reason resulting in a defective liner.

4.0 DELIVERY, STORAGE AND HANDLING

The Contractor shall submit for approval by the Geotechnical Professional method(s) for handling and storage of lining material(s) delivered to the project site. These materials shall be stored in accordance with the Manufacturer's recommendation.

Lining materials delivered to the site shall be inspected for damage, unloaded, and stored with a minimum of handling. Materials shall not be stored directly on the ground. The storage area shall be such that all materials are protected from mud, soil, dirt, and debris. The stacking of lining shall not be higher than two (2) rolls.

Under no circumstances shall the lining be subjected to materials, sandbags, equipment, or other items dragged across its surface. Nor shall workmen and others side down slopes atop the lining. All scuffed surfaces resulting from abuse of any kind caused by the Contractor in performance of the work shall be repaired at the Geotechnical Professional's direction.

The Contractor shall be completely responsible for shipping storage, handling, and installation of all lining materials in compliance with SLQCP.

5.0 PRODUCTS

The HDPE lining materials shall be new, first quality products designed and manufactured specifically for the purposes of the Work and shall have satisfactorily demonstrated by prior use to be suitable and durable for such purposes. The geomembrane shall be unmodified HDPE containing no plasticizers, fillers, chemical additives, reclaimed polymers, or extenders. For ultraviolet resistance, the GML material shall contain not less than 2.0% carbon black as determined by ASTM D1603. The only other compound ingredients to be added to the GML shall be antioxidants and heat stabilizers required for manufacturing. The GML shall be supplied as a single ply continuous sheet with no factory seams and in rolls with a minimum width of 15-feet. The roll length shall be maximized to provide the largest manageable sheet for the fewest field seams.

The GML lining materials shall be as manufactured by GSE Lining Systems, Inc., Houston, Texas; Poly-America, Inc. Grand Prairie, Texas; National Seal Company, Galesburg, Illinois; or approved equal.

The standard tests described in Table D.1 will be performed on the GML material.

Table D.1 – STANDARD TESTS ON HDPE GML MATERIAL

Test	Type of Test	Standard Test Method	Frequency of Testing
Resin	Melt Flow Index	ASTM D1238	per 100,000 ft^2 and every resin lot
	Specific Gravity/Density	ASTM D1505	per 100,000 ft^2 and every resin lot
Manufacturer's Quality Control	Thickness	ASTM D5199 or ASTM D5994	per 100,000 ft^2 and every resin lot
	Specific Gravity/Density	ASTM D1505	per 100,000 ft^2 and every resin lot
	Carbon Black Content	ASTM D1603	per 100,000 ft^2 and every resin lot
	Carbon Black Dispersion	ASTM D5596	per 100,000 ft^2 and every resin lot
	Tensile Properties	ASTM D6693, Type IV	per 100,000 ft^2 and every resin lot
	Tear	ASTM D1004	per 100,000 ft^2 and every resin lot
	Puncture	ASTM D4833	per 100,000 ft^2 and every resin lot
Conformance Testing by 3rd Party Independent Laboratory	Thickness	ASTM D5199 or ASTM D5994	per 100,000 ft^2 and every resin lot
	Specific Gravity/Density	ASTM D1505	per 100,000 ft^2 and every resin lot
	Carbon Black Content	ASTM D1603	per 100,000 ft^2 and every resin lot
	Carbon Black Dispersion	ASTM D5596	per 100,000 ft^2 and every resin lot
	Tensile Properties	ASTM D6693, Type IV	per 100,000 ft^2 and every resin lot

Note: A-NSF 54 modified with 2-in Initial gauge length assumed for elongation at break.

Extrusion resin used for fusion welding with extrudate to make field seams between GML sheets and for repairs shall be HDPE produced from and the same as the HDPE sheet resin. Physical properties shall be same as HDPE lining sheets.

6.0 INSTALLATION PROCEDURES

Prior to installation of the GML, a site inspection will be conducted by the Geotechnical Professional and the Contractor to verify measurements, structures, and surface conditions to support the GML. The Contractor will provide written documentation to the Geotechnical Professional that surfaces to receive the GML have been inspected and are acceptable for installation of the lining.

Before the work begins, the Contractor will inspect all lining materials for damage from transit. Materials that cannot be repaired will be rejected and removed from the work area and site. During unwrapping of lining materials for use and placement, the Contractor will visually inspect all materials, particularly surfaces of lining sheets, for imperfections and faulty areas. All such defective places will be marked and repaired in accordance with approved methods.

The GML will be installed as shown on the project plans and approved installation drawings. Placement of the GML will be done such that good fit, without bridging, is a provided on all covers and grade changes. Excessive slack will be avoided to minimize rippling during the soil cover operation.

Sheets of GML materials will be of such lengths and widths and placed in such a manner as to keeping field seaming to a minimum. The lining will be anchored according to details shown on approved plans and drawings. The lining will be anchored and sealed to structures, pipes, and other types of penetrations, (if any), in accordance with details shown on approved plans and drawings. All changes in approved installation drawings and procedures must be approved by the Geotechnical Professional.

Extreme care will be taken during installation of the lining to be certain no damage is done to any part of the lining. Dragging of the GML material on the foundation layer will be avoided. Smoking by the installation personnel will be prohibited. All handling and installation procedures will be performed by workers wearing shoes with smooth soles. Shoes with patterned soles in relief shall be prohibited. No foot traffic will be allowed on the lining. All motor-driven equipment using fuel will have spark arrestors. No gasoline-driven generators or cans of gas or solvent will be placed directly on the lining material. Under no circumstances will the lining be used as a work area to prepare patches or to store tools and supplies. If needed, a tarpaulin of approved material will be spread out as a work area.

During installation, the Contractor will be responsible for protecting the lining against adverse effects of high winds such as uplift. Sand bags will be used, as required, to hold the lining material in position during installation. Sand bags will be sufficiently close-knit to preclude fines from working through the bottom, sides, or seams. Paper bags, whether or not lined with plastic, will not be permitted. Burlap bags, if used must be lined with plastic. Bags will contain not less than 40-pounds, nor more than 60-pounds of sand having 100% passing a number 8 screen and will be tied closed after filling, using only plastic ties. Bags that are split, torn, or otherwise losing the contents will immediately be removed from the work area and any spills immediately cleaned up. Metal or wire tires will not be used.

During installation, water shall not be allowed to pond on the GML material. The contractor shall have available appropriate pumps to immediately remove ponding water.

The GML material will not be installed under adverse climatic conditions unless the Contractor can demonstrate that his installation techniques adequately compensate for such adverse conditions and quality of workmanship is not compromised. Adverse climatic conditions occur when the air temperature measured 6-inches above the GML surface is less than 32°F and decreasing, or more than 90°F; when relative humidity is more than 80%; when raining; frost on the ground; or during conditions of excessive winds.

GML field seams will be lap seams as shown on approved plans and drawings. The lap seams will be formed by lapping the edges of GML sheets a minimum of 4-inches. The contact surfaces of the sheets will be wiped clean to remove dirt, dust, moisture, and other foreign materials. For fillet weld seams, bevel edge of GML and clean oxidation from surfaces to receive extrudate by disk grinding or equivalent not more than one (1) hour before seaming.

Lap seam intersections involving more than three (3) thicknesses of lining material will be avoided, and all seam intersections will be offset at least 2-feet. Non-horizontal field seams will be allowed on the slope and sheets of lining material on the slopes will extend down slope out onto bottom a minimum of 5-feet from the toe of slope.

Field seams between sheets of GML material will be made using approved fusion welding systems, equipment, and techniques. Approved fusion welding systems include fillet weld using extrudate, lap weld using extrudate, and lap weld using single or double wedge welder. If the wedge welder is used, excess free edge of the seam (wider than 3-inches) of the top sheet will be removed without affecting the integrity of the seam.

Any necessary repairs to the GML will be made with the lining material itself, using approved fusion welding systems, equipment, and techniques. The patch size will be 4-inches larger in all directions than the area to be patched. All corners of the patch will be rounded with a 1-inch minimum radius.

All seams and seals of the GML will be tightly bonded on completion of the work. Any lining surface showing injury because of scuffing or penetration by foreign objects or showing distress will be replaced or repaired as directed by the Geotechnical Professional.

Cleanup within the work area will be an ongoing responsibility of the Contractor. Particular care will be taken to ensure no trash, tools, or other unwanted materials are trapped beneath the lining. Care will be taken to ensure all scraps of lining materials are removed from the work area prior to completion of the installation.

7.0 FIELD QUALITY CONTROL

Inspection and testing will involve the fulltime observation of the installation of the GML, including the making and testing of lining seams, patches, and period measurement of the liner material thickness to ensure compliance. Field thickness measurements must be taken for each panel before it is seamed. The material thickness shall be checked using a micrometer at a minimum frequency of one (1) measurement per 5-feet along the leading edge of each panel with a minimum of five (5) measurements along the leading edge of the panel. No single measurement shall be less than 10% below the required nominal thickness in order for the panel to be accepted. In addition, the average of all measurements along the edge must be at least 60-mils.

Test seams will be made to verify that adequate conditions exist for field seaming to proceed. Each seamer will produce a test seam at the beginning of each shift to determine the peel and tensile strength of the seam. The Geotechnical Professional may require a sample field seam be made at any time during seaming production to verify equipment/operator performance and seam integrity. In addition, if a seaming operation has been suspended for more than half an hour or if a breakdown of the seaming equipment occurs, a test seam will be produced prior to resumption of seaming operations.

The trial weld sample must be a minimum of 3-feet long and 1-foot wide with the seam centered lengthwise. The Geotechnical Professional must observe all trial welding operations, quantitatively test each trial weld for peel and shear, and record the results. A minimum of two (2) peel and two (2) shear tests will be performed per trial seam. Double wedge weld trial seams shall have a minimum of four (4) peel tests performed. The trial weld shall be completed under the same conditions for which the panels will be welded. The trial weld must meet the requirements for peel and shear as stated in the following paragraph and the break must be ductile or a film tearing bond (FTB) for a wedge weld or extrusion weld.

During the field seaming operation, destructive samples will be removed from field seams by the Contractor at locations selected by the Geotechnical Professional. Repairs to the field seams will be made in accordance with repair procedures specified in the SLQCP. The samples will have a width of 12-inches plus the seam width and length of 42- to 48-inches. A minimum of one (1) stratified sample per 500-feet of field seam will be made. All field seams will have a fil tear bond in peel and shear and a minimum pound-per-inch width seam strength in shear when tested as specified in this SLQCP. At the very least, the peel adhesion and bonded shear strength must be 62% and 95% respectively of the strength of the parent material, but not less than 78-ppi and 120-ppi respectively. A sufficient amount of the seam must be removed in order to conduct field testing, independent laboratory testing, and archiving of enough material to retest the seam when necessary. The archived material will be kept at the independent laboratory. Field testing shall include at least two (2) peel tests per sample (four (4) when possible for testing both tracks on dual-track fusion welded seams). Destructive seam-testing locations shall be cap-stripped and the cap completely seamed by extrusion welding to the GML. Capped sections shall be non-destructively tested. Additional destructive test samples may be taken if deemed necessary by the Geotechnical Professional or his representative.

All field-tested samples from a destructive-test location must be passing in both shear and peel for the seam to be considered passing. The independent laboratory testing must confirm these field results. The passing criterion for independent laboratory testing includes four (4) of five (5) samples from each dual track fusion welded seam, when possible to test each seam, must be passing before the seam is considered as passing. Sample testing will be conducted by an independent testing agency who will save all test samples including specimens tested until notified by the Geotechnical Professional relative to their disposal. All specimens which have failed under test will be shipped immediately by express delivery to the Geotechnical Professional for determination or corrective measure to be taken, including retest or repair of failed section.

For destructive samples which have failed the passing criterion, the Contractor will reconstruct all the field seams between any two (2) previously passed seam locations which include the failed seam or will go on both sides of the failed seam location (10-feet minimum), take another sample each side, and test both. If both pass, the Contractor will repeat the process of taking samples for test. In all cases, acceptable field seams must be bound by two (2) passed test locations. The decision of the Geotechnical Professional will be final.

If field seam capping is required, the Contractor will use a cover strip of the same thickness as the lining (and from the same roll, if available) and of 8-inches minimum width. It will be positioned over the center of the field seam and welded to the lining using a fillet weld on each side.

All GML sheets, seams, anchors, seals, and repairs will be visually inspected by the Contractor for defects. In addition, all seams and repairs will be further checked by a metal probe. Depending on seam welding equipment sued, all seams and repairs will be tested by a vacuum testing device, a spark testing device, and/or air pressure. A visual inspection of the lining sheets, seams, anchors, and seals will be made by the Contractor as the installation progresses, and again on completion of the installation. Defective and questionable areas will be clearly marked and repaired. Final approval of repairs will be given by the Geotechnical Professional.

The Contractor will run a metal probe, such as a dull-pointed ice pick, along the length of all seams and repairs to ensure that the seam is a continuous and absent of leak paths. Defects will be clearly marked and repaired.

If the fillet weld, extrusion lap weld, or single hot-wedge fusion weld is used to weld seams, the Contractor will further test all seams and repairs in the GML by vacuum box. All vacuum box testing will be done in the presence of the Geotechnical Professional. The testing area will be cleaned of all dust, debris, dirt, and other foreign matter. A soap solution will be applied to the test area with a paint roller and the vacuum of 3-psi air pressure will be induced and held at least ten (10) seconds to mark for repair any suspicious areas as evidenced by bubbles in the soap solution.

If the fillet weld is used to weld seams, the Contractor will further test all seams and repairs in the GML by using a high voltage spark detector if vacuum box or air pressure methods cannot be performed. The setting of the detector will be 20,000-volts. To conduct this test, all seams to be tested will be provided with not less than gauge 24-30 copper wires properly embedded in the seams and grounded. All spark testing will be done in the presence of the Geotechnical Professional and defective areas marked for repair.

If the double hot-wedge is used, the Contractor will further test all seams in the GML by using the air pressure test consisting of inserting a needle with gauge in the air space between the welds. Air will be pumped into space to 35-psi and held for five (5) minutes. If pressure is not maintained, then the seam is unacceptable.

All costs of retesting of the GML including reruns of field weld tests and all repairs, will be at the Contractor's expense. The Contractor will retain responsibility for the integrity of the GML system until acceptance by the Geotechnical Professional. The GML will be accepted by the Geotechnical Professional when:

- Written certification letters including "as built" drawings are received by the Geotechnical Professional.
- Installation is complete.
- Documentation of completed installation, including all reports is complete.
- Verification of adequacy of field seams and repairs including associated testing is complete.

Acceptance of the competed work will include receipt of all submittals and all work completed to the satisfaction of the Geotechnical Professional.

A. Geocomposite

The geocomposite will be formed of two (2) non-woven geotextiles heat bounded to a geonet core. The geotextile on both sides of the geonet will be a minimum 8-ounce non-woven material meeting the standard test requirements in Table D.2. The geocomposite will be deployed directly on top of the geomembrane. The infiltration layer will be carefully spread on top of the geocomposite to avoid damage to the liner system.

Table D.2 – STANDARD TESTS FOR GEOCOMPOSITE MATERIALS

Test	Type of Test	Standard Test Method	Frequency of Testing
Manufacturer's Quality Control	Thickness	ASTM D5199	per manufacturer's quality control specifications
	Mass per Unit Area	ASTM D3776 (Option C)	per 100,000-ft^2 and every resin lot
	Ply Adhesion	ASTM D7005	per 100,000-ft^2 and every resin lot
	Transmissivity	ASTM D4716	per 100,000-ft^2 and every resin lot
Conformance Testing by 3rd Party Independent Laboratory	Thickness	ASTM D5199	per 100,000-ft^2 and every resin lot
	Mass per Unit Area	ASTM D3776 (Option C)	per 100,000-ft^2 and every resin lot
	Carbon Black Content	ASTM D4218	per 100,000-ft^2 and every resin lot
	Tensile Strength	ASTM D7179	per 100,000-ft^2 and every resin lot

Table D.3 – STANDARD TESTS ON GEOTEXTILE MATERIALS

Test	Type of Test	Standard Test Method	Frequency of Testing
Manufacturer's Quality Control	Mass per Unit Area	ASTM D5261	per 100,000-ft^2
	Grab Tensile Strength (%)(MD/CD)[1]	ASTM D4632	per 100,000-ft^2
	Grab Elongation (%)(MD/CD)[1]	ASTM D4632	per 100,000-ft^2
	Puncture Strength	ASTM D4833	per 100,000-ft^2
	Trapezoidal Tear Strength	ASTM D4533	per 100,000-ft^2
	Apparent Opening Size	ASTM D4751	per 100,000-ft^2
	Permittivity	ASTM D4491	per 100,000-ft^2
	UV Light Resistance	ASTM D4355	per 100,000-ft^2
	Burst Strength	ASTM D3786	per 100,000-ft^2
Conformance Testing by 3rd Party Independent Laboratory	Thickness	ASTM D5199	per 100,000-ft^2
	Mass per Unit Area	ASTM D5261	per 100,000-ft^2
	Grab Tensile Strength (%)(MD/CD)[1]	ASTM D4632	per 100,000-ft^2
	Grab Elongation (%)(MD/CD)[1]	ASTM D4632	per 100,000-ft^2
	Puncture Strength	ASTM D4833	per 100,000-ft^2
	Trapezoidal Tear Strength	ASTM D4533	per 100,000-ft^2
	Apparent Opening Size	ASTM D4751	per 100,000-ft^2
	Permittivity	ASTM D4491	per 100,000-ft^2
	Burst Strength	ASTM D3786	per 100,000-ft^2

1 - MD/CD = MD - Machine Direction/CD - Cross Direction

B. Infiltration Layer

The infiltration layer will consist of a 24-inch thick minimum soil layer (measured perpendicular to the foundation layer surface) placed on the top of and along the side slopes of the landfill. Material used for this layer will be obtained from the landfill site. It will be placed as a two (2) 12-inch lifts, and will be compacted to approximately 85% of standard proctor (ASTM D698) density (+5%), at a moisture content within +/-2% of optimum. The material may be classified as SM, SP, SW, or SC according to the Unified Soil Classification System (USCS). Testing will be completed, as needed, to classify the soil according to the USCS. Over-compacted soil in the infiltration layer will be disked or ripped (or any method approved by the POR) and recompacted to a density within the acceptable limits. If a density test fails, additional tests may be performed to define the

over compacted area. The area to be reworked will be the area between passing density tests. The infiltration layer construction will be conducted in a systematic and timely fashion. Delays will be avoided in completing the infiltration layer. Placement of the infiltration layer will cease during rainfall events to prevent over-compaction. Before proceeding with construction after a rainfall event greater than 0.5-inches, the Contractor will complete, at a minimum, a 10-foot by 10-foot test pad to verify over-compaction will not occur as construction continues. A minimum of two (2) field density tests are required per test pad area. Test pad results will be reported in the Final Cover Evaluation Report.

C Soil Erosion Layer

The soil erosion layer will be placed on top of the infiltration layer over the entire surface of the final cover. The soil will have a minimum thickness of 12-inches and will be capable of sustaining vegetation. The soil will be placed in 6-inch lifts, at 85% standard proctor (ASTM D698) density and within +/-2% of optimum moisture content. The material may be classified as SM, SP, SW, or SC according to the Unified Soil Classification System (USCS). Testing will be completed, as needed, to classify the soil according to the USCS. Over-compacted soil in the soil erosion layer will be disked or ripped (or any method approved by the POR) and recompacted to a density within the acceptable limits. If a density test fails, additional tests may be performed to define the over-compacted area. The area to be reworked will be the area between passing density tests. The surface of the soil cover should be graded to the final grades as shown in Attachment B – Engineered Design Plans, and disked parallel to the proposed contours in preparation for seeding and to prevent excessive erosion after rainfall. The erosion control layer should be placed under the continuous QA/QC observation to ensure that a minimum thickness of 12-inches is applied and existing structures are protected. Placement of the erosion control layer will be stopped during rainfall events to prevent over-compaction of the soil. Construction will continue once CQA personnel determine the soil can be effectively disked. Structural BMP and an effective vegetation plan will aid in erosion prevention. Surveying will be performed to verify the vegetative cover layer has been installed to the minimum thickness of 12-inches.

D. Establishment of Vegetation

Permanent vegetation will be established using appropriate seasonal seeding mixtures. Seeding or sodding shall be performed immediately following application of the final cover.

7.1 Survey and Final Topography

Upon completion of construction of the final cover, a topographic survey will be performed by a qualified land surveyor. The final contour map should include all final contours, location of gas vents, gas monitoring wells, groundwater monitoring wells, drainage structures, fences, gages, access roads, and all other pertinent site features.

7.2 Sampling and Testing

As construction progresses, CQA monitors will conduct field and laboratory tests using standards set forth in the technical specifications. Standard operating procedures for soil testing will be prepared for site testing personnel that follow ASTM Test methods. These procedures will be for the following tests: Soil classification, moisture density relationship, field density and moisture, and thickness verification.

A. Soil Classification

Soil samples will be collected for analysis for the purpose of classifying the soil using the USCS. One (1) sample is required per soil type. The test procedure to follow in the laboratory will be ASTM D2487 and 2488 for soil classification. Extra testing must be performed whenever work or materials are suspect, marginal, or of poor quality. Extra testing may be conducted to provide additional data for engineering. Tests that do not meet minimum requirements will not contribute to the total number of tests performed in meeting the required test frequency.

B. Moisture Density Relationship of Soils

Soil samples will be collected for analysis to determine the Atterberg Limits, the percent passing the No. 200 sieve, and permeability. One (1) sample is required per soil type. The test procedure to be followed in the laboratory will be ASTM D698. Extra testing must be performed whenever work or materials are suspect, marginal, or of poor quality. Extra testing may be conducted to provide additional data for engineering. Tests that do not meet minimum requirements will not contribute to the total number of tests performed in meeting the required test frequency.

C. Field Density and Moisture

Soil testing will be performed in situ or on undisturbed samples for the purpose of determining field density and moisture content. Three (3) tests are required per soil layer per acre. The test procedure to be followed for soil density will be ASTM D2922 which will be performed in the field. The test procedure to be followed for moisture content will be either ASTM D2216 (laboratory) or ASTM D 017 (in situ). Extra testing must be performed whenever work or materials are suspect, marginal, or of poor quality. Extra testing may be conducted to provide additional data for engineering. Tests that do not meet minimum requirements will not contribute to the total number of tests performed in meeting the required test frequency.

D. Thickness Verification

Testing or surveying will be performed to ensure the constructed layer thicknesses meet minimum requirements. This verification will be performed at the top of the foundation layer, top of the vegetative support layer, and top of the vegetative cover layer. The work will be performed every 100-feet in each direction on a grid established by a surveyor registered in the State of New Mexico.

7.3 Vegetation Planting Plan

Planting of vegetation over the final cover system is important to ensure the cover system functions as intended. A recommended seed mixture is provided below in Table D.4.

7.4 Soil Preparation and Seeding

All seeds must conform to the requirements of the U.S. Department of Agriculture rules and regulations set forth in the Federal Seed Act. Cultivation area preparation will start as soon as practicable after completion of the erosion control layer to the lines and grades specified in Attachment B – Engineered Design Plans. The vegetation establishment contractor, with approval from the POR, may modify the seed mixture or the equipment used in the planting process. To prevent over-compaction of the constructed final cover, equipment used should not exert more than 16-psi ground pressure (except for harrowing equipment). The preferred planting period for the seed mix is between September 1 and November 7, taking advantage of the fall rains. If the time frame is unavailable, planting may occur between November 8 and February 14 or will be delayed until the following September. Table D.4 includes the recommended seed mix and application rates in pounds of pure live seed (PLS) per acre.

Table D.4 - SEED MIX AND RATE

Common Name	Pounds (lb) Pure Live Seed (PLS)/acre
Indiangrass	0.6
Green sprangletop	0.8
Sideoats grama	0.6
Little bluestem	1.35
Switchgrass	0.3
Hairy grama	0.2
Blue grama	0.6
Illinois bundleflower	0.75
Engelmann's daisy	0.6
Texas wintergrass	0.75
Canada wildrye	0.6
Western wheatgrass	0.48

A. Broadcast Seeding

Distribute the seed or seed mixture uniformly over the areas shown on the plans using hand or mechanical distribution or hydroseeding on top of the soil. When seed and water are to be distributed as a slurry during hydroseeding, apply the mixture to the area to be seeded within thirty (30) minutes of placement of components in the equipment.

B. Straw or Hay Mulch Seeding

Plant seed using broadcast seeding. Immediately after planting the seed or seed mixture, apply straw or hay mulch uniformly over the seeded area. Apply straw or hay mulch at

0.5- to 2.5-tons/acre depending on the specific area. Use a tacking method over the mulched area.

C. Cellulose Fiber Mulch Seeding

Plant seed using broadcast seeding. Immediately after planting the seed or seed mixture, apply cellulose fiber mulch uniformly over the seeded area at the following rates:

- Sandy soils with slopes of 3:1 or less – 2500-pounds/acre.
- Sandy soils with slopes greater than 3:1 – 3000-pounds/acre.

Cellulose fiber mulch rates are based on dry weight of mulch per acre. Mix cellulose fiber mulch and water to make slurry and apply uniformly over the seeded area using suitable equipment.

D. Drill Seeding

Planting should be done at 3-mph to 5-mph, running the drill seeder in one (1) direction and making a second pass over the same area but perpendicular to the first pass. The optimum depth for seeding shall be from 1/16-inch to 1/8-inch. Grass, wildflower, and winter cover seed shall be applied by a method that achieves consistent distribution and proper seed-to-soil contact. Individual species or supplemental plantings may be planted using broadcast seeders.

E. Straw or Hay Mulching

Apply straw or hay mulch uniformly over the area as indicated on the plans. Apply straw mulch or hay mulch at 0.5- to 2.5-tons/acre depending on the specific area. Use a tacking method over the mulched area.

7.5 Fertilizer Recommendations

Apply the fertilizer uniformly at a rate equal to 50-pounds of nitrogen per acre. Seed and fertilizer may be distributed simultaneously during "Broadcast Seeding" operations, provided each component is applied at the rate specified by POR for the specific area. When temporary and permanent seeding are both specified for the same area, apply half of the required fertilizer during the temporary seeding operation and the other half during the permanent seeding operation. Use a commercial-grade fertilizer of neutral character, consisting of fast and slow release nitrogen, 50% derived from natural organic sources of area formaldehyde, phosphorus, and potassium. The fertilizer should have an N-P-K ration of 20-27-5.

7.6 Documentation

The quality assurance plan requires monitoring and documentation of construction activities; therefore, the POR and CQA monitor will document the means and methods which the quality assurance requirements have been addressed and satisfied. Documentation may consist of daily recordkeeping, testing and installation reports, nonconformance reports (if necessary), progress reports, photographic records, and design and specification revisions. The appropriate documentation will be included in the FCER. Standard report forms will be provided by the POR prior to construction.

7.7 Preparation of FCER

The POR, on behalf of the Owner, shall submit to the OCD an FCER for approval of the final cover system constructed. Final cover QA/QC testing will be performed in accordance with this FCQCP and should be part of the FCER which will be prepared in accordance with this FCQCP.