# CONSTRUCTION QUALITY ASSURANCE (CQA) PLAN

## PLANT WANSLEY COAL COMBUSTION RESIDUALS (CCR) LANDFILL HEARD COUNTY, GEORGIA

**FOR**

Georgia Power

**SEPTEMBER 2022**

GEORGIA
DEPARTMENT OF NATURAL RESOURCES
ENVIRONMENTAL PROTECTION DIVISION

**Approved**

**Solid Waste Management Program**

Approved By: Keith Stevens Digitally signed by Keith Stevens Date: 2022.10.25 08:59:48 -04'00'

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APPENDIX

A. Original CQA Plan for Cell Construction

# 1. GENERAL

This Construction Quality Assurance Plan (CQA Plan) provides the quality assurance standards, procedures, and minimum acceptance criteria for construction of the final cover system at the Plant Wansley CCR Landfill. The landfill consists of three (3) lined disposal cells that were constructed utilizing the approved CQA Plan for the landfill at the time of construction. This CQA Plan only addresses the future closure of the existing landfill cells.

This CQA Plan has been prepared as part of the site's CCR permit application per Rule 391-3-4-.10(9)(c)1(v) and will be utilized for closure of the units under the CCR permit. This CQA Plan establishes the minimum level of activities that provides assurance that construction proceeds in accordance with the approved Closure Plan. The CQA Plan provides for a detailed process of inspections and project controls to ensure the final cover system is constructed in accordance with this CQA Plan and the approved Closure Plan.

This CQA Plan addresses those areas of construction pertaining to environmental protection, including the necessary earthwork required for construction of the landfill disposal area final cover system. As each cell of the disposal facility is closed, a Construction Quality Assurance (CQA) Report will be submitted to Georgia Environmental Protection Division (EPD) Solid Waste Program along with a registered engineer's certification that the area under consideration was closed within the limitations of, and according to, this CQA Plan and approved Closure Plan. Grading, earthwork, and stockpiling of earthen materials subject to this CQA Plan will comply with the Georgia Soil and Water Conservation Commission *Manual for Erosion Control in Georgia*, latest edition.

The original CQA Plan utilized for cell construction is included in Appendix A for reference. The original CQA plan will be followed during any bottom liner repairs or modifications.

Georgia Power will notify EPD of each major closure event prior to construction. Construction Quality Assurance (CQA) services will be provided by an independent third-party consulting engineering firm specializing in the inspection and testing of soils and geosynthetics representing Georgia Power. The services of the CQA firm required during construction and installation of all final cover system components are described in this document.

The CQA project team will consist of the following:

1. <u>Construction Quality Assurance and Construction Quality Control:</u> In the context of this document, construction quality assurance and construction quality control are defined as follows:

    a. Construction Quality Assurance (CQA) - A planned and systematic pattern of actions taken by an organization that operates separately from the Contractor and the Owner (i.e., independent party) to verify that construction materials

and/or services achieve compliance with technical (i.e., design), contractual, and regulatory requirements. This generally involves observation, review of submitted test results by others, and conducting independent testing to verify conformity of the various components of the Project with the requirements of the Construction Documents.

b. Manufacturer Quality Control/Construction Quality Control (MQC/CQC) – A planned system of actions taken by the Contractor, Manufacturers, and Installers to monitor, check, and control the quality of their own work (verify that they are supplying materials and providing the workmanship as required by the Construction Documents). In some cases, CQC services may be performed "in-house" by the Contractor, and other times CQC services are subcontracted to an outside consultant hired by the Contractor. MQC refers to QC functions performed by Manufacturers, and CQC refers to QC functions performed by construction contractors and installers.

2. Design Engineer: Responsible for providing interpretations and clarifications of the Technical Specifications, reviewing and approving shop drawings, authorizing minor variations in the work from the requirements of the Technical Specifications, and rejecting defective work. The DESIGN ENGINEER will be a registered professional engineer licensed in Georgia.

3. CQA Engineer: Responsible for implementing the construction quality assurance requirements as stated in the project plans, technical specifications, this CQA Plan and the project objectives; verifying basic data as reasonable and complete; outlining procedures to process data; developing statistical procedures for the analysis of test data; and preparing quality assurance memoranda and quality assurance reports. The CQA Engineer will report to Georgia Power. This CQA Engineer will be a registered professional engineer licensed in Georgia. Reference to the CQA Engineer, for the purpose of this document, will include the CQA Engineer and/or his/her designated representatives, including CQA Engineering Technicians.

4. Engineering Technicians (or Technicians): Technicians are responsible for field observations, testing and inspection. Technicians will be assigned to the project as deemed necessary by the CQA Engineer and will be under supervision of the CQA Engineer. The CQA Engineer, Technician or the CQA Engineer's representative will be on-site during all construction activities except clearing and grubbing and initial grading activities. Initial evaluation of various soil types by CQA personnel during construction will be largely visual; therefore, all CQA personnel must be experienced with Visual-Manual Procedure for soil description and identification (ASTM D2488).

5. Contractor: The term "Contractor" refers to the General Contractor (i.e., the Prime Contractor) who is retained by the Owner to perform the construction of the landfill cells. In general, the Contractor will be responsible for furnishing and installing materials in accordance with the Construction Documents (unless certain items may be procured and/or installed under separate contracts with or on behalf of the Owner). In this role, the Contractor will be responsible for earthwork activities, installation of the final cover

system, and constructing associated surface water management features and other related site work. The Contractor may subcontract with various parties to conduct certain portions of the Project (e.g., geosynthetic Installer(s)). The Owner will select a Contractor qualified for this Project through experience constructing projects involving similar work elements, and with personnel and equipment availability as needed to execute a project of this magnitude. During construction, the Contractor will work with the Owner/Construction Manager to develop an approved schedule, execute the work according to that schedule, and communicate the timing of key milestones/activities with appropriate project parties (e.g., CQA Engineer). Note that the preceding description of the Contractor's roles and responsibilities is only a general summary and does not represent the comprehensive scope of work required by the Construction Documents. In the event of any discrepancies, the Construction Documents will govern.

6. Geosynthetics Manufacturers and Installers: Geosynthetics are manufactured materials. The Manufacturers who will supply geosynthetic materials for this Project (either procured by the Contractor or procured by the Owner, as established for the scope of work set forth in the Construction Documents) are responsible for the manufacture/fabrication of such materials and for quality control during manufacture/fabrication. The Manufacturer(s) of the geomembrane components of the liner system and final cover system should have experience manufacturing at least ten million square feet of such geomembranes. Further details of the required minimum Manufacturer qualifications for the various other geosynthetic materials of the Project will be provided in the Construction Documents. The geosynthetic Manufacturers must implement an MQC program. MQC refers to actions taken at their manufacturing facility (i.e., prior to shipment to the jobsite) to control the quality of their products and to monitor/verify that the materials and workmanship of the geosynthetics meet the Project requirements as set forth herein and in the Construction Documents. The MQC program will be conducted by MQC personnel who are stationed at the manufacturing facility (i.e., employed or contracted by the Manufacturer), and overseen by an MQC manager. Manufactured geosynthetics products are placed and installed in the field by an Installer, who will be subcontracted by the Contractor. The Installer responsible for the installation of the liner system and final cover system geomembrane components should have experience installing at least five million square feet of such geomembranes. Further details of the required minimum geosynthetics Installer qualifications for the various other geosynthetic materials of the Project will be set forth in the Construction Documents.

7. As-Built Surveyor: As required by specific sections of this CQA Plan, a registered professional land surveyor licensed in Georgia will perform the required as-built certification surveys on the components of the final cover system.

# 2. LOW-PERMEABILITY SOIL LAYER (INFILTRATION LAYER OF FINAL COVER SYSTEM)

## A. GENERAL

The CQA Engineer will confirm and certify that the materials used in the installation of the soil layer are in accordance with the approved closure plan, technical specifications, and this CQA Plan.

## B. MINIMUM REQUIREMENTS

The low-permeability soil layer material will consist of cohesive soils capable of being placed and compacted to meet the permeability criterion of $k \leq 1 \times 10^{-5}$ cm/sec.

## C. PRE-CONSTRUCTION MATERIAL EVALUATION

1. All material to be used to construct the low-permeability soil layer will be sampled and tested by the CQA Engineer in advance of being placed. Such testing can be performed during excavation of the borrow area or from existing stockpiles.

2. The procedure for pre-construction testing of material to be used for low-permeability soil layer on the final cover system is outlined below:

   a. The CQA Engineer will visually examine each load of soil either at the borrow source or the stockpile area. Soil that does not meet the technical specification for low-permeability soil layer material will be rejected or routed to separate stockpiles consistent with its end use.

   b. The following tests will be performed at the frequencies listed in the CCR Landfill Soil Layer Construction Quality Assurance Requirements Table on Page 7 of this plan, prior to placement of any low-permeability soil layer material:

      i. Method for Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures, ASTM D2216.

      ii. Method for Particle - Size Analysis of Soils, ASTM D422 (Mechanical Sieve Method Only).

      iii. Test Method for Liquid Limit, and Plasticity Index of Soils, ASTM D4318, and

      iv. Moisture-Density Curve (ASTM D698).

      v. One (1) sample for every 10,000 cubic yards of material stockpiled will be selected for remolded permeability testing (ASTM D5084 - *Measurement of Hydraulic Conductivity of Saturated Porous Materials using a Flexible Wall Permeameter*).

3. Reports for low-permeability soil layer will be prepared by the CQA Engineer and will include:

   a. Summary of laboratory test data, and
   b. A summary of construction, sampling and testing method, and recommendations.

**D. TEST PAD FOR LOW-PERMEABILITY SOIL LAYER**

1. The CQA Engineer will document the construction of a test pad prior to or coinciding with, the beginning of construction of the low-permeability soil layer component.

2. The CQA Engineer will sample and test soil samples obtained from the constructed test pad to confirm that the material used, and the Contractors' placement and compaction methods can consistently produce a low-permeability soil layer that meets the requirements of the technical specifications.

3. The CQA Engineer will confirm that the Contractor uses the same placement and compaction methods, equipment, and material to construct the low-permeability soil layer.

**E. CONSTRUCTION**

1. Only soil from a source previously sampled, tested and confirmed to meet the technical specifications by the CQA Engineer will be used in construction of the low-permeability soil layer. The CQA Engineer will notify the Contractor when material does not meet the requirements of the technical specification and will document that this material is not used for low-permeability soil layer construction.

2. The CQA Engineer will complete all required field density and moisture content tests before the overlying lift of low-permeability soil is placed.

3. The CQA Engineer will observe and document that the Contractor completes all prior lift surface preparation (e.g., wetting, drying, scarification, etc.) before placement of subsequent lifts.

4. The CQA Engineer will observe and document that loose lift thicknesses do not exceed 10 inches (unless otherwise required in the technical specifications) for a final 6 inches compacted lift thickness.

5. The CQA Engineer will check each lift visually for particle sizes or clods that exceed the technical specifications, rocks, debris, plant materials, and other foreign material. The CQA Engineer will inform the Contractor, if such materials are found, and will document their removal.

6. The CQA Engineer will observe and document that the exposed surface of the low-permeability soil layer is rolled with a smooth drum roller or equivalent at the end of

each work day or when required to protect the compacted soil from adverse weather conditions.

7. The CQA Engineer will observe and document that the exposed surface of the low-permeability soil layer is reasonably free of rock, rock fragments, or loose materials. The CQA Engineer will observe and document that rock or other materials protruding more than ¼-inch and other loose materials are removed, all cracks or voids filled, and the surface made uniform.

8. As-built certification surveys will be performed on the low-permeability soil layer prior to installing the overlying geosynthetics materials. Due to settlement and consolidation of underlying CCR, which may occur during construction of the final cover system, the as-built certification points may not accurately provide actual thickness of the low-permeability soil layer. In such cases, the CQA Engineer will perform hand augers to confirm that the required thickness of the low-permeability soil layer has been achieved. Results of the thickness confirmation borings will be documented by the CQA Engineer in the CQA Construction Certification Report. All holes will be patched with sodium bentonite pellets, mixed with low-permeability soils in the holes, hydrated and compacted.

9. The CQA Engineer will observe and document that the surface on which the geomembrane is to be placed is maintained in a firm, clean, dry, and smooth condition before and during the installation of the geomembrane. Additionally, the CQA Engineer will inform the Contractor when desiccation cracking is excessive and will document that all desiccation cracks are repaired as required by the technical specifications.

10. The CQA Engineer will inspect the low-permeability soil layer and certify that it is constructed in accordance with the approved permit, the technical specifications and approved plans.

## F. SAMPLING AND TESTING

1. Construction Quality Assurance sampling and testing will meet the minimum requirements indicated in the Table below.

2. The CQA Engineer or his /her representative will randomly determine the location of each test. All holes will be patched with a mixture of low-permeability soil and sodium bentonite pellets hydrated and compacted in the holes.

| CCR Landfill<br>Soil Layer Construction Quality Assurance Testing Requirements | | | |
|---|---|---|---|
| **Item** | **Testing** | **Frequency** | **Minimum Criteria** |
| Soil Layer Borrow Source | Grain Size (sieves only) (ASTM D422) | 1,000 $yd^3$ | ≤2" (99.8% of all tests) and ≤¼" (top 6", 99% of all tests)<br><br>$k \leq 1.0 \times 10^{-5}$ cm/sec |
| | Moisture Content (ASTM D2216) | 2,000 $yd^3$ | |
| | Atterberg Limits (ASTM D4318) | 5,000 $yd^3$ | |
| | Moisture-Density Curve (ASTM D698) | 5,000 $yd^3$ and all changes in material | |
| | Permeability (remold) (ASTM D5084) | 10,000 $yd^3$ | |
| Soil Layer During Construction | Density/Moisture-Nuclear, Drive-Cylinders, or Sand Cone (ASTM D6938, D2937 or D1556) | 1 test/10,000 sf/lift | ≥95% Standard Proctor |
| Laboratory Testing on Undisturbed Samples of The Constructed Soil Layer | Undisturbed Permeability (ASTM D5084) | 1 test/40,000 sf/lift | $k \leq 1.0 \times 10^{-5}$ cm/sec |
| | Dry Density (ASTM D6938) | | |
| | Moisture Content (ASTM D2216) | | |
| | Atterberg Limits (ASTM D4318) | | |

3. The CQA Engineer will follow this procedure in the event of a density or permeability test failure. If the density does not meet minimum requirements of the CQA Plan, recompaction of the failed area (minimum 100' x 100') will be performed and retested until the area meets or exceeds requirements outlined in the CQA Plan. If a permeability sample fails to meet the minimum hydraulic conductivity requirements outlined in the CQA Plan, the area of failing permeability (minimum 40,000 sf) will be reconstructed. Optionally, at least four (4) replicate samples will be obtained in the immediate vicinity of the failed test. Should the replicate samples confirm the failure of the low-permeability soil layer to meet CQA Plan, the area of failure will be localized according to the results of the replicate samples and reconstructed in accordance with the CQA Plan. All areas of reconstruction will be retested as outlined in the plan.

# 3. FINAL COVER GEOMEMBRANE

## A. GENERAL

The CQA Engineer will certify the materials and installation are in accordance with the approved permit, technical specifications, and this CQA Plan.

## B. MATERIAL

1. The material will be a minimum 40-mil Textured Linear Low-Density Polyethylene (LLDPE) geomembrane supplied and installed by firms approved by Georgia Power.

2. Seams for providing watertight joints will be extrusion or double hot wedge fusion seams using techniques approved by the CQA Engineer.

3. The textured material will have an interface shear resistance with contiguous final cover system components of 24.8 degrees (friction angle at adhesion equal to 0 psf), or another combination of friction angle and adhesion approved by the Design Engineer. The interface shear strength will be determined by direct shear testing conducted at the confining pressure of 250 PSF or as directed by the Design Engineer.

4. Manufacturer Quality Control will confirm the material meets the minimum physical properties a 40-mil thick LLDPE geomembrane as listed in the latest version of GRI-GM17, "*Test methods, test properties and testing frequency for Linear Low-Density Polyethylene (LLDPE) smooth and textured geomembrane*".

## C. GEOMEMBRANE MANUFACTURER AND INSTALLER

1. The Geomembrane Installer will submit the following documents 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

   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 fourteen (14) days prior to installation:

   a. Qualifications of Geomembrane Installer Superintendent and Foreman

   b. Resumes of Geomembrane Contractor field crew

c. Six (6) sets of proposed geomembrane panel layout drawings

## D. GEOMEMBRANE INSTALLATION

1. A pre-deployment CQA meeting will be held prior to installation. The Geomembrane Installer, the Contractor, the CQA Engineer, and a representative of Georgia Power will attend. The following issues will be discussed and agreed upon by all parties and will be included in a report in the CQA documentation.

   a. Testing of welds

   b. Characteristics of a "good" weld, and

   c. Repair procedures

2. The CQA Engineer will obtain samples of the geomembrane rolls from the manufacturing plant prior to shipment to the disposal facility.

3. The samples must be representative of the material supplied and exclude the outer wrap of geomembrane, if signs of scuffing or other damage are observed. Samples should be full roll width and at least 2 feet long.

4. The laboratory testing of the samples selected will be coordinated by the CQA Engineer and will confirm conformance with the properties listed in the table below:

**Geomembrane Conformance Testing Requirements**

| TEST NAME | TEST METHOD | MINIMUM TESTING FREQUENCY[(1)] |
|---|---|---|
| Density | ASTM D 1505 or ASTM D 792 | See Note 1 |
| Thickness | ASTM D 5994 | |
| Tensile Strength at Yield | ASTM D 6693, Type IV | |
| Tensile Strength at Break | | |
| Elongation at Yield | | |
| Elongation at Break | | |
| Carbon Black Content | ASTM D 1603 or ASTM D 4218 | |
| Interface Shear Strength [(2)] (with geocomposite and low permeability soil layer) | ASTM D5321 | 1 per 10 acres (minimum 2 per project) per interface |

Notes:

(1) The minimum number of rolls to be sampled for each shipment will be determined by computing the cube root of the total number of rolls delivered in the shipment, and rounding this value upward to the nearest integer, with at least one sample per each manufacturer's lot. For instance, if 40 rolls of geomembrane are delivered in a shipment, at least four rolls will be sampled. Testing shall be

performed at a minimum frequency of one per lot or as described above, whichever is more frequent. A lot shall be as defined by ASTM D 4354.

(2) Testing parameters for interface shear strengths are provided in Section B.3

5. The CQA Engineer will review the geomembrane thickness of each roll made for the project prior to shipment. Material that does not fall within acceptable thickness criteria will be rejected.

6. The CQA Engineer will mark all areas where grinding is excessive. The location and repair method for the excessive grinding will be recorded in the daily field reports.

7. Overheating of the geomembrane during welding will be monitored by the CQA Engineer. 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.

8. During seaming, the CQA Engineer will observe the seams for the following:

   a. proper preparation,

   b. grinding technique, where applicable, and

   c. overheating

9. The CQA Engineer 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.

10. The CQA Engineer will mark all areas where the geomembrane indicates a protrusion from the low-permeability soil layer. The method of repair will be determined in the field by the CQA Engineer.

**E. TEST SEAMS**

1. The CQA Engineer will document and verify that the geomembrane installer performs a test seam for each welding machine in use every 4-5 hours, or at a minimum prior to start of construction work, and at midday. At least one test seam will be made for each machine in use for each seam. Should any post-production test seam fail, the immediate prior production seam will be sampled for destructive testing in accordance with Section 3.F below. The test seam should be approximately five (5) feet long. The CQA Engineer will sample the test seam from the center three (3) feet of the test sample.

   a. The date, time, and equipment, as well as welding temperature, and seaming parameters will be recorded for each test seam.

b. A minimum of five (5) specimens for peel and for shear from each sample will be tested for the properties listed in the latest version of GRI-GM19, "*Standard Technical Specification for Seam Strength and Related Properties of Thermally Bonded Polyolefin Geomembrane*" in accordance with test method ASTM D6392. Testing will be performed in the field by the Geomembrane Installer under full-time observation by the CQA Engineer.

c. Untested portions of the test seam will be retained by the CQA Engineer for the project record and future testing as required.

2. All test seams must pass the field-testing before production seaming is performed by the Geomembrane Installer.

## F. FIELD DESTRUCTIVE TESTING

1. The Geomembrane Installer will obtain approximately 12" x 48" samples of field seams, suitable for testing, as indicated in the table below. The date, time and equipment, and seam number will be marked on each sample and recorded by the CQA Engineer.

**Field Seam Testing Requirements**

| TEST NAME | TEST METHOD | AVERAGE TESTING FREQUENCY |
|---|---|---|
| Seam Peel Strength | ASTM D 6392[(1)] | 1 test per 500 feet of seam |
| Seam Shear Strength | ASTM D 6392[(2)] | 1 test per 500 feet of seam |

Notes:
(1) For double wedge fusion seams, both tracks shall be tested in peel.
(2) For shear tests, the sheet shall yield before failure of the seams.

2. Samples retained will be tested in the field by the geomembrane installer. A minimum of five (5) specimens from each sample for peel and for shear will be tested for the properties listed in latest version of GRI-GM19, "*Standard Technical Specification for Seam Strength* and *Related Properties of Thermally Bonded Polyolefin Geomembrane*" in accordance with test method ASTM D6392.

3. The CQA Engineer or Georgia Power may require additional random samples to be taken for testing in areas that visually appear defective and not in accordance with project requirements.

## G. NON-DESTRUCTIVE TESTING

1. The Geomembrane Installer is responsible for the completion of non-destructive testing of the entire length of all field seams, verifying that said seam is airtight. Said testing can be a vacuum test, pressure test, or approved equal and will be described by the Geomembrane Installer and verified by the CQA Engineer in advance.

2. The CQA Engineer will observe all non-destructive testing on a full-time basis.

## H. DESTRUCTIVE LABORATORY TESTING

1. Destructive seam samples will be laboratory tested by the CQA Engineer. Testing frequency will be a minimum average frequency of one (1) sample per 500 linear feet of field seam.

    a. Test samples will be at least 12 x 36 inches. A minimum of five (5) specimens will be tested for the properties listed in the latest version of GRI-GM19, "Standard Technical Specification for Seam Strength and Related Properties of Thermally Bonded Polyolefin Geomembrane" in accordance with test method ASTM D6392. These test samples will be taken at the same locations as the contractor's destructive testing samples.

    b. All laboratory specimens of geomembrane will be conditioned for a minimum of one (1) hour prior to testing at the standard atmosphere for testing geosynthetics, that is, air maintained at a relative humidity of 65% ±5 % and a temperature of 21°C ± 2°C (70°C ± 3.5°F).

    c. Peel tests will be performed on both sides of a double-wedge fusion seam.

2. The load and elongation at failure will be measured for each specimen. 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.

3. The average values of each set of five (5) specimens for peel and for shear must meet the technical specifications, and four of the five specimen tests must meet the technical specifications for the seam to be considered a passing seam. If the average of the five specimens is adequate, but one of the specimens is failing, values for the failing specimen must be at least 80 percent of the values required for the seam for the sample to pass. A maximum of one non-film tear bond failure out of five tests is acceptable provided the destructive sample meets strength requirements discussed above. If unresolved discrepancies exist between the CQA Engineer and Contractor's test results, the archived sample may be tested by the CQA Engineer. Samples that 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.

4. Seams represented by a failing destructive field or laboratory test sample will be cut out and replaced or covered with a geomembrane strip and the seam bounded by supplemental passing field and laboratory destructive test samples at both ends.

5. The CQA Engineer will verify and document that the strength and other properties of the textured 40-mil thick LLDPE geomembrane seams meet or exceed the requirements set forth in the latest version of GRI-GM19, "*Standard Technical Specification for Seam Strength and Related Properties of Thermally Bonded Polyolefin Geomembrane*".

# 4. FINAL COVER GEOCOMPOSITE DRAINAGE MEDIA (GDM)

## A. GENERAL

The CQA Engineer will certify the materials and installation are in accordance with the plans, technical specifications, and this CQA Plan.

## B. GDM MANUFACTURER AND INSTALLER

1. The CQA Engineer will review and verify the following submittals from the GDM Manufacturer:

    a. Production Certification
    b. Material Certification
    c. Test Data for Material

2. The CQA Engineer will review and verify the following documents prior to installation:

    a. Qualifications of the GDM installer superintendent, foreman, and field crew.
    b. Six (6) sets of field installation drawings.

## C. CONFORMANCE TESTING

CQA Conformance Testing will be performed by the CQA Engineer according to the following table:

**GDM Conformance Testing Requirements**

| TEST NAME | TEST METHOD | MINIMUM TESTING FREQUENCY [1] |
|---|---|---|
| Transmissivity [2] | ASTM D 4716 - Modified (100-hour transmissivity of geocomposites) | 1 test per 10 acres |
| Adhesion | ASTM D 7005 | 1 test per 200,000 s.f. |
| Resin Density | ASTM D1505 | 1 test per 200,000 s.f. |
| Interface Shear Strength [3] (with protective layer) | ASTM D5321 | 1 test per 10 acres (minimum 2 per project) |

Notes:

[1] Testing will be performed at a frequency of one per lot or at listed frequency, whichever is more frequent. A lot is defined by ASTM D 4354.

[2] Transmissivity testing will be performed as described below:
Conduct CQA testing for transmissivity at the confining pressure of 250 PSF at a hydraulic gradient equal to 0.33. The boundary conditions are "Protective Cover" soils on top and the specified geomembrane on the bottom of the GDM. The minimum required transmissivity tested under these conditions will be $5x10^{-4}$ $m^2$/sec (test between two steel plates are not acceptable).

[3] The GDM will have an interface shear resistance (friction angle plus cohesion) with contiguous final cover system components of 24.8 deg. (per ASTM D5321). This is the minimum shear strength represented by a

friction angle with an adhesion = 0 psf. Equivalent strength combinations that provide satisfactory factors of safety may be approved by the Design Engineer. The interface shear strength will be determined by direct shear testing conducted at the confining pressure of 250 psf or as directed by the Design Engineer.

Conformance testing for the individual components of the GDM (geotextile and the geonet) will be in accordance with the technical specifications.

**D. INSTALLATION**

1. The CQA Engineer will verify that the installation of the GDM proceeds after he/she has provided certification of the geomembrane or a section thereof.

2. The CQA Engineer will monitor the installation of the GDM to verify there is no damage to the geomembrane cap. Should the final cover system geomembrane be damaged the CQA Engineer will inform the Contractor and document the repairs done.

3. The CQA Engineer will be present during all GDM placement operations and will verify that all work is in accordance with the plans and technical specifications.

4. At the conclusion of this activity, the CQA Engineer will provide a written certification that the work has been installed according to plans and technical specifications.

5. The CQA Engineer will verify that adjacent rolls of GDM:

    a. Overlap a distance of at least three (3) inches; and

    b. Are secured using polyethylene ties as follows:

        i. every ten (10) feet for adjacent rolls, and

        ii. every five (5) feet at end seams.

6. The CQA Engineer will verify that the overlaying filter geotextile, where applicable, extends at least six (6) inches past the geonet joint and is permanently bonded by heat bonding or sewing.

7. The CQA Engineer will verify that any GDM that is torn, crushed, or punctured is repaired or replaced by the GDM installer according to the technical specifications.

# 5. PROTECTIVE SOIL FOR FINAL COVER SYSTEM

## A. GENERAL

The CQA Engineer will verify that the protective soil cover is placed in accordance with the approved plans, technical specifications, and this CQA Plan.

## B. MATERIAL

1. Soil that meets all the following requirements will be classified as select soil fill for use in construction of the protective soil cover for the cap.

    a. Soil will be classified according to the Unified Soil Classification System (USCS) as ML, MH, CH, CL or SC. (ASTM D2487). Liquid limit, plasticity index (PI), and percent passing the No. 200 sieve will be considered for proper classification.

    b. Select soil fill materials will be reasonably free of ferrous, and/or calcareous concretions and nodules, refuse roots, or other deleterious substances.

    c. The soil cover will be uniform, smooth, and substantially free of debris, rock, plant materials, and other foreign material larger than two (2) inches. The material will contain no sharp edges.

2. The top six (6) inches of protective soil for the final cover system must be capable of supporting the growth of grass. The soils noted in 5.B.1.a. can be expanded to include SM and SP soils in the top six (6) inches of cover.

## C. STOCKPILING AND MATERIAL APPROVAL

1. All material to be used as protective soil cover will be approved in advance by the CQA Engineer. The CQA Engineer must verify the soil 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 will prepare reports of all testing, analysis, and verification.

## D. CONSTRUCTION

1. The CQA Engineer will provide verification of the following:

    a. Approved stockpiled material was used to construct the protective soil cover.

    b. The protective soil cover was constructed in accordance with the approved plans, technical specifications, and this CQA Plan.

c. The geomembrane and GDM were not damaged during the construction of the protective soil cover.

d. The protective soil cover thickness has been achieved and verified.

2. The protective soil material will be spread and compacted using low ground pressure equipment such as a CAT D6 low ground pressure (LGP) bulldozer or similar equipment.

3. Protective soil material will be spread by pushing "up slope", and the CQA Engineer will verify that the protective soil cover was not pushed down any side slopes of the landfill cap.

4. Protective soil thickness will be at least 12" thick at all times during spreading and compaction.

## E. SAMPLING AND TESTING

Construction quality assurance testing will meet the minimum requirements listed in the table below.

| Protective Soil for Final Cover System Quality Assurance Testing Requirements | | | |
|---|---|---|---|
| **Item** | **Test Method** | **Minimum Frequency** | **Minimum Criteria** |
| Borrow Source | Grain Size ASTM D422 with Hydrometer | 5,000 cy | See Note (1) below |
| | Atterberg Limits ASTM D4318 | 5,000 cy | |
| | Moisture – Density ASTM D698 | 5,000 cy | |
| | Remolded Permeability (2) ASTM D5084 | 10,000 cy | $7.5 \times 10^{-5}$ cm/sec or less |
| Construction | Density and Moisture (ASTM D6938, 1556, or 2937) | 1 test/20,000 $ft^2$ of planar final cover surface area | 90% of Maximum Dry Density and 0% to 2% of the Optimum Moisture Content per ASTM 698 – Standard Proctor Test |

Notes:

(1) Acceptable soils include those classified according to the Unified Soil Classification System (USCS) as SC, ML or CL (ASTM 02487). Liquid limit, plasticity index (PI), and gradation will be considered for proper classification.

(2) Remold sample to 90% of Maximum Dry Density and 0% to 2% of the Optimum Moisture Content per ASTM 698 – Standard Proctor Test.

# 6. CERTIFICATION

The CQA Engineer will provide, within 30 days of completion of closure activities, written certification that the final cover system, access roads, ditches, sediment basins, and other associated ancillary facilities for the particular landfill area were constructed according to the approved permit, technical specifications, and this CQA Plan. Said certification will have the CQA Engineer's seal as a professional engineer registered in the State of Georgia.

# APPENDIX A. ORIGINAL CQA PLAN FOR CELL CONSTRUCTION

# PLANT WANSLEY PRIVATE INDUSTRIAL SOLID WASTE DISPOSAL FACILITY
# CONSTRUCTION QUALITY ASSURANCE PLAN (CQAP)

## GENERAL

This CQAP provides the quality assurance standards, procedures, and minimum acceptance criteria for construction of the disposal cells and ponds including the composite liner and leachate drainage and collection system. This CQAP, instituted as part of the site's Design and Operation Plan (D&O Plan), provides the minimum level of activities that provides assurance that construction proceeds in accordance with the D&O Plans and the site's Construction Quality Control Plan (CQCP). A separate CQCP (Technical Specifications) will be developed and included in the contract documents for construction of the disposal facility that will provide the detailed processes, inspections and controls that will ensure the facility is constructed in accordance with this CQAP, the Design and Operation Plans, and the Permit. This CQAP addresses those areas of site construction pertaining to environmental protection including the necessary earthwork required for construction of the landfill disposal area liners and the associated leachate drainage and collection systems.

As each cell of the disposal facility is constructed, a Construction Quality Assurance Report (Construction Certification) shall be submitted along with a registered engineer's certification that the cell under consideration was constructed within the limitations of and according to the approved permit plans. Waste may not be placed into the newly constructed disposal area until the Georgia EPD has reviewed and approved the Report. The Report shall include, but not be limited to, the following:

1. Base grade drawings of the subgrade for the soil component of the liner system.
2. Top of finished grade of the soil component of the liner system.
3. Top of finished grade for the granular drainage layer of the liner system.
4. A summary of major construction activities which shall include a description of the activity and schedule dates. This summary shall be based on daily logs provided by the on-site inspector. This shall also serve to document the presence of a qualified member of the inspection team during any construction activity involving structural fill or any component of the liner or leachate collection and transport system.
5. Project QC summary reports including all field testing and inspection results. This summary shall be inclusive of all passing tests as well as failing tests and retests.
6. An as-built final panel layout with panel numbers of the installed HDPE liner is to be submitted upon completion of installation. This plan shall reference the 1) location by roll number of synthetic material, 2) location of referenced destructive tests, 3) location of required repairs to the liner due to defects, accidental punctures, or failed tests.
7. A record topographic survey of the constructed cell and associated structures.

## STRUCTURAL EARTH FILL

The following minimum requirements are to be incorporated into the site's CQCP (Specifications) for construction of structural earth fill. This data must be collected and submitted in support of the Construction Certification required by Rule 391-3-4-.07(2). Borrow material for use as compacted structural fill shall be qualified for use by a borrow investigation.

| | TESTING | STANDARDS | MINIMUM FREQUENCY | MINIMUM CRITERIA |
|---|---|---|---|---|
| Construction | Grain size | ASTM D422 | 1000 cy | |
| | Density – Nuclear or sand cone | ASTM D6938 ASTM D1556 | 1000 cy or 1 per ac. of lift area. Min. 1 per lift/day fill is placed. | ≥ 95% Standard Proctor (ASTM D698) |
| | | | | |
| | Moisture Content | ASTM D2216 | 1000 cy or 1 per ac. of lift area. Min. 1 per lift/day fill is placed. | -4% to +4% of optimum |

4

1. No earth fill shall be placed on any part of the foundation until such areas have proof-rolled and been inspected and approved in writing.
2. Earth fill shall be placed in uniform layers of six (6) to eight (8) inches, nominal thickness, loose measurement, for one (1) foot beyond the full width of the fill on each side. Upon completion of compaction, the slopes shall be cut back to the final slope.
3. The compacted surface of each lift shall provide a proper bonding surface for the succeeding layer.
4. The structural fill shall not contain any roots or other organic matter, rocks greater than 3", largest dimension, or any other deleterious debris.
5. Structural earth fill material shall be compacted to 95% of the relative maximum dry density as determined by the Standard Proctor compaction test (ASTM D 698). The moisture content of the earth fill at the time of placement shall be between -4% and +4% of the optimum moisture obtained by Standard Proctor compaction test. 4
6. Earth fill which cannot be compacted with roller equipment because of inadequate clearances shall be spread in four (4)-inch layers and compacted with hand-guided power tampers to the extent required by these Specifications. Rocks two (2) inches and greater, in any dimension, roots, and debris shall be removed from the fill and disposed of in an approved manner.
7. The location, lift designation, and elevation or depth of the field density and moisture tests (passing, failing, and retests) shall be recorded and noted on the respective test records.
8. If the construction of the embankment is interrupted, the surface of the last lift shall be shaped and smoothed to provide a surface that will shed as much water as possible during the interruption. When the work is resumed, the surface lift shall be leveled, scarified and compacted before placing additional layers.

## COMPACTED CLAY LINER

The following minimum requirements are to be incorporated into the site's CQCP for construction of the compacted clay liner. This data must be collected and submitted in support of the Construction Certification required by Rule 391-3-4-.07(2). Borrow material for use as compacted clay liner shall be qualified for use by a borrow investigation.

| | TESTING | STANDARDS | MINIMUM FREQUENCY | MINIMUM CRITERIA |
|---|---|---|---|---|
| Construction | Density – Nuclear or sand cone | ASTM D6938 ASTM D698 | 1 test/10,000 sf/lift (Approx. 185 cy) & 1 test/lift/200 lf side slope | ≥ 95% Standard Proctor (ASTM D698) |
| | Moisture Content | ASTM D2216 | 1 test/10,000 sf/lift (Approx. 185 cy) & 1 test/lift/200 lf side slope | +2% to +4% of optimum |
| Laboratory | Permeability – undisturbed | ASTM D5084 COE | 1 test/40,000 sf/lift (Approx. 750 cy) & 1 test/lift/800 lf side slope | $\leq 1x10^{-5}$ cm/sec |
| | Dry Density – undisturbed | ASTM D6938 | 1 test/40,000 sf/lift (Approx. 750 cy) & 1 test/lift/800 lf side slope | ≥ 95% Standard Proctor (ASTM D698) |
| | Moisture Content | ASTM D2216 | 1 test/40,000 sf/lift (Approx. 750 cy) & 1 test/lift/800 lf side slope | +2% to +4% of optimum |
| | Atterburg Limits | ASTM D4318 | 1 test/40,000 sf/lift (Approx. 750 cy) & 1 test/lift/800 lf side slope | |

4

1. The clay/silt liner material, i.e. the lower component of the composite liner system, shall be compacted to a minimum 95% maximum dry density, as determined by the Standard Proctor compaction test (ASTM D 698). The moisture content of the earth fill at the time of placement shall be between +2% and +4% of the optimum moisture obtained by Standard Proctor compaction test.
2. The compacted clay liner shall have a maximum permeability of 1E - 5 cm/sec.
3. For compacted clay liner underlying a GCL, the maximum particle size shall be 1/2 inch. The material shall be free of any debris which could puncture or damage the overlying GCL.
4. The compacted clay/silt liner shall be placed in uniform layers of 6 inches, nominal thickness, loose measurement. The compacted surface of each lift shall provde a proper bonding surface for the succeeding layer.
5. Laboratory confirmation testing for the compacted clay/silt liner material shall be performed to verify that the permeability of the compacted fill is equal to or less than that required. The confirmation testing shall consist of obtaining undisturbed samples of the compacted fill for laboratory confirmation of field density, moisture content, and hydraulic conductivity of field compacted material.
6. The drive tubes used to collect the undisturbed samples shall be cleaned and sealed to preserve the moisture content and delivered to the independent soil testing laboratory. A duplicate tube shall be obtained at each location as a spare for confirmation testing.
9. The undisturbed samples shall be stored and handled in such a manner as to prevent damage to the sample from freezing, transporting or other means.
10. After the undisturbed samples are taken, the holes shall be filled with bentonite (powder, chips, or pellets) to maintain the integrity of the liner.
11. The locations of the field density and moisture tests and the undisturbed samples shall be recorded and noted on the respective test records.

## GEOSYNTHETIC CLAY LINER

GCL Contractor Qualifications

1. The manufacturer of the geosynthetic clay liner (GCL) must have produced at least ten (10) million square feet of product, with at least eight (8) million square feet installed.
2. The GCL installer must either have installed at least one (1) million square feet of product, or must provide satisfactory evidence, through similar experience in the installation of other types of geosynthetics, that the respective geosynthetic will be installed in a competent, professional manner.
3. The GCL Inspector shall be an individual or company who is independent from the manufacturer and installer, who shall be responsible for monitoring and documenting activities related to the construction quality control (CQC) of the GCL, throughout installation. The GCL inspector shall have provided CQC services for the installation of the proposed or similar products for at least five (5) completed projects totaling not less than one (1) million square feet. The inspector should be an engineer registered to practice in the state of Georgia or an ICP - certified geosynthetics installation technician. 4

Material

The GCL to be used on slopes of 3H to 1V or steeper shall be a CETCO Bentomat SDN (CR) or approved equal material. The GCL to be used on the bottom slopes of the ponds and cells shall be a CETCO Bentomat 200R (CR) or approved equal material. All GCL to be used in gypsum cells 1, 2 & 3 shall have bentonite enhanced with a polymer additive for chemical compatibility with the gypsum. The reinforced GCL and its components shall have the following properties:

| GCL (per GRI-GCL3) | | | |
|---|---|---|---|
| Material Property | ASTM Test Method | Test Frequency | Required Values |
| **Clay Properties (as received)** | | | |
| Swell Index | D 5890 | 50 tonnes | 24 mL/2g |
| Fluid Loss[1] | D 5891 | 50 tonnes | 18 mL |
| **Geotextiles (as received)** | | | |
| Cap fabric (non-woven) – mass/unit area | D 5261 | 25,000 yd² | 2.1 |
| Carrier fabric (non-woven) composite | D 5261 | 25,000 yd² | 2.7 |
| **GCL (as manufactured)** | | | |
| Mass of GCL[2] | D 5993 | 5,000 yd² | 0.82 lb/ft² |
| Mass of Bentonite[2] | D 5993 | 5,000 yd² | 0.75 lb/ft² |
| Tensile Strength, MD | D 6768 | 25,000 yd² | 23 lb/in |
| Flux[1] | D 5887 | 30,000 yd² | 1 x $10^{-6}$ cm³/sec-cm² |
| Permeability [1] | D 5887 | 30,000 yd² | 5 x $10^{-9}$ cm/sec |

Notes
(1) These numbers are maximum. All others are minimum.
(2) Mass of GCL and bentonite is measured after oven drying per the stated test method.

Labeling and Packaging

1. Prior to shipment, the GCL manufacturer shall label each roll, identifying the product identification information (manufacturer's name and address, brand product code), lot number, roll number, roll length, width and weight.
2. The GCL shall be wound around a rigid core whose diameter is sufficient to facilitate handling. The core is not necessarily intended to support the roll for lifting but should be sufficiently strong to prevent collapse during transit.
3. All rolls shall be labeled and bagged in packaging that is resistant to photodegradation by ultraviolet (UV) light.

Shipping, Handling and Storage

1. A visual inspection of each roll should be made during unloading to identify if any packaging has been damaged. Rolls with damaged packaging should be marked and set aside for further inspection. The packaging should be repaired prior to being placed in storage.
2. The party responsible for unloading the GCL should contact the manufacturer prior to shipment to ascertain the appropriateness of the proposed unloading methods and equipment.
3. Rolls should be stored in a manner that prevents sliding or rolling from the stacks and may be accomplished by the use of chock blocks. Rolls should be stacked at a height no higher than that at which the lifting apparatus can be safely handled (typically no higher than four (4) feet).
4. All stored GCL materials and the accessory bentonite must be covered with a plastic sheet or tarpaulin until their installation.
5. The integrity and legibility of the labels shall be preserved during storage.

Surface Preparation

1. Any surface upon which the GCL is installed shall be smooth, firm, and unyielding, without abrupt elevation changes, voids, cracks, ice, or standing water. The surface shall be free of vegetation, debris, sticks, sharp rocks, and any other foreign matter that could damage the GCL.
2. Immediately prior to GCL deployment, the subgrade shall be finish-graded to fill in all voids or cracks and then smooth-rolled to provide the best practicable surface for the GCL. At completion of this activity, no wheel ruts, footprints or other irregularities shall exist in the subgrade. Furthermore, all protrusions extending more than one-half inch (12 mm) from the surface shall be either removed, crushed or pushed into the surface with a smooth-drum compactor.
3. At the top of sloped areas of the job site, an anchor trench for the GCL, HDPE, and geocomposite shall be excavated. No loose soil shall be allowed at the bottom of the trench and no sharp corners or protrusions shall exist anywhere within the trench.
4. The surface on which the GCL will be installed shall be inspected prior to installation.

GCL Placement

1. The GCL shall be placed in accordance with guidelines and specifications provided by the manufacturer of the material unless otherwise noted.
2. GCL rolls should be delivered to the working area of the site in their original packaging. Immediately prior to deployment, the packaging should be carefully removed without damaging the GCL.
3. Equipment which could damage the GCL shall not be allowed to travel directly on it. If the installation equipment causes rutting of the subgrade, the subgrade must be restored to its originally accepted condition before placement continues. Low ground pressure ATU's (6psi or less) will be allowed to ride over the GCL surface during installation and repair operations.
4. Care must be taken to minimize the extent to which the GCL is dragged across the subgrade in order to avoid damage to the bottom surface of the GCL.
5. The GCL panels shall be placed parallel to the direction of the slope. All GCL panels should lie flat on the underlying surface, with no wrinkles or fold, especially at the exposed edges of the panels.
6. Only as much GCL shall be deployed as can be covered at the end of the working day with soil, a geomembrane, or a temporary waterproof tarpaulin. The GCL shall not be left uncovered overnight. If the GCL is hydrated when no confining stress is present, it may be necessary to remove and replace the hydrated material
7. The end of the GCL roll shall be placed in an anchor trench at the top of the slope. When utilizing an anchor trench design, the front edge of the trench should be rounded so as to eliminate any sharp corners. Loose soil should be removed from the floor of the trench. The GCL should cover the entire trench floor and the rear trench wall.
8. Placement of the GCL shall be under the direct observation of the GCL inspector.

Seaming

1. The GCL seams are constructed by overlapping their adjacent edges. Care should be taken to ensure that the overlap zone is not contaminated with loose soil or other debris. Supplemental bentonite is required for reinforced GCL.
2. The minimum dimension of the longitudinal overlap should be six (6) inches (150 mm). End-of-roll overlapped seams should be similarly constructed, but the minimum overlap should measure 24 inches (600 mm).
3. Seams at the ends of the panels should be constructed such that they are shingled in the direction of the grade to prevent the potential for runoff flow to enter the overlap zone.
4. Unless the GCL contains bentonite grooves to facilitate seaming without additional bentonite, bentonite-enhanced seams are constructed between the overlapping adjacent panels described above. The underlying edge of the longitudinal overlap is exposed and then a continuous bead of granular sodium bentonite is applied along a zone defined by the edge of the underlying panel and the six (6)-inch (150 mm) line. A similar bead of granular sodium bentonite is applied at the end-of-roll overlap. The granular bentonite shall be applied at a minimum application rate of one quarter pound per lineal foot (0.4 kg/m).
5. The granular bentonite sealing clay used for overlap seaming, penetration sealing, and repairs shall be made from the same natural sodium bentonite as used in the GCL and shall be as recommended by the GCL manufacturer.
6. Seaming operations shall be under the direct observation of the GCL inspector.

Damage Repair

1. Any GCL that is damaged during delivery or handling operations and cannot be used in the liner installation shall be replaced.
2. If any GCL is damaged during installation, to include placement of the overlying HDPE liner and placement and compaction of the protection soil cover and topsoil, the affected installed GCL shall be replaced.
3. If the GCL is damaged (torn, punctured, perforated, etc.) during installation, it may be possible to repair it by cutting a patch to fit over the damaged area. The patch shall be obtained from a new GCL roll and shall be cut to size such that a minimum overlap of 12 inches (300 mm) is achieved around all of the damaged area. Granular bentonite or bentonite mastic should be applied around the damaged area prior to placement of the patch. It may be desirable to use an adhesive to affix the patch in place so that it is not displaced during cover placement.
4. Damage repair shall be under the direct observation of the GCL inspector.

## HDPE LINER

Geomembrane Contractor Qualifications

1. The manufacturer of the HDPE material shall have at least five (5) years continuous experience in manufacturing polyethylene geomembrane and/or experience totaling 10,000,000 square feet of manufactured polyethylene geomembrane.
2. The installation contractor shall be the manufacturer or a dealer trained to install the manufacturer's geomembrane. Installation shall be performed under the constant direction of a field installation supervisor who shall remain on site and be responsible, throughout the liner installation, for liner layout, seaming, testing, repairs, and all other activities by the Installer. The field installation supervisor shall have installed or supervised the installation of a minimum of 2,000,000 square feet of polyethylene geomembrane. Seaming shall be performed under the direction of a master seamer (who may also be the field installation supervisor) who has seamed a minimum of 1,000,000 square feet of polyethylene geomembrane, using the same type of seaming apparatus specified for this project. The field installation supervisor and/or master seamer shall be present whenever seaming is performed.
3. The HDPE inspector shall be an individual or company who is independent from the geocomposite manufacturer and installer, who shall be responsible for monitoring and documenting activities related to the CQC of the HDPE throughout installation. The inspector shall have provided CQC services for the installation of the proposed or similar products for at least five (5) completed projects totaling not less than one (1) million square feet. The inspector should be an engineer registered to practice in the state of Georgia or an ICP - certified HDPE installation technician. The HDPE inspector shall directly observe all aspects of HDPE installation, seaming, testing, and damage repair.

4

Geomembrane Material

1. The geomembrane shall be 60 mil thick, textured (both sides), high density polyethylene (HDPE), a minimum 22.5 feet seamless width. Carbon black shall be added to the resin if the resin is not compounded for ultra-violet resistance.
2. The surface of the geomembrane shall not have striations, roughness, pinholes, or bubbles and shall be free of holes, blisters, undispersed raw materials, or any contamination by foreign matter, except that if it has been determined that the blemish will not adversely affect properties and use of the liner, the geomembrane may be accepted after sufficient laboratory test data are provided to support such acceptance.
3. The geomembrane shall be supplied in rolls. Labels on each roll shall identify the thickness of the material, the length and width of the roll, batch and roll numbers, and the name of the manufacturer.

Geomembrane Raw Materials

1. The geomembrane shall be manufactured of polyethylene resins and shall be compounded and manufactured specifically for the intended purpose and meets the following physical property requirements.

| Property | Test Method | HDPE Requirements |
|---|---|---|
| Density, g/cc | ASTM D 1505 | 0.932 |
| Melt Index,g/10 min. | ASTM D 1238 | ≤1.0 |
| OIT, min | ASTM D 3895 | 100 |
| | ASTM D 5885 | |

GEORGIA
Environmental Protection Division
Solid Waste Management Program
MINOR MODIFICATION APPROVAL
SOLID WASTE PERMIT NO. 079-005D(L&I)
APPROVED BY: [signature] DATE: 5/9/12

GEORGIA REGISTERED 12687 PROFESSIONAL ENGINEER [signature] 3/29/12

## REFERENCE DRAWINGS:

1. FOR A COMPLETE DRAWING INDEX SEE DRAWING H1C11120

"REV. 3 OF THIS DRAWING, BEING PART OF THE DESIGN & OPERATIONS PLAN FOR THE PLANT SCHERER CCB DISPOSAL FACILITY, WAS SEALED BY GARY H. McWHORTER, GEORGIA REGISTERED PROFESSIONAL ENGINEER, NO. 12687."

"REV. 2 OF THIS DRAWING, BEING PART OF THE DESIGN & OPERATIONS PLAN FOR THE PLANT SCHERER CCB DISPOSAL FACILITY, WAS SEALED BY GARY H. McWHORTER, GEORGIA REGISTERED PROFESSIONAL ENGINEER, NO. 12687."

"REV. 1 OF THIS DRAWING, BEING PART OF THE DESIGN & OPERATIONS PLAN FOR THE PLANT SCHERER CCB DISPOSAL FACILITY, WAS SEALED BY GARY H. McWHORTER, GEORGIA REGISTERED PROFESSIONAL ENGINEER, NO. 12687."



| REVISION | DATE | BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| | | | | | | | | |
| REVISION 4 | DATE 03-22-2012 | ASF | GHM | JCP | | | | DWM |
| GENERAL REVISION FOR MODIFICATION | | | | | | | | |
| "REV. 4 OF THIS DRAWING, BEING PART OF THE DESIGN & OPERATIONS PLAN FOR THE PLANT SCHERER CCB DISPOSAL FACILITY, WAS SEALED BY GARY H. McWHORTER, GEORGIA REGISTERED PROFESSIONAL ENGINEER, NO. 12687." | | | | | | | | |
| REA: WN05681 | EWO: 3068DE | | | | | | | |
| REVISION 3 | DATE 07-22-2010 | ASF | GHM | JCP | | | | DWM |
| REVISED WORDING FROM MODIFIED TO STANDARD. (TWO PLACES, B7) | | | | | | | | |
| REA: WN05681 | EWO: 3068DE | | | | | | | |
| REVISION 2 | DATE 07-09-2010 | ASF | GHM | JCP | | | | DWM |
| NUMERUS MISC. WORDING CHANGES. | | | | | | | | |
| REA: WN05681 | EWO: 3068DE | | | | | | | |
| REVISION 1 | DATE 03-19-2010 | ASF | GHM | JCP | | | | DWM |
| REVISED PER 10\22\09 EPD LETTER. | | | | | | | | |
| REA: WN05681 | EWO: 3068DE | | | | | | | |
| REVISION 0 | DATE 08/03/2009 | JJB | GHM | JCP | | | | DWM |
| ISSUED FOR PERMIT | | | | | | | | |
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| REA: WN05681 | EWO: 3068DE | | | | | | | |

Southern Company Generation
Engineering and Construction Services
FOR
Georgia Power Company

PLANT WANSLEY
COAL COMBUSTION BY-PRODUCT DISPOSAL FACILITY
CONSTRUCTION QUALITY ASSURANCE PLAN
SHEET 1

| SCALE | PROJ I.D. | DRAWING NUMBER | SHEET | CONT'D | REV |
|---|---|---|---|---|---|
| NOT TO SCALE | 010209 | H1C11166 | 1 | FINAL | 4 |

Drawing name: T:\ESEE MAJOR PROJECTS\PROJECTS\WANSLEY\WANSLEY 2009\ES1744_Wansley D&O Plan\DRAWINGS\H1C11166Rev4.dwg Mar 15, 2012 - 1:58pm
ANSI F: 40x28 Acad2008

Geomembrane Rolls

1. The geomembrane rolls shall meet or exceed the following specifications. Certification shall be provided for each roll stating that these items have been met or exceeded. The certification shall reference the manufacturer's batch and roll number and shall indicate the name of the manufacturer.

| HDPE TEXTURED GEOMEMBRANE (Per GRI GM-13) | | | |
|---|---|---|---|
| TESTING | STANDARDS | TEST VALUES | MINIMUM FREQUEN CY |
| Density | ASTM D1505 ASTM D792 | ≥ 0.940 g/cm³ | Once per 200,000 |
| Carbon Black Content | ASTM D1603 | 2.0% to 3.0% | 20,000 lbs. |
| Carbon Black Dispersion [2] 1. Categories 1 or 2 2. Category 3 | ASTM D5596 | 9 1 | 45,000 lbs. |
| Tensile properties [2] 1. Strength @ yield 2. Strength @ break 3. Elongation @ yield 4. Elongation @ break | ASTM D6693 Type IV Dumbell, 2 ipm G.L.=1.3 in G.L.=2.0 in | ≥ 126 lbs/in ≥ 90 lbs/in 12% 100% | 20,000 lbs. |
| Thickness 1. Min. Avg. 2. Lowest Ind. For 8 out of 10 values 3. Lowest Ind. For Any of the 10 values | ASTM D5994 | 57 mil nom. 54 mils 51 mils | Per roll |
| Asperity Height [1] | GRI-GM 12 | 10 mils (min. avg.) | Every 2nd Roll [2] |
| Puncture Resistance | D4833 | ≥ 90 lbs (min. avg.) | 45,000 lbs |
| Stress Crack Resistance | ASTM D5397 (App) | ≥ 300 hours | Per GRI GM-10 |
| Tear Resistance | ASTM D1004 | ≥ 42 lbs min. avg. | 45,000 lbs |
| Oxidative Induction Time (OIT) 1. Standard OIT, or 2. High pressure OIT | ASTM D3895 ASTM D5885 | 100 min. (min. avg.) or, 400 min. (min. avg.) | 200,000 lbs |
| Oven Aging @ 85°C 1. Standard OIT (min. avg.) - % retained after 90 days, or 2. High Pressure OIT (min. avg.) - % retained after 90 days | ASTM D5721 ASTM D3895 ASTMD5885 | 55% 80% | Per Each Formulation |
| UV Resistance 1. Standard OIT (min. avg.) 2. High Pressure OIT (min. avg.) - % retained after | GM11 ASTM D3895 ASTMD5885 | N. R. 50% | Per Each Formulation |

Notes:
1. Of 10 readings, 8 out of 10 must be ≥ 7 mils, and lowest individual reading must be ≥ 5 mils. 10 mil average.
2. The combination of stress concentrations due to coextrusion texture geometry and the small specimen size results in large variation of test results. Therfore, these tensile properties are minimum average values.
3. Dispersion only applies to near spherical agglomerates. 9 of 10 veiws shall be Cat 1. or Cat. 2. No more than one (1) veiw from Cat. 3.

Geomembrane Installation

1. The geomembrane shall be packaged and shipped by appropriate means to ensure that no damage is incurred. The geomembrane shall be stored so as to be protected from puncture, dirt, grease, moisture and excessive heat. Damaged material shall be stored separately for repair or replacement. The rolls shall be stored on a prepared smooth surface (not wooden pallets) and shall be stacked in accordance with manufacturer's recommendations.
2. The installation of the geomembrane shall be in accordance with the manufacturer's recommendations and CQP.
3. All seams and non-seam areas of the geomembrane shall be inspected for defects, holes, blisters, undispersed raw materials, and any sign of contamination by foreign matter. The surface of the geomembrane shall be clean at the time of inspection.
4. The anchor trench shall be excavated to the lines, grades, and widths shown on the project construction drawings, prior to liner system placement. Slightly rounded corners shall be provided in the trench to avoid sharp bends in the geomembrane.
5. The rolls shall be deployed using a spreader bar assembly attached to a loader bucket or by other approved methods.
6. Equipment or tools shall not damage the geomembrane during handling, transportation and deployment.
7. Personnel working on the geomembrane shall not smoke or wear damaging shoes.
8. The method used to unroll the panels shall not cause scratches or crimps in the geomembrane and shall not damage the supporting GCL.
9. Adequate loading (e.g., sand bags or similar items that will not damage the geomembrane) shall be placed to prevent uplift by wind (in case of high winds, continuous loading is recommended along edges of panels to minimize risk of wind flow under the panels).
10. Geomembrane deployment shall proceed between ambient temperatures of 32° F and 104° F. Placement can proceed below 32° F only after it has been verified by the inspector that the material can be seamed according to the specification. Geomembrane placement shall not be done during any precipitation, in the presence of excessive moisture (e.g., fog, rain, dew) or in the presence of excessive winds.

Geomembrane Field Seaming

1. Field seams shall be made in accordance with the manufacturer's recommendations.
2. Approved seaming processes are fusion and extrusion welding. On side slopes, seams shall be oriented in the general direction of maximum slope, i.e., oriented down, not across the slope. In corners and odd-shaped geometric locations, the number of field seams shall be minimized. Cross seams will be allowed on slopes provided that cross seams are cut at 45° and adjacent cross seams are staggered. Cross seams will be kept to the lower half of the slope and only one cross seam will be allowed per panel slope length.
3. No base T-seam shall be closer than five (5) feet from the toe of the slope. Seams shall be aligned with the least possible number of wrinkles and "fishmouths". If a fishmouth or wrinkle is found, it shall be relieved and cap-stripped.
4. Geomembrane panels must have a finished minimum overlap of four (4) inches for fusion welding and six (6) inches for extrusion welding.
5. Cleaning solvents may not be used unless the product is approved by the liner manufacturer.

Geomembrane Field Test Seams

1. Field test seams shall be made in accordance with the manufacturer's recommendations.
2. Field test seams shall be conducted on the liner to verify that seaming conditions are satisfactory. Test seams shall be conducted at the beginning of each seaming period and at least once every four (4) hours, for each seaming apparatus and personnel used that day.
3. All test seams shall be made in contact with the subgrade. Welding rod used for extrusion welding shall have the same properties as the resin used to manufacture the geomembrane.
4. The installer shall non-destructively test all field seams over their full length using either Vacuum Box Testing or Air Pressure Testing (for double fusion seams only).

Geomembrane Destructive Seam Testing

1. Destructive seam testing should be minimized to preserve the integrity of the liner.
2. In order to obtain test results prior to completion of liner installation, samples shall be cut by the installer as the seaming progresses. The installer shall also record the date, location, and pass or fail description. All holes in the geomembrane resulting from obtaining the seam samples shall be immediately patched and vacuum tested.
3. The samples shall be 12 inches wide by 36 inches long with the seam centered lengthwise. The sample shall be cut into three equal-length pieces, one to be given to the inspector, one to be given to the Owner, and one to the installer.
4. The inspector shall test ten one (1)-inch wide specimens from his sample; five (5) specimens for shear strength and five (5) for peel strength. Seam test results shall be evaluated using the current GRI test method GM19 which allows for four (4) of five (5) specimens meeting the required seam strength and the fifth specimen meeting 80% of the required strength. Additionally, peel excursion will not exceed 25%.
5. Seam samples may be taken and submitted to an independent laboratory for testing. The test method and procedures to be used by the independent laboratory shall be the same as used in field testing.
6. The following procedures shall apply whenever a sample fails the field destructive test:
   a. The installer shall cap strip the seam between the failed location and any passed test locations.
   b. The installer shall retrace the welding path to a location (initially a minimum of 10 feet on each side of the failed seam location) to identify and isolate the failed seam in both previous and next direction of failed destructive, by taking two new samples, one from each direction. If these tests pass, then the seam shall be capped between the passing test. If the test fails, then the process is repeated.
   c. Over the length of seam failure, the installer shall either cut out the old seam, reposition the panel and reseam, or add a cap strip.
   d. Each suspect location in seam and non-seam areas shall be non-destructively tested as appropriate in the presence of the inspector. Each location that fails the non-destructive testing shall be marked by the inspector, and repaired accordingly.

Repair Procedures

1. Defective seams shall be cap stripped or replaced.
2. Small holes shall be repaired by extrusion welding a bead of extrudate over the hole. If the hole is larger than one-quarter inch, it shall be patched.
3. Tears shall be repaired by patching. If the tear is on a slope or an area susceptible to stress and has a sharp end it must be rounded prior to patching.
4. Blisters, large cuts and undispersed raw materials shall be repaired by patches.
5. Patches shall be completed by extrusion welding. The weld area shall be ground no more than 10 minutes prior to welding. No more than 10% of the thickness shall be removed by grinding. Welding shall commence where the grinding started and must overlap the previous seam by at least two (2) inches. Reseaming over an existing seam without regrinding shall not be permitted. The welding shall restart by grinding the existing seam and rewelding a new seam.
6. Patches shall be round or oval in shape, made of the same geomembrane, and extend a minimum of six (6) inches beyond the edge of defects.
7. All T's and intersections shall be patched. Welding the excess overlap is not permitted.

Verification of Repairs

1. Each repair shall be non-destructively tested. Repairs that pass the non-destructive test shall be taken as an indication of an adequate repair. Failed tests indicate that the repair shall be repeated and retested until passing test results are achieved.
2. The inspector shall keep daily documentation of all non-destructive and destructive testing. This documentation shall identify all seams that initially failed the test and include evidence that these seams were repaired and successfully retested.

Backfilling of Anchor Trench

1. The anchor trench shall be backfilled by the earthwork contractor. Trench backfill material shall be placed and compacted in accordance with these specifications.
2. Care shall be taken when backfilling the trenches to prevent any damage to the geomembrane. If damage occurs, it shall be repaired prior to backfilling.

## GEOCOMPOSITE/GEONET DRAINAGE MATERIAL

Geocomposite/Geonet Contractor Qualifications

1. The drainage material manufacturer shall have successfully manufactured five (5) million square feet of polyethylene drainage material.
2. Installation of the drainage material shall be performed by the manufacturer or be a manufacturer-approved dealer/installer. The drainage material installer must either have installed at least one (1) million square feet of product, or must provide satisfactory evidence, through similar experience in the installation of other types of geosynthetics, that the respective geosynthetic will be installed in a competent, professional manner.
3. The installation supervisor shall have worked in a similar capacity on projects similar in size and complexity to the project described in the contract documents.
4. The Geocomposite/geonet inspector shall be an individual or company who is independent from the manufacturer and installer and shall be responsible for monitoring and documenting activities related to the CQC of the geocomposite throughout installation. The inspector shall have provided CQC services for the installation of the proposed or similar products for at least five (5) completed projects totaling not less than one (1) million square feet. The inspector should be an engineer registered to practice in the State of Georgia or an ICP-certified geosynthetics installation technician.

Material Labeling, Delivery, Storage, and Handling Requirements

1. Each roll of material delivered to the site shall be wrapped and labeled by the manufacturer. The label shall contain the following information:
   a. manufacturer's name
   b. product identification
   c. length and width
   d. roll number
2. The drainage material will be stored as specified by the manufacturer in an area specified by the Purchaser. The storage will be free of materials capable of damaging the material.
3. The rolls must be adequate for safe transportation to the point of delivery, offloading and storage. Storage measures will be taken as specifically stated by the manufacturer.

Material Properties

1. The drainage net shall be manufactured of new first quality polyethylene resin and shall be compounded and manufactured specifically for the intended application.
2. The minimum average properties of the drainage layer shall be as follows:

| Tested Property | Test Method | Frequency | Units | Value[1] |
|---|---|---|---|---|
| Geonet Core (HyperNet) [4] | | | | |
| Thickness | ASTM D 5199 | 1/50,000 ft² | mil | 300 |
| Density | ASTM D 1505 | 1/50,000 ft² | g/cc | 0.94 |
| Carbon Black Content | ASTM D 1603*/4218 | 1/50,000 ft² | % | 2.0 |
| Tensile Strength | ASTM D 5035 | | lbs/inch | 75 |
| Transmissivity[2] | ASTM D 4716 | | gal/min ft | 38.64 |
| Transmissivity[2] | ASTM D 4716 | | m²/sec | 8 x 10⁻³ |
| Geotextile (prior to lamination) [4, 5] | | | | |
| Mass per Unit Area | ASTM D 5261 | 1/90,000 ft² | oz/yd² | 6 |
| Grab Tensile | ASTM D 4632 | 1/90,000 ft² | lbs | 160 |
| Flow Rate | ASTM D 4491 | 1/540,000 ft² | gpm/ ft² | 110 |
| Puncture Strength | ASTM D 4833 | 1/90,000 ft² | lbs | 90 |
| Permittivity | ASTM D 4491 | 1/540,000 ft² | Sec⁻¹ | 1.5 |
| AOS | ASTM D 4751 | 1/540,000 ft² | US Sieve | 70 sieve |
| UV Resistance | ASTM D 4355 | once per formulation | % retained (500 hr) | 70 |
| Geocomposite | | | | |
| Transmissivity[2] Single-Sided | ASTM D 4716 | 1/540,000 ft² | gal/min ft | 14.5 |
| Transmissivity[2] Double-Sided | ASTM D 4716 | 1/540,000 ft² | gal/min ft | 4.35 |
| Ply Adhesion | ASTM D 7005 | 1/50,000 ft² | lbs/in | 1.0 |
| Roll Width[3] | | | ft | 15 |
| Roll Length[3] | | | ft | 180 |
| Roll Area | | | ft² | 2,700 |

Notes
1 These are minimum average roll values (MARV values) and are based on the cumulative results of specimens tested by GSE. AOS in mm units is a maximum average roll value.
2 Gradient of 0.1, normal load of 10,000 psf, water at 70° F, between stainless steel plates for 15 minutes.
3 Roll widths and lengths have a tolerance of ±1%.
4 Component properties prior to lamination.
5 Refer to geotextile product data sheet for additional specifications.
* Modified.

Material Placement

1. The geocomposite/geonet roll shall be installed in the direction of the slope and in the intended direction of flow.
2. The single-sided geocomposite shall be installed with the geotextile up, i.e. above the geonet.
3. In the presence of wind, all geocomposites shall be weighted down with sandbags or the equivalent. Such sandbags shall be used during placement and remain until replaced with cover material.
4. The geocomposite shall be properly anchored in the anchor trenches, common to the HDPE and GCL, to resist sliding as shown on the construction drawings. Anchor trench compacting equipment shall not come into direct contact with the geocomposite.
5. In applying fill material, no equipment shall drive directly across the geocomposite. The specified fill material shall be placed and spread utilizing vehicles with a low ground pressure.
6. The cover soil shall be placed in the geocomposite in a manner that prevents damage to the geocomposite.
7. Each component of the geocomposite will be secured or seamed to the like component at overlaps. Adjacent edges of the geonet along the length of the roll shall be placed with the edges of each geonet butted against each other. The overlaps shall be joined by tying the geonet structure with plastic cable ties spaced every five (5) feet along the roll length.
8. Adjoining geocomposite/geonet rolls (end to end) across the roll width should be shingled down in the direction of the slope, with the geonet portion of the top overlapping the geonet portion of the bottom geocomposite/geonet a minimum of 12 inches across the roll width.
9. The geonet portion shall be tied every six (6) inches in the anchor trench.
10. Prior to covering the deployed geocomposite/geonet, each roll shall be inspected for damage resulting from construction.
11. Any rips, tears or damaged areas on the deployed geocomposite shall be removed and patched. The patch shall be secured to the original geonet by tying every six (6) inches with the approved tying devices. If the area to be repaired is more than 50 percent of the width of the panel, the damaged area shall be cut out and the two portions of the geonet shall be cut out and the two portions of the geonet shall be joined in accordance with Items 7 and 8 above.

## GRANULAR DRAINAGE BLANKET - LEACHATE COLLECTION & REMOVAL SYSTEM (LCRS)

1. At a minimum, the following data must be collected and submitted in support of the Construction Certification Report required by Rule 391-3-4-.07(2). Drainage blanket / LCRS material (sand and rock) shall be non-carbonate.

| | TESTING | STANDARDS | MINIMUM FREQUENCY | MINIMUM CRITERIA |
|---|---|---|---|---|
| Construction | Grain size | ASTM D422 | 1 500 cy (provided by supplier) 15.00 cy (verified by contractor) | ≤ 1¼ inch |
| | Permeability | ASTM D2434 | 3000 cy | ≥ 1x10⁻² cm/sec |
| | Filter gradation limits | NA | NA | 0.1mm ≤ D15 ≤ 0.7mm D50 ≤ 1.8mm |

Note: Properties noted on Table are for sand portion only.

2. During placement of drainage material, no equipment shall drive directly across or on the geocomposite drainage material. The specified fill material shall be placed and spread utilizing vehicles with a low ground pressure.
3. The granular drainage material shall be placed at the edge of the geocomposite drainage material and spread ahead of the equipment in lifts no less than 12 inches in thickness.
4. During spreading, the equipment shall be operated in such a manner that the underlying geocomposite and liner system will not be damaged or moved. The equipment shall not make abrupt stops, sharp turns, or other maneuvers that would lessen the required12 inch minimum cover.
5. The drainage should be placed in a manner that prevents the material from entering the geocomposite overlap zones. Placement shall be such that the tensile forces on the geocomposite and underlying liner system are minimized. On slopes, the material shall be placed from bottom of slope up.

## PROTECTIVE SOIL COVER - SEDIMENTATION AND RETURN WATER PONDS

1. The protective soil cover material shall be free of angular stones or other foreign matter that could damage the HDPE liner.
2. The protective cover shall be placed over the liner using low contact pressure, wide - tracked construction equipment that minimizes stresses on the HDPE geomembrane. The cover shall be placed and spread by making a minimum of four complete coverage with the tracks of the equipment. Special care and attention shall be taken to assure that the underlying HDPE is not damaged and an even one-foot thick layer of protective cover is obtained.

## GRANULAR LCRS TENCH BACKFILL

Material

1. The backfill material for the LCRS shall be a gravel material meeting the Georgia Department of Transportation Specifications, No. 57 Stone.
2. The material shall be placed in a manner to prevent damage to the underlying geocomposite and HDPE liner. The initial layer of gravel shall be placed by hand.
3. Backfill material shall be non - carbonate.

**HDPE LCRS PIPING**

1. The LCRS piping shall meet or exceed the physcial properties values listed below for HDPE smooth wall pipe, Polypipe PE3408.

| ASTM Test Method | Description | Values HDPE |
|---|---|---|
| D3350 | Cell Classification | 345464C |
| D1505 | Density, Natural | 0.946 gm/cc |
| D1505 | Density, Black (PE3408) | 0.955 gm/cc |
| D1238 | Melt Index (190°C/2.16 kg) | 0.07 gm/10 min |
| D1238 | Flow Rate (190°C/21.6 kg) | 8.5 gm/10 min |
| D790 | Flexural Modulus | 136,000 psi |
| D638 | Elastic Modulus: short-term | 125,000 psi |
| D638 | Elastic Modulus: long-term | 30,000 psi |
| D638 | Tensile Strength @ Yield | 3,500 psi |
| D1693 | ESCR | >10,000 hrs. failure |
| F1473 | Slow Crack Growth, PENT | <100 hrs. |
| D2837 | HDB @ 73.4°F | 1,600 psi |
| D2837 | HDB @ 140°F | 800 psi |
| D1603 | UV Stabilizer (Carbon) | 2.5% |
| D746 | Brittleness Temperature | <-180°F |
| D789 | Melting Point | 261°F |
| D1525 | Vicat Softening Temperature | 255°F |
| D2240 | Hardness | 64 |
| D256 | Izod Impact Strength (Notched) | 7 ft-lbf/in |
| D696 | Thermal Expansion Coefficient | 1.0 x 10⁻⁴ in/in/°F |
| – | Poisson's Ratio | 0.42 |
| – | Manning Roughness | 0.01 |
| D991 | Volume Resistivity | 2.6 x 10¹⁶ Ω-cm |
| GPC | Average Molecular Weight | 330,000 |

2. The dimensions for the HDPE smooth wall pipe shall meet the following specifications:

| NOM. SIZE | NOM ID | NOM OD | MIN. WALL | WGT/ 100 FT. LBS | |
|---|---|---|---|---|---|
| SDR 13.5 - ASTM D3035 | | | | | |
| 6" | 5.58" | 6.625" | 0.491" | 413.00 | |
| 10" | 9.158" | 10.75" | 0.796" | 1067.75 | |

GEORGIA
Environmental Protection Division
Solid Waste Management Program
MINOR MODIFICATION APPROVAL
SOLID WASTE PERMIT NO. 074-005 D(4J)
APPROVED BY: CBH DATE: 5/2/12

GEORGIA REGISTERED PROFESSIONAL ENGINEER No. 12687 — 3/20/12

## REFERENCE DRAWINGS:

1. FOR A COMPLETE DRAWING INDEX SEE DRAWING 'H1C11120

"REV. 3 OF THIS DRAWING, BEING PART OF THE DESIGN & OPERATIONS PLAN FOR THE PLANT SCHERER CCB DISPOSAL FACILITY, WAS SEALED BY GARY H. McWHORTER, GEORGIA REGISTERED PROFESSIONAL ENGINEER, NO. 12687."

"REV. 2 OF THIS DRAWING, BEING PART OF THE DESIGN & OPERATIONS PLAN FOR THE PLANT SCHERER CCB DISPOSAL FACILITY, WAS SEALED BY GARY H. McWHORTER, GEORGIA REGISTERED PROFESSIONAL ENGINEER, NO. 12687."

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| REVISION | DATE | BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR |
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| REVISION | DATE | BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR |
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| REVISION | DATE | BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR |
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| REVISION 3 | DATE 03-22-2012 | BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR |
| GENERAL REVISION FOR MODIFICATION | | ASF | GHM | JCP | | | | TMU |
| REA: WN05681 | EWO: 3068DE | | | | | | | |
| REVISION 2 | DATE 07-09-2010 | BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR |
| MISCELLANEOUS TEXT REVISIONS | | ASF | GHM | JCP | | | | DWM |
| REA: WN05681 | EWO: 3068DE | | | | | | | |
| REVISION 1 | DATE 03-19-2010 | BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR |
| REVISED NOTE FOR GEOMEMBRANE SEAM PER 10\22\09 EPD LETTER. | | ASF | GHM | JCP | | | | DWM |
| REA: WN05681 | EWO: 3068DE | | | | | | | |
| REVISION 0 | DATE 08/03/2009 | BY | CHK'D | CIVIL APPR | ELECT APPR | I/C APPR | MECH APPR | DISC MGR |
| ISSUED FOR PERMIT | | JJB | GHM | JCP | | | | DWM |
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| REA: WN05681 | EWO: 3511DE | | | | | | | |

Southern Company Generation
Engineering and Construction Services
FOR
Georgia Power Company

PLANT WANSLEY
COAL COMBUSTION BY-PRODUCT DISPOSAL FACILITY
CONSTRUCTION QUALITY ASSURANCE PLAN
SHEET 2

| SCALE | PROJ I.D. | DRAWING NUMBER | SHEET | CONT'D | REV |
|---|---|---|---|---|---|
| NOT TO SCALE | 010209 | H1C11167 | 1 | FINAL | 3 |

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