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MADISON COUNTY
MSW LANDFILL CLOSURE
Madison County, North Carolina
December, 2005

Construction Quality Assurance Documentation

Prepared For

MADISON COUNTY

Prepared By

RECEIVED
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Solid Waste Section
Asheville Regional Office

APPROVED DOCUMENT
Division of Waste Management
Solid Waste Section
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Clayton, Sr., P.E., Inc.
Civil & Environmental Engineering

P.O. BOX 578
46 W. WASHINGTON ST.
COATS, NC 27521
(910) 897-7070
(910) 897-6767 FAX

CTC# 70001

CONSTRUCTION DOCUMENTATION
AND
ENGINEERING CERTIFICATION REPORT

Received
Solid Waste
Section

MADISON COUNTY LANDFILL

MADISON COUNTY LANDFILL
MARSHALL, NORTH CAROLINA
PERMIT # 5803

Prepared By:

Clayton, Sr., P.E., Inc.
Civil & Environmental Engineering

PO Box 578
Coats, NC 27521
Phone: 910-897-7070
Fax: 910-897-6767

Project No. 70001

December 2005

NORTH CAROLINA PROFESSIONAL SEAL 028909 ENGINEER C. TYRUS CLAYTON, JR. 11/21/06

NORTH CAROLINA PROFESSIONAL SEAL 24993 ENGINEER MARK D. CATHEY 11/21/06

C. Tyrus Clayton, Jr., P.E.
Certifying Engineer

Mark Cathey, P.E.
Design Engineer

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1.0 PROFESSIONAL ENGINEERING CERTIFICATION

In accordance with the Solid Waste Management Regulations Section G.S. 130A-294 .1627.c.7, this letter is to certify that the Madison County Landfill Closure has been successfully carried out and the unit meets the requirements of G.S. 130A-294 .1627.

NORTH CAROLINA PROFESSIONAL SEAL 028909 ENGINEER C. TYRUS CLAYTON, JR. 11/21/06

NORTH CAROLINA PROFESSIONAL SEAL 24993 ENGINEER MARK D. CATHEY 11/21/06

C. Tyrus Clayton, Jr., P. E.
Certifying Engineer
North Carolina P. E. Registration 028909

Mark Cathey, P. E.
Design Engineer
North Carolina P. E. Registration 024993

2.0 INTRODUCTION / PROJECT DESCRIPTION

This report documents and summarizes the Construction Quality Assurance (CQA) monitoring activities, testing, and observations performed under the Quality Assurance Plan for the closure of the Madison County Landfill in Marshall, North Carolina. The Madison County Landfill was the primary landfill for municipal solid waste generated within Madison County. This landfill is owned and operated by the Madison County Solid Waste Department. The site is operated under Solid Waste Permit No. 5803.

Construction of the project began in October 2005. The profile for this closure system includes structural fill to grade, compacted clay layer with a permeability no greater than $1x10^{-5}$ centimeters per second, gas venting system, 40 mil textured linear low-density polyethylene (LLDPE) geosynthetic liner, a geocomposite drainage net, and a low permeability vegetative supportive layer with a permeability no greater than $1x10^{-5}$ centimeters per second.

The construction of the Cover System included:

- Verifying the depth of existing sub-grade and adding additional fill
- Construction of Compacted Clay Layer
- Construction of Gas Venting System
- Construction of 40 Mil textured LLDPE Geosynthetic Liner
- Construction of Geocomposite Drainage Layer
- Construction of a Low Permeability Vegetative Supportive Layer
- Surface roughening of final surface, seeding, fertilizing, and mulching of all disturbed areas
- Establishment of vegetative cover

This report and the attached appendices are organized to separate the description, test data, and construction records for this project. Project photographs can be found in the Appendix, Section XII.

3.0 PERSONNEL

The key personnel and companies involved with the construction of the Madison County Landfill Closure are:

1. Owner/Operator:
   Madison County Solid Waste
   271 Craig Rudisill Road
   Marshall, NC 28753
   Phone: (828) 649-2311
   Fax: (828) 649-0324

   Name:
   James L. Huff, Director

2. Construction Quality Assurance:
   C.T. Clayton Sr., P.E., Inc. (CTC)
   48 W. Washington Street
   Coats, NC 27521
   Phone: (910) 897-7070
   Fax: (910) 897-6767

   Name:
   C. Tyrus Clayton, Jr., P. E., Project Manager & Certifying Engineer
   Darren Spier, Engineer's Field Representative/ Field Technician
   Ryan Sadler, Engineer's Field Representative/ Field Technician

   C.T. Clayton Sr., P.E., Inc. (CTC) of Coats, North Carolina was retained by McGill & Associates to perform CQA inspection and testing, and provide onsite project management.

3. Engineering Construction & Design:
   McGill & Associates
   55 Broad Street
   Asheville, NC 228802
   Phone: (828) 252-0575
   Fax: (828) 252-2518

   Name:
   Mark D. Cathey, P. E., Design Engineer

   McGill & Associates of Asheville, North Carolina was retained by Madison County to prepare construction drawings and project specifications based on Solid Waste Permit No. 5803.

5. General Contractor:
   Bob Stout Construction Company
   3112 Roan Creek Rd
   Mtn. City, TN 37683
   Phone: (252) 633-2424
   Fax: (252) 633-1370

   Name:
   Bob Stout, Owner/Operator

   All earthwork construction was performed by Bob Stout Construction Company. Geosynthetic installations were performed by Geo-Synthetics, Inc. (GSI) under contract to Bob Stout Construction Company. The Landfill Gas Venting System was installed by Bob Stout Construction Company.

4.0 SITE AND BASE GRADE PREPARATION

The construction procedures followed by the contractor and the quality assurance protocol implemented by CTC for the site and base grade preparation on this project are summarized in the following sections.

4.1 SITE PREPARATION

In compliance with the North Carolina Erosion and Sediment Control Handbook, the Contractor took appropriate measures to assure erosion control was being regulated and maintained for areas that had been disturbed during site preparation.

4.2 CLOSURE BASE GRADE PREPARATION

The initial phase of the project involved the clearing of existing vegetation lying within the Closure area. The Contractor's surveyor field verified the depth of the existing subgrade after the vegetation had been stripped. The upper portion of this existing subgrade was then proofrolled and tested for soft areas prior to placement of Clay. Certain areas were below the specified design depth for cover due to erosion and weathering, and required additional fill. The Contractor placed this fill before any closure activities were initiated on each slope of the cell. Density test results for the subgrade can be found in Appendix, Section III. A subgrade as-bult is provided in the Appendix, Section XV

5.0 SOIL BORROW SOURCE EVALUATION

A Borrow Area Study was conducted to find suitable soils at the Madison County Landfill facility located adjacent to the project site. A site-specific Borrow Area Study certification letter, with attached geotechnical laboratory test results was prepared by CTC and was certified by C. Tyrus Clayton, Jr., P. E. The letter itemized the quality assurance testing and verified the testing performed met and/or exceeded the required minimum specifications or verified the material was suitable for the intended usage. The letter is contained in Appendix, Section I.

Interface friction QC testing was performed on the Cover System (soil and geosynthetics) by the Contractor utilizing Geotechnics Laboratories. Theses results can be found in Appendix, Section X.

5.1 Closure Soils

5.1.1 Common Fill Material

In our soils laboratory, we performed Grain Size Analysis, Natural Moisture Contents and Standard Proctor tests on bulk samples taken from the borrow area. Testing was performed at the frequencies indicated below:

Test	ASTM Designation	Frequency Performed
Natural Moisture	D2216	2
Grain Size Analysis	D422 and D1140	2
Standard Proctor	D698	2

The samples of soil from within the footprint of the proposed borrow area were field classified as SILT with Sand (MH). No large stones over 2-inches were encountered during the test pit excavation. The soils were Red-Brown to Brown in color.

5.1.2 Low Permeability Soil Material

In our soils laboratory, we performed Atterberg Limits, Grain Size Analysis, Natural Moisture Contents, Remolded Permeability and Standard Proctor tests on bulk samples taken from the borrow area. Testing was performed at the frequencies indicated below:

Test	ASTM Designation	Frequency Performed
Natural Moisture	D2216	10
Grain Size Analysis	D422 and D1140	2
Atterberg Limits	D4318	2
Standard Proctor	D698	2
Remolded Permeability	D5084	2

The soils encountered were classified by using the Standard Classification of Soils (ASTM D2487) using information obtained from Grain Size Analysis and Atterberg Limits. Their maximum dry density and optimum moisture content were found using the Standard Proctor Method (ASTM D698). The samples of soil from within the footprint of the proposed borrow area classified as Elastic SILT with Sand (MH). The soils were Red-Brown to Red in color.

Remolded permeability samples of the soils were created in accordance with ASTM D5084. Laboratory compacted soil permeabilites ranged from 5.1×10^{-06} to 3.7×10^{-06} cm/sec.

Interface friction angle testing was performed on the Low Permeability soil material against the 40 mil textured LLDPE geosynthetic liner. See Appendix, Section X for testing documentation.

5.1.3 Vegetative Supportive Soil Material

In our soils laboratory, we performed Natural Moisture Contents, Standard Proctor, and Remolded Permeability tests on bulk samples taken from the borrow area. Testing was performed at the frequencies indicated below:

Test	ASTM Designation	Frequency Performed
Natural Moisture	D2216	3
Standard Proctor	D698	3
Remolded Permeability	D5084	3

The maximum dry density and optimum moisture content of the soils were found using the Standard Proctor Method (ASTM D698). The soils were Light-Brown to Brown in color.

Remolded permeability samples of the soils were created in accordance with ASTM D5084. Laboratory compacted soil permeabilites ranged from 8.2×10^{-08} to 4.8×10^{-08} cm/sec.

Interface friction testing was performed on the vegetative supportive soils against the Geocomposite drainage layer. See Appendix, Section X for testing documentation.

6.0 COMPACTED CLAY LAYER

The construction procedures followed by the contractor for the placement and compaction of the Compacted Clay Layer and the quality assurance protocol implemented by CTC are summarized by the following sections.

6.1 Test Pad Construction and Documentation

A test pad was constructed within the cell area to establish a repeatable construction sequence using the Contractor's equipment to produce acceptable permeabilities. Testing was performed at the frequencies indicated below:

Test	*ASTM Designation or Other Test Method*	*Frequency Required*	*Frequency Performed*
Compacted Density	D2922 or D2937	3 per lift	3 per lift
Compacted Moisture Content	D3017 or D2216	3 per lift	3 per lift
Atterberg Limits	D4318	Not Required	1 per lift
Particle Size	D422	Not Required	1 per lift
Hydraulic Conductivity – Shelby Tube	D5084	1 per lift	1 per lift
Hydraulic Conductivity – Laboratory Compacted	D5084	1 per lift	1 per lift

The project specifications require an 18-inch thick Compacted Clay Layer Test Pad. The soil was placed within the test pad area in three compacted 6-inch lifts as outlined in the attached Site Visit Reports. Density tests plotted in the permeability "window", which resulted in sufficient compaction and acceptable amounts of moisture.

In addition to field testing, Bulk samples along with Shelby tubes samples were obtained and laboratory permeability and classification tests were performed. Laboratory compacted samples produced permeabilities ranging from 1.2×10^{-7} cm/sec to 1.9×10^{-7} cm/sec. Shelby tube samples taken from the Compacted Clay Layer Test Pad produced permeabilities ranging from 4.1×10^{-6} cm/sec to 3.2×10^{-7} cm/sec. Samples were classified as Elastic SILT with Sand (MH). Our daily reports, field density tests, and laboratory results can be found in Appendix, Section II.

6.2 Clay Layer Placement And Compaction

During construction, the clay material was placed in three 6-inch lifts as directed by the specifications, utilizing a dozer. Each lift was then compacted with sheepsfoot and smoothdrum rollers. The moisture content was maintained within the window of acceptable moisture contents determined by standard Proctor tests and laboratory remolded permeability testing. Lift thickness was monitored continuously by visual observation. Lift thickness was verified at density test locations (minimum of 1/10,000 sq.ft./lift) to ensure proper layer thickness.

During placement and compaction of the lifts of the clay layer, in-place moisture/density tests using a nuclear moisture/density gauge (ASTM D3017) were performed at a minimum of every 10,000 sq. ft per lift of soil. Areas not meeting the required minimum 95 percent of standard Proctor maximum dry density were reworked until testing indicated that satisfactory density had been achieved. The tabulated results of field moisture/density test data are included in Appendix, Section III.

Samples for laboratory testing were obtained from the placed material used in the clay layer. The laboratory testing consisted of Atterberg Limits (ASTM D4318), Particle Size Distribution (ASTM D422 plus wash #200), natural moisture content (ASTM D2216), and hydraulic conductivity (ASTM D5084). The undisturbed samples were obtained using thin-walled (Shelby) tube samplers pushed perpendicular to the soil surface. The permeability values calculated for these samples ranged from 4.7×10^{-6} to 7.5×10^{-8} cm/sec. These results are included in the in Appendix, Section III.

The following tests were performed on the Compacted Clay Layer:

Test	*ASTM Designation or Other Test Method*	*Frequency Required*	*Frequency Performed*
Atterberg Limits	D4318	1 per 5,000 cy	1 per 2,000 cy
Particle Size	D422	1 per 5,000 cy	1 per 2,000 cy
Hydraulic Conductivity	D5084	1 per 40,000 sq. ft./lift	1 per 40,000 sq. ft./lift
Compacted Density	D2922 or D2937	1 per 10,000 sq. ft./lift	1 per 10,000 sq. ft./lift
Compacted Moisture Content	D3017 or D2216	1 per 10,000 sq. ft./lift	1 per 10,000 sq. ft./lift

7.0 VEGETATIVE SUPPORTIVE LAYER

A 24" low permeability Vegetative Supportive Layer was constructed upon the geosynthetic cap system. The layer, once constructed was required to have a maximum permeability of $1x10^{-5}$ cm/sec with the top 6" suitable for sustaining native plant growth. The layer was constructed in one cohesive lift, compacted by the weight of the loaded off-road trucks and dozers.

During placement and compaction of the lifts of the clay layer, in-place moisture/density tests using a nuclear moisture/density gauge (ASTM D3017) were performed at a minimum of one per acre. Areas not meeting the required minimum 95 percent of standard Proctor maximum dry density were reworked until testing indicated that satisfactory density had been achieved. The tabulated results of field moisture/density test data are located in Appendix, Section IV.

Samples for hydraulic conductivity (ASTM D5084) laboratory testing were obtained from the placed material used in the vegetative supportive layer. The undisturbed samples were obtained using thin-walled (Shelby) tube samplers pushed perpendicular to the soil surface. The permeability values calculated for these samples ranged from 1.5×10^{-6} to 3.7×10^{-7} cm/sec. These results are located in Appendix, Section IV.

The following tests were performed on the Vegetative Supportive Layer:

Test	***ASTM Designation or Other Test Method***	***Frequency Required***	***Frequency Performed***
Hydraulic Conductivity	D5084	1 per 5000 cy^3	1 per 5000 cy^3
Compacted Density	D2922 or D2937	1 per acre	1 per acre
Compacted Moisture Content	D3017 or D2216	1 per acre	1 per acre

8.0 CLOSURE – GEOSYNTHETICS

This section summarizes the deployment and installation of the geosynthetics used as the synthetic liner in the landfill closure. The system consisted of a 40-mil textured Low Linear Density Polyethylene (LLDPE), and a drainage net geocomposite.

8.1 Closure Geomembrane Conformance Testing

The geomembrane installed in the synthetic liner closure was manufactured by GSE and installed by GSI. GSE conducted a laboratory quality control (QC) program during the production of the 40-mil textured LLDPE geomembrane. GSE obtained samples of the geomembrane for the QC testing at a rate of one (1) per every three (3) rolls produced prior to shipment. In addition, every roll was tested for thickness. Testing was performed to verify material compliance with the project physical property specifications.

Properties evaluated as part of the QC process by GSE included thickness, tensile properties, tear resistance, carbon black dispersion, carbon black content, puncture resistance and density. In addition, GSE tested samples of the polyethylene resin used to manufacture the liner. Each of the quality control certificates supplied by GSE was checked to ensure that the materials met the manufacturer's specifications, and the specifications of the project. The submitted QC certificates supplied by GSE met all of the specification requirements. A copy of the manufacturer's LLDPE roll quality control testing and resin "Certificates of Analysis" are included in Appendix, Section V.

The testing protocol for the 40-mil textured linear LLDPE geomembrane was as follows:

Manufacturer 40-mil Textured LLDPE geomembrane Quality Control Testing			
Property	Test Designation	Frequency Required	Frequency Performed
Thickness	ASTM D5994	1 per roll	1 per roll
Density	ASTM D1505	1 per 200,000 lb	1 per 200,000 lb
Tensile Properties	ASTM D6693 Type IV	1 per 20,000 lb	1 per 20,000 lb
Tear Resistance	ASTM D1004	1 per 45,000 lb	1 per 45,000 lb
Puncture Resistance	ASTM D4833	1 per 45,000 lb	1 per 45,000 lb
Carbon Black Content	ASTM D1603	1 per 45,000 lb	1 per 20,000 lb
Carbon Black Dispersion	ASTM D5596	1 per 45,000 lb	1 per 45,000 lb

8.2 Closure Geomembrane Deployment Inspection

Prior to the deployment of any geomembrane, the top of the subgrade was visually inspected by CTC personnel to confirm a smooth hard surface free of jagged rock or any material detrimental to the geomembrane. In addition, GSI inspected the surface of the subgrade prior to geomembrane deployment and prepared certificates of acceptance of the clay liner surface. Once these inspections were complete geomembrane deployment commenced. The geomembrane panels were visually inspected as they were deployed from the roll into position in the panel arrangement. Inspection of the geomembrane panels included: quality; identification (roll number and panel number); alignment; overlap with adjacent panel(s); anchoring and panel length. Extensive records were kept during the deployment process. Geomembrane panels were deployed by hand with the aid of a front-end loader. The geomembrane roll was lifted with a spreader bar hooked to a front-end loader and then unrolled by hand once it was positioned as needed. Heavy equipment was prohibited from running on any of the geosynthetics.

Geomembrane panels were overlapped in a "shingle" pattern, whereby the edge of an "upslope" panel was placed over a "down slope" panel. This minimized the potential for up gradient ponding of liquid directly against a seam.

Areas of the geomembrane that were damaged or blemished were repaired as required. Sand bags or rolls of geosynthetics were placed on the LLDPE sheets until the material was seamed into place, to provide proper intermediate material anchorage.

Locations and lengths of seams were documented by GSI personnel following completion of seaming, as were destructive and non-destructive testing, and required repairs. Plan views of the LLDPE geomembrane panel layout with appropriate panel numbers and repair locations are presented in the Installer's QC Report found in Appendix, Section VII.

CTC personnel recorded detailed QA documentation during the geosynthetic installation in order to check the accuracy of the Installer's QC information. The Installer's QC paperwork was reviewed on a daily basis by CTC personnel and any discrepancies between the QA and QC paperwork would be addressed and field corrected if necessary. CTC's backup QA data can be found in Section VIII of this report.

8.2.1 Closure Geomembrane Trial Seams

Trial seams of fusion and extrusion welds were prepared under the existing ambient conditions as a procedural analysis for the seaming apparatus and operator. The trial seams were completed prior to the performance of production welding by a unit or operator. On this project, geomembrane test seams were performed daily at the start-up of every welder unit or operator and at 5-hour maximum intervals subsequently thereafter. Each test seam was sampled and field-tested for peel adhesion strength (peel) and shear strength. Three (3)

bones (replicates) were taken for peel and one (1) for shear field-testing from the test seam. Failure of a single test specimen was treated as a failure of the entire trial seam. A failing peel test required two (2) consecutive passing trial seams. The results of these tests were recorded in the Installer's QC Report Appendix, Section VII.

8.2.2 Closure Geomembrane Field Seams

The LLDPE geomembrane was seamed using double fusion and extrusion methods. Trained GSI technicians performed the seaming of the geomembrane. Double fusion welding was the primary method implemented for the construction of the panel seams. Extrusion welding was used only for repairs and other specialty welding applications

Inspection of the seaming process consisted of visually monitoring the seaming operation to ensure that the proper procedures were being followed. GSI personnel observed the preparation of seams, the seaming apparatus temperatures, the construction of the seams and the completed seam. GSI personnel and CTC personnel visually inspected the entire length of each seam. Documentation of field repair data for the liner can be found in the GSI Repair Reports in the Installer's QC Report Appendix, Section VII.

A detailed tracking process was used during the field seaming. Each seam was identified with a unique seam number. The numbers of the panels joined by the seam were recorded. Other recorded data included: the date and time the seam was made; seam length; specific welding device identification number; and temperature and speed of the welding device used to construct the seam. In addition, the welding device's previous seam and subsequent seams were recorded to permit tracking of any problem in the welding process. The data for the liner seams are summarized in the GSI Panel Seaming Forms and can be found in Appendix, in Section VII of this report.

8.2.3 Closure Non-destructive Seam Testing Inspection

The GSI technicians were responsible for non-destructive testing of the geomembrane seams. This process involved the testing of the complete length of all seams with either a vacuum box or air pressure device, as per the project specifications to determine if any discontinuities were present. Discontinuities which were detected were marked, repaired, and retested for verification of seam integrity. CTC inspected the non-destructive testing on a full-time basis during construction of the LLDPE geomembrane to confirm that the proper procedures were being followed and to observe the test results.

Results from non-destructive tests of the seams are presented in the GSI Non-destructive Testing Forms in Appendix, Section VII of this report.

8.2.4 Closure Destructive Seam Strength Testing

Destructive seam samples were extracted and tested for bonded seam strength (shear) and peel adhesion strength (peel). Samples measuring 36 inches long by 12 inches wide were extracted at each destructive sample location. Before the entire sample was cut from the liner system, a field bone 1-inch wide was cut from each end of the selected sample location. Each of the bones was tested in the field. Samples that passed the field-testing were then cut from the liner system and sent to the geosynthetics laboratory for final testing. Field failures were subjected to the tracking procedures outlined in this report.

A total of 20 locations were sampled and submitted for laboratory destructive testing during the installation of the geomembrane. This resulted in a testing frequency of at least one laboratory destructive test per 500 linear feet of seam per welding crew plus allowances for retest of seam failures and seams that GSI monitors deemed questionable.

The peel and shear laboratory test results, issued by GeoTesting Express, of Boxborough, Massachusetts are included in the Geosynthetic Destructive Test Results in Appendix, Section IX of this report.

i. Initial Field Testing

GSI personnel employing a calibrated tensiometer, under the observation of CTC personnel initially tested each destructive sample in the field. This initial field-testing was conducted to "screen" the sample and identify problem seams as soon as possible. One (1) 1-inch wide test specimen was cut from each end of the seam sample and both tested for peel adhesion strength (peel). If passing results were obtained in the field, the entire sample was then cut from the seam and then cut into two sections. One section measuring 18 inches by 12 inches was sent to the geosynthetics laboratory for testing and one sample measuring 12 inches by 12 inches was retained for archive storage. Areas from which samples were cut were covered immediately with a patch. Repairs and patches were documented in the GSI Repair Reports located in Appendix, Section VII of this report.

ii. Laboratory Testing

Samples tested by the geosynthetics laboratory were cut into ten (10) 1-inch wide test specimens, five (5) of which were tested for shear and five (5) for peel for double wedge fusion welds and extrusion welds. Testing was run at a sample strain rate of 2.0 inches per minute for peel and shear. The specified acceptance criteria for the 40-mil textured LLDPE geomembrane were that at least four of five bonded seam strength specimens must have peel adhesion strengths greater than or equal to 50 pounds per inch (ppi) of width at yield for fusion and 48 ppi for extrusion, with failures occurring as a film tear bond and also that four of five shear adhesion specimens must have strengths greater than or equal to 60 pounds per inch of width, and must also exhibit film tear bond. Details on the laboratory results and testing methods are presented in Appendix, Section IX.

iii. Tracking of Failed Destructive Tests

If a destructive sample failed during either field or laboratory testing, the seam was resampled to determine the limits of the failed section. Resampling of the seam was performed by removing additional destructive samples approximately ten (10) feet on each side of the failing test sample. The two additional samples were then tested in the field. If failing results were obtained on either of the retest samples, additional samples were removed at 10-foot intervals until passing test results were obtained on both sides of the original failing sample. This procedure defined the limits of the faulty section of seam.

Seams identified as failing the destructive testing were repaired in one of two ways depending on the length and location of the failed section. The first repair method was to cap the seam with a strip of LLDPE geomembrane approximately two feet wide. The cap was extrusion welded to the underlying LLDPE panel and the weld then vacuum tested. The second method used was to cut out the "failed" seam in its entirety and double-fusion weld a new section of liner in its place to reconstruct the weld.

A total of 20 samples of the welded LLDPE liner seams were obtained for destructive testing. No samples failed to meet project specifications and therefore no tracking occurred. It is noted however, that a roll of 60 mil LLDPE geomembrane arrived onsite to finish out the project. Although not specified for this project, 60 mil textured LLDPE geomembrane is normally specified to meet minimum values of 90 ppi for peel and 120 ppi for shear. As noted on DS-20 in Appendix, Section IX, two of the five shear tests were below 120 pounds per inch. The two failing tests were both equal to 119 ppi. The average of the 5 shear tests was equal to 120 pounds per inch. Per project specifications, two failing strips would require the destructive test to be tracked and resampled. However, due to the fact that the material supplied (60 mil LLDPE) was superior to what was specified for the project (40 mil LLDPE) and that the shear numbers were double what was specified for the original material, the Design Engineer made the decision to accept the destructive test as passing.

iv. Summary of Laboratory Destructive Test Results

GSI's liner personnel were responsible for the cutting of destructive samples, the patching of seams, and conducting the field tests. CTC personnel observed and documented these procedures. Test results from the laboratories were reviewed as they were received. The destructive field test results are included in Appendix, Section IX of this report.

CTC kept extensive records of the destructive tests. Each test was assigned a unique test number. For each test, the following data were recorded: seam number; date the seam was welded; CTC field monitor; dates tested; and, results of testing. Each laboratory destructive test location is indicated on the McGill Associates Geosynthetic As-Built Panel Layout in Appendix, Section XVI of this report.

Certificates of completion were obtained from GSI prior to placement of the composite drainage net and demobilization from the site. The LLDPE geomembrane installation was not certified until all destructive and non-destructive testing had been satisfactorily completed.

8.3 Closure Geocomposite Drainage Net Conformance Testing

The conformance test documentation for the Geocomposite Drainage Net (Geonet) indicated that the supplied materials met or exceeded the required specifications. Copies of these certifications are included in the Submittal Appendix, Section VI of this report.

The quality control testing of the Geonet performed by the manufacturer included the following:

Manufacturer Geonet Quality Control Testing			
Property	Test Designation	Frequency Required	Frequency Performed
Resin			
Polymer Density	ASTM D 1505	Once Per Lot	Once Per Lot
Melt Flow Index	ASTM D 1238	Once Per Lot	Once Per Lot
HDPE Net Properties			
Thickness	ASTM D1777	1 per 25,000 sq. ft.	1 per 25,000 sq. ft.
Carbon Black	ASTM D4218	1 per 25,000 sq. ft.	1 per 25,000 sq. ft.
Tensile Strength	ASTM D4595	1 per 25,000 sq. ft.	1 per 25,000 sq. ft.
Geotextile Properties			
Mass Per Unit Area	ASTM D 5261	1 per 90,000 sq. ft.	1 per 90,000 sq. ft.
Grab Tensile	ASTM D 4623	1 per 90,000 sq. ft.	1 per 90,000 sq. ft.
Puncture	ASTM D 4833	1 per 90,000 sq. ft.	1 per 90,000 sq. ft.
AOS, US Sieve	ASTM D 4751	1 per 540,000 sq. ft.	1 per 540,000 sq. ft.
Water Flow Rate	ASTM D 4491	1 per 540,000 sq. ft.	1 per 540,000 sq. ft.
Composite Properties			
Transmissivity	ASTM D4716	1 per 672,000 sq. ft.	1 per 540,000 sq. ft.
Ply Adhesion	GRI GC-7	1 per 25,000 sq. ft.	1 per 25,000 sq. ft.

8.3.1 Closure Geocomposite Drainage Net Deployment

This section summarizes the deployment and installation of a geocomposite drainage net (Geonet) used at the facility. The type of Geonet that was used in the construction of the closure was a GSE geocomposite (Product: F42060060S Geocomposite). The geocomposite

consisted of a polypropylene, non-woven, needle punched geotextile heat bonded to either side of a GSE geonet.

The Geocomposite was used as a drainage medium and cushion between the Vegetative Supportive Soil Layer and the 40 mil textured LLDPE.

Prior to the deployment of the geocomposite, the top of the geomembrane was visually inspected by CTC personnel to confirm a smooth surface free of rock or any material detrimental to the geomembrane. In addition, GSI inspected the surface of the geomembrane prior to geocomposite deployment. Once these inspections were complete, geocomposite deployment commenced. The geocomposite panels were visually inspected as they were deployed from the roll into position in the panel arrangement. Inspection of the geocomposite panels included: quality; alignment; overlap with adjacent panel(s); anchoring and total area deployed. Extensive records were kept during the deployment process. Geocomposite panels were deployed by hand with the aid of a front-end loader. The geocomposite roll was lifted with a spreader bar hooked to a front-end loader, and the geocomposite was unrolled as the loader moved into position. Heavy equipment was prohibited from running on any of the geosynthetics.

Geocomposite panels were overlapped in a "shingle" pattern, whereby the edge of an "upslope" panel was placed over a "downslope" panel. Care was taken to insure the internal geonet of adjacent and joining panels were in direct contact with each other to insure proper drainage. The geocomposite panels were "seamed" by connecting the internal geonet of each panel to the internal geonet of adjacent panels by utilizing plastic net ties. These net ties were placed every 6 inches on a horizontal (panel end to panel end) seam and every 60 inches on a vertical (panel side to panel side) seam. CTC personnel inspected each seam to insure an adequate number of plastic net ties were used. Care was taken to ensure the overlap zone was not contaminated with loose soil or other debris. Any required patching was performed by removing the damaged section of the geocomposite and seaming a patch of geocomposite by utilizing plastic ties every 3 inches along the seam. Prior to any backfill being placed on the geocomposite, the geotextile flap of the geocomposite was folded over the exposed internal geonet and heat bonded to prevent soil clogging the internal geonet.

9.0 LANDFILL GAS VENTING SYSTEM

The construction procedures followed by the contractor for the installation of the Landfill Gas Extraction System for the Closure and the quality assurance protocol implemented by CTC is summarized in the following section.

9.1 Installation of Gas Vents

The design of the venting system called for a total of fourteen (14) interconnected vertical gas vents to be installed within a system of 1510 linear feet of 6-inch HDPE CPP collection

piping. A trackhoe was utilized to excavate the trenches for these components of the system. An atmospheric meter was utilized to detect the presence of harmful levels of landfill gas (methane, hydrogen sulfide, etc...) and insure the safety of all persons present around the work site. Bob Stout Construction Company removed all trash excavated from the borings with a trackhoe and dump truck and deposited the trash at the onsite transfer station. All installation and construction was performed under the supervision and observance of qualified CTC personnel. Contractor submittals for the gas vent piping can be found in the Appendix, Section XI.

9.2 Installation of System Piping

The 6-inch HDPE CPP system piping was coupled onsite by trained technicians under the observation of CTC personnel. After sections of the piping were coupled together it was placed in the excavated trenches. A FURNCO coupling was used to attach the HDPE collection piping to the vertical PVC gas vents. The gas vents were positioned so that the turndown would be eight feet above the final cover. Well head boots were fashioned and installed by GSI at time of geomembrane deployment.

10.0 SUMMARY

C.T. Clayton Sr., P.E., Inc. of Coats, North Carolina (CTC) provided construction quality assurance services during construction of the closure at the Madison County Landfill. The construction inspection for this area was performed by CTC on a full-time basis for construction activities from October 2005 through December 2005.

The quality assurance program included general earthworks monitoring and soil compaction testing; soil components quality assurance; conveyance appurtenances construction quality assurance.

During construction, CTC verified that conformance testing and construction quality assurance testing was performed on all construction materials at the frequencies required in the project specifications, and that the materials used conformed to or exceeded the project specifications, with exceptions as previously noted. Also, CTC verified that any condition or material that was identified as not conforming to the project specifications was repaired and retested as necessary. All documentation is presented herein.

The observations associated with the Madison County Landfill, indicate that the construction was completed in compliance with the project design specifications and quality assurance program as required by the NCDENR-Waste Division Solid Waste Permit No. 5803 for this facility. Any and all deviations have been identified herein and CTC has determined that the final completed construction satisfied all project specifications.

11.0 REFERENCE DOCUMENTS

The scope of work for this project will be governed by the documents listed below. CTC was responsible for implementing the quality assurance program described in these documents and with ensuring compliance with all requirements and specifications of Solid Waste Permit No. 5803.

- ANSI – American National Standards Institute.
- ASTM – American Society for Testing and Methods.
- Madison County Landfill Solid Waste Permit No. 5803.
- Madison County Landfill, Site Specific Construction Quality Assurance Plan, Construction Drawings, July 2005.
- Madison County Landfill, Bidding Documents and Technical Specifications, dated July 2005.
- Daniel, D.E., Benson, C.H., "Water Content-Density Criteria for Compacted Soil Liners," Journal of Geotechnical Engineering, Volume 116, No. 12, 1990.
- Daniel, D.E., Benson, C.H., "In-Situ Hydraulic Conductivity Tests for Compacted Clay," Journal of Geotechnical Engineering, Volume 115, No. 9, 1989.
- North Carolina Erosion and Sediment Control Handbook, Latest Edition.
- North Carolina Solid Waste Management Regulations.

SECTION I

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

November 2, 2005

Mr. Mark Cathey
McGill Associates
55 Broad Street
Asheville, NC 28802

Re: Borrow Study – Onsite Soils For Use
Madison County MSW Landfill Closure
CTC Project No. 70001

Dear Mr. Cathey:

Attached, you will find our Soil Laboratory Test Data for the soil material intended for use as Common Fill, Low Permeability Soil, and Vegetative Cover Soil on the above mentioned project. Seven test pits were excavated under the direction of a CTC Senior Soil Technician from within the proposed borrow area, as shown on the attached approximate location plan. Twelve bulk samples were selected for testing.

Soils Testing Performed on Common Fill Material

In our soils laboratory, we performed Grain Size Analysis, Natural Moisture Contents and Standard Proctor tests on the bulk samples. Our detailed laboratory results are attached. Testing was performed at the frequencies indicated below:

Test	ASTM Designation	Frequency Performed
Natural Moisture	D2216	2
Grain Size Analysis	D422 and D1140	2
Standard Proctor	D698	2

The samples of soil from within the footprint of the proposed borrow area were field classified as SILT with Sand (MH). No large stones over 2" were encountered during the test pit excavation. The soils were Red-Brown to Brown in color.

3100 NC 27 East
Coats, NC 27521
Phone: 910-897-7070
Fax: 910-897-6767

Offices located in Coats and New Bern, North Carolina
www.ctclayton.com

Conclusions and Recommendations for Common Fill and Low Permeability Soils

Based on the results of the laboratory testing and our Geotechnical Engineering experience, it is our opinion that the soils referenced above meet the requirements of the project specifications.

Please feel free to contact Ryan Sadler or myself if you should require any additional information.

Sincerely,
C.T. Clayton Sr., P.E., Inc.

NORTH CAROLINA PROFESSIONAL SEAL 028909 ENGINEER C. TYRUS CLAYTON, JR.
11/3/05

C. Tyrus Clayton, Jr., P.E.
Project QA Engineer

attachments

cc: Ryan Sadler, Ken Piazza, File

COMMON FILL LABORATORY DATA

Grain Size Distribution Calculations

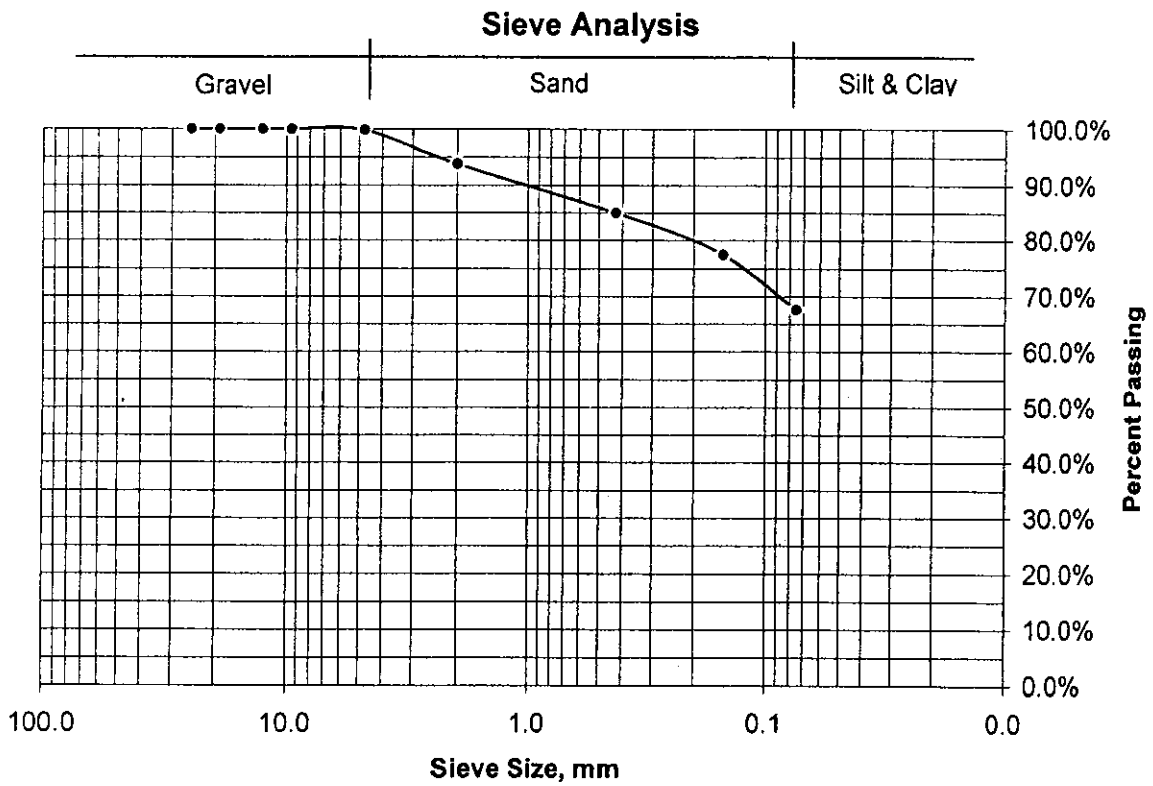
Madison County Landfill
DAA # R05646-01
Prepared By: SDH

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID Common Fill #1
Sample Depth N/A

Mechanical Sieve Analysis

Sieve Size	Weight Retained	Percent Retained	Sieve Size, mm	Percent Passing
1"	0.00	0.0%	25.0	100.0%
3/4"	0.00	0.0%	19.0	100.0%
1/2"	0.00	0.0%	12.5	100.0%
3/8"	0.00	0.0%	9.50	100.0%
No. 4	0.36	0.2%	4.75	99.8%
No. 10	11.84	6.0%	2.00	93.9%
No. 40	17.54	8.8%	0.425	85.0%
No. 100	14.97	7.5%	0.15	77.5%
No. 200	19.56	9.8%	0.075	67.6%
Pan	3.56	1.8%		
Total	67.83	32.4%		



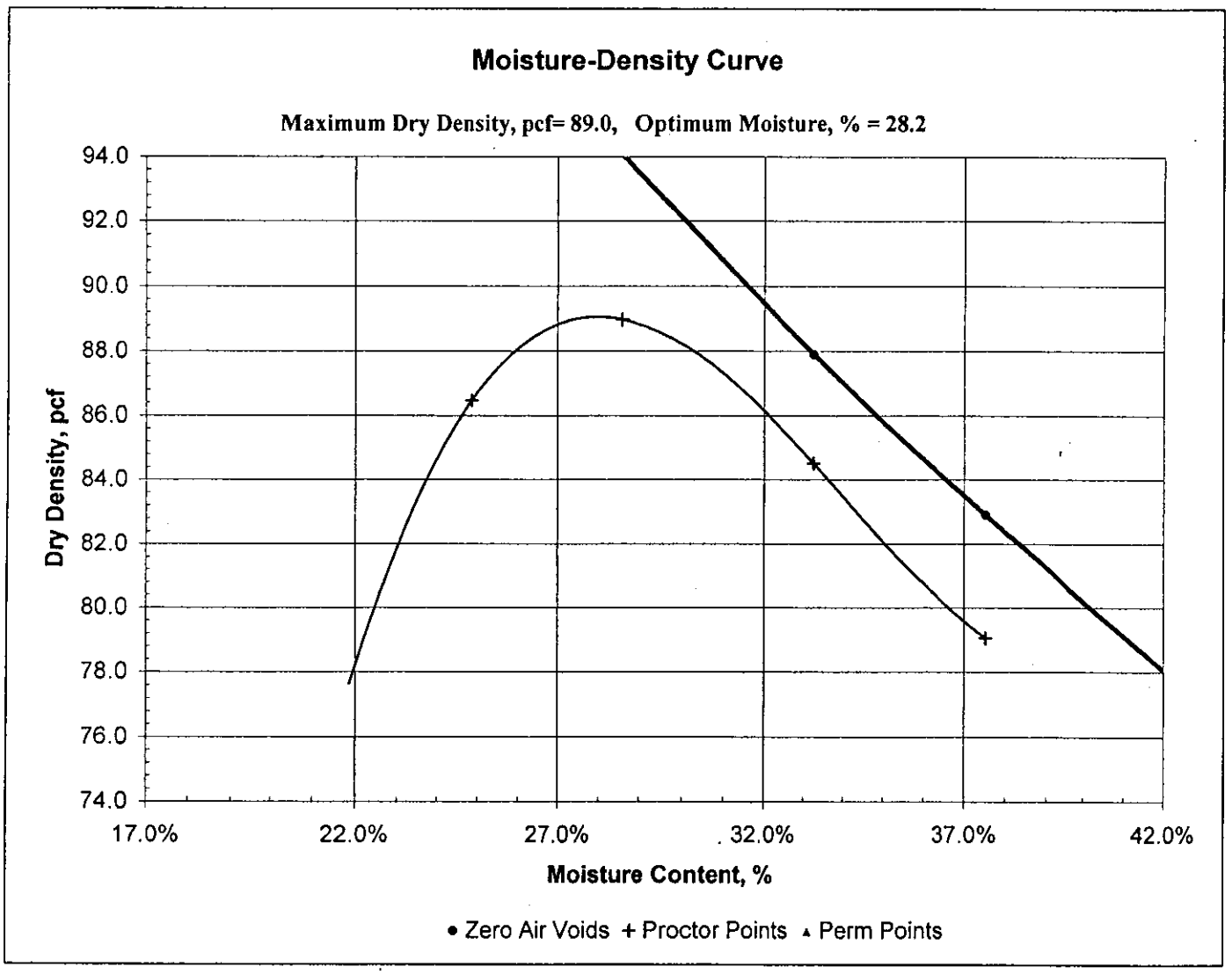
Proctor Test Report
Madison County Landfill
DAA # R05646-01
Prepared by SDH

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Soil and Test Method Data

Sample ID	Common Fill #1
Sample Depth	N/A
Sample Classification	#DIV/0!
USCS Group Symbol	#DIV/0!
Test Method	ASTM D698, Method B, with mechanical hammer
Sample Preparation	Air dried and sieved through a 3/8" sieve.
Mold Size, in	4.0

Test Data	#1	#2	#3	#4	#5
Moisture Content	24.9%	28.6%	33.3%	37.5%	
Dry Density, pcf	86.5	89.0	84.5	79.0	



Grain Size Distribution Calculations

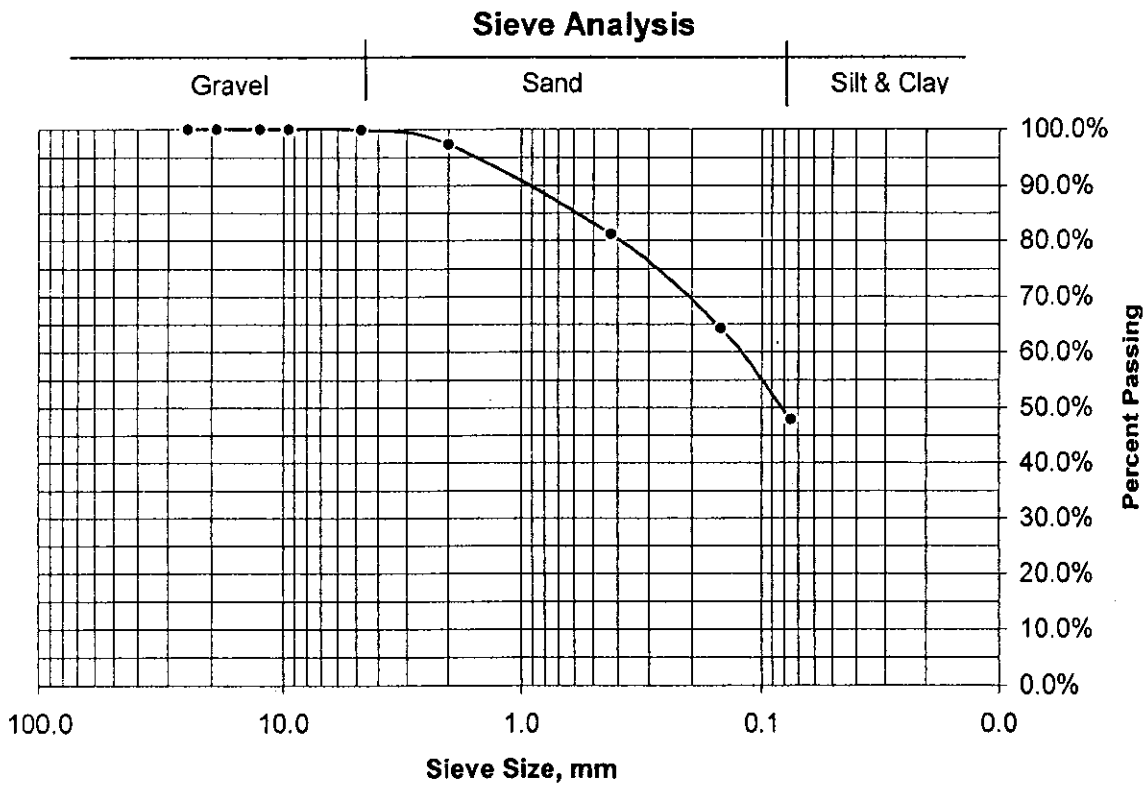
Madison County Landfill
DAA # R05646-01
Prepared By: SDH

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID Common Fill #2
Sample Depth N/A

Mechanical Sieve Analysis

Sieve Size	Weight Retained	Percent Retained	Sieve Size, mm	Percent Passing
1"	0.00	0.0%	25.0	100.0%
3/4"	0.00	0.0%	19.0	100.0%
1/2"	0.00	0.0%	12.5	100.0%
3/8"	0.00	0.0%	9.50	100.0%
No. 4	0.26	0.1%	4.75	99.9%
No. 10	5.65	2.5%	2.00	97.3%
No. 40	35.82	16.1%	0.425	81.2%
No. 100	37.56	16.9%	0.15	64.3%
No. 200	36.27	16.3%	0.075	48.0%
Pan	3.78	1.7%		
Total	119.34	52.0%		



Proctor Test Report
Madison County Landfill
DAA # R05646-01
Prepared by SDH

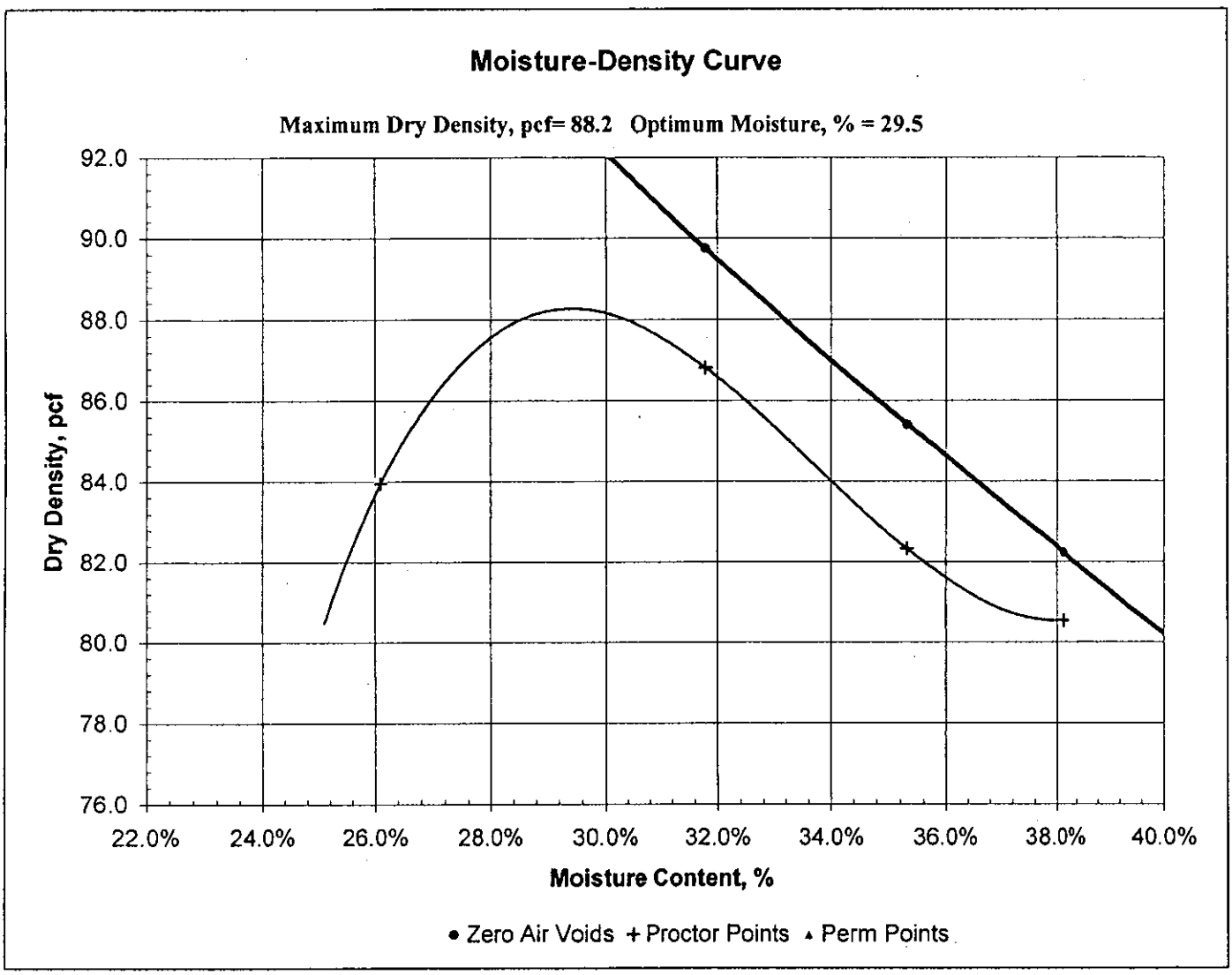
Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Soil and Test Method Data

Sample ID	Common Fill #2
Sample Depth	N/A
Sample Classification	#DIV/0!
USCS Group Symbol	#DIV/0!
Test Method	ASTM D698, Method B, with mechanical hammer
Sample Preparation	Air dried and sieved through a 3/8" sieve.
Mold Size, in	4.0

Test Data

	#1	#2	#3	#4	#5
Moisture Content	26.1%	31.8%	35.3%	38.1%	
Dry Density, pcf	83.9	86.8	82.3	80.5	



LOW PERMEABILITY SOIL LABORATORY DATA

Soil Classification Calculations

Madison County Landfill
DAA #R05646-01
Prepared By: SDH

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID	Low Perm #1
Sample Depth	N/A
Visual Sample Description	Red-Brown Elastic SILT with Sand

Natural Moisture Content

Pan ID	3	
Pan Wt	193.10	grams
Pan + Soil (wet)	549.60	grams
Pan + Soil (dry)	441.20	grams
Natural Moisture Content	*43.7%*	

Coarse or Fine Grained

Pan + Soil retained on No. 200 sieve (dry)	246.31	grams
Percent Passing No. 200 Sieve	78.6%	
Pan + Soil retained on No. 4 sieve (dry)	193.10	grams
Percent Passing No. 4 Sieve	100.0%	
Soil Classifies as	*Fine-Grained Soil*	

Atterberg Limits

Liquid Limit

No of Blows	16	27	34
Pan ID	102	98	108
Pan Wt	24.00	30.43	33.53
Pan + Soil (wet)	31.99	38.94	43.96
Pan + Soil (dry)	28.50	35.26	39.51
Moisture Content	78%	76%	74%
Liquid Limit	73	77	77
Liquid Limit	*76*		

Plastic Limit

Pan ID	1138	18
Pan Weight	6.12	4.30
Pan + Soil (wet)	9.71	7.78
Pan + Soil (dry)	8.70	6.79
Moisture Content	39%	40%
Plastic Limit	*39*	
Plastic Index	*36*	

USCS Classification

Group Symbol	**MH**
Group Name	**Elastic SILT with Sand**

Grain Size Distribution Calculations

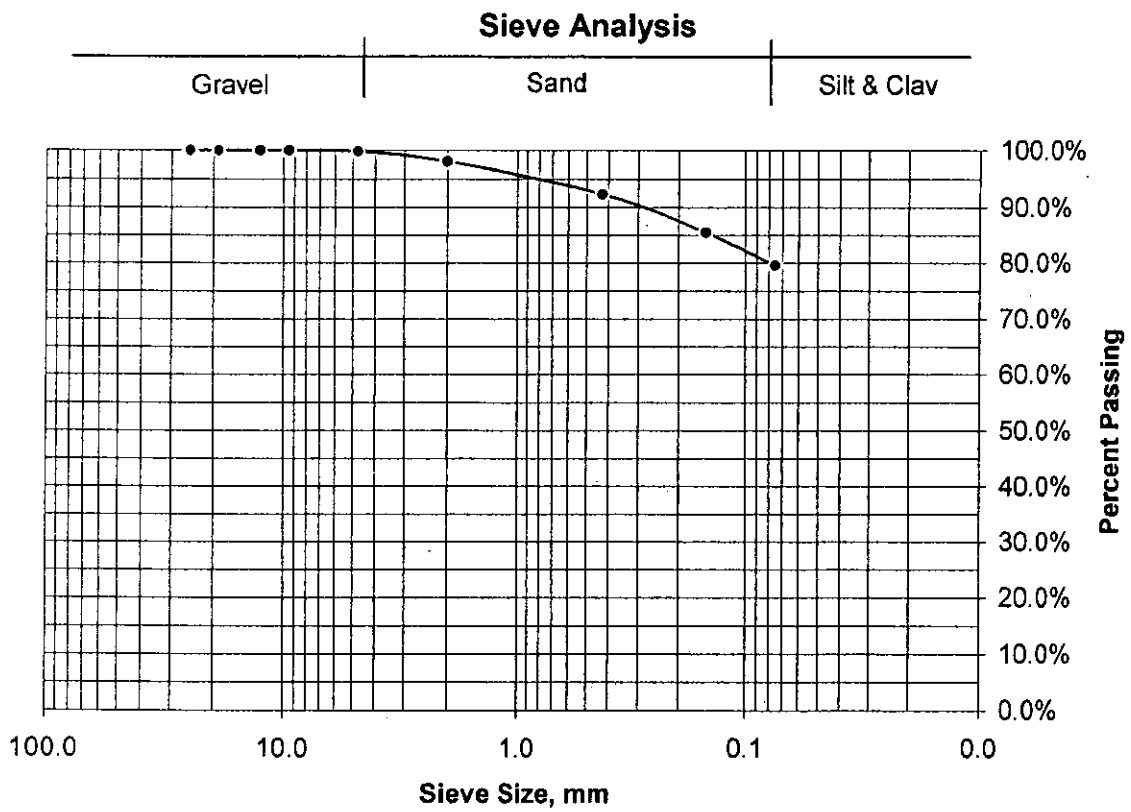
Madison County Landfill
DAA #R05646-01
Prepared By: SDH

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID Low Perm #1
Sample Depth N/A

Mechanical Sieve Analysis

Sieve Size	Weight Retained	Percent Retained	Sieve Size, mm	Percent Passing
1"	0.00	0.0%	25.0	100.0%
3/4"	0.00	0.0%	19.0	100.0%
1/2"	0.00	0.0%	12.5	100.0%
3/8"	0.00	0.0%	9.5	100.0%
No. 4	0.37	0.1%	4.75	99.9%
No. 10	4.55	1.8%	2.0	98.0%
No. 40	14.10	5.7%	0.425	92.3%
No. 100	16.89	6.8%	0.15	85.5%
No. 200	14.81	6.0%	0.075	79.6%
Pan	3.19	1.3%		
Total	53.91	20.4%		



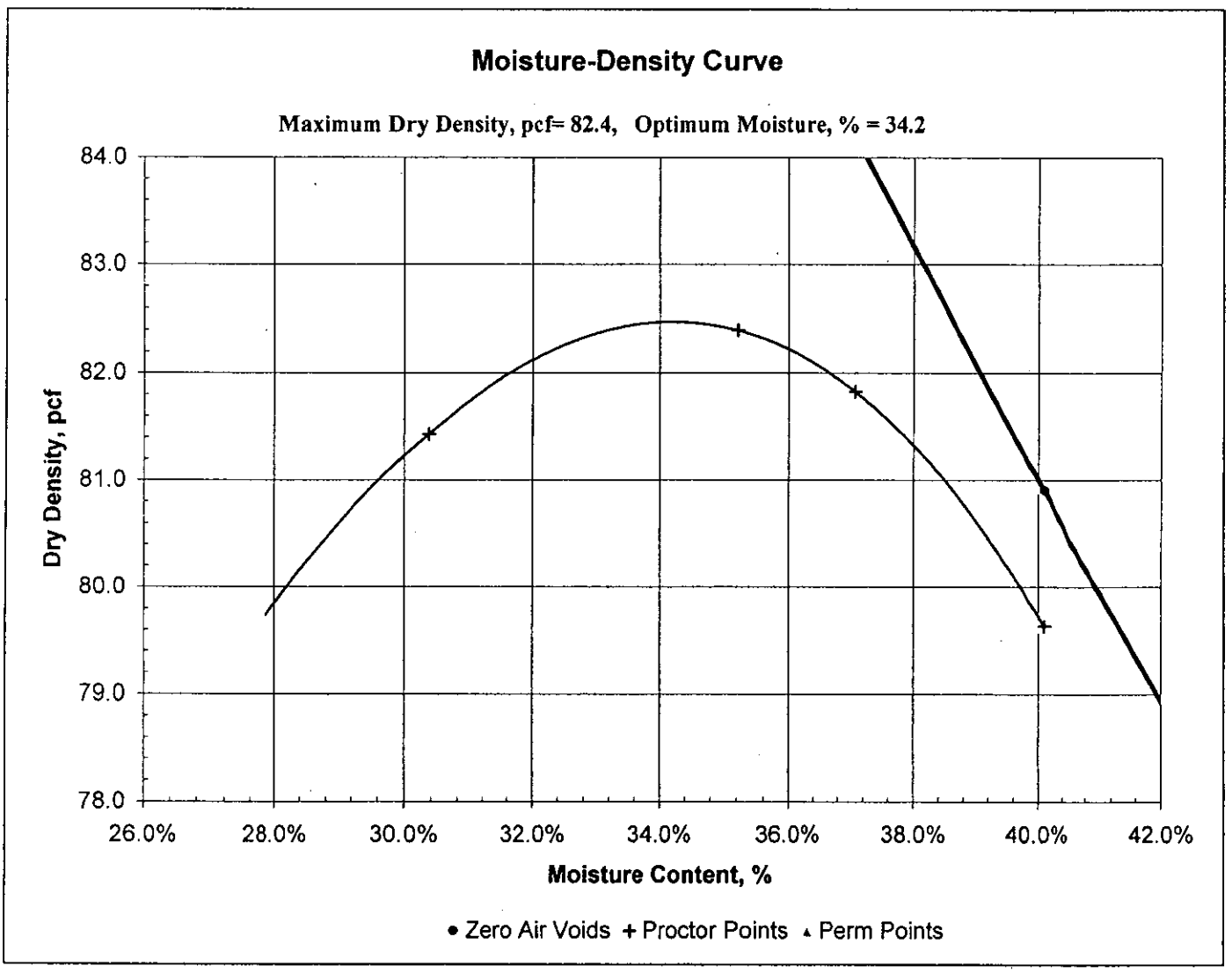
Proctor Test Report
Madison County Landfill
DAA #
Prepared by SDH

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Soil and Test Method Data

Sample ID	Low Perm #1
Sample Depth	N/A
Sample Classification	#DIV/0!
USCS Group Symbol	#DIV/0!
Test Method	ASTM D698, Method B, with mechanical hammer
Sample Preparation	Air dried and sieved through a 3/8" sieve.
Mold Size, in	4.0

Test Data	#1	#2	#3	#4	#5
Moisture Content	30.4%	35.2%	37.1%	40.1%	
Dry Density, pcf	81.4	82.4	81.8	79.6	



Permeability Calculations

Madison County Landfill
DAA #R05646-01
Prepared By: SDH

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID: Low Perm #1
Sample Depth: N/A
Permeability Method: ASTM D5084
Sample Length, in: 3.82
Sample Diamter, in: 2.84

Moisture Content

Pan Wt	1.54	grams
Pan + Soil (wet)	102.53	grams
Pan + Soil (dry)	77.11	grams
Moisture Content	*33.6%*	

Dry Density

Soil (wet)	680.20	grams
Wet Density	107.0	pcf
Dry Density	*80.0*	pcf

Test Conditions

Backpressure, psi	40.0
Cell Pressure, psi	50.0
Influent Buret Area, cm^2	0.03142
Effluent Buret Area, cm^2	0.76712

Permeability Trials

Time min	Influent Head, cm	Influent Flow, cm^3	Effluent Head, cm	Effluent Flow, cm^3	Flow Deviation Ratio	Gradient mm-Hg	Permeabilty, k cm/sec
24-Oct 8:17	14.050		0.900				
24-Oct 8:18	10.000	0.127	1.066	0.127	1.00	17.00	3.7E-06
24-Oct 8:19	7.250	0.086	1.178	0.086	1.00	11.55	3.7E-06
24-Oct 8:20	5.400	0.058	1.254	0.058	1.00	7.85	3.6E-06
24-Oct 8:21	4.100	0.041	1.307	0.041	1.00	5.36	3.8E-06
24-Oct 8:22	3.200	0.028	1.344	0.028	1.00	3.61	3.9E-06

Average Permeability 3.7E-06 cm/sec

Final Data

Assumed Specific Gravity	2.65	
Final Weight of Sample	722.90	grams
Final Moisture Content	42.0%	
Percent Voids	51.6%	
Actual Volume of Voids	204.8	ml
Saturation	100.0%	

Soil Classification Calculations

Madison County Landfill
DAA # R05646-01
Prepared By: SDH

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID	Low Perm #2
Sample Depth	N/A
Visual Sample Description	Red-Brown Elastic SILT with Sand

Natural Moisture Content

Pan ID	35	
Pan Wt	192.73	grams
Pan + Soil (wet)	507.10	grams
Pan + Soil (dry)	424.10	grams
Natural Moisture Content	*35.9%*	

Coarse or Fine Grained

Pan + Soil retained on No. 200 sieve (dry)	245.39	grams
Percent Passing No. 200 Sieve	77.2%	
Pan + Soil retained on No. 4 sieve (dry)	193.07	grams
Percent Passing No. 4 Sieve	99.9%	
Soil Classifies as	*Fine-Grained Soil*	

Atterberg Limits

Liquid Limit

No of Blows	18	22	35
Pan ID	121	62	10
Pan Wt	11.26	10.91	11.3
Pan + Soil (wet)	21.89	22.20	20.26
Pan + Soil (dry)	17.19	17.37	16.52
Moisture Content	79%	75%	72%
Liquid Limit	76	74	75
Liquid Limit	*75*		

Plastic Limit

Pan ID	H	D
Pan Weight	2.40	2.42
Pan + Soil (wet)	10.57	11.68
Pan + Soil (dry)	8.06	8.83
Moisture Content	44%	44%
Plastic Limit	*44*	
Plastic Index	*30*	

USCS Classification

Group Symbol	**MH**
Group Name	**Elastic SILT with Sand**

Grain Size Distribution Calculations

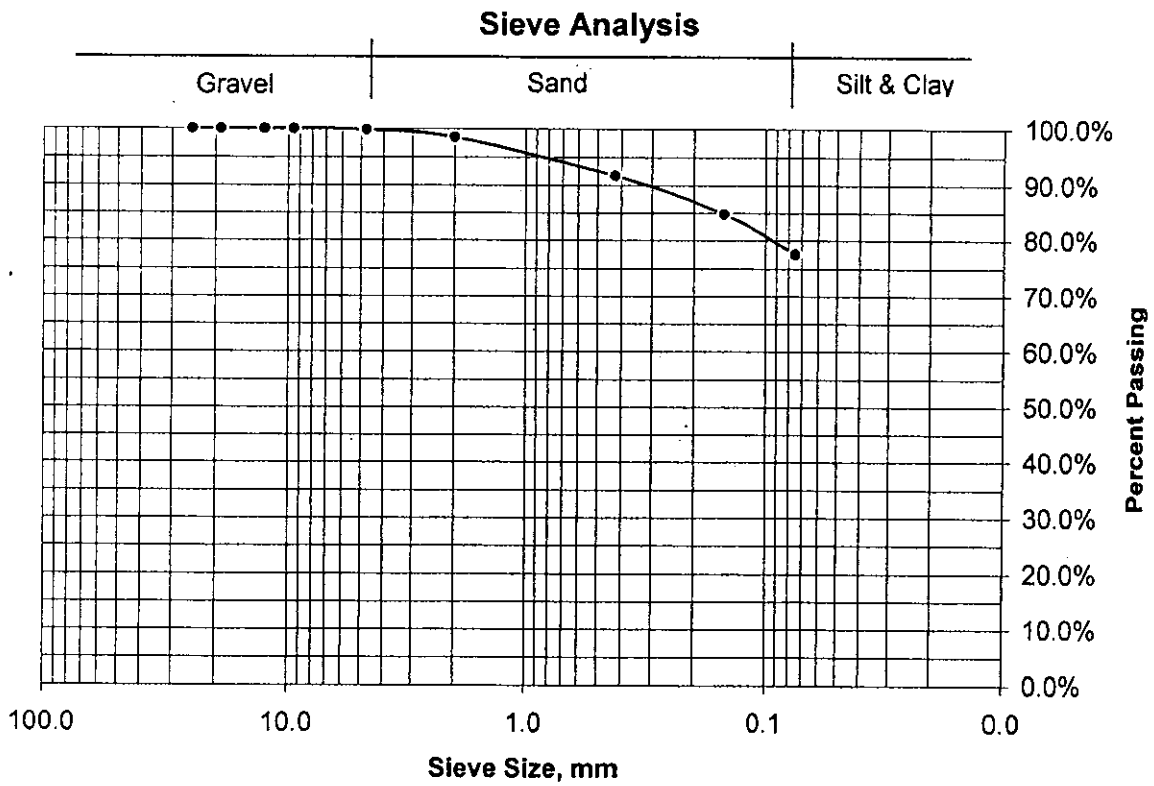
Madison County Landfill
DAA # R05646-01
Prepared By: SDH

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID Low Perm #2
Sample Depth N/A

Mechanical Sieve Analysis

Sieve Size	Weight Retained	Percent Retained	Sieve Size, mm	Percent Passing
1"	0.00	0.0%	25.0	100.0%
3/4"	0.00	0.0%	19.0	100.0%
1/2"	0.00	0.0%	12.5	100.0%
3/8"	0.00	0.0%	9.50	100.0%
No. 4	0.34	0.1%	4.75	99.9%
No. 10	3.12	1.3%	2.00	98.5%
No. 40	15.56	6.7%	0.425	91.8%
No. 100	16.06	6.9%	0.15	84.8%
No. 200	16.77	7.2%	0.075	77.6%
Pan	0.81	0.4%		
Total	52.66	22.4%		



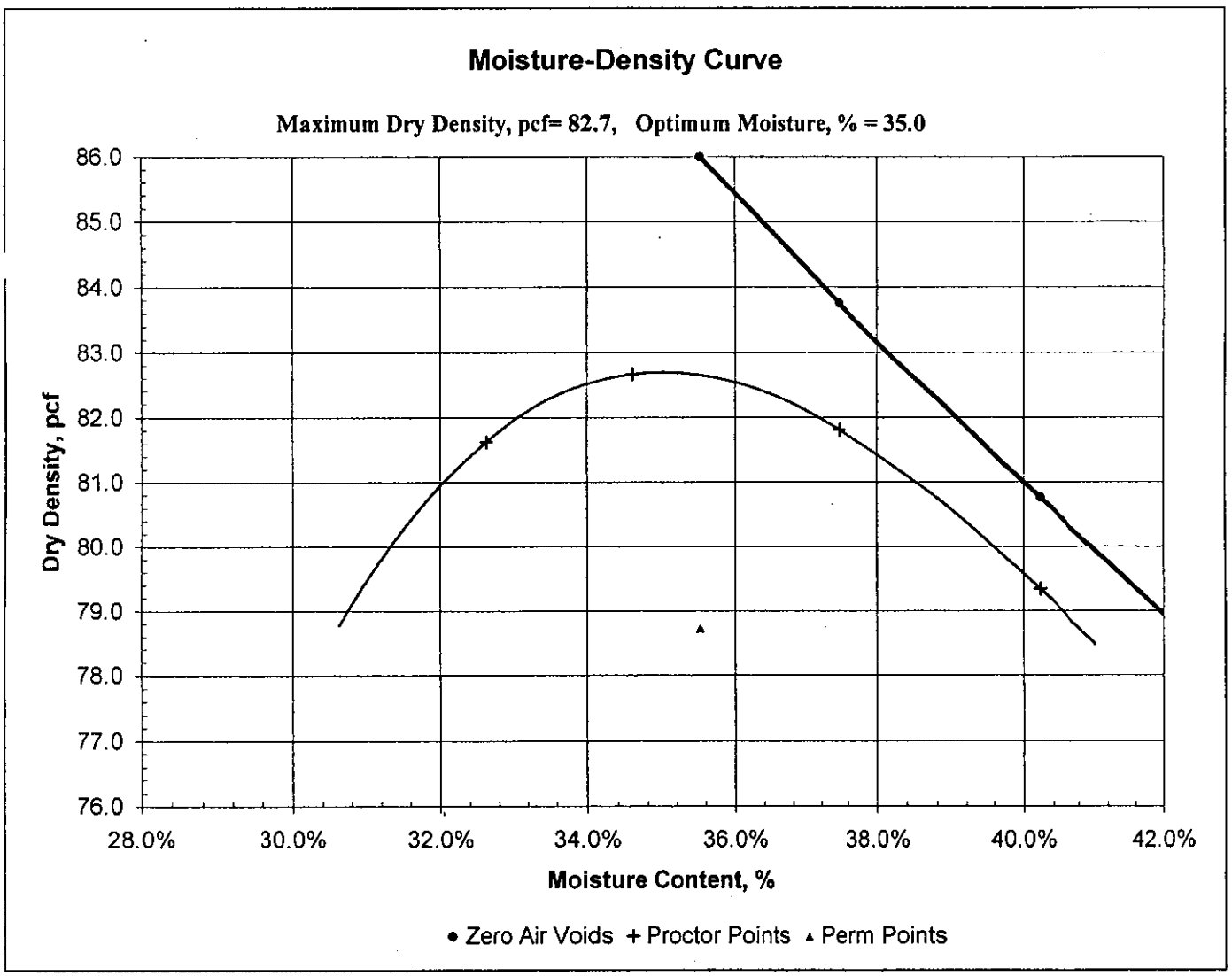
Proctor Test Report
Madison County Landfill
DAA # R05646-01
Prepared by SDH

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Soil and Test Method Data

Sample ID	Low Perm #2
Sample Depth	N/A
Sample Classification	Elastic SILT with Sand
USCS Group Symbol	MH
Test Method	ASTM D698, Method B, with mechanical hammer
Sample Preparation	Air dried and sieved through a 3/8" sieve.
Mold Size, in	4.0

Test Data	#1	#2	#3	#4	#5
Moisture Content	32.6%	34.6%	37.5%	40.2%	
Dry Density, pcf	81.6	82.7	81.8	79.3	



Permeability Calculations

Madison County Landfill
DAA # R05646-01
Prepared By: SDH

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID: Low Perm #2
Sample Depth: N/A
Permeability Method: ASTM D5084
Sample Length, in: 3.64
Sample Diamter, in: 2.85

Moisture Content

Pan Wt	1.67	grams
Pan + Soil (wet)	111.31	grams
Pan + Soil (dry)	82.57	grams
Moisture Content	*35.5%*	

Dry Density

Soil (wet)	651.50	grams
Wet Density	106.7	pcf
Dry Density	*78.7*	pcf

Test Conditions

Backpressure, psi	40.0
Cell Pressure, psi	50.0
Influent Buret Area, cm^2	0.03142
Effluent Buret Area, cm^2	0.76712

Permeability Trials

Time min	Influent Head, cm	Influent Flow, cm^3	Effluent Head, cm	Effluent Flow, cm^3	Flow Deviation Ratio	Gradient mm-Hg	Permeabilty, k cm/sec
26-Oct 12:02	16.450		1.000				
26-Oct 12:03	10.000	0.203	1.264	0.203	1.00	20.97	5.1E-06
26-Oct 12:04	6.900	0.097	1.391	0.097	1.00	11.86	4.1E-06
26-Oct 12:05	4.300	0.082	1.498	0.082	1.00	7.48	6.1E-06
26-Oct 12:06	3.200	0.035	1.543	0.035	1.00	3.80	4.7E-06
26-Oct 12:08	2.100	0.035	1.588	0.035	1.00	2.25	5.3E-06

Average Permeability 5.1E-06 cm/sec

Final Data

Assumed Specific Gravity	2.6
Final Weight of Sample	672.00 grams
Final Moisture Content	39.8%
Percent Voids	50.5%
Actual Volume of Voids	192.5 ml
Saturation	99.4%

VEGETATIVE COVER SOIL LABORATORY DATA

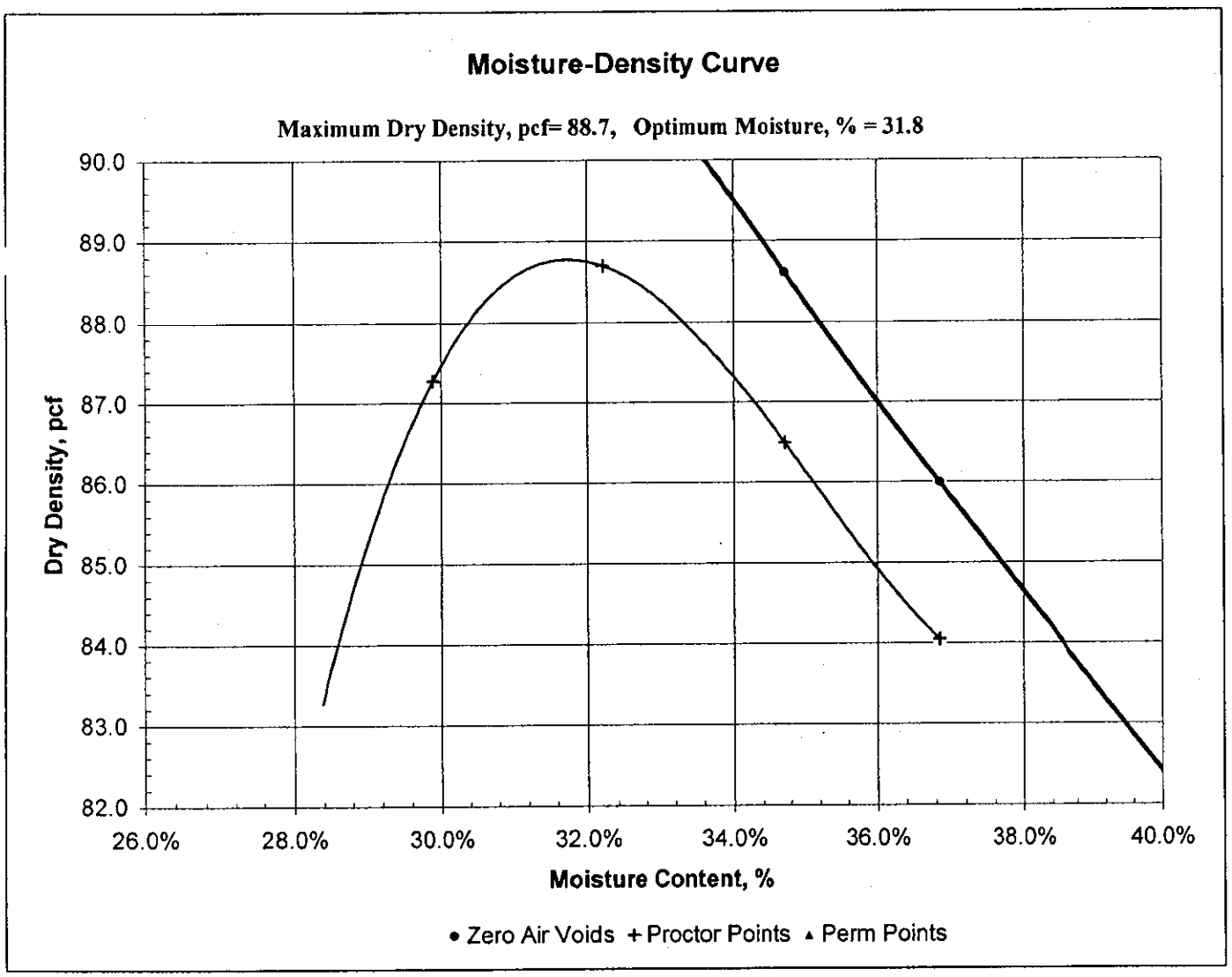
Proctor Test Report
Madison County Landfill
DAA #
Prepared by SDH

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Soil and Test Method Data

Sample ID	Veggie Cover #1
Sample Depth	N/A
Sample Classification	#DIV/0!
USCS Group Symbol	#DIV/0!
Test Method	ASTM D698, Method B, with mechanical hammer
Sample Preparation	Air dried and sieved through a 3/8" sieve.
Mold Size, in	4.0

Test Data	#1	#2	#3	#4	#5
Moisture Content	29.9%	32.2%	34.7%	36.8%	
Dry Density, pcf	87.3	88.7	86.5	84.0	



Permeability Calculations

Madison County Landfill
DAA # R05646-01
Prepared By: SDH

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID: Veggie Cover #1
Sample Depth: N/A
Permeability Method: ASTM D5084
Sample Length, in: 3.78
Sample Diamter, in: 2.84

Moisture Content

Pan Wt	6.67	grams
Pan + Soil (wet)	185.57	grams
Pan + Soil (dry)	141.35	grams
Moisture Content	*32.8%*	

Dry Density

Soil (wet)	736.00	grams
Wet Density	116.8	pcf
Dry Density	*87.9*	pcf

Test Conditions

Backpressure, psi	40.0
Cell Pressure, psi	50.0
Influent Buret Area, cm^2	0.03142
Effluent Buret Area, cm^2	0.76712

Permeability Trials

Time min	Influent Head, cm	Influent Flow, cm^3	Effluent Head, cm	Effluent Flow, cm^3	Flow Deviation Ratio	Gradient mm-Hg	Permeabilty, k cm/sec
1-Nov 8:20	17.200		0.900				
1-Nov 8:21	16.400	0.025	0.933	0.025	1.00	21.31	4.9E-07
1-Nov 8:22	16.000	0.013	0.949	0.013	1.00	20.22	2.6E-07
1-Nov 8:23	15.800	0.006	0.957	0.006	1.00	19.67	1.3E-07
1-Nov 8:24	15.600	0.006	0.966	0.006	1.00	19.40	1.3E-07
1-Nov 8:25	15.400	0.006	0.974	0.006	1.00	19.13	1.3E-07
1-Nov 8:26	15.200	0.006	0.982	0.006	1.00	18.86	1.4E-07
1-Nov 8:27	14.900	0.009	0.994	0.009	1.00	18.58	2.1E-07
1-Nov 8:33	13.900	0.031	1.035	0.031	1.00	18.18	1.2E-07

Average Permeability 1.5E-07 cm/sec

Final Data

Assumed Specific Gravity	2.6
Final Weight of Sample	742.50 grams
Final Moisture Content	34.0%
Percent Voids	44.7%
Actual Volume of Voids	175.9 ml
Saturation	100.0%

Proctor Test Report
Madison County Landfill
DAA # R05646-01
Prepared by SDH

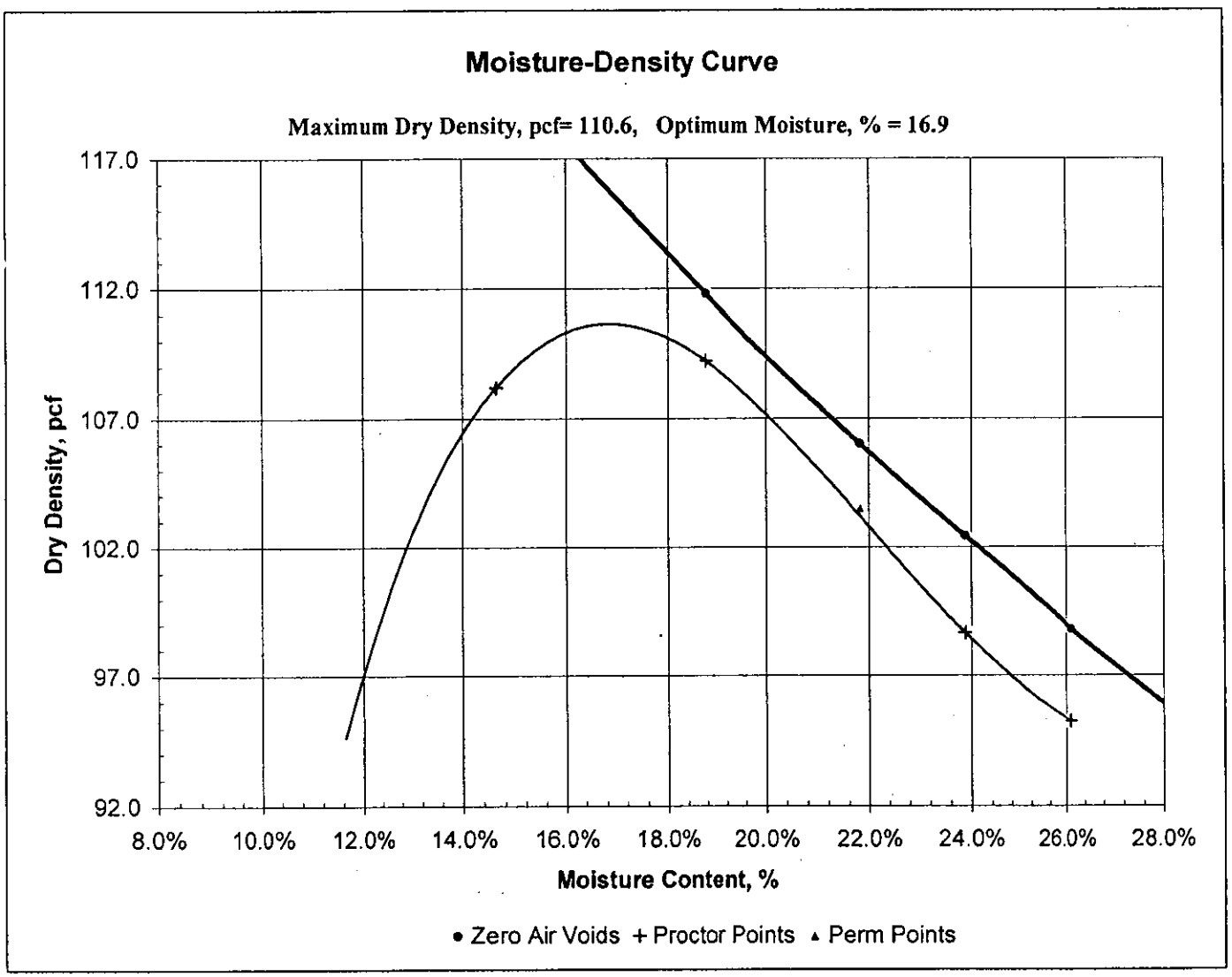
Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Soil and Test Method Data

Sample ID	Veggie Cover #2
Sample Depth	N/A
Sample Classification	#DIV/0!
USCS Group Symbol	#DIV/0!
Test Method	ASTM D698, Method B, with mechanical hammer
Sample Preparation	Air dried and sieved through a 3/8" sieve.
Mold Size, in	4.0

Test Data

	#1	#2	#3	#4	#5
Moisture Content	14.6%	18.8%	23.9%	26.1%	
Dry Density, pcf	108.2	109.2	98.7	95.2	



Permeability Calculations

Madison County Landfill
DAA # R05646-01
Prepared By: SDH

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID: Veggie Cover #2
Sample Depth: N/A
Permeability Method: ASTM D5084
Sample Length, in: 3.75
Sample Diamter, in: 2.84

Moisture Content

Pan Wt	6.61	grams
Pan + Soil (wet)	203.25	grams
Pan + Soil (dry)	168.02	grams
Moisture Content	*21.8%*	

Dry Density

Soil (wet)	788.90	grams
Wet Density	126.1	pcf
Dry Density	*103.5*	pcf

Test Conditions

Backpressure, psi	40.0
Cell Pressure, psi	50.0
Influent Buret Area, cm^2	0.03142
Effluent Buret Area, cm^2	0.76712

Permeability Trials

Time min	Influent Head, cm	Influent Flow, cm^3	Effluent Head, cm	Effluent Flow, cm^3	Flow Deviation Ratio	Gradient mm-Hg	Permeabilty, k cm/sec
1-Nov 8:40	17.000		0.900				
1-Nov 8:41	16.800	0.006	0.908	0.006	1.00	21.21	1.2E-07
1-Nov 8:42	16.500	0.009	0.920	0.009	1.00	20.94	1.8E-07
1-Nov 8:43	16.300	0.006	0.929	0.006	1.00	20.53	1.3E-07
1-Nov 8:44	16.100	0.006	0.937	0.006	1.00	20.25	1.3E-07
1-Nov 8:45	15.950	0.005	0.943	0.005	1.00	19.98	9.6E-08
1-Nov 8:46	15.800	0.005	0.949	0.005	1.00	19.77	9.7E-08
1-Nov 8:47	15.700	0.003	0.953	0.003	1.00	19.57	6.6E-08
1-Nov 8:52	15.200	0.016	0.974	0.016	1.00	19.43	6.7E-08

Average Permeability 8.2E-08 cm/sec

Final Data

Assumed Specific Gravity	2.6
Final Weight of Sample	792.10 grams
Final Moisture Content	22.3%
Percent Voids	34.9%
Actual Volume of Voids	136.4 ml
Saturation	100.0%

Proctor Test Report
Madison County Landfill
DAA # R05646-01
Prepared by SDH

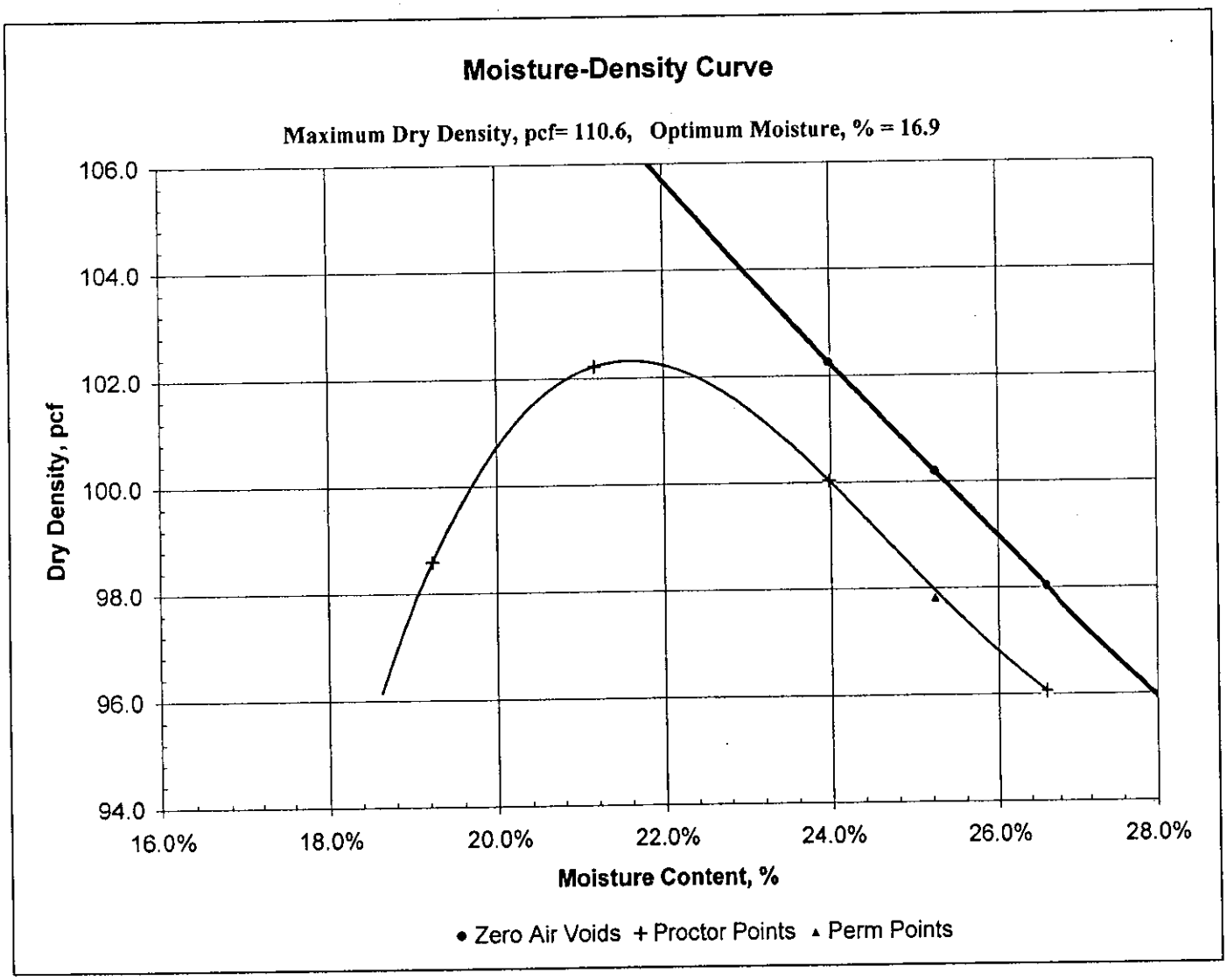
Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Soil and Test Method Data

Sample ID	Veggie Cover #3
Sample Depth	N/A
Sample Classification	#DIV/0!
USCS Group Symbol	#DIV/0!
Test Method	ASTM D698, Method B, with mechanical hammer
Sample Preparation	Air dried and sieved through a 3/8" sieve.
Mold Size, in	4.0

Test Data

	#1	#2	#3	#4	#5
Moisture Content	19.2%	21.2%	24.0%	26.6%	
Dry Density, pcf	98.6	102.2	100.0	96.1	



Permeability Calculations

Madison County Landfill
DAA # R05646-01
Prepared By: SDH

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID: Veggie Cover #3
Sample Depth: N/A
Permeability Method: ASTM D5084
Sample Length, in: 3.80
Sample Diamter, in: 2.84

Moisture Content

Pan Wt	6.77	grams
Pan + Soil (wet)	181.24	grams
Pan + Soil (dry)	146.08	grams
Moisture Content	*25.2%*	

Dry Density

Soil (wet)	776.10	grams
Wet Density	122.5	pcf
Dry Density	*97.8*	pcf

Test Conditions

Backpressure, psi	40.0
Cell Pressure, psi	50.0
Influent Buret Area, cm^2	0.03142
Effluent Buret Area, cm^2	0.76712

Permeability Trials

Time min	Influent Head, cm	Influent Flow, cm^3	Effluent Head, cm	Effluent Flow, cm^3	Flow Deviation Ratio	Gradient mm-Hg	Permeabilty, k cm/sec
1-Nov 9:01	16.900		0.900				
1-Nov 9:02	16.700	0.006	0.908	0.006	1.00	20.80	1.2E-07
1-Nov 9:03	16.500	0.006	0.916	0.006	1.00	20.53	1.3E-07
1-Nov 9:04	16.400	0.003	0.920	0.003	1.00	20.26	6.3E-08
1-Nov 9:05	16.350	0.002	0.923	0.002	1.00	20.13	3.2E-08
1-Nov 9:06	16.300	0.002	0.925	0.002	1.00	20.06	3.2E-08
1-Nov 9:07	16.200	0.003	0.929	0.003	1.00	19.99	6.4E-08
1-Nov 9:08	16.100	0.003	0.933	0.003	1.00	19.86	6.5E-08
1-Nov 9:14	15.800	0.009	0.945	0.009	1.00	19.72	3.3E-08

Average Permeability 4.8E-08 cm/sec

Final Data

Assumed Specific Gravity	2.6
Final Weight of Sample	781.60 grams
Final Moisture Content	26.1%
Percent Voids	38.5%
Actual Volume of Voids	152.2 ml
Saturation	100.0%

NATURAL MOISTURES

Soil Moisture Content Calculations

Madison County Landfill
DAA # R05646-01
Prepared By: SDH

Natural Moisture Content

Sample ID **Low Perm #1**
Sample Depth **N/A**

	Sample 1		Sample 2		Sample 3	
Pan ID	35		38		42	
Pan Wt	192.73	grams	189.56	grams	191.56	grams
Pan + Soil (wet)	507.10	grams	432.56	grams	500.20	grams
Pan + Soil (dry)	424.10	grams	365.30	grams	420.56	grams
Natural Moisture Content	*35.9%*		*38.3%*		*34.8%*	

Sample 4		Sample 5	
27		24	
188.45	grams	194.65	grams
489.60	grams	432.00	grams
410.50	grams	372.56	grams
35.6%		*33.4%*	

Sample ID **Low Perm #2**
Sample Depth **N/A**

	Sample 1		Sample 2		Sample 3	
Pan ID	3		22		28	
Pan Wt	193.10		185.26		187.45	
Pan + Soil (wet)	549.60	grams	488.20	grams	420.10	grams
Pan + Soil (dry)	458.30	grams	406.82	grams	360.01	grams
Natural Moisture Content	*34.4%*	grams	*36.7%*	grams	*34.8%*	grams

Sample 4		Sample 5	
33		15	
187.56	grams	192.74	grams
389.56	grams	365.12	grams
339.80	grams	327.71	grams
32.7%		*27.7%*	

Soil Moisture Content Calculations

Madison County Landfill
DAA # R05646-01
Prepared By: SDH

Natural Moisture Content

Sample ID	Common Fill #1		Common Fill #2	
Sample Depth	N/A		N/A	
Pan ID	10		19	
Pan Wt	184.01	grams	188.48	grams
Pan + Soil (wet)	441.50	grams	461.40	grams
Pan + Soil (dry)	382.67	grams	410.50	grams
Natural Moisture Content	*29.6%*		*22.9%*	

Sample ID	Veggie Cover #1		Veggie Cover #2		Veggie Cover #3	
Sample Depth	N/A		N/A		N/A	
Pan ID	16		22		6	
Pan Wt	188.26	grams	189.56	grams	195.30	grams
Pan + Soil (wet)	432.60	grams	478.20	grams	503.20	grams
Pan + Soil (dry)	398.56	grams	426.50	grams	457.20	grams
Natural Moisture Content	*16.2%*		*21.8%*		*17.6%*	

TEST PIT / SAMPLE LOCATION SKETCH

Tes. Pits

① Low Perm #1 + Veggie Cover #1

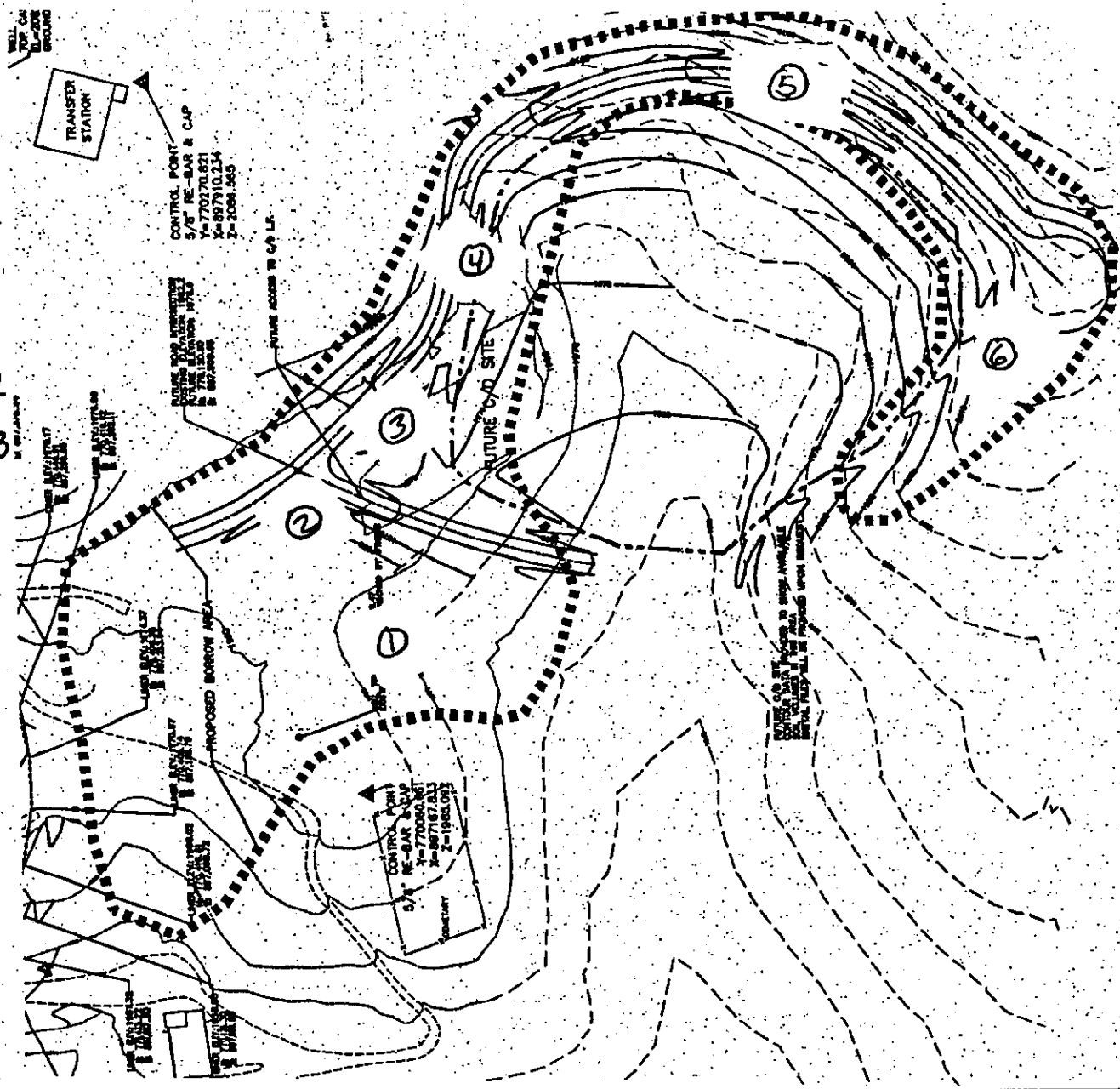
② Common Fill #1

③ Common Fill #2

④ No Sample

⑤ Low Perm #2 + Veggie Cover #2

⑥ Veggie Cover #3



Notes: Test Pits #'s 2, 3, + 4 already stripped of top soil + clay. Test pits #'s 1, 5, + 6 contain approx. 1.5' of vegetative cover material and 4' of clay material then turning to SILT

Tesing Locations

Date: 9-27-05

Madison County MSW Landfill Closure
CTC PN 70001

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

SECTION II

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

December 29, 2005

Mr. Mark Cathey
McGill Associates
55 Broad Street
Asheville, NC 28802

Re: Compacted Clay Layer Test Pad - QA Testing Documentation
Madison County MSW Landfill Closure
CTC Project No. 70001

Dear Mr. Cathey:

Attached, you will find our compiled Laboratory and Field Documentation for the Compacted Clay Layer Test Pad located at the above referenced project site.

Inspection and Field Testing

The following tests were conducted on the test pad:

Test	*ASTM Designation or Other Test Method*	*Frequency Required*	*Frequency Performed*
Compacted Density	D2922 or D2937	3 per lift	3 per lift
Compacted Moisture Content	D3017 or D2216	3 per lift	3 per lift
Atterberg Limits	D4318	Not Required	1 per lift
Particle Size	D422	Not Required	1 per lift
Hydraulic Conductivity – Shelby Tube	D5084	1 per lift	1 per lift
Hydraulic Conductivity – Laboratory Compacted	D5084	1 per lift	1 per lift

3100 NC 27 East
Coats, NC 27521
Phone: 910-897-7070
Fax: 910-897-6767

Offices located in Coats and New Bern, North Carolina
www.ctclayton.com

During our site visit on November 2, 2005 quality assurance testing was performed on the Compacted Clay Layer Test Pad. The project specifications require an 18-inch thick Compacted Clay Layer Test Pad. The soil was placed within the test pad area in three compacted 6-inch lifts as outlined in the attached Site Visit Reports. Density tests plotted in the permeability "window", which resulted in sufficient compaction and acceptable amounts of moisture.

In addition to our field testing, Bulk samples along with Shelby tubes samples were obtained and laboratory permeability and classification tests were performed. Laboratory compacted samples produced permeabilities ranging from 1.2×10^{-7} cm/sec to 1.9×10^{-7} cm/sec. Shelby tube samples taken from the Compacted Clay Layer Test Pad produced permeabilities ranging from 4.1×10^{-6} cm/sec to 3.2×10^{-7} cm/sec. Samples were classified as Elastic SILT with Sand (MH). Our daily reports, field density tests, and laboratory results are attached.

Conclusions

Based on our field documentation, laboratory test results and geotechnical engineering experience, we conclude that the test pad on the above referenced project site has been completed in accordance with the project specifications and acceptable engineering practices. These results verify that the test pad material is consistent with the preconstruction borrow study. We feel the construction method and equipment used is suitable for the construction of the soil liner.

Sincerely,
C.T. CLAYTON SR. P.E., INC.

NORTH CAROLINA PROFESSIONAL SEAL 028909 ENGINEER C. TYRUS CLAYTON, JR.
12/29/05

C. Tyrus Clayton, Jr., P.E.
Project QA Engineer

attachments
cc: File

FIELD DATA

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Site Visit Report

Project: Madison County MSW Landfill

Job No.: 70001	**Date:** 02-Nov-05
Location: Marshall, NC	
Visit by: MDS	**Page:** 1 of 2

Personnel - Construction

Contractor / Subcontractor:

Bob Stout - Bob Stout Const.

Personnel - Inspection / Other

Engineer (QA / QC):

Darren Spier - CT Clayton

Owner Representatives:

Jim Huff - Madison County

Visitors:

Equipment

Description	No. on Site	No. in Use
Trackhoe	2	2
Rubber Tired Backhoe		
Dozer	3	2
Front End Loader		
Track Loader		
Pan / Scraper		
Grader		
Sheepsfoot Roller	1	1
Smooth Drum Roller		
Dump Truck	3	2

Materials Delivered

Description	Quantity

Weather Conditions

Morning: sun

Temp: 55

Noon: -

Temp: 65

Evening: -

Temp: -

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Site Visit Report

Project No.: 70001

Date: 2-Nov-05

Supplemental fill placement continued on the west side of the dome. Placement and compaction duties were both carried out by the sheepsfoot roller.

In the afternoon a test pad was constructed in the cell near the peak on the east side of the cell. Conditioning of the material was performed with the sheepsfoot roller. Tests were taken in six inch lifts. After achieving acceptable compaction tests, one shelby tube per lift was taken for laboratory testing. If lab test results pass permeability tests the pad will be left in place as part of the clay liner.

Signature: Darren Lewis

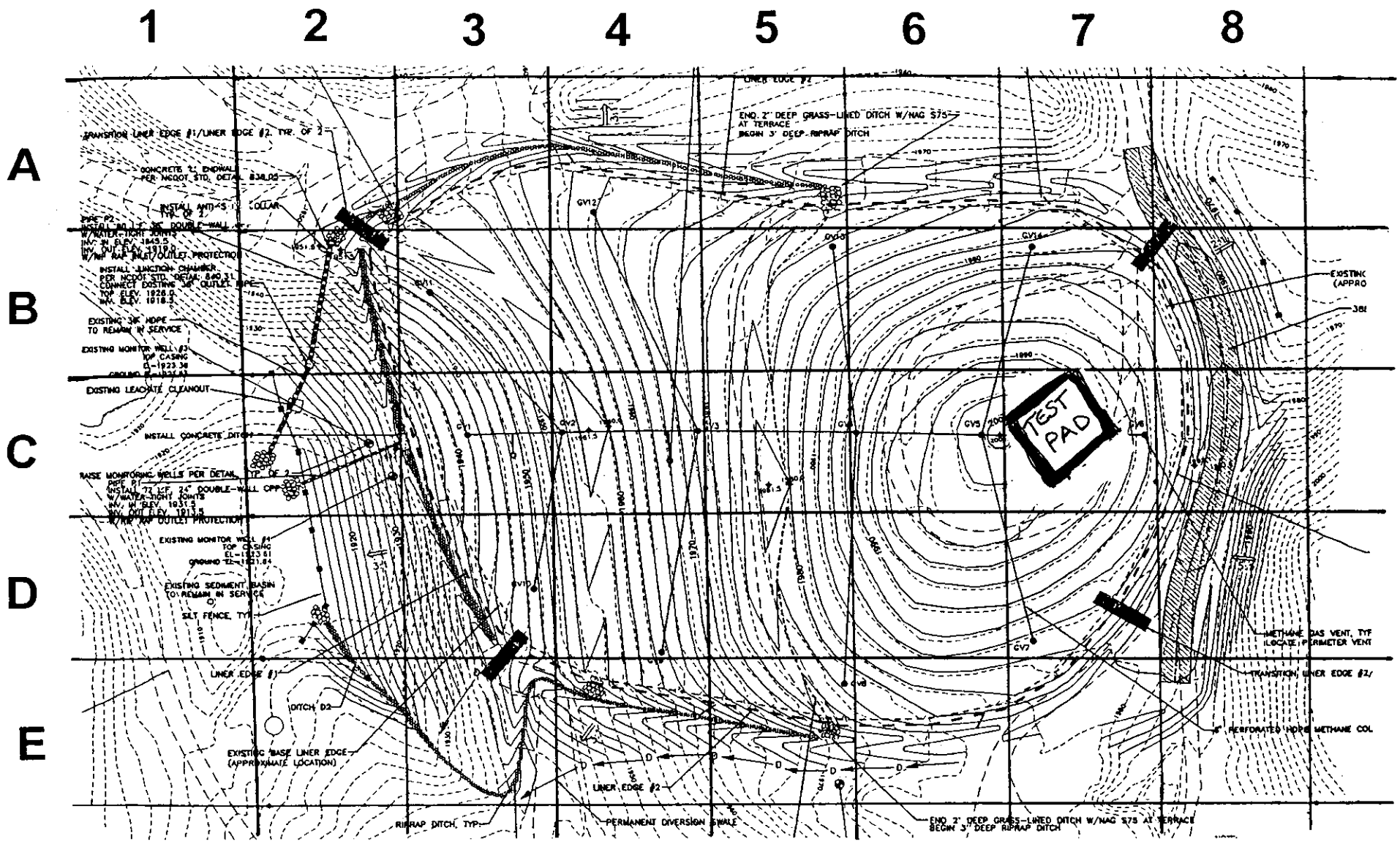
Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

PROJECT: Madison County MSW Landfill
PROJECT #: 70001
DATE: 11/2/2005
PAGE 1 of 1

Test ID	Retest of	Station	Offset	Lift	Wet Density	Dry Density	Moisture (%)	Proctor (PCF)	Compaction (%)	Optimum Moisture	Deviation from Opt.	Comments DC / SC	Shelby Tube ID
1		C	7	1	108.6	82.1	32.2%	82.4	99.7%	34.2%	-2.0%		
2		C	7	1	108.6	81.4	33.4%	82.4	98.8%	34.2%	-0.8%		TP-ST-1
3		C	7	1	109.0	81.5	33.8%	82.4	98.9%	34.2%	-0.4%		
4		C	7	2	109.2	81.6	33.8%	82.4	99.0%	34.2%	-0.4%		
5		C	7	2	108.4	81.4	33.1%	82.4	98.8%	34.2%	-1.1%		
6		C	7	2	110.1	82.0	34.2%	82.4	99.6%	34.2%	0.0%		TP-ST-2
7		C	7	3	108.8	80.8	34.6%	82.4	98.1%	34.2%	0.4%		
8		C	7	3	108.9	80.8	34.8%	82.4	98.0%	34.2%	0.6%		TP-ST-3
9		C	7	3	109.1	81.9	33.2%	82.4	99.4%	34.2%	-1.0%		

DC = Drive Cylinder, SC = Sand Cone, Opt = Optimum Moisture, PCF = pounds per cubic foot

FIELD DENSITY TEST



Tesing Locations

Date: 11/2/05

Madison County MSW Landfill Closure
CTC PN 70001

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

LABORATORY DATA

Soil Classification Calculations

Madison County
DAA #R05646-01
Prepared By: SDH

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID TP-ST-1
Sample Depth Lift 1
Visual Sample Description Red-Brown Elastic SILT with Sand

Natural Moisture Content

Pan ID	33
Pan Wt	193.77 grams
Pan + Soil (wet)	432.60 grams
Pan + Soil (dry)	375.95 grams
Natural Moisture Content	*31.1%*

Coarse or Fine Grained

Pan + Soil retained on No. 200 sieve (dry)	248.41 grams
Percent Passing No. 200 Sieve	70.0%
Pan + Soil retained on No. 4 sieve (dry)	193.77 grams
Percent Passing No. 4 Sieve	100.0%
Soil Classifies as	*Fine-Grained Soil*

Atterberg Limits

Liquid Limit

No of Blows	19	25	35
Pan ID	71	9	1
Pan Wt	11.01	11.19	11.25
Pan + Soil (wet)	18.17	19.16	17.77
Pan + Soil (dry)	15.11	15.83	15.14
Moisture Content	75%	72%	68%
Liquid Limit	72	72	70
Liquid Limit	*72*		

Plastic Limit

Pan ID	52	A
Pan Weight	2.44	2.43
Pan + Soil (wet)	10.02	10.34
Pan + Soil (dry)	7.69	7.91
Moisture Content	44%	44%
Plastic Limit	*44*	
Plastic Index	*27*	

USCS Classification

Group Symbol **MH**
Group Name **Elastic SILT with Sand**

Grain Size Distribution Calculations

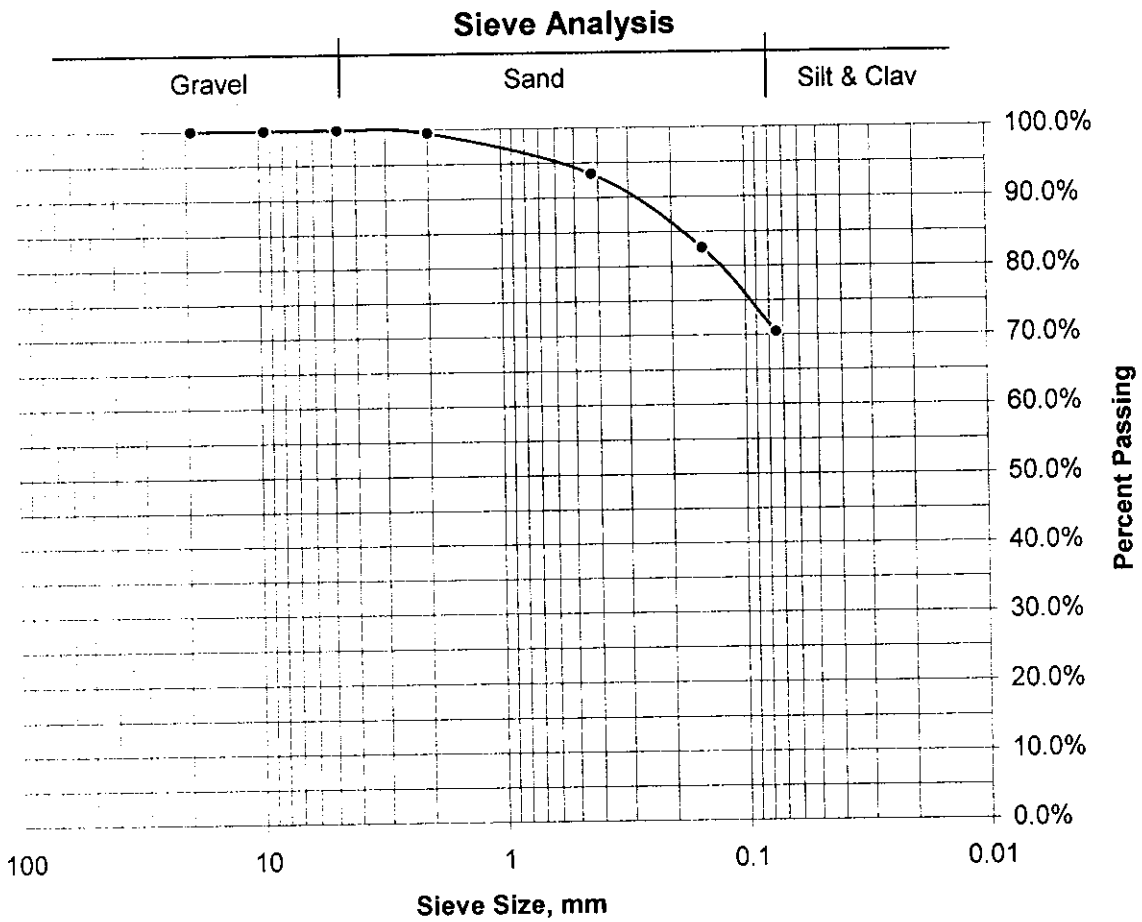
Madison County
DAA #R05646-01
Prepared By: SDH

Draper Aden Associat
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID TP-ST-1
Sample Depth Lift 1

Mechanical Sieve Analysis

Sieve Size	Weight Retained	Percent Retained	Sieve Size, mm	Percent Passing
3/4"	0.00	0.0%	19.05	100.0%
3/8"	0.00	0.0%	9.5	100.0%
No. 4	0.00	0.0%	4.75	100.0%
No. 10	0.96	0.5%	2	99.5%
No. 40	11.04	6.1%	0.425	93.4%
No. 100	19.53	10.7%	0.15	82.7%
No. 200	22.38	12.3%	0.075	70.4%
Pan	1.02	0.6%		
Total	54.93	29.6%		



Permeability Calculations

Madison County
DAA #R05646-01
Prepared By: LTW

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID: TP-ST-1
Sample Depth: Lift 1
Permeability Method: ASTM D5084
Sample Length, in: 3.22
Sample Diamter, in: 2.84

Moisture Content

Pan Wt	193.77	grams
Pan + Soil (wet)	432.60	grams
Pan + Soil (dry)	375.95	grams
Moisture Content	*31.1%*	

Dry Density

Soil (wet)	597.50	grams
Wet Density	111.7	pcf
Dry Density	*85.2*	pcf

Test Conditions

Influent Pressure, psi	45.7
Effluent Pressure, psi	40.5
Cell Pressure, psi	55.3
Standpipe Area, cm^2	0.92

Permeability Trials

Time min	Influent Head, cm	Influent Flow, cm^3	Effluent Head, cm	Effluent Flow, cm^3	Flow Deviation Ratio	Permeabilty, k cm/sec
7-Nov 10:37	0.6		48.9			
7-Nov 10:38	0.9	0.3	48.5	0.4	1.33	2.6E-06
7-Nov 10:39	1.1	0.2	48.3	0.2	1.00	1.5E-06
7-Nov 10:40	1.2	0.1	48.1	0.2	2.00	1.1E-06
7-Nov 10:41	1.3	0.1	48.0	0.1	1.00	7.4E-07
7-Nov 10:42	1.5	0.2	47.8	0.2	1.33	1.3E-06
7-Nov 10:43	1.6	0.2	47.6	0.2	1.33	1.3E-06
7-Nov 10:44	1.8	0.2	47.4	0.2	1.00	1.5E-06
7-Nov 10:49	2.4	0.6	46.9	0.5	0.83	8.2E-07

Average Permeability 1.2E-06 cm/sec

Final Data

Assumed Specific Gravity	2.6
Final Weight of Sample	614.40 grams
Final Moisture Content	34.8%
Percent Voids	47.5%
Actual Volume of Voids	158.6 ml
Saturation	100.0%

Permeability Calculations

Madison County Landfill
DAA #R05646-01
Prepared By: SDH

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID: TP
Sample Depth: Lift 1
Permeability Method: ASTM D5084
Sample Length, in: 3.84
Sample Diamter, in: 2.84

Moisture Content

Pan Wt	194.47 grams
Pan + Soil (wet)	570.80 grams
Pan + Soil (dry)	482.17 grams
Moisture Content	*30.8%*

Dry Density

Soil (wet)	704.50 grams
Wet Density	110.3 pcf
Dry Density	*84.3* pcf

Test Conditions

Backpressure, psi	40.0
Cell Pressure, psi	50.0
Influent Buret Area, cm^2	0.03142
Effluent Buret Area, cm^2	0.76712

Permeability Trials

Time min	Influent Head, cm	Influent Flow, cm^3	Effluent Head, cm	Effluent Flow, cm^3	Flow Deviation Ratio	Gradient mm-Hg	Permeabilty, k cm/sec
2-Dec 8:20	16.500		0.900				
2-Dec 8:21	16.100	0.013	0.916	0.013	1.00	20.07	2.6E-07
2-Dec 8:22	15.800	0.009	0.929	0.009	1.00	19.54	2.0E-07
2-Dec 8:23	15.600	0.006	0.937	0.006	1.00	19.14	1.3E-07
2-Dec 8:24	15.400	0.006	0.945	0.006	1.00	18.87	1.4E-07
2-Dec 8:25	15.200	0.006	0.953	0.006	1.00	18.60	1.4E-07
2-Dec 8:26	15.000	0.006	0.961	0.006	1.00	18.33	1.4E-07
2-Dec 8:27	14.800	0.006	0.970	0.006	1.00	18.06	1.4E-07
2-Dec 8:32	14.400	0.013	0.986	0.013	1.00	17.80	5.8E-08

Average Permeability 1.2E-07 cm/sec

Final Data

Assumed Specific Gravity	2.65
Final Weight of Sample	735.90 grams
Final Moisture Content	36.6%
Percent Voids	49.0%
Actual Volume of Voids	195.3 ml
Saturation	100.0%

Soil Classification Calculations

Madison County Landfill
DAA #R05646-01
Prepared By: SDH

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID	TP-ST-2
Sample Depth	Lift 2
Visual Sample Description	Red-Brown Sandy Elastic SILT

Natural Moisture Content

Pan ID	11
Pan Wt	187.50 grams
Pan + Soil (wet)	449.70 grams
Pan + Soil (dry)	385.24 grams
Natural Moisture Content	*32.6%*

Coarse or Fine Grained

Pan + Soil retained on No. 200 sieve (dry)	257.19 grams
Percent Passing No. 200 Sieve	64.8%
Pan + Soil retained on No. 4 sieve (dry)	187.50 grams
Percent Passing No. 4 Sieve	100.0%
Soil Classifies as	*Fine-Grained Soil*

Atterberg Limits

Liquid Limit

No of Blows	19	28	34
Pan ID	6	72	63
Pan Wt	11.27	11.10	10.86
Pan + Soil (wet)	17.83	18.45	17.93
Pan + Soil (dry)	14.98	15.31	14.92
Moisture Content	77%	75%	74%
Liquid Limit	74	76	77
Liquid Limit	*76*		

Plastic Limit

Pan ID	33	D
Pan Weight	2.43	2.45
Pan + Soil (wet)	10.03	10.75
Pan + Soil (dry)	7.67	8.17
Moisture Content	45%	45%
Plastic Limit	*45*	
Plastic Index	*30*	

USCS Classification

Group Symbol	**MH**
Group Name	**Sandy Elastic SILT**

Grain Size Distribution Calculations

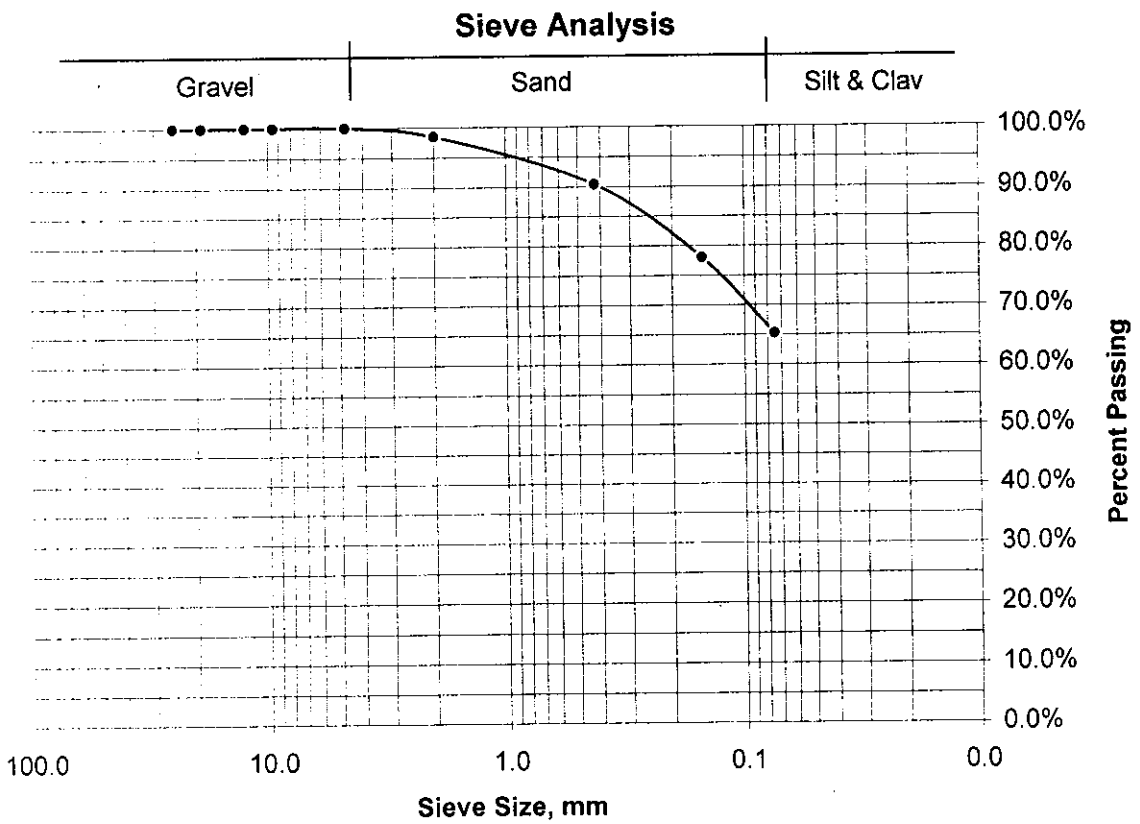
Madison County Landfill
DAA #R05646-01
Prepared By: SDH

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID TP-ST-2
Sample Depth Lift 2

Mechanical Sieve Analysis

Sieve Size	Weight Retained	Percent Retained	Sieve Size, mm	Percent Passing
1"	0.00	0.0%	25.0	100.0%
3/4"	0.00	0.0%	19.0	100.0%
1/2"	0.00	0.0%	12.5	100.0%
3/8"	0.00	0.0%	9.5	100.0%
No. 4	0.00	0.0%	4.75	100.0%
No. 10	2.94	1.5%	2.0	98.5%
No. 40	15.86	8.0%	0.425	90.5%
No. 100	24.61	12.4%	0.15	78.0%
No. 200	25.32	12.8%	0.075	65.2%
Pan	1.31	0.7%		
Total	70.04	34.8%		



Permeability Calculations

Madison County Landfill
DAA #R05646-01
Prepared By: SDH

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID: TP-ST-2
Sample Depth: Lift 2
Permeability Method: ASTM D5084
Sample Length, in: 3.91
Sample Diamter, in: 2.83

Moisture Content

Pan Wt	187.50 grams
Pan + Soil (wet)	449.70 grams
Pan + Soil (dry)	385.24 grams
Moisture Content	*32.6%*

Dry Density

Soil (wet)	726.10 grams
Wet Density	112.1 pcf
Dry Density	*84.6* pcf

Test Conditions

Backpressure, psi	40.0
Cell Pressure, psi	50.0
Influent Buret Area, cm^2	0.03142
Effluent Buret Area, cm^2	0.76712

Permeability Trials

Time min	Influent Head, cm	Influent Flow, cm^3	Effluent Head, cm	Effluent Flow, cm^3	Flow Deviation Ratio	Gradient mm-Hg	Permeabilty, k cm/sec
7-Nov 10:51	17.800		0.900				
7-Nov 10:52	17.000	0.025	0.933	0.025	1.00	21.36	4.9E-07
7-Nov 10:53	16.500	0.016	0.953	0.016	1.00	20.30	3.2E-07
7-Nov 10:54	15.900	0.019	0.978	0.019	1.00	19.65	4.0E-07
7-Nov 10:55	15.400	0.016	0.998	0.016	1.00	18.86	3.5E-07
7-Nov 10:56	14.950	0.014	1.017	0.014	1.00	18.20	3.2E-07
7-Nov 10:57	14.400	0.017	1.039	0.017	1.00	17.61	4.1E-07
7-Nov 10:58	14.100	0.009	1.052	0.009	1.00	16.88	2.3E-07
7-Nov 11:03	12.300	0.057	1.125	0.057	1.00	16.49	3.0E-07

Average Permeability 3.2E-07 cm/sec

Final Data

Assumed Specific Gravity	2.65
Final Weight of Sample	756.70 grams
Final Moisture Content	38.2%
Percent Voids	48.9%
Actual Volume of Voids	197.5 ml
Saturation	100.0%

Permeability Calculations

Madison County Landfill
DAA #R05646-01
Prepared By: SDH

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID: TP
Sample Depth: Lift 2
Permeability Method: ASTM D5084
Sample Length, in: 3.69
Sample Diamter, in: 2.84

Moisture Content

Pan Wt	189.56 grams
Pan + Soil (wet)	457.80 grams
Pan + Soil (dry)	387.60 grams
Moisture Content	*35.4%*

Dry Density

Soil (wet)	706.50 grams
Wet Density	115.1 pcf
Dry Density	*85.0* pcf

Test Conditions

Backpressure, psi	40.0
Cell Pressure, psi	50.0
Influent Buret Area, cm^2	0.03142
Effluent Buret Area, cm^2	0.76712

Permeability Trials

Time min	Influent Head, cm	Influent Flow, cm^3	Effluent Head, cm	Effluent Flow, cm^3	Flow Deviation Ratio	Gradient mm-Hg	Permeabilty, k cm/sec
2-Dec 8:36	16.200		0.900				
2-Dec 8:37	15.800	0.013	0.916	0.013	1.00	20.49	2.5E-07
2-Dec 8:38	15.500	0.009	0.929	0.009	1.00	19.93	1.9E-07
2-Dec 8:39	15.200	0.009	0.941	0.009	1.00	19.51	2.0E-07
2-Dec 8:40	15.000	0.006	0.949	0.006	1.00	19.09	1.4E-07
2-Dec 8:41	14.800	0.006	0.957	0.006	1.00	18.81	1.4E-07
2-Dec 8:42	14.600	0.006	0.966	0.006	1.00	18.54	1.4E-07
2-Dec 8:43	14.300	0.009	0.978	0.009	1.00	18.26	2.1E-07
2-Dec 8:48	14.000	0.009	0.990	0.009	1.00	17.84	4.4E-08

Average Permeability 1.3E-07 cm/sec

Final Data

Assumed Specific Gravity	2.65
Final Weight of Sample	718.60 grams
Final Moisture Content	37.8%
Percent Voids	48.6%
Actual Volume of Voids	186.2 ml
Saturation	100.0%

Soil Classification Calculations

Madison County
DAA #R05646-01
Prepared By: SDH

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID TP-ST-3
Sample Depth Lift 3
Visual Sample Description Red-Brown Elastic SILT with Sand

Natural Moisture Content

Pan ID	16
Pan Wt	189.45 grams
Pan + Soil (wet)	512.00 grams
Pan + Soil (dry)	431.30 grams
Natural Moisture Content	*33.4%*

Coarse or Fine Grained

Pan + Soil retained on No. 200 sieve (dry)	258.80 grams
Percent Passing No. 200 Sieve	71.3%
Pan + Soil retained on No. 4 sieve (dry)	189.45 grams
Percent Passing No. 4 Sieve	100.0%
Soil Classifies as	*Fine-Grained Soil*

Atterberg Limits

Liquid Limit

No of Blows	18	23	32
Pan ID	6	69	64
Pan Wt	11.23	10.98	11.03
Pan + Soil (wet)	22.37	25.45	23.04
Pan + Soil (dry)	17.24	18.89	17.69
Moisture Content	85%	83%	80%
Liquid Limit	82	82	83
Liquid Limit	*83*		

Plastic Limit

Pan ID	A	29
Pan Weight	2.39	2.40
Pan + Soil (wet)	10.93	9.29
Pan + Soil (dry)	8.39	7.24
Moisture Content	42%	42%
Plastic Limit	*42*	
Plastic Index	*40*	

USCS Classification

Group Symbol **MH**
Group Name **Elastic SILT with Sand**

Grain Size Distribution Calculations

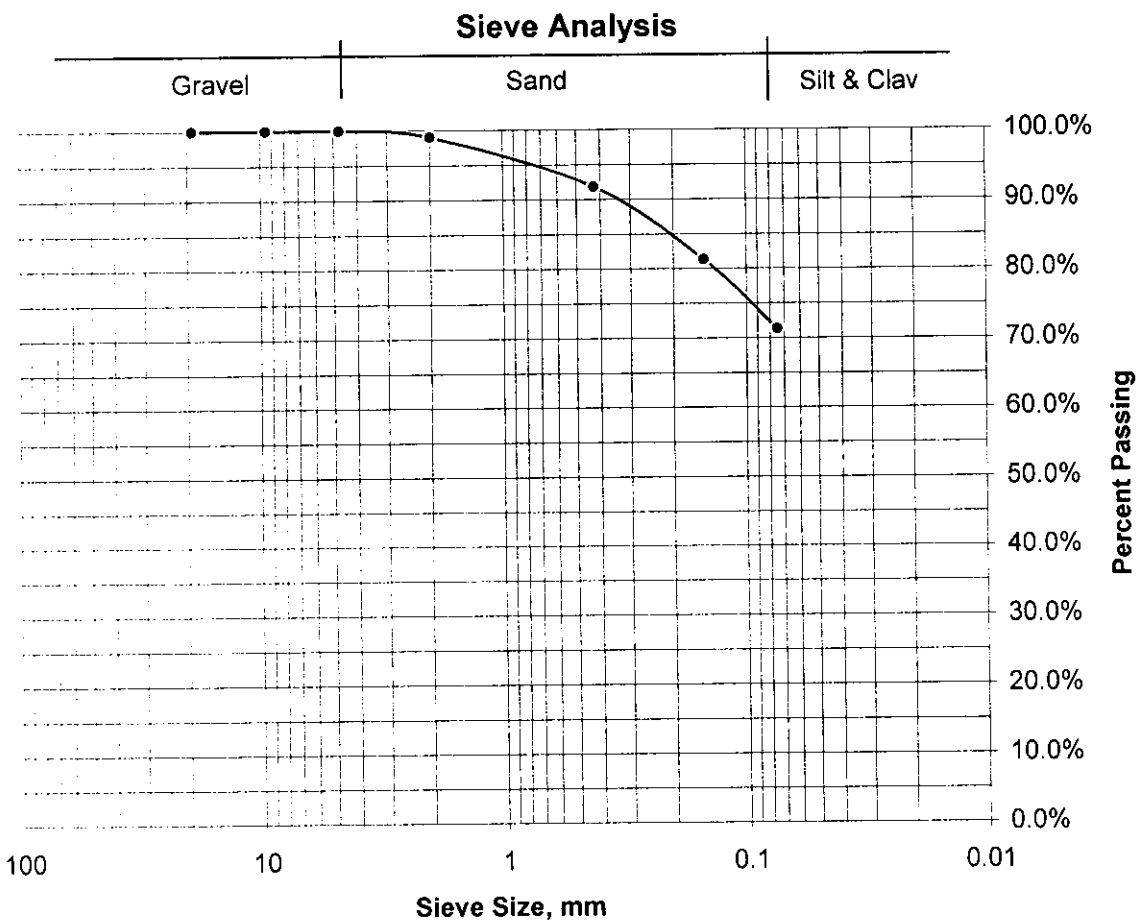
Madison County
DAA #R05646-01
Prepared By: SDH

Draper Aden Associat
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Service

Sample ID TP-ST-3
Sample Depth Lift 3

Mechanical Sieve Analysis

Sieve Size	Weight Retained	Percent Retained	Sieve Size, mm	Percent Passing
3/4"	0.00	0.0%	19.05	100.0%
3/8"	0.00	0.0%	9.5	100.0%
No. 4	0.00	0.0%	4.75	100.0%
No. 10	2.29	0.9%	2	99.1%
No. 40	17.41	7.2%	0.425	91.9%
No. 100	25.48	10.5%	0.15	81.3%
No. 200	24.09	10.0%	0.075	71.4%
Pan	0.54	0.2%		
Total	69.81	28.6%		



Permeability Calculations

Madison County
DAA #R05646-01
Prepared By: LTW

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID: TP-ST-3
Sample Depth: Lift 3
Permeability Method: ASTM D5084
Sample Length, in: 3.66
Sample Diamter, in: 2.82

Moisture Content

Pan Wt	189.45 grams
Pan + Soil (wet)	512.00 grams
Pan + Soil (dry)	431.30 grams
Moisture Content	*33.4%*

Dry Density

Soil (wet)	651.40 grams
Wet Density	108.6 pcf
Dry Density	*81.4* pcf

Test Conditions

Influent Pressure, psi	45.2
Effluent Pressure, psi	40.1
Cell Pressure, psi	54.9
Standpipe Area, cm^2	0.92

Permeability Trials

Time min	Influent Head, cm	Influent Flow, cm^3	Effluent Head, cm	Effluent Flow, cm^3	Flow Deviation Ratio	Permeabilty, k cm/sec
7-Nov 10:20	0.4		49.4			
7-Nov 10:21	1.7	1.3	49.0	0.4	0.31	7.4E-06
7-Nov 10:22	2.2	0.5	48.4	0.6	1.20	4.8E-06
7-Nov 10:23	2.7	0.5	47.9	0.5	1.00	4.4E-06
7-Nov 10:24	3.1	0.4	47.6	0.3	0.75	3.1E-06
7-Nov 10:25	3.6	0.5	47.1	0.5	1.00	4.4E-06
7-Nov 10:26	4.0	0.4	46.7	0.4	1.00	3.5E-06
7-Nov 10:27	4.6	0.6	46.2	0.5	0.83	4.9E-06
7-Nov 10:32	6.7	2.1	44.1	2.1	1.00	3.7E-06

Average Permeability 4.1E-06 cm/sec

Final Data

Assumed Specific Gravity	2.6
Final Weight of Sample	675.00 grams
Final Moisture Content	38.2%
Percent Voids	49.8%
Actual Volume of Voids	186.5 ml
Saturation	100.0%

Permeability Calculations

Madison County Landfill
DAA #R05646-01
Prepared By: SDH

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID: TP
Sample Depth: Lift 3
Permeability Method: ASTM D5084
Sample Length, in: 3.72
Sample Diamter, in: 2.84

Moisture Content

Pan Wt	192.78 grams
Pan + Soil (wet)	472.50 grams
Pan + Soil (dry)	412.80 grams
Moisture Content	*27.1%*

Dry Density

Soil (wet)	722.90 grams
Wet Density	116.8 pcf
Dry Density	*91.9* pcf

Test Conditions

Backpressure, psi	40.0
Cell Pressure, psi	50.0
Influent Buret Area, cm^2	0.03142
Effluent Buret Area, cm^2	0.76712

Permeability Trials

Time min	Influent Head, cm	Influent Flow, cm^3	Effluent Head, cm	Effluent Flow, cm^3	Flow Deviation Ratio	Gradient mm-Hg	Permeabilty, k cm/sec
2-Dec 8:49	16.800		0.900				
2-Dec 8:50	16.400	0.013	0.916	0.013	1.00	21.12	2.5E-07
2-Dec 8:51	16.000	0.013	0.933	0.013	1.00	20.57	2.5E-07
2-Dec 8:52	15.700	0.009	0.945	0.009	1.00	20.01	1.9E-07
2-Dec 8:53	15.400	0.009	0.957	0.009	1.00	19.60	2.0E-07
2-Dec 8:54	15.100	0.009	0.970	0.009	1.00	19.18	2.0E-07
2-Dec 8:55	14.700	0.013	0.986	0.013	1.00	18.77	2.8E-07
2-Dec 8:56	14.400	0.009	0.998	0.009	1.00	18.22	2.1E-07
2-Dec 9:00	14.000	0.013	1.015	0.013	1.00	17.80	7.3E-08

Average Permeability 1.9E-07 cm/sec

Final Data

Assumed Specific Gravity	2.65
Final Weight of Sample	740.90 grams
Final Moisture Content	30.3%
Percent Voids	44.4%
Actual Volume of Voids	171.6 ml
Saturation	100.0%

SECTION III

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

December 29, 2005

Mr. Mark Cathey
McGill Associates
55 Broad Street
Asheville, NC 28802

Re: Subgrade and Compacted Clay Layer – QA Testing Documentation
Madison County MSW Landfill Closure
CTC Project No. 70001

Dear Mr. Cathey:

Attached, you will find our compiled Field and Soil Laboratory Test Data for the Subgrade and Compacted Clay Layer material placed on the above mentioned project.

Inspection and Field Testing

The following tests were conducted on the Compacted Clay Layer:

Test	*ASTM Designation or Other Test Method*	*Frequency Required*	*Frequency Performed*
Atterberg Limits	D4318	1 per 5,000 cy	1 per 2,000 cy
Particle Size	D422	1 per 5,000 cy	1 per 2,000 cy
Hydraulic Conductivity	D5084	1 per 40,000 sq. ft./lift	1 per 40,000 sq. ft./lift
Compacted Density	D2922 or D2937	1 per 10,000 sq. ft./lift	1 per 10,000 sq. ft./lift
Compacted Moisture Content	D3017 or D2216	1 per 10,000 sq. ft./lift	1 per 10,000 sq. ft./lift

C. T. Clayton Sr., P.E., Inc. provided quality assurance observation and testing as the Subgrade and Compacted Clay Layer were constructed from October 25, 2005 through November 26, 2005. Subgrade soils were placed and compacted in 6-inch lifts. Field density testing was performed on the Subgrade soils to assure proper moisture and densities were obtained during construction. Clay Layer

3100 NC 27 East
Coats, NC 27521
Phone: 910-897-7070
Fax: 910-897-6767

Offices located in Coats and New Bern, North Carolina
www.ctclayton.com

soils were placed and compacted within the cell area in three 6-inch lifts. Field density testing confirmed that an acceptable degree of compaction was achieved during the soil liner placement. Testing also confirmed that the range of soil moistures was satisfactory. In addition to our field density testing, Shelby tube samples were obtained and laboratory permeability and classification tests were performed. The Compacted Clay Layer produced acceptable permeabilities ranging from 4.7×10^{-6} cm/sec to 7.5×10^{-8} cm/sec. Samples were classified and were found to range from Fat CLAY with Sand (CH) to Elastic SILT with Sand (MH). Our laboratory data and field density test results are attached.

Conclusions

Based on our field documentation, laboratory test results and geotechnical engineering experience, we conclude that the Subgrade and Compacted Clay Layer on the above referenced project site has been completed in accordance with the project requirements and acceptable engineering practices.

Sincerely,
C.T. CLAYTON SR. P.E., INC.

NORTH CAROLINA PROFESSIONAL SEAL 028909 ENGINEER C. TYRUS CLAYTON, JR.
12/29/05

C. Tyrus Clayton, Jr., P.E.
Project QA Engineer

attachments
cc: File

DAILY REPORTS

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Site Visit Report

Project: Madison County MSW Landfill

Job No.: 70001	**Date:** 25-Oct-05
Location: Marshall, NC	
Visit by: MDS	**Page:** 1 of 2

Personnel - Construction

Contractor / Subcontractor:

Bob Stout - Bob Stout Const.

Personnel - Inspection / Other

Engineer (QA / QC):

Darren Spier - CT Clayton

Owner Representatives:

Jim Huff - Madison County

Visitors:

Equipment

Description	No. on Site	No. in Use
Trackhoe	1	1
Rubber Tired Backhoe		
Dozer	2	2
Front End Loader		
Track Loader		
Pan / Scraper		
Grader		
Sheepsfoot Roller	1	1
Smooth Drum Roller		
Dump Truck		
Farm tractor w/ disc	1	1

Materials Delivered

Description	Quantity

Weather Conditions

Morning: drizzle

Temp: 45

Noon: Partly cloudy

Temp: 60

Evening: -

Temp: 60

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Site Visit Report

Project No.: 70001

Date: 25-Oct-05

The cover of structural fill was compacted throughout the site in preparation of grade markings to delineate any supplemental fill that is required on the site. An 815 sheepsfoot roller made crossing passes across the site.

Bob Stout construction continued work for Madison County in its proposed C&D site near the borrow area. The proposed area was cleared and grubbed of trees and stumps, and the debris was carried to the base of the hollow. This work continued throughout the morning.

Towards the afternoon placement of structural fill material near the toe of the west slope. Material was pushed from a borrow site immediately south of the fill area with a dozer and placed in six inch maximum lifts. The material was compacted constantly as it was placed with the 815 roller. Nuclear density tests and observation of compacting methods confirmed that necessary compaction was being obtained.

Signature: Darren Jones

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Site Visit Report

Project: Madison County MSW Landfill

Job No.: 70001	**Date:** 26-Oct-05
Location: Marshall, NC	
Visit by: MDS	**Page:** 1 of 2

Personnel - Construction

Contractor / Subcontractor:

Bob Stout - Bob Stout Const.

Personnel - Inspection / Other

Engineer (QA / QC):

Darren Spier - CT Clayton

Owner Representatives:

Jim Huff - Madison County

Visitors:

Equipment

Description	No. on Site	No. in Use
Trackhoe	1	
Rubber Tired Backhoe		
Dozer	3	3
Front End Loader		
Track Loader		
Pan / Scraper		
Grader		
Sheepsfoot Roller	1	1
Smooth Drum Roller		
Dump Truck		
Farm tractor w/ disc	1	

Materials Delivered

Description	Quantity

Weather Conditions

Morning: Partly cloudy

Temp: 45

Noon: Sun

Temp: 60

Evening: -

Temp: 60

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Site Visit Report

Project No.: 70001

Date: 26-Oct-05

Placement and compaction of structural fill material continued throughout the day. Methods were the same as yesterday, a dozer tandem pushed material from the adjacent borrow site and graded it to approximate 6 inch lifts. The 815 sheepsfoot roller compacted the material as it was being placed. Passes were made parallel to and across the slope. Material achieved necessary compaction throughout.

Signature:

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Site Visit Report

Project: Madison County MSW Landfill

Job No.: 70001	**Date:** 27-Oct-05
Location: Marshall, NC	
Visit by: MDS	**Page:** 1 of 2

Personnel - Construction

Contractor / Subcontractor:

Bob Stout - Bob Stout Const.

Personnel - Inspection / Other

Engineer (QA / QC):

Darren Spier - CT Clayton

Owner Representatives:

Jim Huff - Madison County

Visitors:

Equipment

Description	No. on Site	No. in Use
Trackhoe	1	1
Rubber Tired Backhoe		
Dozer	3	3
Front End Loader		
Track Loader		
Pan / Scraper		
Grader		
Sheepsfoot Roller	1	1
Smooth Drum Roller		
Dump Truck	1	1
Farm tractor w/ disc	1	

Materials Delivered

Description	Quantity

Weather Conditions

Morning: Partly cloudy

Temp: 45

Noon: sun

Temp: 65

Evening: -

Temp: -

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Site Visit Report

Project No.: 70001

Date: 27-Oct-05

The cell was surveyed in order to denote areas of fill throughout the site. Placement of material began on the southeast part of the cell near the peak. Material was hauled with a dump truck and graded with a dozer. In any areas that required more than 6 inches of fill material was placed and compacted with the sheepsfoot roller in multiple lifts. Structural fill supplemental material placement continued throughout the day.

Signature:

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Site Visit Report

Project: Madison County MSW Landfill

Job No.: 70001	**Date:** 28-Oct-05
Location: Marshall, NC	
Visit by: MDS	**Page:** 1 of 2

Personnel - Construction

Contractor / Subcontractor:

Bob Stout - Bob Stout Const.

Personnel - Inspection / Other

Engineer (QA / QC):

Darren Spier - CT Clayton

Owner Representatives:

Jim Huff - Madison County

Visitors:

Equipment

Description	No. on Site	No. in Use
Trackhoe	2	1
Rubber Tired Backhoe		
Dozer	3	
Front End Loader		
Track Loader		
Pan / Scraper		
Grader		
Sheepsfoot Roller	1	1
Smooth Drum Roller		
Dump Truck	1	1
Farm tractor w/ disc	1	

Materials Delivered

Description	Quantity

Weather Conditions

Morning: sun

Temp: 50

Noon: -

Temp: 65

Evening: -

Temp: -

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Site Visit Report

Project No.: 70001

Date: 28-Oct-05

Placement of supplemental fill continued throughout the day. Bob Stout Construction sent men to retrieve off-road dump trucks back to the site. The shortened crew used the 815 sheepsfoot roller to both grade and compact dumped material. The fill material was placed in thinner than 6 inch lifts. Cross passes on placed material were performed intermittently to ensure proper compaction.

Signature: Darren Lois

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Site Visit Report

Project: Madison County MSW Landfill

Job No.: 70001	**Date:** 31-Oct-05
Location: Marshall, NC	
Visit by: MDS	**Page:** 1 of 2

Personnel - Construction

Contractor / Subcontractor:

Bob Stout - Bob Stout Const.

Personnel - Inspection / Other

Engineer (QA / QC):

Darren Spier - CT Clayton

Owner Representatives:

Jim Huff - Madison County

Visitors:

Equipment

Description	No. on Site	No. in Use
Trackhoe	2	2
Rubber Tired Backhoe		
Dozer	3	2
Front End Loader		
Track Loader		
Pan / Scraper		
Grader		
Sheepsfoot Roller	1	1
Smooth Drum Roller		
Dump Truck	3	2
Farm tractor w/ disc	1	

Materials Delivered

Description	Quantity

Weather Conditions

Morning:

Temp:

Noon: sun

Temp: 65

Evening: -

Temp: -

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Site Visit Report

Project No.: 70001

Date: 31-Oct-05

Supplemental fill placement continued on the low area on the west side of the dome of the cell. Material was delivered from a borrow area to the southwest of the cell. Grading and compaction was done with the 815 roller. Material was placed in thinner than 6 inch lifts and was so compacated as it was graded. Cross passes with the roller were done throughout placement to ensure proper compaction.

In other areas of the cell, particularly the east side of the dome, material was graded with a dozer in six inch lifts. Fill to grade in this area was less than six inches and was compacted with the sheepsfoot roller.

Signature: Darren Jones

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Site Visit Report

Project: Madison County MSW Landfill

Job No.: 70001 | **Date:** 01-Nov-05

Location: Marshall, NC

Visit by: MDS | **Page:** 1 of 2

Personnel - Construction

Contractor / Subcontractor:

Bob Stout - Bob Stout Const.

Personnel - Inspection / Other

Engineer (QA / QC):

Darren Spier - CT Clayton

Owner Representatives:

Jim Huff - Madison County

Visitors:

Equipment

Description	No. on Site	No. in Use
Trackhoe	2	2
Rubber Tired Backhoe		
Dozer	3	2
Front End Loader		
Track Loader		
Pan / Scraper		
Grader		
Sheepsfoot Roller	1	1
Smooth Drum Roller		
Dump Truck	3	2
Farm tractor w/ disc	1	

Materials Delivered

Description	Quantity

Weather Conditions

Morning: sun

Temp: 55

Noon: -

Temp: 65

Evening: -

Temp: -

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Site Visit Report

Project No.: 70001

Date: 1-Nov-05

Supplemental fill placement continued on the west side of the dome. Placement and compaction duties were both carried out by the sheepsfoot roller.

Signature:

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Site Visit Report

Project: Madison County MSW Landfill

Job No.: 70001	**Date:** 02-Nov-05
Location: Marshall, NC	
Visit by: MDS	**Page:** 1 of 2

Personnel - Construction

Contractor / Subcontractor:

Bob Stout - Bob Stout Const.

Personnel - Inspection / Other

Engineer (QA / QC):

Darren Spier - CT Clayton

Owner Representatives:

Jim Huff - Madison County

Visitors:

Equipment

Description	No. on Site	No. in Use
Trackhoe	2	2
Rubber Tired Backhoe		
Dozer	3	2
Front End Loader		
Track Loader		
Pan / Scraper		
Grader		
Sheepsfoot Roller	1	1
Smooth Drum Roller		
Dump Truck	3	2

Materials Delivered

Description	Quantity

Weather Conditions

Morning: sun

Temp: 55

Noon: -

Temp: 65

Evening: -

Temp: -

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Site Visit Report

Project No.: 70001

Date: 2-Nov-05

Supplemental fill placement continued on the west side of the dome. Placement and compaction duties were both carried out by the sheepsfoot roller.

In the afternoon a test pad was constructed in the cell near the peak on the east side of the cell. Conditioning of the material was performed with the sheepsfoot roller. Tests were taken in six inch lifts. After achieving acceptable compaction tests, one shelby tube per lift was taken for laboratory testing. If lab test results pass permeability tests the pad will be left in place as part of the clay liner.

Signature: Darren Jones

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Site Visit Report

Project: Madison County MSW Landfill

Job No.: 70001	**Date:** 03-Nov-05
Location: Marshall, NC	
Visit by: MDS	**Page:** 1 of 2

Personnel - Construction

Contractor / Subcontractor:

Bob Stout - Bob Stout Const.

Personnel - Inspection / Other

Engineer (QA / QC):

Darren Spier - CT Clayton

Owner Representatives:

Jim Huff - Madison County

Visitors:

Equipment

Description	No. on Site	No. in Use
Trackhoe	2	2
Rubber Tired Backhoe		
Dozer	3	2
Front End Loader		
Track Loader		
Pan / Scraper		
Grader		
Sheepsfoot Roller	1	1
Smooth Drum Roller		
Dump Truck	3	2

Materials Delivered

Description	Quantity

Weather Conditions

Morning: sun

Temp: 60

Noon: -

Temp: 65

Evening: -

Temp: -

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Site Visit Report

Project No.: 70001

Date: 3-Nov-05

Supplemental fill continued today, building up the low area in the middle of the cell. Placement and compaction was done with the dozer and 815 roller working in tandem. The sheepsfoot rolled material as it was graded.

Surveyors will arrive tomorrow to finalize the subgrade and mark grade on the 18 inch clay liner to be placed.

Signature: Darren Jones

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Site Visit Report

Project: Madison County MSW Landfill

Job No.: 70001	**Date:** 04-Nov-05
Location: Marshall, NC	
Visit by: MDS	**Page:** 1 of 2

Personnel - Construction

Contractor / Subcontractor:

Bob Stout - Bob Stout Const.

Personnel - Inspection / Other

Engineer (QA / QC):

Darren Spier - CT Clayton

Owner Representatives:

Jim Huff - Madison County

Visitors:

Equipment

Description	No. on Site	No. in Use
Trackhoe	2	2
Rubber Tired Backhoe		
Dozer	3	2
Front End Loader		
Track Loader		
Pan / Scraper		
Grader		
Sheepsfoot Roller	1	1
Smooth Drum Roller		
Dump Truck	3	2

Materials Delivered

Description	Quantity

Weather Conditions

Morning: sun

Temp: 60

Noon: -

Temp: 70

Evening: -

Temp: -

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Site Visit Report

Project No.: 70001

Date: 4-Nov-05

The surveyors arrived on site to mark grade for the 18 inch clay liner around the cell. Once subgrade was noted and clay grade placed, placement of clay liner began on the top of the dome on the cell. Placement of clay was done in the same manner as subgrade, with the dozer and sheepsfoot roller working in tandem. Both machines graded material with the sheepsfoot also compacting areas with the dozer.

Material was tested in lifts of 6 inches. If any area exceeded this maximum, the material was cut down to its 6 inch grade to achieve frequencies in testing for each lift. Clay placement and compaction continued throughout the day.

Signature: Steven Jones

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Site Visit Report

Project: Madison County MSW Landfill

Job No.: 70001	**Date:** 07-Nov-05
Location: Marshall, NC	
Visit by: MDS	**Page:** 1 of 2

Personnel - Construction

Contractor / Subcontractor:

Bob Stout - Bob Stout Const.

Personnel - Inspection / Other

Engineer (QA / QC):

Darren Spier - CT Clayton

Owner Representatives:

Jim Huff - Madison County

Visitors:

Equipment

Description	No. on Site	No. in Use
Trackhoe	2	2
Rubber Tired Backhoe		
Dozer	3	2
Front End Loader		
Track Loader		
Pan / Scraper		
Grader		
Sheepsfoot Roller	1	1
Smooth Drum Roller		
Dump Truck	3	2

Materials Delivered

Description	Quantity

Weather Conditions

Morning: partly cloudy

Temp: 60

Noon: sun

Temp: 70

Evening: -

Temp: -

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Site Visit Report

Project No.: 70001

Date: 7-Nov-05

Clay placement continued along the north side of the cell. Placement was the same as previous placement. Tests were conducted in 6 inch lifts according to directions outlined in specifications. In areas with more than lifts of 6 inches the material was graded down in order to achieve tests. In addition to nuclear density gauge method, the drive cylinder method was utilized to ensure proper calibration of the nuclear gauge.

Signature: Darren Jones

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Site Visit Report

Project: Madison County MSW Landfill

Job No.: 70001	**Date:** 08-Nov-05
Location: Marshall, NC	
Visit by: MDS	**Page:** 1 of 2

Personnel - Construction

Contractor / Subcontractor:

Bob Stout - Bob Stout Const.

Personnel - Inspection / Other

Engineer (QA / QC):

Darren Spier - CT Clayton

Owner Representatives:

Jim Huff - Madison County

Visitors:

Equipment

Description	No. on Site	No. in Use
Trackhoe	2	2
Rubber Tired Backhoe		
Dozer	3	2
Front End Loader		
Track Loader		
Pan / Scraper		
Grader		
Sheepsfoot Roller	1	1
Smooth Drum Roller		
Dump Truck	3	2

Materials Delivered

Description	Quantity

Weather Conditions

Morning: partly cloudy

Temp: 65

Noon: -

Temp: 70

Evening: -

Temp: -

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Site Visit Report

Project No.: 70001

Date: 8-Nov-05

Clay placement continued in the middle of the cell. Material was graded both with the dozer and 815 sheepsfoot roller. Testing and sampling were performed as needed.

Signature:

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Site Visit Report

Project: Madison County MSW Landfill

Job No.: 70001 | **Date:** 09-Nov-05

Location: Marshall, NC

Visit by: MDS | **Page:** 1 of 2

Personnel - Construction

Contractor / Subcontractor:

Bob Stout - Bob Stout Const.

Personnel - Inspection / Other

Engineer (QA / QC):

Darren Spier - CT Clayton

Owner Representatives:

Jim Huff - Madison County

Visitors:

Equipment

Description	No. on Site	No. in Use
Trackhoe	2	2
Rubber Tired Backhoe		
Dozer	3	2
Front End Loader		
Track Loader		
Pan / Scraper		
Grader		
Sheepsfoot Roller	1	1
Smooth Drum Roller	1	
Dump Truck	3	2

Materials Delivered

Description	Quantity

Weather Conditions

Morning: partly cloudy

Temp: 65

Noon: -

Temp: 70

Evening: -

Temp: -

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Site Visit Report

Project No.: 70001

Date: 9-Nov-05

Clay placement and compaction continued on the north-northeast portion of the cell moving south. Material was conditioned with the dozer and sheepsfoot working in tandem. Material was tested as it was placed.

Signature: [illegible]

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Site Visit Report

Project: Madison County MSW Landfill

Job No.: 70001	**Date:** 10-Nov-05
Location: Marshall, NC	
Visit by: MDS	**Page:** 1 of 2

Personnel - Construction

Contractor / Subcontractor:

Bob Stout - Bob Stout Const.

Personnel - Inspection / Other

Engineer (QA / QC):

Darren Spier - CT Clayton

Owner Representatives:

Jim Huff - Madison County

Visitors:

Equipment

Description	No. on Site	No. in Use
Trackhoe	2	2
Rubber Tired Backhoe		
Dozer	2	2
Front End Loader		
Track Loader		
Pan / Scraper		
Grader		
Sheepsfoot Roller	1	1
Smooth Drum Roller	1	
Dump Truck	2	2

Materials Delivered

Description	Quantity

Weather Conditions

Morning: sun, wind

Temp: 65

Noon: -

Temp: 75

Evening: -

Temp: -

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Site Visit Report

Project No.: 70001

Date: 10-Nov-05

Clay material was delivered and conditioned on the cell from the east-central portion south. The borrow material was taken outside of the existing cemetary grounds to the west. This area will be regraded at a later time to create a plot for parking and a slope leading up to the cemetary gate.

Material was placed and compacted in a similar manner to previous days. Tests were taken as needed.

Signature:

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Site Visit Report

Project: Madison County MSW Landfill

Job No.: 70001	**Date:** 11-Nov-05
Location: Marshall, NC	
Visit by: MDS	**Page:** 1 of 2

Personnel - Construction

Contractor / Subcontractor:

Bob Stout - Bob Stout Const.

Personnel - Inspection / Other

Engineer (QA / QC):

Darren Spier - CT Clayton

Owner Representatives:

Jim Huff - Madison County

Visitors:

Equipment

Description	No. on Site	No. in Use
Trackhoe	2	2
Rubber Tired Backhoe		
Dozer	2	2
Front End Loader		
Track Loader		
Pan / Scraper		
Grader		
Sheepsfoot Roller	1	1
Smooth Drum Roller	1	
Dump Truck	2	2

Materials Delivered

Description	Quantity

Weather Conditions

Morning: sun

Temp: 55

Noon: -

Temp: 65

Evening: -

Temp: -

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Site Visit Report

Project No.: 70001

Date: 11-Nov-05

Clay placement and compaction continued on the eastern end of the cell. Material was placed and compacted by both the sheepsfoot roller and dozer. Material was brought up to 18 inch grade in continual lifts for each area conditioned, with tests taken in 6 inch increments. As material reached roughly finished grade more material was conditioned adjacent to it. Placement of material continued throughout the day.

The locations of methane pipeline and outlets were surveyed and marked on the clay. Construction of the methane pipelines will begin once clay conditioning finishes.

Signature: Darren Jones

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Site Visit Report

Project: Madison County MSW Landfill

Job No.: 70001 | **Date:** 14-Nov-05

Location: Marshall, NC

Visit by: MDS | **Page:** 1 of 2

Personnel - Construction

Contractor / Subcontractor:

Bob Stout - Bob Stout Const.

Personnel - Inspection / Other

Engineer (QA / QC):

Darren Spier - CT Clayton

Owner Representatives:

Jim Huff - Madison County

Visitors:

Equipment

Description	No. on Site	No. in Use
Trackhoe	2	1
Rubber Tired Backhoe	2	2
Dozer	2	2
Front End Loader		
Track Loader		
Pan / Scraper		
Grader		
Sheepsfoot Roller	1	
Smooth Drum Roller	1	
Dump Truck	2	

Materials Delivered

Description	Quantity

Weather Conditions

Morning: cloudy

Temp:

Noon: -

Temp: 65

Evening: -

Temp: -

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Site Visit Report

Project No.: 70001

Date: 14-Nov-05

Methane collection piping continued today in the central portion of the cell. Clay and subgrade material was removed down to approximate grade of waste. After excavation a piece of 10 feet wide 6oz geofabric was placed in the trench and pinned along the trench walls. The corrugated and perforated pipe sections were then placed and coupled together according to specifications. Number 57 stone was then used to encapsulate the pipe to a height of 8 inches or more along the entire length and width of the trench. In lieu of sewing and because of danger of ignition due to heat welding, the fabric was placed on top of the stone, overlapping itself by at least 2 feet or the width of the trench. In areas where overlap was less than 2 feet a second piece of fabric was placed flat on top of the short material. A trackhoe then placed a fine lift of material on the wrapped stone to anchor the fabric in place. The trackhoe then backfilled the trench in successive lifts, compacting the material dynamically with a filled bucket of material. Around the PVC outlets a handheld "Wacker" style compactor was used to bring material up in compactive lifts.

Signature: [illegible]

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Site Visit Report

Project: Madison County MSW Landfill

Job No.: 70001 | **Date:** 15-Nov-05

Location: Marshall, NC

Visit by: MDS | **Page:** 1 of 2

Personnel - Construction

Contractor / Subcontractor:

Bob Stout - Bob Stout Const.

Personnel - Inspection / Other

Engineer (QA / QC):

Darren Spier - CT Clayton

Owner Representatives:

Jim Huff - Madison County

Visitors:

Equipment

Description	No. on Site	No. in Use
Trackhoe	2	1
Rubber Tired Backhoe	2	2
Dozer	2	2
Front End Loader		
Track Loader		
Pan / Scraper		
Grader		
Sheepsfoot Roller	1	1
Smooth Drum Roller	1	
Dump Truck	2	

Materials Delivered

Description	Quantity

Weather Conditions

Morning: cloudy

Temp: 65

Noon: clouds/wind

Temp: 70

Evening: light drizzle

Temp: -

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Site Visit Report

Project No.: 70001

Date: 15-Nov-05

Placement of the methane collection pipe continued today on the dome side of the cell. Soil was excavated according to survey down to waste level. 6oz fabric was then pinned to the trench walls to provide a bedding for the HDPE vented pipe and #57 stone. Once the pipe and stone were placed and seated, material was back filled with the excavator. The excavator compacted the material dynamically with its bucket in successive lifts along the trench. The 815 roller will compact the final lift at the top of clay grade. Around the vertical PVC pipe outlets a handheld compactor was used so as to not disturb the plumb of the piping.

The material around the two large outlet pipes was excavated by hand in order to place #57 stone to provide a bedding for the concrete to be placed around the HDPE pipe. Once stone backfill finished a formwork of #4 (1/2") rebar was anchored and wired in place around the pipe as shown in the onsite plans. A plant mix of concrete rated to 4,000psi was ordered and placed around the pipe.

Signature: Darren Jones

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Site Visit Report

Project: Madison County MSW Landfill

Job No.: 70001	**Date:** 21-Nov-05
Location: Marshall, NC	
Visit by: MDS	**Page:** 1 of 2

Personnel - Construction

Contractor / Subcontractor:

Bob Stout - Bob Stout Const.

Personnel - Inspection / Other

Engineer (QA / QC):

Darren Spier - CT Clayton

Owner Representatives:

Jim Huff - Madison County

Visitors:

Equipment

Description	No. on Site	No. in Use
Trackhoe	2	1
Rubber Tired Backhoe	2	
Dozer	2	2
Front End Loader		
Track Loader		
Pan / Scraper		
Grader		
Sheepsfoot Roller	1	
Smooth Drum Roller	1	1
Dump Truck	2	
Tractor w/ box grader	1	

Materials Delivered

Description	Quantity

Weather Conditions

Morning: cloudy/drizzle

Temp: 60

Noon: -

Temp:

Evening: -

Temp: -

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Site Visit Report

Project No.: 70001

Date: 21-Nov-05

Fine grading and finish rolling of the cell was set to begin in the morning. Rain in the area suspended work for the day due to possibility of peeling and rutting the placed material. The material will be finish rolled when weather permits.

Signature: Steven Jones

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Site Visit Report

Project: Madison County MSW Landfill

Job No.: 70001	**Date:** 26-Nov-05
Location: Marshall, NC	
Visit by: MDS	**Page:** 1 of 2

Personnel - Construction

Contractor / Subcontractor:

Bob Stout Const.

GSI

Personnel - Inspection / Other

Engineer (QA / QC):

Darren Spier - CT Clayton

Owner Representatives:

Jim Huff - Madison County

Visitors:

Equipment

Description	No. on Site	No. in Use
Trackhoe	2	
Rubber Tired Backhoe	2	
Dozer	2	
Front End Loader		
Track Loader		
Pan / Scraper		
Grader		
Sheepsfoot Roller	1	
Smooth Drum Roller	1	
Dump Truck	2	
Tractor w/ box grader	1	

Materials Delivered

Description	Quantity

Weather Conditions

Morning: sun

Temp: 50

Noon: partly cloudy

Temp: 65

Evening: -

Temp: -

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Site Visit Report

Project No.: 70001

Date: 26-Nov-05

Material was finish rolled yesterday afternoon in preparation for LLDPE liner placement today. A rain event last night caused the surface material to be saturated and sticky. Deployment of liner was not possible without damaging the clay liner and causing a hindrance to proper seaming procedure. GSI and Bob Stout Construction waited until the afternoon to allow the top of the clay liner to dry enough to deploy liner or recompact as necessary. In the meantime GSI inspected their equipment and made preparations for deployment.

In the mid-afternoon it was observed that not enough clay liner had dried to the point where beginning liner deployment would be practical. Work is scheduled to resume in the morning.

Signature: Darren Jones

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Site Visit Report

Project: Madison County MSW Landfill

Job No.: 70001	**Date:** 27-Nov-05
Location: Marshall, NC	
Visit by: MDS	**Page:** 1 of 2

Personnel - Construction

Contractor / Subcontractor:

Bob Stout Const.

GSI

Personnel - Inspection / Other

Engineer (QA / QC):

Darren Spier - CT Clayton

Owner Representatives:

Jim Huff - Madison County

Visitors:

Equipment

Description	No. on Site	No. in Use
Trackhoe	2	
Rubber Tired Backhoe	2	
Dozer	2	
Front End Loader		
Track Loader		
Pan / Scraper		
Grader		
Sheepsfoot Roller	1	
Smooth Drum Roller	1	
Dump Truck	2	
Tractor w/ box grader	1	

Materials Delivered

Description	Quantity

Weather Conditions

Morning: sun

Temp: 40

Noon: partly cloudy

Temp: 55

Evening: -

Temp: -

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Site Visit Report

Project No.: 70001

Date: 27-Nov-05

Liner deployment began on the dome of the cell. LLDPE was pulled from a hoisting rig on the edge of the cell by 4 wheeled ATV across the clay liner. Panels were layed in consecutive rows in a manner to maximize downslope joining.

After deployed liner was moved in place a "mouse" style fusion seamer joined panels together. A piece of scrap LLDPE liner was used as a slipsheet by the seaming technician under the panels being welded. Welds carried past the edge of the cell into the material placed in the liner. Where applicable a small test strip was cut out of the liner, mostly inside the anchor trench, and tested in the field for tear type. Destructive seaming tests were also taken in various areas of the placed liner in at least 500' fractions for each machine per specifications.

Placed and seamed panels covered the northern half of the dome of the cell and parts of the western edges of the cell.

QC testing included observation of methods, stationing of panels, marking of defects, air testing fusion welds, and field destructive testing of samples adjacent to the Destructs marked for laboratory analysis.

As liner was being deployed a smooth drum roller refinished the material ahead of the liner crew to provide an ideal subsurface.

Signature: Darren Lewis

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Site Visit Report

Project: Madison County MSW Landfill

Job No.: 70001	**Date:** 28-Nov-05
Location: Marshall, NC	
Visit by: MDS	**Page:** 1 of 2

Personnel - Construction

Contractor / Subcontractor:

Bob Stout Const.

GSI

Personnel - Inspection / Other

Engineer (QA / QC):

Darren Spier - CT Clayton

Owner Representatives:

Jim Huff - Madison County

Visitors:

Equipment

Description	No. on Site	No. in Use
Trackhoe	2	
Rubber Tired Backhoe	2	
Dozer	2	
Front End Loader		
Track Loader		
Pan / Scraper		
Grader		
Sheepsfoot Roller	1	
Smooth Drum Roller	1	
Dump Truck	2	
Tractor w/ box grader	1	

Materials Delivered

Description	Quantity

Weather Conditions

Morning: cloudy/rain

Temp: 40

Noon: wind/rain

Temp: 55

Evening: -

Temp: -

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Site Visit Report

Project No.: 70001

Date: 28-Nov-05

A major rain event yesterday made further deployment of liner impossible. The clay liner was saturated and must dry and be refinished in order to remove the small rilling that took place.

GSI made preparations to make repairs to cross seams and holes and make boots for the air vents. But high winds and rain suspended work for the day at approximately 9:30am.

Signature: Darren Jones

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Site Visit Report

Project: Madison County MSW Landfill

Job No.:	70001	**Date:**	30-Nov-05
Location:	Marshall, NC		
Visit by:	MDS	**Page:**	1 of 2

Personnel - Construction

Contractor / Subcontractor:

Bob Stout Const.

GSI

Personnel - Inspection / Other

Engineer (QA / QC):

Darren Spier - CT Clayton

Owner Representatives:

Jim Huff - Madison County

Visitors:

Equipment

Description	No. on Site	No. in Use
Trackhoe	2	
Rubber Tired Backhoe	2	
Dozer	2	
Front End Loader		
Track Loader		
Pan / Scraper		
Grader		
Sheepsfoot Roller	1	
Smooth Drum Roller	1	
Dump Truck	2	
Tractor w/ box grader	1	

Materials Delivered

Description	Quantity

Weather Conditions

Morning: sunny

Temp: 40

Noon: -

Temp: 60

Evening: -

Temp: -

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Site Visit Report

Project No.: 70001

Date: 30-Nov-05

Repairs to liner was conducted today. GSI spent the day patching cross seams and booting the air vents. Patches were tacked into place with a lister heat gun. The edges of the patch and the adjacent liner was then ground to provide a bonding surface for the extrusion welder. The patch was then extruded. Pieces of liner were also tacked and welded to the methane vent pipes, which were in turn welded to a single large piece of liner surrounding the pipe. This boot was then extrusion welded into place in the same manner as smaller patches.

Toward the end of the day panels which were unable to be fusion seamed before the rain events of the previous days were cleaned of any deleterious material and welded together. Destructive samples were taken as needed.

Signature: Darren Jones

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Site Visit Report

Project: Madison County MSW Landfill

Job No.: 70001	**Date:** 01-Dec-05
Location: Marshall, NC	
Visit by: MDS	**Page:** 1 of 2

Personnel - Construction

Contractor / Subcontractor:

Bob Stout Const.

GSI

Personnel - Inspection / Other

Engineer (QA / QC):

Darren Spier - CT Clayton

Owner Representatives:

Jim Huff - Madison County

Visitors:

Equipment

Description	No. on Site	No. in Use
Trackhoe	2	
Rubber Tired Backhoe	2	
Dozer	2	
Front End Loader		
Track Loader		
Pan / Scraper		
Grader		
Sheepsfoot Roller	1	
Smooth Drum Roller	1	
Dump Truck	2	
Tractor w/ box grader	1	

Materials Delivered

Description	Quantity

Weather Conditions

Morning: sunny

Temp: 40

Noon: -

Temp: 60

Evening: -

Temp: -

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Site Visit Report

Project No.: 70001

Date: 1-Dec-05

Repairs continued today in the same manner as yesterday. Patches were tacked into place, ground to a uniform condition, and extrusion welded into place. Tests were taken as needed on all areas of liner.

The edge of the liner placed when the cell opened was located on the existing clay grade in order to ensure at least 18 inches of clay material was in place between the old liner and new. This ensured proper coverage of clay material. Grade was 19 inches + for all areas. As built surveying was then conducted on the placed liner. Cross and T seam patches were located, as well as destruct locations and methane vent boots. Panels were located at the edge of the cell in front of the anchor trench.

Since GSI was unable to deploy geocomposite liner until surveying completes, they spent the end of the day cleaning debris from around the site.

The clay liner was regraded with the box grader to eliminate any rilling to the material. The clay was then finish rolled with the smooth drum roller. Deployment of LLDPE will resume in the morning.

Signature: Darren Jones

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Site Visit Report

Project: Madison County MSW Landfill

Job No.: 70001	**Date:** 02-Dec-05
Location: Marshall, NC	
Visit by: MDS	**Page:** 1 of 2

Personnel - Construction

Contractor / Subcontractor:

Bob Stout Const.

GSI

Personnel - Inspection / Other

Engineer (QA / QC):

Darren Spier - CT Clayton

Owner Representatives:

Jim Huff - Madison County

Visitors:

Equipment

Description	No. on Site	No. in Use
Trackhoe	2	
Rubber Tired Backhoe	2	
Dozer	2	
Front End Loader		
Track Loader		
Pan / Scraper		
Grader		
Sheepsfoot Roller	1	
Smooth Drum Roller	1	
Dump Truck	2	
Tractor w/ box grader	1	

Materials Delivered

Description	Quantity

Weather Conditions

Morning: sunny

Temp: 35

Noon: -

Temp: 55

Evening: -

Temp: -

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Site Visit Report

Project No.: 70001

Date: 2-Dec-05

Deployment of LLDPE liner continued on the east/southeast section of the cell. Liner was pulled into place the four wheeled ATV and overlapped with placed liner by hand to a uniform 6 inch coverage. The liner was deployed throughout the day. As necessary, the liner changed direction so as to maximize downslope coverage.

Placed panels were fusion bonded together with the "mouse" type welder. A rubsheet was used underneath the panels so the clay liner material would not harm the welds. A worker stayed in front of each machine scouring the bonding surfaces with a wire brush to loosen anything that may have dirtied the liner, followed by a whisk brush or cloth for final cleaning. Seaming was done in a continuous manner in order to minimize burnouts or turnouts. Where failing seams did occur the machine was placed back on the panels to continue the fusion weld and the damaged area was marked for repair.

LLDPE liner material ran out on the far east slope with approximately 6,000 square feet remaining to be covered More material was requested and will be delivered from Wisconsin sometime after the weekend. In the mean-time the liner crew will concentrate on repairs and geocomposite placement.

The survey crew finished the as-built locations of panels and repairs. This clears the entire north face of the dome and the western portion of the cell up to panel 40. Geocomposite placement can start in any of these areas.

Signature: Darren Jones

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Site Visit Report

Project: Madison County MSW Landfill

Job No.: 70001	**Date:** 03-Dec-05
Location: Marshall, NC	
Visit by: MDS	**Page:** 1 of 2

Personnel - Construction

Contractor / Subcontractor:

Bob Stout Const.

GSI

Personnel - Inspection / Other

Engineer (QA / QC):

Darren Spier - CT Clayton

Owner Representatives:

Jim Huff - Madison County

Visitors:

Equipment

Description	No. on Site	No. in Use
Trackhoe	2	
Rubber Tired Backhoe	2	
Dozer	2	
Front End Loader		
Track Loader		
Pan / Scraper		
Grader		
Sheepsfoot Roller	1	
Smooth Drum Roller	1	
Dump Truck	2	
Tractor w/ box grader	1	

Materials Delivered

Description	Quantity

Weather Conditions

Morning: cloudy

Temp: 35

Noon: cloudy/drizzle

Temp: 55

Evening: -

Temp: -

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Site Visit Report

Project No.: 70001

Date: 3-Dec-05

Repairs to the liner placed yesterday resumed today. Patches were made on the cross seams and any areas of failure. Boots were placed on methane air vents. The manholes received steel battens around the perimeter on the concrete pad per specifications.

Geocomposite liner placement began on the north side of the dome of the cell. Deployment was carried out by 2 four wheeled ATVs. Utilizing 2 machines minimized drag to any one area of liner. No detrimental effects to the LLDPE liner by the ATVs were observed when used in this manner. Care was taken to avoid sharp starts, stops or turns.

The geonet of the composite liner was joined together by placement of nylon zip-ties. The top fabric was then overlapped to the downslope side and joined by torch welding. Care was taken by the technician to avoid a burnout of the fabric while maintaining a strong bond. Manual inspection of the heat welding showed the bond to be strong enough to hold up to significant pulling force. Any burnouts that may occur or any damaged liner encountered will be covered and bonded into place with scrap fabric in the same manner as the seam bonding.

Signature: Darren Jones

FIELD DATA

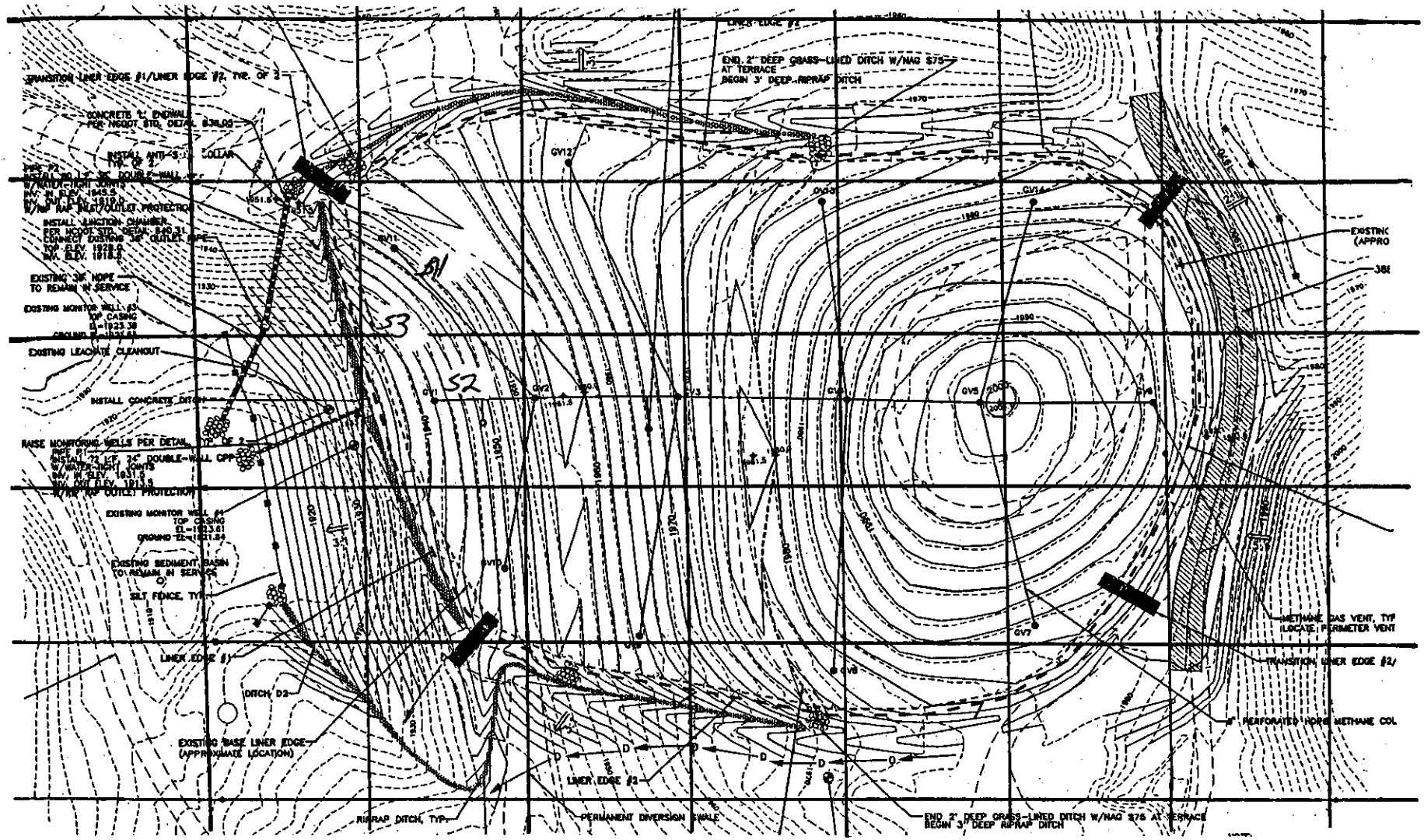
Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

PROJECT: Madison County MSW Landfill
PROJECT #: 70001
DATE: 10/25/2005
PAGE 1 of 1

Test ID	Retest of	Station	Offset	Lift	Wet Density	Dry Density	Moisture (%)	Proctor (PCF)	Compaction (%)	Optimum Moisture	Deviation from Opt.	Comments DC / SC	Shelby Tube ID
S1		B	3	1	113.3	88.2	28.4%	89.0	99.1%	28.2%	0.2%		
S2		C	3	2	113.4	88.1	28.7%	89.0	99.0%	28.2%	0.5%		
S3		B	3	3	112.9	87.5	29.0%	89.0	98.3%	28.2%	0.8%		

DC = Drive Cylinder, SC = Sand Cone, Opt = Optimum Moisture, PCF = pounds per cubic foot

FIELD DENSITY TEST



Tesing Locations

Date: 10/25/05

Madison County MSW Landfill Closure
CTC PN 70001

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

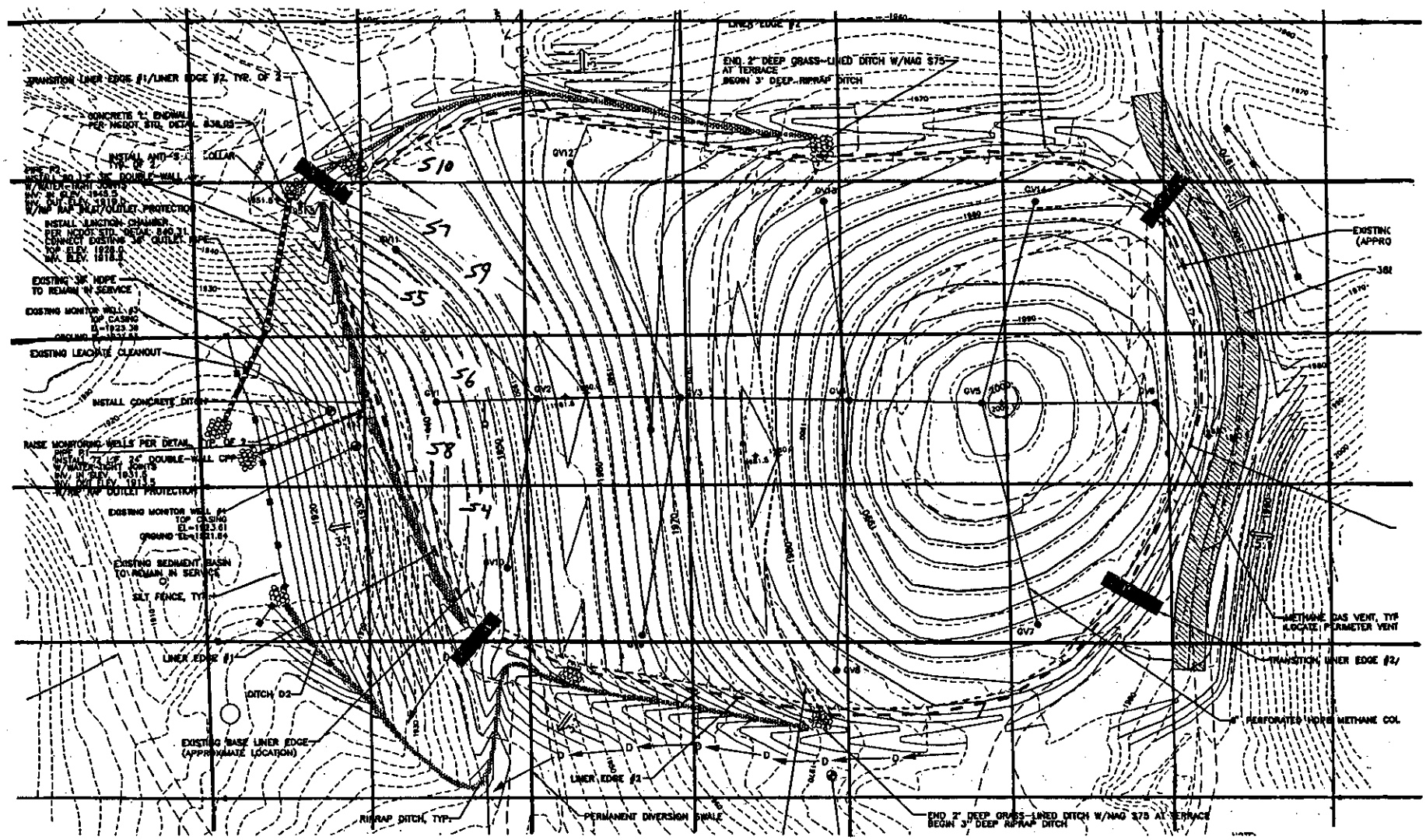
Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

PROJECT: Madison County MSW Landfill
PROJECT #: 70001
DATE: 10/26/2005
PAGE 1 of 1

Test ID	Retest of	Station	Offset	Lift	Wet Density	Dry Density	Moisture (%)	Proctor (PCF)	Compaction (%)	Optimum Moisture	Deviation from Opt.	Comments DC / SC	Shelby Tube ID
S4		D	3	4	112.9	87.8	28.6%	89.0	98.6%	28.2%	0.4%		
S5		B	3	4	113.8	88.1	29.2%	89.0	99.0%	28.2%	1.0%		
S6		C	3	5	112.9	88.3	27.9%	89.0	99.2%	28.2%	-0.3%		
S7		B	3	6	111.3	86.1	29.3%	89.0	96.7%	28.2%	1.1%		
S8		C	3	7	112.2	86.3	30.0%	89.0	97.0%	28.2%	1.8%		
S9		B	3	8	113.1	87.9	28.6%	89.0	98.8%	28.2%	0.4%		
S10		A	3	9	112.3	86.9	29.2%	89.0	97.7%	28.2%	1.0%		

DC = Drive Cylinder, SC = Sand Cone, Opt = Optimum Moisture, PCF = pounds per cubic foot

FIELD DENSITY TEST



Tesing Locations

Date: 10/24/05

Madison County MSW Landfill Closure
CTC PN 70001

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

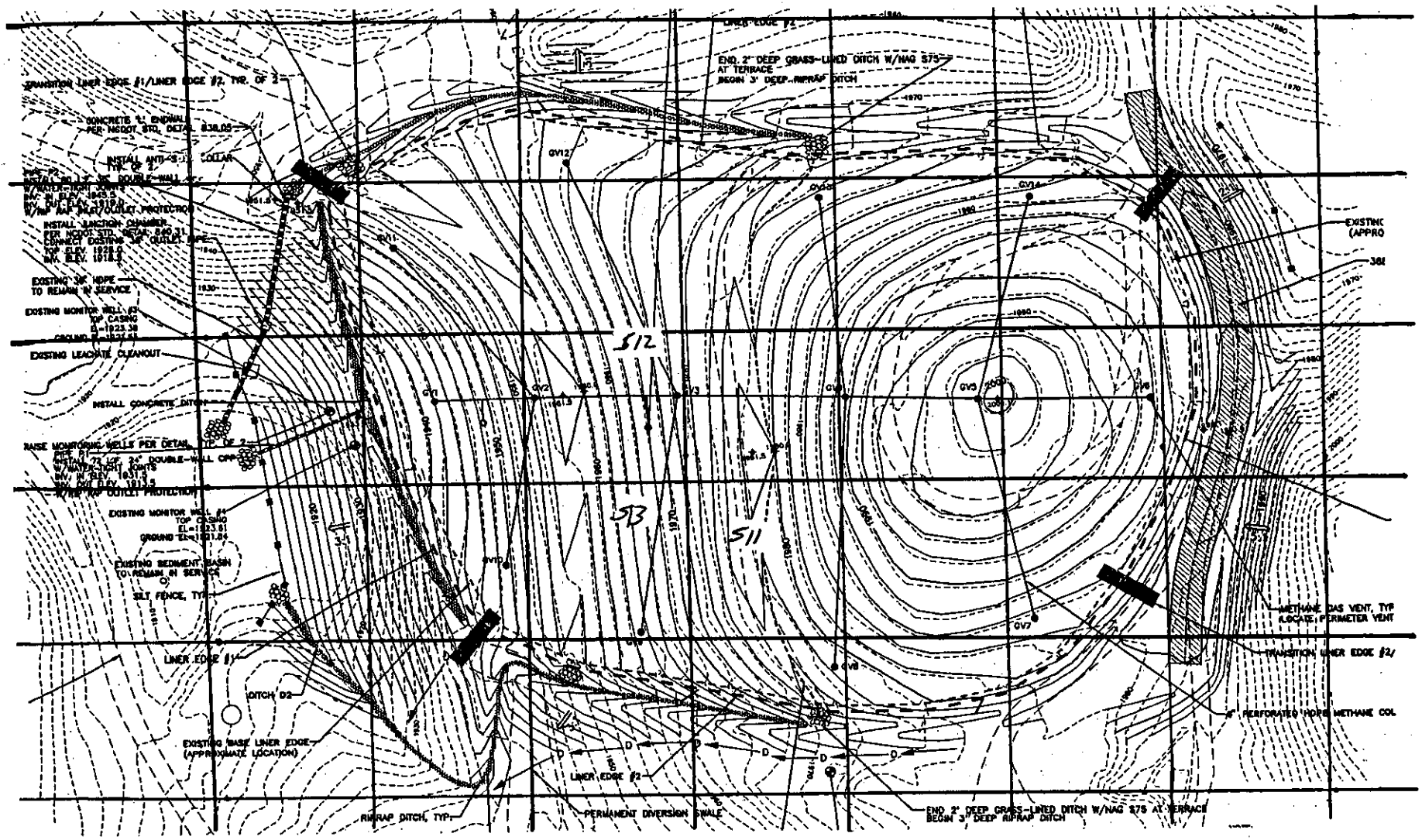
Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

PROJECT: Madison County MSW Landfill
PROJECT #: 70001
DATE: 10/27/2005
PAGE 1 of 1

Test ID	Retest of	Station	Offset	Lift	Wet Density	Dry Density	Moisture (%)	Proctor (PCF)	Compaction (%)	Optimum Moisture	Deviation from Opt.	Comments DC / SC	Shelby Tube ID
S11		D	5	1	113.1	87.1	29.9%	89.0	97.8%	28.2%	1.7%		
S12		C	4	2	113.2	87.0	30.1%	89.0	97.8%	28.2%	1.9%		
S13		D	4	3	113.8	87.3	30.4%	89.0	98.1%	28.2%	2.2%		

DC = Drive Cylinder, SC = Sand Cone, Opt = Optimum Moisture, PCF = pounds per cubic foot

FIELD DENSITY TEST



Tesing Locations

Date: 10/27/05

Madison County MSW Landfill Closure
CTC PN 70001

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

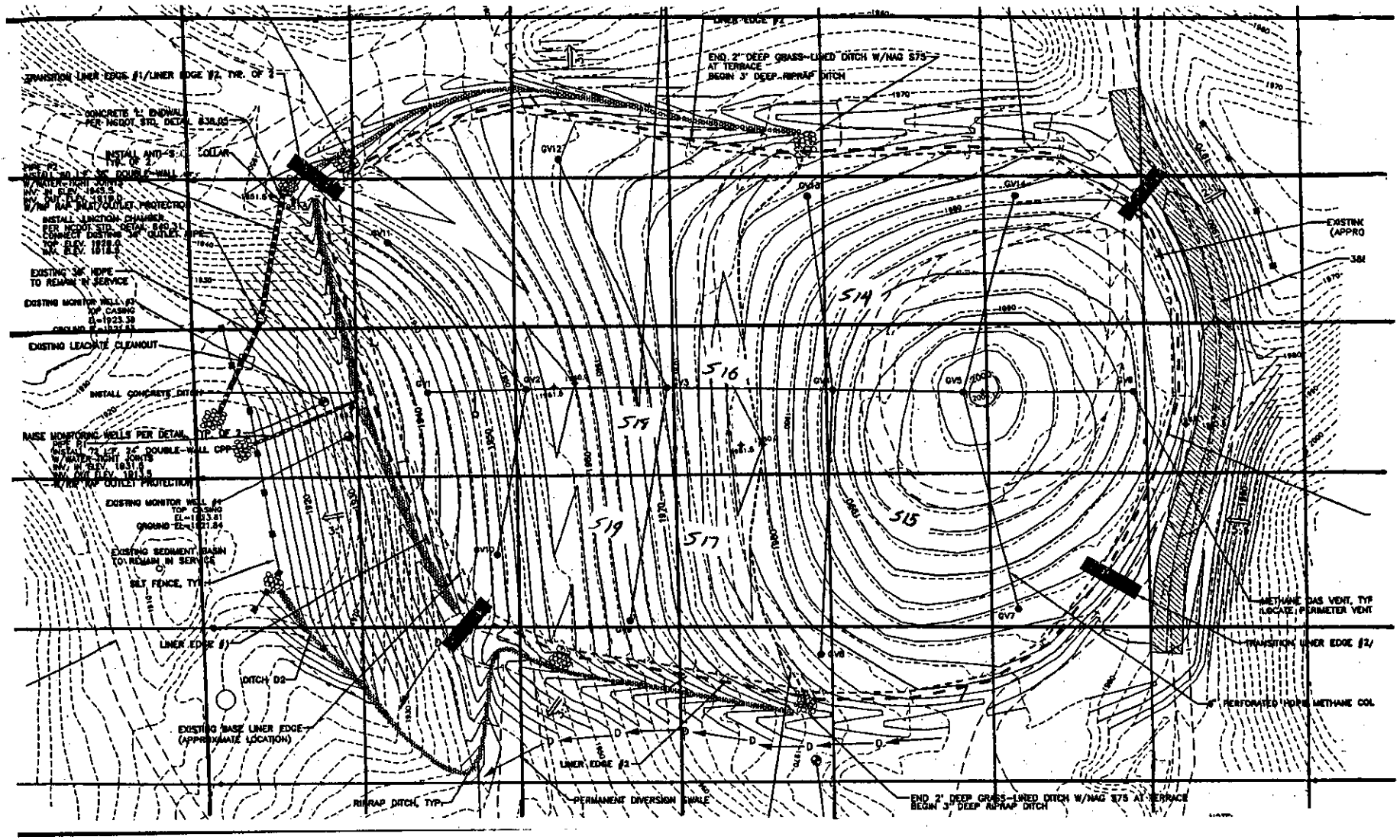
Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

PROJECT: Madison County MSW Landfill
PROJECT #: 70001
DATE: 10/31/2005
PAGE 1 of 1

Test ID	Retest of	Station	Offset	Lift	Wet Density	Dry Density	Moisture (%)	Proctor (PCF)	Compaction (%)	Optimum Moisture	Deviation from Opt.	Comments DC / SC	Shelby Tube ID
S14		B	6	1	109.7	83.0	32.2%	82.4	100.7%	34.2%	-2.0%		
S15		D	6	1	109.3	82.1	33.1%	82.4	99.7%	34.2%	-1.1%		
S16		C	5	4	109.2	81.7	33.7%	82.4	99.1%	34.2%	-0.5%		
S17		D	5	5	108.8	81.3	33.9%	82.4	98.6%	34.2%	-0.3%		
S18		C	4	6	109.6	81.5	34.4%	82.4	99.0%	34.2%	0.2%		
S19		D	4	7	109.1	82.1	32.9%	82.4	99.6%	34.2%	-1.3%		

DC = Drive Cylinder, SC = Sand Cone, Opt = Optimum Moisture, PCF = pounds per cubic foot

FIELD DENSITY TEST



Tesing Locations

Date: 10/31/05

Madison County MSW Landfill Closure
CTC PN 70001

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

PROJECT: Madison County MSW LF
PROJECT #: 70001
DATE: 11/1/2005
PAGE 1 of 1

	Oven Moisture					Gauge Moisture	
	Weight P (g)	Weight P+WS (g)	Weight P+DS (g)	Moisture (%)		Test Number	Moisture (%)
K1	114.5	225.6	200.2	29.6%		1	32.5%
K2	114.5	226.8	200.9	30.0%		2	32.1%
K3	114.5	222.9	198.2	29.5%		3	31.0%
K4	114.5	240.5	210.5	31.3%		4	32.9%
K5	114.5	231.8	203.9	31.2%		5	33.0%
			Average:	30.3%		Average:	32.3%

	OM-GM	100+GM	(OM-GM)/(100+GM)*1000
K1	-2.9%	1.325	-21.60
K2	-2.1%	1.321	-16.07
K3	-1.5%	1.31	-11.37
K4	-1.7%	1.329	-12.42
K5	-1.8%	1.33	-13.47
		Average K:	-14.99

P= Pan, WS= Wet Soil, DS= Dry Soil, g= grams, OM=Oven Moisture, GM= Gauge Moisture

MOISTURE CALIBRATION

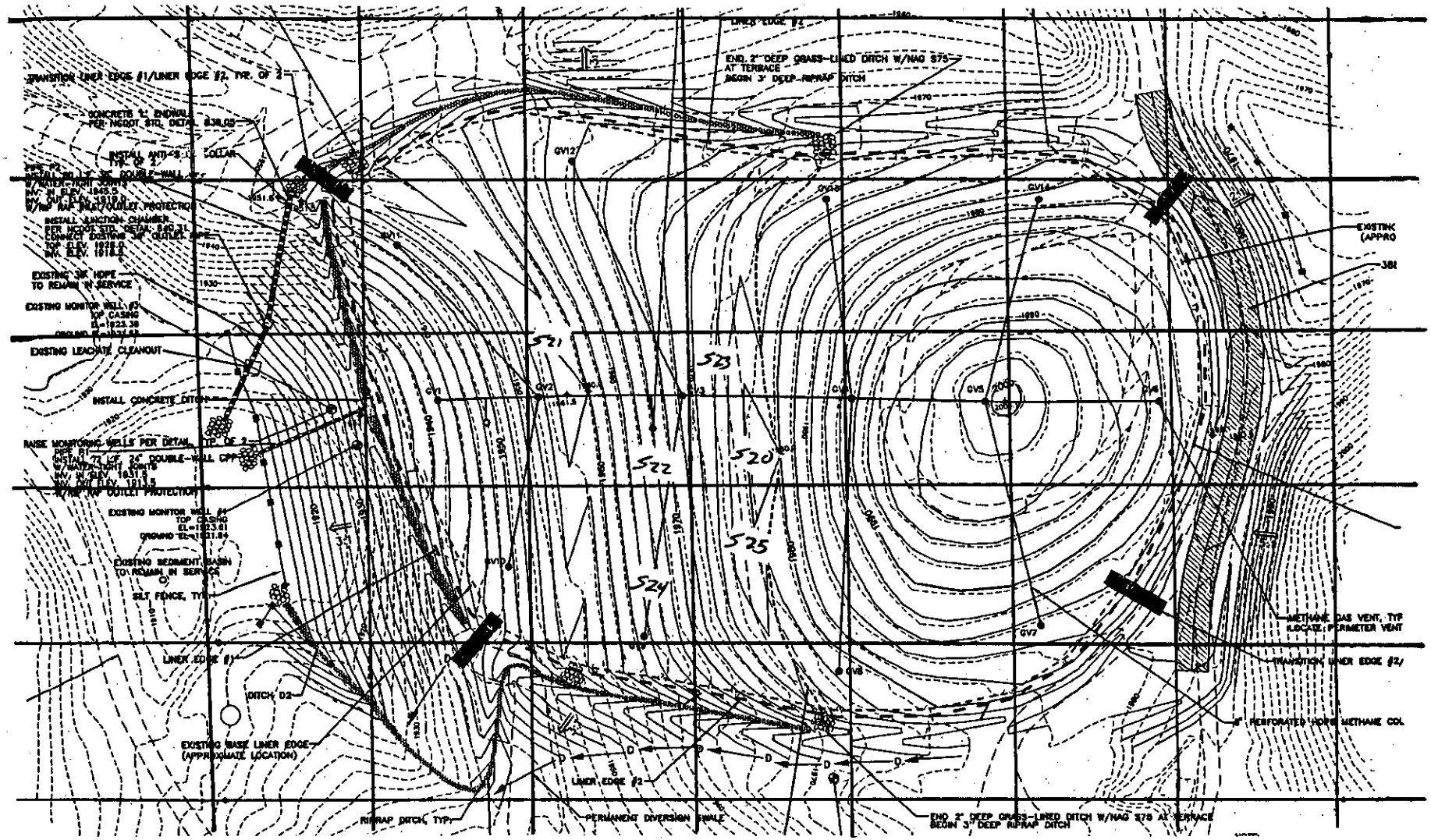
Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

PROJECT: Madison County MSW Landfill
PROJECT #: 70001
DATE: 11/1/2005
PAGE 1 of 1

Test ID	Retest of	Station	Offset	Lift	Wet Density	Dry Density	Moisture (%)	Proctor (PCF)	Compaction (%)	Optimum Moisture	Deviation from Opt.	Comments DC / SC	Shelby Tube ID
S20		C	5	8	108.7	81.9	32.7%	82.4	99.4%	34.2%	-1.5%		
S21		C	4	9	109.1	82.2	32.8%	82.4	99.7%	34.2%	-1.4%		
S22		C	4	10	107.9	81.1	33.1%	82.4	98.4%	34.2%	-1.1%		
S23		C	5	11	107.8	80.6	33.7%	82.4	97.8%	34.2%	-0.5%		
S24		D	4	12	108.4	80.9	34.0%	82.4	98.2%	34.2%	-0.2%		
S25		D	5	12	109.2	81.9	33.3%	82.4	99.4%	34.2%	-0.9%		

DC = Drive Cylinder, SC = Sand Cone, Opt = Optimum Moisture, PCF = pounds per cubic foot

FIELD DENSITY TEST



Tesing Locations

Date: 11/01/05

Madison County MSW Landfill Closure
CTC PN 70001

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

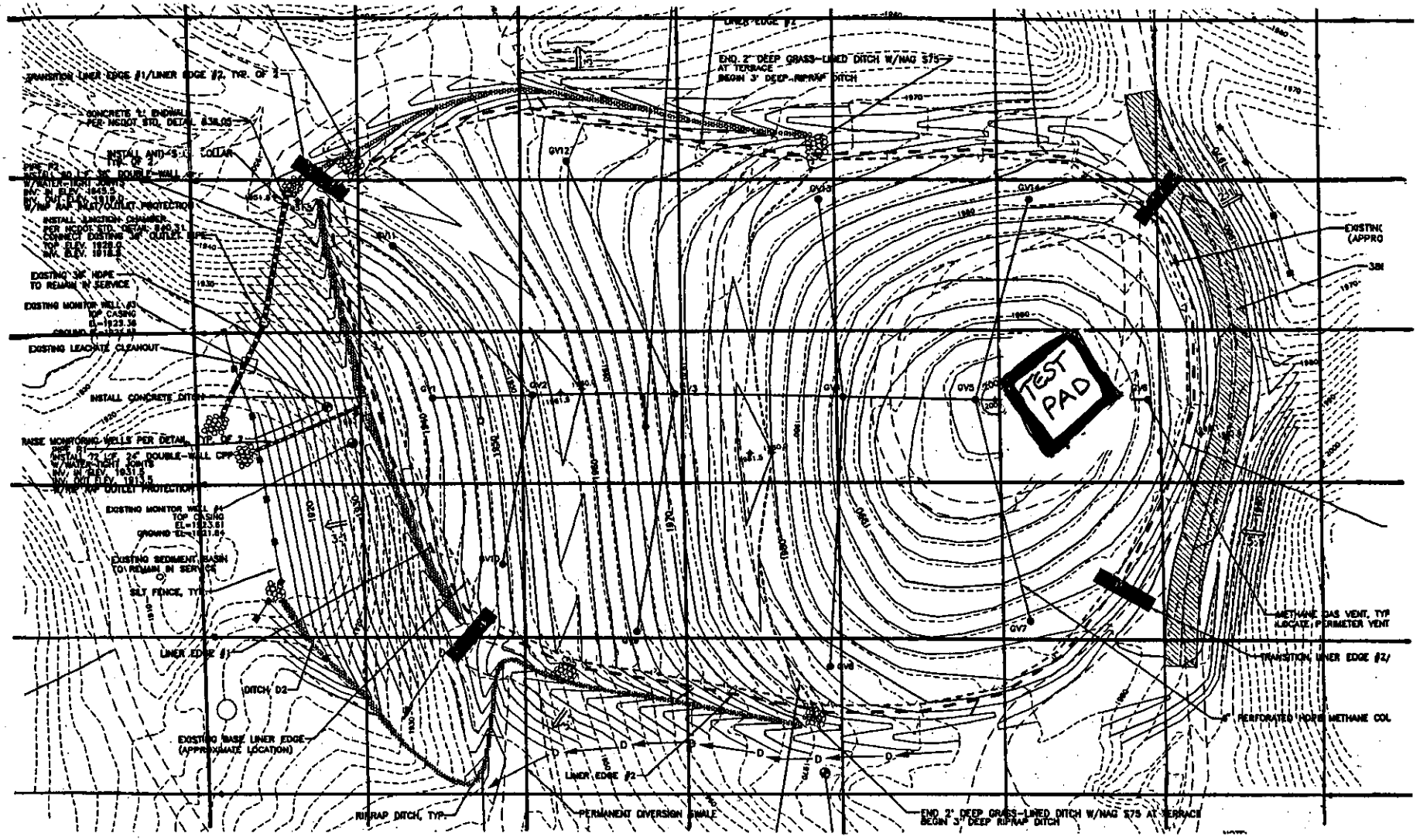
Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

PROJECT: Madison County MSW Landfill
PROJECT #: 70001
DATE: 11/2/2005
PAGE 1 of 1

Test ID	Retest of	Station	Offset	Lift	Wet Density	Dry Density	Moisture (%)	Proctor (PCF)	Compaction (%)	Optimum Moisture	Deviation from Opt.	Comments DC / SC	Shelby Tube ID
1		C	7	1	108.6	82.1	32.2%	82.4	99.7%	34.2%	-2.0%		
2		C	7	1	108.6	81.4	33.4%	82.4	98.8%	34.2%	-0.8%		TP-ST-1
3		C	7	1	109.0	81.5	33.8%	82.4	98.9%	34.2%	-0.4%		
4		C	7	2	109.2	81.6	33.8%	82.4	99.0%	34.2%	-0.4%		
5		C	7	2	108.4	81.4	33.1%	82.4	98.8%	34.2%	-1.1%		
6		C	7	2	110.1	82.0	34.2%	82.4	99.6%	34.2%	0.0%		TP-ST-2
7		C	7	3	108.8	80.8	34.6%	82.4	98.1%	34.2%	0.4%		
8		C	7	3	108.9	80.8	34.8%	82.4	98.0%	34.2%	0.6%		TP-ST-3
9		C	7	3	109.1	81.9	33.2%	82.4	99.4%	34.2%	-1.0%		

DC = Drive Cylinder, SC = Sand Cone, Opt = Optimum Moisture, PCF = pounds per cubic foot

FIELD DENSITY TEST



Tesing Locations

Date: 11/2/05

Madison County MSW Landfill Closure
CTC PN 70001

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

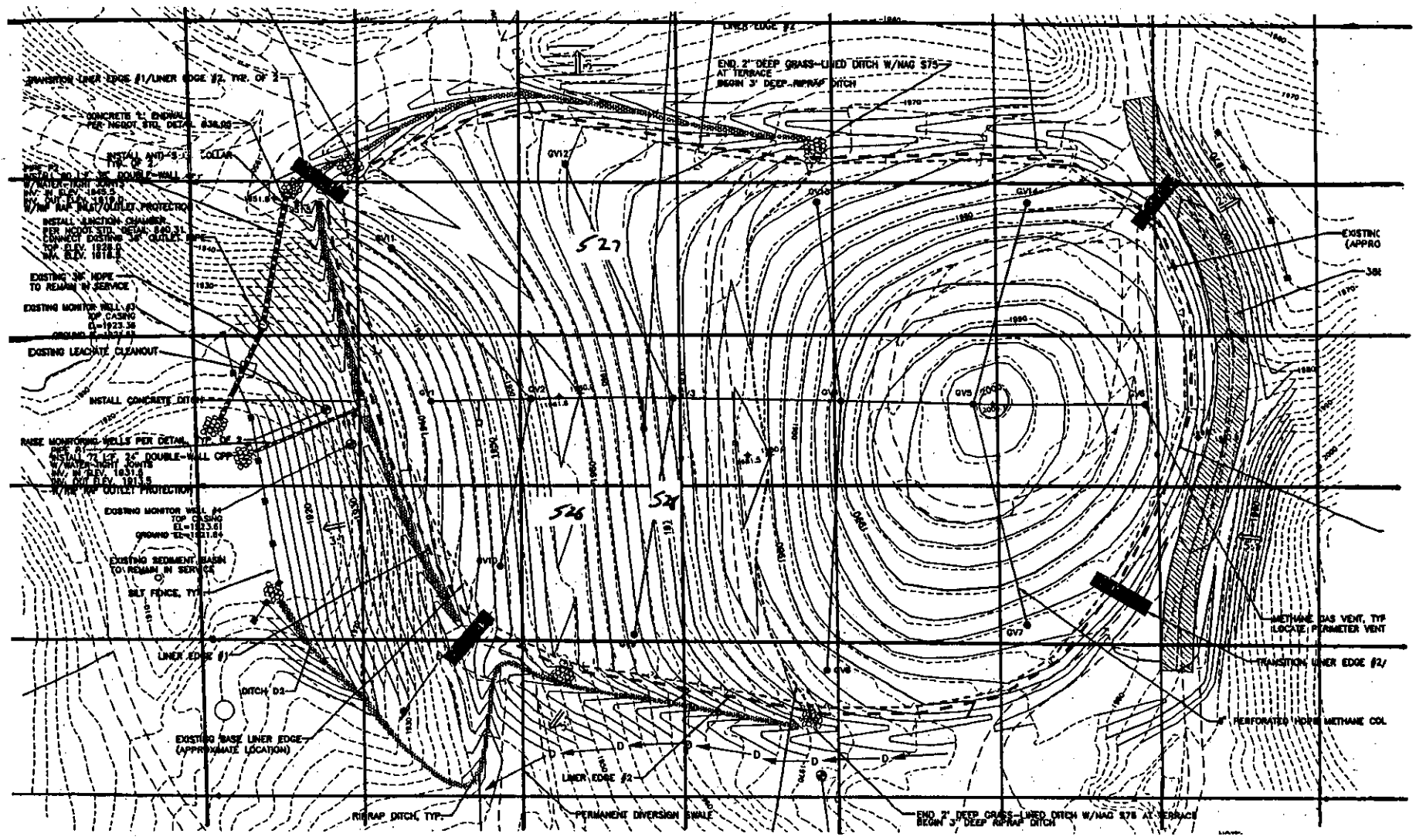
Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

PROJECT: Madison County MSW Landfill
PROJECT #: 70001
DATE: 11/3/2005
PAGE 1 of 1

Test ID	Retest of	Station	Offset	Lift	Wet Density	Dry Density	Moisture (%)	Proctor (PCF)	Compaction (%)	Optimum Moisture	Deviation from Opt.	Comments DC / SC	Shelby Tube ID
S26		D	4	13	109.2	82.0	33.1%	82.4	99.6%	34.2%	-1.1%		
S27		B	4	13	108.9	81.8	33.2%	82.4	99.2%	34.2%	-1.0%		
S28		D	4	14	109.1	82.1	32.9%	82.4	99.6%	34.2%	-1.3%		

DC = Drive Cylinder, SC = Sand Cone, Opt = Optimum Moisture, PCF = pounds per cubic foot

FIELD DENSITY TEST



Tesing Locations

Date: 11/03/05

Madison County MSW Landfill Closure
CTC PN 70001

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

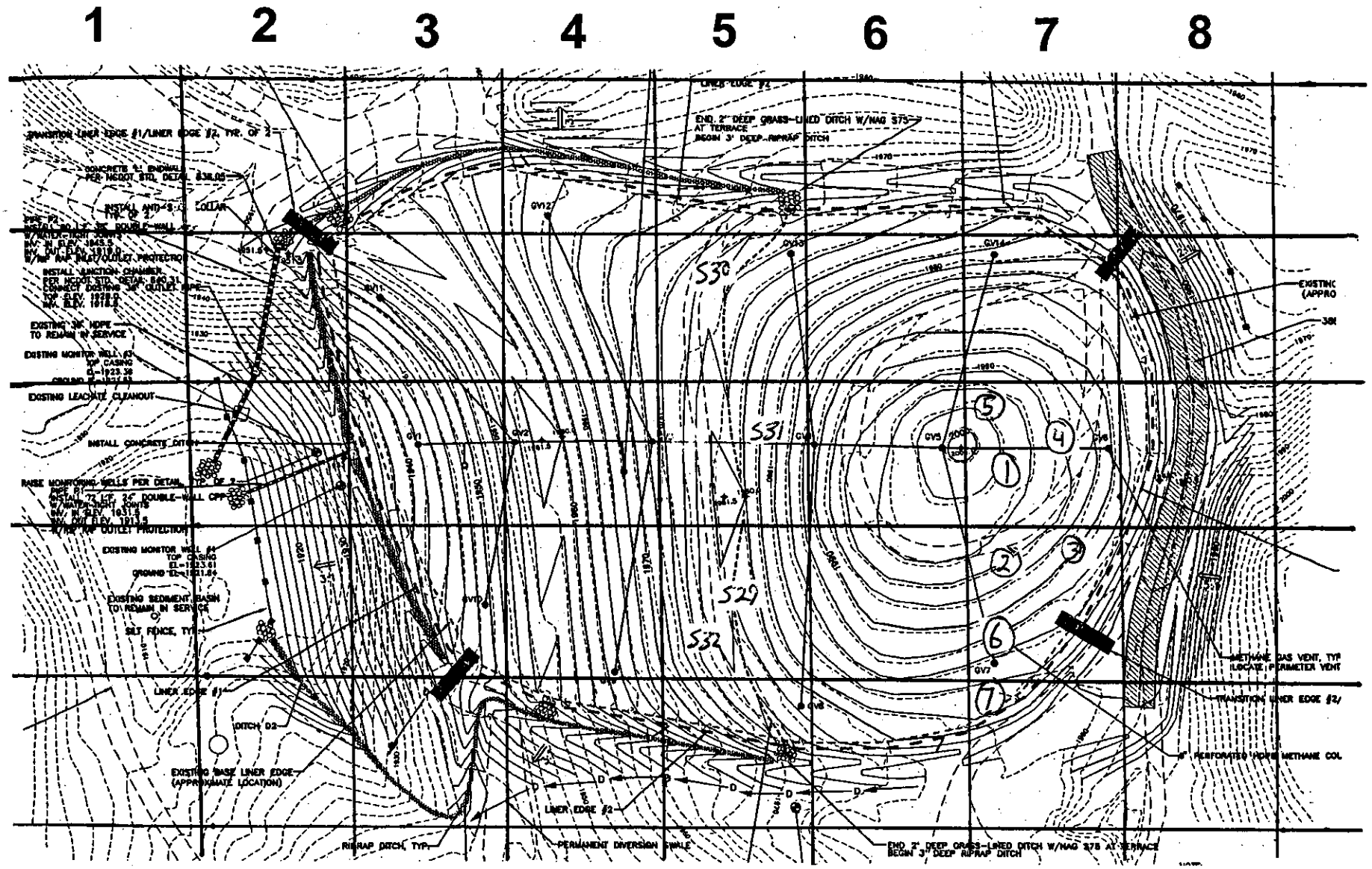
Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

PROJECT: Madison County MSW Landfill
PROJECT #: 70001
DATE: 11/4/2005
PAGE 1 of 1

Test ID	Retest of	Station	Offset	Lift	Wet Density	Dry Density	Moisture (%)	Proctor (PCF)	Compaction (%)	Optimum Moisture	Deviation from Opt.	Comments DC / SC	Shelby Tube ID
S29		D	5	15	109.1	82.1	32.9%	82.4	99.6%	34.2%	-1.3%		
S30		B	5	15	108.7	82.5	31.8%	82.4	100.1%	34.2%	-2.4%		
S31		C	5	16	108.4	81.0	33.9%	82.4	98.2%	34.2%	-0.3%		
S32		D	5	17	109.1	81.5	33.8%	82.4	99.0%	34.2%	-0.4%		
1		C	7	1	109.5	81.8	33.9%	82.4	99.2%	34.2%	-0.3%		
2		D	7	1	109.4	81.9	33.6%	82.4	99.4%	34.2%	-0.6%		ST-1
3		D	7	2	108.7	81.2	33.8%	82.4	98.6%	34.2%	-0.4%		
4		C	7	2	108.9	81.9	32.9%	82.4	99.4%	34.2%	-1.3%		
5		C	7	3	109.3	81.3	34.5%	82.4	98.6%	34.2%	0.3%		
6		D	7	3	109.8	81.4	34.9%	82.4	98.8%	34.2%	0.7%		
7		E	7	3	110.1	81.9	34.4%	82.4	99.4%	34.2%	0.2%		

DC = Drive Cylinder, SC = Sand Cone, Opt = Optimum Moisture, PCF = pounds per cubic foot

FIELD DENSITY TEST



Tesing Locations

Date: 11/04/05

Madison County MSW Landfill Closure
CTC PN 70001

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

PROJECT: Madison County MSW Landfill
PROJECT #: 70001
DATE: 11/7/2005
PAGE 1 of 1

Test ID	Retest of	Station	Offset	Lift	Wet Density	Dry Density	Moisture (%)	Proctor (PCF)	Compaction (%)	Optimum Moisture	Deviation from Opt.	Comments DC / SC	Shelby Tube ID
8		C	6	1	110.1	80.7	33.7%	82.4	98.0%	34.2%	0.6%		
9		D	6	1	109.4	82.0	34.6%	82.4	99.5%	34.2%	-0.3%	DC	
10		E	6	1	110.6	81.6	35.1%	82.4	99.0%	34.2%	0.3%		
11		E	6	2	110.9	81.6	33.8%	82.4	99.0%	34.2%	0.0%		
12		D	6	2	109.5	82.2	33.7%	82.4	99.7%	34.2%	-0.2%		ST-2
13		C	6	2	108.8	81.3	33.9%	82.4	98.6%	34.2%	-0.3%		ST-3
14		C	6	3	110.4	82.4	33.9%	82.4	100.1%	34.2%	-0.3%		
15		D	6	3	109.5	82.4	32.9%	82.4	100.0%	34.2%	-1.3%		
16		E	6	3	109.8	81.9	34.1%	82.4	99.4%	34.2%	-0.1%		
17		B	6	1	110.4	82.2	34.3%	82.4	99.8%	34.2%	0.1%		
18		B	7	2	108.8	80.7	34.8%	82.4	98.0%	34.2%	0.6%		
19		B	7	1	109.8	82.0	33.9%	82.4	99.5%	34.2%	-0.3%		ST-4
20		B	7	2	109.7	81.6	34.5%	82.4	99.0%	34.2%	0.3%		
21		B	7	3	109.5	81.6	34.2%	82.4	99.0%	34.2%	0.0%		
22		B	6	3	110.1	82.2	34.0%	82.4	99.7%	34.2%	-0.2%		

DC = Drive Cylinder, SC = Sand Cone, Opt = Optimum Moisture, PCF = pounds per cubic foot

FIELD DENSITY TEST

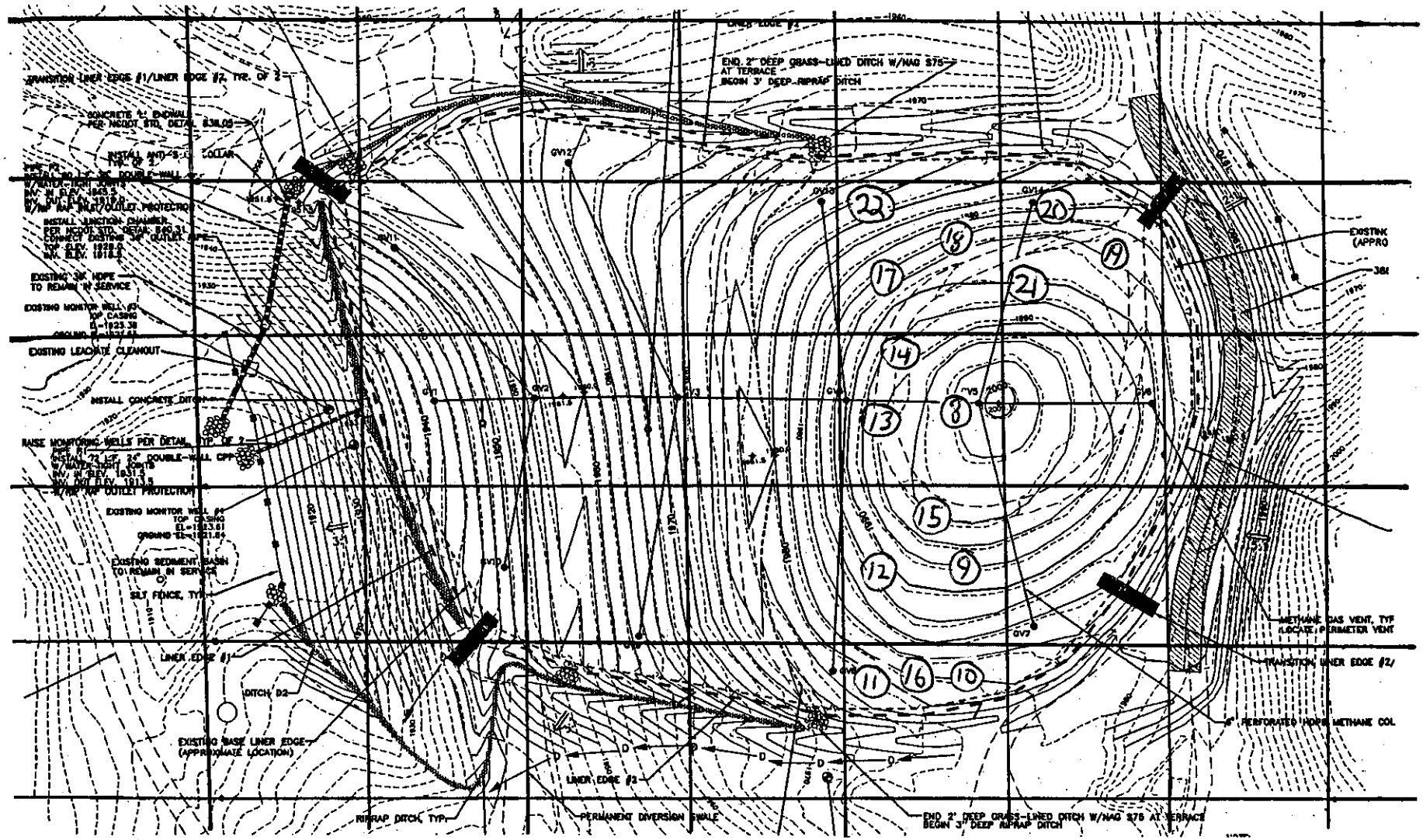
Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

PROJECT: Madison County MSW Landfill
PROJECT #: 70001
DATE: 11/7/2005
PAGE of

				A	B	C	D	E	F	G	H	I	J	K	L
						(B-A)/0.0333				(E-F)/(F-D)	C/(1+G)		H/I		G-K
Test ID	Station	Offset	Lift	Weight M (lbs)	Weight M+WS (lbs)	Wet Density (PCF)	Weight P (g)	Weight P+WS (g)	Weight P+DS (g)	Moisture (%)	Dry Density (PCF)	Proctor	Compaction (%)	Optimum Moisture (%)	Deviation from Opt. (%)
8	D	6	1	1.34	5.00	109.9	114.5	235.6	204.9	34.0%	82.0	82.4	99.6%	34.2%	-0.2%

M= Mold, P=Pan, WS= Wet Soil, DS= Dry Soil, lbs= pounds, g= grams, PCF = pounds per cubic foot

DRIVE CYLINDER



Tesing Locations

Date: 11/07/05

Madison County MSW Landfill Closure
CTC PN 70001

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

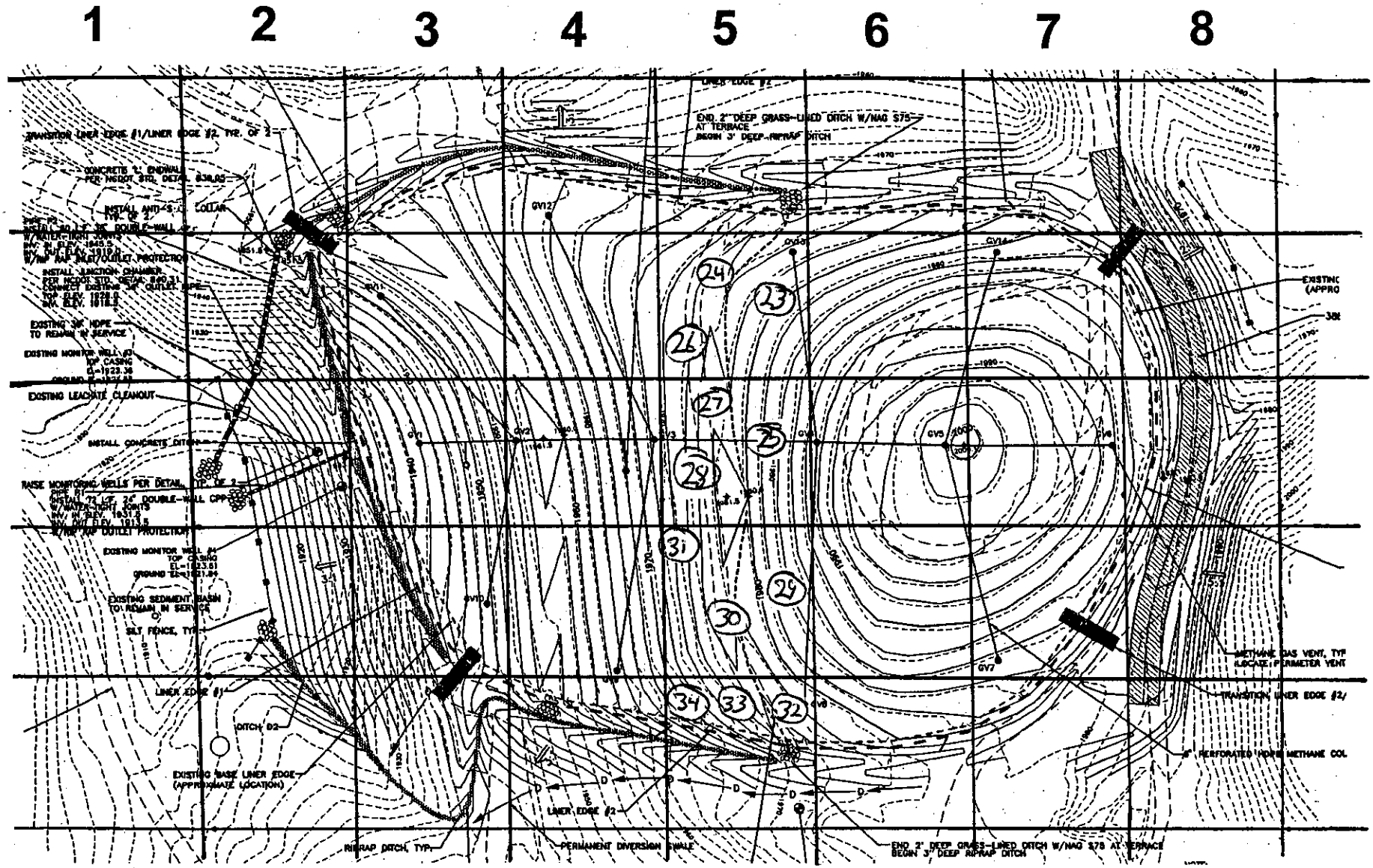
Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

PROJECT: Madison County MSW Landfill
PROJECT #: 70001
DATE: 11/8/2005
PAGE 1 of 1

Test ID	Retest of	Station	Offset	Lift	Wet Density	Dry Density	Moisture (%)	Proctor (PCF)	Compaction (%)	Optimum Moisture	Deviation from Opt.	Comments DC / SC	Shelby Tube ID
23		B	5	1	111.1	81.6	33.8%	82.4	99.0%	34.2%	-0.1%		
24		B	5	2	109.8	81.9	34.1%	82.4	99.3%	34.2%	-0.3%		ST-5
25		C	5	1	110.5		33.9%	82.4		34.2%			
26		B	5	3	109.5		33.7%	82.4		34.2%			
27		C	5	2	110.2		34.4%	82.4		34.2%			
28		C	5	3	109.2	81.7	33.6%	82.4	99.2%	34.2%	-0.6%		ST-6
29		D	5	1	109.8	81.5	34.8%	82.4	98.9%	34.2%	0.6%		
30		D	5	2	108.6	80.6	34.7%	82.4	97.8%	34.2%	0.5%		
31		D	5	3	107.9	80.6	33.9%	82.4	97.8%	34.2%	-0.3%		
32		E	5	1	110.8	82.6	34.2%	82.4	100.2%	34.2%	0.0%		
33		E	5	2	109.4	81.6	34.1%	82.4	99.0%	34.2%	-0.1%		
34		E	5	3	109.6	81.9	33.9%	82.4	99.3%	34.2%	-0.3%		

DC = Drive Cylinder, SC = Sand Cone, Opt = Optimum Moisture, PCF = pounds per cubic foot

FIELD DENSITY TEST



Tesing Locations

Date: 11/08/25

Madison County MSW Landfill Closure
CTC PN 70001

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

PROJECT: Madison County MSW Landfill
PROJECT #: 70001
DATE: 11/9/2005
PAGE 1 of 1

Test ID	Retest of	Station	Offset	Lift	Wet Density	Dry Density	Moisture (%)	Proctor (PCF)	Compaction (%)	Optimum Moisture	Deviation from Opt.	Comments DC / SC	Shelby Tube ID
35		E	4	1	110.2	82.1	34.3%	82.4	99.6%	34.2%	0.1%		
36		D	4	1	109.8	81.5	34.8%	82.4	98.9%	34.2%	0.6%		ST-7
37		E	4	2	110.4	82.3	34.2%	82.4	99.8%	34.2%	0.0%	DC	
38		E	4	3	110.2	82.4	33.8%	82.4	100.0%	34.2%	-0.4%		
39		D	4	2	109.8	81.5	34.8%	82.4	98.9%	34.2%	0.6%		
40		D	4	3	110.5	81.5	35.6%	82.4	98.9%	34.2%	1.4%		
41		C	4	1	110.5	81.4	35.8%	82.4	98.7%	34.2%	1.6%		
42		C	4	2	110.4	81.8	34.9%	82.4	99.3%	34.2%	0.7%		ST-8
43		C	4	3	111.1	82.2	35.2%	82.4	99.7%	34.2%	1.0%		

DC = Drive Cylinder, SC = Sand Cone, Opt = Optimum Moisture, PCF = pounds per cubic foot

FIELD DENSITY TEST

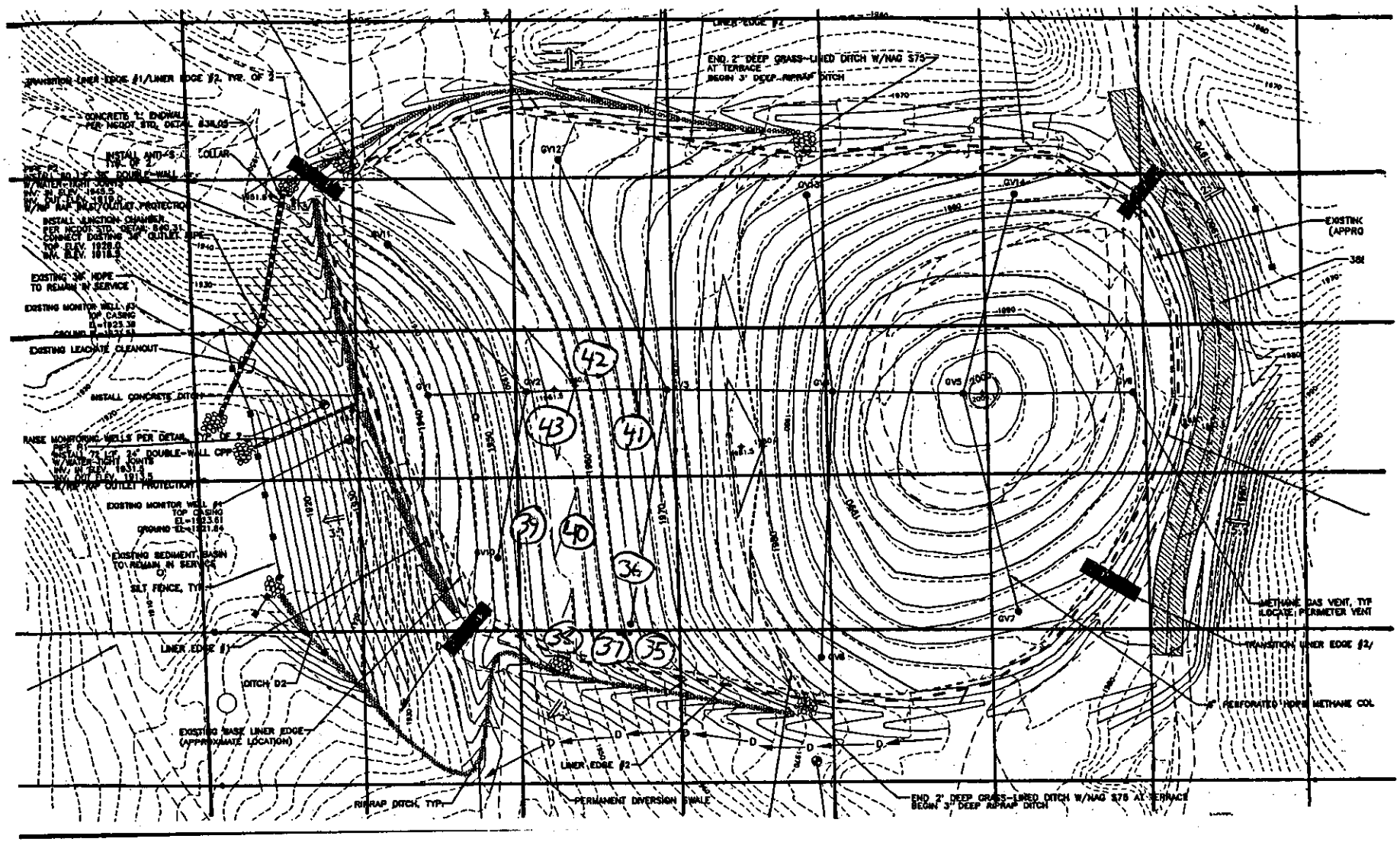
Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

PROJECT: Madison County MSW Landfill
PROJECT #: 70001
DATE: 11/9/2005
PAGE 1 of 1

				A	B	C	D	E	F	G	H	I	J	K	L
						(B-A)/0.0333				(E-F)/(F-D)	C/(1+G)		H/I		G-K
Test ID	Station	Offset	Lift	Weight M (lbs)	Weight M+WS (lbs)	Wet Density (PCF)	Weight P (g)	Weight P+WS (g)	Weight P+DS (g)	Moisture (%)	Dry Density (PCF)	Proctor	Compaction (%)	Optimum Moisture (%)	Deviation from Opt. (%)
37	D	6	1	1.34	5.05	111.4	114.5	237.3	206.3	33.8%	83.3	82.4	101.1%	34.2%	-0.4%

M= Mold, P=Pan, WS= Wet Soil, DS= Dry Soil, lbs= pounds, g= grams, PCF = pounds per cubic foot

DRIVE CYLINDER



Tesing Locations

Date: 11/09/05

Madison County MSW Landfill Closure
CTC PN 70001

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

PROJECT: Madison County MSW Landfill
PROJECT #: 70001
DATE: 11/10/2005
PAGE 1 of 1

Test ID	Retest of	Station	Offset	Lift	Wet Density	Dry Density	Moisture (%)	Proctor (PCF)	Compaction (%)	Optimum Moisture	Deviation from Opt.	Comments DC / SC	Shelby Tube ID
44		B	4	1	111.2	82.0	35.6%	82.4	99.5%	34.2%	1.4%		
45		B	4	2	110.4	81.3	35.8%	82.4	98.7%	34.2%	1.6%		
46		B	4	3	110.5	81.4	35.7%	82.4	98.8%	34.2%	1.5%		ST-9
47		A	4	1	110.2	81.6	35.0%	82.4	99.1%	34.2%	0.8%		
48		A	4	2	109.4	80.5	35.9%	82.4	97.7%	34.2%	1.7%	DC	
49		A	4	3	109.7	80.9	35.6%	82.4	98.2%	34.2%	1.4%		

DC = Drive Cylinder, SC = Sand Cone, Opt = Optimum Moisture, PCF = pounds per cubic foot

FIELD DENSITY TEST

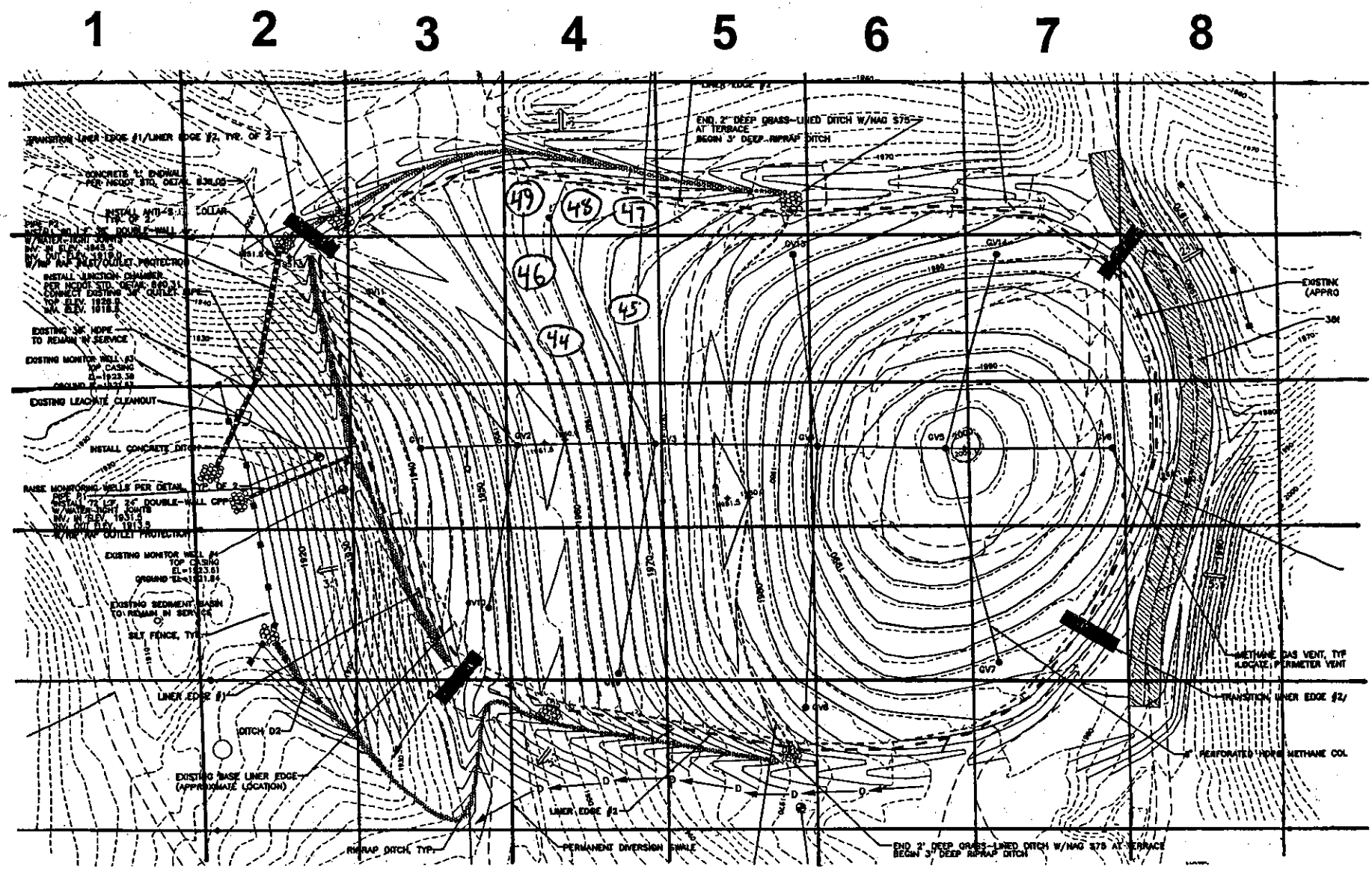
Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

PROJECT: Madison County MSW Landfill
PROJECT #: 70001
DATE: 11/10/2005
PAGE 1 of 1

				A	B	C	D	E	F	G	H	I	J	K	L
						(B-A)/0.0333				(E-F)/(F-D)	C/(1+G)		H/I		G-K
Test ID	Station	Offset	Lift	Weight M (lbs)	Weight M+WS (lbs)	Wet Density (PCF)	Weight P (g)	Weight P+WS (g)	Weight P+DS (g)	Moisture (%)	Dry Density (PCF)	Proctor	Compaction (%)	Optimum Moisture (%)	Deviation from Opt. (%)
48	A	4	2	1.34	5.00	109.9	114.5	245.8	211.4	35.5%	81.1	82.4	98.4%	34.2%	1.3%

M= Mold, P=Pan, WS= Wet Soil, DS= Dry Soil, lbs= pounds, g= grams, PCF = pounds per cubic foot

DRIVE CYLINDER



Tesing Locations

Date: 11/10/05

Madison County MSW Landfill Closure
CTC PN 70001

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

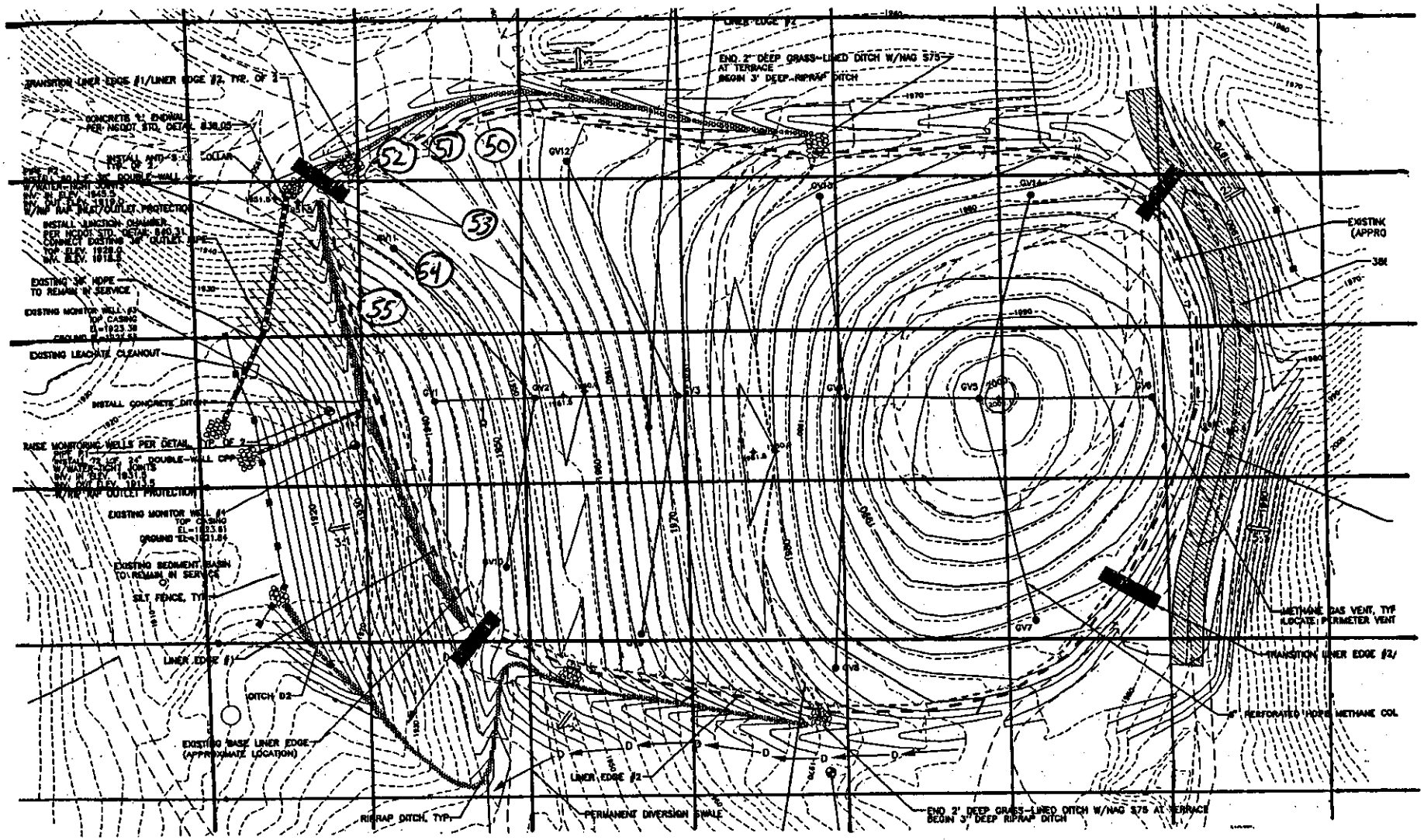
Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

PROJECT: Madison County MSW Landfill
PROJECT #: 70001
DATE: 11/11/2005
PAGE 1 of 1

Test ID	Retest of	Station	Offset	Lift	Wet Density	Dry Density	Moisture (%)	Proctor (PCF)	Compaction (%)	Optimum Moisture	Deviation from Opt.	Comments DC / SC	Shelby Tube ID
50		A	3	1	111.2	82.3	35.1%	82.4	99.9%	34.2%	0.9%		ST-10
51		A	3	2	110.3	81.6	35.2%	82.4	99.0%	34.2%	1.0%		
52		A	3	3	110.3	81.7	35.0%	82.4	99.2%	34.2%	0.8%		
53		B	3	1	111.1	82.2	35.1%	82.4	99.8%	34.2%	0.9%		
54		B	3	2	110.7	82.1	34.9%	82.4	99.6%	34.2%	0.7%		
55		B	3	3	111.9	83.0	34.8%	82.4	100.7%	34.2%	0.6%		

DC = Drive Cylinder, SC = Sand Cone, Opt = Optimum Moisture, PCF = pounds per cubic foot

FIELD DENSITY TEST



Tesing Locations

Date: 11/11/05

Madison County MSW Landfill Closure
CTC PN 70001

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

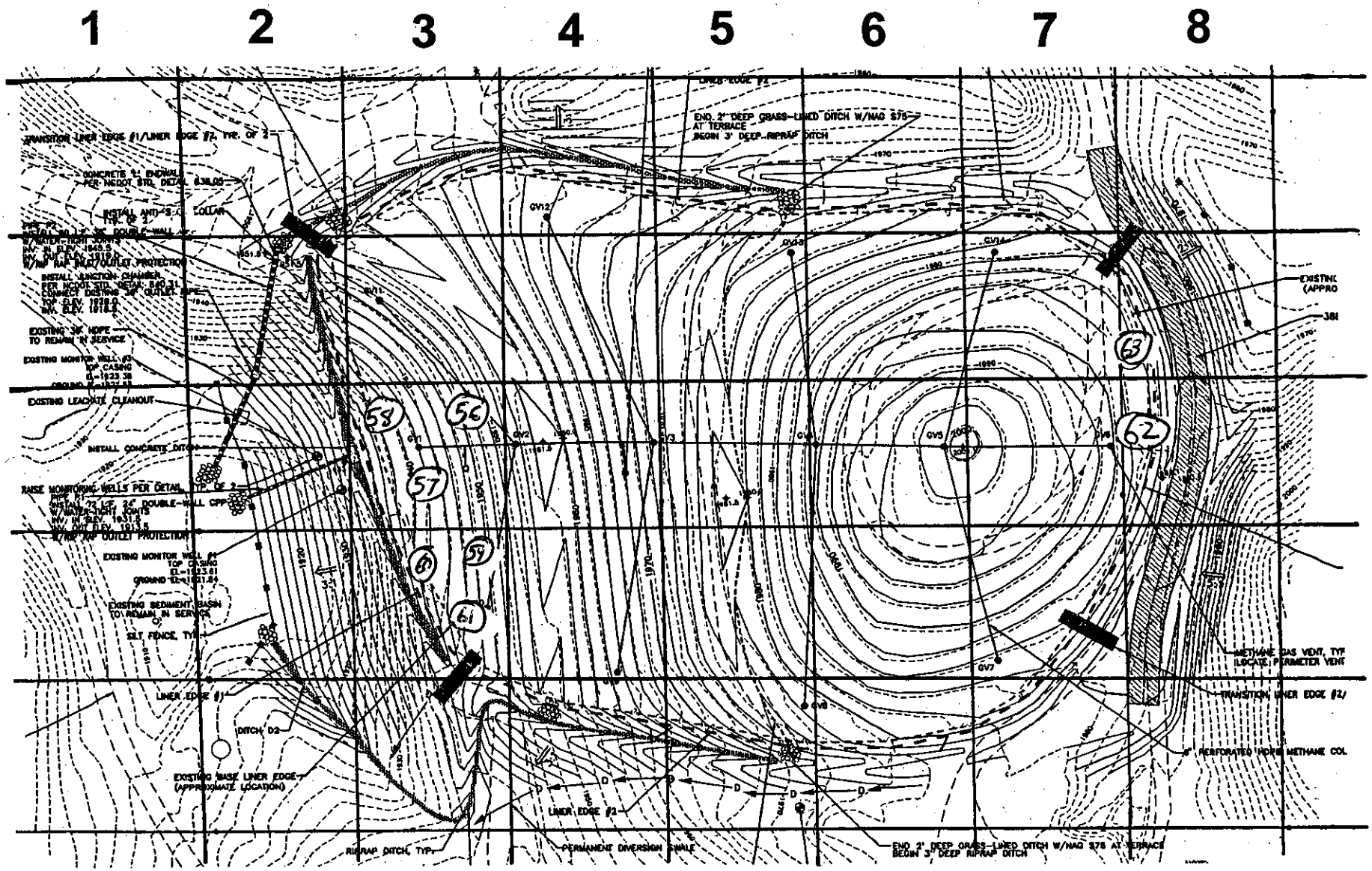
Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

PROJECT: Madison County MSW Landfill
PROJECT #: 70001
DATE: 11/14/2005
PAGE 1 of 1

Test ID	Retest of	Station	Offset	Lift	Wet Density	Dry Density	Moisture (%)	Proctor (PCF)	Compaction (%)	Optimum Moisture	Deviation from Opt.	Comments DC / SC	Shelby Tube ID
56		C	3	1	111.2	82.2	35.2%	82.4	99.8%	34.2%	1.0%		
57		C	3	2	111.8	82.8	35.0%	82.4	100.5%	34.2%	0.8%		ST-11
58		C	3	3	110.2	81.8	34.8%	82.4	99.2%	34.2%	0.6%		
59		D	3	1	110.5	82.0	34.8%	82.4	99.5%	34.2%	0.6%		
60		D	3	2	110.8	81.8	35.4%	82.4	99.3%	34.2%	1.2%		
61		D	3	3	110.8	81.7	35.6%	82.4	99.2%	34.2%	1.4%		ST-12
62		C	8	1	109.3	80.4	35.9%	82.4	97.6%	34.2%	1.7%		
63		B	8	1	110.0	81.2	35.4%	82.4	98.6%	34.2%	1.2%		

DC = Drive Cylinder, SC = Sand Cone, Opt = Optimum Moisture, PCF = pounds per cubic foot

FIELD DENSITY TEST



Tesing Locations

Date: 11/14/05

Madison County MSW Landfill Closure
CTC PN 70001

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

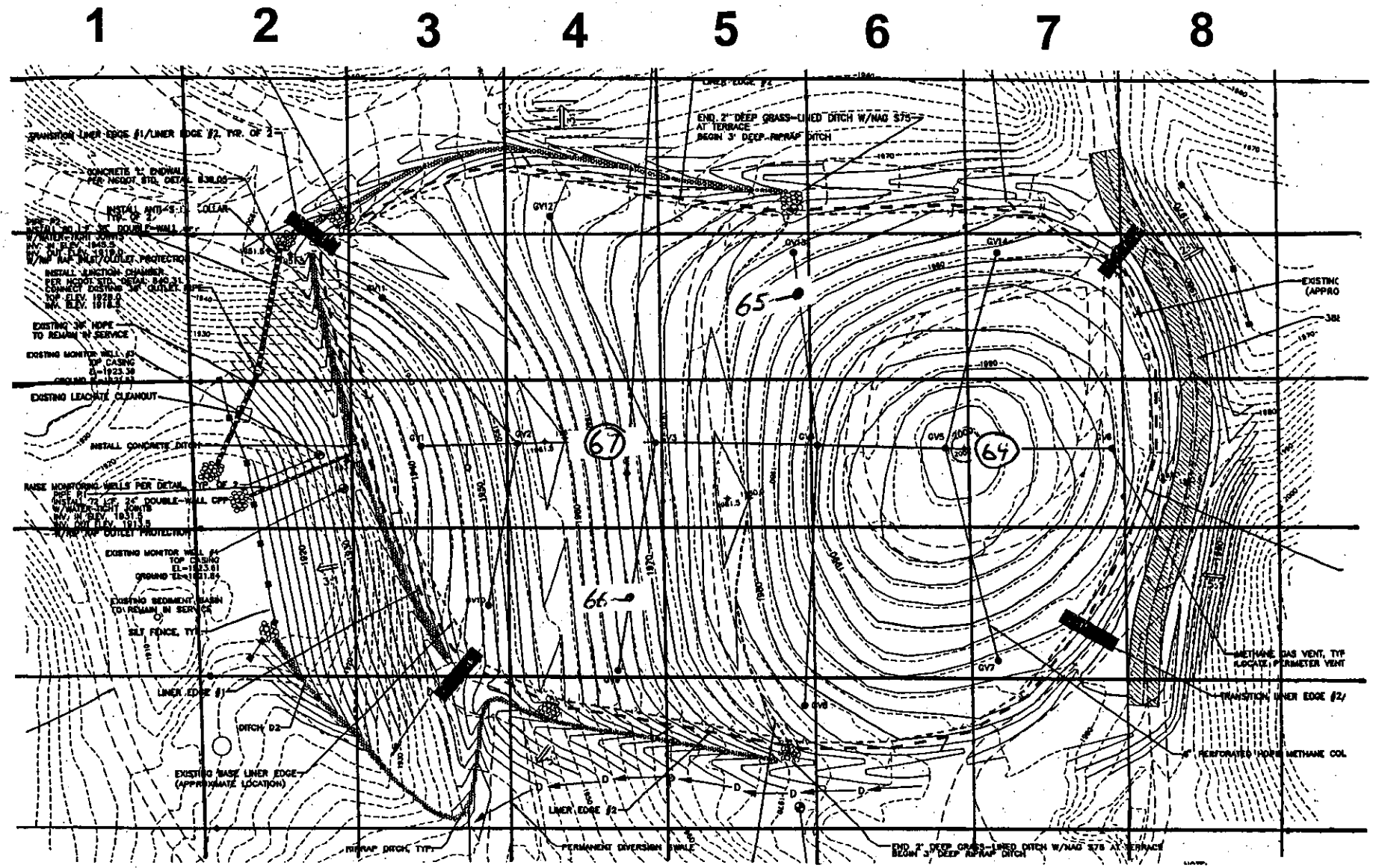
Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

PROJECT: Madison County MSW Landfill
PROJECT #: 70001
DATE: 11/15/2005
PAGE 1 of 1

Test ID	Retest of	Station	Offset	Lift	Wet Density	Dry Density	Moisture (%)	Proctor (PCF)	Compaction (%)	Optimum Moisture	Deviation from Opt.	Comments DC / SC	Shelby Tube ID
64		C	7	1	110.8	82.0	35.1%	82.4	99.5%	34.2%	0.9%		ST-13
65		B	5	2	113.2	84.0	34.8%	82.4	101.9%	34.2%	0.6%		ST-14
66		D	6	3	109.9	82.3	33.6%	82.4	99.8%	34.2%	-0.6%		
67		C	4	3	110.7	82.1	34.9%	82.4	99.6%	34.2%	0.7%		ST-15

DC = Drive Cylinder, SC = Sand Cone, Opt = Optimum Moisture, PCF = pounds per cubic foot

FIELD DENSITY TEST



Tesing Locations

Date: 11/15/05

Madison County MSW Landfill Closure
CTC PN 70001

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

LABORATORY DATA

Soil Classification Calculations

Madison County
DAA #R05646-01
Prepared By: SDH

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID	ST-1
Sample Depth	Lift 1
Visual Sample Description	Red-Brown Elastic SILT with Sand

Natural Moisture Content

Pan ID	4
Pan Wt	194.52 grams
Pan + Soil (wet)	454.70 grams
Pan + Soil (dry)	388.70 grams
Natural Moisture Content	*34.0%*

Coarse or Fine Grained

Pan + Soil retained on No. 200 sieve (dry)	246.59 grams
Percent Passing No. 200 Sieve	73.2%
Pan + Soil retained on No. 4 sieve (dry)	194.52 grams
Percent Passing No. 4 Sieve	100.0%
Soil Classifies as	*Fine-Grained Soil*

Atterberg Limits

Liquid Limit

No of Blows	17	21	30
Pan ID	9	68	10
Pan Wt	11.14	11.01	11.26
Pan + Soil (wet)	23.15	26.98	21.51
Pan + Soil (dry)	17.80	19.99	17.1
Moisture Content	80%	78%	76%
Liquid Limit	77	76	77
Liquid Limit	*77*		

Plastic Limit

Pan ID	26	52
Pan Weight	2.36	2.39
Pan + Soil (wet)	11.63	11.71
Pan + Soil (dry)	8.64	8.67
Moisture Content	48%	48%
Plastic Limit	*48*	
Plastic Index	*29*	

USCS Classification

Group Symbol	**MH**
Group Name	**Elastic SILT with Sand**

Grain Size Distribution Calculations

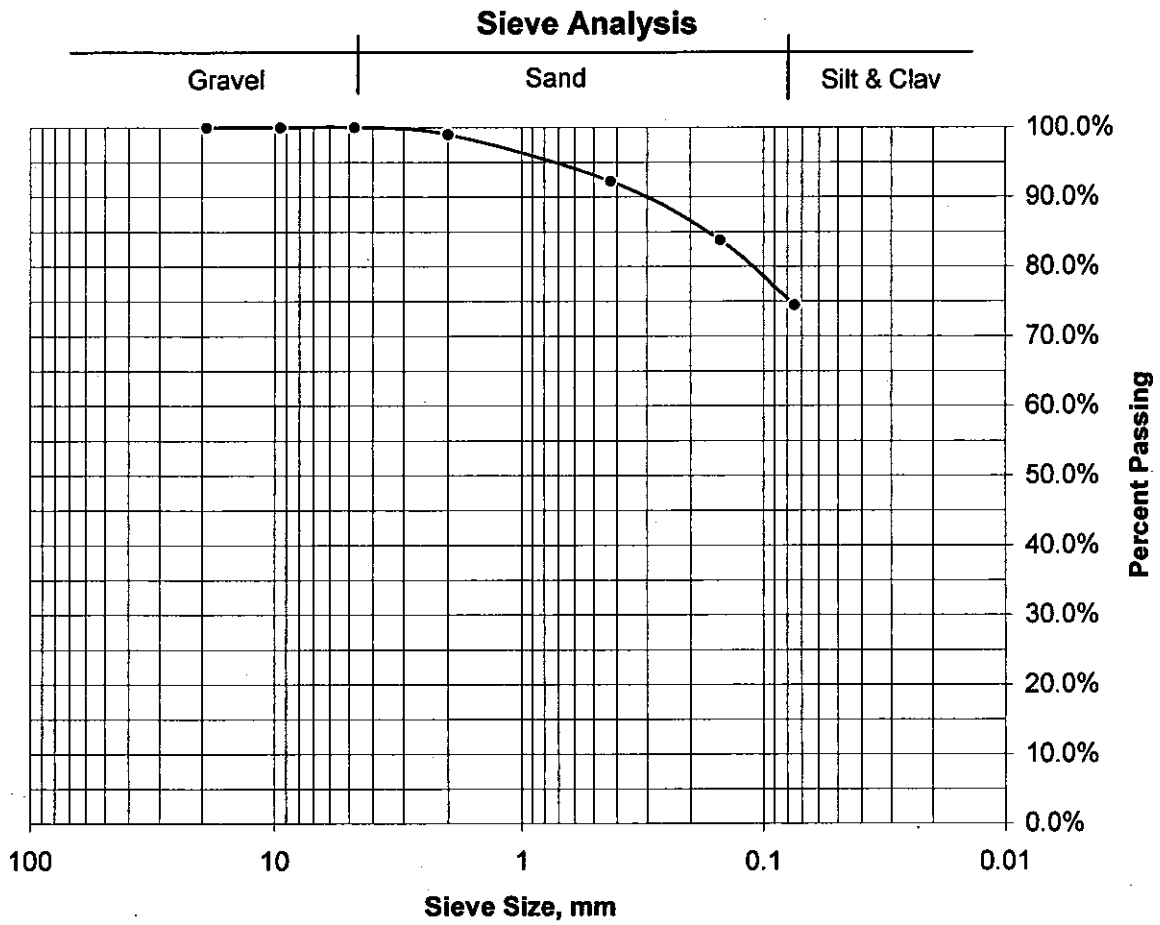
Madison County
DAA #R05646-01
Prepared By: SDH

Draper Aden Associat
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID ST-1
Sample Depth Lift 1

Mechanical Sieve Analysis

Sieve Size	Weight Retained	Percent Retained	Sieve Size, mm	Percent Passing
3/4"	0.00	0.0%	19.05	100.0%
3/8"	0.00	0.0%	9.5	100.0%
No. 4	0.00	0.0%	4.75	100.0%
No. 10	1.93	1.0%	2	99.0%
No. 40	13.09	6.7%	0.425	92.3%
No. 100	16.51	8.5%	0.15	83.8%
No. 200	18.14	9.3%	0.075	74.4%
Pan	2.39	1.2%		
Total	52.06	25.6%		



Permeability Calculations

Madison County
DAA #R05646-01
Prepared By: LTW

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID: ST-1
Sample Depth: Lift 1
Permeability Method: ASTM D5084
Sample Length, in: 3.84
Sample Diamter, in: 2.86

Moisture Content

Pan Wt	194.52	grams
Pan + Soil (wet)	454.70	grams
Pan + Soil (dry)	388.70	grams
Moisture Content	*34.0%*	

Dry Density

Soil (wet)	703.70	grams
Wet Density	109.0	pcf
Dry Density	*81.4*	pcf

Test Conditions

Influent Pressure, psi	45.5
Effluent Pressure, psi	39.9
Cell Pressure, psi	55.4
Standpipe Area, cm^2	0.92

Permeability Trials

Time min	Influent Head, cm	Influent Flow, cm^3	Effluent Head, cm	Effluent Flow, cm^3	Flow Deviation Ratio	Permeabilty, k cm/sec
10-Nov 10:47	0.1		49.4			
10-Nov 10:48	1.0	0.9	48.5	0.9	1.00	7.4E-06
10-Nov 10:49	1.5	0.5	48.0	0.5	1.00	4.1E-06
10-Nov 10:50	2.0	0.5	47.5	0.5	1.00	4.1E-06
10-Nov 10:51	2.5	0.5	47.0	0.5	1.00	4.1E-06
10-Nov 10:52	3.0	0.5	46.5	0.5	1.00	4.1E-06
10-Nov 10:53	3.5	0.5	46.0	0.5	1.00	4.1E-06
10-Nov 10:54	4.0	0.5	45.0	1.0	2.00	6.2E-06
10-Nov 10:59	6.8	2.8	42.7	2.3	0.82	4.3E-06

Average Permeability 4.7E-06 cm/sec

Final Data

Assumed Specific Gravity	2.6
Final Weight of Sample	726.00 grams
Final Moisture Content	38.2%
Percent Voids	49.8%
Actual Volume of Voids	200.8 ml
Saturation	100.0%

Soil Classification Calculations

Madison County
DAA #R05646-01
Prepared By: SDH

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID	ST-2
Sample Depth	Lift 2
Visual Sample Description	Red-Brown Elastic SILT with Sand

Natural Moisture Content

Pan ID	5
Pan Wt	194.90 grams
Pan + Soil (wet)	439.20 grams
Pan + Soil (dry)	383.70 grams
Natural Moisture Content	*29.4%*

Coarse or Fine Grained

Pan + Soil retained on No. 200 sieve (dry)	237.71 grams
Percent Passing No. 200 Sieve	77.3%
Pan + Soil retained on No. 4 sieve (dry)	195.19 grams
Percent Passing No. 4 Sieve	99.8%
Soil Classifies as	*Fine-Grained Soil*

Atterberg Limits

Liquid Limit

No of Blows	15	25	30
Pan ID	98	97	169
Pan Wt	30.42	26.18	27.33
Pan + Soil (wet)	43.65	39.64	39.17
Pan + Soil (dry)	38.57	34.54	34.85
Moisture Content	62%	61%	57%
Liquid Limit	59	61	59
Liquid Limit	*60*		

Plastic Limit

Pan ID	18	48
Pan Weight	2.39	2.40
Pan + Soil (wet)	7.80	8.65
Pan + Soil (dry)	6.08	6.65
Moisture Content	47%	47%
Plastic Limit	*47*	
Plastic Index	*12*	

USCS Classification

Group Symbol	**MH**
Group Name	**Elastic SILT with Sand**

Grain Size Distribution Calculations

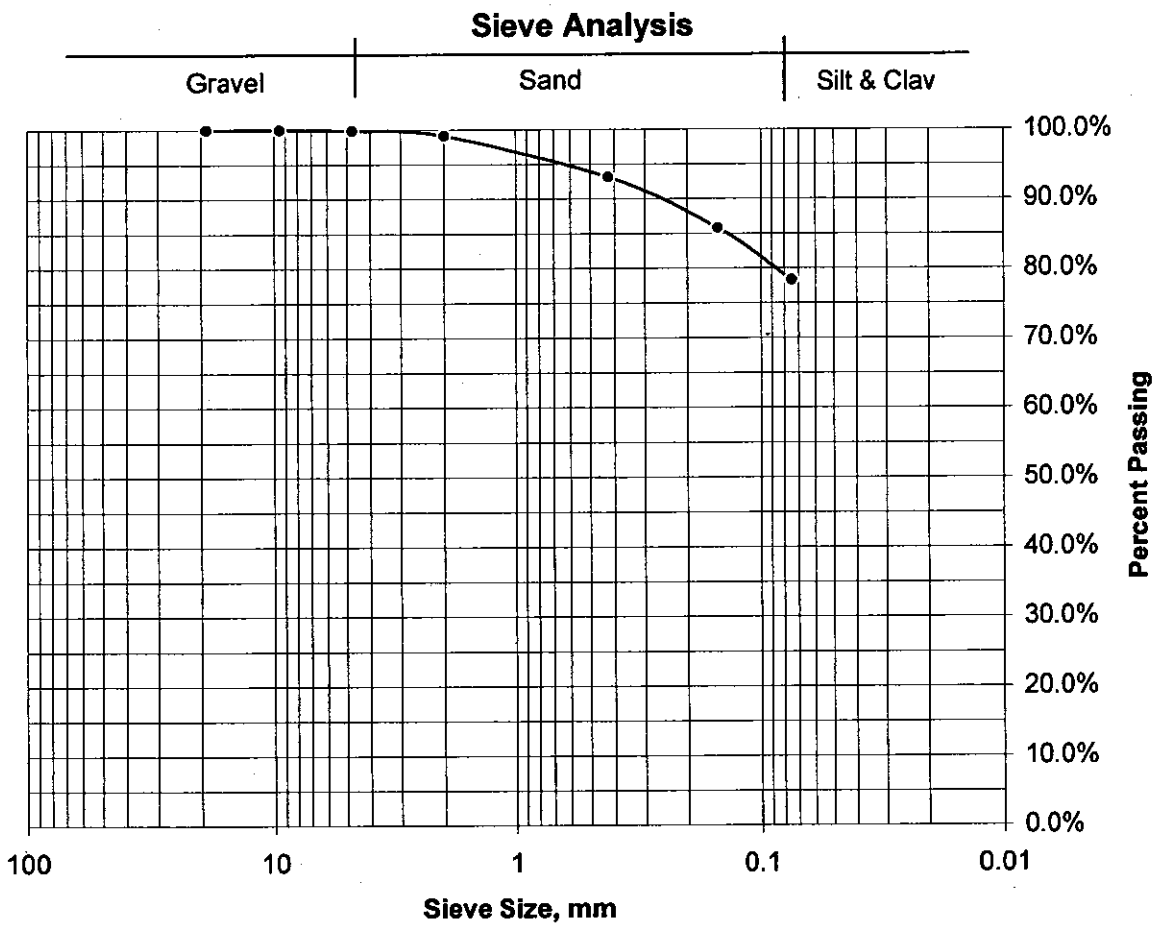
Madison County
DAA #R05646-01
Prepared By: SDH

Draper Aden Associat
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID ST-2
Sample Depth Lift 2

Mechanical Sieve Analysis

Sieve Size	Weight Retained	Percent Retained	Sieve Size, mm	Percent Passing
3/4"	0.00	0.0%	19.05	100.0%
3/8"	0.00	0.0%	9.5	100.0%
No. 4	0.29	0.2%	4.75	99.8%
No. 10	1.37	0.7%	2	99.1%
No. 40	11.34	6.0%	0.425	93.1%
No. 100	13.84	7.3%	0.15	85.8%
No. 200	14.18	7.5%	0.075	78.3%
Pan	1.78	0.9%		
Total	42.80	21.7%		



Permeability Calculations

Madison County
DAA #R05646-01
Prepared By: LTW

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID: ST-2
Sample Depth: Lift 2
Permeability Method: ASTM D5084
Sample Length, in: 3.84
Sample Diamter, in: 2.86

Moisture Content

Pan Wt	194.90	grams
Pan + Soil (wet)	439.20	grams
Pan + Soil (dry)	383.70	grams
Moisture Content	*29.4%*	

Dry Density

Soil (wet)	755.50	grams
Wet Density	117.1	pcf
Dry Density	*90.5*	pcf

Test Conditions

Influent Pressure, psi	45.1
Effluent Pressure, psi	39.5
Cell Pressure, psi	55.1
Standpipe Area, cm^2	0.92

Permeability Trials

Time min	Influent Head, cm	Influent Flow, cm^3	Effluent Head, cm	Effluent Flow, cm^3	Flow Deviation Ratio	Permeabilty, k cm/sec
10-Nov 11:16	1.2		48.8			
10-Nov 11:17	1.3	0.1	48.2	0.6	6.00	2.9E-06
10-Nov 11:19	1.4	0.1	48.1	0.1	1.00	4.1E-07
10-Nov 11:21	1.5	0.1	48.0	0.1	1.00	4.1E-07
10-Nov 11:24	1.5	0.0	47.9	0.1	3.33	1.8E-07
10-Nov 11:27	1.6	0.1	47.8	0.1	1.43	2.3E-07
10-Nov 11:31	1.7	0.1	47.7	0.1	1.00	2.1E-07
10-Nov 11:35	1.8	0.1	47.6	0.1	1.00	2.1E-07
10-Nov 13:13	4.1	2.3	45.3	2.3	1.00	1.9E-07

Average Permeability 2.1E-07 cm/sec

Final Data

Assumed Specific Gravity	2.6	
Final Weight of Sample	762.00	grams
Final Moisture Content	30.5%	
Percent Voids	44.2%	
Actual Volume of Voids	178.2	ml
Saturation	100.0%	

Soil Classification Calculations

Madison County Landfill
DAA #R05646-01
Prepared By: SDH

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID	ST-3
Sample Depth	Lift 3
Visual Sample Description	Red-Brown Sandy Elastic SILT

Natural Moisture Content

Pan ID	15
Pan Wt	188.48 grams
Pan + Soil (wet)	444.20 grams
Pan + Soil (dry)	383.90 grams
Natural Moisture Content	*30.9%*

Coarse or Fine Grained

Pan + Soil retained on No. 200 sieve (dry)	254.00 grams
Percent Passing No. 200 Sieve	66.5%
Pan + Soil retained on No. 4 sieve (dry)	188.89 grams
Percent Passing No. 4 Sieve	99.8%
Soil Classifies as	*Fine-Grained Soil*

Atterberg Limits

Liquid Limit

No of Blows	19	28	35
Pan ID	98	107	169
Pan Wt	30.40	25.18	27.29
Pan + Soil (wet)	39.93	34.03	36.09
Pan + Soil (dry)	35.83	30.35	32.55
Moisture Content	76%	71%	67%
Liquid Limit	73	72	70
Liquid Limit	*72*		

Plastic Limit

Pan ID	H	30
Pan Weight	2.44	2.41
Pan + Soil (wet)	10.23	11.26
Pan + Soil (dry)	7.86	8.61
Moisture Content	44%	43%
Plastic Limit	*43*	
Plastic Index	*29*	

USCS Classification

Group Symbol	**MH**
Group Name	**Sandy Elastic SILT**

Grain Size Distribution Calculations

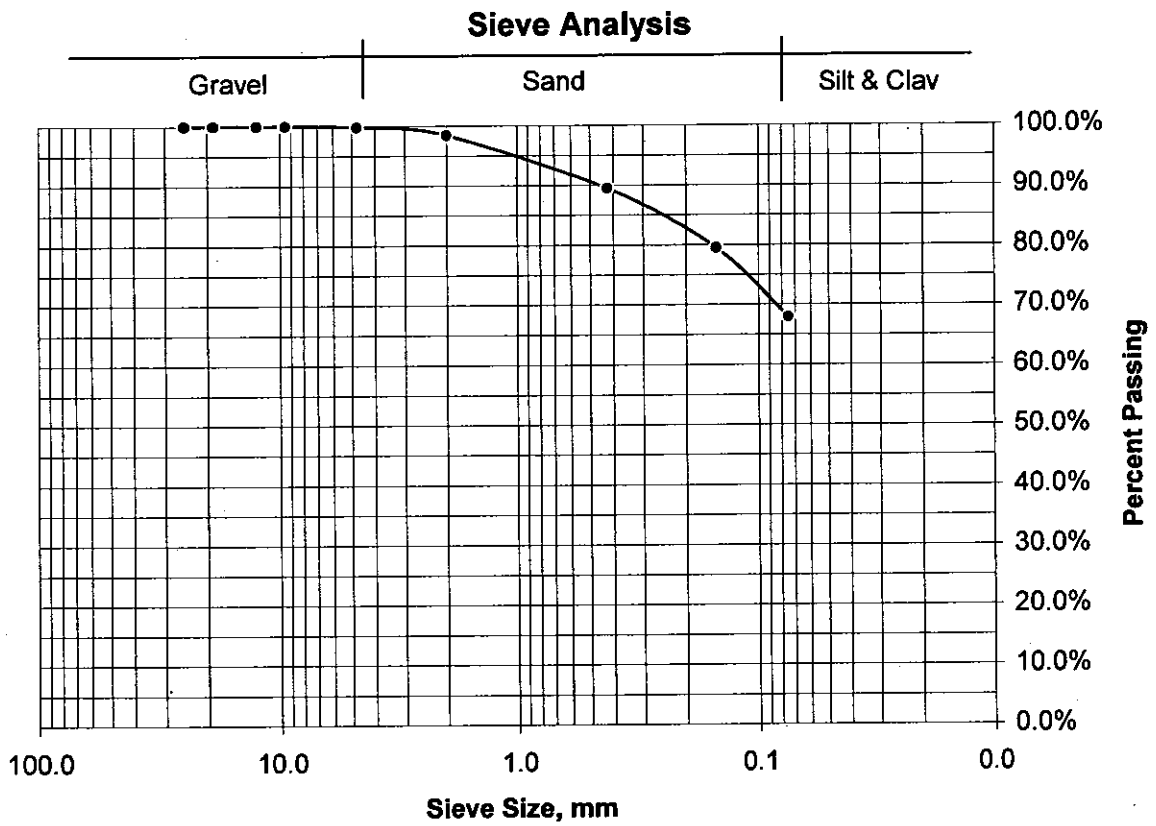
Madison County Landfill
DAA #R05646-01
Prepared By: SDH

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID ST-3
Sample Depth Lift 3

Mechanical Sieve Analysis

Sieve Size	Weight Retained	Percent Retained	Sieve Size, mm	Percent Passing
1"	0.00	0.0%	25.0	100.0%
3/4"	0.00	0.0%	19.0	100.0%
1/2"	0.00	0.0%	12.5	100.0%
3/8"	0.00	0.0%	9.5	100.0%
No. 4	0.41	0.2%	4.75	99.8%
No. 10	2.58	1.3%	2.0	98.5%
No. 40	17.55	9.0%	0.425	89.5%
No. 100	19.54	10.0%	0.15	79.5%
No. 200	22.58	11.6%	0.075	67.9%
Pan	2.86	1.5%		
Total	65.52	32.1%		



Permeability Calculations

Madison County Landfill
DAA #R05646-01
Prepared By: SDH

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID: ST-3
Sample Depth: Lift 3
Permeability Method: ASTM D5084
Sample Length, in: 3.82
Sample Diamter, in: 2.86

Moisture Content

Pan Wt	8.27	grams
Pan + Soil (wet)	217.06	grams
Pan + Soil (dry)	159.34	grams
Moisture Content	*38.2%*	

Dry Density

Soil (wet)	719.30	grams
Wet Density	111.5	pcf
Dry Density	*80.7*	pcf

Test Conditions

Backpressure, psi	40.0
Cell Pressure, psi	50.0
Influent Buret Area, cm^2	0.03142
Effluent Buret Area, cm^2	0.76712

Permeability Trials

Time min	Influent Head, cm	Influent Flow, cm^3	Effluent Head, cm	Effluent Flow, cm^3	Flow Deviation Ratio	Gradient mm-Hg	Permeabilty, k cm/sec
15-Nov 10:31	17.400		0.900				
15-Nov 10:32	16.050	0.042	0.955	0.042	1.00	21.34	8.3E-07
15-Nov 10:33	15.200	0.027	0.990	0.027	1.00	19.52	5.7E-07
15-Nov 10:34	14.250	0.030	1.029	0.030	1.00	18.37	6.8E-07
15-Nov 10:35	13.750	0.016	1.049	0.016	1.00	17.10	3.8E-07
15-Nov 10:36	13.250	0.016	1.070	0.016	1.00	16.42	3.9E-07
15-Nov 10:38	12.300	0.030	1.109	0.030	1.00	15.75	4.0E-07
15-Nov 10:39	11.900	0.013	1.125	0.013	1.00	14.47	3.6E-07
15-Nov 10:44	10.250	0.052	1.193	0.052	1.00	13.93	3.3E-07

Average Permeability 3.7E-07 cm/sec

Final Data

Assumed Specific Gravity	2.65
Final Weight of Sample	745.80 grams
Final Moisture Content	43.3%
Percent Voids	51.2%
Actual Volume of Voids	206.1 ml
Saturation	100.0%

Soil Classification Calculations

Madison County Landfill
DAA #R05646-01
Prepared By: SDH

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID ST-4
Sample Depth Lift 1
Visual Sample Description Red-Brown Elastic SILT with Sand

Natural Moisture Content

Pan ID	30
Pan Wt	193.64 grams
Pan + Soil (wet)	459.60 grams
Pan + Soil (dry)	399.00 grams
Natural Moisture Content	*29.5%*

Coarse or Fine Grained

Pan + Soil retained on No. 200 sieve (dry)	244.80 grams
Percent Passing No. 200 Sieve	75.1%
Pan + Soil retained on No. 4 sieve (dry)	193.64 grams
Percent Passing No. 4 Sieve	100.0%
Soil Classifies as	*Fine-Grained Soil*

Atterberg Limits

Liquid Limit

No of Blows	16	25	34
Pan ID	7	9	71
Pan Wt	11.17	11.11	10.95
Pan + Soil (wet)	23.95	21.95	21.75
Pan + Soil (dry)	18.15	17.14	17.28
Moisture Content	83%	80%	71%
Liquid Limit	79	80	73
Liquid Limit	*78*		

Plastic Limit

Pan ID	D	K
Pan Weight	2.42	2.38
Pan + Soil (wet)	11.29	10.96
Pan + Soil (dry)	8.66	8.40
Moisture Content	42%	43%
Plastic Limit	*42*	
Plastic Index	*35*	

USCS Classification

Group Symbol **MH**
Group Name **Elastic SILT with Sand**

Grain Size Distribution Calculations

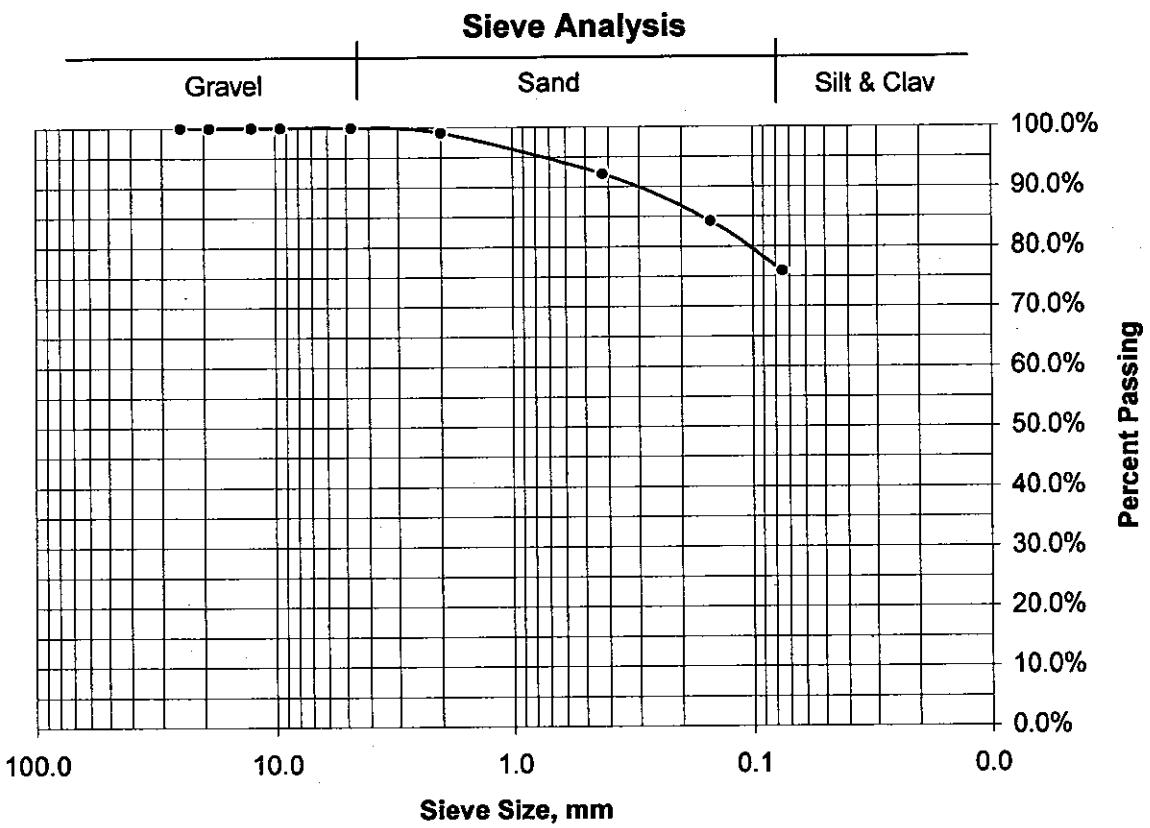
Madison County Landfill
DAA #R05646-01
Prepared By: SDH

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID ST-4
Sample Depth Lift 1

Mechanical Sieve Analysis

Sieve Size	Weight Retained	Percent Retained	Sieve Size, mm	Percent Passing
1"	0.00	0.0%	25.0	100.0%
3/4"	0.00	0.0%	19.0	100.0%
1/2"	0.00	0.0%	12.5	100.0%
3/8"	0.00	0.0%	9.5	100.0%
No. 4	0.00	0.0%	4.75	100.0%
No. 10	1.92	0.9%	2.0	99.1%
No. 40	14.15	6.9%	0.425	92.2%
No. 100	16.36	8.0%	0.15	84.2%
No. 200	17.01	8.3%	0.075	75.9%
Pan	1.84	0.9%		
Total	51.28	24.1%		



Permeability Calculations

Madison County Landfill
DAA #R05646-01
Prepared By: SDH

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID: ST-4
Sample Depth: Lift 1
Permeability Method: ASTM D5084
Sample Length, in: 3.81
Sample Diamter, in: 2.83

Moisture Content

Pan Wt	193.64 grams
Pan + Soil (wet)	459.60 grams
Pan + Soil (dry)	399.00 grams
Moisture Content	*29.5%*

Dry Density

Soil (wet)	705.30 grams
Wet Density	112.1 pcf
Dry Density	*86.5* pcf

Test Conditions

Backpressure, psi	40.0
Cell Pressure, psi	50.0
Influent Buret Area, cm^2	0.03142
Effluent Buret Area, cm^2	0.76712

Permeability Trials

Time min	Influent Head, cm	Influent Flow, cm^3	Effluent Head, cm	Effluent Flow, cm^3	Flow Deviation Ratio	Gradient mm-Hg	Permeabilty, k cm/sec
15-Nov 14:31	16.300		0.900				
15-Nov 14:32	15.300	0.031	0.941	0.031	1.00	19.97	6.7E-07
15-Nov 14:33	14.600	0.022	0.970	0.022	1.00	18.62	5.0E-07
15-Nov 14:34	13.950	0.020	0.996	0.020	1.00	17.68	4.9E-07
15-Nov 14:35	13.400	0.017	1.019	0.017	1.00	16.80	4.3E-07
15-Nov 14:36	12.850	0.017	1.041	0.017	1.00	16.06	4.5E-07
15-Nov 14:37	12.300	0.017	1.064	0.017	1.00	15.31	4.7E-07
15-Nov 14:38	11.800	0.016	1.084	0.016	1.00	14.57	4.5E-07
15-Nov 14:43	9.600	0.069	1.174	0.069	1.00	13.90	4.6E-07

Average Permeability 4.6E-07 cm/sec

Final Data

Assumed Specific Gravity	2.65
Final Weight of Sample	713.00 grams
Final Moisture Content	30.9%
Percent Voids	47.7%
Actual Volume of Voids	187.2 ml
Saturation	90.0%

Permeability Calculations

Madison County Landfill
DAA #R05646-01
Prepared By: SDH

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID: ST-5
Sample Depth: Lift 2
Permeability Method: ASTM D5084
Sample Length, in: 3.86
Sample Diamter, in: 2.84

Moisture Content

Pan Wt	191.89	grams
Pan + Soil (wet)	399.41	grams
Pan + Soil (dry)	348.40	grams
Moisture Content	*32.6%*	

Dry Density

Soil (wet)	735.20	grams
Wet Density	114.9	pcf
Dry Density	*86.6*	pcf

Test Conditions

Backpressure, psi	40.0
Cell Pressure, psi	50.0
Influent Buret Area, cm^2	0.03142
Effluent Buret Area, cm^2	0.76712

Permeability Trials

Time min	Influent Head, cm	Influent Flow, cm^3	Effluent Head, cm	Effluent Flow, cm^3	Flow Deviation Ratio	Gradient mm-Hg	Permeabilty, k cm/sec
15-Nov 10:55	16.900		0.900				
15-Nov 10:56	15.000	0.060	0.978	0.060	1.00	20.48	1.3E-06
15-Nov 10:57	14.250	0.024	1.009	0.024	1.00	17.94	5.5E-07
15-Nov 10:58	13.650	0.019	1.033	0.019	1.00	16.95	4.7E-07
15-Nov 10:59	13.150	0.016	1.054	0.016	1.00	16.15	4.1E-07
15-Nov 11:00	12.650	0.016	1.074	0.016	1.00	15.48	4.2E-07
15-Nov 11:01	12.300	0.011	1.088	0.011	1.00	14.81	3.1E-07
15-Nov 11:02	11.950	0.011	1.103	0.011	1.00	14.35	3.2E-07
15-Nov 11:07	10.200	0.055	1.174	0.055	1.00	13.88	3.5E-07

Average Permeability 3.5E-07 cm/sec

Final Data

Assumed Specific Gravity	2.65
Final Weight of Sample	740.40 grams
Final Moisture Content	33.5%
Percent Voids	47.6%
Actual Volume of Voids	190.1 ml
Saturation	97.8%

Soil Classification Calculations

Madison County
DAA #R05646-01
Prepared By: SDH

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID ST-6
Sample Depth Lift 3
Visual Sample Description Red-Brown Elastic SILT with Sand

Natural Moisture Content

Pan ID	22
Pan Wt	189.06 grams
Pan + Soil (wet)	413.10 grams
Pan + Soil (dry)	362.40 grams
Natural Moisture Content	*29.2%*

Coarse or Fine Grained

Pan + Soil retained on No. 200 sieve (dry)	230.90 grams
Percent Passing No. 200 Sieve	75.9%
Pan + Soil retained on No. 4 sieve (dry)	189.55 grams
Percent Passing No. 4 Sieve	99.7%

Soil Classifies as Fine-Grained Soil

Atterberg Limits

Liquid Limit

No of Blows	18	23	31
Pan ID	A-1	C-3	121
Pan Wt	14.02	13.98	11.29
Pan + Soil (wet)	22.14	21.75	20.23
Pan + Soil (dry)	18.53	18.35	16.37
Moisture Content	80%	78%	76%
Liquid Limit	77	77	78
Liquid Limit	*78*		

Plastic Limit

Pan ID	15	19
Pan Weight	4.30	4.38
Pan + Soil (wet)	12.92	12.79
Pan + Soil (dry)	10.28	10.23
Moisture Content	44%	44%
Plastic Limit	*44*	
Plastic Index	*33*	

USCS Classification

Group Symbol **MH**
Group Name **Elastic SILT with Sand**

Grain Size Distribution Calculations

Madison County
DAA #R05646-01
Prepared By: SDH

Draper Aden Associat
Blacksburg • Richmond, Virginia
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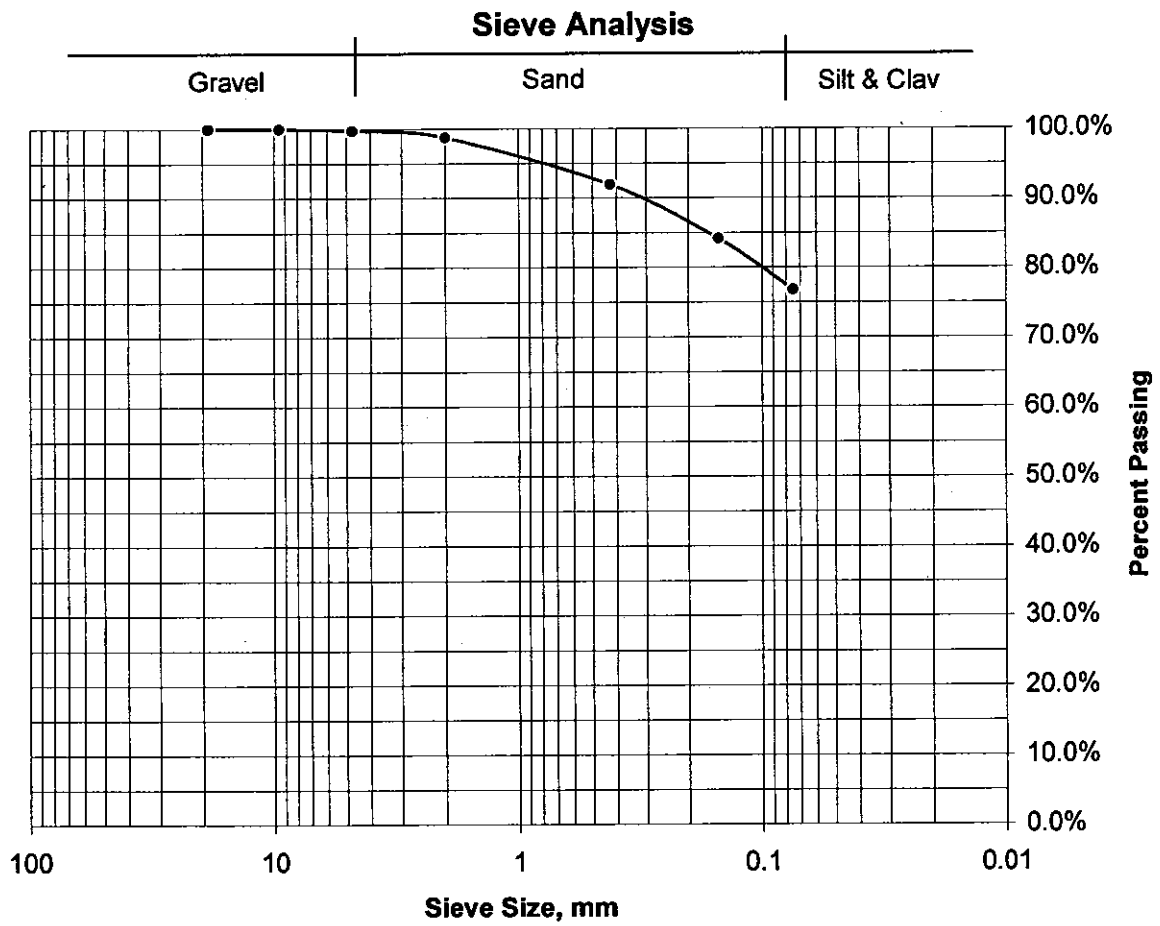
Sample ID ST-6
Sample Depth Lift 3

Mechanical Sieve Analysis

Sieve Size	Weight Retained	Percent Retained	Sieve Size, mm	Percent Passing
3/4"	0.00	0.0%	19.05	100.0%
3/8"	0.00	0.0%	9.5	100.0%
No. 4	0.49	0.3%	4.75	99.7%
No. 10	1.69	1.0%	2	98.7%
No. 40	11.77	6.8%	0.425	92.0%
No. 100	13.54	7.8%	0.15	84.1%
No. 200	12.78	7.4%	0.075	76.8%
Pan	1.73	1.0%		
Total	42.00	23.2%		



Permeability Calculations

Madison County
DAA #R05646-01
Prepared By: LTW

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID: ST-6
Sample Depth: Lift 3
Permeability Method: ASTM D5084
Sample Length, in: 3.84
Sample Diamter, in: 2.83

Moisture Content

Pan Wt	189.06 grams
Pan + Soil (wet)	413.10 grams
Pan + Soil (dry)	362.40 grams
Moisture Content	*29.2%*

Dry Density

Soil (wet)	709.90 grams
Wet Density	112.1 pcf
Dry Density	*86.7* pcf

Test Conditions

Influent Pressure, psi	45.3
Effluent Pressure, psi	40.1
Cell Pressure, psi	55.2
Standpipe Area, cm^2	0.92

Permeability Trials

Time min	Influent Head, cm	Influent Flow, cm^3	Effluent Head, cm	Effluent Flow, cm^3	Flow Deviation Ratio	Permeabilty, k cm/sec
10-Nov 13:33	0.2		49.5			
10-Nov 13:34	0.5	0.3	49.3	0.2	0.67	2.2E-06
10-Nov 13:35	0.7	0.2	49.1	0.2	1.00	1.8E-06
10-Nov 13:37	0.9	0.2	48.7	0.4	2.00	1.3E-06
10-Nov 13:39	1.0	0.1	48.3	0.4	3.64	1.1E-06
10-Nov 13:41	1.3	0.3	48.2	0.1	0.34	8.7E-07
10-Nov 13:43	1.5	0.2	47.9	0.3	1.50	1.1E-06
10-Nov 13:45	1.7	0.2	47.7	0.2	1.00	9.0E-07
10-Nov 13:51	2.3	0.6	47.1	0.6	1.00	9.0E-07

Average Permeability 9.5E-07 cm/sec

Final Data

Assumed Specific Gravity	2.6
Final Weight of Sample	733.20 grams
Final Moisture Content	33.5%
Percent Voids	46.5%
Actual Volume of Voids	183.9 ml
Saturation	100.0%

Soil Classification Calculations

Madison County Landfill
DAA #R05646-01
Prepared By: SDH

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID	ST-7
Sample Depth	Lift 1
Visual Sample Description	Red-Brown Elastic SILT

Natural Moisture Content

Pan ID	25
Pan Wt	194.09 grams
Pan + Soil (wet)	411.60 grams
Pan + Soil (dry)	353.29 grams
Natural Moisture Content	*36.6%*

Coarse or Fine Grained

Pan + Soil retained on No. 200 sieve (dry)	213.65 grams
Percent Passing No. 200 Sieve	87.7%
Pan + Soil retained on No. 4 sieve (dry)	203.82 grams
Percent Passing No. 4 Sieve	93.9%
Soil Classifies as	*Fine-Grained Soil*

Atterberg Limits

Liquid Limit

No of Blows	18	25	32
Pan ID	64	6	62
Pan Wt	10.99	11.22	10.92
Pan + Soil (wet)	21.51	24.17	22.98
Pan + Soil (dry)	16.44	18.10	17.48
Moisture Content	93%	88%	84%
Liquid Limit	89	88	86
Liquid Limit	*88*		

Plastic Limit

Pan ID	A	29
Pan Weight	2.38	2.39
Pan + Soil (wet)	11.13	11.56
Pan + Soil (dry)	8.71	9.04
Moisture Content	38%	38%
Plastic Limit	*38*	
Plastic Index	*50*	

USCS Classification

Group Symbol	**MH**
Group Name	**Elastic SILT**

Grain Size Distribution Calculations

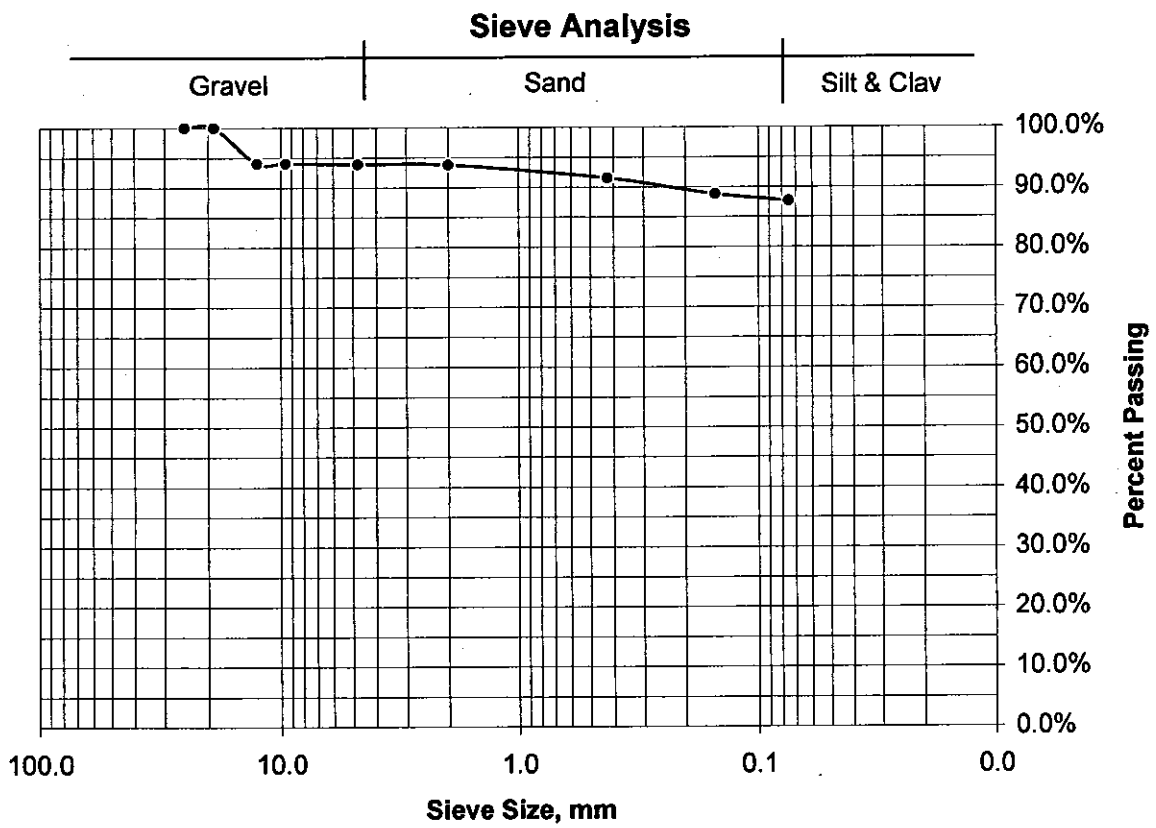
Madison County Landfill
DAA #R05646-01
Prepared By: SDH

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID ST-7
Sample Depth Lift 1

Mechanical Sieve Analysis

Sieve Size	Weight Retained	Percent Retained	Sieve Size, mm	Percent Passing
1"	0.00	0.0%	25.0	100.0%
3/4"	0.00	0.0%	19.0	100.0%
1/2"	9.42	5.9%	12.5	94.1%
3/8"	0.00	0.0%	9.5	94.1%
No. 4	0.31	0.2%	4.75	93.9%
No. 10	0.12	0.1%	2.0	93.8%
No. 40	3.61	2.3%	0.425	91.5%
No. 100	4.39	2.8%	0.15	88.8%
No. 200	1.77	1.1%	0.075	87.7%
Pan	0.06	0.0%		
Total	19.68	12.3%		



Permeability Calculations

Madison County Landfill
DAA #R05646-01
Prepared By: SDH

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID: ST-7
Sample Depth: Lift 1
Permeability Method: ASTM D5084
Sample Length, in: 3.74
Sample Diamter, in: 2.86

Moisture Content

Pan Wt	194.09 grams
Pan + Soil (wet)	411.60 grams
Pan + Soil (dry)	353.29 grams
Moisture Content	*36.6%*

Dry Density

Soil (wet)	707.50 grams
Wet Density	112.7 pcf
Dry Density	*82.5* pcf

Test Conditions

Backpressure, psi	40.0
Cell Pressure, psi	50.0
Influent Buret Area, cm^2	0.03142
Effluent Buret Area, cm^2	0.76712

Permeability Trials

Time min	Influent Head, cm	Influent Flow, cm^3	Effluent Head, cm	Effluent Flow, cm^3	Flow Deviation Ratio	Gradient mm-Hg	Permeabilty, k cm/sec
12-Nov 10:16	17.200		0.900				
12-Nov 10:17	16.800	0.013	0.916	0.013	1.00	21.56	2.4E-07
12-Nov 10:18	16.500	0.009	0.929	0.009	1.00	21.01	1.8E-07
12-Nov 10:19	16.250	0.008	0.939	0.008	1.00	20.60	1.6E-07
12-Nov 10:20	16.000	0.008	0.949	0.008	1.00	20.25	1.6E-07
12-Nov 10:21	15.800	0.006	0.957	0.006	1.00	19.91	1.3E-07
12-Nov 10:22	15.650	0.005	0.963	0.005	1.00	19.64	9.7E-08
12-Nov 10:23	15.500	0.005	0.970	0.005	1.00	19.43	9.8E-08
12-Nov 10:28	14.700	0.025	1.002	0.025	1.00	19.22	1.1E-07

Average Permeability 1.1E-07 cm/sec

Final Data

Assumed Specific Gravity	2.65
Final Weight of Sample	716.20 grams
Final Moisture Content	38.3%
Percent Voids	50.1%
Actual Volume of Voids	196.4 ml
Saturation	100.0%

Permeability Calculations

Madison County Landfill
DAA #R05646-01
Prepared By: SDH

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID: ST-8
Sample Depth: Lift 2
Permeability Method: ASTM D5084
Sample Length, in: 3.71
Sample Diamter, in: 2.86

Moisture Content

Pan Wt	189.99 grams
Pan + Soil (wet)	442.90 grams
Pan + Soil (dry)	374.59 grams
Moisture Content	*37.0%*

Dry Density

Soil (wet)	720.80 grams
Wet Density	115.6 pcf
Dry Density	*84.4* pcf

Test Conditions

Backpressure, psi	40.0
Cell Pressure, psi	50.0
Influent Buret Area, cm^2	0.03142
Effluent Buret Area, cm^2	0.76712

Permeability Trials

Time min	Influent Head, cm	Influent Flow, cm^3	Effluent Head, cm	Effluent Flow, cm^3	Flow Deviation Ratio	Gradient mm-Hg	Permeabilty, k cm/sec
12-Nov 10:30	17.400		0.900				
12-Nov 10:31	17.100	0.009	0.912	0.009	1.00	21.97	1.7E-07
12-Nov 10:32	16.800	0.009	0.925	0.009	1.00	21.56	1.8E-07
12-Nov 10:33	16.700	0.003	0.929	0.003	1.00	21.14	6.0E-08
12-Nov 10:34	16.500	0.006	0.937	0.006	1.00	21.00	1.2E-07
12-Nov 10:35	16.400	0.003	0.941	0.003	1.00	20.73	6.1E-08
12-Nov 10:36	16.200	0.006	0.949	0.006	1.00	20.59	1.2E-07
12-Nov 10:37	16.100	0.003	0.953	0.003	1.00	20.31	6.3E-08
12-Nov 10:42	15.400	0.022	0.982	0.022	1.00	20.17	9.0E-08

Average Permeability 8.5E-08 cm/sec

Final Data

Assumed Specific Gravity	2.65
Final Weight of Sample	728.30 grams
Final Moisture Content	38.4%
Percent Voids	49.0%
Actual Volume of Voids	190.6 ml
Saturation	100.0%

Soil Classification Calculations

Madison County Landfill
DAA #R05646-01
Prepared By: SDH

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID ST-9
Sample Depth Lift 3
Visual Sample Description Red-Brown Elastic SILT

Natural Moisture Content

Pan ID	36
Pan Wt	193.79 grams
Pan + Soil (wet)	412.80 grams
Pan + Soil (dry)	351.01 grams
Natural Moisture Content	*39.3%*

Coarse or Fine Grained

Pan + Soil retained on No. 200 sieve (dry)	209.90 grams
Percent Passing No. 200 Sieve	89.8%
Pan + Soil retained on No. 4 sieve (dry)	194.70 grams
Percent Passing No. 4 Sieve	99.4%
Soil Classifies as	*Fine-Grained Soil*

Atterberg Limits

Liquid Limit

No of Blows	19	27	35
Pan ID	61	69	121
Pan Wt	10.96	10.99	11.28
Pan + Soil (wet)	22.57	22.59	22.88
Pan + Soil (dry)	17.12	17.29	17.74
Moisture Content	88%	84%	80%
Liquid Limit	86	85	83
Liquid Limit	*85*		

Plastic Limit

Pan ID	H	30
Pan Weight	2.42	2.41
Pan + Soil (wet)	10.99	10.58
Pan + Soil (dry)	8.53	8.22
Moisture Content	40%	41%
Plastic Limit	*40*	
Plastic Index	*44*	

USCS Classification

Group Symbol **MH**
Group Name **Elastic SILT**

Grain Size Distribution Calculations

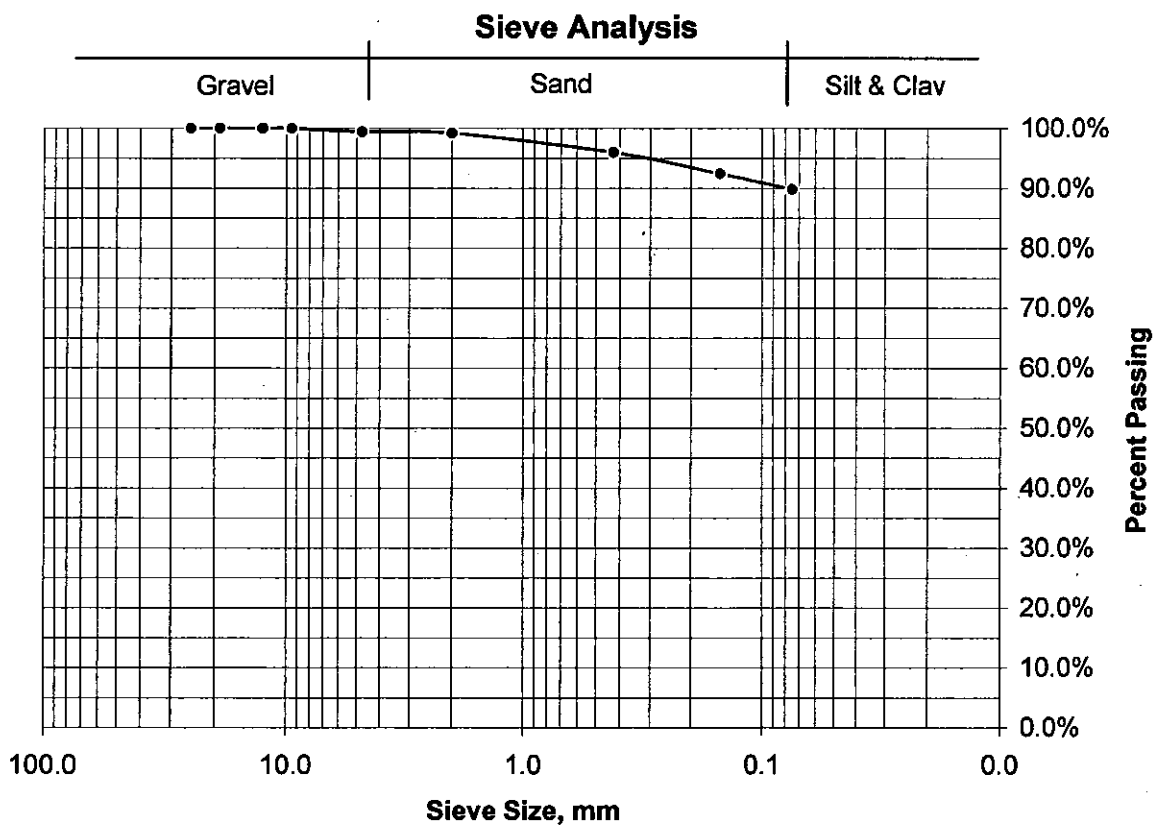
Madison County Landfill
DAA #R05646-01
Prepared By: SDH

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID ST-9
Sample Depth Lift 3

Mechanical Sieve Analysis

Sieve Size	Weight Retained	Percent Retained	Sieve Size, mm	Percent Passing
1"	0.00	0.0%	25.0	100.0%
3/4"	0.00	0.0%	19.0	100.0%
1/2"	0.00	0.0%	12.5	100.0%
3/8"	0.00	0.0%	9.5	100.0%
No. 4	0.91	0.6%	4.75	99.4%
No. 10	0.32	0.2%	2.0	99.2%
No. 40	5.06	3.2%	0.425	96.0%
No. 100	5.59	3.6%	0.15	92.4%
No. 200	4.12	2.6%	0.075	89.8%
Pan	0.30	0.2%		
Total	16.30	10.2%		



Permeability Calculations

Madison County Landfill
DAA #R05646-01
Prepared By: SDH

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID: ST-9
Sample Depth: Lift 3
Permeability Method: ASTM D5084
Sample Length, in: 3.73
Sample Diamter, in: 2.86

Moisture Content

Pan Wt	193.79 grams
Pan + Soil (wet)	412.80 grams
Pan + Soil (dry)	351.01 grams
Moisture Content	*39.3%*

Dry Density

Soil (wet)	719.60 grams
Wet Density	114.9 pcf
Dry Density	*82.5* pcf

Test Conditions

Backpressure, psi	40.0
Cell Pressure, psi	50.0
Influent Buret Area, cm^2	0.03142
Effluent Buret Area, cm^2	0.76712

Permeability Trials

Time min	Influent Head, cm	Influent Flow, cm^3	Effluent Head, cm	Effluent Flow, cm^3	Flow Deviation Ratio	Gradient mm-Hg	Permeabilty, k cm/sec
12-Nov 10:47	17.350		0.900				
12-Nov 10:48	17.000	0.011	0.914	0.011	1.00	21.82	2.1E-07
12-Nov 10:49	16.800	0.006	0.923	0.006	1.00	21.34	1.2E-07
12-Nov 10:50	16.500	0.009	0.935	0.009	1.00	21.06	1.8E-07
12-Nov 10:51	16.350	0.005	0.941	0.005	1.00	20.65	9.3E-08
12-Nov 10:52	16.100	0.008	0.951	0.008	1.00	20.44	1.6E-07
12-Nov 10:53	16.000	0.003	0.955	0.003	1.00	20.09	6.3E-08
12-Nov 10:54	15.900	0.003	0.959	0.003	1.00	19.96	6.4E-08
12-Nov 10:59	15.200	0.022	0.988	0.022	1.00	19.82	9.2E-08

Average Permeability 9.4E-08 cm/sec

Final Data

Assumed Specific Gravity	2.65
Final Weight of Sample	725.50 grams
Final Moisture Content	40.4%
Percent Voids	50.1%
Actual Volume of Voids	195.8 ml
Saturation	100.0%

Permeability Calculations

Madison County Landfill
DAA #R05646-01
Prepared By: SDH

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID: ST-10
Sample Depth: Lift 1
Permeability Method: ASTM D5084
Sample Length, in: 3.88
Sample Diamter, in: 2.83

Moisture Content

Pan Wt	194.86 grams
Pan + Soil (wet)	374.86 grams
Pan + Soil (dry)	331.65 grams
Moisture Content	*31.6%*

Dry Density

Soil (wet)	763.30 grams
Wet Density	119.1 pcf
Dry Density	*90.5* pcf

Test Conditions

Backpressure, psi	40.0
Cell Pressure, psi	50.0
Influent Buret Area, cm^2	0.03142
Effluent Buret Area, cm^2	0.76712

Permeability Trials

Time min	Influent Head, cm	Influent Flow, cm^3	Effluent Head, cm	Effluent Flow, cm^3	Flow Deviation Ratio	Gradient mm-Hg	Permeabilty, k cm/sec
17-Nov 8:50	16.500		0.900				
17-Nov 8:51	16.200	0.009	0.912	0.009	1.00	19.87	2.0E-07
17-Nov 8:52	15.950	0.008	0.923	0.008	1.00	19.47	1.7E-07
17-Nov 8:53	15.700	0.008	0.933	0.008	1.00	19.14	1.7E-07
17-Nov 8:54	15.500	0.006	0.941	0.006	1.00	18.81	1.4E-07
17-Nov 8:55	15.300	0.006	0.949	0.006	1.00	18.54	1.4E-07
17-Nov 8:56	15.100	0.006	0.957	0.006	1.00	18.28	1.4E-07
17-Nov 8:57	14.900	0.006	0.966	0.006	1.00	18.01	1.4E-07
17-Nov 9:02	14.000	0.028	1.002	0.028	1.00	17.75	1.4E-07

Average Permeability 1.4E-07 cm/sec

Final Data

Assumed Specific Gravity	2.65
Final Weight of Sample	772.70 grams
Final Moisture Content	33.2%
Percent Voids	45.3%
Actual Volume of Voids	181.2 ml
Saturation	100.0%

Soil Classification Calculations

Madison County Landfill
DAA #R05646-01
Prepared By: SDH

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID	ST-11
Sample Depth	Lift 2
Visual Sample Description	Red-Brown Fat CLAY with Sand

Natural Moisture Content

Pan ID	8
Pan Wt	187.22 grams
Pan + Soil (wet)	433.10 grams
Pan + Soil (dry)	369.70 grams
Natural Moisture Content	*34.7%*

Coarse or Fine Grained

Pan + Soil retained on No. 200 sieve (dry)	219.74 grams
Percent Passing No. 200 Sieve	82.2%
Pan + Soil retained on No. 4 sieve (dry)	188.52 grams
Percent Passing No. 4 Sieve	99.3%
Soil Classifies as	*Fine-Grained Soil*

Atterberg Limits

Liquid Limit

No of Blows	18	26	34
Pan ID	97	95	102
Pan Wt	26.15	28.28	24.04
Pan + Soil (wet)	33.98	35.56	32.3
Pan + Soil (dry)	30.56	32.42	28.82
Moisture Content	78%	76%	73%
Liquid Limit	75	76	76
Liquid Limit	*76*		

Plastic Limit

Pan ID	60	54
Pan Weight	1.91	1.90
Pan + Soil (wet)	8.94	9.15
Pan + Soil (dry)	7.14	7.32
Moisture Content	34%	34%
Plastic Limit	*34*	
Plastic Index	*41*	

USCS Classification

Group Symbol	**CH**
Group Name	**Fat CLAY with Sand**

Grain Size Distribution Calculations

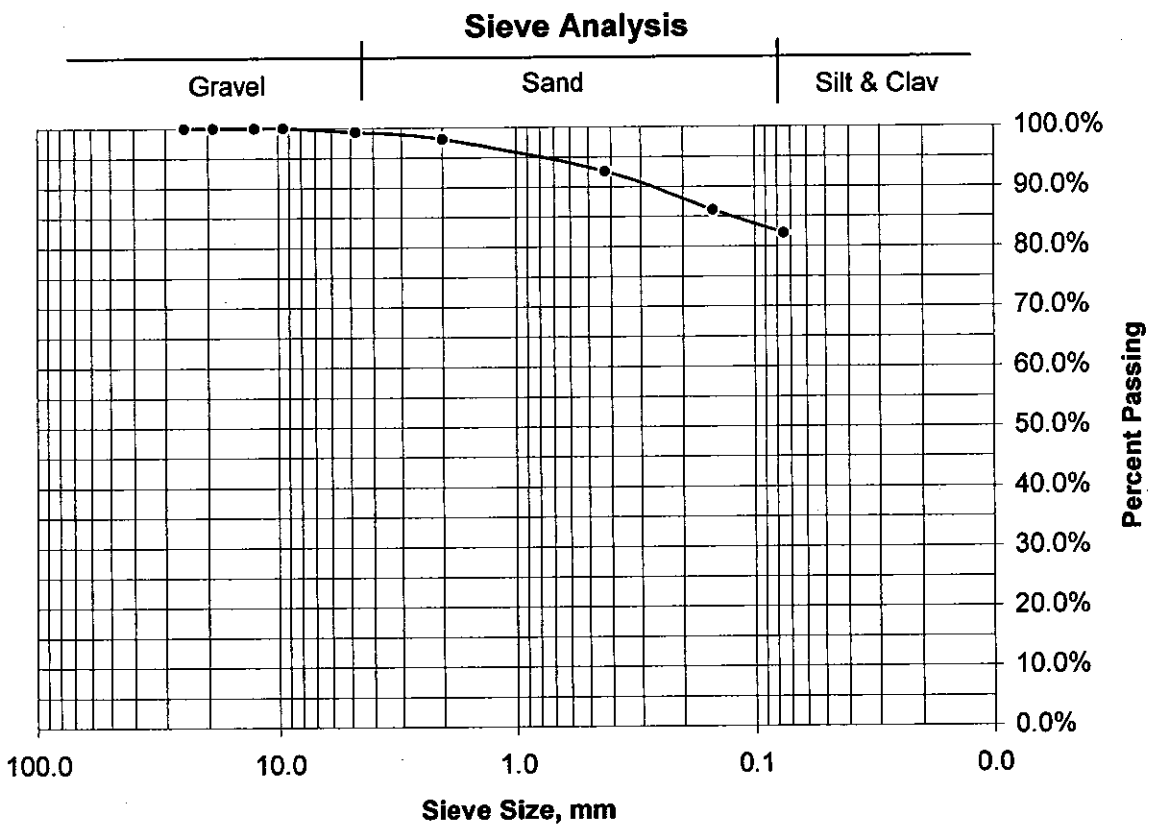
Madison County Landfill
DAA #R05646-01
Prepared By: SDH

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID ST-11
Sample Depth Lift 2

Mechanical Sieve Analysis

Sieve Size	Weight Retained	Percent Retained	Sieve Size, mm	Percent Passing
1"	0.00	0.0%	25.0	100.0%
3/4"	0.00	0.0%	19.0	100.0%
1/2"	0.00	0.0%	12.5	100.0%
3/8"	0.00	0.0%	9.5	100.0%
No. 4	1.30	0.7%	4.75	99.3%
No. 10	2.23	1.2%	2.0	98.1%
No. 40	9.95	5.5%	0.425	92.6%
No. 100	11.87	6.5%	0.15	86.1%
No. 200	7.21	4.0%	0.075	82.2%
Pan	0.24	0.1%		
Total	32.80	17.8%		



Permeability Calculations

Madison County Landfill
DAA #R05646-01
Prepared By: SDH

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID: ST-11
Sample Depth: Lift 2
Permeability Method: ASTM D5084
Sample Length, in: 3.70
Sample Diamter, in: 2.83

Moisture Content

Pan Wt	187.22 grams
Pan + Soil (wet)	433.10 grams
Pan + Soil (dry)	369.70 grams
Moisture Content	*34.7%*

Dry Density

Soil (wet)	710.70 grams
Wet Density	116.5 pcf
Dry Density	*86.4* pcf

Test Conditions

Backpressure, psi	40.0
Cell Pressure, psi	50.0
Influent Buret Area, cm^2	0.03142
Effluent Buret Area, cm^2	0.76712

Permeability Trials

Time min	Influent Head, cm	Influent Flow, cm^3	Effluent Head, cm	Effluent Flow, cm^3	Flow Deviation Ratio	Gradient mm-Hg	Permeabilty, k cm/sec
17-Nov 8:26	16.950		1.000				
17-Nov 8:27	16.600	0.011	1.014	0.011	1.00	21.29	2.2E-07
17-Nov 8:28	16.250	0.011	1.029	0.011	1.00	20.80	2.2E-07
17-Nov 8:29	16.000	0.008	1.039	0.008	1.00	20.32	1.6E-07
17-Nov 8:30	15.750	0.008	1.049	0.008	1.00	19.97	1.6E-07
17-Nov 8:31	15.550	0.006	1.057	0.006	1.00	19.62	1.3E-07
17-Nov 8:32	15.300	0.008	1.068	0.008	1.00	19.34	1.7E-07
17-Nov 8:33	15.100	0.006	1.076	0.006	1.00	19.00	1.4E-07
17-Nov 8:38	14.050	0.033	1.119	0.033	1.00	18.72	1.5E-07

Average Permeability 1.5E-07 cm/sec

Final Data

Assumed Specific Gravity	2.65
Final Weight of Sample	714.80 grams
Final Moisture Content	35.5%
Percent Voids	47.7%
Actual Volume of Voids	181.7 ml
Saturation	100.0%

Soil Classification Calculations

Madison County Landfill
DAA #R05646-01
Prepared By: SDH

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID ST-12
Sample Depth Lift 3
Visual Sample Description Red-Brown Elastic SILT with Sand

Natural Moisture Content

Pan ID	30
Pan Wt	193.70 grams
Pan + Soil (wet)	400.40 grams
Pan + Soil (dry)	347.89 grams
Natural Moisture Content	*34.1%*

Coarse or Fine Grained

Pan + Soil retained on No. 200 sieve (dry)	223.31 grams
Percent Passing No. 200 Sieve	80.8%
Pan + Soil retained on No. 4 sieve (dry)	199.32 grams
Percent Passing No. 4 Sieve	96.4%
Soil Classifies as	*Fine-Grained Soil*

Atterberg Limits

Liquid Limit

No of Blows	19	26	35
Pan ID	12	63	5
Pan Wt	11.23	10.76	11.09
Pan + Soil (wet)	18.98	17.89	17.86
Pan + Soil (dry)	15.61	14.88	15.04
Moisture Content	77%	73%	71%
Liquid Limit	74	73	74
Liquid Limit	*74*		

Plastic Limit

Pan ID	18	48
Pan Weight	2.39	2.40
Pan + Soil (wet)	11.89	11.54
Pan + Soil (dry)	9.36	9.13
Moisture Content	36%	36%
Plastic Limit	*36*	
Plastic Index	*38*	

USCS Classification

Group Symbol **MH**
Group Name **Elastic SILT with Sand**

Grain Size Distribution Calculations

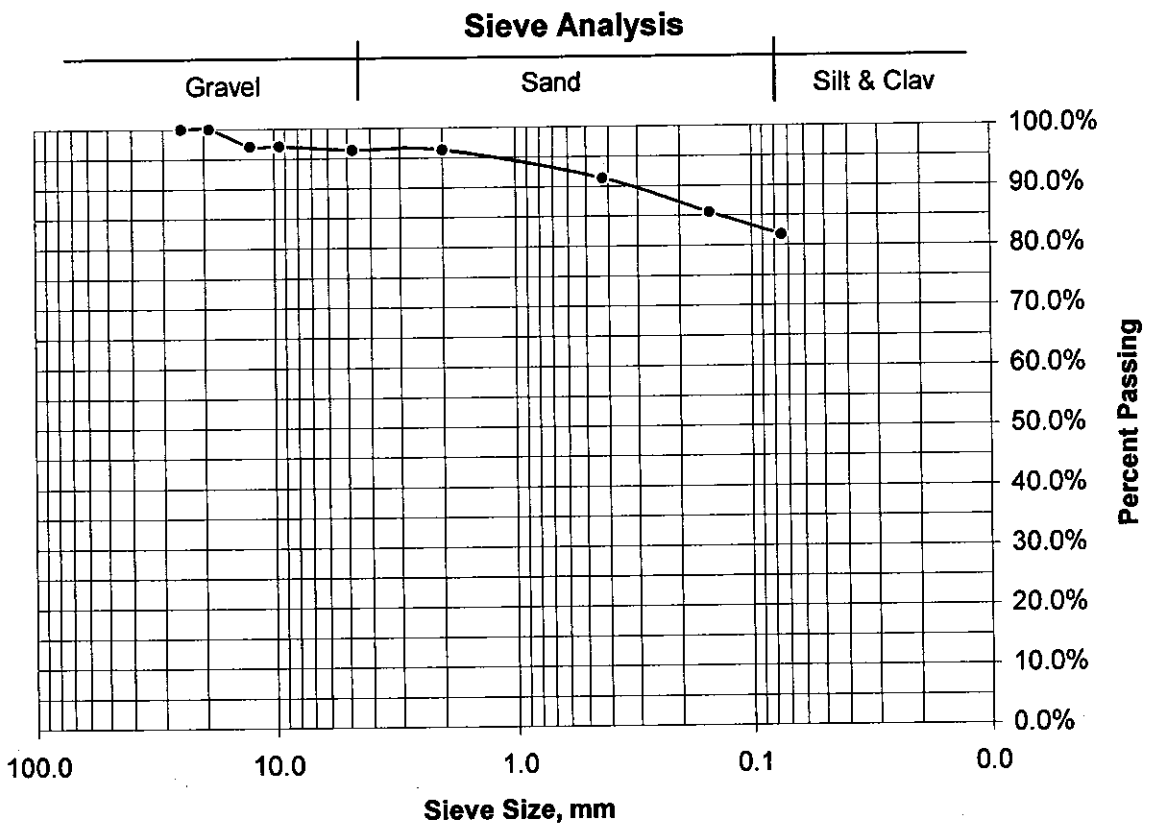
Madison County Landfill
DAA #R05646-01
Prepared By: SDH

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID ST-12
Sample Depth Lift 3

Mechanical Sieve Analysis

Sieve Size	Weight Retained	Percent Retained	Sieve Size, mm	Percent Passing
1"	0.00	0.0%	25.0	100.0%
3/4"	0.00	0.0%	19.0	100.0%
1/2"	4.57	3.0%	12.5	97.0%
3/8"	0.00	0.0%	9.5	97.0%
No. 4	1.05	0.7%	4.75	96.4%
No. 10	0.08	0.1%	2.0	96.3%
No. 40	7.62	4.9%	0.425	91.4%
No. 100	8.94	5.8%	0.15	85.6%
No. 200	5.88	3.8%	0.075	81.7%
Pan	1.16	0.8%		
Total	29.30	18.3%		



Permeability Calculations

Madison County Landfill
DAA #R05646-01
Prepared By: SDH

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID: ST-12
Sample Depth: Lift 3
Permeability Method: ASTM D5084
Sample Length, in: 3.82
Sample Diamter, in: 2.85

Moisture Content

Pan Wt	193.70	grams
Pan + Soil (wet)	400.40	grams
Pan + Soil (dry)	347.89	grams
Moisture Content	*34.1%*	

Dry Density

Soil (wet)	743.30	grams
Wet Density	116.0	pcf
Dry Density	*86.5*	pcf

Test Conditions

Backpressure, psi	40.0
Cell Pressure, psi	50.0
Influent Buret Area, cm^2	0.03142
Effluent Buret Area, cm^2	0.76712

Permeability Trials

Time min	Influent Head, cm	Influent Flow, cm^3	Effluent Head, cm	Effluent Flow, cm^3	Flow Deviation Ratio	Gradient mm-Hg	Permeabilty, k cm/sec
17-Nov 9:06	16.000		0.900				
17-Nov 9:07	15.600	0.013	0.916	0.013	1.00	19.54	2.6E-07
17-Nov 9:08	15.250	0.011	0.931	0.011	1.00	19.00	2.4E-07
17-Nov 9:09	15.000	0.008	0.941	0.008	1.00	18.53	1.7E-07
17-Nov 9:10	14.750	0.008	0.951	0.008	1.00	18.19	1.8E-07
17-Nov 9:11	14.500	0.008	0.961	0.008	1.00	17.86	1.8E-07
17-Nov 9:12	14.300	0.006	0.970	0.006	1.00	17.52	1.5E-07
17-Nov 9:13	14.100	0.006	0.978	0.006	1.00	17.25	1.5E-07
17-Nov 9:18	13.200	0.028	1.015	0.028	1.00	16.98	1.4E-07

Average Permeability 1.5E-07 cm/sec

Final Data

Assumed Specific Gravity	2.65
Final Weight of Sample	751.00 grams
Final Moisture Content	35.4%
Percent Voids	47.7%
Actual Volume of Voids	190.7 ml
Saturation	100.0%

Permeability Calculations

Madison County Landfill
DAA #R05646-01
Prepared By: SDH

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID: ST-13
Sample Depth: Lift 1
Permeability Method: ASTM D5084
Sample Length, in: 3.76
Sample Diamter, in: 2.84

Moisture Content

Pan Wt	189.56 grams
Pan + Soil (wet)	412.30 grams
Pan + Soil (dry)	358.95 grams
Moisture Content	*31.5%*

Dry Density

Soil (wet)	785.10 grams
Wet Density	125.5 pcf
Dry Density	*95.5* pcf

Test Conditions

Backpressure, psi	40.0
Cell Pressure, psi	50.0
Influent Buret Area, cm^2	0.03142
Effluent Buret Area, cm^2	0.76712

Permeability Trials

Time min	Influent Head, cm	Influent Flow, cm^3	Effluent Head, cm	Effluent Flow, cm^3	Flow Deviation Ratio	Gradient mm-Hg	Permeabilty, k cm/sec
2-Dec 9:01	16.400		0.900				
2-Dec 9:02	16.200	0.006	0.908	0.006	1.00	20.37	1.3E-07
2-Dec 9:03	16.000	0.006	0.916	0.006	1.00	20.09	1.3E-07
2-Dec 9:04	15.800	0.006	0.925	0.006	1.00	19.82	1.3E-07
2-Dec 9:05	15.600	0.006	0.933	0.006	1.00	19.55	1.3E-07
2-Dec 9:06	15.400	0.006	0.941	0.006	1.00	19.27	1.3E-07
2-Dec 9:07	15.200	0.006	0.949	0.006	1.00	19.00	1.4E-07
2-Dec 9:08	15.000	0.006	0.957	0.006	1.00	18.73	1.4E-07
2-Dec 9:13	14.600	0.013	0.974	0.013	1.00	18.45	5.6E-08

Average Permeability 1.2E-07 cm/sec

Final Data

Assumed Specific Gravity	2.65
Final Weight of Sample	788.60 grams
Final Moisture Content	32.1%
Percent Voids	42.3%
Actual Volume of Voids	165.0 ml
Saturation	100.0%

Permeability Calculations

Madison County Landfill
DAA #R05646-01
Prepared By: SDH

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID: ST-14
Sample Depth: Lift 2
Permeability Method: ASTM D5084
Sample Length, in: 3.66
Sample Diamter, in: 2.83

Moisture Content

Pan Wt	192.56 grams
Pan + Soil (wet)	487.50 grams
Pan + Soil (dry)	415.90 grams
Moisture Content	*32.1%*

Dry Density

Soil (wet)	765.20 grams
Wet Density	126.6 pcf
Dry Density	*95.9* pcf

Test Conditions

Backpressure, psi	40.0
Cell Pressure, psi	50.0
Influent Buret Area, cm^2	0.03142
Effluent Buret Area, cm^2	0.76712

Permeability Trials

Time min	Influent Head, cm	Influent Flow, cm^3	Effluent Head, cm	Effluent Flow, cm^3	Flow Deviation Ratio	Gradient mm-Hg	Permeabilty, k cm/sec
2-Dec 9:28	16.400		0.900				
2-Dec 9:29	16.100	0.009	0.912	0.009	1.00	20.92	1.9E-07
2-Dec 9:30	15.900	0.006	0.920	0.006	1.00	20.50	1.3E-07
2-Dec 9:31	15.750	0.005	0.927	0.005	1.00	20.22	9.6E-08
2-Dec 9:32	15.550	0.006	0.935	0.006	1.00	20.01	1.3E-07
2-Dec 9:33	15.400	0.005	0.941	0.005	1.00	19.73	9.9E-08
2-Dec 9:34	15.300	0.003	0.945	0.003	1.00	19.52	6.6E-08
2-Dec 9:35	15.200	0.003	0.949	0.003	1.00	19.38	6.7E-08
2-Dec 9:40	14.700	0.016	0.970	0.016	1.00	19.24	6.8E-08

Average Permeability 7.5E-08 cm/sec

Final Data

Assumed Specific Gravity	2.65
Final Weight of Sample	778.90 grams
Final Moisture Content	34.4%
Percent Voids	42.0%
Actual Volume of Voids	158.6 ml
Saturation	100.0%

Permeability Calculations

Madison County Landfill
DAA #R05646-01
Prepared By: SDH

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID: ST-15
Sample Depth: Lift 3
Permeability Method: ASTM D5084
Sample Length, in: 3.75
Sample Diamter, in: 2.84

Moisture Content

Pan Wt	196.87 grams
Pan + Soil (wet)	420.70 grams
Pan + Soil (dry)	370.14 grams
Moisture Content	*29.2%*

Dry Density

Soil (wet)	777.60 grams
Wet Density	124.7 pcf
Dry Density	*96.5* pcf

Test Conditions

Backpressure, psi	40.0
Cell Pressure, psi	50.0
Influent Buret Area, cm^2	0.03142
Effluent Buret Area, cm^2	0.76712

Permeability Trials

Time min	Influent Head, cm	Influent Flow, cm^3	Effluent Head, cm	Effluent Flow, cm^3	Flow Deviation Ratio	Gradient mm-Hg	Permeabilty, k cm/sec
2-Dec 9:43	16.700		0.900				
2-Dec 9:44	16.400	0.009	0.912	0.009	1.00	20.82	1.9E-07
2-Dec 9:45	16.100	0.009	0.925	0.009	1.00	20.41	1.9E-07
2-Dec 9:46	15.800	0.009	0.937	0.009	1.00	19.99	1.9E-07
2-Dec 9:47	15.500	0.009	0.949	0.009	1.00	19.58	2.0E-07
2-Dec 9:48	15.200	0.009	0.961	0.009	1.00	19.17	2.0E-07
2-Dec 9:49	15.000	0.006	0.970	0.006	1.00	18.76	1.4E-07
2-Dec 9:50	14.800	0.006	0.978	0.006	1.00	18.49	1.4E-07
2-Dec 9:55	14.200	0.019	1.002	0.019	1.00	18.21	8.6E-08

Average Permeability 1.4E-07 cm/sec

Final Data

Assumed Specific Gravity	2.65
Final Weight of Sample	780.20 grams
Final Moisture Content	29.6%
Percent Voids	41.6%
Actual Volume of Voids	162.1 ml
Saturation	100.0%

SECTION IV

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

January 20, 2006

Mr. Mark Cathey
McGill Associates
55 Broad Street
Asheville, NC 28802

Re: Vegetative Supportive Soil Layer and Anchor Trench Backfill
QA Testing Documentation
Madison County MSW Landfill Closure
CTC Project No. 70001

Dear Mr. Cathey:

Attached, you will find our compiled Field and Soil Laboratory Test Data for the Vegetative Supportive Soil Layer and Anchor Trench Backfill placed on the above mentioned project.

Inspection and Field Testing

The following tests were conducted on the Vegetative Supportive Soil Layer:

Test	*ASTM Designation or Other Test Method*	*Frequency Required*	*Frequency Performed*
Hydraulic Conductivity	D5084	1/5,000 CY^3	1/5,000 CY^3
Compacted Density	D2922 or D2937	1/Acre	1/Acre
Compacted Moisture Content	D3017 or D2216	1/Acre	1/Acre

C. T. Clayton Sr., P.E., Inc. provided quality assurance observation and testing as the Vegetative Supportive Soil Layer and Anchor Trench Backfill were placed from December 6, 2005 through December 28, 2005. Field density testing was performed on the Anchor Trench Backfill to assure proper moisture and densities were obtained during construction.

3100 NC 27 East
Coats, NC 27521
Phone: 910-897-7070
Fax: 910-897-6767

Offices located in Coats and New Bern, North Carolina
www.ctclayton.com

Vegetative Supportive Soils were placed within the cell area maintaining a minimum cushion depth of 18-inches between the geosynthetics and light tracked dozer. High traffic haul roads maintained a minimum of 3-feet soil cushion. Depth of the Vegetative Supportive Soil Layer was verified by field observation and measurement at density test locations. Field density testing confirmed that an acceptable degree of compaction was achieved during the soil liner placement. Testing also confirmed that the range of soil moistures was satisfactory. In addition to our field density testing, Shelby tube samples were obtained and laboratory permeability and classification tests were performed. The Vegetative Supportive Soil Layer produced acceptable permeabilities ranging from 1.5×10^{-6} cm/sec to 3.7×10^{-7} cm/sec. Our laboratory data and field density test results are attached.

Conclusions

Based on our field documentation, laboratory test results and geotechnical engineering experience, we conclude that the Vegetative Supportive Soil Layer and Anchor Trench Backfill on the above referenced project site has been completed in accordance with the project requirements and acceptable engineering practices.

Sincerely,
C.T. CLAYTON SR. P.E., INC.

NORTH CAROLINA PROFESSIONAL SEAL 028909 ENGINEER C. TYRUS CLAYTON, JR.

01/20/06

C. Tyrus Clayton, Jr., P.E.
Project QA Engineer

attachments
cc: File

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Site Visit Report

Project: Madison County MSW Landfill

Job No.: 70001	**Date:** 06-Dec-05
Location: Marshall, NC	
Visit by:	**Page:** 1 of 2

Personnel - Construction

Contractor / Subcontractor:

Bob Stout Const.

GSI

Personnel - Inspection / Other

Engineer (QA / QC):

Darren Spier - CT Clayton

Owner Representatives:

Jim Huff - Madison County

Visitors:

Equipment

Description	No. on Site	No. in Use
Trackhoe	2	
Rubber Tired Backhoe	2	
Dozer	2	
Front End Loader		
Track Loader		
Pan / Scraper		
Grader		
Sheepsfoot Roller	1	
Smooth Drum Roller	1	
Dump Truck	2	
Tractor w/ box grader	1	

Materials Delivered

Description	Quantity

Weather Conditions

Morning: sun

Temp: 35

Noon: -

Temp: 55

Evening: -

Temp: -

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Site Visit Report

Project No.: 70001

Date: 6-Dec-05

The LLDPE liner on site was insufficient to finish covering the entire cell so a roll of 60 mil HDPE liner was delivered by GSI to cover the approximately 6,000 square feet on the east corner of the cell which remained. The HDPE liner was placed in the same manner as the LLDPE and welded using the double-weld fusion method. Once the liner was placed and welded the entire cell was complete for plastic liner. Repairs of today and previous days placement then continued for the southeast portion of the cell. As repair crews patched and tested joints and holes the rest of the GSI team continued placement of the Geonet fabric. The placement utilized two four-wheeled ATVs in order to minimize drag. These activities continued throughout the day.

Signature: Darren Jones

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Site Visit Report

Project: Madison County MSW Landfill

Job No.: 70001 | **Date:** 07-Dec-05

Location: Marshall, NC

Visit by: | **Page:** 1 of 2

Personnel - Construction

Contractor / Subcontractor:

Bob Stout Const.

GSI

Personnel - Inspection / Other

Engineer (QA / QC):

Darren Spier - CT Clayton

Owner Representatives:

Jim Huff - Madison County

Visitors:

Equipment

Description	No. on Site	No. in Use
Trackhoe	2	
Rubber Tired Backhoe	2	
Dozer	2	
Front End Loader		
Track Loader		
Pan / Scraper		
Grader		
Sheepsfoot Roller	1	
Smooth Drum Roller	1	
Dump Truck	2	
Tractor w/ box grader	1	

Materials Delivered

Description	Quantity

Weather Conditions

Morning: sun

Temp: 35

Noon: -

Temp: 40

Evening: -

Temp: -

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Site Visit Report

Project No.: 70001

Date: 7-Dec-05

Placement and seaming of Geonet fabric continued today. Rolls were placed in the same manner as previous days and joined with nylon zip-ties at approximately 4 feet intervals parallel to the slope and every 6 inches when seams were perpendicular to the slope. The top fabric was then welded by torch with care taken to ensure a uniform seal with no burnouts. Any burnouts or other holes and defects encountered on the rolls were patched with a scrap piece of fabric. The patches were checked manually to ensure as complete a seal as the other seams.

While Geonet placement continued the crew of Bob Stout Inc. prepared the anchor trench and geocomposite at the edge of the cell for backfill and drain pipe placement. The anchor trench was backfilled with material that had been stockpiled as it was excavated. If material appeared to be saturated as a result of recent rain events a load of material from the borrow area was placed near to replace the failing material. The placed material was compacted dynamically with the filled bucket of the excavator. A spotter on the liner guided the excavator when necessary to ensure that no damage was incurred on the plastic liner. Once backfill was complete and the area passed for compaction, the geonet fabric was laid out flat, which extended 3 or 4 feet beyond the edge of the LLDPE liner. The perforated corrugated pipe sections were then coupled together and placed in the depression which formed at the near end of the anchor trench area. The geonet was then flipped on top of the pipe, sealing the pipe in a geonet "burrito". Nylon zip-ties were then placed at 4 to 5 foot intervals, more frequently if needed, connecting the HDPE grid to itself. Care was taken while making holes for tying so as to not puncture the LLDPE liner underneath. Once zip-ties were in place for a number of sections the fabric was torch welded along its edges to provide a seal. Finally, a two foot wide strip of 6oz. fabric was torch welded across the edge of the geonet and any seams that required covering. This covered the holes caused by zip-tying and sealed off the exposed edge of the geonet fabric. The corrugated pipe has a double layer of 6oz fabric plus HDPE grid surrounding it with this configuration.

Signature: Darren Jones

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Site Visit Report

Project: Madison County MSW Landfill

Job No.: 70001 | **Date:** 12-Dec-05

Location: Marshall, NC

Visit by: | **Page:** 1 of 2

Personnel - Construction

Contractor / Subcontractor:

Bob Stout Const.

Personnel - Inspection / Other

Engineer (QA / QC):

Darren Spier - CT Clayton

Owner Representatives:

Jim Huff - Madison County

Visitors:

Equipment

Description	No. on Site	No. in Use
Trackhoe	2	1
Rubber Tired Backhoe	2	
Dozer	2	1
Front End Loader		
Track Loader		
Pan / Scraper		
Grader		
Sheepsfoot Roller	1	
Smooth Drum Roller	1	
Dump Truck	2	2
Tractor w/ box grader	1	

Materials Delivered

Description	Quantity

Weather Conditions

Morning:

Temp:

Noon: Cloudy/drizzle

Temp: 40

Evening: -

Temp: -

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Site Visit Report

Project No.: 70001

Date: 12-Dec-05

Placement of vegetative cover began today on the eastern portion of the dome nearest the haul road to the borrow area. A 2 foot marker was placed on each methane gas vent to mark grade.

The material was placed in a lift of approximately 4 feet over the corrugated drain pipe at the edge of the cell to bridge over the area without crushing. As material was worked into the cell the dozer placed material to approximately 3 feet. Material will be worked up to the top of the dome of the cell, then will be worked down the sides so that dump trucks can make a wide arc around the cell to dump their loads. While the trucks must back up and change direction during hauling the grade of the material will remain at 3+ feet. Once loads are able to be dumped without any abrupt stops, starts, or turns the grade will be lowered to closer to the 24 inch final grade. Finish grading of vegetative cover, including the 6 inch topsoil material, will begin once material has been delivered for each section and truck traffic is no longer as frequent.

Signature: Darren Jones

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Site Visit Report

Project: Madison County MSW Landfill

Job No.: 70001	**Date:** 13-Dec-05
Location: Marshall, NC	
Visit by:	**Page:** 1 of 2

Personnel - Construction

Contractor / Subcontractor:

Bob Stout Const.

Personnel - Inspection / Other

Engineer (QA / QC):

Darren Spier - CT Clayton

Owner Representatives:

Jim Huff - Madison County

Visitors:

Equipment

Description	No. on Site	No. in Use
Trackhoe	2	1
Rubber Tired Backhoe	2	
Dozer	2	1
Front End Loader		
Track Loader		
Pan / Scraper		
Grader		
Sheepsfoot Roller	1	
Smooth Drum Roller	1	
Dump Truck	2	2
Tractor w/ box grader	1	

Materials Delivered

Description	Quantity

Weather Conditions

Morning: sun

Temp: 30

Noon: partly cloudy

Temp: 40

Evening: -

Temp: -

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Site Visit Report

Project No.: 70001

Date: 13-Dec-05

Placement of vegetative cover material continued today. Material was placed to the 2 foot grade on top of the dome around the methane vent. The material was placed to provide a turnaround for the dumptrucks. This will provide a staging area for placement on the northern half of the cell.

Material was pushed downslope parallel to the direction of the placed geonet fabric. The material is being placed so as to attempt to minimize lateral movement of the soil which may tear apart seams. The geonet in front of material being placed was monitored for signs of these tears. No bunching of the fabric or excess movement was detected.

Signature: Darren Jones

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Site Visit Report

Project: Madison County MSW Landfill

Job No.: 70001 | **Date:** 14-Dec-05

Location: Marshall, NC

Visit by: | **Page:** 1 of 2

Personnel - Construction

Contractor / Subcontractor:

Bob Stout Const.

Personnel - Inspection / Other

Engineer (QA / QC):

Darren Spier - CT Clayton

Owner Representatives:

Jim Huff - Madison County

Visitors:

Equipment

Description	No. on Site	No. in Use
Trackhoe	2	2
Rubber Tired Backhoe	2	
Dozer	2	1
Front End Loader		
Track Loader		
Pan / Scraper		
Grader		
Sheepsfoot Roller	1	
Smooth Drum Roller	1	
Dump Truck	2	2
Tractor w/ box grader	1	

Materials Delivered

Description	Quantity

Weather Conditions

Morning: partly cloudy

Temp: 30

Noon: -

Temp: 40

Evening: -

Temp: -

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Site Visit Report

Project No.: 70001

Date: 14-Dec-05

Vegetative cover placement continued today on the north face of the dome along to the west. Along the edge of the cell additional care was taken to ensure the pipe enclosure was not compromised. Material was placed to where the edge of the geonet was tied to itself. Then material was placed and graded so that the direction of placement went with the perimeter of the cell. This was done to minimize pulling force which may tear away the seal of the geonet. Material was placed to a 2'+ grade and dump trucks will not be allowed near the perimeter of the cell as there is not enough material over the pipes to provide a bridge for that size load.

Signature: [illegible]

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Site Visit Report

Project: Madison County MSW Landfill

Job No.: 70001 | **Date:** 19-Dec-05

Location: Marshall, NC

Visit by: | **Page:** 1 of 2

Personnel - Construction

Contractor / Subcontractor:

Bob Stout Const.

Personnel - Inspection / Other

Engineer (QA / QC):

Darren Spier - CT Clayton

Owner Representatives:

Jim Huff - Madison County

Visitors:

Equipment

Description	No. on Site	No. in Use
Trackhoe	2	2
Rubber Tired Backhoe	2	
Dozer	2	1
Front End Loader		
Track Loader		
Pan / Scraper		
Grader		
Sheepsfoot Roller	1	
Smooth Drum Roller	1	
Dump Truck	2	2
Tractor w/ box grader	1	

Materials Delivered

Description	Quantity

Weather Conditions

Morning:

Temp:

Noon: sunny

Temp: 40

Evening: -

Temp: -

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Site Visit Report

Project No.: 70001

Date: 19-Dec-05

Vegetative cover placement resumed after an ice storm last week suspended work. Material was placed in the same manner as previous. Trucks hauled material and dumped in a manner that minimized sudden starts or stops which may shift soil underneath. There have been no indications that this is possible in the current manner in which the trucks are being used. Around methane vents the dozer has not conditioned the soil to any grade so as to avoid any accidents. Material is in sufficient quantity around the vents to provide grade and will be placed either by dozer once material delivery is stopped for the section and the operator can more finely grade the area or by hand with a manual compactor.

Signature: [illegible]

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Site Visit Report

Project: Madison County MSW Landfill

Job No.: 70001 | **Date:** 20-Dec-05

Location: Marshall, NC

Visit by: | **Page:** 1 of 2

Personnel - Construction

Contractor / Subcontractor:

Bob Stout Const.

Personnel - Inspection / Other

Engineer (QA / QC):

Darren Spier - CT Clayton

Owner Representatives:

Jim Huff - Madison County

Visitors:

Equipment

Description	No. on Site	No. in Use
Trackhoe	2	2
Rubber Tired Backhoe	2	
Dozer	2	1
Front End Loader		
Track Loader		
Pan / Scraper		
Grader		
Sheepsfoot Roller	1	
Smooth Drum Roller	1	
Dump Truck	2	2
Tractor w/ box grader	1	

Materials Delivered

Description	Quantity

Weather Conditions

Morning:

Temp:

Noon: sunny

Temp: 40

Evening: -

Temp: -

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Site Visit Report

Project No.: 70001

Date: 20-Dec-05

The placement of vegetative cover continued today. Placement was on the west side of the dome and south down to the first terrace. As there is no grade stakes other than the methane vents the grade of vegetative cover will follow the grade of the clay and geocomposite liners. This will provide the material on the spot for finish grading and any changes which need to be made will occur after a survey to determine exact locations of benches and grade.

Signature: Darren Jones

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Site Visit Report

Project: Madison County MSW Landfill

Job No.: 70001 | **Date:** 21-Dec-05

Location: Marshall, NC

Visit by: | **Page:** 1 of 2

Personnel - Construction

Contractor / Subcontractor:

Bob Stout Const.

Personnel - Inspection / Other

Engineer (QA / QC):

Darren Spier - CT Clayton

Owner Representatives:

Jim Huff - Madison County

Visitors:

Equipment

Description	No. on Site	No. in Use
Trackhoe	2	1
Rubber Tired Backhoe	1	
Dozer	2	1
Front End Loader		
Track Loader		
Pan / Scraper		
Grader		
Sheepsfoot Roller		
Smooth Drum Roller		
Dump Truck	2	2
Tractor w/ box grader	1	

Materials Delivered

Description	Quantity

Weather Conditions

Morning: sunny

Temp: 40

Noon: -

Temp: -

Evening: -

Temp: -

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Site Visit Report

Project No.: 70001

Date: 21-Dec-05

Vegetative cover material was placed today on the south of the dome on the west side and a hauling road was built up on the top terrace of the slope. Material was pushed away from the haul road down to the next terrace. The material was tracked in with a dozer when material was approximately 18 inches from the Geonet grade and that lift was covered to at least 2 feet for approximate final grade. Trucks made wide turns at the end of their run to minimize shear force. With material well over 2 feet in all areas there was no indication that material at the bottom of the vegetative cover layer is capable of movement.

Signature:

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Site Visit Report

Project: Madison County MSW Landfill

Job No.: 70001 | **Date:** 22-Dec-05

Location: Marshall, NC

Visit by: | **Page:** 1 of 2

Personnel - Construction

Contractor / Subcontractor:

Bob Stout Const.

Personnel - Inspection / Other

Engineer (QA / QC):

Darren Spier - CT Clayton

Owner Representatives:

Jim Huff - Madison County

Visitors:

Equipment

Description	No. on Site	No. in Use
Trackhoe	2	1
Rubber Tired Backhoe	1	
Dozer	2	1
Front End Loader		
Track Loader		
Pan / Scraper		
Grader		
Sheepsfoot Roller		
Smooth Drum Roller		
Dump Truck	2	2
Tractor w/ box grader	1	

Materials Delivered

Description	Quantity

Weather Conditions

Morning: sunny

Temp: 40

Noon: -

Temp: -

Evening: -

Temp: -

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Site Visit Report

Project No.: 70001

Date: 22-Dec-05

Placement of vegetative cover continued today down the slope toward the south toe. Method of placement was the same as previous days, with care taken to avoid standing pipe work. The soil around the methane vent pipes will be conditioned after the holiday.

Signature: Darren Jones

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Site Visit Report

Project: Madison County MSW Landfill

Job No.: 70001 | **Date:** 27-Dec-05

Location: Marshall, NC

Visit by: | **Page:** 1 of 2

Personnel - Construction

Contractor / Subcontractor:

Bob Stout Const.

Personnel - Inspection / Other

Engineer (QA / QC):

Darren Spier - CT Clayton

Owner Representatives:

Jim Huff - Madison County

Visitors:

Equipment

Description	No. on Site	No. in Use
Trackhoe	2	1
Rubber Tired Backhoe	1	
Dozer	2	1
Front End Loader		
Track Loader		
Pan / Scraper		
Grader		
Sheepsfoot Roller		
Smooth Drum Roller		
Dump Truck	2	2
Tractor w/ box grader	1	

Materials Delivered

Description	Quantity

Weather Conditions

Morning: clouds

Temp: 40

Noon: -

Temp: -

Evening: -

Temp: -

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Site Visit Report

Project No.: 70001

Date: 27-Dec-05

Vegetative cover material placement continued on the southern portion of the cell. Haul roads were built to at least 4 feet over the edge of the cell to ensure the placed drainpipe would be protected. Tests of the material passed required specifications.

Signature:

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Site Visit Report

Project: Madison County MSW Landfill

Job No.: 70001 | **Date:** 28-Dec-05

Location: Marshall, NC

Visit by: | **Page:** 1 of 2

Personnel - Construction

Contractor / Subcontractor:

Bob Stout Const.

Personnel - Inspection / Other

Engineer (QA / QC):

Darren Spier - CT Clayton

Owner Representatives:

Jim Huff - Madison County

Visitors:

Equipment

Description	No. on Site	No. in Use
Trackhoe	2	1
Rubber Tired Backhoe	1	
Dozer	2	1
Front End Loader		
Track Loader		
Pan / Scraper		
Grader		
Sheepsfoot Roller		
Smooth Drum Roller		
Dump Truck	2	2
Tractor w/ box grader	1	

Materials Delivered

Description	Quantity

Weather Conditions

Morning: clouds

Temp: 40

Noon: rain

Temp: -

Evening: -

Temp: -

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Site Visit Report

Project No.: 70001

Date: 28-Dec-05

Vegetative cover placement continued today on the last slope of the cell next to the southern toe.
The soil around the methane vent pipes were conditioned by hand. Material around the vent pipes was dug by hand to a depth of approximately 2 feet. Care was taken at the bottom of the hole to ensure the geonet was not damaged. Once material was removed, bentonite pellets were placed around the pipe along with some of the removed material. This layering and mixing of the half bentonite/soil mixture proceeded to the top of grade. One 60 pound bag of bentonite was used per pipe. The pipes will be elevated to their 8 feet above grade final position once placement and conditioning is complete.
Rain suspended work around lunchtime. Placement will finish tomorrow if weather allows.

Signature: Darren Davis

FIELD DATA

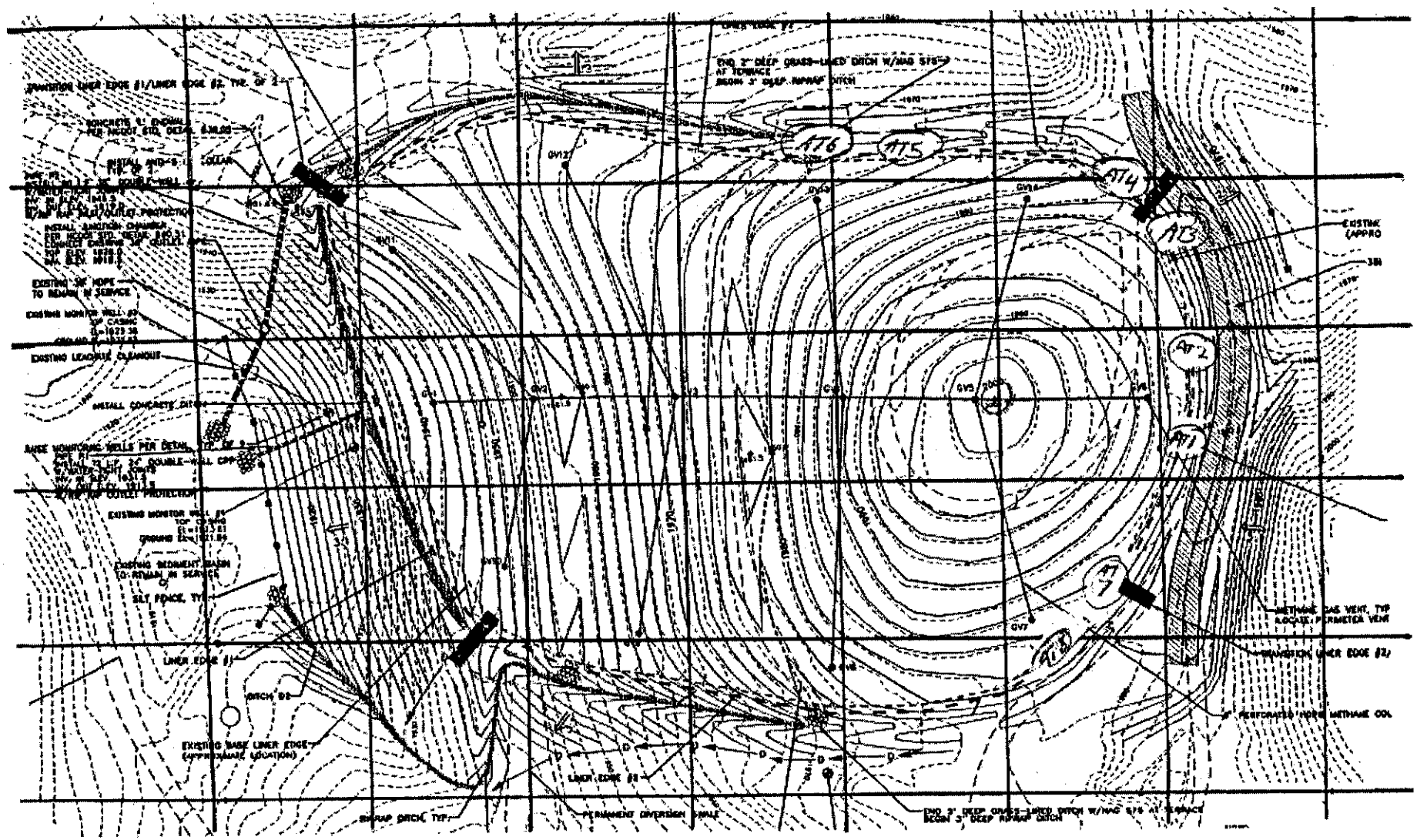
Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

PROJECT: Madison County MSW Landfill
PROJECT #: 70001
DATE: 12/7/2005
PAGE 1 of 1

Test ID	Retest of	Station	Offset	Lift	Wet Density	Dry Density	Moisture (%)	Proctor (PCF)	Compaction (%)	Optimum Moisture	Deviation from Opt.	Comments DC / SC	Shelby Tube ID
AT1		C	8	1	109.4	80.5	35.9%	82.4	97.7%	34.2%	1.7%		
AT2		C	8	2	108.4	80.4	34.9%	82.4	97.5%	34.2%	0.7%		
AT3		B	8	1	106.6	78.3	36.2%	82.4	95.0%	34.2%	2.0%		
AT4		A	7	2	106.9	78.8	35.6%	82.4	95.7%	34.2%	1.4%		
AT5		A	6	1	105.8	78.7	34.5%	82.4	95.5%	34.2%	0.3%		
AT6		A	5	2	109.2	81.0	34.8%	82.4	98.3%	34.2%	0.6%		
AT7		D	7	1	105.9	78.6	34.8%	82.4	95.3%	34.2%	0.6%		
AT8		E	7	2	107.6	79.6	35.2%	82.4	96.6%	34.2%	1.0%		

DC = Drive Cylinder, SC = Sand Cone, Opt = Optimum Moisture, PCF = pounds per cubic foot

FIELD DENSITY TEST



Tesing Locations

Date: 12/07/05

Madison County MSW Landfill Closure
CTC PN 70001

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

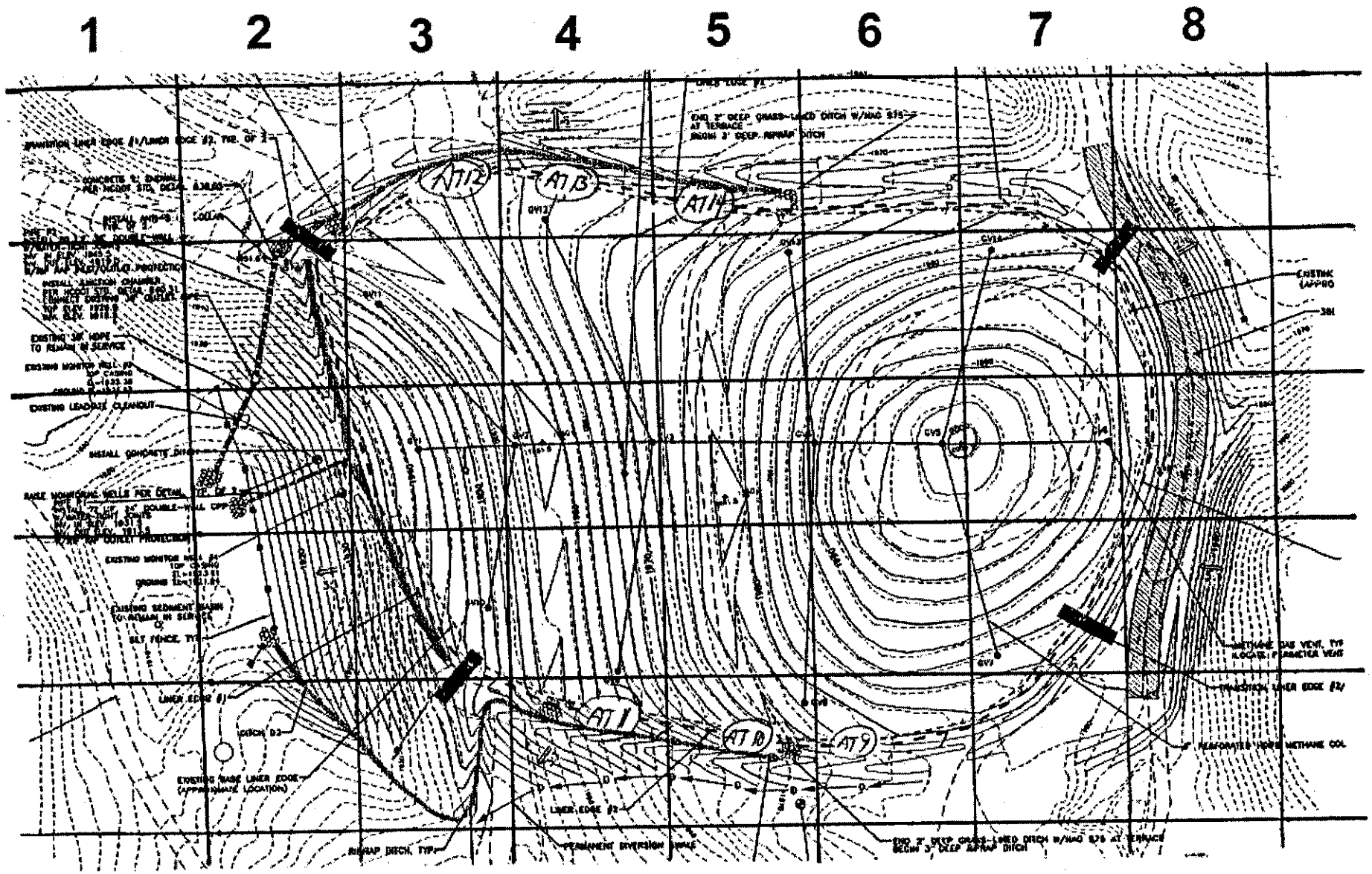
Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

PROJECT: Madison County MSW Landfill
PROJECT #: 70001
DATE: 12/12/2005
PAGE 1 of 1

Test ID	Retest of	Station	Offset	Lift	Wet Density	Dry Density	Moisture (%)	Proctor (PCF)	Compaction (%)	Optimum Moisture	Deviation from Opt.	Comments DC / SC	Shelby Tube ID
AT9		E	6	1	105.8	78.6	34.6%	82.4	95.4%	34.2%	0.4%		
AT10		E	5	2	106.3	79.2	34.2%	82.4	96.1%	34.2%	0.0%		
AT11		E	4	2	105.9	79.1	33.8%	82.4	96.1%	34.2%	-0.4%		
AT12		A	3	1	107.1	79.3	35.1%	82.4	96.2%	34.2%	0.9%		
AT13		A	4	2	107.5	79.6	35.0%	82.4	96.6%	34.2%	0.8%		
AT14		A	5	2	108.3	80.5	34.5%	82.4	97.7%	34.2%	0.3%		

DC = Drive Cylinder, SC = Sand Cone, Opt = Optimum Moisture, PCF = pounds per cubic foot

FIELD DENSITY TEST



Tesing Locations

Date: 12/12/05

Madison County MSW Landfill Closure
CTC PN 70001

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

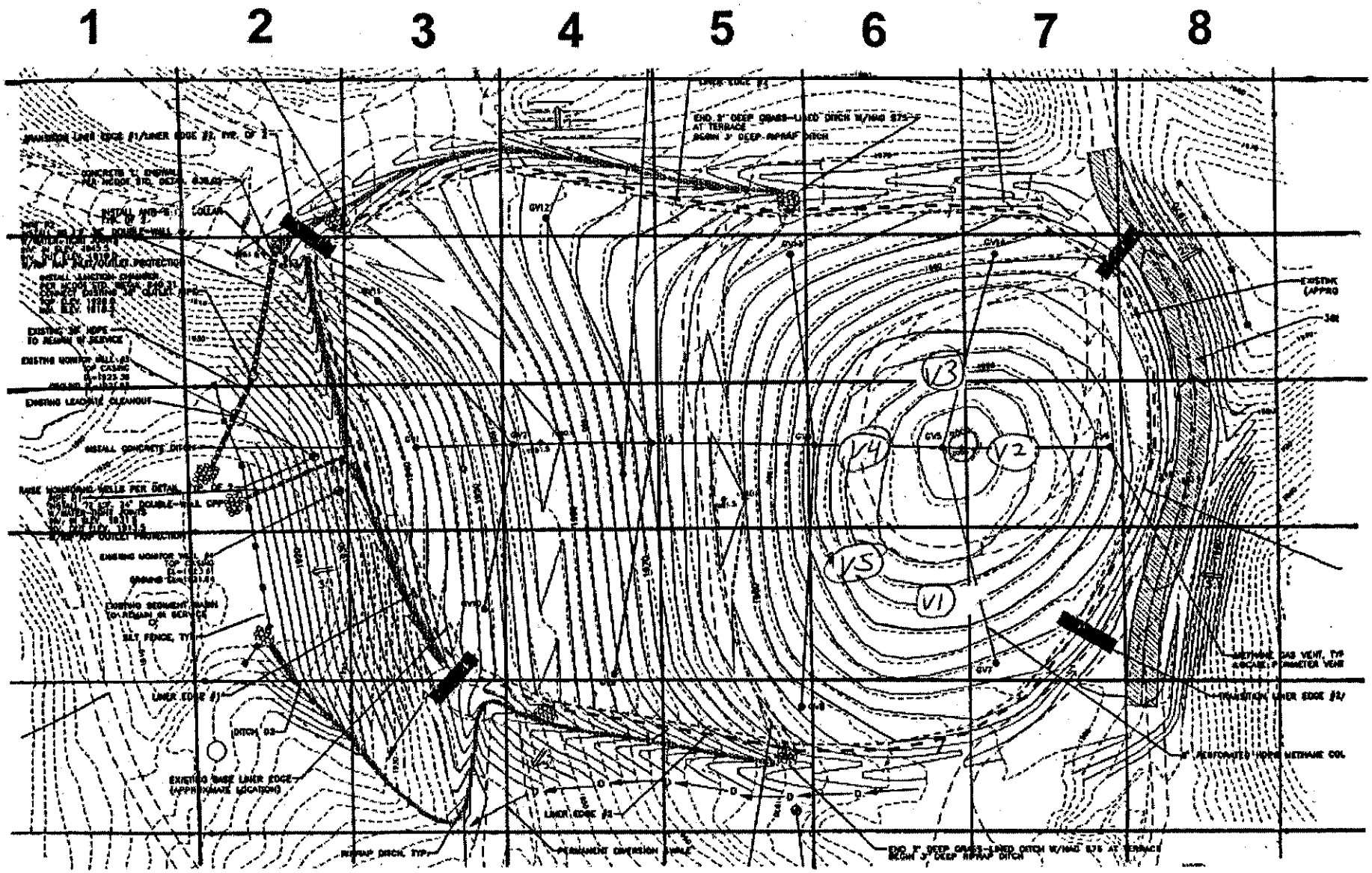
Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

PROJECT: Madison County MSW Landfill
PROJECT #: 70001
DATE: 12/13/2005
PAGE 1 of 1

Test ID	Retest of	Station	Offset	Lift	Wet Density	Dry Density	Moisture (%)	Proctor (PCF)	Compaction (%)	Optimum Moisture	Deviation from Opt.	Comments DC / SC	Shelby Tube ID
V1		D	6	1	106.3	79.2	34.3%	82.4	96.1%	34.2%	0.1%		
V2		C	7	1	107.0	79.8	34.1%	82.4	96.8%	34.2%	-0.1%		
V3		B	6	2	108.9	81.4	33.8%	82.4	98.8%	34.2%	-0.4%		
V4		C	6	2	109.2	81.4	34.2%	82.4	98.8%	34.2%	0.0%		
V5		D	6	2	110.4	81.9	34.8%	82.4	99.4%	34.2%	0.6%		VST-1

DC = Drive Cylinder, SC = Sand Cone, Opt = Optimum Moisture, PCF = pounds per cubic foot

FIELD DENSITY TEST



Tesing Locations

Date: 12/13/05

Madison County MSW Landfill Closure
CTC PN 70001

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

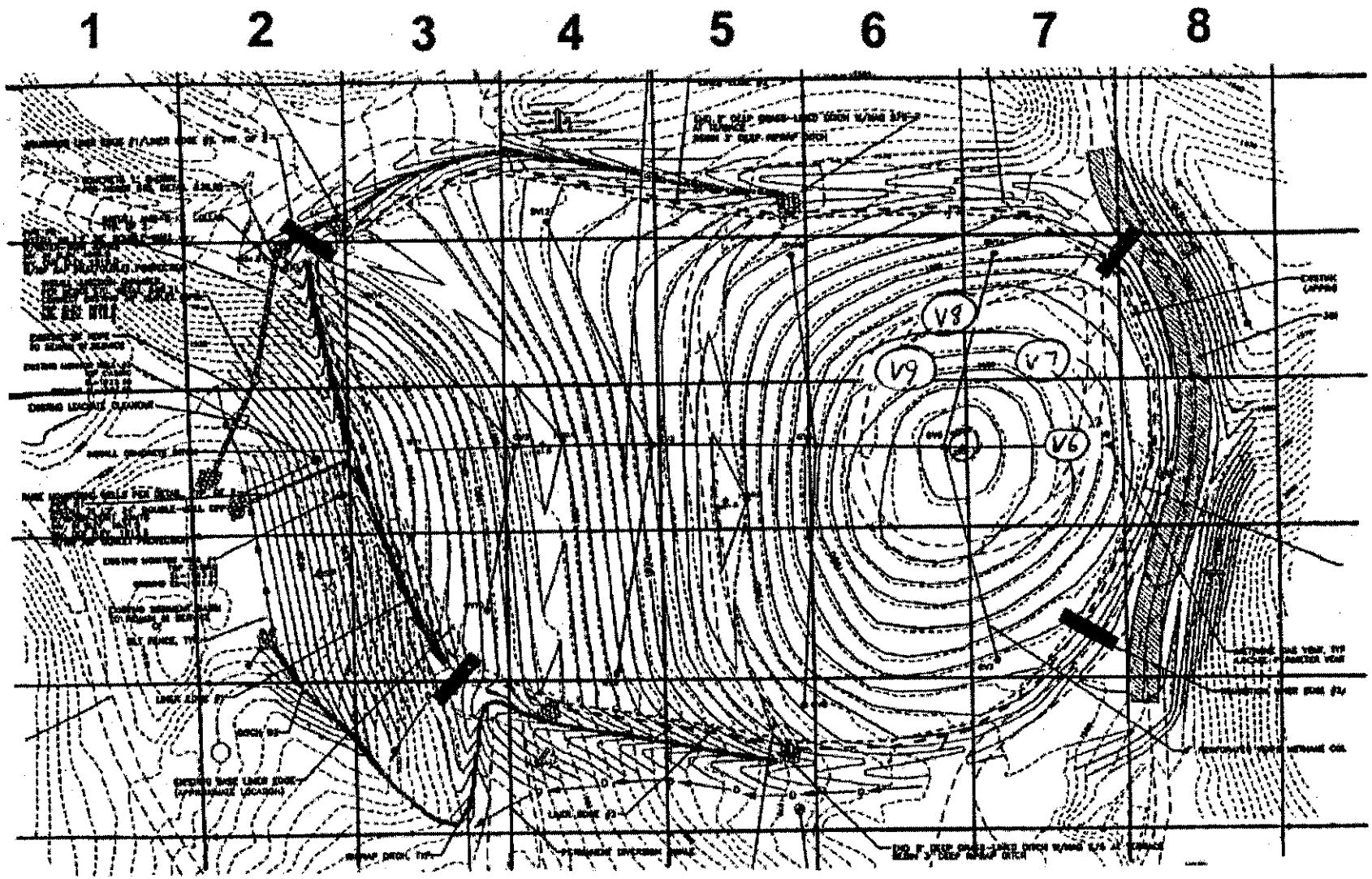
Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

PROJECT: Madison County MSW Landfill
PROJECT #: 70001
DATE: 12/14/2005
PAGE 1 of 1

Test ID	Retest of	Station	Offset	Lift	Wet Density	Dry Density	Moisture (%)	Proctor (PCF)	Compaction (%)	Optimum Moisture	Deviation from Opt.	Comments DC / SC	Shelby Tube ID
V6		C	7	1	106.9	79.3	34.8%	82.4	96.2%	34.2%	0.6%		
V7		B	7	2	109.3	81.7	33.8%	82.4	99.1%	34.2%	-0.4%		
V8		B	6	2	110.0	82.5	33.4%	82.4	100.1%	34.2%	-0.8%		VST-2
V9		B	6	2	108.8	80.9	34.5%	82.4	98.2%	34.2%	0.3%		

DC = Drive Cylinder, SC = Sand Cone, Opt = Optimum Moisture, PCF = pounds per cubic foot

FIELD DENSITY TEST



Tesing Locations

Date: 12/14/05

Madison County MSW Landfill Closure
CTC PN 70001

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

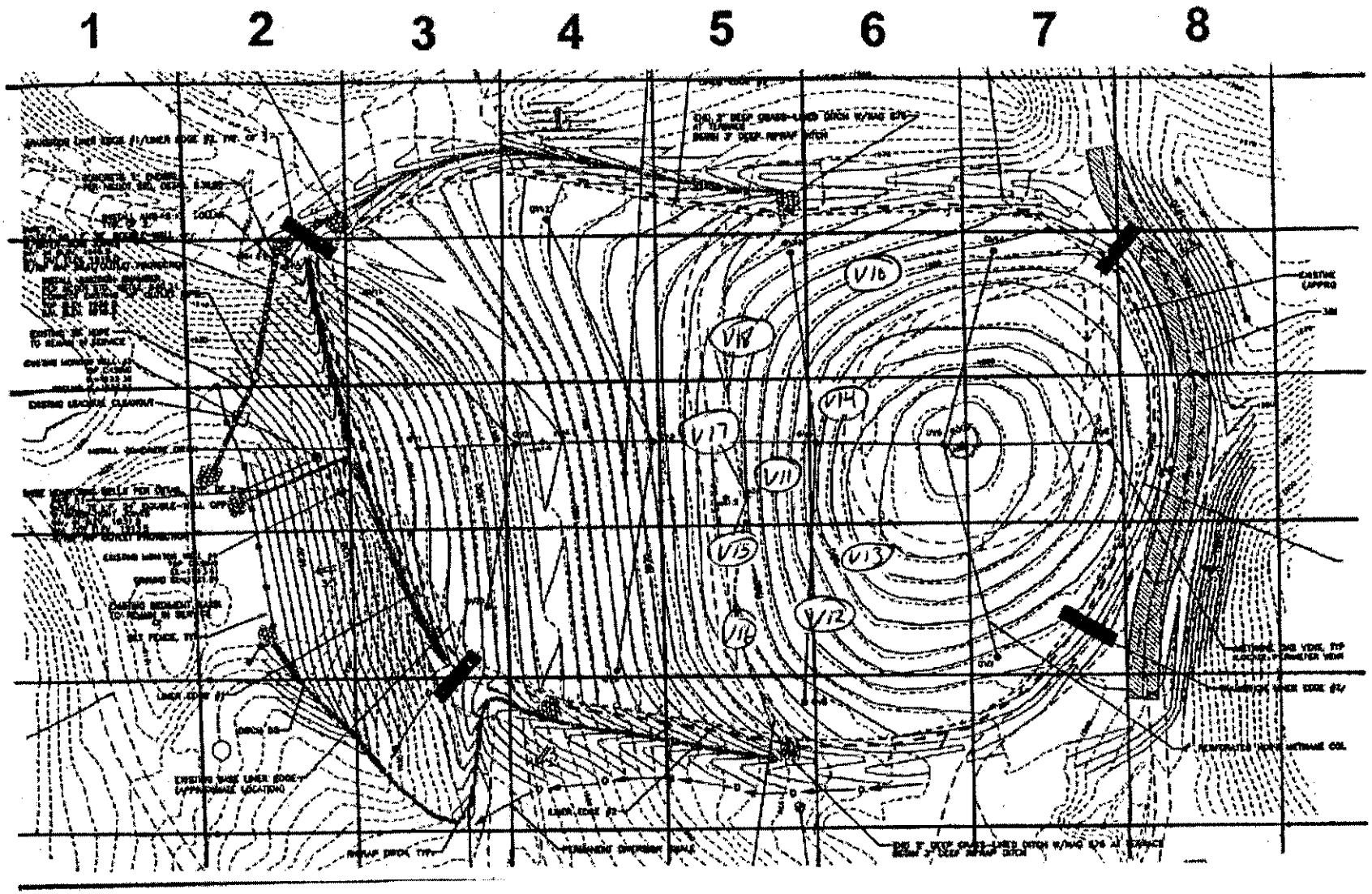
Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

PROJECT: Madison County MSW Landfill
PROJECT #: 70001
DATE: 12/19/2005
PAGE 1 of 1

Test ID	Retest of	Station	Offset	Lift	Wet Density	Dry Density	Moisture (%)	Proctor (PCF)	Compaction (%)	Optimum Moisture	Deviation from Opt.	Comments DC / SC	Shelby Tube ID
V10		B	6	1	108.0	80.5	34.2%	82.4	97.7%	34.2%	0.0%		
V11		C	5	1	107.1	80.0	33.8%	82.4	97.1%	34.2%	-0.4%		
V12		D	6	1	110.0	82.2	33.9%	82.4	99.7%	34.2%	-0.3%		
V13		D	6	2	110.8	81.9	35.3%	82.4	99.4%	34.2%	1.1%		
V14		C	6	2	108.4	80.1	35.4%	82.4	97.2%	34.2%	1.2%		
V15		D	5	2	109.4	81.2	34.8%	82.4	98.5%	34.2%	0.6%		
V16		D	5	2	109.6	81.1	35.2%	82.4	98.4%	34.2%	1.0%		
V17		C	5	2	110.5	81.4	35.8%	82.4	98.7%	34.2%	1.6%		VST-3
V18		B	5	2	110.2	82.1	34.3%	82.4	99.6%	34.2%	0.1%		

DC = Drive Cylinder, SC = Sand Cone, Opt = Optimum Moisture, PCF = pounds per cubic foot

FIELD DENSITY TEST



Tesing Locations

Date: 12/19/05

Madison County MSW Landfill Closure
CTC PN 70001

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

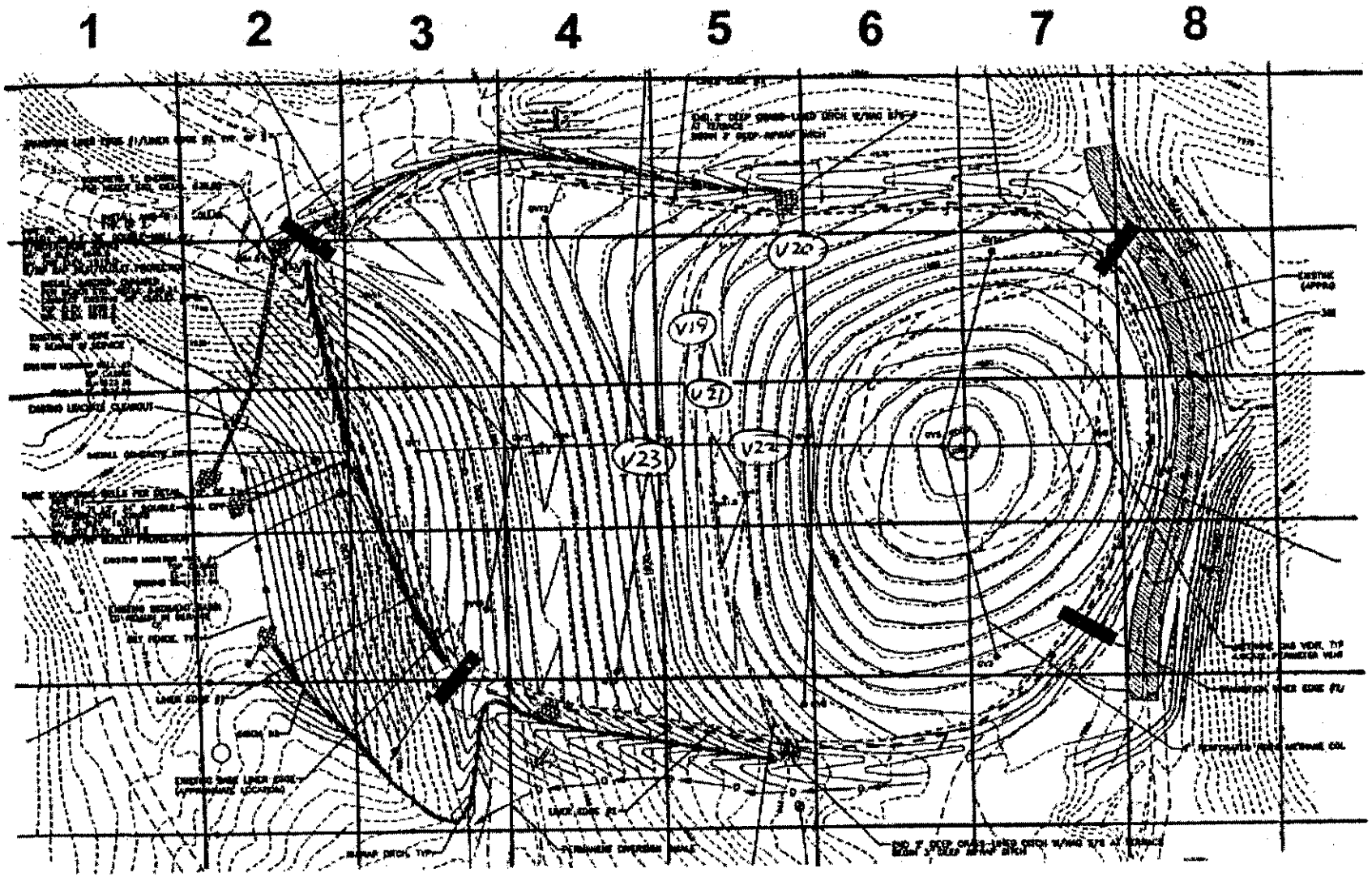
Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

PROJECT: Madison County MSW Landfill
PROJECT #: 70001
DATE: 12/20/2005
PAGE 1 of 1

Test ID	Retest of	Station	Offset	Lift	Wet Density	Dry Density	Moisture (%)	Proctor (PCF)	Compaction (%)	Optimum Moisture	Deviation from Opt.	Comments DC / SC	Shelby Tube ID
V19		B	5	1	108.1	80.2	34.8%	82.4	97.3%	34.2%	0.6%		
V20		B	5	2	109.4	81.8	33.8%	82.4	99.2%	34.2%	-0.4%		
V21		C	5	2	110.4	82.3	34.1%	82.4	99.9%	34.2%	-0.1%		
V22		C	5	2	109.7	81.4	34.8%	82.4	98.8%	34.2%	0.6%		
V23		C	4	2	108.6	80.6	34.7%	82.4	97.8%	34.2%	0.5%		

DC = Drive Cylinder, SC = Sand Cone, Opt = Optimum Moisture, PCF = pounds per cubic foot

FIELD DENSITY TEST



Tesing Locations

Date: 12/20/05

Madison County MSW Landfill Closure
CTC PN 70001

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

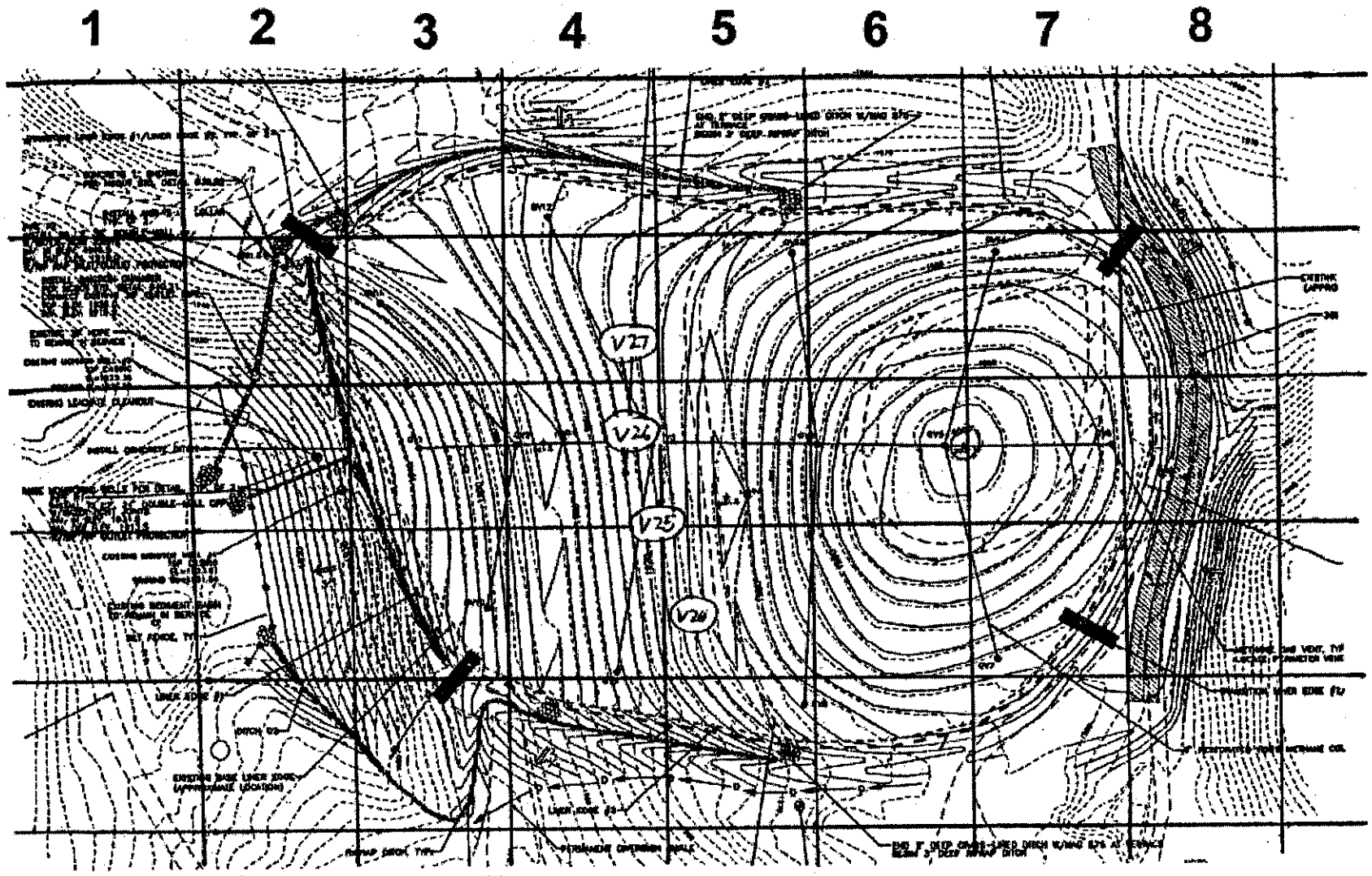
Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

PROJECT: Madison County MSW Landfill
PROJECT #: 70001
DATE: 12/22/2005
PAGE 1 of 1

Test ID	Retest of	Station	Offset	Lift	Wet Density	Dry Density	Moisture (%)	Proctor (PCF)	Compaction (%)	Optimum Moisture	Deviation from Opt.	Comments DC / SC	Shelby Tube ID
V24		D	5	2	109.0	81.5	33.8%	82.4	98.9%	34.2%	-0.4%		
V25		C	4	2	108.3	81.3	33.2%	82.4	98.7%	34.2%	-1.0%		
V26		C	4	2	107.8	80.0	34.7%	82.4	97.1%	34.2%	0.5%		
V27		B	4	2	109.4	81.6	34.1%	82.4	99.0%	34.2%	-0.1%		

DC = Drive Cylinder, SC = Sand Cone, Opt = Optimum Moisture, PCF = pounds per cubic foot

FIELD DENSITY TEST



Tesing Locations

Date: 12/22/05

Madison County MSW Landfill Closure
CTC PN 70001

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

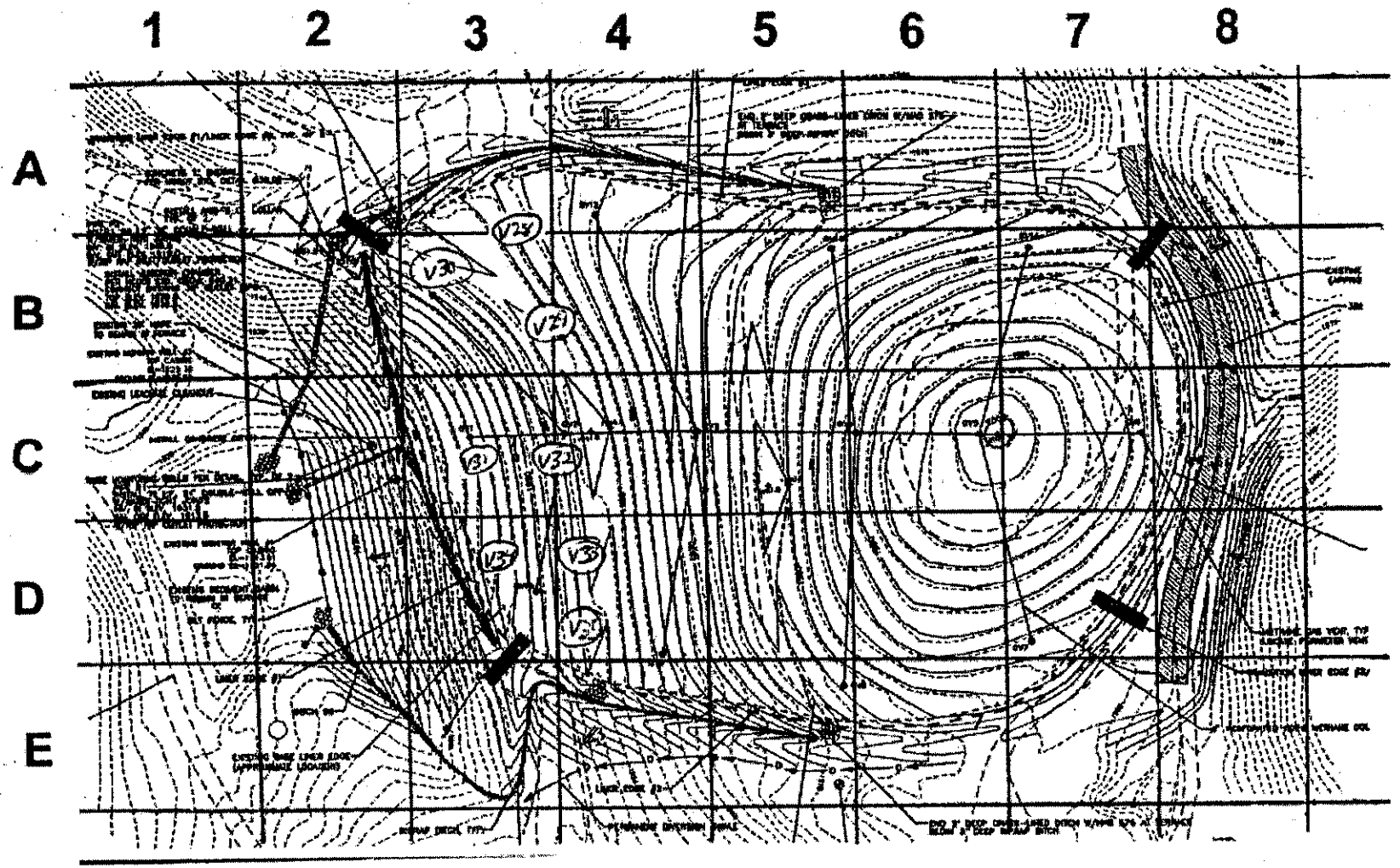
Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

PROJECT: Madison County MSW Landfill
PROJECT #: 70001
DATE: 12/27/2005
PAGE 1 of 1

Test ID	Retest of	Station	Offset	Lift	Wet Density	Dry Density	Moisture (%)	Proctor (PCF)	Compaction (%)	Optimum Moisture	Deviation from Opt.	Comments DC / SC	Shelby Tube ID
V28		A	3	2	109.2	81.7	33.7%	82.4	99.1%	34.2%	-0.5%		VST-4
V29		B	3	2	108.9	80.8	34.7%	82.4	98.1%	34.2%	0.5%		
V30		B	3	2	108.4	80.7	34.4%	82.4	97.9%	34.2%	0.2%		
V31		C	3	2	109.4	81.2	34.7%	82.4	98.6%	34.2%	0.5%		
V32		C	4	2	110.2	81.9	34.5%	82.4	99.4%	34.2%	0.3%		
V33		D	4	2	108.3	81.1	33.6%	82.4	98.4%	34.2%	-0.6%		
V34		D	3	2	110.5	81.9	35.0%	82.4	99.3%	34.2%	0.8%		
V35		D	4	2	111.0	82.3	34.8%	82.4	99.9%	34.2%	0.6%		VST-5

DC = Drive Cylinder, SC = Sand Cone, Opt = Optimum Moisture, PCF = pounds per cubic foot

FIELD DENSITY TEST



Tesing Locations

Date: 12/27/05

Madison County MSW Landfill Closure
CTC PN 70001

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

LABORATORY DATA

Permeability Calculations

Madison County Landfill
DAA #R05646-01
Prepared By: SDH

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID: VST-1
Sample Depth: Lift 1
Permeability Method: ASTM D5084
Sample Length, in: 3.59
Sample Diamter, in: 2.85

Moisture Content

Pan Wt	6.75	grams
Pan + Soil (wet)	222.60	grams
Pan + Soil (dry)	163.15	grams
Moisture Content	*38.0%*	

Dry Density

Soil (wet)	685.20	grams
Wet Density	114.1	pcf
Dry Density	*82.7*	pcf

Test Conditions

Backpressure, psi	40.0
Cell Pressure, psi	50.0
Influent Buret Area, cm^2	0.03142
Effluent Buret Area, cm^2	0.76712

Permeability Trials

Time min	Influent Head, cm	Influent Flow, cm^3	Effluent Head, cm	Effluent Flow, cm^3	Flow Deviation Ratio	Gradient mm-Hg	Permeabilty, k cm/sec
23-Dec 8:39	17.700		0.900				
23-Dec 8:40	16.000	0.053	0.970	0.053	1.00	23.15	9.9E-07
23-Dec 8:41	15.500	0.016	0.990	0.016	1.00	20.72	3.1E-07
23-Dec 8:42	14.800	0.022	1.019	0.022	1.00	20.00	4.6E-07
23-Dec 8:43	14.200	0.019	1.043	0.019	1.00	18.99	4.1E-07
23-Dec 8:44	13.600	0.019	1.068	0.019	1.00	18.13	4.3E-07
23-Dec 8:45	13.100	0.016	1.088	0.016	1.00	17.27	3.8E-07
23-Dec 8:46	12.700	0.013	1.105	0.013	1.00	16.55	3.1E-07
23-Dec 8:51	10.600	0.066	1.191	0.066	1.00	15.98	3.7E-07

Average Permeability 3.7E-07 cm/sec

Final Data

Assumed Specific Gravity	2.65
Final Weight of Sample	690.00 grams
Final Moisture Content	39.0%
Percent Voids	50.0%
Actual Volume of Voids	187.4 ml
Saturation	100.0%

Permeability Calculations

Madison County Landfill
DAA #R05646-01
Prepared By: SDH

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID: VST-2
Sample Depth: Lift 1
Permeability Method: ASTM D5084
Sample Length, in: 3.81
Sample Diamter, in: 2.85

Moisture Content

Pan Wt	6.65	grams
Pan + Soil (wet)	225.31	grams
Pan + Soil (dry)	161.77	grams
Moisture Content	*41.0%*	

Dry Density

Soil (wet)	723.30	grams
Wet Density	113.7	pcf
Dry Density	*80.6*	pcf

Test Conditions

Backpressure, psi	40.0
Cell Pressure, psi	50.0
Influent Buret Area, cm^2	0.03142
Effluent Buret Area, cm^2	0.76712

Permeability Trials

Time min	Influent Head, cm	Influent Flow, cm^3	Effluent Head, cm	Effluent Flow, cm^3	Flow Deviation Ratio	Gradient mm-Hg	Permeabilty, k cm/sec
23-Dec 8:53	16.700		0.900				
23-Dec 8:54	15.600	0.035	0.945	0.035	1.00	20.49	7.1E-07
23-Dec 8:55	14.900	0.022	0.974	0.022	1.00	19.01	4.8E-07
23-Dec 8:56	14.200	0.022	1.002	0.022	1.00	18.06	5.1E-07
23-Dec 8:57	13.600	0.019	1.027	0.019	1.00	17.12	4.6E-07
23-Dec 8:58	12.900	0.022	1.056	0.022	1.00	16.31	5.6E-07
23-Dec 8:59	12.300	0.019	1.080	0.019	1.00	15.36	5.1E-07
23-Dec 9:00	11.800	0.016	1.101	0.016	1.00	14.55	4.5E-07
23-Dec 9:07	8.700	0.097	1.228	0.097	1.00	13.88	4.8E-07

Average Permeability 5.0E-07 cm/sec

Final Data

Assumed Specific Gravity	2.65
Final Weight of Sample	725.00 grams
Final Moisture Content	41.3%
Percent Voids	51.2%
Actual Volume of Voids	203.5 ml
Saturation	100.0%

Permeability Calculations

Madison County Landfill
DAA #R05646-01
Prepared By: SDH

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID: VST-3
Sample Depth: Lift 1
Permeability Method: ASTM D5084
Sample Length, in: 3.70
Sample Diamter, in: 2.82

Moisture Content

Pan Wt	6.64	grams
Pan + Soil (wet)	202.77	grams
Pan + Soil (dry)	149.88	grams
Moisture Content	*36.9%*	

Dry Density

Soil (wet)	715.40	grams
Wet Density	117.6	pcf
Dry Density	*85.9*	pcf

Test Conditions

Backpressure, psi	40.0
Cell Pressure, psi	50.0
Influent Buret Area, cm^2	0.03142
Effluent Buret Area, cm^2	0.76712

Permeability Trials

Time min	Influent Head, cm	Influent Flow, cm^3	Effluent Head, cm	Effluent Flow, cm^3	Flow Deviation Ratio	Gradient mm-Hg	Permeabilty, k cm/sec
4-Jan 8:17	15.850		1.000				
4-Jan 8:18	14.450	0.044	1.057	0.044	1.00	19.82	9.6E-07
4-Jan 8:19	13.300	0.036	1.104	0.036	1.00	17.87	8.7E-07
4-Jan 8:20	12.250	0.033	1.147	0.033	1.00	16.28	8.8E-07
4-Jan 8:21	11.300	0.030	1.186	0.030	1.00	14.82	8.7E-07
4-Jan 8:22	10.500	0.025	1.219	0.025	1.00	13.50	8.0E-07
4-Jan 8:23	9.700	0.025	1.252	0.025	1.00	12.39	8.8E-07
4-Jan 8:24	8.950	0.024	1.283	0.024	1.00	11.28	9.0E-07
4-Jan 8:29	6.200	0.086	1.395	0.086	1.00	10.23	8.7E-07

Average Permeability 8.6E-07 cm/sec

Final Data

Assumed Specific Gravity	2.65
Final Weight of Sample	715.20 grams
Final Moisture Content	36.9%
Percent Voids	48.1%
Actual Volume of Voids	182.5 ml
Saturation	100.0%

Permeability Calculations

Madison County Landfill
DAA #R05646-01
Prepared By: SDH

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID: VST-4
Sample Depth: Lift 1
Permeability Method: ASTM D5084
Sample Length, in: 3.83
Sample Diamter, in: 2.84

Moisture Content

Pan Wt	8.49	grams
Pan + Soil (wet)	240.64	grams
Pan + Soil (dry)	179.11	grams
Moisture Content	*36.1%*	

Dry Density

Soil (wet)	742.70	grams
Wet Density	116.7	pcf
Dry Density	*85.7*	pcf

Test Conditions

Backpressure, psi	40.0
Cell Pressure, psi	50.0
Influent Buret Area, cm^2	0.03142
Effluent Buret Area, cm^2	0.76712

Permeability Trials

Time min	Influent Head, cm	Influent Flow, cm^3	Effluent Head, cm	Effluent Flow, cm^3	Flow Deviation Ratio	Gradient mm-Hg	Permeabilty, k cm/sec
4-Jan 8:35	16.900		1.000				
4-Jan 8:36	14.900	0.063	1.082	0.063	1.00	20.51	1.3E-06
4-Jan 8:37	13.550	0.042	1.137	0.042	1.00	17.83	1.0E-06
4-Jan 8:38	12.350	0.038	1.186	0.038	1.00	16.01	1.0E-06
4-Jan 8:39	11.350	0.031	1.227	0.031	1.00	14.40	9.3E-07
4-Jan 8:40	10.350	0.031	1.268	0.031	1.00	13.06	1.0E-06
4-Jan 8:41	9.500	0.027	1.303	0.027	1.00	11.72	9.8E-07
4-Jan 8:42	8.750	0.024	1.334	0.024	1.00	10.57	9.6E-07
4-Jan 8:47	5.900	0.090	1.450	0.090	1.00	9.57	9.8E-07

Average Permeability 9.9E-07 cm/sec

Final Data

Assumed Specific Gravity	2.65
Final Weight of Sample	745.40 grams
Final Moisture Content	36.6%
Percent Voids	48.1%
Actual Volume of Voids	191.3 ml
Saturation	100.0%

Permeability Calculations

Madison County Landfill
DAA #R05646-01
Prepared By: SDH

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID: VST-5
Sample Depth: Lift 1
Permeability Method: ASTM D5084
Sample Length, in: 3.83
Sample Diamter, in: 2.84

Moisture Content

Pan Wt	6.76	grams
Pan + Soil (wet)	196.96	grams
Pan + Soil (dry)	146.51	grams
Moisture Content	*36.1%*	

Dry Density

Soil (wet)	708.40	grams
Wet Density	111.3	pcf
Dry Density	*81.8*	pcf

Test Conditions

Backpressure, psi	40.0
Cell Pressure, psi	50.0
Influent Buret Area, cm^2	0.03142
Effluent Buret Area, cm^2	0.76712

Permeability Trials

Time min	Influent Head, cm	Influent Flow, cm^3	Effluent Head, cm	Effluent Flow, cm^3	Flow Deviation Ratio	Gradient mm-Hg	Permeabilty, k cm/sec
4-Jan 8:58	16.500		1.000				
4-Jan 8:59	14.300	0.069	1.090	0.069	1.00	20.00	1.5E-06
4-Jan 9:00	12.500	0.057	1.164	0.057	1.00	17.04	1.5E-06
4-Jan 9:01	11.000	0.047	1.225	0.047	1.00	14.62	1.4E-06
4-Jan 9:02	9.700	0.041	1.278	0.041	1.00	12.61	1.4E-06
4-Jan 9:03	8.550	0.036	1.326	0.036	1.00	10.86	1.5E-06
4-Jan 9:04	7.550	0.031	1.367	0.031	1.00	9.32	1.5E-06
4-Jan 9:05	6.650	0.028	1.403	0.028	1.00	7.98	1.6E-06
4-Jan 9:10	3.800	0.090	1.520	0.090	1.00	6.77	1.6E-06

Average Permeability 1.5E-06 cm/sec

Final Data

Assumed Specific Gravity	2.65
Final Weight of Sample	722.80 grams
Final Moisture Content	38.9%
Percent Voids	50.6%
Actual Volume of Voids	200.9 ml
Saturation	100.0%

SECTION V

GSE Roll Allocation

Order 43333
Customer GSI
Madison County

Roll#	*Resin Lot*	*Product Code*	*Description*	*Mfg. Date*	*Length*
103132044	CSG811850	LUT040M000	LUT040M000	8/19/2005	700
103132045	CSG811850	LUT040M000	LUT040M000	8/19/2005	700
103132914	CSK810620	LUT040M000	LUT040M000	10/30/2005	700
103132915	CSK810620	LUT040M000	LUT040M000	10/30/2005	700
103132916	CSK810620	LUT040M000	LUT040M000	10/30/2005	700
103132917	CSK810620	LUT040M000	LUT040M000	10/31/2005	700
103132918	CSK810620	LUT040M000	LUT040M000	10/31/2005	700
103132919	CSK810620	LUT040M000	LUT040M000	10/31/2005	700
103132920	CSK810620	LUT040M000	LUT040M000	10/31/2005	700
103132921	CSK810620	LUT040M000	LUT040M000	10/31/2005	700
103132922	CSK810620	LUT040M000	LUT040M000	10/31/2005	625
104121431	CRA811840	LUT040M000	LUT040M000	4/29/2004	700
104121438	CRA811840	LUT040M000	LUT040M000	4/30/2004	698

GSE Lining Technology, Inc

Roll Test Data Report

Lading:

Sales Order No.	Project Number	Customer Name	Pro. ocation	Product Name	Report Date
43333	518117	GSI	Madison County, NC	LUT040M000	10/31/2005

GSE OC APPROVED

*Modified

Roll No	ASTM D 5994 Average Thickness (mils)	ASTM D 5994 Minimum Thickness (mils)	ASTM D638, Type IV / D6693 TD Strength @ Break (ppi)	ASTM D638, Type IV / D6693 MD Strength @ Break (ppi)	ASTM D638, Type IV / D6693 TD Elongation @ Break (%)	ASTM D638, Type IV / D6693 MD Elongation @ Break (%)	ASTM D 1004 TD Tear Resistance (lbs)	ASTM D 1004 MD Tear Resistance (lbs)	ASTM D 4833 Puncture Resistance (lbs)	ASTM D 1505 Density (g/cc)	ASTM D 1603* Carbon Black Content (%)	ASTM D 5596 Carbon Black Dispersion Views in Cat1 - Cat2	GRI GM 12 Asperity Height Side A (mils)	GRI GM 12 Asperity Height Side B (mils)
	every roll		every 3rd				every 3rd		every 3rd	every 3rd	every 3rd	every 3rd	every 2nd	
103132044	50	41	160	201	578	684	32	32	96	0.928	2.3	10	18	15
103132045	43	42	160	201	578	684	32	32	96	0.928	2.3	10	18	15
103132914	43	41	160	187	622	689	31	32	96	0.927	2.4	10	23	23
103132915	44	41	160	187	622	689	31	32	96	0.927	2.4	10	23	23
103132916	43	41	160	187	622	689	31	32	96	0.927	2.4	10	23	24
103132917	43	41	165	192	594	688	30	30	97	0.927	2.4	10	23	24
103132918	43	41	165	192	594	688	30	30	97	0.927	2.4	10	21	22
103132919	43	41	165	192	594	688	30	30	97	0.927	2.4	10	21	22
103132920	43	41	165	192	594	688	30	30	101	0.927	2.4	10	23	23
103132921	43	41	149	171	573	645	30	30	101	0.928	2.4	10	23	23
103132922	43	41	149	171	573	645	30	30	101	0.928	2.4	10	23	24
104121431	44	42	167	187	642	697	31	31	101	0.927	2.6	10	18	20
104121438	47	41	170	198	670	750	29	32	95	0.929	2.6	10	18	17

Laboratory Manager

GSE-8.2 4-029 Rev -- 03/05

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19103 Gundle Road - Houston, Texas 77073

CoA Date: 10/14/2005

Certificate of Analysis

Shipped To: GSE LINING TECHNOLOGY INC HC
19103 GUNDLE ROAD
WESTFIELD TX 77090
USA

Recipient: BOHAC
Fax: 281-230-8630

CPC Delivery #: 86995143
PO #: 33979
Weight: 187150 LB
Ship Date: 10/13/2005
Package: BULK
Mode: Hopper Car
Car #: PSPX006237
Seal No: 441786

Product: PE 7104 BULK

Lot Number: CSK810620

Property	Test Method	Value	Unit
Melt Index	ST-103	0.35	g/10mi
Density	ST-292	0.919	g/cm3
Production Date		10/12/2005	

The data set forth herein have been carefully compiled by Chevron Phillips Chemical Company LP. **However, there is no warranty of any kind, either expressed or implied, applicable to its use, and the user assumes all risk and liability in connection therewith.**

Kay F. Donaldson
Quality Control Supervisor

For CoA questions contact Tom Scheirman at 832-813-4637

CoA Date: 07/29/2005

Certificate of Analysis

Shipped To: GSE LINING TECHNOLOGY INC HC
19103 GUNDLE ROAD
WESTFIELD TX 77090
USA

Recipient: DON BOHAC
Fax:

CPC Delivery #: 86944505
PO #: 33979
Weight: 186250 LB
Ship Date: 07/29/2005
Package: BULK
Mode: Hopper Car
Car #: ACFX038928
Seal No: 438185

Product: PE 7104 BULK

Lot Number: CSG811850

Property	Test Method	Value	Unit
Melt Index	ST-103	0.34	g/10mi
Density	ST-292	0.918	g/cm3
Production Date		07-29-05	

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Kay F. Donaldson
Quality Control Supervisor

For CoA questions contact Tom Scheirman at 832-813-4637

CoA Date: 03/22/2004

Certificate of Analysis

Shipped To: GSE LINING TECHNOLOGY INC HC
19103 GUNDLE ROAD
WESTFIELD TX 77090
USA

Recipient: DON BOHAC
Fax: 281-230-8630

CPC Delivery #: 86586729
PO #: 30131
Weight: 182200 LB
Ship Date: 03/19/2004
Package: BULK
Mode: Hopper Car
Car #: GOCX058781
Seal No: 423175

Product: PE 7104 BULK

Lot Number: CRA811840

Property	Test Method	Value	Unit
Melt Index	ST-103	0.36	g/10mi
Density	ST-292	0.919	g/cm3
Production Date		1/28/2004	

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Kay F. Donaldson
Quality Control Supervisor

For CoA questions contact Peter Scheirman at 713-289-4799

GSE Lining Technology, Inc.

Roll Test Data Report

Roll No. 104117356

ROLL IDENTIFICATION

Roll Number	104117356
Product Name	LUT060A000
Production Date	4/30/2003

Length ≈(+/- 1%)	520 158	feet meters
Width (Nominal)	22 5 6 9	feet meters
Sheet Area	11,700 1,086	sq feet sq meters
Weight	4,030 1,828	pounds kilograms

RESIN INFORMATION

Lot Number	CPB811140
Type	7104
Supplier	Chevron

GSE RESIN TEST DATA

Property	Test Method	Results
Density, g/cc	ASTM D 1505	0 918
Melt index, g/10 min.	ASTM D 1238 (190/2.16)	0.34

Physical Property	Test Method	Test Frequency	Customer Minimum English	Customer Minimum Metric	Test Results English	Test Results Metric
Thickness, mil (mm)	ASTM D 5994					
Average		every roll	60	(1.5)	63	(1 6)
Minimum		every roll	54	(1 4)	60	(1.5)
Tensile Properties:	ASTM D638,Type IV / D6693					
Break Strength, ppi (N/cm) - TD		every 4th	132	(231)	199	(349)
- MD		every 4th	132	(231)	219	(383)
Break Elongation, % - TD	gauge length = 2 0"	every 4th	500		559	
- MD	(51 mm)	every 4th	500		606	
Tear Resistance, lb (N)	ASTM D 1004					
- TD		every 4th	33	(147)	47	(209)
- MD		every 4th	33	(147)	48	(214)
Puncture Resistance, lb (N)	ASTM D 4833					
		every 4th	73	(323)	116	(516)
Carbon Black Content, %	ASTM D 1603*					
		every 4th	2 0		2 6	
Carbon Black Dispersion	ASTM D 5596					
Views in Cat1 - Cat2		every 4th	9		10	
Density	ASTM D 1505					
		every 4th	0 920		0 930	
Asperity Height	GRI GM 12					
Average (mils) - Side A		every 2nd	10	(0 254)	24	(0.610)

Order No.	28731
Customer Name	Ash Grove Cement Pile Cover / CKD Landfill
Project Name	GSI
Location	Louisville, NE

*Modified

GSE-8.2 4-007 Rev - - 02/03

APPROVED
12/2/2005
QA

CoA Date: 04/07/2003

Certificate of Analysis

Shipped To: GSE LINING TECHNO WESTFIELD WESTFIELD TX 77090 USA	CPC Delivery #: 86346571 PO #: Weight: 183850 LB Ship Date: 04/04/2003 Package: BULK
Recipient: DON BOHAC Fax: 281-230-8630	Mode: Hopper Car Car #: CHVX893026

Product: PE 7104 BULK

Lot Number: CP8811140

Property	Test Method	Value	Unit
Melt Index	ST-103	0 34	g/10mi
Density	ST-292	0.9183	g/om3

The data set forth herein have been carefully compiled by Chevron Phillips Chemical Company LP. **However, there is no warranty of any kind, either expressed or implied, applicable to its use, and the user assumes all risk and liability in connection therewith.**

Kay F. Donaldson
Quality Control Supervisor

For CoA questions contact Peter Scheirman at 713-289-4799

To: John - 4 pages

SECTION VI

GSE Geocomposite Traceability

Customer GSI
Location Madison County, NC

Job Name Madison County
Order 43333

Roll_No	*Product*	*Resin Lot*	*Top Geo*	*Bottom Geo*
131191829	F42060060S	CSE610661	130205374	130205354
131191830	F42060060S	CSE610661	130205374	130205354
131191831	F42060060S	CSE610661	130205374	130205354
131191832	F42060060S	CSE610661	130205374	130205354
131191837	F42060060S	CSE610661	130205446	130205451
131191838	F42060060S	CSE610661	130205446	130205458
131191839	F42060060S	CSE610661	130205446	130205458
131191840	F42060060S	CSE610661	130205445	130205458
131191841	F42060060S	CSE610661	130205445	130205458
131191842	F42060060S	CSE610661	130205445	130205458
131191843	F42060060S	CSE610661	130205445	130205458
131191844	F42060060S	CSE610661	130205445	130205444
131191845	F42060060S	CSE610661	130205445	130205444
131191849	F42060060S	CSE610661	130205528	130205444
131191851	F42060060S	CSE610661	130205528	130205449
131191855	F42060060S	CSE610661	130205443	130205449
131191856	F42060060S	CSE610661	130205443	130205449
131191857	F42060060S	CSE610661	130205443	130205453
131191858	F42060060S	CSE610661	130205342	130205453
131191859	F42060060S	CSE610661	130205342	130205453
131191861	F42060060S	CSE610661	130205342	130205453
131191862	F42060060S	CSE610661	130205342	130205453
131191863	F42060060S	CSE610661	130205342	130205456
131191864	F42060060S	CSE610661	130205454	130205456
131191865	F42060060S	CSE610661	130205454	130205456
131191866	F42060060S	CSE610661	130205454	130205456
131191867	F42060060S	CSE610661	130205454	130205456
131192024	F42060060S	CSE610661	130205369	130204670
131192025	F42060060S	CSE610661	130205369	130204670
131192026	F42060060S	CSE610661	130205369	130204703
131192027	F42060060S	CSE610661	130204705	130204703
131192028	F42060060S	CSE610661	130204705	130204703
131192029	F42060060S	CSE610661	130204705	130204703
131192030	F42060060S	CSE610661	130204705	130204703

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Roll_No	Product	Resin Lot	Top Geo	Bottom Geo
131192031	F42060060S	CSE610661	130204705	130204703
131192032	F42060060S	CSE610661	130204705	130204094
131192033	F42060060S	CSE610661	130204656	130204094
131192069	F42060060S	CSE610661	130204659	130204073
131192074	F42060060S	CSE610661	130204659	130204073
131192084	F42060060S	CSE610661	130204065	130204637
131192090	F42060060S	CSE610661	130204063	130204657
131192091	F42060060S	CSE610661	130204063	130204657
131192092	F42060060S	CSE610661	130204063	130204657
131192093	F42060060S	CSE610661	130204063	130204657
131192094	F42060060S	CSE610661	130204063	130189376
131192095	F42060060S	CSE610661	130205348	130189376
131192096	F42060060S	CSE610661	130205348	130189376
131192097	F42060060S	CSE610661	130205348	130189376
131192098	F42060060S	CSE610661	130205348	130189376
131192099	F42060060S	CSE610661	130205348	130189376
131192100	F42060060S	CSE610661	130205348	130189376
131192101	F42060060S	CSE610661	130204064	130204655
131192102	F42060060S	CSE610661	130204064	130204655
131192103	F42060060S	CSE610661	130204064	130204655
131192104	F42060060S	CSE610661	130204064	130204655
131192105	F42060060S	CSE610661	130204064	130204655
131192106	F42060060S	CSE610661	130204064	130204655

Report Date
11/2/2005

Quality Assurance Laboratory Test Results

Job Name: Madison County
SO Number: 43333

Test: ASTM D 4595 - Test Method for Tensile Properties of Geotexiles by the Wide Width Method
8" x 8" specimen, 4 inch gauge length, 0.4 in/min test speed, Machine Direction

Customer Frequency: 1/25,000 ft^2

200 Mil Geonet

Roll Number	Maximum Tensile Load per Width lbs/ft
131191829	753.4
131191840	819.4
131191851	692.9
131191862	782.9
131192025	743.9
131192032	772.2
131192092	766.1
131192099	722.2
131192106	744.6

Approved By: Don Cunningham
Date Approved: 11/2/2005

The above stated data shall not be reproduced except in full, without the written approval of the laboratory.

3-Nov-05

RE: Madison County
Project Number: 43333-518117

I certify, that the geocomposite supplied for the subject project meets or exceeds the project specified properties for thickness, geonet tensile, carbon black content, density, and peel strength.

I also certify the geocomposite was tested a frequency which meets or exceeds the 25000 square foot requirement.

Charles Miller
Lab Manager

GSE
GSE Nonwoven Technology

Roll Test Data Report

Bill of Lading:

Sales Order No.	Project Number	Customer Name	Project Location	Product Name	Report Date
				FBR0608200	11/10/2005 *Modified

GSE QC APPROVED

	ASTM D 4491			ASTM D 4751	ASTM D 3786	ASTM D 4833	ASTM D 4533			ASTM D 4632			ASTM D 5199	ASTM D 5261
	Average Sample Flow Rate (gallon/min/ft2)	Water permeability (cm/sec)	Permittivity (Sec-1)	Apparent Opening Size (mm)	Mullen Burst Strength (psi)	Puncture Resistance (lbs)	Trap Tear Strength CD (lbs)	Trap Tear Strength MD (lbs)	Grab Elongation CD (%)	Grab Elongation MD (%)	Grab Strength CD (lbs)	Grab Strength MD (lbs)	Thickness (mils)	Mass per Unit Area (oz/yd2)
Roll No.		every roll		every roll	every 4th	every 2nd	every 4th			every 4th			every 4th	every 2nd
130204063	186	0.50	2.5	0.212	354	109	145	103	135	99	208	212	93	7.1
130204064	186	0.50	2.5	0.212	354	109	145	103	135	99	208	212	93	7.1
130204065	186	0.50	2.5	0.212	304	114	100	76	139	96	198	193	83	6.5
130204094	153	0.50	2.1	0.212	316	103	105	89	137	90	189	206	79	6.5
130204656	172	0.50	2.3	0.212	384	105	127	103	128	94	204	175	80	6.7
130204659	172	0.50	2.3	0.212	374	133	114	148	136	88	189	190	86	6.1
130204670	172	0.50	2.3	0.212	348	111	134	93	125	89	195	201	84	6.3
130204703	188	0.60	2.6	0.212	356	122	124	94	142	101	200	223	104	7.2
130204705	188	0.60	2.6	0.212	356	122	124	94	142	101	200	223	104	7.2
130205342	165	0.60	2.2	0.212	370	124	140	131	134	96	192	193	105	6.9
130205348	165	0.60	2.2	0.212	378	121	163	129	144	95	202	202	96	6.3
130205354	165	0.60	2.2	0.212	378	122	129	100	139	99	201	208	96	6.5
130205369	165	0.60	2.2	0.212	388	120	96	91	133	96	212	219	88	6.9
130205374	165	0.60	2.2	0.212	358	108	102	88	128	91	192	215	100	6.6
130205443	170	0.70	2.3	0.212	408	120	210	107	137	125	267	210	112	7.8
130205444	170	0.70	2.3	0.212	406	97	183	110	130	111	243	216	115	6.8
130205445	170	0.70	2.3	0.212	408	97	183	110	130	111	243	216	115	6.8
130205446	170	0.70	2.3	0.212	406	129	183	110	130	111	243	216	115	7.9
130205449	170	0.70	2.3	0.212	342	148	108	91	141	116	187	181	100	7.4
130205451	170	0.70	2.3	0.212	342	136	108	91	141	116	187	181	100	6.1
130205453	170	0.70	2.3	0.212	350	112	117	92	138	107	222	179	96	7.2
130205454	170	0.70	2.3	0.212	350	148	117	92	138	107	222	179	96	6.9
130205456	170	0.70	2.3	0.212	368	116	134	103	126	95	222	209	102	6.6

Approved By: _____

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Kingstree Lab - US

GSE
GSE Nonwoven Technology

Roll Test Data Report

Bill of Lading:

Sales Order No.	Project Number	Customer Name	Project Location	Product Name	Report Date
				FBR0608200	11/10/2005 *Modified

GSE QC APPROVED

Roll No.	Average Sample Flow Rate (gallons/min/ft2)	Water permeability (cm/sec)	Permittivity (Sec-1)	Apparent Opening Size (mm)	Mullen Burst Strength (psi)	Puncture Resistance (lbs)	Trap Tear Strength CD (lbs)	Trap Tear Strength MD (lbs)	Grab Elongation CD (%)	Grab Elongation MD (%)	Grab Strength CD (lbs)	Grab Strength MD (lbs)	Thickness (mils)	Mass per Unit Area (oz/yd2)
	ASTM D 4491			ASTM D 4751	ASTM D 3786	ASTM D 4833	ASTM D 4533		ASTM D 4632				ASTM D 5199	ASTM D 5261
	every roll			every roll	every 4th	every 2nd	every 4th		every 4th				every 4th	every 2nd
130205458	170	0.70	2.3	0.212	368	131	134	103	126	95	222	209	102	7.4
130205528	172	0.60	2.3	0.212	328	102	103	89	141	103	182	184	85	6.0

Approved By: _____

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GSE
GSE Nonwoven Technology

Roll Test Data Report

Bill of Lading:

GSE QC APPROVED

Sales Order No.	Project Number	Customer Name	Project Location	Product Name	Report Date
42503	514625	Atlantic Lining Company	Suffolk County, New Jersey	FBR0608200	11/10/2005 *Modified

	ASTM D 4491			ASTM D 4751	ASTM D 3786	ASTM D 4833	ASTM D 4533		ASTM D 4632				ASTM D 5199	ASTM D 5261
	Average Sample Flow Rate (gallons/min/ft2)	Water permeability (cm/sec)	Permittivity (Sec-1)	Apparent Opening Size (mm)	Mullen Burst Strength (psi)	Puncture Resistance (lbs)	Trap Tear Strength CD (lbs)	Trap Tear Strength MD (lbs)	Grab Elongation CD (%)	Grab Elongation MD (%)	Grab Strength CD (lbs)	Grab Strength MD (lbs)	Thickness (mils)	Mass per Unit Area (oz/yd2)
Roll No.		every roll		every roll	every 4th	every 2nd	every 4th		every 4th				every 4th	every 2nd
130204637	129	0.40	1.7	0.212	378	119	118	108	125	91	208	206	95	6.9
130204655	172	0.50	2.3	0.212	384	105	127	103	128	94	204	175	80	6.7

Approved By: _____

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GSE
GSE Nonwoven Technology

Roll Test Data Report

Bill of Lading:

Sales Order No.	Project Number	Customer Name	Project Location	Product Name	Report Date
				FBR0608200	11/10/2005 *Modified

GSE QC APPROVED

Roll No.	Average Sample Flow Rate (gallon/min/ft2)	Water permeability (cm/sec)	Permittivity (Sec-1)	Apparent Opening Size (mm)	Mullen Burst Strength (psi)	Puncture Resistance (lbs)	Trap Tear Strength CD (lbs)	Trap Tear Strength MD (lbs)	Grab Elongation CD (%)	Grab Elongation MD (%)	Grab Strength CD (lbs)	Grab Strength MD (lbs)	Thickness (mils)	Mass per Unit Area (oz/yd2)
	ASTM D 4491			ASTM D 4751	ASTM D 3786	ASTM D 4833	ASTM D 4533		ASTM D 4632				ASTM D 5199	ASTM D 5261
	every roll			every roll	every 4th	every 2nd	every 4th		every 4th				every 4th	every 2nd
130189376	192	0.50	2.6	0.212	294	107	126	82	128	111	177	171	100	6.7

Approved By: _____

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GSE Nonwoven Technology

Roll Test Data Report

Bill of Lading:

GSE QC APPROVED

Sales Order No.	Project Number	Customer Name	Project Location	Product Name	Report Date
				HBR0608200	11/10/2005 *Modified

	ASTM D 4491			ASTM D 4751	ASTM D 3786	ASTM D 4833	ASTM D 4533		ASTM D 4632				ASTM D 5199	ASTM D 5261
	Average Sample Flow Rate (gallons/min/ft2)	Water permeability (cm/sec)	Permittivity (Sec-1)	Apparent Opening Size (mm)	Mullen Burst Strength (psi)	Puncture Resistance (lbs)	Trap Tear Strength CD (lbs)	Trap Tear Strength MD (lbs)	Grab Elongation CD (%)	Grab Elongation MD (%)	Grab Strength CD (lbs)	Grab Strength MD (lbs)	Thickness (mils)	Mass per Unit Area (oz/yd2)
Roll No.	every roll			every roll	every 4th	every 2nd	every 4th		every 4th				every 4th	every 2nd
130204073	186	0.50	2.5	0.212	272	93	90	83	135	98	181	193	86	6.5

Approved By: _____

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Page: 1 of 1

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Kingstree Lab - US

GSE

GSE Nonwoven Technology

Roll Test Data Report

SO-Number	Project-Number	BOL-Number	Product-Name
43333	518117		P420600608

GSE QC APPROVED

Report Date: 10/26/2005

*Modified

Roll No.	ASTM D 5199 Average Thickness (mils)	ASTM D 5035 Grab Tensile Strength (ppi)	ASTM D 1603* Carbon Black Content (%)	ASTM D 1505 Density (g/cc)	GRI GC7* / ASTM D7185 Peel Strength Side A - Minimum	Peel Strength Side B - Minimum	Peel Strength Side A - Average	Peel Strength Side B - Average
131191829	221	60	2.5	0.964	3.31	3.14	3.50	3.68
131191830	221	60	2.5	0.964	3.31	3.14	3.50	3.68
131191831	221	60	2.5	0.964	3.31	3.14	3.50	3.68
131191832	221	60	2.5	0.964	3.31	3.14	3.50	3.68
131191837	220	62	2.4	0.964	3.86	4.53	4.30	5.27
131191838	220	62	2.4	0.964	3.86	4.53	4.30	5.27
131191839	220	62	2.4	0.964	3.86	4.53	4.30	5.27
131191840	220	62	2.4	0.964	3.86	4.53	4.30	5.27
131191841	220	62	2.4	0.964	3.86	4.53	4.30	5.27
131191842	220	62	2.4	0.964	3.86	4.53	4.30	5.27
131191843	220	62	2.4	0.964	3.86	4.53	4.30	5.27
131191844	224	68	2.4	0.962	3.07	4.05	3.51	4.61
131191845	224	68	2.4	0.962	3.07	4.05	3.51	4.61
131191849	224	68	2.4	0.962	3.07	4.05	3.51	4.61
131191851	224	68	2.4	0.962	3.07	4.05	3.51	4.61
131191855	223	67	2.5	0.965	3.72	3.58	4.14	4.08
131191856	223	67	2.5	0.965	3.72	3.58	4.14	4.08
131191857	223	67	2.5	0.965	3.72	3.58	4.14	4.08
131191858	223	67	2.5	0.965	3.72	3.58	4.14	4.08
131191859	223	67	2.5	0.965	3.72	3.58	4.14	4.08
131191861	223	67	2.5	0.965	3.72	3.58	4.14	4.08
131191862	223	67	2.5	0.965	3.72	3.58	4.14	4.08
131191863	223	67	2.5	0.965	3.72	3.58	4.14	4.08
131191864	218	59	2.5	0.964	5.41	4.98	6.13	5.69
131191865	218	59	2.5	0.964	5.41	4.98	6.13	5.69

Approved By: [signature]

GSE-8.2.4-029 Rev - - 03/05

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GSE

GSE Nonwoven Technology

Roll Test Data Report

SO-Number	Project-Number	BOL-Number	Product-Name
43333	518117		F420600605

GSE QC APPROVED

Report Date: 10/26/2005

*Modified

Roll No.	ASTM D 5199 Average Thickness (mils)	ASTM D 5035 Grab Tensile Strength (psi)	ASTM D 1603* Carbon Black Content (%)	ASTM D 1505 Density (g/cc)	GRI GC7* / ASTM D7005 Peel Strength Side A - Minimum	Peel Strength Side B - Minimum	Peel Strength Side A - Average	Peel Strength Side B - Average
131191866	218	59	2.5	0.964	5.41	4.98	6.13	5.69
131191867	218	59	2.5	0.964	5.41	4.98	6.13	5.69
131192024	228	61	2.4	0.965	3.35	3.04	3.85	3.52
131192025	228	61	2.4	0.965	3.35	3.04	3.85	3.52
131192026	228	61	2.4	0.965	3.35	3.04	3.85	3.52
131192027	228	61	2.4	0.965	3.35	3.04	3.85	3.52
131192028	228	61	2.4	0.965	3.35	3.04	3.85	3.52
131192029	228	61	2.4	0.965	3.35	3.04	3.85	3.52
131192030	228	61	2.4	0.965	3.35	3.04	3.85	3.52
131192031	228	61	2.4	0.965	3.35	3.04	3.85	3.52
131192032	228	61	2.4	0.965	3.35	3.04	3.85	3.52
131192033	228	61	2.4	0.965	3.35	3.04	3.85	3.52
131192069	225	61	2.4	0.963	3.70	3.86	4.39	4.37
131192074	225	62	2.5	0.964	3.31	4.41	3.90	5.05
131192084	220	61	2.3	0.963	3.70	3.70	4.34	4.16
131192090	220	61	2.3	0.963	3.70	3.70	4.34	4.16
131192091	220	61	2.3	0.963	3.70	3.70	4.34	4.16
131192092	220	61	2.3	0.963	3.70	3.70	4.34	4.16
131192093	220	61	2.3	0.963	3.70	3.70	4.34	4.16
131192094	220	60	2.5	0.964	4.57	3.41	4.79	4.02
131192095	220	60	2.5	0.964	4.57	3.41	4.79	4.02
131192096	220	60	2.5	0.964	4.57	3.41	4.79	4.02
131192097	220	60	2.5	0.964	4.57	3.41	4.79	4.02
131192098	220	60	2.5	0.964	4.57	3.41	4.79	4.02
131192099	220	60	2.5	0.964	4.57	3.41	4.79	4.02

Approved By: _____

GSE-8.2.4-029 Rev - - 03/05

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GSE Nonwoven Technology

Roll Test Data Report

SO-Number	Project-Number	BOL-Number	Product-Name
43333	518117		F42060060S

GSE QC APPROVED

Report Date: 10/26/2005

*Modified

Roll No.	ASTM D 5199 Average Thickness (mils)	ASTM D 5035 Grab Tensile Strength (ppf)	ASTM D 1603* Carbon Black Content (%)	ASTM D 1505 Density (g/cc)	GRI GC7* / ASTM D7005 Peel Strength Side A - Minimum	Peel Strength Side B - Minimum	Peel Strength Side A - Average	Peel Strength Side B - Average
131192100	220	60	2.5	0.964	4.57	3.41	4.79	4.02
131192101	220	60	2.5	0.964	4.57	3.41	4.79	4.02
131192102	220	60	2.5	0.964	4.57	3.41	4.79	4.02
131192103	220	60	2.5	0.964	4.57	3.41	4.79	4.02
131192104	225	62	2.4	0.963	3.80	4.27	4.23	4.77
131192105	225	62	2.4	0.963	3.80	4.27	4.23	4.77
131192106	225	62	2.4	0.963	3.80	4.27	4.23	4.77

Approved By: _____

GSE-8.2.4-029 Rev - - 03/05

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CoA Date: 06/29/2005

Chevron Phillips

Certificate of Analysis

Shipped To: GSE NONWOVEN TECHNOLOGY CO
1245 EASTLAND AVE.
KINGSTREE SC 29556
USA

Recipient: NORMAN LEGETTE
Fax

CPC Delivery #: 88921909
PO #: 84294
Weight: 206350 LB
Ship Date: 06/29/2005
Package: BULK
Mode: Hopper Car
Car #: HGBX001562
Seal No: 437462

Product:
Marlex Polyethylene HHM 55028N BULK

Lot Number: CSE610661

Property	Test Method	Value	Unit
Melt Index	ST-103	0.34	g/10mi
Density	ST-292	0.9548	g/em3

The data set forth herein have been carefully compiled by Chevron Phillips Chemical Company LP. However, there is no warranty of any kind, either expressed or implied, applicable to its use, and the user assumes all risk and liability in connection therewith.

Kay F. Donaldson
Quality Control Supervisor

For CoA questions contact Tom Scheirman at 832-813-4637

GSE Lining Technology, Inc.

Transmissivity Report
ASTM D4716

Roll No. 131191863

ROLL IDENTIFICATION		CUSTOMER INFORMATION	
Roll Number	131191863	Order Number	43933
Product Name	F42060060S	Customer Name	GSI
Production Date	9/10/2005	Project Name	Madison County
Resin Lot #	CSE610661	Location	Madison County, NC

Pressure (psf)	Gradient	Net/Composite	Transmissivity Results (m^2/sec)	(gal/min/ft)	Seat Time (min)	Boundary
10000	0.10	Composite	1.90E-04	0.92	15	SS Plates

GSE Lining Technology, Inc.

1245 Eastland Avenue
Kingstree, SC 29556
Phone 843-382-4603
Fax 843-382-4504

Date 11-10-05

Ref: Ultraviolet (UV) Resistance and Test Frequency of GSE Geotextiles

Project 518117

To Whom It May Concern:

The resistance of nonwoven needle punched geotextiles to ultraviolet light depends primarily on antioxident and carbon black package mixed with resin to prepare a formulation for fiber extrusion. As long as this formulation remains the same the UV resistance of a geotextiles does not change. Therefore, GSE performs UV testing only once per resin formulation. The testing is performed according to ASTM Test Method D 4355 and results are included on GSE geotextile specification sheet. Currently, all GSE geotextiles meet or exceed a value of 70% strength retained after 500 hours of UV exposure. GSE will meet or exceed this value for the referenced project.

Although GSE geotextiles are manufactured using one of the best available antioxident packages, we recommend covering the geotextiles within 15 days of exposure to direct Sunlight. This period does not include time during which geotextiles rolls remain on site covered in black shrink-wrap. Our recommendation is based on UV performance data published in technical literature indicating geotextile strength can decrease sharply after prolonged exposure to Sunlight.

Actual data from an independent laboratory can be supplied upon request.

Charles L. Miller
Laboratory Manager - Kingstree

SECTION VII

GEO-SYNTHETICS, INC.

CERTIFICATE OF ACCEPTANCE OF SUBGRADE SURFACE PREPARATION FOR GEOMEMBRANE INSTALLATION

PROJECT NAME: Madison Co. SMWLF Closure

LOCATION: Madison, NC

Job #: 25084 Owner: Madison Cty

AREA ACCEPTED: P1 thru P35

INSTALLER: The undersigned authorized representative of GSI certifies that he or she has visually inspected the subgrade surface of the area described above and has found the surface to be acceptable for installation of the Geomembrane materials.

GSI shall be responsible for the integrity of finished GCL and Geomembrane material until completion of the installation or demobilization from site.

This certification is based on observations of the subgrade surface conditions only. GSI has made no sub-terrain inspections or tests and makes no representations or warranties as to the conditions that may exist below the surface of the subgrade.

INSPECTOR: X

CERTIFICATE APPROVED AND ACCEPTED BY:

Fran Fran — Signature

11/27/05 — Date

Q.C — Title

G.S.I. — Company

W239 N428 PEWAUKEE ROAD • WAUKESHA, WI 53188 • 262-524-7979 • Fax: 262-524-7961 • 800-444-5523 • www.geo-synthetics.com

GEO-SYNTHETICS, INC.

CERTIFICATE OF ACCEPTANCE OF SUBGRADE SURFACE PREPARATION FOR GEOMEMBRANE INSTALLATION

PROJECT NAME: Madison Co. SMWLF Closure

LOCATION: Madison, NC

Job #: 25084 Owner: Madison Cty

AREA ACCEPTED: P36 thru P40

INSTALLER: The undersigned authorized representative of GSI certifies that he or she has visually inspected the subgrade surface of the area described above and has found the surface to be acceptable for installation of the Geomembrane materials.

GSI shall be responsible for the integrity of finished GCL and Geomembrane material until completion of the installation or demobilization from site.

This certification is based on observations of the subgrade surface conditions only. GSI has made no sub-terrain inspections or tests and makes no representations or warranties as to the conditions that may exist below the surface of the subgrade.

INSPECTOR: X

CERTIFICATE APPROVED AND ACCEPTED BY:

Fran Fran
Signature

11/30/05
Date

Q.C.
Title

G.S.I
Company

W239 N428 PEWAUKEE ROAD • WAUKESHA, WI 53188 • 262-524-7979 • Fax: 262-524-7961 • 800-444-5523 • www.geo-synthetics.com

GEO-SYNTHETICS, INC.

CERTIFICATE OF ACCEPTANCE OF SUBGRADE SURFACE PREPARATION FOR GEOMEMBRANE INSTALLATION

PROJECT NAME: Madison Co. SMWLF Closure

LOCATION: Madison, NC

Job #: 25084 Owner: Madison Cty

AREA ACCEPTED: P41 thru P58

INSTALLER: The undersigned authorized representative of GSI certifies that he or she has visually inspected the subgrade surface of the area described above and has found the surface to be acceptable for installation of the Geomembrane materials.

GSI shall be responsible for the integrity of finished GCL and Geomembrane material until completion of the installation or demobilization from site.

This certification is based on observations of the subgrade surface conditions only. GSI has made no sub-terrain inspections or tests and makes no representations or warranties as to the conditions that may exist below the surface of the subgrade.

INSPECTOR: X

CERTIFICATE APPROVED AND ACCEPTED BY:

Fan Fan — Signature

12/2/05 — Date

Q.C. — Title

G.S.I. — Company

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GEO-SYNTHETICS, INC.

CERTIFICATE OF ACCEPTANCE OF SUBGRADE SURFACE PREPARATION FOR GEOMEMBRANE INSTALLATION

PROJECT NAME: Madison Co. SMWLF Closure

LOCATION: Madison, NC

Job #: 25084 Owner: Madison Cty

AREA ACCEPTED: P59 thru P61

INSTALLER: The undersigned authorized representative of GSI certifies that he or she has visually inspected the subgrade surface of the area described above and has found the surface to be acceptable for installation of the Geomembrane materials.

GSI shall be responsible for the integrity of finished GCL and Geomembrane material until completion of the installation or demobilization from site.

is certification is based on observations of the subgrade surface conditions only. GSI has made no sub-terrain spections or tests and makes no representations or warranties as to the conditions that may exist below the surface of the subgrade.

INSPECTOR: X

CERTIFICATE APPROVED AND ACCEPTED BY:

Fran Fran — Signature

12/6/05 — Date

Q.C. — Title

G.S.I. — Company

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GEO-SYNTHETICS, INC.

PANEL PLACEMENT FORM

PROJECT NAME:	Madison Co. SMWLF Closure
PROJECT NO.:	25084
MATERIAL TYPE:	40 mil LLDPE
MATERIAL LAYER:	Primary
QC NAME:	Tran Tran

PANEL NO.	ROLL NO.	PLACEMENT DATE	PANEL LENGTH (FT)	PANEL WIDTH (FT)	COMMENTS
1	13132044	11/27/05	400'	22'	22 X 400 = 8,800
2	103132044	11/27/05	110.5'	22'	22 X 110.5 = 2,431
3	103132044	11/27/05	112'	22'	22 X 112 = 2,464
4	103132917	11/27/05	85.5'	22'	22 X 85.5 = 1,881
5	103132917	11/27/05	140'	22'	22 X 140 = 3,080
6	103132917	11/27/05	80'	22'	22 X 80 = 1,760
7	103132917	11/27/05	71.5'	22'	22 X 71.5 = 1,573
8	103132917	11/27/05	60'	22'	22 X 60 = 1,320
9	103132917	11/27/05	43.5'	22'	22 X 43.5 = 957
10	103132917	11/27/05	11'	11'	Triangle 60.5
11	103132044	11/27/05	18.5'	22'	22 X 18.5 = 407
12	103132917	11/27/05	113'	22'	22 X 113 = 2,486
13	104121431	11/27/05	112'	22'	22 X 112 = 2,464
14	104121431	11/27/05	77.5'	22'	22 X 77.5 = 1,705
15	104121431	11/27/05	53'	22'	22 X 53 = 1,166
16	104121431	11/27/05	30'	22'	22 X 30 = 660
17	104121431	11/27/05	153.5'	22'	22 X 153.5 = 3,377
18	104121431	11/27/05	126.5'	22'	22 X 126.5 = 2,783
19	103132045	11/27/05	88'	22'	22 X 88 = 1,936

11/27/05
41,310

GSI GEO-SYNTHETICS, INC.

GSI

PANEL PLACEMENT FORM

PROJECT NAME:	Madison Co. SMWLF Closure
PROJECT NO.:	25084
MATERIAL TYPE:	40 mil LLDPE
MATERIAL LAYER:	Primary
QC NAME:	Tran Tran

PANEL NO.	ROLL NO.	PLACEMENT DATE	PANEL LENGTH (FT)	PANEL WIDTH (FT)	COMMENTS
20	103132045	11/27/05	19'	12'	Triangle 114
21	103132045	11/27/05	33'	22'	22X33 = 726
22	103132045	11/27/05	37'	22'	Triangle 407
23	103132045	11/27/05	406'	22'	22 X 406 = 8,932
24	103132918	11/27/05	331'	22'	22 X 331 = 7,282
25	103132918	11/27/05	325'	22'	22 X 325 = 7,150
26	103132915	11/27/05	126'	22'	22 X 126 = 2,772
27	103132915	11/27/05	117.5'	22'	22 X 117.5 = 2,585
28	103132915	11/27/05	102'	22'	22 X 102 = 2,244
29	103132915	11/27/05	89'	22'	22 X 89 = 1,958
30	103132915	11/27/05	82'	22'	22 X 82 = 1,804
31	103132915	11/27/05	70'	22'	22 X 70 = 1,540
32	103132045	11/27/05	135'	22'	22 X 135 = 2,970
33	103132045	11/27/05	77'	22'	22 X 77 = 1,694
34	103132915	11/27/05	28'	22'	22 X 28 = 616
35	103132915	11/27/05	45'	20'	Triangle 400
36	103132916	11/30/05	26.5'	22'	22 X 26.5 = 583
37	103132916	11/30/05	374'	22'	22 X 374 = 8,228
38	103132916	11/30/05	264'	22'	22 X 264 = 5,808

Total for 11/27/05 84,503

11/27/05 43,193

GSI
GEO-SYNTHETICS, INC.

GSI

PANEL PLACEMENT FORM

PROJECT NAME:	Madison Co. SMWLF Closure
PROJECT NO.:	25084
MATERIAL TYPE:	40 mil LLDPE
MATERIAL LAYER:	Primary
QC NAME:	Tran Tran

PANEL NO.	ROLL NO.	PLACEMENT DATE	PANEL LENGTH (FT)	PANEL WIDTH (FT)	COMMENTS
39	103132919	11/30/05	127'	22'	22X127 = 2,794 ☐
40	103132919	11/30/05	400'	22'	22X400 = 8,800 ☐
41	103132914	12/2/05	275-5'	22'	22X275-5 = 6,061 ☐
42	103132914	12/2/05	278-5'	22'	22X278.5 = 6,127 ☐
43	103132914	12/2/05	140'	22'	22X140 = 3,080 ☐
44	103132920	12/2/05	100-5'	22'	22X100-5 = 2,211 ☐
45	103132920	12/2/05	246'	22'	22X246 = 5,412 ☐
46	103132920	12/2/05	127'	22'	22X127 = 2,794 ☐
47	103132920	12/2/05	106-5'	22'	22X106-5 = 2,343 ☐
48	103132919	12/2/05	85'	22'	22X85 = 1,870 ☐
49	103132920	12/2/05	64'	22'	22X64 = 1,408 ☐
50	103132919	12/2/05	43'	22'	22X43 = 946 ☐
51	104121438	12/2/05	32'	22'	22X32 = 704 ☐
52	104121438	12/2/05	99-5'	22'	22X99.5 = 2,189 ☐
53	104121438	12/2/05	125'	22'	22X125 = 2,750 ☐
54	104121438	12/2/05	253'	22'	22X253 = 5,566 ☐
55	104121438	12/2/05	148'	22'	22X148 = 3,256 ☐
56	103132921	12/2/05	111'	22'	22X111 = 2,442 ☐
57	103132921	12/2/05	263'	22'	22X263 = 5,786 ☐

11/30/05
26,237 ☐

12/2/05
60,797 ☐

GEO-SYNTHETICS, INC.

Go.

PANEL PLACEMENT FORM

PROJECT NAME:	Madison Co. SMWLF Closure
PROJECT NO.:	25084
MATERIAL TYPE:	40 mil LLDPE
MATERIAL LAYER:	Primary
QC NAME:	Tran Tran

1515 X 4 = 6,060 ☑ anchor trench + 172,419 = 178,479 ☑

PANEL NO.	ROLL NO.	PLACEMENT DATE	PANEL LENGTH (FT)	PANEL WIDTH (FT)	COMMENTS
58	103132921	12/2/05	266'	22'	22X266 = 5,852 ☑
59	041173	12/6/05	246'	22'	~~22X~~246 = 5,412 ☑
60	041173	12/6/05	57'	14'	14X57 = 798 ☑
61	041173	12/6/05	54'	14'	14X54 = 756 ☑
		"BLACK	OUT	LINER"	

60 MIL LINER

6,966 ☑

178,479 ☑ TOTAL 40 MIL

GEO-SYNTHETICS, INC.

TRIAL WELD FORM

PROJECT NAME:	Madison Co. SMWLF Closure	Test Criteria	40 mil	mil	mil
PROJECT NO.:	25084	3 Peel Fusion	56		
MATERIAL TYPE:	40 mil LLDPE	3 Peel Extrusion	48		
QC NAME:	Tran Tran	3 Shear	60		

Trial No.	Date of Trial	Time of Trial	Technicians Initials	Ambient Temp.	WELDER TYPE	Wedge / Barrel	Speed / Preheat	Peel ppi	Peel ppi	Peel ppi	Shear ppi	Shear ppi	Shear ppi	Pass / Fail
1	11/27/05	735	K.S		fusion 5	750	4-0	110 112	113 108	116 104	118	121	119	P
2	11/27/05	740	Y-N		fusion 3	800	4-0	108 103	111 102	109 96	116	115	120	P
3	11/27/05	744	D-N		fusion 20	800	4-0	114 111	115 102	103 109	128	120	117	P
4	11/27/05	1236	K.S		fusion 5	800	4-0	99 103	100 98	101 98	120	120	118	P
5	11/27/05	1238	Y-N		fusion 3	800	4-0	113 110	111 108	109 99	117	121	118	P
6	11/27/05	1245	D-N		fusion 24	800	4-0	100 98	101 98	102 100	118	119	121	P
7	11/27/05	1250	K-N		extrusion 36	250	300	110	109	110	119	120	119	P
8	11/30/05	740	Y-N		extrusion 42	350	430	118	111	111	123	121	117	P
9	11/30/05	745	K-S		extrusion 36	250	300	110	110	108	118	118	120	P
10	11/30/05	1300	Y-N		extrusion 42	350	430	110	99	109	120	120	119	P
11	11/30/05	1420	D-N		fusion 3	800	4-0	113 110	116 111	108 103	119	118	118	P
12	11/30/05	1525	K-S		fusion 5	800	4-0	98 99	110 99	111 105	118	119	118	P

GEO-SYNTHETICS, INC.

TRIAL WELD FORM

PROJECT NAME:	Madison Co. SMWLF Closure	Test Criteria	40 mil	mil	mil
PROJECT NO.:	25084	3 Peel Fusion	50		
MATERIAL TYPE:	40 mil LLDPE	3 Peel Extrusion	48		
QC NAME:	Tran Tran	3 Shear	60		

Trial No.	Date of Trial	Time of Trial	Technicians Initials	Ambient Temp.	WELDER TYPE	Wedge Barrel	Speed Preheat	Peel ppi	Peel ppi	Peel ppi	Shear ppi	Shear ppi	Shear ppi	Pass Fail
13	12/1/05	1020	D-N		fusion 3	800	4-0	94 96	98 95	91 93	117	117	119	P
14	12/1/05	1025	K-S		extrusion 42	350	430	90	88	91	108	113	107	P
15	12/1/05	1235	K-S		extrusion 42	350	430	91	90	88	110	116	118	P
16	12/2/05	740	Y-N		fusion 3	800	4-0	108 109	111 109	103 101	113	118	110	P
17	12/2/05	745	K-S		fusion 5	800	4-0	99 101	102 99	103 100	119	112	111	P
18	12/2/05	800	K-N		extrusion 36	250	300	93	91	90	110	110	109	P
19	12/2/05	1230	K-N		extrusion 36	250	300	89	92	95	109	110	112	P
20	12/2/05	1235	Y-N		fusion 3	800	4-0	111 110	110 113	109 111	113	112	117	P
21	12/2/05	1240	K-S		fusion 5	800	4-0	98 100	96 101	99 100	111	115	115	P
22	12/3/05	730	D-N		extrusion 36	250	300	93	96	91	116	119	110	P
23	12/6/05	755	K.S.		fusion 3	800	4-0	91 90	88 93	91 96	120	120	123	P
24	12/6/05	810	K-N		extrusion 36	250	300	89	90	90	121	120	119	P

60 MIL LINER

GEO-SYNTHETICS, INC.

TRIAL WELD FORM

PROJECT NAME:	Madison Co. SMWLF Closure	Test Criteria	40 mil	mil	mil
PROJECT NO.:	25084	3 Peel Fusion	56		
MATERIAL TYPE:	40 mil LLDPE	3 Peel Extrusion	48		
QC NAME:	Tran Tran	3 Shear	60		

Trial No.	Date of Trial	Time of Trial	Technicians Initials	Ambient Temp.	WELDER TYPE	Wedge Barrel	Speed Preheat	Peel ppi	Peel ppi	Peel ppi	Shear ppi	Shear ppi	Shear ppi	Pass Fail
25	12/6/05	815	N-Y		extrusion 27	250	250	93	89	89	120	123	121	P
26	12/6/05	1250	K-N		extrusion 36	250	300	90	96	99	121	120	120	P
27	12/6/05	1300	N-Y		extrusion 27	250	250	91	92	89	122	120	123	P

GSI GEO-SYNTHETICS, INC.

PANEL SEAMING FORM

PROJECT	Madison Co. SMWLF Closure
PROJECT NO.:	25084
MATERIAL	40 mil LLDPE
MTL LAYER:	Primary
QC NAME:	Tran Tran

SEAM NO.	DATE	TIME	SEAM LENGTH	SEAMER INT	MACHINE NO.	Wedge / Barrel	Speed / Preheat	Comments	Non Destructive Testing Completed
P2/3	11/27/05	750	111'	K-S	5	750	4-0		
P2/4	11/27/05	817	88'	Y-N	3	800	4-0		
P4/6	11/27/05	822	83'	D-N	20	800	4-0		
P6/7	11/27/05	835	77'	K-S	5	750	4-0		
P7/8	11/27/05	840	66'	Y-N	3	800	4-0		
P8/9	11/27/05	842	54'	D-N	20	800	4-0		
P10/11	11/27/05	900	11'	D-N	20	800	4-0		
P3/12	11/27/05	850	113'	K-S	5	750	4-0		
P9/11	11/27/05	909	22'	D-N	20	800	4-0		
P9/10	11/30/05	A-M	11'	Y-N	MX 42	350	430	ext weld - not mouse	
P12/13	11/27/05	914	113'	K-S	5	750	4-0		
P13/14	11/27/05	930	89'	K-S	5	750	4-0		
P4/5	11/27/05	932	22'	D-N	20	800	4-0	begin bone tested 93/89 88/90 87/97	
P5/6	↓	↓	22'	↓	↓	↓	↓		
P5/7			22'						
P5/8			22'						
P5/9			22'						
P5/11	↓	↓	26'	↓	↓	↓	↓	and bone tested 88/91 100/88 93/86	
P14/15	11/27/05	940	66'	Y-N	3	800	4-0		
P2/5	11/27/05	930	22'	D-N	20	800	4-0		

GSI GEO-SYNTHETICS, INC.

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PANEL SEAMING FORM

PROJECT	Madison Co. SMWLF Closure
PROJECT NO.:	25084
MATERIAL	40 mil LLDPE
MTL LAYER:	Primary
QC NAME:	Tran Tran

SEAM NO.	DATE	TIME	SEAM LENGTH	SEAMER INT	MACHINE NO.	Wedge / Barrel	Speed / Preheat	Comments	Non Destructive Testing Completed
P15/16	11/27/05	950	40'	K-S	5	750	4-0		
P1/17	11/27/05	1000	162'	Y-N	3	800	4-0	end & begin bones tested 91/90	89/91 88/93
P17/18	11/27/05	1005	145'	K-S	5	750	4-0		
P18/19	11/27/05	1042	108'	Y-N	3	800	4-0		
P1/5	11/27/05	1050	144'	K-S	5	750	4-0		
P21/22	11/27/05	1106	24'	Y-N	3	800	4-0		
P16/20	11/27/05	1113	19'	Y-N	3	800	4-0		
P19/21	11/27/05	1127	31'	K-S	5	750	4-0		
P19/22	↓	↓	37'	↓	↓	↓	↓		
P1/23	11/27/05	1255	232'	Y-N	3	800	4-0	232' W to EEOS (begin end bones tested) 93/98	90/100 101/9
↓	↓	1305	174'	D-N	24	800	4-0	232' E to WEOS (begin end bones tested) 91/89	90/9 98/93
P13/17	11/27/05	1320	22'	K-S	5	800	4-0		
P14/18	↓	↓	31'	↓	↓	↓	↓		
P15/18	↓	↓	2'	↓	↓	↓	↓	cover by patch	
P15/19	↓	↓	29'	↓	↓	↓	↓		
P16/19	↓	↓	2'	↓	↓	↓	↓	cover by patch	
P16/21	↓	↓	21'	↓	↓	↓	↓		
P20/21	↓	↓	20'	↓	↓	↓	↓	(end bones tested) 88/100 90/97	101/92

GEO-SYNTHETICS, INC.

PANEL SEAMING FORM

PROJECT	Madison Co. SMWLF Closure
PROJECT NO.:	25084
MATERIAL	40 mil LLDPE
MTL LAYER:	Primary
QC NAME:	Tran Tran

SEAM NO.	DATE	TIME	SEAM LENGTH	SEAMER INT	MACHINE NO.	Wedge / Barrel	Speed / Preheat	Comments	Non Destructive Testing Completed
P1/13	11/27/05	1348	22'	D-N	24	800	4-0		
P1/12	↓	↓	22'	↓	↓	↓	↓		
P1/3	↓	↓	22'	↓	↓	↓	↓		
P1/2	↓	↓	22'	↓	↓	↓	↓		
P24/25	11/27/05	1345	(330')	Y-N	3	800	4-0	begin bones tested 100/93 101/98 97/99 end bones tested beginning and end 98/101	
P26/27	11/27/05	1420	122'	D-N	24	800	4-0		93/103
P27/28	11/27/05	1435	113'	K-S	5	800	4-0		
P28/29	11/27/05	1458	90'	Y-N	3	800	4-0		
P23/24	11/27/05	1500	22'	D-N	24	800	4-0		
P23/25	↓	↓	22'	↓	↓	↓	↓		
P25/29	11/27/05	1500	22'	K-S	5	800	4-0		
P25/28	↓	↓	22'	↓	↓	↓	↓		
P25/27	↓	↓	22'	↓	↓	↓	↓		
P25/26	↓	↓	22'	↓	↓	↓	↓	end bones tested 91/89	93/96 90/98
P29/30	11/27/05	1512	88'	D-N	24	800	4-0		
P25/31	11/27/05	1520	22'	K-S	5	800	4-0		
P25/30	↓	↓	22'	↓	↓	↓	↓		
P30/31	11/27/05	1530	76'	Y-N	3	800	4-0		
P31/32	11/27/05	1613	22'	D-N	24	800	4-0		
P23/26	11/27/05	1405	129'	K-S	5	800	4-0		

GEO-SYNTHETICS, INC.

PANEL SEAMING FORM

PROJECT	Madison Co. SMWLF Closure
PROJECT NO.:	25084
MATERIAL	40 mil LLDPE
MTL LAYER:	Primary
QC NAME:	Tran Tran

SEAM NO.	DATE	TIME	SEAM LENGTH	SEAMER INT	MACHINE NO.	Wedge / Barrel	Speed / Preheat	Comments	Non Destructive Testing Completed
P25/32	11/27/05	1614	168'	K-S	5	800	4-0	(end bones tested) 88/90	89/88 90/93
P32/33	11/27/05	1638	77'	Y-N	3	800	4-0		
P32/34	↓	↓	25'	↓	↓	↓	↓		
P33/34	11/27/05	1640	22'	D-N	24	800	4-0		
P31/34	11/27/05	1650	22'	K-S	5	800	4-0		
P31/35	↓	↓	20'	↓	↓	↓	↓		
P34/35	11/27/05	1700	13'	K-S	5	800	4-0	NEOS to 13's	
↓	11/30/05	A-M	17'	Y-N	MX 42	350	430	13's to SEOS (not mouse)	
P33/35	11/30/05	A-M	15'	Y-N	MX 42	350	430		
P24/37	11/30/05	1440	332'	D-N	3	800	4-0	begin (end bones tested) 101/99	103/100 93/101
P36/37	↓	↓	34'	↓	↓	↓	↓		
P37/39	11/30/05	1530	127'	K-S	5	800	4-0	begin bone tested 99/101	98/103 100/103
P37/38	↓	↓	272'	↓	↓	↓	↓	(end bones tested) 103/111	99/109 100/98
P25/36	12/1/05	A-M	19'	K-S	MX 42	350	430	ext weld	
P24/36	12/1/05	A-M	22'	K-S	MX 42	350	430	ext weld	
P38/39	12/1/05	A-M	22'	K-S	MX 42	350	430	ext weld	
P39/40	12/1/05	1035	127'	D-N	3	800	4-0	begin bone tested 100/93	99/101 97/100
P38/40	↓	↓	272'	↓	↓		↓	end bone tested 90/96	93/100 98/105

GSI GEO-SYNTHETICS, INC.

PANEL SEAMING FORM

PROJECT	Madison Co. SMWLF Closure
PROJECT NO.:	25084
MATERIAL	40 mil LLDPE
MTL LAYER:	Primary
QC NAME:	Tran Tran

SEAM NO.	DATE	TIME	SEAM LENGTH	SEAMER INT	MACHINE NO.	Wedge / Barrel	Speed / Preheat	Comments	Non Destructive Testing Completed
P23/40	12/1/05	1145	22'	D-N	3	800	4-0		
P23/39	↓	↓	22'	↓	↓	↓	↓		
P23/37	↓	↓	22'	↓	↓	↓	↓		
P41/42	12/2/05	830	276'	Y-N	3	800	4-0	93/90 91/90 begin 91/100 end bone ~~tested~~	101/93 98/100 99/
P43/44	12/2/05	900	22'	K-S	5	800	4-0		
P42/43	12/2/05	905	140'	K-S	5	800	4-0	90/88 93/90 begin 87/91 end bone tested	88/90 90/85 /97/
P42/44	↓	↓	97'	↓	↓	↓	↓		
P43/45	12/2/05	929	140'	Y-N	3	800	4-0	99/100 93/102 begin 101/98 end bone tested	99/100 98/100 93/
P44/45	↓	↓	104'	↓	↓	↓	↓		
P46/47	12/2/05	915	117'	K-S	5	800	4-0		
P47/48	12/2/05	1055	96'	Y-N	3	800	4-0		
P48/49	12/2/05	1111	74'	K-S	5	800	4-0		
P49/50	12/2/05	1113	54'	Y-N	3	800	4-0		
P50/51	12/2/05	1132	32'	Y-N	3	800	4-0		
P40/41	12/2/05	1305	275'	K-S	5	800	4-0	91/93 90/91 begin 90/88 end bone ~~tested~~	93/91 90/89 90/8
P41/46	12/2/05	1328	22'	Y-N	3	800	4-0		
P42/46	↓	↓	22'	↓	↓	↓	↓		
P46/52	↓	↓	92'	↓	↓	↓	↓		
P52/53	12/2/05	1405	107'	Y-N	3	800	4-0		

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GEO-SYNTHETICS, INC.

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PANEL SEAMING FORM

PROJECT	Madison Co. SMWLF Closure
PROJECT NO.:	25084
MATERIAL	40 mil LLDPE
MTL LAYER:	Primary
QC NAME:	Tran Tran

SEAM NO.	DATE	TIME	SEAM LENGTH	SEAMER INT	MACHINE NO.	Wedge / Barrel	Speed / Preheat	Comments	Non Destructive Testing Completed
P45/54	12/2/05	1430	248	Y-N	3	800	4-0	begin bone tested 101/98 100/93	99/96
P40/46	12/2/05	1435	16'	K-S	5				
P40/47			23'						
P40/48			23'						
P40/49			23'						
P40/50			23'						
P40/51			23'					end bone tested 93/90	89/90 89/88
P55/56	12/2/05	1435	22'	D-N	24'	800	4-0		
P54/56	12/2/05	1445	111'	D-N	24	800	4-0	begin bone tested 88/86	83/89 90/86
P54/55			146'					end bone tested 89/86	90/83 88/91
P56/57	12/2/05	1510	111'	Y-N	3	800	4-0	begin bone tested 100/93	99/101 96/103
P55/57			150'					end bone tested 98/101	98/96 95/90
P57/55	12/2/05	1527	271'	D-N	24	800	4-0	begin & end bone tested 90/103	99/91 100/98
P53/42	12/2/05	1552	22'	Y-N	3	800	4-0		
P52/42			22'						
P44/53	12/2/05	1603	22'	Y-N	3	800	4-0		
P53/58	12/2/05	1618	22'	Y-N	3	800	4-0		
P53/57			22'						
P53/55			22'						
P53/54			22'						
~~P53/54~~ P45/53			22'						

GSI GEO-SYNTHETICS, INC.

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PANEL SEAMING FORM

PROJECT	Madison Co. SMWLF Closure
PROJECT NO.:	25084
MATERIAL	40 mil LLDPE
MTL LAYER:	Primary
QC NAME:	Tran Tran

SEAM NO.	DATE	TIME	SEAM LENGTH	SEAMER INT	MACHINE NO.	Wedge / Barrel	Speed / Preheat	Comments	Non Destructive Testing Completed
P23/58	12/2/05	1510	22'	K-S	5	800	4-0	begin bone tested 89/91 93/90 88/91	
P23/57	↓	↓	22'	↓	↓	↓	↓		
P23/56			22'						
P23/54			22'						
P23/45			22'						
P23/43			22'						
P23/42			22'						
P23/41	↓	↓	22'	↓	↓	↓	↓	end bone tested 90/89 101/99 99/88	
P59/60	12/6/05	825	57'	K-S	3	800	4-0		
P59/61	↓	↓	54'	↓	↓	↓	↓		
P60/61	12/6/05	850	14'	K-S	3	800	4-0	begin bone tested 91/90 89/93 90/88	
P58/59	12/6/05	940	221'	K-S	3	800	4-0	end bone tested 89/91 88/90 89/92	

GEO-SYNTHETICS, INC.

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DESTRUCTIVE TEST FORM

PROJECT NAME:	Madison Co. SMWLF Closure	Test Criteria	40 Mil	Mil	Mil
PROJECT NO.:	25084	Peel	F=56 / E=48		
MATERIAL TYPE	40 mil LLDPE	Peel Sep.			
MATERIAL LAYER:	Primary	Shear	60		
QC NAME:	Tran Tran	% Elongation	10		

SAMPLE I.D.	SEAM NO.	Q.C. INT.	MACH NO.	SEAMER INT	FIELD VALUES PEEL (ppi)					SHEAR (ppi)					PASS / FAIL	SAMPLE LOCATION
DT-1	P2/3	T-T	3	K-S	100 98	103 99	99 96								P	75' N OF SEDS
DT-2	P4/6	T-T	20	D-N	108 116	113 111	109 111								P	40' N OF SEDS
DT-3	P7/8	T-T	3	Y-N	107 101	101 109	110 111								P	35' N OF SEDS
DT-4	P17/18	T-T	5	K-S	108 106	99 111	103 110								P	88' E OF WEDS
DT-5	P1/23	T-T	24	D-N	101 99	103 98	100 99								P	280' W OF EEDS
DT-6	P1/23	T-T	3	Y-N	118 110	113 111	119 98								P	125' W OF EEDS
DT-7	P27/28	T-T	5	K-S	96 89	99 93	88 91								P	44' W OF EEDS
DT-8	P30/31	T-T	3	Y-N	110 106	109 112	99 103								P	34' W OF EEDS
DT-9	P33/34	T-T	24	D-N	99 101	98 101	100 99								P	EEDS
DT-10	P31/34	T-T	5	K-S	89 93	91 98	88 96								P	7' W OF EEDS

GSI GEO-SYNTHETICS, INC.

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DESTRUCTIVE TEST FORM

PROJECT NAME:	Madison Co. SMWLF Closure	Test Criteria	40 Mil	Mil	Mil
PROJECT NO.:	25084	Peel	F=56 / E=48		
MATERIAL TYPE	40 mil LLDPE	Peel Sep.			
MATERIAL LAYER:	Primary	Shear	60		
QC NAME:	Tran Tran	% Elongation	10		

SAMPLE I.D.	SEAM NO.	Q.C. INT.	MACH NO.	SEAMER INT	FIELD VALUES PEEL (ppi)					FIELD VALUES SHEAR (ppi)					PASS / FAIL	SAMPLE LOCATION	
DT-11	P31/35	T-T	MX 42	Y-N	109	109	101								P	191' S OF NEOS	
DT-12	P24/37	T-T			100 93	101 96	99 93								P	175' S OF NEOS	
DT-13	P37/38	T-T			100 98	99 93	96 91								P	75' S OF NEOS	12/1/05
DT-14	P24/36	T-T	MX 42	K-S	60	49	56								P	10' E OF WEOS	
DT-15	P38/40	T-T			99 89	89 93	101 98								P	160' S OF NEOS	
DT-16	P44/45	T-T			88 92	91 89	93 91								P	90' S OF NEOS	
DT-17	P40/41	T-T			100 93	98 96	97 96								P	158' S OF NEOS	12/3/05
DT-18	P55/57	T-T			98 101	99 88	96 93								P	65' S OF NEOS	
DT-19	P23/54	T-T			99 101	103 100	100 101								P	8' W OF EEOS	
DT-20	P59/61	TJ			101 100	99 101	98 100									20' S OF NEOS	12/6/05

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GEO-SYNTHETICS, INC.

GSI
NON-DESTRUCTIVE TESTING FORM

PROJECT NAME:	Madison Co. SMWLF Closure	Test Criteria		Vac Time	15 Seconds
PROJECT NO.:	25084	Start Pressure	30 psi minimum	Vac. Pres.	3 psi
MATERIAL TYPE:	40 mil LLDPE	Test Time	5 minutes		
MATERIAL LAYER:	Primary	Accept. Drop	3 psi		
QC NAME:	Tran Tran				

Seam Number	Test Date	Tech Initials	Test Type (A or V)	Air Pressure Test psi start	psi finish	Time Start	Time End	Test Result (P or F)	Test Locations
P10/11	11/27/05	T-T	ATOK	30	30	1015	1020	P	Entire Seam
P9/10	11/30/05	V-L	VTOK	ext	weld	-(not fusion weld)		P	Entire Seam
P9/11	11/27/05	T-T	ATOK	30	30	1016	1021	P	Entire Seam
P5/11	11/27/05	T-T	ATOK	30	30	1017	1022	P	Entire Seam
P5/9	11/27/05	T-T	ATOK	30	30	1023	1028	P	Entire Seam
P8/9	11/27/05	T-T	ATOK	30	30	1024	1029	P	Entire Seam
P5/8	11/27/05	T-T	ATOK	30	30	1025	1030	P	Entire Seam
P7/8	11/27/05	T-T	ATOK	30	30	1032	1037	P	Entire Seam
P5/7	11/27/05	T-T	ATOK	30	30	1033	1038	P	Entire Seam
P6/7	11/27/05	T-T	ATOK	30	30	1034	1039	P	Entire Seam
P5/6	11/27/05	T-T	ATOK	30	30	1040	1045	P	Entire Seam
P4/6	11/27/05	T-T	ATOK	30	30	1047	1052	P	SEOS to 49'N
↓	11/27/05	T-T	ATOK	30	30	1048	1053	P	49'N to NEOS
P4/5	11/27/05	T-T	ATOK	30	28	1049	1054	P	Entire Seam
P2/5	11/27/05	T-T	ATOK	30	30	1055	1100	P	Entire Seam
P2/4	11/27/05	T-T	ATOK	30	30	1056	1101	P	SEOS to 62'N
↓	11/27/05	T-T	ATOK	30	30	1057	1102	P	62'N to NEOS
P2/3	11/27/05	T-T	ATOK	30	30	1105	1110	P	Entire Seam

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GEO-SYNTHETICS, INC.

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NON-DESTRUCTIVE TESTING FORM

PROJECT NAME:	Madison Co. SMWLF Closure	Test Criteria		Vac Time	15 Seconds
PROJECT NO.:	25084	Start Pressure	30 psi minimum	Vac. Pres.	3 psi
MATERIAL TYPE:	40 mil LLDPE	Test Time	5 minutes		
MATERIAL LAYER:	Primary	Accept. Drop	3 psi		
QC NAME:	Tran Tran				

Seam Number	Test Date	Tech Initials	Test Type (A or V)	Air Pressure Test psi start	psi finish	Time Start	Time End	Test Result (P or F)	Test Locations
P3/12	11/27/05	T-T	ATOK	30	30	1106	1111	P	Entire Seam
P12/13	11/27/05	T-T	ATOK	30	30	1107	1112	P	Entire Seam
P13/14	11/27/05	T-T	ATOK	30	30	1220	1225	P	Entire Seam
P14/15	11/27/05	T-T	ATOK	30	30	1221	1226	P	SEOS to 58'N
↓	11/27/05	T-T	ATOK	30	30	1222	1227	P	58'N to NEOS
P15/16	11/27/05	T-T	ATOK	30	30	1230	1235	P	SEOS to 12'N
↓	11/27/05	T-T	ATOK	30	30	1231	1236	P	12'N to 36'N
↓	11/30/05	V-L	VTOK	cover by patch —				P	36'N to NEOS
P16/20	11/27/05	T-T	ATOK	30	30	1240	1245	P	Entire Seam
P1/5	11/27/05	T-T	ATOK	30	30	1310	1315	P	EEOS to 15'W
↓	11/27/05	T-T	ATOK	30	30	1311	1316	P	15'W to WEOS
P1/2	11/27/05	T-T	ATOK	30	30	1430	1435	P	Entire Seam
P1/3	11/27/05	T-T	ATOK	30	30	1431	1436	P	Entire Seam
P1/12	11/27/05	T-T	ATOK	30	30	1432	1437	P	Entire Seam
P1/13	11/27/05	T-T	ATOK	30	30	1449	1454	P	Entire Seam
P1/17	11/27/05	T-T	ATOK	30	29	1450	1455	P	Entire Seam
P13/17	11/27/05	T-T	ATOK	30	30	1510	1515	P	Entire Seam
P17/18	11/27/05	T-T	ATOK	30	30	1512	1517	P	Entire Seam

GSI
GEO-SYNTHETICS, INC.

GSI
NON-DESTRUCTIVE TESTING FORM

PROJECT NAME:	Madison Co. SMWLF Closure	Test Criteria		Vac Time	15 Seconds
PROJECT NO.:	25084	Start Pressure	30 psi minimum	Vac. Pres.	3 psi
MATERIAL TYPE:	40 mil LLDPE	Test Time	5 minutes		
MATERIAL LAYER:	Primary	Accept. Drop	3 psi		
QC NAME:	Tran Tran				

Seam Number	Test Date	Tech Initials	Test Type (A or V)	Air Pressure Test psi start	psi finish	Time Start	Time End	Test Result (P or F)	Test Locations
P14/18	11/27/05	T-T	ATOK	30	28	1513	1518	P	Entire Seam
P15/18	11/30/05	V-L	VTOK	Cover	by T-	inter	patch	P	Entire Seam
P18/19	11/27/05	T-T	ATOK	30	30	1550	1555	P	WEOS to 79'E
↓	11/27/05	T-T	ATOK	30	30	1551	1556	P	79'E to EEOS
P19/21	11/27/05	T-T	ATOK	30	29	1559	1604	P	WEOS to 25'E
P19/22	11/27/05	T-T	ATOK	30	30	1600	1605	P	Entire Seam
P21/22	11/27/05	T-T	ATOK	30	30	1601	1606	P	Entire Seam
P15/19	11/27/05	T-T	ATOK	30	30	1610	1615	P	Entire Seam
P16/19	11/30/05	V-L	VTOK	Cover	by T-	inter	patch	P	Entire Seam
P16/21	11/30/05	T-T	ATOK	30	28	705	710	P	Entire Seam
P20/21	11/30/05	T-T	ATOK	30	29	706	711	P	Entire Seam
11/23	11/30/05	T-T	ATOK	30	30	715	720	P	EEOS to 232'W
↓	11/30/05	T-T	ATOK	30	29	716	721	P	232'W to DT-5
↓	11/30/05	T-T	ATOK	30	30	717	722	P	DT-5 to WEOS
P23/24	11/30/05	T-T	ATOK	30	30	724	729	P	Entire Seam
P23/25	11/30/05	T-T	ATOK	30	30	725	730	P	Entire Seam
P23/26	11/30/05	T-T	ATOK	30	30	726	731	P	Entire Seam
P25/26	11/30/05	T-T	ATOK	30	30	734	739	P	Entire Seam
7/22	11/27/05	T-T	ATOK	30	30	1611	1616	P	25'E to EEOS

GSI
GEO-SYNTHETICS, INC.

GSI
NON-DESTRUCTIVE TESTING FORM

PROJECT NAME:	Madison Co. SMWLF Closure	Test Criteria		Vac Time	15 Seconds
PROJECT NO.:	25084	Start Pressure	30 psi minimum	Vac. Pres.	3 psi
MATERIAL TYPE:	40 mil LLDPE	Test Time	5 minutes		
MATERIAL LAYER:	Primary	Accept. Drop	3 psi		
QC NAME:	Tran Tran				

Seam Number	Test Date	Tech Initials	Test Type (A or V)	Air Pressure Test psi start	psi finish	Time Start	Time End	Test Result (P or F)	Test Locations
P26/27	11/30/05	T-T	ATOK	30	30	736	741	P	EEOS to 93' W
↓	11/30/05	T-T	ATOK	30	30	737	742	P	93' W to WEOS
P25/27	11/30/05	T-T	ATOK	30	30	743	748	P	Entire Seam
P27/28	11/30/05	T-T	ATOK	30	29	744	749	P	Entire Seam
P25/28	11/30/05	T-T	ATOK	30	30	746	751	P	Entire Seam
P25/29	11/30/05	T-T	ATOK	30	30	755	800	P	Entire Seam
P25/29	11/30/05	T-T	ATOK	30	30	756	801	P	Entire Seam
P29/30	11/30/05	T-T	ATOK	30	30	757	802	P	Entire Seam
P25/30	11/30/05	T-T	ATOK	30	30	830	835	P	Entire Seam
P30/31	11/30/05	T-T	ATOK	30	30	831	836	P	Entire Seam
P25/31	11/30/05	T-T	ATOK	30	30	832	837	P	Entire Seam
P25/32	11/30/05	T-T	ATOK	30	30	840	845	P	Entire Seam
P31/32	11/30/05	T-T	ATOK	30	29	841	846	P	Entire Seam
P32/34	11/30/05	T-T	ATOK	30	30	849	854	P	Entire Seam
P32/33	11/30/05	T-T	ATOK	30	28	850	855	P	Entire Seam
P31/34	11/30/05	T-T	ATOK	30	30	900	905	P	EEOS to DT-10
↓	11/30/05	T-T	ATOK	30	30	901	906	P	DT-10 to WEOS
P33/34	11/30/05	T-T	ATOK	30	29	908	913	P	Entire Seam

GSI
GEO-SYNTHETICS, INC.

GSI
NON-DESTRUCTIVE TESTING FORM

PROJECT NAME:	Madison Co. SMWLF Closure	Test Criteria		Vac Time	15 Seconds
PROJECT NO.:	25084	Start Pressure	30 psi minimum	Vac. Pres.	3 psi
MATERIAL TYPE:	40 mil LLDPE	Test Time	5 minutes		
MATERIAL LAYER:	Primary	Accept. Drop	3 psi		
QC NAME:	Tran Tran				

Seam Number	Test Date	Tech Initials	Test Type (A or V)	Air Pressure Test psi start	Air Pressure Test psi finish	Time Start	Time End	Test Result (P or F)	Test Locations
P31/35	11/30/05	T-T	ATOK	30	30	920	925	P	Entire Seam
P34/35	11/30/05	T-T	ATOK	30	30	921	926	P	NEOS to 13's
↓	11/30/05	V-L	VTOK	ext weld	—	—		P	13's to SEOS
P33/35	11/30/05	V-L	VTOK	ext weld	—	—		P	Entire Seam
P24/25	11/30/05	T-T	ATOK	30	28	932	937	P	NEOS to 286's
↓	11/30/05	T-T	ATOK	30	30	933	938	P	286's to SEOS
P24/37	11/30/05	T-T	ATOK	30	30	1600	1605	P	NEOS to 286's
↓	11/30/05	T-T	ATOK	30	30	1602	1607	P	286's to SEOS
P36/37	11/30/05	T-T	ATOK	30	30	1610	1615	P	Entire Seam
P37/39	11/30/05	T-T	ATOK	30	29	1623	1628	P	Entire Seam
P37/38	11/30/05	T-T	ATOK	30	30	1630	1635	P	NEOS to 193's
↓	11/30/05	T-T	ATOK	30	30	1632	1637	P	193's to SEOS
P25/36	12/1/05	V-L	VTOK	ext weld	—	—		P	Entire Seam
P24/36	12/1/05	V-L	VTOK	ext weld	—	—		P	Entire Seam
P38/39	12/1/05	V-L	VTOK	ext weld	—	—		P	Entire Seam

GSI
GEO-SYNTHETICS, INC.

GSI
NON-DESTRUCTIVE TESTING FORM

PROJECT NAME:	Madison Co. SMWLF Closure	Test Criteria		Vac Time	15 Seconds
PROJECT NO.:	25084	Start Pressure	30 psi minimum	Vac. Pres.	3 psi
MATERIAL TYPE:	40 mil LLDPE	Test Time	5 minutes		
MATERIAL LAYER:	Primary	Accept. Drop	3 psi		
QC NAME:	Tran Tran				

Seam Number	Test Date	Tech Initials	Test Type (A or V)	Air Pressure Test psi start	psi finish	Time Start	Time End	Test Result (P or F)	Test Locations
P23/40	12/1/05	T-T	ATOK	30	30	1200	1205	P	Entire Seam
P23/39	12/1/05	T-T	ATOK	30	29	1202	1207	P	Entire Seam
P23/37	12/1/05	T-T	ATOK	30	30	1203	1208	P	Entire Seam
P39/40	12/1/05	T-T	ATOK	30	30	1250	1255	P	NEOS to 109's
↓	12/1/05	T-T	ATOK	30	30	1251	1256	P	109's to SEOS
P38/40	12/1/05	T-T	ATOK	30	30	1252	1257	P	NEOS to 25's
	12/1/05	T-T	ATOK	30	30	1300	1305	P	25's to 127's
	12/1/05	T-T	ATOK	30	30	1301	1306	P	127's to DT-15 (160')
	12/1/05	T-T	ATOK	30	30	1308	1313	P	DT-15 to 261's
↓	12/1/05	T-T	ATOK	30	30	1309	1314	P	261's to SEOS
P41/42	12/2/05	T-T	ATOK	30	30	1130	1135	P	Entire Seam
P42/43	12/2/05	T-T	ATOK	30	28	1132	1137	P	Entire Seam
P43/P44	12/2/05	T-T	ATOK	30	30	1133	1138	P	Entire Seam
P42/44	12/2/05	T-T	ATOK	30	30	1140	1145	P	NEOS to 30's
↓	12/2/05	T-T	ATOK	30	30	1141	1146	P	30's to SEOS
P43/45	12/2/05	T-T	ATOK	30	29	1149	1154	P	Entire Seam
P44/45	12/2/05	T-T	ATOK	30	30	1150	1155	P	Entire Seam
P46/47	12/2/05	T-T	ATOK	30	30	1205	1210	P	Entire Seam

GSI
GEO-SYNTHETICS, INC.

GSI
NON-DESTRUCTIVE TESTING FORM

PROJECT NAME:	Madison Co. SMWLF Closure	Test Criteria		Vac Time	15 Seconds
PROJECT NO.:	25084	Start Pressure	30 psi minimum	Vac. Pres.	3 psi
MATERIAL TYPE:	40 mil LLDPE	Test Time	5 minutes		
MATERIAL LAYER:	Primary	Accept. Drop	3 psi		
QC NAME:	Tran Tran				

Seam Number	Test Date	Tech Initials	Test Type (A or V)	Air Pressure Test psi start	psi finish	Time Start	Time End	Test Result (P or F)	Test Locations
P47/48	12/2/05	T-T	ATOK	30	30	1229	1234	P	WEOS to 11'E
↓	12/2/05	T-T	ATOK	30	30	1230	1235	P	11'E to EEOS
P48/49	12/2/05	T-T	ATOK	30	30	1236	1241	P	WEOS to 22'E
↓	12/2/05	T-T	ATOK	30	30	1237	1242	P	22'E to EEOS
P49/50	12/2/05	T-T	ATOK	30	30	1238	1243	P	Entire Seam
P50/51	12/2/05	T-T	ATOK	30	29	1250	1255	P	Entire Seam
P42/46	12/2/05	T-T	ATOK	30	30	1600	1605	P	Entire Seam
P41/46	12/2/05	T-T	ATOK	30	30	1601	1606	P	Entire Seam
P46/52	12/2/05	T-T	ATOK	30	30	1603	1608	P	WEOS to 50'E
↓	12/2/05	T-T	ATOK	30	30	1604	1609	P	50'E to EEOS
P52/53	12/2/05	T-T	ATOK	30	30	1613	1618	P	WEOS to 49'E
↓	12/2/05	T-T	ATOK	30	30	1615	1620	P	49'E to EEOS
P42/52	12/2/05	T-T	ATOK	30	30	1616	1621	P	Entire Seam
P42/53	12/2/05	T-T	ATOK	303	30	1622	1627	P	Entire Seam
P44/53	12/2/05	T-T	ATOK	30	30	1623	1628	P	Entire Seam
P53/58				Cover by Patch					Entire Seam
~~P53/58~~	~~12/2/05~~	~~T-T~~	~~ATOK~~	~~30~~	~~28~~	~~1630~~	~~1635~~	~~P~~	~~Entire Seam~~
P53/57	12/2/05	T-T	ATOK	30	~~30~~ 28	1630	1635	P	Entire Seam
P53/55	12/2/05	T-T	ATOK	30	30	1632	1637	P	Entire Seam

GSI
GEO-SYNTHETICS, INC.

NON-DESTRUCTIVE TESTING FORM

PROJECT NAME:	Madison Co. SMWLF Closure	Test Criteria		Vac Time	15 Seconds
PROJECT NO.:	25084	Start Pressure	30 psi minimum	Vac. Pres.	3 psi
MATERIAL TYPE:	40 mil LLDPE	Test Time	5 minutes		
MATERIAL LAYER:	Primary	Accept. Drop	3 psi		
QC NAME:	Tran Tran				

Seam Number	Test Date	Tech Initials	Test Type (A or V)	Air Pressure Test psi start	Air Pressure Test psi finish	Time Start	Time End	Test Result (P or F)	Test Locations
P53/54	12/2/05	T-T	ATOK	30	30	1638	1643	P	Entire Seam
P53/~~54~~ 45	12/2/05	T-T	ATOK	30	30	1639	1644	P	Entire Seam
P40/41	12/2/05	T-T	ATOK	30	30	1645	1650	P	NEOS to 142's
↓	12/2/05	T-T	ATOK	30	30	1646	1651	P	142's to 230's
↓	12/2/05	T-T	ATOK	30	30	1647	1652	P	230's to SEOS
P40/46	12/2/05	T-T	ATOK	30	29	1653	1658	P	Entire Seam
P40/47	12/2/05	T-T	ATOK	30	29	1654	1659	P	Entire Seam
P40/48	12/2/05	T-T	ATOK	30	30	1655	1700	P	Entire Seam
P40/49	12/2/05	T-T	ATOK	30	30	1701	1706	P	Entire Seam
P40/50	12/2/05	T-T	ATOK	30	30	1702	1707	P	Entire Seam
P40/51	12/2/05	T-T	ATOK	30	30	1704	1709	P	Entire Seam
P45/54	12/2/05	T-T	ATOK	30	29	1711	1716	P	NEOS to 236's
↓	12/2/05	T-T	ATOK	30	30	1712	1717	P	236's to SEOS
P55/56	12/2/05	T-T	ATOK	30	30	1718	1723	P	WEOS to 13'E
↓	12/2/05	T-T	ATOK	30	30	1719	1724	P	13'E to EOS
P54/56	12/2/05	T-T	ATOK	30	30	1725	1730	P	Entire Seam
P54/55	12/2/05	T-T	ATOK	30	30	1726	1731	P	Entire Seam

GSI
GEO-SYNTHETICS, INC.

GSI
NON-DESTRUCTIVE TESTING FORM

PROJECT NAME:	Madison Co. SMWLF Closure	Test Criteria		Vac Time	15 Seconds
PROJECT NO.:	25084	Start Pressure	30 psi minimum	Vac. Pres.	3 psi
MATERIAL TYPE:	40 mil LLDPE	Test Time	5 minutes		
MATERIAL LAYER:	Primary	Accept. Drop	3 psi		
QC NAME:	Tran Tran				

Seam Number	Test Date	Tech Initials	Test Type (A or V)	Air Pressure Test psi start	Air Pressure Test psi finish	Time Start	Time End	Test Result (P or F)	Test Locations
P56/57	12/2/05	T-T	ATOK	30	30	1732	1737	P	Entire Seam
P55/57	12/2/05	T-T	ATOK	30	30	1733	1738	P	Entire Seam
P23/55	12/3/05	T-T	ATOK	30	30	710	715	P	Entire Seam
P23/57	12/3/05	T-T	ATOK	30	30	711	716	P	Entire Seam
P23/56	12/3/05	T-T	ATOK	30	30	712	717	P	Entire Seam
P23/54	12/3/05	T-T	ATOK	30	30	719	724	P	Entire Seam
P23/45	12/3/05	T-T	ATOK	30	29	720	725	P	Entire Seam
P23/43	12/3/05	T-T	ATOK	30	30	721	726	P	Entire Seam
P23/42	12/3/05	T-T	ATOK	30	28	726	731	P	Entire Seam
P23/41	12/3/05	T-T	ATOK	30	30	727	732	P	Entire Seam
P57/55	12/3/05	T-T	ATOK	30	30	740	745	P	NEOS to 75's
↓	12/3/05	T-T	ATOK	30	30	741	746	P	75's to SEOS
P59/60	12/6/05	T-T	ATOK	30	30	1130	1135	P	Entire Seam
P59/61	12/6/05	T-T	ATOK	30	30	1131	1136	P	Entire Seam
P60/61	12/6/05	T-T	ATOK	30	30	1133	1138	P	Entire Seam
P58/59	12/6/05	T-T	ATOK	30	30	1144	1149	P	NEOS to 68's
↓	12/6/05	T-T	ATOK	30	30	1145	1150	P	68's to 180's
↓	12/6/05	T-T	ATOK	30	30	1146	1151	P	180's to SEOS

GSI
GEO-SYNTHETICS, INC.

GSI
REPAIR FORM

PROJECT NAME:	Madison Co. SMWLF Closure
PROJECT NO.:	25084
MATERIAL TYPE:	40 mil LLDPE
MATERIAL LAYER:	Primary
QC NAME:	Tran Tran

	Seam / Panel No.	Loction of Repairs	Repair Date	Repair Tech	Repair Type	Repair Size	Vacuum Test Date	Test Tech	Test P/F
1	P23	232' W OF P1/23 & 3's	11/30/05	Y-N	Boot	6x7	11/30/05	V-L	P
	P1/2/5	T-inter	11/30/05	Y-N	Patch	2x2	11/30/05	V-L	P
	P1/5	15' W OF EEOS	11/30/05	Y-N	Patch	1x1	11/30/05	V-L	P
	P2/4/5	T-inter	11/30/05	Y-N	Patch	2x3	11/30/05	V-L	P
	P4/5/6	T-inter	11/27/05	K-N	Patch	1x2	11/30/05	V-L	P
	P5/6/7	T-inter	11/27/05	K-N	Patch	1x2	11/30/05	V-L	P
	P5/7/8	T-inter	11/27/05	K-N	Patch	3x3	11/30/05	V-L	P
	P5/8/9	T-inter	11/27/05	K-N	Patch	2x2	11/30/05	V-L	P
	P5/9/11	T-inter	11/27/05	K-N	Patch	1x1	11/30/05	V-L	P
	P9/10/11	T-inter	11/30/05	Y-N	Patch	3x3	11/30/05	V-L	P
	P9/10	entire seam	11/30/05	Y-N	ext weld		11/30/05	V-L	P
	P7/8	35' N OF SEOS	11/30/05	Y-N	DT-3	2x3	11/30/05	V-L	P
	P4/6	40' N OF SEOS	11/27/05	K-N	DT-2	2x3	11/30/05	V-L	P
2	P6	49' N OF P4/6 & 3' W	11/30/05	Y-N	Boot	6x7	11/30/05	V-L	P
	P2/4	62' N OF SEOS	11/27/05	K-N	Patch	2x3	11/30/05	V-L	P
	P2/3	75' N OF SEOS	11/30/05	Y-N	DT-1	2x3	11/30/05	V-L	P
	P1/2/3	T-inter	11/30/05	Y-N	Patch	1x1	11/30/05	V-L	P
	P1/3/12	T-inter	11/30/05	Y-N	Patch	1x1	11/30/05	V-L	P
	P1/12/13	T-inter	11/30/05	K-S	Patch	1x2	11/30/05	V-L	P
	P1/13/17	T-inter	11/30/05	K-S	Patch	3x3	11/30/05	V-L	P
	P13/14/17/18	T-inter	11/30/05	K-S	Patch	2x3	11/30/05	V-L	P

GSI
GEO-SYNTHETICS, INC.

GSI
REPAIR FORM

PROJECT NAME:	Madison Co. SMWLF Closure
PROJECT NO.:	25084
MATERIAL TYPE:	40 mil LLDPE
MATERIAL LAYER:	Primary
QC NAME:	Tran Tran

	Seam / Panel No.	Loction of Repairs	Repair Date	Repair Tech	Repair Type	Repair Size	Vacuum Test Date	Test Tech	Test P/F
	P14/15/18/19	(covering over P15/18) T-inter	11/30/05	K-S	Patch	2X6	11/30/05	V-L	P
	P15/16	12' N OF SEOS	11/30/05	K-S	Patch	1X2	11/30/05	V-L	P
	P15/16	36' N OF SEOS	11/30/05	K-S	Patch	2X4	11/30/05	V-L	P
3	P16	4' E OF P16/21 & 1's	11/30/05	K-S	BOOT	7X10	11/30/05	V-L	P
	(BOOT) covering	over P16/19 & T-inter	of P15/16/19/21				11/30/05	V-L	P
	P16/20/21	T-inter	11/30/05	K-S	Patch	1X1	11/30/05	V-L	P
	P20/21	N.E. EOS	11/30/05	K-S	Patch	2X5	11/30/05	V-L	P
	P14/15	58' N OF SEOS	11/30/05	K-S	Patch	2X3	11/30/05	V-L	P
	P18/19	79' E OF WEOS	11/30/05	K-S	Patch	1X2	11/30/05	V-L	P
	P19/22	25' E OF WEOS	11/30/05	K-S	Patch	1X2	11/30/05	V-L	P
	P19	24' E OF P19/22 & 10's	11/30/05	K-S	Patch	2X5	11/30/05	V-L	P
	P17/18	88' E OF WEOS	11/30/05	K-S	DT-4	2X3	11/30/05	V-L	P
4	P23	32' W OF P1/23 & 6's	11/30/05	K-S	BOOT	5X8	11/30/05	V-L	P
	P1/23	125' W OF EEOS	11/30/05	K-S	DT-6	2X3	11/30/05	V-L	P
	P1/23	280' W OF EEOS	11/30/05	Y-N	DT-5	2X3	11/30/05	V-L	P
	P23/24/25	T-inter	11/30/05	Y-N	Patch	2X2	11/30/05	V-L	P
	P23/25/26	T-inter	11/30/05	Y-N	Patch	3X3	11/30/05	V-L	P
	P25/26/27	T-inter	11/30/05	Y-N	Patch	1X2	11/30/05	V-L	P
5	P26	93' W OF P26/27 & 9' N	11/30/05	Y-N	BOOT	5X10	11/30/05	V-L	P
	P27/28	44' W OF EEOS	11/30/05	Y-N	DT-7	2X3	11/30/05	V-L	P
	P25/27/28	T-inter	11/30/05	Y-N	Patch	1X1	11/30/05	V-L	P

GEO-SYNTHETICS, INC.

GSI
REPAIR FORM

PROJECT NAME:	Madison Co. SMWLF Closure
PROJECT NO.:	25084
MATERIAL TYPE:	40 mil LLDPE
MATERIAL LAYER:	Primary
QC NAME:	Tran Tran

Seam / Panel No.	Loction of Repairs	Repair Date	Repair Tech	Repair Type	Repair Size	Vacuum Test Date	Test Tech	Test P/F
P25/28/29	T-inter	11/30/05	Y-N	Patch	1X1	11/30/05	V-L	P
P25/29/30	T-inter	11/30/05	Y-N	Patch	2X3	11/30/05	V-L	P
P25/30/31	T-inter	11/30/05	Y-N	Patch	1X1	11/30/05	V-L	P
P25/31/32	T-inter	11/30/05	Y-N	Patch	3X5	11/30/05	V-L	P
P31/32/34	T-inter	11/30/05	Y-N	Patch	2X5	11/30/05	V-L	P
(6) P31/34	7' W OF EEOS (DT-10)	11/30/05	Y-N	DT-10/BOOT	6X8	11/30/05	V-L	P
BOOT (9' W OF P31/34 & 3' N) BOOT ON Panel 31						11/30/05	V-L	P
P31/34/35	T-inter	11/30/05	Y-N	Patch	1X1	11/30/05	V-L	P
P34/35	19' S OF NEOS	11/30/05	Y-N	DT-11	2X3	11/30/05	V-L	P
P34/35	13' S OF NEOS	11/30/05	Y-N	Patch	1X1	11/30/05	V-L	P
P33/35	entire seam	11/30/05	Y-N	ext weld	—	11/30/05	V-L	P
P33/34/35	T-inter	11/30/05	Y-N	Patch	1X1	11/30/05	V-L	P
DT-9 ON EEOS P33/34 — P32/33/34	EEOS (DT-9) T-inter	11/30/05	Y-N	DT-9	2X6	11/30/05	V-L	P
P30/31	34' W OF EEOS	11/30/05	Y-N	DT-8	2X3	11/30/05	V-L	P
(7) P24	28½' S OF P24/25 & 2' E	11/30/05	Y-N	BOOT	7X10	11/30/05	V-L	P

GSI
GEO-SYNTHETICS, INC.

GSI
REPAIR FORM

PROJECT NAME:	Madison Co. SMWLF Closure
PROJECT NO.:	25084
MATERIAL TYPE:	40 mil LLDPE
MATERIAL LAYER:	Primary
QC NAME:	Tran Tran

Seam / Panel No.	Loction of Repairs	Repair Date	Repair Tech	Repair Type	Repair Size	Vacuum Test Date	Test Tech	Test P/F
P23/24/37	T-inter	12/1/05	K-S	Patch	2X2	12/1/05	V-L	P
P23/37/39	T-inter	12/1/05	K-S	Patch	2X2	12/1/05	V-L	P
P23/39/40	T-inter	12/1/05	K-S	Patch	2X3	12/1/05	V-L	P
P24/37	175'S OF NEOS	12/1/05	K-S	DT-12	2X3	12/1/05	V-L	P
P24/37	286'S OF NEOS	12/1/05	K-S	Patch	1X2	12/1/05	V-L	P
P24/36/37	T-inter	12/1/05	K-S	Patch	2X2	12/1/05	V-L	P
P25/36	entire seam	12/1/05	K-S	ext weld		12/1/05	V-L	P
P24/36	entire seam	12/1/05	K-S	ext weld		12/1/05	V-L	P
P24/25/36	T-inter	12/1/05	K-S	Patch	2X2	12/1/05	V-L	P
P37/38/39	T-inter	12/1/05	K-S	Patch	2X3	12/1/05	V-L	P
P37/38	75'S OF NEOS	12/1/05	K-S	DT-13	2X3	12/1/05	V-L	P
P37/38	193'S OF NEOS	12/1/05	K-S	Patch	2X4	12/1/05	V-L	P
(8) P39	54'S OF P39/40 & 11'W	12/1/05	K-S	BOOT	6X8	12/1/05	V-L	P
P39/40	109'S OF NEOS	12/1/05	K-S	Patch	2X4	12/1/05	V-L	P
P38/39/40	T-inter	12/1/05	K-S	Patch	2X6	12/1/05	V-L	P
P38/40	25'S OF NEOS	12/1/05	K-S	Patch	4X5	12/1/05	V-L	P
P38/40	127'S OF NEOS	12/1/05	K-S	Patch	1X2	12/1/05	V-L	P
P38/40	160'S OF NEOS	12/1/05	K-S	DT-15	2X4	12/1/05	V-L	P
P38/40	261'S OF NEOS	12/1/05	K-S	Patch	1X2	12/1/05	V-L	P
P24/36	10'E OF NEOS	12/1/05	K-S	DT-14	2X3	12/1/05	V-L	P

GEO-SYNTHETICS, INC.

GSI
REPAIR FORM

PROJECT NAME:	Madison Co. SMWLF Closure
PROJECT NO.:	25084
MATERIAL TYPE:	40 mil LLDPE
MATERIAL LAYER:	Primary
QC NAME:	Tran Tran

Seam / Panel No.	Loction of Repairs	Repair Date	Repair Tech	Repair Type	Repair Size	Vacuum Test Date	Test Tech	Test P/F
P40/41/46	T-inter	12/3/05	D-N	Patch	5X8	12/3/05	V-L	P
P40/46/47	T-inter	12/3/05	D-N	Patch	2X5	12/3/05	V-L	P
P40/47/48	T-inter	12/3/05	D-N	Patch	4X6	12/3/05	V-L	P
P47/48	11' E OF WEOS	12/3/05	D-N	Patch	2X4	12/3/05	V-L	P
P40/48/49	T-inter	12/3/05	D-N	Patch	2X7	12/3/05	V-L	P
P40/49/50	T-inter	12/3/05	D-N	Patch	1X1	12/3/05	V-L	P
P40/50/51	T-inter	12/3/05	D-N	Patch	2X8	12/3/05	V-L	P
P51	S-East corner of P51	12/3/05	D-N	Patch	Triangle 8X10	12/3/05	V-L	P
(9) P49	22' E OF P48/49 & 11'S			BOOT/Patch				
P41/42/46	T-inter	12/3/05	D-N	Patch	3X3	12/3/05	V-L	P
P42/46/52	T-inter	12/3/05	D-N	Patch	4X10	12/3/05	V-L	P
P46/52	50' E OF WEOS	12/3/05	D-N	Patch	2X3	12/3/05	V-L	P
(10) P52	50' E OF P42/52 & 8' N	12/6/05	K-N	BOOT	6X6	12/6/05	V-L	P
Bead between Patch & Boot						↓	↓	↓
(11) P52/53	49' E OF P52/53 & 5'S			BBOOT/Patch	5X5	12/6/05	V-L	P
Bead between Boot & Boot — Boot is on P52						↓	↓	↓
P42/52/53	T-inter	12/3/05	D-N	Patch	2X6	12/3/05	V-L	P
P42/44/53	T-inter	12/3/05	D-N	Patch	3X3	12/3/05	V-L	P
P40/41	230' S OF NEOS	12/6/05	N-Y	Patch	2X3	12/6/05	V-L	P
P40/41	158' S OF NEOS	12/6/05	N-Y	DT-17	2X3	12/6/05	V-L	P
P40/41	142' S OF NEOS	12/6/05	N-Y	Patch	1X2	12/6/05	V-L	P

P52

(12) (13) 50'

GSI
GEO-SYNTHETICS, INC.

GSI
REPAIR FORM

PROJECT NAME:	Madison Co. SMWLF Closure
PROJECT NO.:	25084
MATERIAL TYPE:	40 mil LLDPE
MATERIAL LAYER:	Primary
QC NAME:	Tran Tran

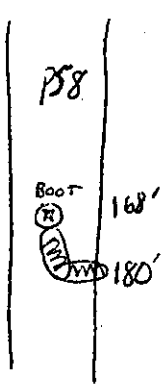
	Seam / Panel No.	Loction of Repairs	Repair Date	Repair Tech	Repair Type	Repair Size	Vacuum Test Date	Test Tech	Test P/F
	P23/40/41	T-inter	12/6/05	N-Y	Patch	1X1	12/6/05	V-L	P
	P23/41/42	T-inter	12/6/05	N-Y	Patch	1X1	12/6/05	V-L	P
	P23/42/43	T-inter	12/6/05	N-Y	Patch	1X1	12/6/05	V-L	P
	P23/43/45	T-inter	12/6/05	N-Y	Patch	1X1	12/6/05	V-L	P
	P23/45/54	T-inter	12/6/05	N-Y	Patch	1X1	12/6/05	V-L	P
	P23/54	8' E OF WEOS	12/6/05	N-Y	DT-19	2X3	12/6/05	V-L	P
	P23/54/56	T-inter	12/6/05	N-Y	Patch	1X1	12/6/05	V-L	P
	P23/56/57	T-inter	12/6/05	N-Y	Patch	1X1	12/6/05	V-L	P
	P23/57/58	T-inter	12/6/05	N-Y	Patch	2X4	12/6/05	V-L	P
12	P41	153' S OF P41/42 & 5' W	12/2/05	K-N	BOOT	5X8	12/2/05	V-L	P
	P42/43/44	T-inter	12/2/05	K-N	Patch	1X1	12/2/05	V-L	P
	P44	10' E OF P43/44 & 1' S	12/2/05	K-N	Patch	1X1	12/2/05	V-L	P
	P43/44/45	T-inter	12/2/05	K-N	Patch	1X1	12/2/05	V-L	P
13	P42/44	30' S OF P42/44 & 6' W	12/2/05	K-N	B-BOOT	8X13	12/2/05	V-L	P
	B-Boot is on Panel 42								
	P44/45/53	T-inter	12/6/05	K-N	Patch	5X12	12/6/05	V-L	P
14	P44	95' S OF P44/45 & 5' W	12/6/05	N-Y	BOOT	5X6	12/6/05	V-L	P
	P44/45	90' S OF NEOS	12/6/05	N-Y	DT-16	2X3	12/6/05	V-L	P
	P45/54	236' S OF NEOS	12/6/05	N-Y	Patch	2X3	12/6/05	V-L	P
	P45/53/54	T-inter	12/6/05	N-Y	Patch	1X3	12/6/05	V-L	P
	P53/54/55	T-inter	12/6/05	K-N	Patch	1X1	12/6/05	V-L	P

GEO-SYNTHETICS, INC.

GSI
REPAIR FORM

PROJECT NAME:	Madison Co. SMWLF Closure
PROJECT NO.:	25084
MATERIAL TYPE:	40 mil LLDPE
MATERIAL LAYER:	Primary
QC NAME:	Tran Tran

Seam / Panel No.	Loction of Repairs	Repair Date	Repair Tech	Repair Type	Repair Size	Vacuum Test Date	Test Tech	Test P/F
P53/55/57	T-inter	12/6/05	K-N	Patch	2X4	12/6/05	V-L	P
P53/57/58	T-inter (Patch	12/6/05	K-N	Patch	2X8	12/6/05	V-L	P
covering over	P53/58 Seam)					↓	↓	↓
P55/57	65'S OF NEOS	12/6/05	N-Y	DT-18	2X3	12/6/05	V-L	P
P54/55/56	T-inter	12/6/05	N-Y	Patch	1X1	12/6/05	V-L	P
P55/56	13'E OF WEOS	12/6/05	N-Y	Patch	1X1	12/6/05	V-L	P
P55/56/57	T-inter	12/6/05	N-Y	Patch	2X4	12/6/05	V-L	P
(15) P57/58	68'S OF P57/58 & 11'W	12/6/05	N-Y	BOOT/Patch	4X11	12/6/05	V-L	P
BOOT IS	ON Panel P58							
(16) P58	168'S OF P57/58 & 11'W	12/6/05	N-Y	BOOT	6X5	12/6/05	V-L	P
P57/58	180'S OF NEOS	12/6/05	N-Y	Patch	2X8	12/6/05	V-L	P
P59/60/61	T-inter	12/6/05	N-Y	Patch	2X2	12/6/05	V-L	P
P59/61	20'S OF NEOS	12/6/05	N-Y	DT-20	2X3	12/6/05	V-L	P
P59/61	SEOS	12/6/05	K-N	Patch	2X15	12/6/05	V-L	P



16 BOOTS TOTAL

Shipping Order - Packing List - Original - Not Negotiable

GSE Lining Technology, Inc. at Kingstree, SC

Shippers No. 55100

eceived at Kingstree, SC from GSE Lining Technology, Inc. the property described below, in apparent good order, except as noted (contents and condition of packages unknown), marked, consignec and destined as indicated below, which said Carrier agrees to carry to the place of delivery at said destination. It is mutually agreed as to each Carrier of all or any said property, over all or any portic of said route to destination, and as to each party at any time interested in all or any of said property, that every service performed hereunder shall be subject to the rates and contract agreed to in writing by GSE Lining Technology, Inc. and Carrier. GSE Lining Technology, Inc.'s obligation to pay freight charges for the shipment is conditioned on (1) the existence of a separate written contract with the carrier transporting the freight and (2) the carrier's name appearing on this Bill of Lading, and other carriers must look solely to a party other than GSE Lining Technology, Inc. for payment.

Ship To: Madison County Landfill Closure
C/O GSI
271 Craig Rudisill Rd.
attn: JimHuff@828-649-2311
Marshall NC 28753

Date: 11/16/05

Branch Plant: 1503 621812

Shipping Instructions:

attn: Jim Huff@828-649-2311 24 hrs B4 delivery

Sales Order 43333 SO

No. Line	Roll #	QTY Shipped	UM	Kind of Package, Description of Articles, Special Marks and Exceptions	Weight
18	131192091	3335	SF	F42060060S FabriNet w/ 6 oz/yd2 MARV XL4 Fabrinet, 2 Side, 14.5'	976.00
19	131192095	3335	SF	F42060060S FabriNet w/ 6 oz/yd2 MARV XL4 Fabrinet, 2 Side, 14.5'	962.00
20	131192097	3335	SF	F42060060S FabriNet w/ 6 oz/yd2 MARV XL4 Fabrinet, 2 Side, 14.5'	963.00
21	131192101	3335	SF	F42060060S FabriNet w/ 6 oz/yd2 MARV XL4 Fabrinet, 2 Side, 14.5'	974.00
22	131192103	3335	SF	F42060060S FabriNet w/ 6 oz/yd2 MARV XL4 Fabrinet, 2 Side, 14.5'	974.00
23	131192104	3335	SF	F42060060S FabriNet w/ 6 oz/yd2 MARV XL4 Fabrinet, 2 Side, 14.5'	977.00
24	131192105	3335	SF	F42060060S FabriNet w/ 6 oz/yd2 MARV XL4 Fabrinet, 2 Side, 14.5'	1,000.00

Total Quantity 80,040 Total Weight: 23,557.00

Project# 518117

Freight charges are prepaid unless marked collect.

Check box if collect ☐

Customer P.O. Number: 10906-00

If this shipment is to be delivered to consignor, consignor shall sign the following statement.

Carrier may decline to deliver this shipment without payment of freight and all other lawful charges.

Signature of Consignor

Local Verification Signed:

X

Pick Up # 6126KS

Seal #

Truckers P.O. #

Driver Requirements:

1) Driver must pre call 24 hrs prior to delivery and on Friday for Monday delivery.
2) Driver must call (843) 201-1520 when unloaded.
3) Driver must call and advise any delay in transit.
4) A copy of this bill of lading must accompany Freight Invoice.

Carrier Name: _____

Carrier Signature: _____

Date: _____

Shipping Order - Packing List - Original - Not Negotiable

GSE Lining Technology, Inc. at Kingstree, SC

Shippers No. 55100

Received at Kingstree, SC from GSE Lining Technology, Inc. the property described below, in apparent good order, except as noted (contents and condition of packages unknown), marked, consigned, and destined as indicated below, which said Carrier agrees to carry to the place of delivery at said destination. It is mutually agreed as to each Carrier of all or any said property, over all or any portion of said route to destination, and as to each party at any time interested in all or any of said property, that every service performed hereunder shall be subject to the rates and contract agreed to in writing by GSE Lining Technology, Inc. and Carrier. GSE Lining Technology, Inc.'s obligation to pay freight charges for the shipment is conditioned on (1) the existence of a separate written contract with the carrier transporting the freight and (2) the carrier's name appearing on this Bill of Lading, and other carriers must look solely to a party other than GSE Lining Technology, Inc. for payment.

Ship To: Madison County Landfill Closure
C/0 GSI
271 Craig Rudisill Rd.
attn: JimHuff@828-649-2311
Marshall NC 28753

Date: 11/16/05

Branch Plant: 1503 621812

Shipping Instructions:

attn: Jim Huff@828-649-2311 24 hrs B4 delivery

Sales Order 43333 SO

No. Line	Roll #	QTY Shipped	UM	Kind of Package, Description of Articles, Special Marks and Exceptions	Weight
1	131191829	3335	SF	F42060060S FabriNet w/ 6 oz/yd2 MARV XL4 Fabrinet, 2 Side, 14.5'	980.00
2	131191838	3335	SF	F42060060S FabriNet w/ 6 oz/yd2 MARV XL4 Fabrinet, 2 Side, 14.5'	998.00
3	131191839	3335	SF	F42060060S FabriNet w/ 6 oz/yd2 MARV XL4 Fabrinet, 2 Side, 14.5'	998.00
4	131191841	3335	SF	F42060060S FabriNet w/ 6 oz/yd2 MARV XL4 Fabrinet, 2 Side, 14.5'	995.00
5	131191845	3335	SF	F42060060S FabriNet w/ 6 oz/yd2 MARV XL4 Fabrinet, 2 Side, 14.5'	997.00
6	131191849	3335	SF	F42060060S FabriNet w/ 6 oz/yd2 MARV XL4 Fabrinet, 2 Side, 14.5'	997.00
	131191851	3335	SF	F42060060S FabriNet w/ 6 oz/yd2 MARV XL4 Fabrinet, 2 Side, 14.5'	995.00
8	131191859	3335	SF	F42060060S FabriNet w/ 6 oz/yd2 MARV XL4 Fabrinet, 2 Side, 14.5'	980.00
9	131191861	3335	SF	F42060060S FabriNet w/ 6 oz/yd2 MARV XL4 Fabrinet, 2 Side, 14.5'	978.00
10	131191862	3335	SF	F42060060S FabriNet w/ 6 oz/yd2 MARV XL4 Fabrinet, 2 Side, 14.5'	981.00
11	131191863	3335	SF	F42060060S FabriNet w/ 6 oz/yd2 MARV XL4 Fabrinet, 2 Side, 14.5'	983.00
12	131192024	3335	SF	F42060060S FabriNet w/ 6 oz/yd2 MARV XL4 Fabrinet, 2 Side, 14.5'	976.00
13	131192025	3335	SF	F42060060S FabriNet w/ 6 oz/yd2 MARV XL4 Fabrinet, 2 Side, 14.5'	975.00
14	131192027	3335	SF	F42060060S FabriNet w/ 6 oz/yd2 MARV XL4 Fabrinet, 2 Side, 14.5'	977.00
15	131192029	3335	SF	F42060060S FabriNet w/ 6 oz/yd2 MARV XL4 Fabrinet, 2 Side, 14.5'	977.00
16	131192031	3335	SF	F42060060S FabriNet w/ 6 oz/yd2 MARV XL4 Fabrinet, 2 Side, 14.5'	972.00
17	131192090	3335	SF	F42060060S FabriNet w/ 6 oz/yd2 MARV XL4 Fabrinet, 2 Side, 14.5'	972.00
	80,040				23,557.00

Continued on next page.....

Project# 518117

Freight charges are prepaid unless marked collect.

Check box if collect ☐

Customer P.O. Number: 10906-00

If this shipment is to be delivered to consignor, consignor shall sign the following statement.

Carrier may decline to deliver this shipment without payment of freight and all other lawful charges.

Signature of Consignor

Local Verification Signed:

X

Pick Up # 6126KS

Seal #

Truckers P.O. #

Driver Requirements:

1) Driver must pre call 24 hrs prior to delivery and on Friday for Monday delivery.
2) Driver must call (843) 201-1520 when unloaded.
3) Driver must call and advise any delay in transit.
4) A copy of this bill of lading must accompany Freight Invoice.

Carrier Name: _____

Carrier Signature: _____

Date: _____

Shipping Order - Packing List - Original - Not Negotiable

GSE Lining Technology, Inc. at Kingstree, SC

Shippers No. 55092

.ved at Kingstree, SC from GSE Lining Technology, Inc. the property described below, in apparent good order, except as noted (contents and condition of packages unknown), marked, consigned, , destined as indicated below, which said Carrier agrees to carry to the place of delivery at said destination. It is mutually agreed as to each Carrier of all or any said property, over all or any portion .f said route to destination, and as to each party at any time interested in all or any of said property, that every service performed hereunder shall be subject to the rates and contract agreed to in writing by GSE Lining Technology, Inc. and Carrier. GSE Lining Technology, Inc.'s obligation to pay freight charges for the shipment is conditioned on (1) the existence of a separate written contract with the carrier transporting the freight and (2) the carrier's name appearing on this Bill of Lading, and other carriers must look solely to a party other than GSE Lining Technology, Inc. for payment.

Ship To: Madison County Landfill Closure
C/O GSI
271 Craig Rudisill Rd.
attn: JimHuff@828-649-2311
Marshall NC 28753

Date: 11/16/05

Branch Plant: 1503 621812

Shipping Instructions:

attn: Jim Huff@828-649-2311 24 hrs B4 delivery

Sales Order 43333 SO

No. Line	Roll #	QTY Shipped	UM	Kind of Package, Description of Articles, Special Marks and Exceptions	Weight
18	131192106	3335	SF	F42060060S FabriNet w/ 6 oz/yd2 MARV XL4 Fabrinet, 2 Side, 14.5'	1,045.00

Project# 518117

Freight charges are prepaid unless marked collect.

Check box if collect ☐

Customer P.O. Number: 10906-00

If this shipment is to be delivered to consignor, consignor shall sign the following statement.

Carrier may decline to deliver this shipment without payment of freight and all other lawful charges.

Signature of Consignor

Local Verification Signed:

X

Pick Up # 6125KS

Seal #

Truckers P.O. #

Total Quantity 60,030

Total Weight: 17,687.00

rer Requirements:

iver must pre call 24 hrs prior to delivery and on Friday for Monday delivery.
2) Driver must call (843) 201-1520 when unloaded.
3) Driver must call and advise any delay in transit.
4) A copy of this bill of lading must accompany Freight Invoice.

Carrier Name: _____

Carrier Signature: _____

Date: _____

GSE 7.5.5-007

CONSIGNEE

REV02 - Date 06/12/01

Shipping Order - Packing List - Original - Not Negotiable

GSE Lining Technology, Inc. at Kingstree, SC

Shippers No. 55092

Received at Kingstree, SC from GSE Lining Technology, Inc. the property described below, in apparent good order, except as noted (contents and condition of packages unknown), marked, consigned, and destined as indicated below, which said Carrier agrees to carry to the place of delivery at said destination. It is mutually agreed as to each Carrier of all or any said property, over all or any portion of said route to destination, and as to each party at any time interested in all or any of said property, that every service performed hereunder shall be subject to the rates and contract agreed to in writing by GSE Lining Technology, Inc. and Carrier. GSE Lining Technology, Inc.'s obligation to pay freight charges for the shipment is conditioned on (1) the existence of a separate written contract with the carrier transporting the freight and (2) the carrier's name appearing on this Bill of Lading, and other carriers must look solely to a party other than GSE Lining Technology, Inc. for payment.

Ship To: Madison County Landfill Closure
C/O GSI
271 Craig Rudisill Rd.
attn: JimHuff@828-649-2311
Marshall NC 28753

Date: 11/16/05

Branch Plant: 1503 621812

Shipping Instructions:
attn: Jim Huff@828-649-2311 24 hrs B4 delivery

Sales Order 43333 SO

No. Line	Roll #	QTY Shipped	UM	Kind of Package, Description of Articles, Special Marks and Exceptions	Weight
1	131191830	3335	SF	F42060060S FabriNet w/ 6 oz/yd2 MARV XL4 Fabrinet, 2 Side, 14.5'	972.00
2	131191840	3335	SF	F42060060S FabriNet w/ 6 oz/yd2 MARV XL4 Fabrinet, 2 Side, 14.5'	995.00
3	131191844	3335	SF	F42060060S FabriNet w/ 6 oz/yd2 MARV XL4 Fabrinet, 2 Side, 14.5'	996.00
4	131191856	3335	SF	F42060060S FabriNet w/ 6 oz/yd2 MARV XL4 Fabrinet, 2 Side, 14.5'	999.00
5	131191857	3335	SF	F42060060S FabriNet w/ 6 oz/yd2 MARV XL4 Fabrinet, 2 Side, 14.5'	993.00
	131192026	3335	SF	F42060060S FabriNet w/ 6 oz/yd2 MARV XL4 Fabrinet, 2 Side, 14.5'	980.00
	131192069	3335	SF	F42060060S FabriNet w/ 6 oz/yd2 MARV XL4 Fabrinet, 2 Side, 14.5'	980.00
8	131192074	3335	SF	F42060060S FabriNet w/ 6 oz/yd2 MARV XL4 Fabrinet, 2 Side, 14.5'	978.00
9	131192088	3335	SF	F42060060S FabriNet w/ 6 oz/yd2 MARV XL4 Fabrinet, 2 Side, 14.5'	973.00
10	131192092	3335	SF	F42060060S FabriNet w/ 6 oz/yd2 MARV XL4 Fabrinet, 2 Side, 14.5'	975.00
11	131192093	3335	SF	F42060060S FabriNet w/ 6 oz/yd2 MARV XL4 Fabrinet, 2 Side, 14.5'	978.00
12	131192094	3335	SF	F42060060S FabriNet w/ 6 oz/yd2 MARV XL4 Fabrinet, 2 Side, 14.5'	970.00
13	131192096	3335	SF	F42060060S FabriNet w/ 6 oz/yd2 MARV XL4 Fabrinet, 2 Side, 14.5'	964.00
14	131192098	3335	SF	F42060060S FabriNet w/ 6 oz/yd2 MARV XL4 Fabrinet, 2 Side, 14.5'	967.00
15	131192099	3335	SF	F42060060S FabriNet w/ 6 oz/yd2 MARV XL4 Fabrinet, 2 Side, 14.5'	971.00
16	131192100	3335	SF	F42060060S FabriNet w/ 6 oz/yd2 MARV XL4 Fabrinet, 2 Side, 14.5'	972.00
17	131192102	3335	SF	F42060060S FabriNet w/ 6 oz/yd2 MARV XL4 Fabrinet, 2 Side, 14.5'	979.00
	60,030				17,687.00

Continued on next page....

Project# 518117

Freight charges are prepaid unless marked collect.

Check box if collect ☐

Customer P.O. Number: 10906-00

If this shipment is to be delivered to consignor, consignor shall sign the following statement.

Carrier may decline to deliver this shipment without payment of freight and all other lawful charges.

Signature of Consignor

Local Verification Signed:

X

Pick Up # 6125KS

Seal #

Truckers P.O. #

er Requirements:

1) Driver must pre call 24 hrs prior to delivery and on Friday for Monday delivery.
2) Driver must call (843) 201-1520 when unloaded.
3) Driver must call and advise any delay in transit.
4) A copy of this bill of lading must accompany Freight Invoice.

Carrier Name: _____

Carrier Signature: _____

Date: _____

Shipping Order - Packing List - Original - Not Negotiable

GSE Lining Technology, Inc. at Kingstree, SC

Shippers No. 55091

Received at Kingstree, SC from GSE Lining Technology, Inc. the property described below, in apparent good order, except as noted (contents and condition of packages unknown), marked, consigned, and destined as indicated below, which said Carrier agrees to carry to the place of delivery at said destination. It is mutually agreed as to each Carrier of all or any said property, over all or any portion of said route to destination, and as to each party at any time interested in all or any of said property, that every service performed hereunder shall be subject to the rates and contract agreed to in writing by GSE Lining Technology, Inc. and Carrier. GSE Lining Technology, Inc.'s obligation to pay freight charges for the shipment is conditioned on (1) the existence of a separate written contract with the carrier transporting the freight and (2) the carrier's name appearing on this Bill of Lading, and other carriers must look solely to a party other than GSE Lining Technology, Inc. for payment.

Ship To: Madison County Landfill Closure
C/O GSI
271 Craig Rudisill Rd.
attn: JimHuff@828-649-2311
Marshall NC 28753

Date: 11/16/05

Branch Plant: 1503 621812

Shipping Instructions:

attn: Jim Huff@828-649-2311 24 hrs B4 delivery

Sales Order 43333 SO

No. Line	Roll #	QTY Shipped	UM	Kind of Package, Description of Articles, Special Marks and Exceptions	Weight
1	131191831	3335	SF	F42060060S FabriNet w/ 6 oz/yd2 MARV XL4 Fabrinet, 2 Side, 14.5'	977.00
2	131191832	3335	SF	F42060060S FabriNet w/ 6 oz/yd2 MARV XL4 Fabrinet, 2 Side, 14.5'	981.00
3	131191837	3335	SF	F42060060S FabriNet w/ 6 oz/yd2 MARV XL4 Fabrinet, 2 Side, 14.5'	1,002.00
4	131191842	3335	SF	F42060060S FabriNet w/ 6 oz/yd2 MARV XL4 Fabrinet, 2 Side, 14.5'	995.00
5	131191843	3335	SF	F42060060S FabriNet w/ 6 oz/yd2 MARV XL4 Fabrinet, 2 Side, 14.5'	997.00
	131191855	3335	SF	F42060060S FabriNet w/ 6 oz/yd2 MARV XL4 Fabrinet, 2 Side, 14.5'	997.00
7	131191858	3335	SF	F42060060S FabriNet w/ 6 oz/yd2 MARV XL4 Fabrinet, 2 Side, 14.5'	989.00
8	131191864	3335	SF	F42060060S FabriNet w/ 6 oz/yd2 MARV XL4 Fabrinet, 2 Side, 14.5'	985.00
9	131191865	3335	SF	F42060060S FabriNet w/ 6 oz/yd2 MARV XL4 Fabrinet, 2 Side, 14.5'	984.00
10	131191866	3335	SF	F42060060S FabriNet w/ 6 oz/yd2 MARV XL4 Fabrinet, 2 Side, 14.5'	987.00
11	131191867	3335	SF	F42060060S FabriNet w/ 6 oz/yd2 MARV XL4 Fabrinet, 2 Side, 14.5'	985.00
12	131192028	3335	SF	F42060060S FabriNet w/ 6 oz/yd2 MARV XL4 Fabrinet, 2 Side, 14.5'	972.00
13	131192030	3335	SF	F42060060S FabriNet w/ 6 oz/yd2 MARV XL4 Fabrinet, 2 Side, 14.5'	980.00
14	131192032	3335	SF	F42060060S FabriNet w/ 6 oz/yd2 MARV XL4 Fabrinet, 2 Side, 14.5'	982.00
15	131192033	3335	SF	F42060060S FabriNet w/ 6 oz/yd2 MARV XL4 Fabrinet, 2 Side, 14.5'	987.00

Total Quantity 50,025 Total Weight: 14,800.00

Project# 518117

Freight charges are prepaid unless marked collect.

Check box if collect ☐

Customer P.O. Number: 10906-00

If this shipment is to be delivered to consignor, consignor shall sign the following statement.

Carrier may decline to deliver this shipment without payment of freight and all other lawful charges.

Signature of Consignor

Local Verification Signed:

X

Pick Up # 6127KS

Seal #

Truckers P.O. #

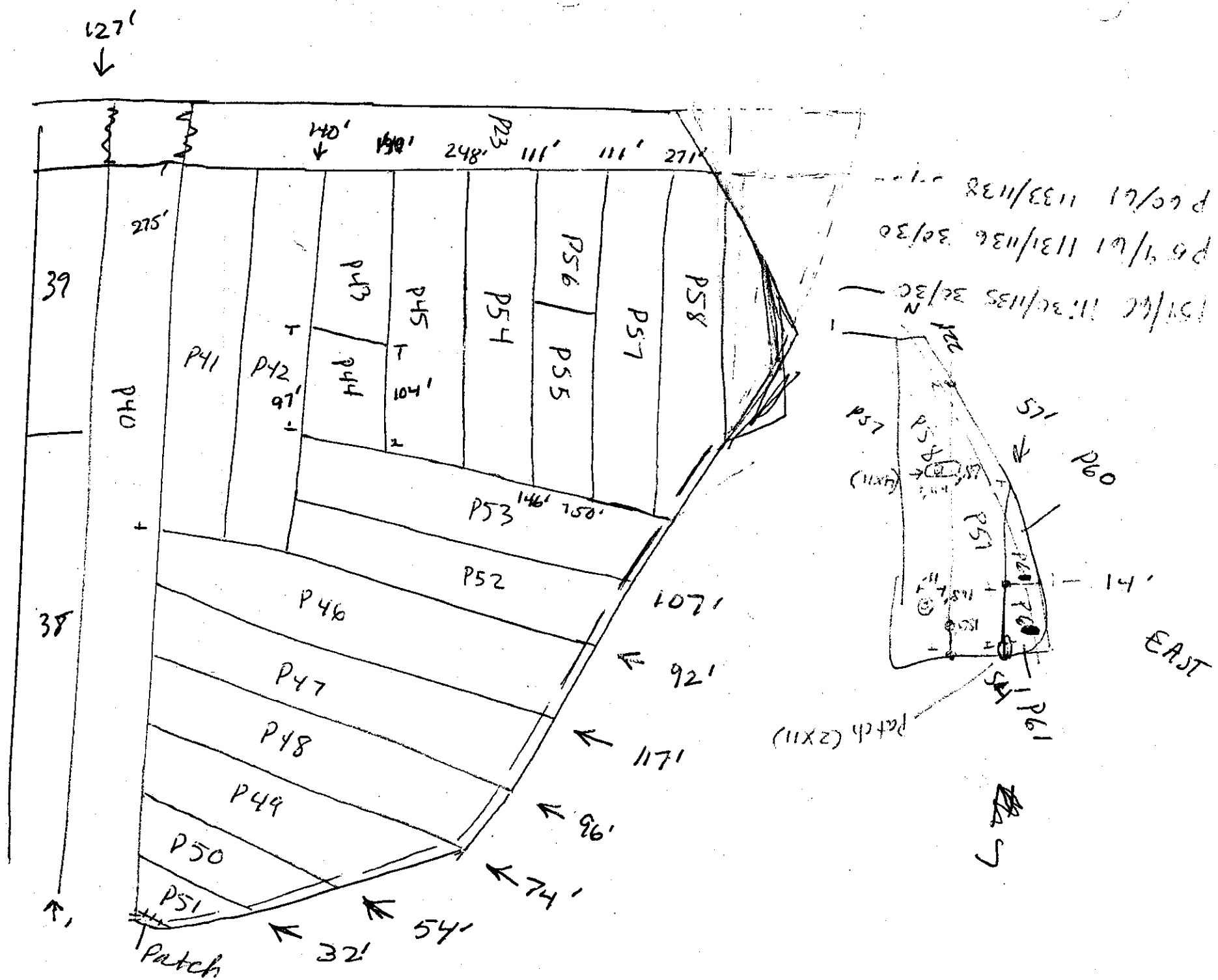
Driver Requirements:

1) Driver must pre call 24 hrs prior to delivery and on Friday for Monday delivery.
2) Driver must call (843) 201-1520 when unloaded.
3) Driver must call and advise any delay in transit.
4) A copy of this bill of lading must accompany Freight Invoice.

Carrier Name:

Carrier Signature:

Date: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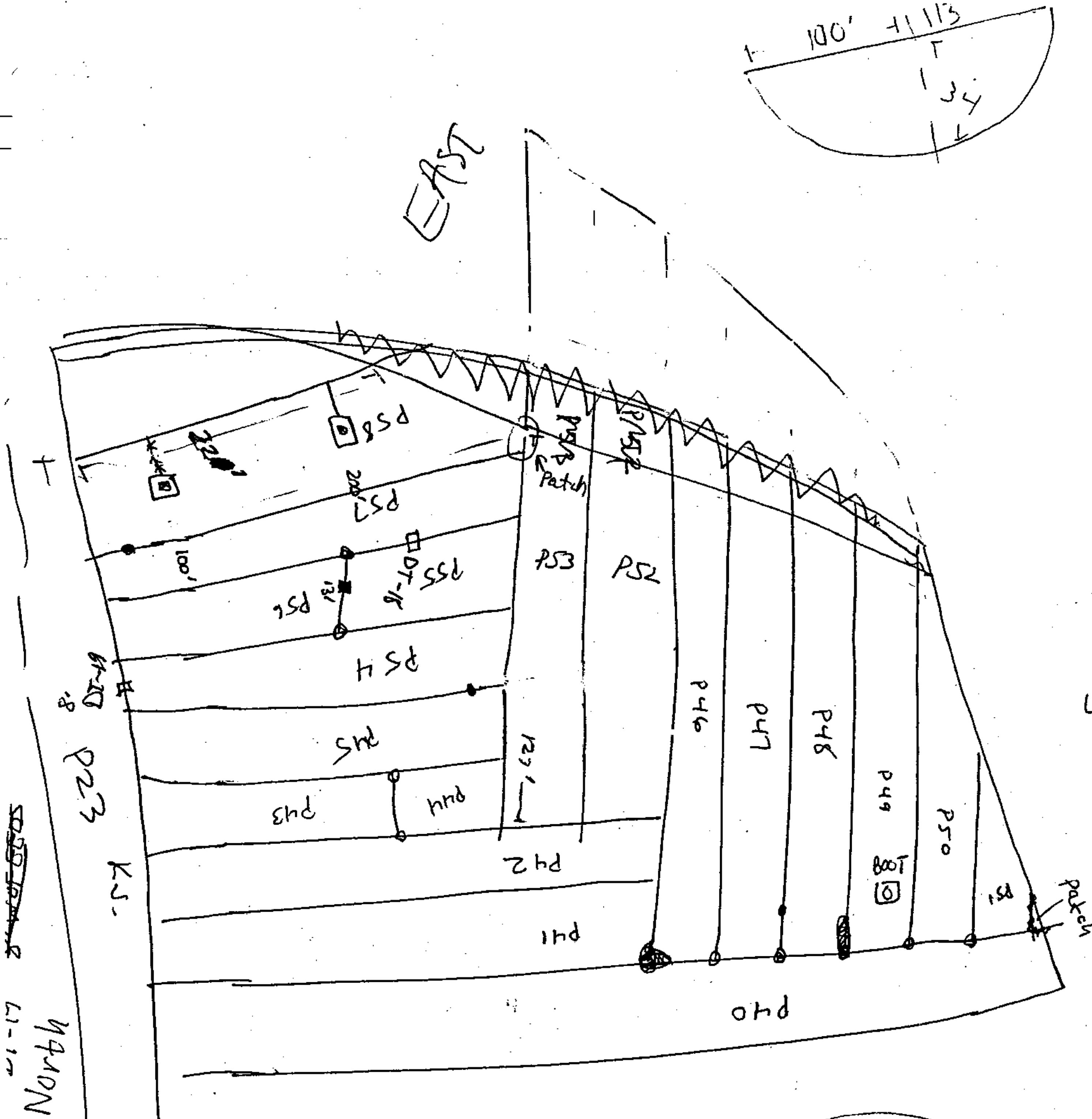

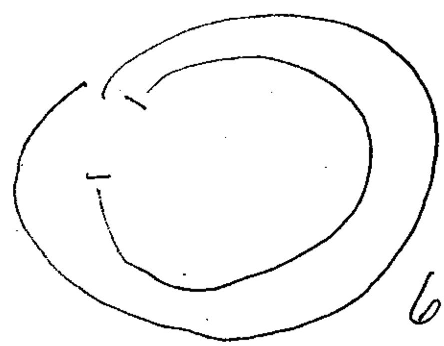

1515'x4
anchor
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6,060

SECTION VIII

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Project: Madison Co. MSW Landfill
Project No.: 70001
Page: 1 of 1
Date:

MATERIAL TYPE: 40MIL LLDPE Ultraflex Textured
MANUFACTURER: GSE

Lot Number	Roll Number	Dimensions	Conformance Sample Number	Comments
LUT040M000	103132044	15,750		
	103132045	15,750		
	103132914	15,750		
	103132915	15,750		
	103132916	15,750		
	103132917	15,750		
	103132918	15,750		
	103132919	15,750		
	103132920	15,750		
	103132921	15,750		
	104121431	15,750		
	104121438	15,750		

MATERIAL TYPE: 60MIL LLDPE Ultraflex Textured
MANUFACTURER: GSE

Lot Number	Roll Number	Dimensions	Conformance Sample Number	Comments
CPB811140	104117356	11,700		

Total Square Feet: 200,700

Geosynthetic Material Inventory

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Project: Madison Co. MSW Landfill
Project No.: 70001
Page: 1 of 2
Date: 11/2/2005

MATERIAL TYPE: XL4 Fabrinet, 2 side, 14.5'
MANUFACTURER: GSE

Lot Number	Roll Number	Dimensions	Conformance Sample Number	Comments
1503 62182	131191829	3,335		
	131191830	3,335		
	131191838	3,335		
	131191839	3,335		
	131191840	3,335		
	131191841	3,335		
	131191844	3,335		
	131191845	3,335		
	131191849	3,335		
	131191851	3,335		
	131191856	3,335		
	131191857	3,335		
	131191859	3,335		
	131191861	3,335		
	131191862	3,335		
	131191863	3,335		
	131192024	3,335		
	131192025	3,335		
	131192026	3,335		
	131192069	3,335		
	131191831	3,335		
	131191832	3,335		
	131191837	3,335		
	131191842	3,335		
	131191843	3,335		
	131191855	3,335		
	131191858	3,335		
	131191864	3,335		
	131191865	3,335		
	131191866	3,335		
	131191867	3,335		

Total Square Feet: continued -->

Geosynthetic Material Inventory

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Project: Madison Co. MSW Landfill
Project No.: 70001
Page: 2 of 2
Date: 11/2/2005

MATERIAL TYPE: XL4 Fabrinet, 2 side, 14.5'
MANUFACTURER: GSE

Lot Number	Roll Number	Dimensions	Conformance Sample Number	Comments
	131192027	3,335		
	131192028	3,335		
	131192029	3,335		
	131192030	3,335		
	131192031	3,335		
	131192032	3,335		
	131192033	3,335		
	131192074	3,335		
	131192088	3,335		
	131192090	3,335		
	131192091	3,335		
	131192092	3,335		
	131192093	3,335		
	131192094	3,335		
	131192095	3,335		
	131192096	3,335		
	131192097	3,335		
	131192098	3,335		
	131192099	3,335		
	131192100	3,335		
	131192101	3,335		
	131192102	3,335		
	131192103	3,335		
	131192104	3,335		
	131192105	3,335		
	131192106	3,335		

Total Square Feet: 190,095

Geosynthetic Material Inventory

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Daily Geosynthetics Summary

Project: Madison County Landfill Closure
Project #: CTC # 70001

Page: 1 of 1
Date: 11/27/2005

MATERIAL DEPLOYMENT

Material	SF Today	Cum. SF
LLDPE 40 mil	85096	85096

FUSION SEAMING

Machine	LF Today	Cum. LF	No. of Cum. DS
3	1214	1214	4
5	1418	1418	3
20	320	320	1
24	522	522	2

EXTRUSION WELDING

Machine	LF Today	Cum. LF	No. of Cum. DS
42	39	39	1

DESTRUCTS LABELED TODAY

DS	Seam	Location	Machine
1	2-3	0+70	5
2	4-6	0+40	20
3	7-8	0+35	3
4	17-18	0+90	5
5	1-23	2+75	24
6	1-23	1+20	3
7	27-28	0+45	5
8	30-31	0+35	3
9	33-34	0+05	24
10	31-34	0+10	5
11	34-35	0+20	42

COMMENTS:

Signed: Darren Jones

Key: DS - Destructive Sample LF - Lineal Footage SF - Square Footage Cum. - Cumulative

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Daily Geosynthetics Summary

Project: Madison County Landfill Closure

Project #: CTC # 70001

Page: 1 of 1

Date: 11/30/2005

MATERIAL DEPLOYMENT

Material	SF Today	Cum. SF
LLDPE 40 mil	26444	111540

FUSION SEAMING

Machine	LF Today	Cum. LF	No. of Cum. DS
3	363	1557	4
5	0	1418	4
20	0	320	1
24	378	900	3

EXTRUSION WELDING

Machine	LF Today	Cum. LF	No. of Cum. DS
42	0	39	1

DESTRUCTS LABELED TODAY

DS	Seam	Location	Machine
12	24-37	1+75	3
13	37-38	0+80	24

COMMENTS:

Signed: [signature]

Key: DS - Destructive Sample LF - Lineal Footage SF - Square Footage Cum. - Cumulative

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Daily Geosynthetics Summary

Project: Madison County Landfill Closure
Project #: CTC # 70001

Date: 12/1/2005

MATERIAL DEPLOYMENT

Material	SF Today	Cum. SF
LLDPE 40 mil	0	111540

FUSION SEAMING

Machine	LF Today	Cum. LF	No. of Cum. DS
3	463	2020	5
5	0	1418	4
20	0	320	1
24	378	900	3

EXTRUSION WELDING

Machine	LF Today	Cum. LF	No. of Cum. DS
42	55	94	2

DESTRUCTS LABELED TODAY

DS	Seam	Location	Machine
14	24-36	0+10	42
15	38-40	1+60	3

COMMENTS:

Signed: [signature]

Key: DS - Destructive Sample LF - Lineal Footage SF - Square Footage Cum. - Cumulative

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Daily Geosynthetics Summary

Project: Madison County Landfill Closure

Project #: CTC # 70001

Page: 1 of 1

Date: 12/2/2005

MATERIAL DEPLOYMENT

Material	SF Today	Cum. SF
LLDPE 40 mil	61314	172854

FUSION SEAMING

Machine	LF Today	Cum. LF	No. of Cum. DS
3	1517	3537	7
5	1019	2437	6
20	0	320	1
24	551	1451	3

EXTRUSION WELDING

Machine	LF Today	Cum. LF	No. of Cum. DS
42	0	94	2

DESTRUCTS LABELED TODAY

DS	Seam	Location	Machine
16	44-45	0+90	3
17	40-41	1+60	5
18	55-57	0+65	3
19	23-54	0+15	5

COMMENTS:

Signed: Darren Jones

Key: DS - Destructive Sample LF - Lineal Footage SF - Square Footage Cum. - Cumulative

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Daily Geosynthetics Summary

Project: Madison County Landfill Closure
Project #: CTC # 70001

Page: 1 of 1
Date: 12/3/2005

MATERIAL DEPLOYMENT

Material	SF Today	Cum. SF
LLDPE 40 mil	0	172854
6oz Geonet	85000	85000

FUSION SEAMING

Machine	LF Today	Cum. LF	No. of Cum. DS
3	0	3537	7
5	0	2437	6
20	0	320	1
24	0	1451	3

EXTRUSION WELDING

Machine	LF Today	Cum. LF	No. of Cum. DS
42	0	94	2

DESTRUCTS LABELED TODAY

DS	Seam	Location	Machine

COMMENTS:

Signed:

Key: DS - Destructive Sample LF - Lineal Footage SF - Square Footage Cum. - Cumulative

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Daily Geosynthetics Summary

Project: Madison County Landfill Closure

Project #: CTC # 70001

Page: 1 of 1

Date: 12/6/2005

MATERIAL DEPLOYMENT

Material	SF Today	Cum. SF
LLDPE 40 mil	0	172854
6oz Geonet	25000	110000
HDPE 60 mil	7634	7634

FUSION SEAMING

Machine	LF Today	Cum. LF	No. of Cum. DS
3	357	3894	8
5	0	2437	6
20	0	320	1
24	0	1451	3

EXTRUSION WELDING

Machine	LF Today	Cum. LF	No. of Cum. DS
42	0	94	2

DESTRUCTS LABELED TODAY

DS	Seam	Location	Machine
20	59-61	0+20	3

COMMENTS:

Signed: [signature]

Key: DS - Destructive Sample LF - Lineal Footage SF - Square Footage Cum. - Cumulative

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Daily Geosynthetics Summary

Project: Madison County Landfill Closure
Project #: CTC # 70001

Date: 12/7/2005

MATERIAL DEPLOYMENT

Material	SF Today	Cum. SF
LLDPE 40 mil	0	172854
6oz Geonet	70000	180000
HDPE 60 mil	0	7634

FUSION SEAMING

Machine	LF Today	Cum. LF	No. of Cum. DS
3	0	3894	8
5	0	2437	6
20	0	320	1
24	0	1451	3

EXTRUSION WELDING

Machine	LF Today	Cum. LF	No. of Cum. DS
42	0	94	2

DESTRUCTS LABELED TODAY

DS	Seam	Location	Machine

COMMENTS:

Signed: [signature]

Key: DS - Destructive Sample LF - Lineal Footage SF - Square Footage Cum. - Cumulative

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

PROJECT: Madison CoLF
PROJECT #: CTC 70001
DATE: 11/27/05
PAGE 1 of 2

Time	Panel Identification			Batch/Roll Number	Deployed Panel Length	Observer	Comments
	Layer	Number	Location				
	LLDPE	1	See Map	103132044	396	MDS	
	Textured	2		2044	105		
	40 mil	3		2044	108		
		4		2917	84		
		5		2917	140		
		6		2917	78		
		7		2917	70		
		8		2917	62		
		9		2917	32		
		10		2917	22		
		11		2044	10		
		12		2917	108		
		13		104121431	109		
		14		1431	85		
		15		1431	61		
		16		1431	36		Total Feet for Day
		17		1431	158		3868
		18		1431	141		Total Sq. Footage
		19		103132045	104		85096
		20		2045	19		

Total Panel Length: 1928

PANEL PLACEMENT

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

PROJECT: Madison CoLF
PROJECT #: CTC 70001
DATE: 11/27/05
PAGE 2 of 2

Time	Panel Identification			Batch/Roll Number	Deployed Panel Length	Observer	Comments
	Layer	Number	Location				
		21		2045	25		
		22		2045	20		
		23		2045	398		
		24		2918	330		
		25		2918	350		
		26		2915	125		
		27		2915	118		
		28		2915	109		
		29		2915	86		
		30		2915	84		
		31		2915	75		
		32		2045	95		
		33		2045	71		
		34		2915	24		
		35		2915	30		

Total Panel Length: 3868

PANEL PLACEMENT

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

PROJECT: Madison CoLF
PROJECT #: CTC 70001
DATE: 11/30/05
PAGE 1 of 1

Time	Panel Identification			Batch/Roll Number	Deployed Panel Length	Observer	Comments
	Layer	Number	Location				
	LLDPE	36	See Map	103132916	30	MDS	
	Textured	37		2916	378		
	40 mil	38		2916	271		
		39		2916	126		
		40		2916	397		
							Total Feet for Day
							1202
							Total Sq. Footage
							26444

Total Panel Length: 1202

PANEL PLACEMENT

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

PROJECT: Madison CoLF
PROJECT #: CTC 70001
DATE: 12/2/05
PAGE 1 of 1

Time	Panel Identification			Batch/Roll Number	Deployed Panel Length	Observer	Comments
	Layer	Number	Location				
	LLDPE	41	See Map	2914	276	MDS	
	Textured	42		2914	276		
	40 mil	43		2914	140		
		44		2920	103		
		45		2920	250		
		46		2920	134		
		47		2920	113		
		48		2919	91		
		49		2920	70		
		50		2919	41		
		51		104121438	27		
		52		1438	109		
		53		1438	107		
		54		1438	250		
		55		1438	147		
		56		2921	111		Total Feet for Day
		57		2921	271		2787
		58		2921	271		Total Sq. Footage
							61314

Total Panel Length: 2787

PANEL PLACEMENT

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

PROJECT: Madison CoLF
PROJECT #: CTC 70001
DATE: 12/6/05
PAGE 1 of 1

Time	Panel Identification			Batch/Roll Number	Deployed Panel Length	Observer	Comments
	Layer	Number	Location				
	HDPE	58	See Map	41173	240	MDS	
	Textured	59		41173	57		
	60 mil	60		41173	50		
							End of Liner
							Cell "Blacked Out"
							Total Feet for Day
							347
							Total Sq. Footage
							7634

Total Panel Length: 347

PANEL PLACEMENT

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

PROJECT: Madison CoLF
PROJECT #: CTC 70001
DATE: 11/27/05
PAGE 1 of 2

Start Time	Seam ID	Seam Location	Seamer ID	Machine ID	Station		Seam Length	Observer	Comments
					Begin	End			
0722	4-6	See Map	DN	20	0+00	0+78	78	MDS	DS-2 0+40
0750	2-3		KS	5	0+00	1+05	105		DS-1 0+75
0817	2-4		YN	3	0+00	0+83	83		
0835	6-7		KS	5	0+00	0+70	70		
0840	7-8		YN	3	0+00	0+62	62		DS-3 0+35
0842	8-9		DN	20	0+00	0+47	47		
0900	10-11		DN	20	0+00	0+11	11		Total Footage per Machine:
0909	9-11		DN	20	0+00	0+22	22		3 = 1214
0932	5-(4-10)		DN	20	0+00	1+40	140		5 = 1418
1000	2-5		DN	20	0+00	0+22	22		20 = 320
0837	3-12		KS	5	0+00	1+08	108		24 = 522
0914	12-13		KS	5	0+00	1+08	108		42 = 39
0930	13-14		KS	5	0+00	0+85	85		
0940	14-15		YN	3	0+00	0+61	61		
0950	15-16		KS	5	0+00	0+36	36		
1000	1-17		YN	3	0+00	1+58	158		
1005	17-18		KS	5	0+00	1+41	141		DS-4 0+90
1042	18-19		KS	5	0+00	1+03	103		
1130	19-21		KS	5	0+00	0+26	26		
1140	19-22		KS	5	0+00	0+32	32		
	9-10		YN	X42	0+00	0+10	10		

Total Seam Length: 1508

PANEL SEAMING

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

PROJECT: Madison CoLF
PROJECT #: CTC 70001
DATE: 11/27/05
PAGE 2 of 2

Start Time	Seam ID	Seam Location	Seamer ID	Machine ID	Station		Seam Length	Observer	Comments
					Begin	End			
1113	21-22		YN	3	0+00	0+19	19	MDS	
1255	1-23		YN	3	0+00	2+28	228		DS-6 1+20
1305	1-23		DN	24	2+28	3+97	169		DS-5 2+75
1320	TI (14-20)		KS	5	0+00	1+24	124		
1345	24-25		YN	3	0+00	3+30	330		
1350	1 (2-13)		DN	24	0+00	0+90	90		
1405	23-26		KS	5	0+00	1+25	125		
1420	26-27		DN	24	0+00	1+18	118		
1435	27-28		KS	5	0+00	1+09	109		DS-7 0+45
1440	33-34		DN	24	0+00	0+22	22		DS-9 0+05
1458	28-29		YN	3	0+00	0+86	86		
1500	23-(24-25)		DN	24	0+00	0+42	42		
1512	29-30		DN	24	0+00	0+81	81		
1520	25-(30-31)		KS	5	0+00	0+44	44		
1527	30-31		YN	3	0+00	0+72	72		DS-8 0+35
1614	25-32		KS	5	0+00	1+65	165		
1638	32-33		YN	3	0+00	0+71	71		
1638	32-34		YN	3	0+00	0+24	24		
1700	34-35		YN	X42	0+00	0+29	29		DS-11 0+20
1750	31-(32-35)		KS	5	0+00	0+37	37		DS-10 0+10
1106	21-22		YN	3	0+00	0+20	20		

Total Seam Length: 3513

PANEL SEAMING

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

PROJECT: Madison CoLF
PROJECT #: CTC 70001
DATE: 11/30/05
PAGE 1 of 1

Start Time	Seam ID	Seam Location	Seamer ID	Machine ID	Station		Seam Length	Observer	Comments
					Begin	End			
1440	24-37	See Map	DN	3	0+00	3+32	332	MDS	DS-12 1+75
1440	36-37		DN	3	0+00	0+31	31		
1520	37-38		YN	24	0+00	2+55	255		DS-13 0+80
1520	37-39		YN	24	0+00	1+23	123		
									Total Footage per Machine:
									3 = 363
									24 = 378

Total Seam Length: 741

PANEL SEAMING

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

PROJECT: Madison CoLF
PROJECT #: CTC 70001
DATE: 12/1/05
PAGE 1 of 1

Start Time	Seam ID	Seam Location	Seamer ID	Machine ID	Station		Seam Length	Observer	Comments
					Begin	End			
	24-36	See Map	KS	42	0+00	0+22	22	MDS	DS 14 0+10
	23-(37-40)		DN	3	0+00	0+66	66		
	25-36		KS	42	0+00	0+11	11		
1023	39-40		DN	3	0+00	1+26	126		
1023	38-40		DN	3	0+00	2+71	271		DS 15 1+60
	38-39		KS	42	0+00	0+22	22		
									Total Footage per Machine:
									3 = 463
									42 = 55

Total Seam Length: 518

PANEL SEAMING

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

PROJECT: Madison CoLF
PROJECT #: CTC 70001
DATE: 12/2/05
PAGE 1 of 2

Start Time	Seam ID	Seam Location	Seamer ID	Machine ID	Station		Seam Length	Observer	Comments
					Begin	End			
0830	41-42	See Map	YN	3	0+00	2+76	276	MDS	
0900	43-44		KS	5	0+00	0+22	22		
0905	42-43		KS	5	0+00	1+40	140		
0905	42-44		KS	5	0+00	1+03	103		
0915	46-47		KS	5	0+00	1+13	113		
0929	43-45		YN	3	0+00	1+39	139		
0929	44-45		YN	3	0+00	1+01	101		DS 16 0+90
1055	47-48		YN	3	0+00	0+91	91		
1111	48-49		KS	5	0+00	0+70	70		
1113	49-50		YN	3	0+00	0+41	41		
1132	50-51		YN	3	0+00	0+27	27		
1305	40-41		KS	5	0+00	2+76	276		DS 17 1+60
1344	46-52		YN	3	0+00	0+90	90		
1405	52-53		YN	3	0+00	1+01	101		Total Footage per Machine:
1430	40-(46-51)		KS	5	0+00	1+30	130		3 = 1517
1430	45-54		YN	3	0+00	2+50	250		5 = 1019
1440	55-56		DN	24	0+00	0+22	22		24 = 551
1446	54-55		DN	24	0+00	1+47	147		
1446	54-56		DN	24	0+00	1+11	111		
1510	55-57		YN	3	0+00	1+50	150		DS 18 0+65
1510	56-57		YN	3	0+00	1+11	111		

Total Seam Length: 2511

PANEL SEAMING

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

PROJECT: Madison CoLF
PROJECT #: CTC 70001
DATE: 12/2/05
PAGE 2 of 2

Start Time	Seam ID	Seam Location	Seamer ID	Machine ID	Station		Seam Length	Observer	Comments
					Begin	End			
1418	53-(44-57)		YN	3		0+96	96	MDS	
1510	23-(41-58)		KS	5		1+65	165		DS-19 P 23-54 0+15
1527	57-58	See Map	DN	24		2+71	271		
1552	42-(52-53)		YN	3		0+44	44		

Total Seam Length: 3087

PANEL SEAMING

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

PROJECT: Madison CoLF
PROJECT #: CTC 70001
DATE: 12/6/05
PAGE 1 of 1

Start Time	Seam ID	Seam Location	Seamer ID	Machine ID	Station		Seam Length	Observer	Comments
					Begin	End			
0800	59-60	See Map	KS	3	0+00	0+57	57	MDS	
0800	59-61		KS	3	0+00	0+50	50		DS-20 0+20
0850	60-61		KS	3	0+00	0+10	10		
0940	58-59		KS	3	0+00	2+40	240		
									Total Footage per Machine:
									3 = 357

Total Seam Length: 357

PANEL SEAMING

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

PROJECT: Madison CoLF
PROJECT #: CTC # 70001
DATE: 11/30/2005
PAGE 1 of 3

Time/Date Repaired	Repair Number	Panel(s)	Location	Description of Damage	Type of Repair	Size of Repair	Repair Crew	Date Tested	Tested by	Observer	Comments
am	1	2-4	0+62	burnout	patch	1x3	KN	30-Nov	VL	MDS	
am	2	4	0+70	hole	patch	1' dia	KN	30-Nov	VL		
am	3	4-6	0+40	DS-2	patch	2x3	KN	30-Nov	VL		
0840	4	6	0+49	Methane Vent	boot	7	KN	30-Nov	VL		
0835	5	7-8	0+35	DS-3	patch	2x3	KN	30-Nov	VL		
am	6	9-10-11	T-Int.	T join	patch	2	KN	30-Nov	VL		
am	7	5-9-11	T-Int.	T join	patch	1	KN	30-Nov	VL		
am	8	5-8-9	T-Int.	T join	patch	1	KN	30-Nov	VL		
am	9	5-7-8	T-Int.	T join	patch	2	KN	30-Nov	VL		
am	10	5-6-7	T-Int.	T join	patch	1	KN	30-Nov	VL		
am	11	4-5-6	T-Int.	T join	patch	1	KN	30-Nov	VL		
0820	12	2-4-5	T-Int.	T join	patch	1	YN	30-Nov	VL		
0825	13	1-5	0+15	hole	patch	1	YN	30-Nov	VL		
0910	14	1-2-5	T-Int.	T join	patch	1	YN	30-Nov	VL		
0800	15	1-2-3	T-Int.	T join	patch	1	YN	30-Nov	VL		
0808	16	1-3-12	T-Int.	T join	patch	1	YN	30-Nov	VL		
0830	17	1-12-13	T-Int.	T join	patch	1	KS	30-Nov	VL		
0745	18	1-13-17	T-Int.	T join	patch	1	KS	30-Nov	VL		
0816	19	13-14-17-18	Quad int.	Quad join	patch	1	KS	30-Nov	VL		
0830	20	14-15-18-19	Quad int.	Quad join	patch	1x4	KS	30-Nov	VL		

GEOMEMBRANE REPAIR LOG

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

PROJECT: Madison CoLF
PROJECT #: CTC # 70001
DATE: 11/30/2005
PAGE 2 of 3

Time/Date Repaired	Repair Number	Panel(s)	Location	Description of Damage	Type of Repair	Size of Repair	Repair Crew	Date Tested	Tested by	Observer	Comments
0903	21	15-16-19-21	Quad Int.	Quad join/MV	Boot	6x10	KS	30-Nov	VL	MDS	
0848	22	16-20-21	T-Int.	T join	patch	1	KS	30-Nov	VL		
0943	23	19-21-22	T-Int.	T join	patch	1	KS	30-Nov	VL		
0950	24	21-22	0+15	burnout	patch	1	KS	30-Nov	VL		
0955	25	21-22	EOL	burnout edge	patch	1	KS	30-Nov	VL		
0957	26	19	0+25	hole	patch	1x2	KS	30-Nov	VL		
0841	27	15-16	0+10	burnout	patch	1x3	KS	30-Nov	VL		
0930	28	15-16	0+36	burnout edge	patch	1x2	KS	30-Nov	VL		
0835	29	14-15	0+55	burnout	patch	1x3	KS	30-Nov	VL		
0820	30	2-3	0+75	DS-1	patch	2x3	YN	30-Nov	VL		
0954	31	23	2+00	Methane Vent	boot	4x8	KS	30-Nov	VL		
0910	32	1-23	2+75	DS-5	patch	2x3	YN	30-Nov	VL		
0915	33	23-25-26	T-Int.	T join	patch	2	YN	30-Nov	VL		
0920	34	23-24-25	T-Int.	T join	patch	2	YN	30-Nov	VL		
0930	35	25-26-27	T-Int.	T join	patch	2	YN	30-Nov	VL		
0935	36	25-27-28	T-Int.	T join	patch	2	YN	30-Nov	VL		
0942	37	27-28	0+45	DS-7	patch	2x3	YN	30-Nov	VL		
1010	38	26	0+95	Methane Vent	Boot	5x11	YN	30-Nov	VL		
1015	39	18-19	0+85	hole	patch	2	KS	30-Nov	VL		
1021	40	17-18	0+90	DS-4	patch	2x3	KS	30-Nov	VL		

GEOMEMBRANE REPAIR LOG

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

PROJECT: Madison CoLF
PROJECT #: CTC # 70001
DATE: 11/30/2005
PAGE 3 of 3

Time/Date Repaired	Repair Number	Panel(s)	Location	Description of Damage	Type of Repair	Size of Repair	Repair Crew	Date Tested	Tested by	Observer	Comments
1050	41	23	0+30	Methane Vent	boot	4x9	KS	30-Nov	VL	MDS	
1110	42	1-23	1+20	DS-6	patch	2x3	KS	30-Nov	VL		
1015	43	25-28-29	T-Int.	T join	patch	2	YN	30-Nov	VL		
1050	44	25-29-30	T-Int.	T join	patch	2	YN	30-Nov	VL		
1100	45	25-30-31	T-Int.	T join	patch	1	YN	30-Nov	VL		
1033	46	30-31	0+35	DS-8	patch	2x3	YN	30-Nov	VL		
1108	47	31-34	0+10	DS-10+MV	boot	5x7	YN	30-Nov	VL		
1042	48	31-32-34	T-Int.	T join	patch	2x4	YN	30-Nov	VL		
1035	49	25-31-32	T-Int.	T join	patch	3	YN	30-Nov	VL		
1041	50	34-35	0+20	DS-11	patch	2x3	YN	30-Nov	VL		
1046	51	33-34-35	T-Int.	T join	patch	1	YN	30-Nov	VL		
1120	52	32-33-34	T-Int.	DS-9 + T join	patch	2x7	YN	30-Nov	VL		
1108	53	24	2+90	Methane Vent	boot	10	YN	30-Nov	VL		

GEOMEMBRANE REPAIR LOG

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

PROJECT: Madison CoLF
PROJECT #: CTC # 70001
DATE: 12/1/2005
PAGE 1 of 1

Time/Date Repaired	Repair Number	Panel(s)	Location	Description of Damage	Type of Repair	Size of Repair	Repair Crew	Date Tested	Tested by	Observer	Comments
1030	54	24-36-37	T-inter	T join	patch	2	KS	1-Dec	VL	MDS	
1035	55	24-25-36	T-inter	T join	patch	2	KS	1-Dec	VL		
1305	56	23-24-37	T-inter	T join	patch	2	KS	1-Dec	VL		
1450	57	23-37-39	T-inter	T join	patch	2	KS	1-Dec	VL		
1500	58	23-39-40	T-inter	T join	patch	2	KS	1-Dec	VL		
1310	59	24	0+05	hole	patch	1	KS	1-Dec	VL		
1000	60	39	0+50	Methane Vent	boot	6x9	KS	1-Dec	VL		
1315	61	37-38-39	T-inter	T join	patch	2	KS	1-Dec	VL		
1303	62	37-38	0+80	DS-13	patch	2x3	KS	1-Dec	VL		
1137	63	37-38	1+95	burnout	patch	3	KS	1-Dec	VL		
1256	64	24-37	1+75	DS-12	patch	2x3	KS	1-Dec	VL		
1320	65	39-40	1+10	burnout	patch	2x3	KS	1-Dec	VL		
1325	66	38-39-40	T-inter	T join	patch	2x5	KS	1-Dec	VL		
1335	67	38-40	0+25	burnout	patch	2x4	KS	1-Dec	VL		
1340	68	38-40	1+25	burnout	patch	2	KS	1-Dec	VL		
1345	69	38-40	1+60	DS-15	patch	2x3	KS	1-Dec	VL		
1130	70	24-36	0+10	DS-14	patch	2x3	KS	1-Dec	VL		

GEOMEMBRANE REPAIR LOG

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

PROJECT: Madison CoLF
PROJECT #: CTC # 70001
DATE: 12/2/2005
PAGE 1 of 1

Time/Date Repaired	Repair Number	Panel(s)	Location	Description of Damage	Type of Repair	Size of Repair	Repair Crew	Date Tested	Tested by	Observer	Comments
1320	71	41	1+55	Methane Vent	boot	5x8	KN	2-Dec	VL	MDS	
1645	72	42-43-44	T-inter	T join	patch	2	KN	2-Dec	VL		
1650	73	43-44-45	T-inter	T join	patch	2	KN	2-Dec	VL		
1700	74	44	0+01	hole	patch	1x2	KN	2-Dec	VL		

GEOMEMBRANE REPAIR LOG

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

PROJECT: Madison CoLF
PROJECT #: CTC # 70001
DATE: 12/6/2005
PAGE 1 of 3

Time/Date Repaired	Repair Number	Panel(s)	Location	Description of Damage	Type of Repair	Size of Repair	Repair Crew	Date Tested	Tested by	Observer	Comments
	75	54-55-56	T-inter	T join	patch	2	NY	6-Dec	VL	MDS	
	76	55-56	0+15	hole	patch	1x2	NY	6-Dec	VL		
	77	55-56-57	T-inter	T join	patch	2	NY	6-Dec	VL		
	78	58	0+70	Methane Vent	boot	4x12	NY	6-Dec	VL		
	79	56-57	0+65	DS-18	patch	2x3	NY	6-Dec	VL		
	80	42	1+70	Manhole	boot	8x15	KN	3-Dec	VL		
	81	40-41	1+60	DS-17	patch	2x3	NY	6-Dec	VL		
	82	40-41	1+40	burnout	patch	1	NY	6-Dec	VL		
	83	40-41	2+30	burnout	patch	2x3	NY	6-Dec	VL		
	84	58	1+70	Methane Vent	boot	7x10	NY	3-Dec	VL		
	85	44-45	0+90	DS-16	patch	2x3	NY	3-Dec	VL		
	86	44	1+00	Methane Vent	boot	5x5	NY	3-Dec	VL		
	87	42-44-53	T-inter	T join	patch	3	NY	3-Dec	VL		
	88	42-52-53	T-inter	T join	patch	2x6	NY	3-Dec	VL		
	89	42-46-52	T-inter	T join	patch	5x10	NY	3-Dec	VL		
	90	44-45-53	T-inter	T join	patch	4x10	NY	3-Dec	VL		
	91	45-53-54	T-inter	T join	patch	2	NY	3-Dec	VL		
	92	53-54-55	T-inter	T join	patch	2	NY	3-Dec	VL		
	93	53-55-57	T-inter	T join	patch	2	KN	3-Dec	VL		
	94	53-57-58	T-inter	T join	patch	2x8	KN	3-Dec	VL		

GEOMEMBRANE REPAIR LOG

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

PROJECT: Madison CoLF
PROJECT #: CTC # 70001
DATE: 12/6/2005
PAGE 2 of 3

Time/Date Repaired	Repair Number	Panel(s)	Location	Description of Damage	Type of Repair	Size of Repair	Repair Crew	Date Tested	Tested by	Observer	Comments
	95	46-52	0+50	burnout	patch	1x3	NY	3-Dec	VL	MDS	
	96	41-42-46	T-inter	T join	patch	2	NY	3-Dec	VL		
	97	40-41-46	T-inter	T join	patch	3x7	DN	3-Dec	VL		
	98	40-46-47	T-inter	T join	patch	4x2	DN	3-Dec	VL		
	99	40-47-48	T-inter	T join	patch	5x6	DN	3-Dec	VL		
	100	40-48-49	T-inter	T join	patch	3x6	DN	3-Dec	VL		
	101	47-48	0+10	hole	patch	3x2	DN	3-Dec	VL		
	102	40-49-50	T-inter	T join	patch	1	DN	3-Dec	VL		
	103	40-50-51	T-inter	T join	patch	3x10	DN	3-Dec	VL		
	104	24-37	0+70	hole	patch	2x2	DN	3-Dec	VL		
	105	49	0+20	Methane Vent	boot	6	KN	6-Dec	VL		
	106	23-40-41	T-inter	T join	patch	2	NY	6-Dec	VL		
	107	23-41-42	T-inter	T join	patch	2	NY	6-Dec	VL		
	108	23-42-43	T-inter	T join	patch	2	NY	6-Dec	VL		
	109	23-43-45	T-inter	T join	patch	2	NY	6-Dec	VL		
	110	23-45-54	T-inter	T join	patch	2	NY	6-Dec	VL		
	111	23-54	0+15	DS-19	patch	2x3	NY	6-Dec	VL		
	112	23-54-56	T-inter	T join	patch	2	NY	6-Dec	VL		
	113	23-56-57	T-inter	T join	patch	2	NY	6-Dec	VL		
	114	23-57-58	T-inter	T join	patch	2	NY	6-Dec	VL		

GEOMEMBRANE REPAIR LOG

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

PROJECT: Madison CoLF
PROJECT #: CTC # 70001
DATE: 12/6/2005
PAGE 3 of 3

Time/Date Repaired	Repair Number	Panel(s)	Location	Description of Damage	Type of Repair	Size of Repair	Repair Crew	Date Tested	Tested by	Observer	Comments
	115	23-58-59	T-inter	T join	patch	3x5		6-Dec	VL	MDS	
	116	59-60-61	T-inter	T join	patch	2		6-Dec	VL		
	117	57-58	0+65	burnout	patch	2x4		6-Dec	VL		
	118	58	1+70	Methane Vent	boot	4x10		6-Dec	VL		
	119	59-61	0+35	bad seam	patch	3x15		6-Dec	VL		
	120	45-54	2+35	burnout	patch	2x4		6-Dec	VL		
	121	52	0+50	Methane Vent	boot	5		6-Dec	VL		
	122	52	0+50	Manhole	boot	15		6-Dec	VL		
	123	59-61	0+20	DS-20	patch	2x3		6-Dec	VL		

GEOMEMBRANE REPAIR LOG

SECTION IX

GeoTesting
express
a subsidiary of Geocomp Corporation

1145 Massachusetts Avenue
Boxborough, MA 01719
978 635 0424 Tel
978 635 0266 Fax

Geotechnical Test Report

January 2, 2006

Madison County NC Landfill Project

Prepared for:

CT Clayton Engineering

GeoTesting
express

Client:	CT Clayton Engineering		
Project Name:	Madison County NC Landfill		
Project Location:	---		
Installer:	---		
GTX #:	6375		
Test Date:	11/29/05		
Tested By:	gjp	Report #:	1
Checked By:	rmt	Page:	1 of 5

Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods by ASTM D 6392

peel & shear destructive test

Upper Geomembrane:	40 mil textured LLDPE	Testing Machine:	Instron 1123
Lower Geomembrane:	40 mil textured LLDPE	Testing Speed:	20 in/min
Seaming Method:	Dual Hot Wedge Weld	Grips:	ATS pneumatic
		Specimen Size:	1 in x 8 in

Sample ID:	DS-1	Machine ID:	75
Seam ID:	2/3	Welder ID:	Ot
		Date Sampled:	11/27/05

Specimen Number	Peel Strength						Shear Strength		
	Weld A			Weld B					
	lb./in	Seam Separation, %	Failure Type	lb./in	Seam Separation, %	Failure Type	lb./in	Elongation, %	Rupture Mode
1	80	---	SE1	85	---	SE1	90	>1100%	both
2	81	---	SE1	89	---	SE1	90	>1100%	both
3	78	---	SE1	86	---	SE1	90	>1100%	both
4	80	---	SE1	87	---	SE1	94	>1100%	both
5	79	---	SE1	85	---	SE1	88	250%	BRK
Average	80	---	---	86	---	---	90	---	---

Comments:

Estimate of seam separation visually determined based upon proportion of linear length of separated bond in the direction of the test to the length of original bonding to the nearest 25%.

Shear test halted for HDPE and LMDPE materials once specimen has elongated 50%.
Shear test halted for PVC, fPP, LLDPE, VFPE and VLDPE once specimen has elongated past machine capacity.

Rupture mode for specimens with >50% elongation (HDPE and LMDPE) or > machine capacity (PVC, fPP, LLDPE, VFPE and VLDPE) interpreted as occurring in the membrane that exhibits yielding.

GeoTesting
express

Client:	CT Clayton Engineering		
Project Name:	Madison County NC Landfill		
Project Location:	---		
Installer:	---		
GTX #:	6375		
Test Date:	11/29/05		
Tested By:	gjp	Report #:	1
Checked By:	rmt	Page:	2 of 5

Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods by ASTM D 6392

peel & shear destructive test

Upper Geomembrane:	40 mil textured LLDPE	Testing Machine:	Instron 1123
Lower Geomembrane:	40 mil textured LLDPE	Testing Speed:	20 in/min
Seaming Method:	Dual Hot Wedge Weld	Grips:	ATS pneumatic
		Specimen Size:	1 in x 8 in

Sample ID:	DS-2	Machine ID:	40
Seam ID:	4/6	Welder ID:	OT
		Date Sampled:	11/27/05

Specimen Number	Peel Strength						Shear Strength		
	Weld A			Weld B					
	lb./in	Seam Separation, %	Failure Type	lb./in	Seam Separation, %	Failure Type	lb./in	Elongation, %	Rupture Mode
1	83	---	SE1	91	---	SE1	95	>1100%	both
2	86	---	SE1	91	---	SE1	92	>1100%	both
3	88	---	SE1	91	---	SE1	92	>1100%	both
4	83	---	SE1	88	---	SE1	93	>1100%	both
5	86	---	SE1	88	---	SE1	91	>1100%	both
Average	85	---	---	90	---	---	93	---	---

Comments:

Estimate of seam separation visually determined based upon proportion of linear length of separated bond in the direction of the test to the length of original bonding to the nearest 25%.

Shear test halted for HDPE and LMDPE materials once specimen has elongated 50%.
Shear test halted for PVC, fPP, LLDPE, VFPE and VLDPE once specimen has elongated past machine capacity.

Rupture mode for specimens with >50% elongation (HDPE and LMDPE) or > machine capacity (PVC, fPP, LLDPE, VFPE and VLDPE) interpreted as occurring in the membrane that exhibits yielding.

GeoTesting
express

Client:	CT Clayton Engineering		
Project Name:	Madison County NC Landfill		
Project Location:	---		
Installer:	---		
GTX #:	6375		
Test Date:	11/29/05		
Tested By:	gjp	Report #:	1
Checked By:	rmt	Page:	3 of 5

Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods by ASTM D 6392

peel & shear destructive test

Upper Geomembrane:	40 mil textured LLDPE	Testing Machine:	Instron 1123
Lower Geomembrane:	40 mil textured LLDPE	Testing Speed:	20 in/min
Seaming Method:	Dual Hot Wedge Weld	Grips:	ATS pneumatic
		Specimen Size:	1 in x 8 in

Sample ID:	DS-3	Machine ID:	35
Seam ID:	7/9	Welder ID:	OT
		Date Sampled:	11/27/05

Specimen Number	Peel Strength						Shear Strength		
	Weld A			Weld B					
	lb./in	Seam Separation, %	Failure Type	lb./in	Seam Separation, %	Failure Type	lb./in	Elongation, %	Rupture Mode
1	89	---	SE1	83	---	SE1	90	1000%	SE1
2	88	---	SE1	84	---	SE1	91	1000%	SE1
3	89	---	SE1	87	---	SE1	98	>1100%	both
4	89	---	SE1	85	---	SE1	95	1050%	SE1
5	84	---	SE1	84	---	SE1	97	>1100%	both
Average	88	---	---	85	---	---	94	---	---

Comments:

Estimate of seam separation visually determined based upon proportion of linear length of separated bond in the direction of the test to the length of original bonding to the nearest 25%.

Shear test halted for HDPE and LMDPE materials once specimen has elongated 50%.
Shear test halted for PVC, fPP, LLDPE, VFPE and VLDPE once specimen has elongated past machine capacity.

Rupture mode for specimens with >50% elongation (HDPE and LMDPE) or > machine capacity (PVC, fPP, LLDPE, VFPE and VLDPE) interpreted as occurring in the membrane that exhibits yielding.

GeoTesting
express

Client:	CT Clayton Engineering		
Project Name:	Madison County NC Landfill		
Project Location:			
Installer:	---		
GTX #:	6375		
Test Date:	11/29/05		
Tested By:	gjp	Report #:	1
Checked By:	rmt	Page:	4 of 5

Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods by ASTM D 6392

peel & shear destructive test

Upper Geomembrane:	40 mil textured LLDPE	Testing Machine:	Instron 1123
Lower Geomembrane:	40 mil textured LLDPE	Testing Speed:	20 in/min
Seaming Method:	Dual Hot Wedge Weld	Grips:	ATS pneumatic
		Specimen Size:	1 in x 8 in

Sample ID:	DS-4	Machine ID:	90
Seam ID:	17/18	Welder ID:	Ot
		Date Sampled:	11/27/05

	Peel Strength						Shear Strength		
	Weld A			Weld B					
Specimen Number	lb./in	Seam Separation, %	Failure Type	lb./in	Seam Separation, %	Failure Type	lb./in	Elongation, %	Rupture Mode
1	91	---	SE1	87	---	SE1	91	>1100%	both
2	90	---	SE1	90	---	SE1	90	>1100%	both
3	90	---	SE1	91	---	SE1	92	>1100%	both
4	89	---	SE1	89	---	SE1	92	>1100%	both
5	89	---	SE1	89	---	SE1	91	>1100%	both
Average	90	---	---	89	---	---	91	---	---

Comments:

Estimate of seam separation visually determined based upon proportion of linear length of separated bond in the direction of the test to the length of original bonding to the nearest 25%.

Shear test halted for HDPE and LMDPE materials once specimen has elongated 50%.
Shear test halted for PVC, fPP, LLDPE, VFPE and VLDPE once specimen has elongated past machine capacity.

Rupture mode for specimens with >50% elongation (HDPE and LMDPE) or > machine capacity (PVC, fPP, LLDPE, VFPE and VLDPE) interpreted as occurring in the membrane that exhibits yielding.

GeoTesting
express

Client:	CT Clayton Engineering		
Project Name:	Madison County NC Landfill		
Project Location:	---		
Installer:	---		
GTX #:	6375		
Test Date:	11/29/05		
Tested By:	gjp	Report #:	1
Checked By:	rmt	Page:	5 of 5

Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods by ASTM D 6392

peel & shear destructive test

Upper Geomembrane:	40 mil textured LLDPE	Testing Machine:	Instron 1123
Lower Geomembrane:	40 mil textured LLDPE	Testing Speed:	20 in/min
Seaming Method:	Dual Hot Wedge Weld	Grips:	ATS pneumatic
		Specimen Size:	1 in x 8 in

Sample ID:	DS-5	Machine ID:	75
Seam ID:	1/23	Welder ID:	Ot
		Date Sampled:	11/27/05

Specimen Number	Peel Strength						Shear Strength		
	Weld A			Weld B					
	lb./in	Seam Separation, %	Failure Type	lb./in	Seam Separation, %	Failure Type	lb./in	Elongation, %	Rupture Mode
1	85	---	SE1	86	---	SE1	92	>1100%	both
2	89	---	SE1	85	---	SE1	91	>1100%	both
3	89	---	SE1	92	---	SE1	92	>1100%	both
4	83	---	SE1	86	---	SE1	89	1050%	SE1
5	85	---	SE1	85	---	SE1	88	1050%	SE1
Average	86	---	---	87	---	---	90	---	---

Comments:

Estimate of seam separation visually determined based upon proportion of linear length of separated bond in the direction of the test to the length of original bonding to the nearest 25%.

Shear test halted for HDPE and LMDPE materials once specimen has elongated 50%.
Shear test halted for PVC, fPP, LLDPE, VFPE and VLDPE once specimen has elongated past machine capacity.

Rupture mode for specimens with >50% elongation (HDPE and LMDPE) or > machine capacity (PVC, fPP, LLDPE, VFPE and VLDPE) interpreted as occurring in the membrane that exhibits yielding.

GeoTesting
express

Client:	CT Clayton Engineering		
Project Name:	Madison County NC Landfill		
Project Location:	---		
Installer:	---		
GTX #:	6375		
Test Date:	12/01/05		
Tested By:	gjp	Report #:	2
Checked By:	rmt	Page:	1 of 6

Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods by ASTM D 6392

peel & shear destructive test

Upper Geomembrane:	40 mil textured LLDPE	Testing Machine:	Instron 1123
Lower Geomembrane:	40 mil textured LLDPE	Testing Speed:	20 in/min
Seaming Method:	Dual Hot Wedge Weld	Grips:	ATS pneumatic
		Specimen Size:	1 in x 8 in

Sample ID:	DS-6	Machine ID:	3
Seam ID:	1/23	Welder ID:	YN
		Date Sampled:	11/27/05

	Peel Strength						Shear Strength		
	Weld A			Weld B					
Specimen Number	lb./in	Seam Separation, %	Failure Type	lb./in	Seam Separation, %	Failure Type	lb./in	Elongation, %	Rupture Mode
1	89	---	SE1	88	---	SE1	91	>1100%	both
2	91	---	SE1	88	---	SE1	97	>1100%	both
3	93	---	SE1	87	---	SE1	93	>1100%	both
4	88	---	SE1	87	---	SE1	94	>1100%	both
5	87	---	SE1	88	---	SE1	93	1050%	SE1
Average	90	---	---	88	---	---	94	---	---

Comments:

Estimate of seam separation visually determined based upon proportion of linear length of separated bond in the direction of the test to the length of original bonding to the nearest 25%.

Shear test halted for HDPE and LMDPE materials once specimen has elongated 50%.
Shear test halted for PVC, fPP, LLDPE, VFPE and VLDPE once specimen has elongated past machine capacity.

Rupture mode for specimens with >50% elongation (HDPE and LMDPE) or > machine capacity (PVC, fPP, LLDPE, VFPE and VLDPE) interpreted as occurring in the membrane that exhibits yielding.

GeoTesting
express

Client:	CT Clayton Engineering		
Project Name:	Madison County NC Landfill		
Project Location:	---		
Installer:	---		
GTX #:	6375		
Test Date:	12/01/05		
Tested By:	gjp	Report #:	2
Checked By:	rmt	Page:	2 of 6

Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods by ASTM D 6392

peel & shear destructive test

Upper Geomembrane:	40 mil textured LLDPE	Testing Machine:	Instron 1123
Lower Geomembrane:	40 mil textured LLDPE	Testing Speed:	20 in/min
Seaming Method:	Dual Hot Wedge Weld	Grips:	ATS pneumatic
		Specimen Size:	1 in x 8 in

Sample ID:	DS-7	Machine ID:	5
Seam ID:	27/28	Welder ID:	KS
		Date Sampled:	11/27/05

Specimen Number	Peel Strength						Shear Strength		
	Weld A			Weld B					
	lb./in	Seam Separation, %	Failure Type	lb./in	Seam Separation, %	Failure Type	lb./in	Elongation, %	Rupture Mode
1	89	---	SE1	74	---	SE1	92	1075%	SE1
2	93	---	SE1	82	---	SE1	96	>1100%	both
3	94	---	SE1	86	---	SE1	93	1075%	SE1
4	87	---	SE1	75	---	SE1	94	>1100%	both
5	91	---	SE1	83	---	SE1	92	1050%	SE1
Average	91	---	---	80	---	---	93	---	---

Comments:

Estimate of seam separation visually determined based upon proportion of linear length of separated bond in the direction of the test to the length of original bonding to the nearest 25%.

Shear test halted for HDPE and LMDPE materials once specimen has elongated 50%.
Shear test halted for PVC, fPP, LLDPE, VFPE and VLDPE once specimen has elongated past machine capacity.

Rupture mode for specimens with >50% elongation (HDPE and LMDPE) or > machine capacity (PVC, fPP, LLDPE, VFPE and VLDPE) interpreted as occurring in the membrane that exhibits yielding.

GeoTesting express

Client:	CT Clayton Engineering		
Project Name:	Madison County NC Landfill		
Project Location:	---		
Installer:	---		
GTX #:	6375		
Test Date:	12/01/05		
Tested By:	gjp	Report #:	2
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Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods by ASTM D 6392

peel & shear destructive test

Upper Geomembrane:	40 mil textured LLDPE	Testing Machine:	Instron 1123
Lower Geomembrane:	40 mil textured LLDPE	Testing Speed:	20 in/min
Seaming Method:	Dual Hot Wedge Weld	Grips:	ATS pneumatic
		Specimen Size:	1 in x 8 in

Sample ID:	DS-8	Machine ID:	3
Seam ID:	30/31	Welder ID:	YN
		Date Sampled:	11/27/05

Specimen Number	Peel Strength						Shear Strength		
	Weld A			Weld B					
	lb./in	Seam Separation, %	Failure Type	lb./in	Seam Separation, %	Failure Type	lb./in	Elongation, %	Rupture Mode
1	89	---	SE1	91	---	SE1	94	1050%	SE1
2	93	---	SE1	95	---	SE1	94	>1100%	both
3	88	---	SE1	91	---	SE1	96	>1100%	both
4	89	---	SE1	87	---	SE1	94	>1100%	both
5	88	---	SE1	90	---	SE1	96	>1100%	both
Average	89	---	---	91	---	---	95	---	---

Comments:

Estimate of seam separation visually determined based upon proportion of linear length of separated bond in the direction of the test to the length of original bonding to the nearest 25%.

Shear test halted for HDPE and LMDPE materials once specimen has elongated 50%.
Shear test halted for PVC, fPP, LLDPE, VFPE and VLDPE once specimen has elongated past machine capacity.

Rupture mode for specimens with >50% elongation (HDPE and LMDPE) or > machine capacity (PVC, fPP, LLDPE, VFPE and VLDPE) interpreted as occurring in the membrane that exhibits yielding.

GeoTesting
express

Client:	CT Clayton Engineering		
Project Name:	Madison County NC Landfill		
Project Location:	---		
Installer:	---		
GTX #:	6375		
Test Date:	12/01/05		
Tested By:	gjp	Report #:	2
Checked By:	rmt	Page:	4 of 6

Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods by ASTM D 6392

peel & shear destructive test

Upper Geomembrane:	40 mil textured LLDPE	Testing Machine:	Instron 1123
Lower Geomembrane:	40 mil textured LLDPE	Testing Speed:	20 in/min
Seaming Method:	Dual Hot Wedge Weld	Grips:	ATS pneumatic
		Specimen Size:	1 in x 8 in

Sample ID:	DS-9	Machine ID:	24
Seam ID:	33/34	Welder ID:	DN
		Date Sampled:	11/27/05

	Peel Strength						Shear Strength		
	Weld A			Weld B					
Specimen Number	lb./in	Seam Separation, %	Failure Type	lb./in	Seam Separation, %	Failure Type	lb./in	Elongation, %	Rupture Mode
1	88	---	SE1	88	---	SE1	94	>1100%	both
2	89	---	SE1	89	---	SE1	97	>1100%	both
3	84	---	SE1	86	---	SE1	94	>1100%	both
4	83	---	SE1	85	---	SE1	95	>1100%	both
5	87	---	SE1	85	---	SE1	95	>1100%	both
Average	86	---	---	87	---	---	95	---	---

Comments:

Estimate of seam separation visually determined based upon proportion of linear length of separated bond in the direction of the test to the length of original bonding to the nearest 25%.

Shear test halted for HDPE and LMDPE materials once specimen has elongated 50%.
Shear test halted for PVC, fPP, LLDPE, VFPE and VLDPE once specimen has elongated past machine capacity.

Rupture mode for specimens with >50% elongation (HDPE and LMDPE) or > machine capacity (PVC, fPP, LLDPE, VFPE and VLDPE) interpreted as occurring in the membrane that exhibits yielding.

GeoTesting
express

Client:	CT Clayton Engineering		
Project Name:	Madison County NC Landfill		
Project Location:	---		
Installer:	---		
GTX #:	6375		
Test Date:	12/01/05		
Tested By:	gjp	Report #:	2
Checked By:	rmt	Page:	5 of 6

Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods by ASTM D 6392

peel & shear destructive test

Upper Geomembrane:	40 mil textured LLDPE	Testing Machine:	Instron 1123
Lower Geomembrane:	40 mil textured LLDPE	Testing Speed:	20 in/min
Seaming Method:	Dual Hot Wedge Weld	Grips:	ATS pneumatic
		Specimen Size:	1 in x 8 in

Sample ID:	DS-10	Machine ID:	5
Seam ID:	31-34	Welder ID:	KS
		Date Sampled:	11/27/05

Specimen Number	Peel Strength						Shear Strength		
	Weld A			Weld B					
	lb./in	Seam Separation, %	Failure Type	lb./in	Seam Separation, %	Failure Type	lb./in	Elongation, %	Rupture Mode
1	89	---	SE1	77	---	SE1	95	>1100%	both
2	90	---	SE1	93	---	SE1	91	800%	SE1
3	87	---	SE1	89	---	SE1	96	>1100%	both
4	87	---	SE1	85	---	SE1	89	1000%	SE1
5	87	---	SE1	89	---	SE1	97	>1100%	both
Average	88	---	---	87	---	---	94	---	---

Comments:

Estimate of seam separation visually determined based upon proportion of linear length of separated bond in the direction of the test to the length of original bonding to the nearest 25%.

Shear test halted for HDPE and LMDPE materials once specimen has elongated 50%.
Shear test halted for PVC, fPP, LLDPE, VFPE and VLDPE once specimen has elongated past machine capacity.

Rupture mode for specimens with >50% elongation (HDPE and LMDPE) or > machine capacity (PVC, fPP, LLDPE, VFPE and VLDPE) interpreted as occurring in the membrane that exhibits yielding.

GeoTesting express

Client:	CT Clayton Engineering		
Project Name:	Madison County NC Landfill		
Project Location:	---		
Installer:	---		
GTX #:	6375		
Test Date:	12/01/05		
Tested By:	gjp	Report #:	2
Checked By:	rmt	Page:	6 of 6

Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods by ASTM D 6392

peel & shear destructive test

Upper Geomembrane:	40 mil textured LLDPE	Testing Machine:	Instron 1123
Lower Geomembrane:	40 mil textured LLDPE	Testing Speed:	20 in/min
Seaming Method:	Fillet-Extrusion Weld	Grips:	ATS pneumatic
		Specimen Size:	1 in x 8 in

Sample ID:	DS-11	Machine ID:	42
Seam ID:	34/35	Welder ID:	YN
		Date Sampled:	11/30/05

Specimen Number	Peel Strength						Shear Strength		
	Weld A			Weld B					
	lb./in	Seam Separation, %	Failure Type	lb./in	Seam Separation, %	Failure Type	lb./in	Elongation, %	Rupture Mode
1	86	---	*	---	---	---	86	>1100%	both
2	89	---	*	---	---	---	89	>1100%	both
3	89	---	*	---	---	---	88	>1100%	both
4	88	---	SE2	---	---	---	89	>1100%	both
5	87	---	SE3	---	---	---	91	>1100%	both
Average	88	---	---	---	---	---	89	---	---

Comments:

Estimate of seam separation visually determined based upon proportion of linear length of separated bond in the direction of the test to the length of original bonding to the nearest 25%.

Shear test halted for HDPE and LMDPE materials once specimen has elongated 50%.
Shear test halted for PVC, fPP, LLDPE, VFPE and VLDPE once specimen has elongated past machine capacity.

Rupture mode for specimens with >50% elongation (HDPE and LMDPE) or > machine capacity (PVC, fPP, LLDPE, VFPE and VLDPE) interpreted as occurring in the membrane that exhibits yielding.

* = sample elongation exceded machine capacity prior to weld failure.

GeoTesting
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Client:	CT Clayton Engineering		
Project Name:	Madison County NC Landfill		
Project Location:	---		
Installer:	---		
GTX #:	6375		
Test Date:	12/02/05		
Tested By:	gjp	Report #:	3
Checked By:	rmt	Page:	1 of 4

Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods by ASTM D 6392

peel & shear destructive test

Upper Geomembrane:	40 mil textured LLDPE	Testing Machine:	Instron 1123
Lower Geomembrane:	40 mil textured LLDPE	Testing Speed:	20 in/min
Seaming Method:	Dual Hot Wedge Weld	Grips:	ATS pneumatic
		Specimen Size:	1 in x 8 in

Sample ID:	DS-12	Machine ID:	3
Seam ID:	24/37	Welder ID:	YN
		Date Sampled:	11/30/05

Specimen Number	Peel Strength						Shear Strength		
	Weld A			Weld B					
	lb./in	Seam Separation, %	Failure Type	lb./in	Seam Separation, %	Failure Type	lb./in	Elongation, %	Rupture Mode
1	92	---	SE1	89	---	SE1	96	>1100%	both
2	95	---	SE1	89	---	SE1	97	>1100%	both
3	92	---	SE1	90	---	SE1	98	>1100%	both
4	92	---	SE1	90	---	SE1	96	>1100%	both
5	88	---	SE1	86	---	SE1	99	>1100%	both
Average	92	---	---	89	---	---	97	---	---

Comments:

Estimate of seam separation visually determined based upon proportion of linear length of separated bond in the direction of the test to the length of original bonding to the nearest 25%.

Shear test halted for HDPE and LMDPE materials once specimen has elongated 50%.
Shear test halted for PVC, fPP, LLDPE, VFPE and VLDPE once specimen has elongated past machine capacity.

Rupture mode for specimens with >50% elongation (HDPE and LMDPE) or > machine capacity (PVC, fPP, LLDPE, VFPE and VLDPE) interpreted as occurring in the membrane that exhibits yielding.

GeoTesting
express

Client:	CT Clayton Engineering		
Project Name:	Madison County NC Landfill		
Project Location:	---		
Installer:	---		
GTX #:	6375		
Test Date:	12/02/05		
Tested By:	gjp	Report #:	3
Checked By:	rmt	Page:	2 of 4

Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods by ASTM D 6392

peel & shear destructive test

Upper Geomembrane:	40 mil textured LLDPE	Testing Machine:	Instron 1123
Lower Geomembrane:	40 mil textured LLDPE	Testing Speed:	20 in/min
Seaming Method:	Dual Hot Wedge Weld	Grips:	ATS pneumatic
		Specimen Size:	1 in x 8 in

Sample ID:	DS-13	Machine ID:	24
Seam ID:	37/38	Welder ID:	DN
		Date Sampled:	11/30/05

	Peel Strength						Shear Strength		
	Weld A			Weld B					
Specimen Number	lb./in	Seam Separation, %	Failure Type	lb./in	Seam Separation, %	Failure Type	lb./in	Elongation, %	Rupture Mode
1	91	---	SE1	91	---	SE1	95	>1100%	both
2	91	---	SE1	93	---	SE1	96	>1100%	both
3	94	---	SE1	98	---	SE1	95	>1100%	both
4	91	---	SE1	91	---	SE1	96	>1100%	both
5	91	---	SE1	89	---	SE1	95	>1100%	both
Average	92	---	---	92	---	---	95	---	---

Comments:

Estimate of seam separation visually determined based upon proportion of linear length of separated bond in the direction of the test to the length of original bonding to the nearest 25%.

Shear test halted for HDPE and LMDPE materials once specimen has elongated 50%.
Shear test halted for PVC, fPP, LLDPE, VFPE and VLDPE once specimen has elongated past machine capacity.

Rupture mode for specimens with >50% elongation (HDPE and LMDPE) or > machine capacity (PVC, fPP, LLDPE, VFPE and VLDPE) interpreted as occurring in the membrane that exhibits yielding.

GeoTesting express

Client:	CT Clayton Engineering		
Project Name:	Madison County NC Landfill		
Project Location:	---		
Installer:	---		
GTX #:	6375		
Test Date:	12/02/05		
Tested By:	gjp	Report #:	3
Checked By:	rmt	Page:	3 of 4

Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods by ASTM D 6392

peel & shear destructive test

Upper Geomembrane:	40 mil textured LLDPE	Testing Machine:	Instron 1123
Lower Geomembrane:	40 mil textured LLDPE	Testing Speed:	20 in/min
Seaming Method:	Fillet-Extrusion Weld	Grips:	ATS pneumatic
		Specimen Size:	1 in x 8 in

Sample ID:	DS-14	Machine ID:	42
Seam ID:	24/36	Welder ID:	X
		Date Sampled:	12/01/05

Specimen Number	Peel Strength						Shear Strength		
	Weld A			Weld B					
	lb./in	Seam Separation, %	Failure Type	lb./in	Seam Separation, %	Failure Type	lb./in	Elongation, %	Rupture Mode
1	47	---	SE3	---	---	---	84	>1100%	both
2	66	---	SE3	---	---	---	82	>1100%	both
3	48	---	SE3	---	---	---	81	>1100%	both
4	52	---	SE3	---	---	---	82	>1100%	both
5	54	---	SE3	---	---	---	83	>1100%	both
Average	53	---	---	---	---	---	82	---	---

Comments:

Estimate of seam separation visually determined based upon proportion of linear length of separated bond in the direction of the test to the length of original bonding to the nearest 25%.

Shear test halted for HDPE and LMDPE materials once specimen has elongated 50%.
Shear test halted for PVC, fPP, LLDPE, VFPE and VLDPE once specimen has elongated past machine capacity.

Rupture mode for specimens with >50% elongation (HDPE and LMDPE) or > machine capacity (PVC, fPP, LLDPE, VFPE and VLDPE) interpreted as occurring in the membrane that exhibits yielding.

GeoTesting
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Client:	CT Clayton Engineering		
Project Name:	Madison County NC Landfill		
Project Location:	---		
Installer:	---		
GTX #:	6375		
Test Date:	12/02/05		
Tested By:	gjp	Report #:	3
Checked By:	rmt	Page:	4 of 4

Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods by ASTM D 6392

peel & shear destructive test

Upper Geomembrane:	40 mil textured LLDPE	Testing Machine:	Instron 1123
Lower Geomembrane:	40 mil textured LLDPE	Testing Speed:	20 in/min
Seaming Method:	Dual Hot Wedge Weld	Grips:	ATS pneumatic
		Specimen Size:	1 in x 8 in

Sample ID:	DS-15	Machine ID:	3
Seam ID:	38/40	Welder ID:	YN
		Date Sampled:	12/01/05

Specimen Number	Peel Strength						Shear Strength		
	Weld A			Weld B					
	lb./in	Seam Separation, %	Failure Type	lb./in	Seam Separation, %	Failure Type	lb./in	Elongation, %	Rupture Mode
1	87	---	SE1	88	---	SE1	91	>1100%	both
2	90	---	SE1	91	---	SE1	89	>1100%	both
3	91	---	SE1	90	---	SE1	90	>1100%	both
4	88	---	SE1	85	---	SE1	89	>1100%	both
5	89	---	SE1	89	---	SE1	93	>1100%	both
Average	89	---	---	89	---	---	90	---	---

Comments:

Estimate of seam separation visually determined based upon proportion of linear length of separated bond in the direction of the test to the length of original bonding to the nearest 25%.

Shear test halted for HDPE and LMDPE materials once specimen has elongated 50%.
Shear test halted for PVC, fPP, LLDPE, VFPE and VLDPE once specimen has elongated past machine capacity.

Rupture mode for specimens with >50% elongation (HDPE and LMDPE) or > machine capacity (PVC, fPP, LLDPE, VFPE and VLDPE) interpreted as occurring in the membrane that exhibits yielding.

GeoTesting
express

Client:	CT Clayton Engineering		
Project Name:	Madison County NC Landfill		
Project Location:	---		
Installer:	---		
GTX #:	6375		
Test Date:	12/06/05		
Tested By:	nar	Report #:	4
Checked By:	rmt	Page:	1 of 4

Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods by ASTM D 6392

peel & shear destructive test

Upper Geomembrane:	40 mil textured LLDPE	Testing Machine:	Instron 1123
Lower Geomembrane:	40 mil textured LLDPE	Testing Speed:	20 in/min
Seaming Method:	Dual Hot Wedge Weld	Grips:	ATS pneumatic
		Specimen Size:	1 in x 8 in

Sample ID:	DS-16	Machine ID:	---
Seam ID:	44/45	Welder ID:	---
		Date Sampled:	12/02/05

Specimen Number	Peel Strength						Shear Strength		
	Weld A			Weld B					
	lb./in	Seam Separation, %	Failure Type	lb./in	Seam Separation, %	Failure Type	lb./in	Elongation, %	Rupture Mode
1	93	---	SE1	91	---	SE1	97	>1100%	both
2	92	---	SE1	94	---	SE1	96	>1100%	both
3	94	---	SE1	92	---	SE1	94	>1100%	both
4	92	---	SE1	90	---	SE1	97	>1100%	both
5	93	---	SE1	91	---	SE1	95	>1100%	both
Average	93	---	---	92	---	---	96	---	---

Comments:

Estimate of seam separation visually determined based upon proportion of linear length of separated bond in the direction of the test to the length of original bonding to the nearest 25%.

Shear test halted for HDPE and LMDPE materials once specimen has elongated 50%.
Shear test halted for PVC, fPP, LLDPE, VFPE and VLDPE once specimen has elongated past machine capacity.

Rupture mode for specimens with >50% elongation (HDPE and LMDPE) or > machine capacity (PVC, fPP, LLDPE, VFPE and VLDPE) interpreted as occurring in the membrane that exhibits yielding.

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Client:	CT Clayton Engineering		
Project Name:	Madison County NC Landfill		
Project Location:	---		
Installer:	---		
GTX #:	6375		
Test Date:	12/06/05		
Tested By:	nar	Report #:	4
Checked By:	rmt	Page:	3 of 4

Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods by ASTM D 6392

peel & shear destructive test

Upper Geomembrane:	40 mil textured LLDPE	Testing Machine:	Instron 1123
Lower Geomembrane:	40 mil textured LLDPE	Testing Speed:	20 in/min
Seaming Method:	Dual Hot Wedge Weld	Grips:	ATS pneumatic
		Specimen Size:	1 in x 8 in

Sample ID:	DS-18	Machine ID:	---
Seam ID:	55/57	Welder ID:	---
		Date Sampled:	12/02/05

Specimen Number	Peel Strength						Shear Strength		
	Weld A			Weld B					
	lb./in	Seam Separation, %	Failure Type	lb./in	Seam Separation, %	Failure Type	lb./in	Elongation, %	Rupture Mode
1	94	---	SE1	88	---	SE1	91	>1100%	both
2	91	---	SE1	89	---	SE1	93	>1100%	both
3	95	---	SE1	91	---	SE1	93	>1100%	both
4	91	---	SE1	88	---	SE1	90	>1100%	both
5	93	---	SE1	89	---	SE1	95	>1100%	both
Average	93	---	---	89	---	---	92	---	---

Comments:

Estimate of seam separation visually determined based upon proportion of linear length of separated bond in the direction of the test to the length of original bonding to the nearest 25%.

Shear test halted for HDPE and LMDPE materials once specimen has elongated 50%.
Shear test halted for PVC, fPP, LLDPE, VFPE and VLDPE once specimen has elongated past machine capacity.

Rupture mode for specimens with >50% elongation (HDPE and LMDPE) or > machine capacity (PVC, fPP, LLDPE, VFPE and VLDPE) interpreted as occurring in the membrane that exhibits yielding.

GeoTesting
express

Client:	CT Clayton Engineering		
Project Name:	Madison County NC Landfill		
Project Location:	---		
Installer:	---		
GTX #:	6375		
Test Date:	12/06/05		
Tested By:	nar	Report #:	4
Checked By:	rmt	Page:	4 of 4

Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods by ASTM D 6392

peel & shear destructive test

Upper Geomembrane:	40 mil textured LLDPE	Testing Machine:	Instron 1123
Lower Geomembrane:	40 mil textured LLDPE	Testing Speed:	20 in/min
Seaming Method:	Dual Hot Wedge Weld	Grips:	ATS pneumatic
		Specimen Size:	1 in x 8 in

Sample ID:	DS-19	Machine ID:	---
Seam ID:	23/54	Welder ID:	---
		Date Sampled:	12/02/05

Specimen Number	Peel Strength						Shear Strength		
	Weld A			Weld B					
	lb./in	Seam Separation, %	Failure Type	lb./in	Seam Separation, %	Failure Type	lb./in	Elongation, %	Rupture Mode
1	94	---	SE1	92	---	SE1	89	>1100%	both
2	97	---	SE1	90	---	SE1	88	>1100%	both
3	91	---	SE1	94	---	SE1	93	>1100%	both
4	89	---	SE1	90	---	SE1	94	>1100%	both
5	91	---	SE1	96	---	SE1	94	>1100%	both
Average	92	---	---	92	---	---	92	---	---

Comments:

Estimate of seam separation visually determined based upon proportion of linear length of separated bond in the direction of the test to the length of original bonding to the nearest 25%.

Shear test halted for HDPE and LMDPE materials once specimen has elongated 50%.
Shear test halted for PVC, fPP, LLDPE, VFPE and VLDPE once specimen has elongated past machine capacity.

Rupture mode for specimens with >50% elongation (HDPE and LMDPE) or > machine capacity (PVC, fPP, LLDPE, VFPE and VLDPE) interpreted as occurring in the membrane that exhibits yielding.

GeoTesting express

Client:	CT Clayton Engineering		
Project Name:	Madison County NC Landfill		
Project Location:	---		
Installer:	---		
GTX #:	6375		
Test Date:	12/07/05		
Tested By:	gjp	Report #:	5
Checked By:	rmt	Page:	1 of 1

Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods by ASTM D 6392

peel & shear destructive test

Upper Geomembrane:	60 mil textured LLDPE	Testing Machine:	Instron 1123
Lower Geomembrane:	60 mil textured LLDPE	Testing Speed:	20 in/min
Seaming Method:	Dual Hot Wedge Weld	Grips:	ATS pneumatic
		Specimen Size:	1 in x 8 in

Sample ID:	DS-20	Machine ID:	---
Seam ID:	59/61	Welder ID:	---
		Date Sampled:	12/06/05

Specimen Number	Peel Strength						Shear Strength		
	Weld A			Weld B					
	lb./in	Seam Separation, %	Failure Type	lb./in	Seam Separation, %	Failure Type	lb./in	Elongation, %	Rupture Mode
1	113	---	SE1	116	---	SE1	121	>1100%	both
2	104	---	SE1	120	---	SE1	119	>1100%	both
3	117	---	SE1	114	---	SE1	121	>1100%	both
4	113	---	SE1	115	---	SE1	121	>1100%	both
5	105	---	SE1	115	---	SE1	119	>1100%	both
Average	110	---	---	116	---	---	120	---	---

Comments:

Estimate of seam separation visually determined based upon proportion of linear length of separated bond in the direction of the test to the length of original bonding to the nearest 25%.

Shear test halted for HDPE and LMDPE materials once specimen has elongated 50%.
Shear test halted for PVC, fPP, LLDPE, VFPE and VLDPE once specimen has elongated past machine capacity.

Rupture mode for specimens with >50% elongation (HDPE and LMDPE) or > machine capacity (PVC, fPP, LLDPE, VFPE and VLDPE) interpreted as occurring in the membrane that exhibits yielding.

GeoTesting
express
a subsidiary of Geocomp Corporation

WARRANTY and LIABILITY

GeoTesting Express (GTX) warrants that all tests it performs are run in general accordance with the specified test procedures and accepted industry practice. GTX will correct or repeat any test that does not comply with this warranty. GTX has no specific knowledge as to conditioning, origin, sampling procedure or intended use of the material.

GTX may report engineering parameters that require us to interpret the test data. Such parameters are determined using accepted engineering procedures. However, GTX does not warrant that these parameters accurately reflect the true engineering properties of the *in situ* material. Responsibility for interpretation and use of the test data and these parameters for engineering and/or construction purposes rests solely with the user and not with GTX or any of its employees.

GTX's liability will be limited to correcting or repeating a test which fails our warranty. GTX's liability for damages to the Purchaser of testing services for any cause whatsoever shall be limited to the amount GTX received for the testing services. GTX will not be liable for any damages, or for any lost benefits or other consequential damages resulting from the use of these test results, even if GTX has been advised of the possibility of such damages. GTX will not be responsible for any liability of the Purchaser to any third party.

Commonly Used Symbols

A	pore pressure parameter for $\Delta\sigma_1 - \Delta\sigma_3$
B	pore pressure parameter for $\Delta\sigma_3$
CIU	isotropically consolidated undrained triaxial shear test
CR	compression ratio for one dimensional consolidation
C_c	coefficient of curvature, $(D_{30})^2 / (D_{10} \times D_{60})$
C_u	coefficient of uniformity, D_{60}/D_{10}
C_c	compression index for one dimensional consolidation
C_α	coefficient of secondary compression
c_v	coefficient of consolidation
c	cohesion intercept for total stresses
c'	cohesion intercept for effective stresses
D	diameter of specimen
D_{10}	diameter at which 10% of soil is finer
D_{15}	diameter at which 15% of soil is finer
D_{30}	diameter at which 30% of soil is finer
D_{50}	diameter at which 50% of soil is finer
D_{60}	diameter at which 60% of soil is finer
D_{85}	diameter at which 85% of soil is finer
d_{50}	displacement for 50% consolidation
d_{90}	displacement for 90% consolidation
d_{100}	displacement for 100% consolidation
E	Young's modulus
e	void ratio
e_c	void ratio after consolidation
e_o	initial void ratio
G	shear modulus
G_s	specific gravity of soil particles
H	height of specimen
PI	plasticity index
i	gradient
K_o	lateral stress ratio for one dimensional strain
k	permeability
LI	Liquidity Index
m_v	coefficient of volume change
n	porosity
PI	plasticity index
P_c	preconsolidation pressure
p	$(\sigma_1 + \sigma_3) / 2$, $(\sigma_v + \sigma_h) / 2$
p'	$(\sigma'_1 + \sigma'_3) / 2$, $(\sigma'_v + \sigma'_h) / 2$
p'_c	p' at consolidation
Q	quantity of flow
q	$(\sigma_1 . \sigma_3) / 2$
q_f	q at failure
q_o, q_i	initial q
q_c	q at consolidation
S	degree of saturation
SL	shrinkage limit
s_u	undrained shear strength
T	time factor for consolidation
T	temperature
t	time
U, UC	unconfined compression test
UU, Q	unconsolidated undrained triaxial test
u_a	pore gas pressure
u_e	excess pore water pressure
u, u_w	pore water pressure
V	total volume
V_g	volume of gas
V_s	volume of solids
V_v	volume of voids
V_w	volume of water
V_o	initial volume
v	velocity
W	total weight
W_s	weight of solids
W_w	weight of water
w	water content
w_c	water content at consolidation
w_f	final water content
w_l	liquid limit
w_n	natural water content
w_p	plastic limit
w_s	shrinkage limit
w_o, w_i	initial water content
α	slope of q_f versus p_f
α'	slope of q_f versus p_f'
γ_t	total unit weight
γ_d	dry unit weight
γ_s	unit weight of solids
γ_w	unit weight of water
ε	strain
ε_{vol}	volume strain
ε_h, ε_v	horizontal strain, vertical strain
μ	Poisson's ratio, also viscosity
σ	normal stress
σ'	effective normal stress
σ_c, σ'_c	consolidation stress in isotropic stress system
σ_h, σ'_h	horizontal normal stress
σ_v, σ'_v	vertical normal stress
σ_1	major principal stress
σ_2	intermediate principal stress
σ_3	minor principal stress
τ	shear stress
φ	friction angle based on total stresses
φ'	friction angle based on effective stresses
φ'_r	residual friction angle
φ_{ult}	φ for ultimate strength

GeoTesting
express

Client:	CT Clayton Engineering		
Project Name:	Madison County NC Landfill		
Project Location:	---		
Installer:	---		
GTX #:	6375		
Test Date:	12/06/05		
Tested By:	nar	Report #:	4
Checked By:	rmt	Page:	2 of 4

Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods by ASTM D 6392

peel & shear destructive test

Upper Geomembrane:	40 mil textured LLDPE	Testing Machine:	Instron 1123
Lower Geomembrane:	40 mil textured LLDPE	Testing Speed:	20 in/min
Seaming Method:	Dual Hot Wedge Weld	Grips:	ATS pneumatic
		Specimen Size:	1 in x 8 in

Sample ID:	DS-17	Machine ID:	---
Seam ID:	40/41	Welder ID:	---
		Date Sampled:	12/02/05

Specimen Number	Peel Strength						Shear Strength		
	Weld A			Weld B					
	lb./in	Seam Separation, %	Failure Type	lb./in	Seam Separation, %	Failure Type	lb./in	Elongation, %	Rupture Mode
1	93	---	SE1	88	---	SE1	97	1100%	SE1
2	93	---	SE1	96	---	SE1	94	>1100%	both
3	92	---	SE1	96	---	SE1	96	>1100%	both
4	93	---	SE1	91	---	SE1	93	>1100%	both
5	88	---	SE1	92	---	SE1	94	>1100%	both
Average	92	---	---	93	---	---	95	---	---

Comments:

Estimate of seam separation visually determined based upon proportion of linear length of separated bond in the direction of the test to the length of original bonding to the nearest 25%.

Shear test halted for HDPE and LMDPE materials once specimen has elongated 50%.
Shear test halted for PVC, fPP, LLDPE, VFPE and VLDPE once specimen has elongated past machine capacity.

Rupture mode for specimens with >50% elongation (HDPE and LMDPE) or > machine capacity (PVC, fPP, LLDPE, VFPE and VLDPE) interpreted as occurring in the membrane that exhibits yielding.

SECTION X

geotechnics
INTEGRITY IN TESTING

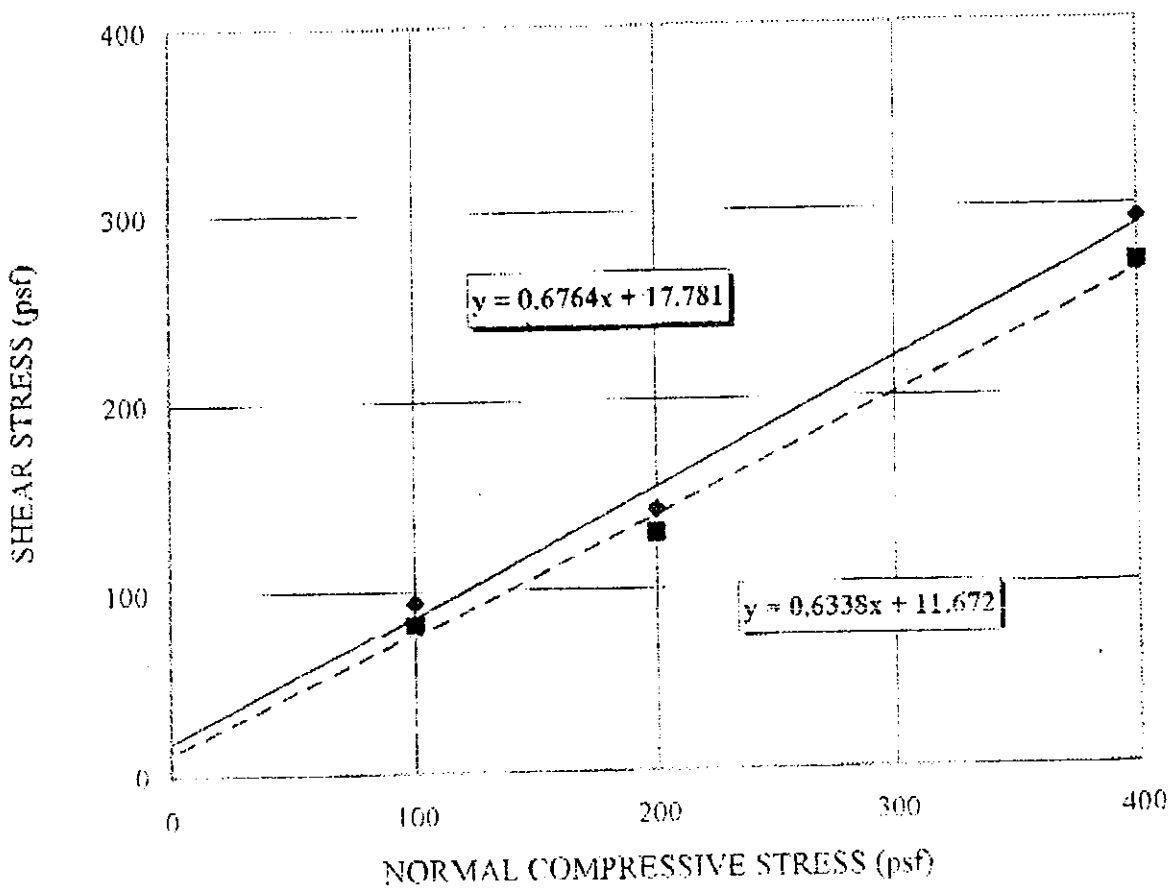
INTERFACE FRICTION TEST RESULTS
ASTM D 5321

CLIENT : BOB STOUT CONSTRUCTION COMPANY, INC
CLIENT PROJECT : MADISON COUNTY LANDFILL, N C
PROJECT NO. : L05187-01
LAB I. D. NO S: SUBGRADE SOIL; L05187-01-03
GSE 40-MIL LLDPE; L05187-01-01; ROLL 103132044

INTERFACE : **SUBGRADE SOIL* VS 40-MIL TEXTURED LLDPE**
*Soil placed at 78 pcf at 34% w c

	PEAK SHEAR	LARGE DISPL. SHEAR
FRICTION ANGLE (deg) :	Φ = 34.1	Φ = 32.4
COEFFICIENT OF FRICTION :	= 0.676	= 0 634
ADHESION [Calculated] (psf) :	a = 18	a = 12

NOTES:
1.)A component of the adhesion values reported may be an anomaly of the laboratory procedure and calculation algorithm
2.)The friction angles were calculated using linear regression on the three sets of test values.
3.)The "Large Displ. Shear" values are the average shear resistance recorded from 1.5 in to end of test.
4.)The displacement limit for the direct shear unit used is 2.8 inches
5.)The interfaces were inundated with water.



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11/14/2005

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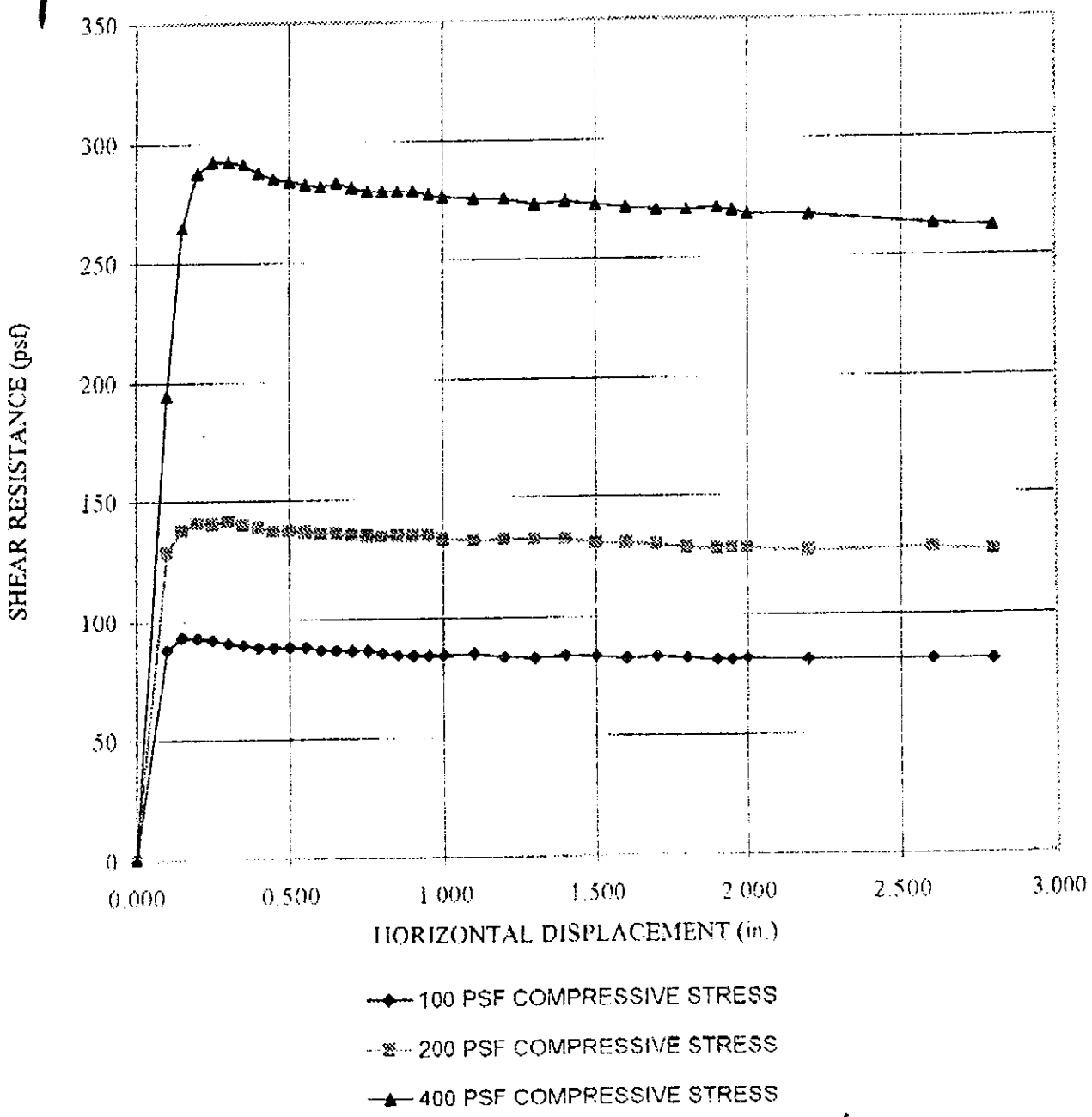
INTERFACE FRICTION TEST RESULTS
ASTM D 5321

geotechnics
INTEGRITY IN TESTING

CLIENT: BOB STOUT CONSTRUCTION COMPANY, INC
CLIENT PROJECT: MADISON COUNTY LANDFILL, N.C.
PROJECT NO: L05187-01
LAB I D NO.S: SUBGRADE SOIL; L05187-01-03
GSE 40-MIL LLDPE; L05187-01-01; ROLL 103132044

INTERFACE: **SUBGRADE SOIL* VS 40-MIL TEXTURED LLDPE**
*Soil placed at 78 pcf at 34% w.c.

SHEAR RESISTANCE VS HORIZONTAL DISPLACEMENT



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INTERFACE FRICTION TEST RESULTS
ASTM D 5321

geotechnics
INTEGRITY IN TESTING

CLIENT : BOB STOUT CONSTRUCTION COMPANY, INC.
CLIENT PROJECT : MADISON COUNTY LANDFILL, N C
PROJECT NO . L05187-01
LAB I. D. NO S: SUBGRADE SOIL; L05187-01-03
GSE 40-MIL LLDPE; L05187-01-01; ROLL 103132044

INTERFACE : SUBGRADE SOIL* VS 40-MIL TEXTURED LLDPE
*Soil placed at 78 pcf at 34% w.c

STRAIN RATE(in / min) : 0.04

TEST DATA

DIRECT SHEAR UNIT:GS277

NORMAL LOAD (psf)		100	NORMAL LOAD (psf)		200	NORMAL LOAD (psf)		400
NORMAL LOAD (psi)		0.7	NORMAL LOAD (psi)		1.4	NORMAL LOAD (psi)		2.8
PEAK SHEAR STRESS(psf)		93	PEAK SHEAR STRESS(psf)		141	PEAK SHEAR STRESS(psf)		292
RESIDUAL STRESS (psf)		82	RESIDUAL STRESS (psf)		129	RESIDUAL STRESS (psf)		269
GM ASPERITY HT., (mils)		15	GM ASPERITY HT., (mils)		15	GM ASPERITY HT., (mils)		16
HORIZONTAL			HORIZONTAL			HORIZONTAL		
DISPLACE (in.)	SHEAR FORCE (lbs)	STRESS (psf)	DISPLACE (in.)	SHEAR FORCE (lbs)	STRESS (psf)	DISPLACE (in.)	SHEAR FORCE (lbs)	STRESS (psf)
0.000	0	0	0.000	0	0	0.000	0	0
0.10	88	88	0.10	129	129	0.10	195	195
0.15	93	93	0.15	138	138	0.15	265	265
0.20	93	93	0.20	141	141	0.20	287	287
0.25	92	92	0.25	141	141	0.25	292	292
0.30	90	90	0.30	141	141	0.30	292	292
0.35	89	89	0.35	140	140	0.35	291	291
0.40	88	88	0.40	139	139	0.40	287	287
0.45	88	88	0.45	137	137	0.45	285	285
0.50	88	88	0.50	137	137	0.50	284	284
0.55	88	88	0.55	137	137	0.55	282	282
0.60	87	87	0.60	136	136	0.60	281	281
0.65	87	87	0.65	136	136	0.65	283	283
0.70	87	87	0.70	135	135	0.70	281	281
0.75	87	87	0.75	135	135	0.75	279	279
0.80	85	85	0.80	134	134	0.80	279	279
0.85	84	84	0.85	135	135	0.85	279	279
0.90	84	84	0.90	135	135	0.90	279	279
0.95	84	84	0.95	135	135	0.95	277	277
1.00	84	84	1.00	133	133	1.00	276	276
1.10	83	83	1.10	132	132	1.10	276	276
1.20	83	83	1.20	133	133	1.20	275	275
1.30	82	82	1.30	133	133	1.30	273	273
1.40	84	84	1.40	133	133	1.40	274	274
1.50	83	83	1.50	131	131	1.50	272	272
1.60	82	82	1.60	131	131	1.60	271	271
1.70	83	83	1.70	130	130	1.70	270	270
1.80	82	82	1.80	129	129	1.80	270	270
1.90	81	81	1.90	128	128	1.90	271	271
1.95	81	81	1.95	128	128	1.95	270	270
2.00	82	82	2.00	128	128	2.00	268	268
2.20	81	81	2.20	127	127	2.20	267	267
2.60	81	81	2.60	128	128	2.60	263	263
2.80	81	81	2.80	127	127	2.80	262	262

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11/14/2005

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INTERFACE FRICTION TEST RESULTS
ASTM D 5321

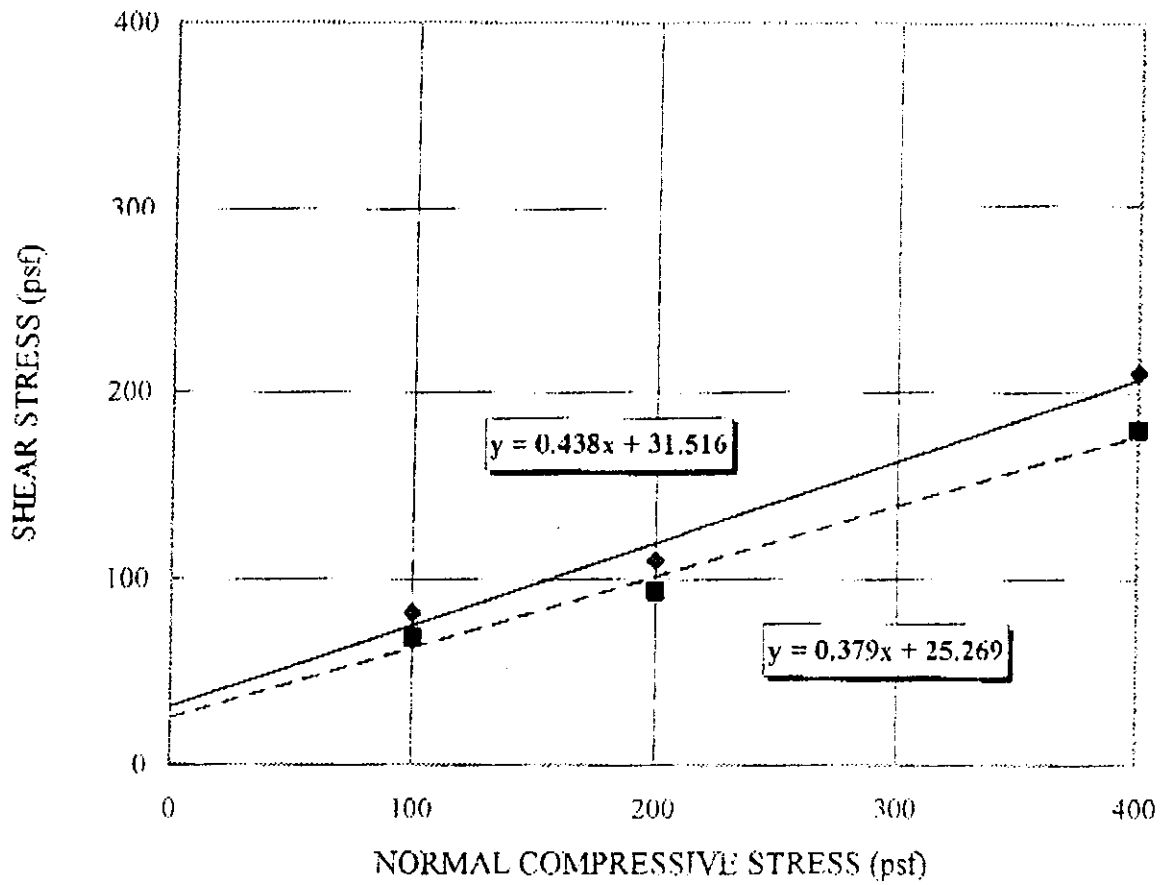
geotechnics
INTEGRITY IN TESTING

CLIENT : BOB STOUT CONSTRUCTION COMPANY, INC.
CLIENT PROJECT : MADISON COUNTY LANDFILL, N.C.
PROJECT NO. : L05187-01
LAB I. D. NO.S: 200 MIL GEOCOMPOSITE; L05187-01-02;ROLL 131191926
GSE 40-MIL LLDPE; L05187-01-01, ROLL 103132044

INTERFACE : **GEOCOMPOSITE VS 40-MIL TEXTURED LLDPE**

	PEAK SHEAR	LARGE DISPL. SHEAR
FRICTION ANGLE (deg) :	Φ = 23.7	Φ = 20.8
COEFFICIENT OF FRICTION :	= 0.438	= 0.379
ADHESION [Calculated] (psf):	a = 32	a = 25

NOTES:
1.)A component of the adhesion values reported may be an anomaly of the laboratory procedure and calculation algorithm.
2.)The friction angles were calculated using linear regression on the three sets of test values.
3.)The "Large Displ. Shear" values are the average shear resistance recorded from 1.5 in to end of test.
4.)The displacement limit for the direct shear unit used is 2.8 inches.
5.)The interfaces were inundated with water



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\\Geotechnics-data drive\Synthetics\2005 Synthetics\[L05187-01 LNL Shear-LNL Composites\Textured.xls]3 Points 11/4/2005

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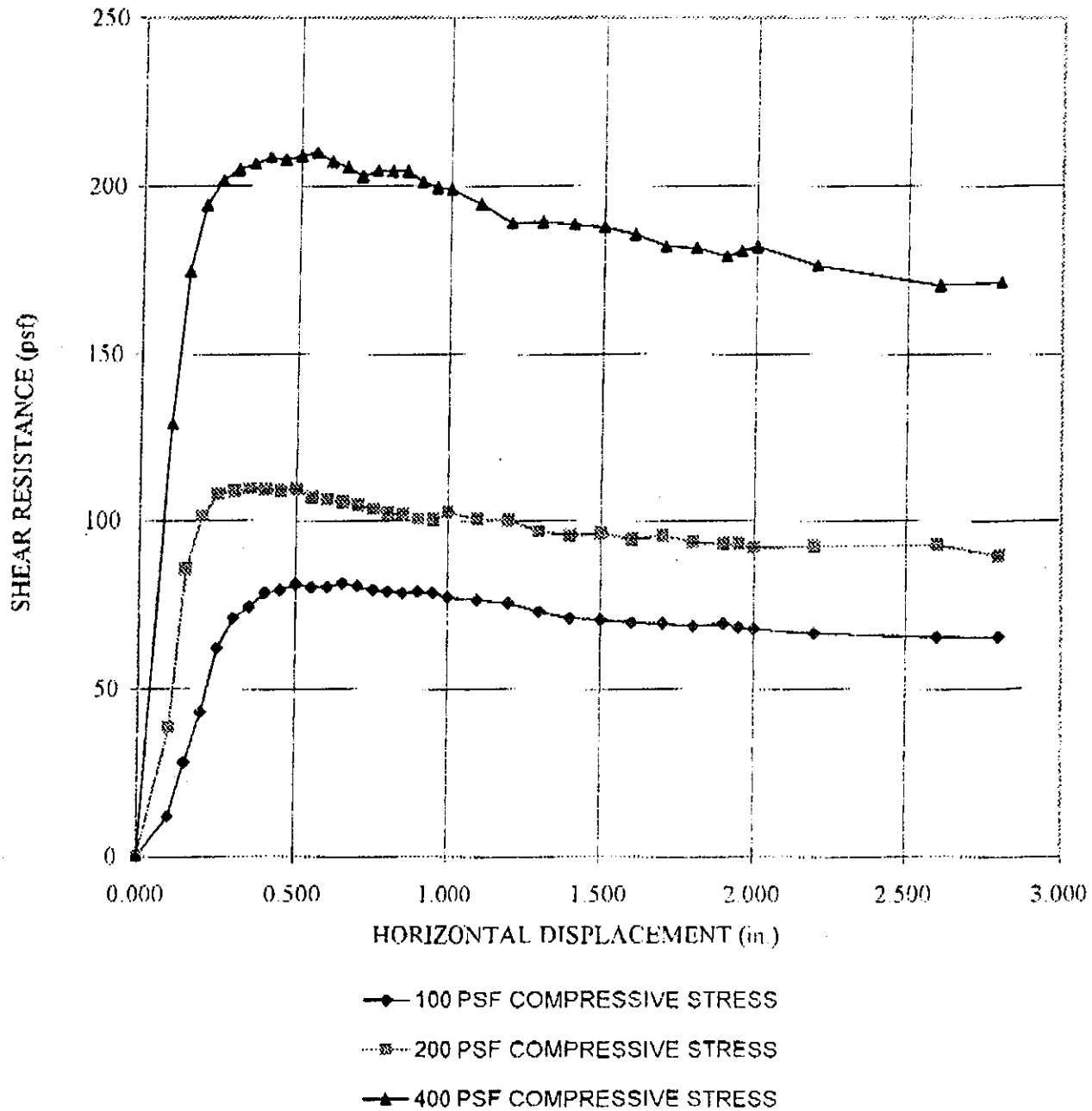
INTERFACE FRICTION TEST RESULTS
ASTM D 5321

geotechnics
INTEGRITY IN TESTING

CLIENT : BOB STOUT CONSTRUCTION COMPANY, INC.
CLIENT PROJECT : MADISON COUNTY LANDFILL, N.C.
PROJECT NO. : L05187-01
LAB I. D. NO.S: 200 MIL GEOCOMPOSITE; L05187-01-02;ROLL 131191926
GSE 40-MIL LLDPE; L05187-01-01; ROLL 103132044

INTERFACE : **GEOCOMPOSITE VS 40-MIL TEXTURED LLDPE**

SHEAR RESISTANCE VS HORIZONTAL DISPLACEMENT



CHECKED BY : MM DATE : 11-4-05

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INTERFACE FRICTION TEST RESULTS
ASTM D 5321

geotechnics
INTEGRITY IN TESTING

CLIENT : BOB STOUT CONSTRUCTION COMPANY, INC.
CLIENT PROJECT : MADISON COUNTY LANDFILL, N.C.
PROJECT NO : L05187-01
LAB I. D. NO.S: 200 MIL GEOCOMPOSITE; L05187-01-02;ROLL 131191926
GSE 40-MIL LLDPE; L05187-01-01; ROLL 103132044

INTERFACE : **GEOCOMPOSITE VS 40-MIL TEXTURED LLDPE**

STRAIN RATE(in / min) : 0.10 **TEST DATA** DIRECT SHEAR UNIT GS277

NORMAL LOAD (psf)	100	NORMAL LOAD (psf)	200	NORMAL LOAD (psf)	400
NORMAL LOAD (psi)	0.7	NORMAL LOAD (psi)	1.4	NORMAL LOAD (psi)	2.8
PEAK SHEAR STRESS(psf)	82	PEAK SHEAR STRESS(psf)	110	PEAK SHEAR STRESS(psf)	210
RESIDUAL STRESS (psf)	68	RESIDUAL STRESS (psf)	93	RESIDUAL STRESS (psf)	179
GM ASPERITY HT., (mils)	14	GM ASPERITY HT., (mils)	13	GM ASPERITY HT., (mils)	13

HORIZONTAL			HORIZONTAL			HORIZONTAL		
DISPLACE. (in.)	SHEAR FORCE (lbs)	STRESS (psf)	DISPLACE. (in.)	SHEAR FORCE (lbs)	STRESS (psf)	DISPLACE. (in.)	SHEAR FORCE (lbs)	STRESS (psf)
0.000	0	0	0.000	0	0	0.000	0	0
0.10	12	12	0.10	38	38	0.10	129	129
0.15	28	28	0.15	86	86	0.15	174	174
0.20	43	43	0.20	101	101	0.20	194	194
0.25	62	62	0.25	108	108	0.25	202	202
0.30	71	71	0.30	109	109	0.30	205	205
0.35	75	75	0.35	110	110	0.35	207	207
0.40	79	79	0.40	109	109	0.40	209	209
0.45	80	80	0.45	109	109	0.45	208	208
0.50	81	81	0.50	109	109	0.50	209	209
0.55	80	80	0.55	107	107	0.55	210	210
0.60	80	80	0.60	106	106	0.60	207	207
0.65	82	82	0.65	106	106	0.65	206	206
0.70	81	81	0.70	105	105	0.70	203	203
0.75	80	80	0.75	103	103	0.75	204	204
0.80	79	79	0.80	102	102	0.80	204	204
0.85	79	79	0.85	102	102	0.85	204	204
0.90	79	79	0.90	101	101	0.90	201	201
0.95	79	79	0.95	100	100	0.95	199	199
1.00	78	78	1.00	103	103	1.00	199	199
1.10	77	77	1.10	101	101	1.10	195	195
1.20	76	76	1.20	100	100	1.20	189	189
1.30	73	73	1.30	97	97	1.30	189	189
1.40	71	71	1.40	96	96	1.40	188	188
1.50	71	71	1.50	96	96	1.50	188	188
1.60	70	70	1.60	94	94	1.60	185	185
1.70	70	70	1.70	96	96	1.70	182	182
1.80	69	69	1.80	94	94	1.80	181	181
1.90	70	70	1.90	93	93	1.90	179	179
1.95	68	68	1.95	93	93	1.95	180	180
2.00	68	68	2.00	92	92	2.00	182	182
2.20	67	67	2.20	92	92	2.20	176	176
2.60	66	66	2.60	93	93	2.60	170	170
2.80	66	66	2.80	89	89	2.80	171	171

CHECKED BY: MJ DATE: 11-4-05

11/4/2005

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INTERFACE FRICTION TEST RESULTS
ASTM D 5321

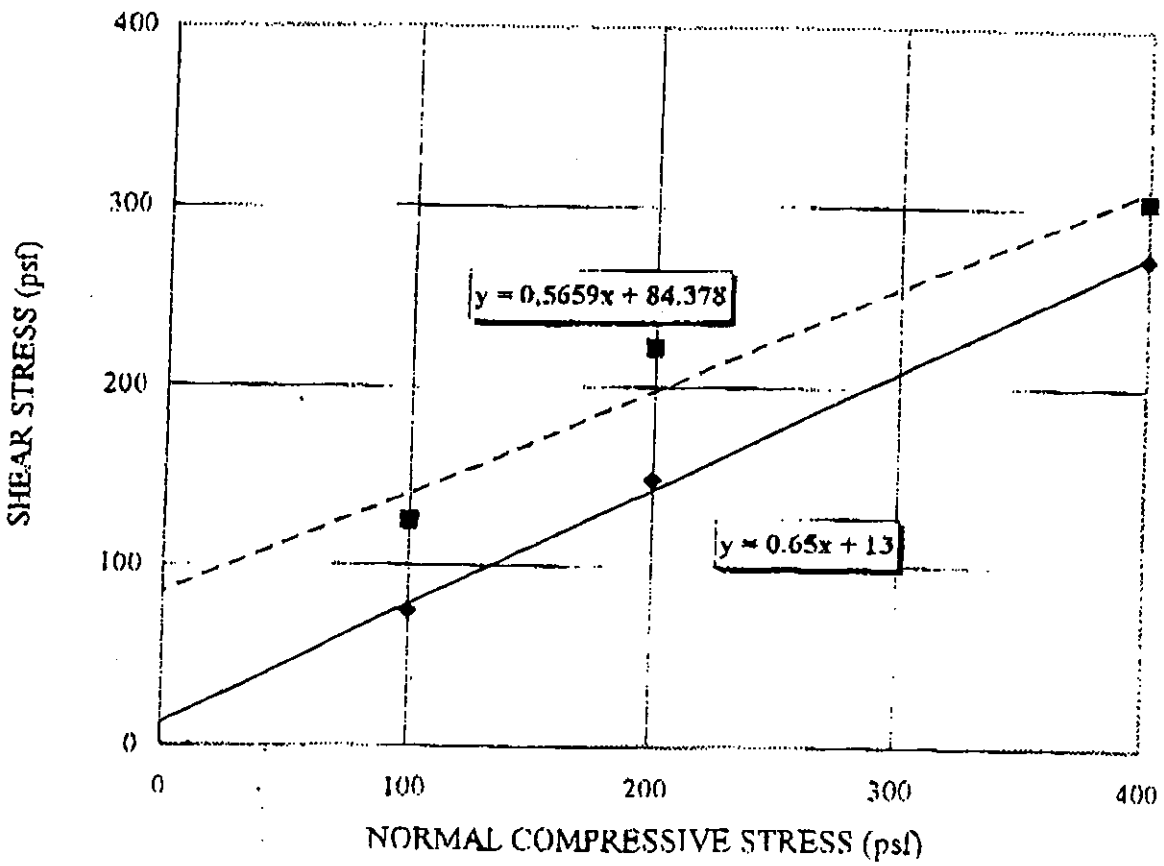
geotechnics
INTEGRITY IN TESTING

CLIENT : BOB STOUT CONSTRUCTION COMPANY, INC.
CLIENT PROJECT : MADISON COUNTY LANDFILL, N.C.
PROJECT NO. : L05187-01
LAB I. D. NO.S: VEGETATIVE COVER SOIL; L05187-01-04; 2005-367-01-01
200 MIL GEOCOMPOSITE: L05187-01-02;ROLL 131191926

INTERFACE : VEGETATIVE COVER* VS GEOCOMPOSITE
*Soil placed at 96 pcf at 21% w.c.

	INFL. PT. SHEAR	LARGE DISPL. SHEAR
FRICTION ANGLE (deg) :	Φ = 33.0	Φ = 29.5
COEFFICIENT OF FRICTION :	= 0.650	= 0.566
ADHESION [Calculated] (psf):	a = 13	a = 84

NOTES:
1.)A component of the adhesion values reported may be an anomaly of the laboratory procedure and calculation algorithm.
2.)The friction angles were calculated using linear regression on the three sets of test values.
3.)The "Large Displ. Shear" values are the average shear resistance recorded from 1.5 in to end of test.
4.)The "Infl. Pt. Peak Shear" values are at the inflection pt. on the shear vs displacement plots.
5.)The displacement limit for the direct shear unit used is 2.8 inches.
6.)The interfaces were inundated with water.



11-15-05
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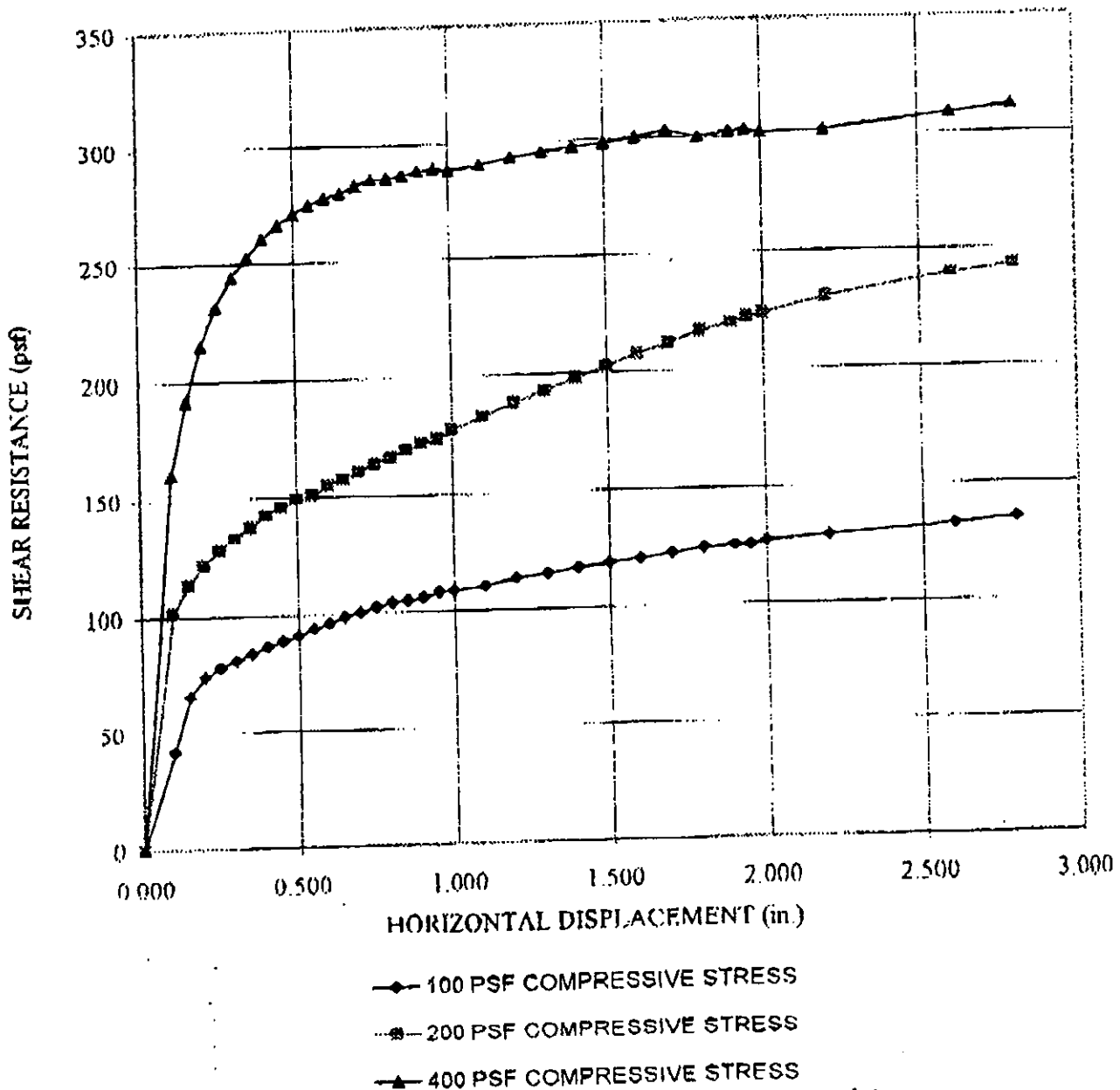
INTERFACE FRICTION TEST RESULTS
ASTM D 5321

geotechnics
INTEGRITY IN TESTING

CLIENT : BOB STOUT CONSTRUCTION COMPANY, INC.
CLIENT PROJECT : MADISON COUNTY LANDFILL, N.C.
PROJECT NO. : L05187-01
LAB I. D. NO.S: VEGETATIVE COVER SOIL; L05187-01-04; 2005-367-01-01
200 MIL GEOCOMPOSITE; L05187-01-02;ROLL 131191925

INTERFACE : VEGETATIVE COVER* VS GEOCOMPOSITE
*Soil placed at 96 pcf at 21% w.c.

SHEAR RESISTANCE VS HORIZONTAL DISPLACEMENT



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INTERFACE FRICTION TEST RESULTS
ASTM D 5321

geotechnics
INTEGRITY IN TESTING

CLIENT : BOB STOUT CONSTRUCTION COMPANY, INC.
CLIENT PROJECT : MADISON COUNTY LANDFILL, N.C.
PROJECT NO. : L05187-01
LAB I. D. NO.S: VEGETATIVE COVER SOIL; L05187-01-04; 2005-367-01-01
200 MIL GEOCOMPOSITE; L05187-01-02;ROLL 131191926

INTERFACE : VEGETATIVE COVER* VS GEOCOMPOSITE
*Soil placed at 96 pcf at 21% w.c.

STRAIN RATE(in / min) : 0.04 **TEST DATA** DIRECT SHEAR UNIT:GS277

NORMAL LOAD (psf)	100	NORMAL LOAD (psf)	200	NORMAL LOAD (psf)	400
NORMAL LOAD (psi)	0.7	NORMAL LOAD (psi)	1.4	NORMAL LOAD (psi)	2.8
INF.PT.SHEAR STRESS(psf)	74	INF.PT.SHEAR STRESS(psf)	149	INF.PT.SHEAR STRESS(psf)	271
LARG. DISPL.STRESS (psf)	125	LARG. DISPL.STRESS (psf)	221	LARG. DISPL.STRESS (psf)	303

HORIZONTAL			HORIZONTAL			HORIZONTAL		
DISPLACE. (in.)	SHEAR FORCE (lbs)	STRESS (psf)	DISPLACE (in.)	SHEAR FORCE (lbs)	STRESS (psf)	DISPLACE. (in.)	SHEAR FORCE (lbs)	STRESS (psf)
0.000	0	0	0.000	0	0	0.000	0	0
0.10	42	42	0.10	101	101	0.10	161	161
0.15	66	66	0.15	113	113	0.15	192	192
0.20	74	74	0.20	121	121	0.20	215	215
0.25	78	78	0.25	127	127	0.25	231	231
0.30	81	81	0.30	132	132	0.30	244	244
0.35	84	84	0.35	137	137	0.35	252	252
0.40	87	87	0.40	142	142	0.40	261	261
0.45	89	89	0.45	146	146	0.45	267	267
0.50	91	91	0.50	149	149	0.50	271	271
0.55	94	94	0.55	151	151	0.55	275	275
0.60	96	96	0.60	155	155	0.60	278	278
0.65	99	99	0.65	157	157	0.65	279	279
0.70	100	100	0.70	161	161	0.70	283	283
0.75	102	102	0.75	164	164	0.75	285	285
0.80	104	104	0.80	167	167	0.80	285	285
0.85	105	105	0.85	170	170	0.85	286	286
0.90	106	106	0.90	173	173	0.90	288	288
0.95	108	108	0.95	174	174	0.95	289	289
1.00	108	108	1.00	178	178	1.00	289	289
1.10	110	110	1.10	183	183	1.10	291	291
1.20	113	113	1.20	188	188	1.20	293	293
1.30	114	114	1.30	193	193	1.30	295	295
1.40	116	116	1.40	198	198	1.40	297	297
1.50	118	118	1.50	202	202	1.50	298	298
1.60	120	120	1.60	207	207	1.60	300	300
1.70	122	122	1.70	211	211	1.70	303	303
1.80	124	124	1.80	216	216	1.80	300	300
1.90	124	124	1.90	219	219	1.90	302	302
1.95	124	124	1.95	221	221	1.95	302	302
2.00	126	126	2.00	223	223	2.00	301	301
2.20	128	128	2.20	230	230	2.20	302	302
2.60	132	132	2.60	239	239	2.60	308	308
2.80	134	134	2.80	242	242	2.80	311	311

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SECTION XI

Madison Co. MSWLF Closure
SUBMITTAL PACKAGE

Note: Individual items are separated by bright colored sheet

SECTION 02622 GEOCOMPOSITE DRAINAGE LAYER

SECTION I.D.	SUBMITTAL DESCRIPTION	Comments
	Manufactures Clarifications	
	Material Data Sheet	
1.04.A.1	Manufactures Background	
1.04.A.2	Manufactures Experience	
1.04.B.1 & 2	Installers Experience	
1.04.B.3	Supervisors Resume	Available After Crew Determination
1.06.A	Manufactures Warranty	Available After Project Completion
1.06.B	Installation Warranty	Available After Project Completion
2.02.A	Manufactures Quality Control Plan	

CONTRACTOR

Bob Stout Construction Co., Inc.

A -- Certified to comply with contract drawings and specifications.

B -- Certified to comply with contract drawings and specifications as noted on shop drawings and/or attached sheet(s). (Resubmission not required provided installation conforms as noted).

Signature: [illegible]

Title: President

Date: 10/3/05

SECTION 02622 GEOCOMPOSITE DRAINAGE LAYER

Manufactures Clarifications

GSE

GSE Internal Specification Review

Clarifications

Date 22 July 2005

Project No. 518117
Project: Madison County Landfill
Products: 1) 40 mil Min. Double Side Textured HDPE Geomembrane; 2) 6 oz. Double Side 200 mil FabriNet Geocomposite
Sections: **02622** – pages 1 to 7; **02623** – page 4, 5 & 10

Level 1 Exceptions

02623-6, Table 1

GSE asks that the project specifications be amended to standard GSE specifications.

Geomembrane Property	Project Specifications	GSE Specifications
Carbon Black Dispersion	Category 1 or 2	Note 1

Note:

1. As per GRI GM 13, Carbon black dispersion test shall satisfy that 9 of 10 views shall be from Category 1 or 2. No more than 1 view shall be from Category 3.

02622-6, Section 3.01.A

GSE asks that this section be amended with the following statement:

- Direct Shear testing (ASTM D 5321 and D 6243) is a performance test, not an index test. As such, GSE does not perform or certify to direct shear results since the test relies on site-specific conditions. Interface values are greatly affected by (1) the material interface, (2) the rate of displacement, and (3) the normal load applied. However, GSE understands that this test is critical to design confirmation and can supply material to a laboratory of the customer's choice for testing or GSE can have the test performed at an outside laboratory for an additional cost if requested.

Level 2 Exceptions

02622-

GSE asks that the project specifications be amended to standard GSE specifications.

Geocomposite Property	Project Specifications	GSE Specifications
Geonet Component		
Thickness	1/25,000 sf	1/50,000 sf
Carbon Black Content	1/25,000 sf per ASTM D 4218	1/50,000 sf per ASTM D 1603
Tensile Strength	1/25,000 sf per ASTM D 4595	1/50,000 sf per ASTM D 5035
Geocomposite		
Ply Adhesion	1/25,000 sf	1/50,000 sf

Level 3 Exceptions

None

SECTION 02622 GEOCOMPOSITE DRAINAGE LAYER

Material Data Sheet

GSE

GSE STANDARD PRODUCTS

Product Data Sheet

GSE FabriNet Geocomposites

GSE FabriNet geocomposite consists of GSE HyperNet geonet heat-laminated on one or both sides with a GSE nonwoven needlepunched geotextile. GSE HyperNet is a 200 mil thick geonet manufactured from a premium grade high density polyethylene resin. For the purpose of lamination to geonets, GSE nonwoven needlepunched geotextiles are available in mass per unit area range of 6 oz/yd² (200 g/m²) to 16 oz/yd² (540 g/m²). GSE FabriNet geocomposites are designed and formulated to perform drainage function under a range of anticipated site loads, gradients and boundary conditions. Index properties for the product are provided in the table below. Please contact GSE for further information regarding performance under site-specific conditions.

Product Specifications

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM AVERAGE ROLL VALUE[d]		
			6 oz/yd²	8 oz/yd²	10 oz/yd²
Geocomposite					
Product Code			F42060060S	F42080080S	F42100100S
Transmissivity[a], gal/min/ft (m²/sec)	ASTM D 4716-00	1/540,000 ft²	0.48 (1 x 10^{-4})	0.48 (1 x 10^{-4})	0.43 (9 x 10^{-5})
Ply Adhesion, lb/in (g/cm)	GRI GC-7	1/50,000 ft²	1.0 (178)	1.0 (178)	1.0 (178)
Roll Width, ft (m)			14.5 (4.4)	14.5 (4.4)	14.5 (4.4)
Roll Length, ft (m)			230 (70.1)	200 (60.9)	190 (58.0)
Roll Area, ft² (m²)			3,335 (310)	2,900 (269)	2,755 (256)
Geonet core[b]					
Transmissivity,[a] gal/min/ft (m²/sec)	ASTM D 4716-00		9.66 (2 x 10^{-3})	9.66 (2 x 10^{-3})	9.66 (2 x 10^{-3})
Thickness, mil (mm)	ASTM D 5199	1/50,000 ft²	200 (5)	200 (5)	200 (5)
Density, g/cm³	ASTM D 1505	1/50,000 ft²	0.94	0.94	0.94
Tensile Strength (MD), lb/in (N/mm)	ASTM D 5035	1/50,000 ft²	45 (7.9)	45 (7.9)	45 (7.9)
Carbon Black Content, %	ASTM D 1603	1/50,000 ft²	2.0	2.0	2.0
Geotextile (prior to lamination)[b,c]					
Mass per Unit Area, oz/yd² (g/m²)	ASTM D 5261	1/90,000 ft²	6 (200)	8 (270)	10 (335)
Grab Tensile, lb (N)	ASTM D 4632	1/90,000 ft²	170 (755)	220 (975)	260 (1,155)
Puncture Strength, lb (N)	ASTM D 4833	1/90,000 ft²	90 (395)	120 (525)	165 (725)
AOS, US sieve (mm)	ASTM D 4751	1/540,000 ft²	70 (0.212)	80 (0.180)	100 (0.150)
Permittivity, (sec⁻¹)	ASTM D 4491	1/540,000 ft²	1.5	1.5	1.2
Flow Rate, gpm/ft² (lpm/m²)	ASTM D 4491	1/540,000 ft²	110 (4,480)	110 (4,480)	85 (3,460)
UV Resistance, % retained	ASTM D 4355 (after 500 hours)	once per formulation	70	70	70

NOTES:

- [a]Gradient of 0.1, normal load of 10,000 psf, water at 70° F between steel plates for 15 minutes.
- [b]Component properties prior to lamination.
- [c]Several geotextiles are available and may be supplied as determined by GSE.
- [d]These are MARV values that are based on the cumulative results of specimens tested and determined by GSE. AOS in mm is maximum average roll value.

DS018 R07/07/03

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Americas	GSE Lining Technology, Inc.	Houston, Texas	800-435-2008	281-443-8564	Fax: 281-230-8650
Europe/Middle East/Africa	GSE Lining Technology GmbH	Hamburg, Germany		49-40-767420	Fax: 49-40-7674233
Asia/Pacific	GSE Lining Technology Company Ltd.	Bangkok, Thailand		66-2-937-0091	Fax: 66-2-937-0097

This product data sheet is also available on our website at:

www.gseworld.com

SECTION 02622 GEOCOMPOSITE DRAINAGE LAYER

1.04.A.1
Manufactures Background

GSE Lining Technology, Inc.

Corporate Profile

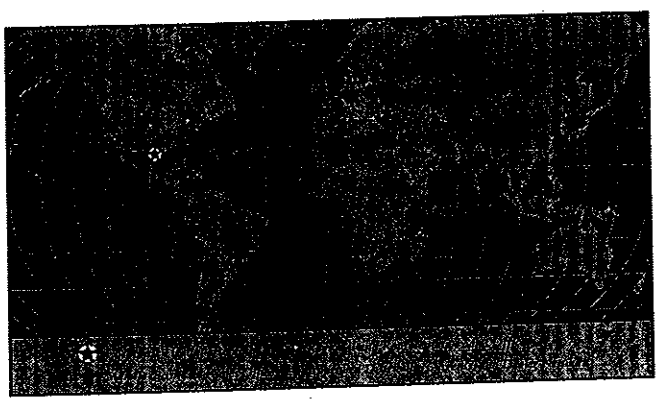
INTRODUCTION

Gundle/SLT Environmental, Inc. (GSE) is a global manufacturer and marketer of geosynthetic lining solutions, products and services used in the containment and management of solids, liquids and gases for organization engaged in waste management, mining, water, wastewater, agriculture, aquaculture, and other industrial industries.

GSE's history started in early 1981 when Gundle Lining Systems, Inc. pioneered the manufacture of high density polyethylene (HDPE) geomembrane liners.

In July 1995 and February 2002, GSE acquired SLT Environmental, Inc. and Serrot International, Inc. The acquisitions have provided GSE's customers more comprehensive and cost effective lines of geosynthetic products and services.

Headquartered in Houston, Texas, GSE has nine manufacturing facilities in six countries - the United States, Canada, Germany, the United Kingdom, Thailand, and Egypt.



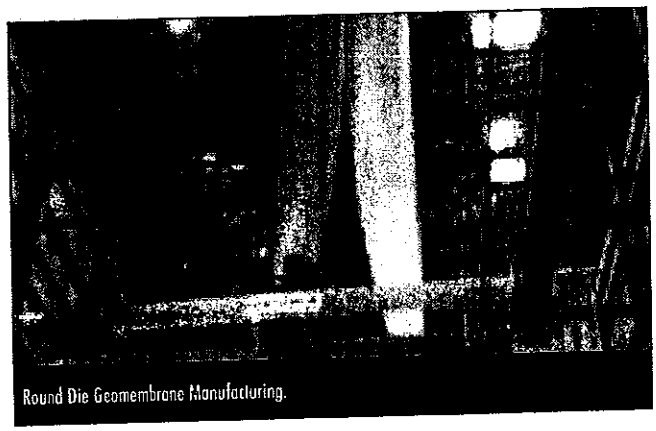
GSE NORTH AMERICA MANUFACTURING CAPABILITIES

GSE's manufacturing facilities in North America are owned and operated by its subsidiary, GSE Lining Technology, Inc. The geomembrane manufacturing facilities in the U.S. are ISO 9001 Certified with labs accredited by the Geosynthetic Accreditation Institute-Lab accreditation Program (GAI-LAP).

There are two geomembrane manufacturing facilities located in Houston, Texas. The Houston facilities are equipped with seven round die HDPE/LLDPE geomembrane extrusion lines, one flat cast extrusion manufacturing line, and an HDPE geonet/geocomposite drainage product manufacturing line. The nonwoven geotextiles used in the geocomposite products are manufactured at the GSE facility located in Kingstree, South Carolina. A third geonet/geocomposite manufacturing line is located in Kingstree.

Bentofix® fabric encased geosynthetic clay liners are manufactured in Barrie, Ontario, Canada. GSE GundSeal geomembrane supported geosynthetic clay liners are manufactured at its owned facility in Spearfish, South Dakota.

In addition to the geomembrane manufacturing facilities in North America, GSE has a 12,000 ft² (1,100 square meters) facility for the fabrication of a range of specialty plastic products, including pipes, sumps, bladders, and other specialty items.



Round Die Geomembrane Manufacturing.

GSE STANDARD PRODUCTS

GSE standard products are known throughout the world for their quality, performance and reliability. GSE's total annual polyethylene manufacturing capacity of approximately 300 million pounds (136,000 tonnes) provides the largest selection of geosynthetic products in the industry.

- Geomembranes – GSE HD, GSE White, GSE Conductive, and GSE Green are available in high density polyethylene (HDPE) with either a smooth or textured surface. These HPDE geomembrane liners are excellent for use in a variety of covered or exposed lining applications. GSE UltraFlex, GSE UltraFlex White, GSE UltraFlex Textured, and GSE UltraFlex White Textured are available in linear low density polyethylene (LLDPE). These LLDPE geomembranes are designed for use in a variety of buried applications that require improved elongation properties when compared with HDPE geomembranes.
- Geosynthetic Clay Liners (GCLs) - Bentofix® fabric encased GCLs are needle punched reinforced composites that combine two durable geotextile outer layers with a uniform core of natural sodium bentonite clay to form a hydraulic barrier. GSE GundSeal geomembrane supported GCLs are the most hydraulically advanced lining product available with improved leakage performance over conventional geomembrane/clay composite liners.
- Geonets – GSE HyperNet geonets are synthetic drainage materials manufactured from a premium grade HPDE resin. These products are ideal for transmitting fluids uniformly under a variety of field conditions, normal stresses and hydraulic gradients.

- Continued -

- Geocomposites – GSE FabriNet geocomposites are geonets with nonwoven geotextiles heat bonded to the upper and lower surface. These drainage products are designed to perform drainage functions as a replacement for granular drainage layers.
- Nonwoven Geotextiles – NW4, NW6, NW8, NW10, NW12, and NW16 are polypropylene, staple-fiber, nonwoven needle punched fabrics ranging in weight from 4 to 16 oz/yd² (130 to 530 g/m²). They are used in environmental and industrial applications for separation and filtration of soils and liquids.
- Concrete Protection Systems – GSE StudLiner is an HDPE embedment liner that provides concrete protection against mechanical and corrosive damage in a wide range of industrial, municipal and civil applications.

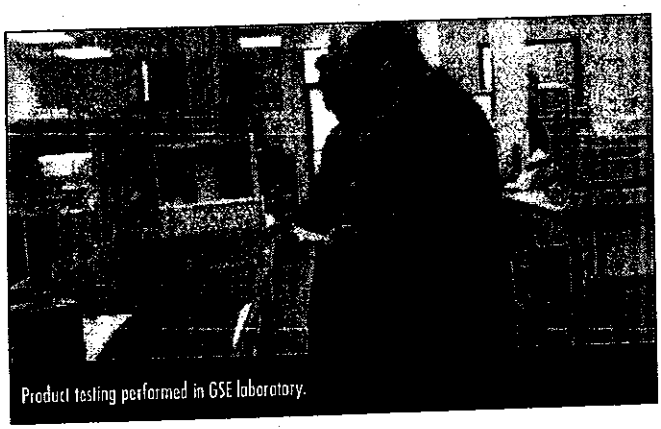
GSE QUALITY ASSURANCE PROGRAM

GSE standard products are backed by an extensive manufacturing quality assurance (MQA) program through its own state-of-the-art and GAI-LAP accredited laboratories located at each US and Canadian manufacturing facility.

The GSE MQA program ensures that all manufactured materials meet or exceed the most stringent quality standards in the industry. All quality control tests are conducted in accordance with established guidelines outlined by ASTM, as well as other recognized test standards and organizations, such as the Geosynthetic Research Institute (GRI).

The MQA program begins with testing and verification of specially formulated resins and other raw materials and extends through delivery to the site. GSE inspects and tests all virgin polyethylene resins upon delivery and before unloading to ensure it meets the strict requirements for geomembrane manufacturing.

All GSE geomembranes are 100% spark tested for pinholes during the manufacturing process to ensure each delivered roll is leak free. Samples from each geomembrane roll are subjected to an array of quality assurance tests to verify that all physical property requirements meet or exceed GSE's and the customers' specification standards. Roll Test Data Reports (RTDRs) are provided for each roll of geosynthetic to certify the material meets the required specifications before shipping to the jobsite.


Product testing performed in GSE laboratory.

GSE INSTALLATION SERVICES

GSE has the most experienced and comprehensive turn-key installation capabilities of any geosynthetic lining company. GSE provides a worldwide installation network of more than 100 installers that utilize state-of-the-art equipment and high standards for safety. GSE crews are equipped with state-of-the-art welding and testing equipment.

GSE installation crews consist of experienced and highly trained Site Managers, Welding Technicians and Quality Assurance Technicians. All GSE installation crews are under the supervision of a GSE Site Manager: GSE Site Managers' installation experience averages more than 30,000,000 ft² (2,800,000 m²) of installed geosynthetic lining materials. Their experience and commitment assures each installation will be conducted in accordance with the contract specifications and GSE high quality standards.

GSE Installation Quality Assurance Technicians work closely with the Installation Site Managers to ensure that the commitment to quality is foremost for each project. As the liner project progresses, GSE Quality Assurance Technicians carry out a four step quality control plan to ensure that all welds and installed liner meet GSE's requirements.

Experienced Crew Installing Geomembrane Liners.

CONCLUSION

GSE manufactures and installs the most reliable high performance lining systems within the environmental containment industry. GSE's unique combination of resources provide its customers assurance that GSE standard products and containment solutions will meet or exceed the project's performance requirements.

CP001 R04/26/04

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Americas	GSE Lining Technology, Inc.	Houston, Texas	800-435-2008	281-443-8564	Fax: 281-230-8650
Asia/Pacific	GSE Lining Technology Company Ltd.	Bangkok, Thailand		66-2-937-0091	Fax: 66-2-937-0097
Europe/Middle East/Africa	GSE Lining Technology GmbH	Hamburg, Germany		49-40-767420	Fax: 49-40-7674233

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SECTION 02622 GEOCOMPOSITE DRAINAGE LAYER

1.04.A.2
Manufactures Experience

GSE Lining Technology, Inc.

Large Projects over 1.2 million square feet

Project Name:	Waste Mgt/GROWS Landfill Northeast Cell 1 and Slope Cap Area		
Site Location:	Morrisville, PA	**GSE No.:** 510002	
Owner:	Waste Management, Inc.		
Products:	GSE HD Textured 60 mil	1,915,440	sq. ft.
	GSE FabriNet	866,915	sq. ft.
	Bentofix NS	1,034,625	sq. ft.
	GSE Geotextile 16 oz	110,970	sq. ft.
Date completed:	Aug-03		

Project Name:	Cominco Pend Oreille Mine		
Site Location:	Metaline Falls, WA	**GSE No.:** 507170	
Owner:	Teck Cominco American, Inc.		
Products:	GSE HD 60 mil	5,260,500	sq. ft.
	GSE HD 100 mil	30,600	sq. ft.
	GSE HyperNet	2,291,810	sq. ft.
	GSE HyperNet HF	292,940	sq. ft.
	GSE Geotextile 8 oz	55,210	sq. ft.
	GSE Geotextile 12 oz	74,560	sq. ft.
Date completed:	Sep-03		

Project Name:	U.S. Borax Boric Acid Pond 4		
Site Location:	Boron, CA	**GSE No.:** 509321	
Owner:	U.S. Borax, Inc.		
Products:	GSE White Conductive 60 mil	3,108,285	sq. ft.
	GSE HD Textured 80 mil	31,865	sq. ft.
	GSE FabriNet Single-Sided	1,564,200	sq. ft.
	GSE HyperNet HF	1,070,850	sq. ft.
	GSE HyperNet	444,820	sq. ft.
	GSE Gundseal	31,500	sq. ft.
	GSE Geotextile 8 oz	7,000	sq. ft.
Date completed:	Mar-03		

Project Name:	APS Four Corners Ash Pond Project		
Site Location:	Fruitland, NM	**GSE No.:** 513331	
Owner:	Arizona Public Service		
Products:	GSE White 60 mil	4,484,650	sq. ft.
	GSE Conductive White 60 mil	3,452,900	sq. ft.
	GSE Hypernet	2,247,900	sq. ft.
Date completed:	Dec-03		

Project Name:	Waste Mgt/Hardy Road Landfill Area 3 Closure		
Site Location:	Akron, OH	**GSE No.:** 512851	
Owner:	Waste Management, Inc.		
Products:	GSE UltraFlex Textured 40 mil	1,814,560	sq. ft.
	GSE FabriCap	1,846,520	sq. ft.
Date completed:	Nov-03		

Project Name:	Round Mountain Gold West Dedicated Leach Pad 4		
Site Location:	Round Mountain, NV	**GSE No.**: 511410	
Owner:	Round Mountain Gold Corp.		
Products:	GSE HD 60 mil	5,102,920	sq. ft.
	GSE HD 80 mil	318,375	sq. ft.
	GSE HD Textured 80 mil Single-Sided	6,800	sq. ft.
	GSE Geotextile 8 oz	35,600	sq. ft.
Date completed:	Jul-03		

Project Name:	Waste Mgt/King George County Landfill Cell 9A & 9B		
Site Location:	King George, VA	**GSE No.**: 512029	
Owner:	Waste Management, Inc.		
Products:	GSE HD Textured 60 mil	1,262,240	sq. ft.
	GSE HD Textured 40 mil	644,000	sq. ft.
	GSE UltraFlex 40	40,480	sq. ft.
	GSE HD 40	65,525	sq. ft.
	GSE FabriNet	655,300	sq. ft.
	Bentofix NSE	1,215,975	sq. ft.
	GSE Geotextile 16 oz	71,540	sq. ft.
Date completed:	Nov-03		

Project Name:	Superior/Greentree Landfill Cells 6 and 7		
Site Location:	Kersey, PA	**GSE No.**: 510288	
Owner:	Superior Services		
Products:	GSE HD Textured 60 mil	2,535,180	sq. ft.
	GSE FabriNet HF	1,251,785	sq. ft.
Date completed:	May-03		

Project Name:	Waste Management/Alliance Sanitary Landfill Cap 2003		
Site Location:	Taylor, PA	**GSE No.**: 512825	
Owner:	Waste Management, Inc.		
Products:	GSE UltraFlex Textured 40 mil	1,449,000	sq. ft.
	GSE HD 80 mil	38,810	sq. ft.
	GSE FabriNet	1,563,610	sq. ft.
	GSE HyperNet	9,000	sq. ft.
	GSE Geotextile 8 oz	162,000	sq. ft.
Date completed:	Sep-03		

Project Name:	Mississippi Phosphates West Gypsum Stack Closure		
Site Location:	Pascagoula, MS	**GSE No.**: 501063	
Owner:	Mississippi Phosphates Corp.		
Products:	GSE White 40 mil	3,252,975	sq. ft.
	GSE FabriNet	62,890	sq. ft.
Date completed:	May-03		

Project Name:	BP Three Crowns Golf Course Project		
Site Location:	Casper, WY	**GSE No.**: 510982	
Owner:	British Petroleum		
Products:	GSE HD Textured 40 mil	1,692,250	sq. ft.
Amount:	$356,250		
Date completed:	Jul-03		

Project Name:	Mesquite Power Sempra Energy Evaporation Pond		
Site Location:	Tonopah, AZ	507370	
Owner:	Mesquite Power Company		
Products:	GSE HD 60 mil	6,218,600	sq. ft.
	GSE HD 40 mil	6,229,875	sq. ft.
	GSE HyperNet	5,051,225	sq. ft.
	GSE HyperNet HF	1,225,200	sq. ft.

	Bentofix EC	6,355,150	sq. ft.
Date completed:	Oct-02		

Project Name:	Cement Kiln Dust Piles 4,5,8 Landfill Cap		
Site Location:	Charlevoix, MI		508103
Owner:	Cemex		
Products:	GSE HD Textured 60 mil	1,719,800	sq. ft.
	GSE FabriNet HF	638,550	sq. ft.
	GSE FabriNet	1,150,575	sq. ft.
Date completed:	Aug-02		

Project Name:	Hanor/ Roberts Ranch Ponds 9 & 10		508813
Site Location:	Mooreland, OK		
Owner:	The Hanor Company, Inc.		
Products:	GSE HD 40 mil	2,823,075	sq. ft.
Date completed:	Mar-02		

Project Name:	Cortez South Area Heap Leach Project		509341
Site Location:	Crescent Valley, NV		
Owner:	Cortez Joint Venture		
Products:	GSE HD 80 mil	8,376,422	sq. ft.
	GSE HD 60 mil	3,162,600	sq. ft.
Date completed:	Jul-02		

Project Name:	J.H. Campbell Ash Disposal Landfill Cell 3		509378
Site Location:	West Olive, MI		
Owner:	Consumers Energy Company		
Products:	GSE HD 60 mil	1,436,400	sq. ft.
	GSE HD Textured 60 mil	281,750	sq. ft.
	GSE FabriNet	256,800	sq. ft.
	GSE HyperNet	1,651,500	sq. ft.
	Bentofix NSL	107,333	sq. ft.
	Geotextile	94,000	sq. ft.
Date completed:	Jun-02		

Project Name:	Panda Gila River Evaporation Impoundments		
Site Location:	Gila Bent, AZ		509460
Owner:	Panda Energy Company		
Products:	GSE HD 80 mil	2,050,975	sq. ft.
	GSE HD 60 mil	2,709,630	sq. ft.
	GSE HD Textured 80 mil Single-Sided	662,400	sq. ft.
	GSE HyperNet	2,749,500	sq. ft.
	Bentofix EC	2,126,750	sq. ft.
	Bentofix NSL	669,600	sq. ft.
Date completed:	Aug-02		

Project Name:	Alliance Landfill 11B Primary and Secondary Liner		
Site Location:	Taylor, PA		509682
Owner:	Waste Management, Inc.		
Products:	GSE HD Textured 100 mil	1,466,460	sq. ft.
	GSE HD 60 mil	37,800	sq. ft.
	Bentofix NSL	750,271	sq. ft.
Date completed:	Aug-02		

Project Name:	Ash Grove Cement Landfill and Closure		509953
Site Location:	Foreman, AR		
Owner:	Ash Grove Cement Company		
Products:	GSE UltraFlex Textured 40 mil	1,715,625	sq. ft.
	GSE HD 60 mil	352,800	sq. ft.
	GSE HD Textured 60 mil	23,400	sq. ft.

	GSE HyperNet	283,500	sq. ft.
Date completed:	Jul-02		

Project Name:	Dorman Facility Ponds		510938
Site Location:	Beaver County, OK		
Owner:	Seaboard Farms, Inc.		
Products:	GSE HD 40 mil	1,883,700	sq. ft.
	GSE HD Textured 40 mil	63,000	sq. ft.
Date completed:	Aug-02		

Project Name:	Atlantic Waste Disposal Landfill Cell 6A		510016
Site Location:	Waverly, VA		
Owner:	Waste Management, Inc.		
Products:	GSE HD Textured 60 mil	2,073,390	sq. ft.
	GSE HD 30 mil	2,056,591	sq. ft.
	GSE HD 60 mil	11,925	sq. ft.
	Geotextile	4,500	sq. ft.
Date completed:	Dec-02		

Project Name:	Brooks Landfill Closure		500412
Site Location:	Wichita, KS		
Owner:	City of Wichita, Dept. of Public Works		
Products:	GSE HD 40 mil	3,632,175	sq. ft.
	GSE FabriCap	3,613,680	sq. ft.
Date completed:	Dec-01		

Project Name:	Waste Management/Atlantic Waste Cell 4		504963
Site Location:	Waverly, VA		
Owner:	Waste Management, Inc.		
Products:	GSE HD Textured 60 mil	1,368,900	sq. ft.
	GSE HD Textured 30 mil	485,550	sq. ft.
	GSE TP300-66 Triplaner	1,381,025	sq. ft.
Date completed:	Apr-01		

Project Name:	Northside Generating Station By-Product Storage Area and Ponds		506076
Site Location:	Jacksonville, FL		
Owner:	Jacksonville Electric Authority		
Products:	GSE HyperFlex 60 mil	1,725,850	sq. ft.
	GSE HyperFrictionFlex 60 mil	1,658,460	sq. ft.
	GSE FabriNet	802,450	sq. ft.
	GSE HyperNet	864,875	sq. ft.
	BentomatST	94,500	sq. ft.
	Geotextile	125,000	sq. ft.
Date completed:	Mar-01		

Project Name:	Dow-Ludington 6th Street Lime Pond Closure		506532
Site Location:	Ludington, MI		
Owner:	Dow Chemical		
Products:	GSE UltraFlex 40 mil	2,062,460	sq. ft.
Date completed:	Jul-01		

Project Name:	Allied Waste/Conestoga Cells 11 & 12		507328
Site Location:	Morgantown, PA		
Owner:	Allied Waste Industries		
Products:	GSE HD Textured 60 mil	1,240,200	sq. ft.
	GSE HyperFlex 60 mil	67,680	sq. ft.
	GSE FabriNet	241,500	sq. ft.
	Geotextile	269,000	sq. ft.
Date completed:	Jun-01		

Project Name:	Buttonwillow WMU 35, Cell 1		507369
Site Location:	Buttonwilliow, CA		
Owner:	Safety-Kleen, Inc.		
Products:	GSE HyperFrictionFlex 80 mil	1,600,500	sq. ft.
Date completed:	Dec-01		

Project Name:	Town of North Hempstead		507651
Site Location:	North Hempstead, NY		
Owner:	Town of North Hempstead		
Products:	GSE White 60 mil	1,334,875	sq. ft.
	GSE FabriNet HF	1,330,575	sq. ft.
	GSE CF315-66 Triplaner	1,368,875	sq. ft.
	BentomatST	335,250	sq. ft.
Date completed:	Dec-01		

Project Name:	Redhawk Power Pond Project		508035
Site Location:	Arlington, AZ		
Owner:	Pinnacle West Energy Corp.		
Products:	GSE White 60 mil	2,947,150	sq. ft.
	GSE White Textured 60 mil	1,098,600	sq. ft.
	GSE HyperNet	151,200	sq. ft.
	BentomatST	504,000	sq. ft.
	Geotextile	37,500	sq. ft.
Date completed:	Dec-01		

Project Name:	Barrick Goldstrike Mines North Block Tailings Dam Stage 5		
Site Location:	Elko, NV		508096
Owner:	Barrick Goldstrike Mines, Inc.		
Products:	GSE HD Textured 60 mil	46,800	sq. ft.
	GSE HyperFlex 60 mil	1,263,350	sq. ft.
Date completed:	Oct-01		

Project Name:	Brown Station Landfill		500041
Site Location:	Upper Marlboro, MD		
Owner:	Prince Georges County		
Products:	GSE White 40 mil	1,257,750	sq. ft.
	GSE UltraFlex White Textured 40 mil	4,023,550	sq. ft.
	GSE HyperNet	1,302,400	sq. ft.
	GSE FabriNet HF	3,988,625	sq. ft.
	Geotextile	30,000	sq. ft.
Date completed:	Nov-00		

Project Name:	Oaks Landfill Cap Phase 2		500400
Site Location:	Laytonville, MD		
Owner:	Montgomery County		
Products:	GSE UltraFlex White Textured 40 mil	1,943,235	sq. ft.
Date completed:	Aug-00		

Project Name:	Sonia Road Landfill		500871
Site Location:	Bayshore, NY		
Owner:	Town of Islip		
Products:	GSE HD Textured 60 mil	1,954,340	sq. ft.
	GSE FabriNet 8 oz	1,886,600	sq. ft.
Date completed:	Jun-00		

Project Name:	Waste Management Inc. / Alliance Landfill		501262
Site Location:	Taylor, PA		
Owner:	Waste Management Inc.		
Products:	GSE HyperFriction Flex 100 mil	1,942,134	sq. ft.

	GSE HyperFlex 60 mil	56,400	sq. ft.
	GSE FabriNet	16,800	sq. ft.
	GSE HyperNet	84,000	sq. ft.
	Bentomat ST	6,500	sq. ft.
Date completed:	Jun-00		

Project Name:	Lanchester Landfill Cap	502006	
Site Location:	Narvon, PA		
Owner:	Lanchester Landfill		
Products:	GSE HD Textured 40 mil	1,855,300	sq. ft.
	GSE FabriCap	1,814,150	sq. ft.
Date completed:	Jul-00		

Project Name:	Barrick North Block Tailings Dam Stage 4	502095	
Site Location:	Carlin, NV		
Owner:	Barrick Goldstrike Mines		
Products:	GSE HyperFlex 60 mil	2,827,660	sq. ft.
	GSE HyperFrictionFlex 60 mil	33,650	sq. ft.
	GSE HyperFlex 80 mil	152,280	sq. ft.
	GSE HyperFrictionFlex 100 mil	173,550	sq. ft.
	Geotextile	39,000	sq. ft.
Date completed:	Feb-00		

Project Name:	Allen Creek Landfill Closure	503215	
Site Location:	Gainesville, GA		
Owner:	Hall County Board of Commissioners		
Products:	GSE FabriNet	132,000	sq. ft.
	GSE FabriCap	2,484,350	sq. ft.
	Claymax200R	892,250	sq. ft.
	Bentomat ST	1,793,250	sq. ft.
Date completed:	Nov-00		

Project Name:	Salt River Landfill - Phase IVB & V Expansion	503601	
Site Location:	Scottsdale, AZ		
Owner:	Pima-Maricopa Indian Community		
Products:	GSE HD Textured 60 mil	1,509,300	sq. ft.
	GSE UltraFlex 30 mil	18,900	sq. ft.
	Bentomat ST	1,476,000	sq. ft.
Date completed:	May-00		

Project Name:	River Birch Landfill Phase 6	504077	
Site Location:	Avondale, LA		
Owner:	River Birch,Inc.		
Products:	GSE HD 60 mil	1,048,550	sq. ft.
	GSE HyperFlex 60 mil	146,640	sq. ft.
	GSE GundSeal 40 mil	1,226,700	sq. ft.
	GSE FabriNet Single-Sided 6 oz	1,434,160	sq. ft.
Date completed:	Jun-00		

Project Name:	Glades Cut-Off Road Cell 3A	504212	
Site Location:	Fort Pierce, FL		
Owner:	St. Lucie County Solid Waste		
Products:	GSE HyperFlex 60 mil	1,263,360	sq. ft.
	GSE HyperNet	1,889,000	sq. ft.
	Claymax 200R	491,775	sq. ft.
	Bentomat ST	154,725	sq. ft.
	Geotextile 8 oz	70,500	sq. ft.
Date completed:	Aug-00		

Project Name:	Allied/Conestoga Landfill Cell 10I	504721	

Site Location:	Morgantown, PA		
Owner:	Allied Waste Industries		
Products:	GSE HD Textured 60 mil	1,415,700	sq. ft.
	GSE FabriNet 6 oz	215,740	sq. ft.
	Geotextile 6 oz	504,000	sq. ft.
Date completed:	Jul-00		

Project Name:	Allied Waste/Conestoga 2000 Cap	504799	
Site Location:	Morgantown, PA		
Owner:	Allied Waste Industries, Inc.		
Products:	GSE HD Textured 60	1,415,700	sq. ft.
	GSE FabriNet	215,740	sq. ft.
Date completed:	Nov-00		

Project Name:	Waste Management / Saginaw Valley Closure	504982	
Site Location:	Saginaw, MI		
Owner:	Waste Management, Inc.		
Products:	GSE HD Textured 40 mil	2,558,200	sq. ft.
	Bentomat ST	2,265,750	sq. ft.
Date completed:	Oct-00		

Project Name:	Waste Management Inc. / Pioneer Rock Final Closure	504986	
Site Location:	Brown City, MI		
Owner:	Waste Management, Inc.		
Products:	GSE HD 40 mil	44,850	sq. ft.
	GSE UltraFlex Textured 40 mil	661,500	sq. ft.
	GSE HD Textured 40 mil	1,555,200	sq. ft.
	GSE FabriCap	1,555,200	sq. ft.
Date completed:	Oct-00		

Project Name:	Hilltop Sand & Gravel	505319	
Site Location:	Alexandria, VA		
Owner:	Hilltop Sand & Gravel Company		
Products:	GSE UltraFlex White Textured 40 mil	2,317,680	sq. ft.
	GSE FabriCap	1,943,570	sq. ft.
	GSE FabriCap Single-Sided	525,000	sq. ft.
Date completed:	Oct-00		

Project Name:	Newton Power Cooling Water Pond	505559	
Site Location:	Newton, IL		
Owner:	Ameren UE		
Products:	GSE HD 60 mil	1,362,060	sq. ft.
Date completed:	Jul-00		

Project Name:	IT Panoche 2000 Closure Cover	505566	
Site Location:	Benicia, CA		
Owner:	U.S. Navy		
Products:	GSE HD Textured 80 mil	1,466,170	sq. ft.
	GSE HD 80 mil	504,000	sq. ft.
	GSE FabriCap	1,633,000	sq. ft.
	GSE FabriCap Single-Sided	508,130	sq. ft.
	Bentomat ST	623,070	sq. ft.
	Claymax200R	485,430	sq. ft.
Date completed:	Nov-00		

Project Name:	D & D Farm Lagoon Repair	500193	
Site Location:	Holyoke, CO		
Owner:	D & D Farms		
Products:	GSE HyperFlex 40 mil	1,588,881	sq. ft.
Date completed:	Sep-99		

Project Name:	Mobil Mining & Minerals Pond		500438
Site Location:	Pasadena, TX		
Owner:	Mobil Mining & Minerals		
Products:	GSE HyperFlex 60 mil	899,887	sq. ft.
	GSE HyperFrictionFlex 60 mil	1,459,532	sq. ft.
Date completed:	Dec-99		

Project Name:	USA Waste / Alliance Cap		500446
Site Location:	Taylor, PA		
Owner:	USA Waste		
Products:	GSE UltraFlex Textured 40 mil	2,186,820	sq. ft.
	GSE FabriCap	2,100,100	sq. ft.
Date completed:	Sep-99		

Project Name:	Allied / Brunswick County Landfill		500454
Site Location:	Lawrenceville, VA		
Owner:	Allied Waste Industries		
Products:	GSE White Textured 60 mil	2,047,500	sq. ft.
	GSE Geotextile 16 oz	2,020,500	sq. ft.
Date completed:	Feb-99		

Project Name:	Rhode Island Resource Recovery		500869
Site Location:	Johnston, RI		
Owner:	Rhode Island Resource Recovery Corporation		
Products:	GSE HyperFlex 60 mil	1,125,885	sq. ft.
	GSE HyperFlex 80 mil	1,333,640	sq. ft.
	Claymax200R	1,050,378	sq. ft.
	Geotextile	19,500	sq. ft.
Date completed:	Jul-99		

Project Name:	Wicomico County/Newland Park Landfill Closure		
Site Location:	Salisbury, MD		500917
Owner:	Wicomico County		
Products:	GSE HyperFrictionFlex 60 mil	142,364	sq. ft.
	GSE HD Textured 40 mil	1,432,936	sq. ft.
	GSE FabriNet	1,399,874	sq. ft.
	Bentomat ST	101,250	sq. ft.
Date completed:	Nov-99		

Project Name:	Lancaster County SWMA Frey Farm		500922
Site Location:	Conestoga, PA		
Owner:	Lancaster County		
Products:	GSE White Textured 60 mil	716,288	sq. ft.
	GSE UltraFlex 40 mil	1,033,800	sq. ft.
	GSE HD Textured 60 mil	654,386	sq. ft.
	GSE FabriCap	1,855,940	sq. ft.
	GSE FabriNet Single-Sided	1,242,068	sq. ft.
	GSE FabriNet	9,660	sq. ft.
	Claymax 200R	68,000	sq. ft.
Date completed:	Sep-99		

Project Name:	Panoche Landfill Cover		501195
Site Location:	Benicia, CA		
Owner:	U.S. Navy		
Products:	GSE HD 80 mil	648,000	sq. ft.
	GSE White 80 mil	187,680	sq. ft.
	GSE HD Textured 80 mil	1,782,450	sq. ft.
	GSE White Textured 80 mil	305,377	sq. ft.
	GSE FabriCap	1,683,668	sq. ft.

	BentomatST	378,000	sq. ft.
	Claymax 200R	756,625	sq. ft.
Date completed:	Oct-99		

Project Name:	Palm City Landfill		501676
Site Location:	Palm City, FL		
Owner:	Martin County		
Products:	GSE HyperFlex 60 mil	1,285,900	sq. ft.
	GSE HyperNet	1,696,400	sq. ft.
Date completed:	Jul-99		

Project Name:	Cortez Gold Cell 2		502060
Site Location:	Beowawe, NV		
Owner:	Cortez Gold Mines		
Products:	GSE HyperFlex 60 mil	2,412,679	sq. ft.
Date completed:	May-99		

Project Name:	Barrick North Block Tailings		502095
Site Location:	Elko, NV		
Owner:	Barrick Goldstrike Mines		
Products:	GSE HyperFlex 60 mil	2,780,520	sq. ft.
	GSE HyperFrictionFlex 60 mil	33,653	sq. ft.
	GSE HyperFriction Flex 100 mil	173,552	sq. ft.
	GSE HyperFlex 80 mil	152280	sq. ft.
	Geotextile	39,000	sq. ft.
Date completed:	Nov-99		

Project Name:	Waste Management Inc. / Pine Tree Acres Cells 12 & 13		
Site Location:	Lennox, MI		502641
Owner:	Waste Management, Inc.		
Products:	GSE UltraFlex Textured 40 mil	756,100	sq. ft.
	GSE HyperFlex 60 mil	1,351,500	sq. ft.
	GSE HD Textured 60 mil	245,700	sq. ft.
Date completed:	Sep-99		

Project Name:	Enterprise Brine Pit 2		503539
Site Location:	Mt. Belvieu, TX		
Owner:	Enterprise Brine Pit Reline		
Products:	GSE HD 60 mil	1,346,670	sq. ft.
	GSE HyperNet	656,090	sq. ft.
	GSE HD Textured 60 mil Single-Sided	198,450	sq. ft.
Date completed:	Sep-99		

Project Name:	Browning Ferris Industries / Davis Junction Cap		
Site Location:	Davis Junction, IL		503577
Owner:	Browning Ferris Industries		
Products:	GSE UltraFlex 40 mil	1,638,000	sq. ft.
	GSE HyperNet CP	1,668,000	sq. ft.
Date completed:	Nov-99		

Project Name:	Keystone Tabor Landfill Cells 3, 4, 7		B1110
Site Location:	Dunmore, PA		
Owner:	Keystone Sanitary Landfill, Inc.		
Products:	GSE HD 40 mil	1,277,306	sq. ft.
	GSE HD 60 mil	1,185,000	sq. ft.
Date completed:	Oct-98		

Project Name:	Brown Station Road Landfill		B1119

Site Location:	Upper Marlboro, MD		
Owner:	Brown Station Landfill		
Products:	GSE Geotextile 16 oz	1,600,000	sq. ft.
	GSE HD 60 mil	930,000	sq. ft.
	GSE HyperNet	110,000	sq. ft.
	GSE Geotextile 12 oz	210,000	sq. ft.
Date completed:	Nov-98		

Project Name:	Cardington Road Landfill Closure		C1141
Site Location:	Moraine, OH		
Owner:	Tremont Landfill		
Products:	GSE GundSeal 40 mil	1,538,075	sq. ft.
Date completed:	Aug-98		

Project Name:	IMCO Recycling Landfill Cell B		D1185
Site Location:	Morgantown, KY		
Owner:	IMCO Recycling		
Products:	GSE HyperFlex 80 mil	1,542,672	sq. ft.
Date completed:	Oct-98		

Project Name:	Polk County North Central Landfill Cell 2		E1026
Site Location:	Winter Haven, FL		
Owner:	Polk County		
Products:	GSE HD Textured 60 mil	4,112,541	sq. ft.
	GSE FabriNet 8 oz	1,964,515	sq. ft.
Date completed:	Mar-98		

Project Name:	Newton Power Cell & Closure		F1176
Site Location:	Newton Grove, IL		
Owner:	Central Illinois Public Services		
Products:	GSE UltraFlex 40 mil	1,586,035	sq. ft.
	GSE UltraFlex Textured 40 mil	315,600	sq. ft.
	GSE FabriCap Single-Sided 6 oz	1,588,500	sq. ft.
	GSE HD 60 mil	108,750	sq. ft.
	GSE HD Textured 60 mil	67,250	sq. ft.
Date completed:	Sep-98		

Project Name:	Enterprise Mt. Belvieu - Pond # 2		H1265
Site Location:	Mt. Belvieu, TX		
Owner:	Enterprise		
Products:	GSE HD 60 mil	1,397,632	sq. ft.
	GSE HyperNet	749,000	sq. ft.
	GSE Geotextile 11.2 oz	378,000	sq. ft.
Date completed:	Mar-98		

Project Name:	American Chrome & Chemical Pond		H1311
Site Location:	Corpus Christi, TX		
Owner:	American Chrome & Chemical		
Products:	GSE HyperFlex 60 mil	1,369,127	sq. ft.
	GSE HyperFlex 40 mil	1,364,927	sq. ft.
	GSE HyperNet	1,364,927	sq. ft.
	GSE FabriNet 6 oz	1,160,616	sq. ft.
Date completed:	Apr-98		

Project Name:	Pacific Northwest Sugar Waste		J1164
Site Location:	Moses Lake, WA		
Owner:	Pacific Northwest Sugar Company		
Products:	GSE HyperFlex 60 mil	2,327,750	sq. ft.
Date completed:	May-98		

Project Name:	Naughton Unit 3 FGD Pond 2		J1246
Site Location:	Kemmerer, WY		
Owner:	Pacific Corp		
Products:	GSE HD 40 mil	1,922,964	sq. ft.
Date completed:	Oct-98		

Project Name:	Barrick North Block		L1203
Site Location:	Carlin, NV		
Owner:	Barrick Goldstrike Mines		
Products:	GSE HyperFlex 60 mil	2,204,036	sq. ft.
	GSE HyperNet	454,500	sq. ft.
	GSE HyperFrictionFlex 60 mil	22815	sq. ft.
Date completed:	Jun-98		

Project Name:	U. S. Borax / Evaporation Ponds		L1278
Site Location:	Boron, CA		
Owner:	U. S. Borax		
Products:	GSE Conductive White 60 mil	6,973,854	sq. ft.
	GSE HyperNet	5,591,473	sq. ft.
	GSE HyperFrictionFlex 80 mil	63,005	sq. ft.
	GSE Geotextile 8 oz	14,400	sq. ft.
	GSE GundSeal 15 mil	7,200	sq. ft.
	GSE FabriNet Single-Sided 6 oz	2,791,950	sq. ft.
	FabriCap Single-Sided 6 oz	1,399,715	sq. ft.
Date completed:	Aug-98		

Project Name:	PDTS / Cortez Pipeline Pad Expansion 2		L1353
Site Location:	Beowawe, NV		
Owner:	PDTS / Cortez USA, Inc		
Products:	GSE HyperFlex 60 mil	1,213,378	sq. ft.
Date completed:	Jul-98		

Project Name:	Vine Hill Closure		L1385
Site Location:	Martinez, CA		
Owner:	IT Corporation		
Products:	GSE White 80 mil	1,255,655	sq. ft.
	GSE FabriNet 6 oz	403,764	sq. ft.
	GSE HyperFlex 80 mil	261,920	sq. ft.
	GSE FabriNet Single-Sided 6 oz	1,255,655	sq. ft.
	GSE HD Textured 80 mil	141,844	sq. ft.
Date completed:	Dec-98		

Project Name:	Browning Ferris Industries / Conestoga Cells 3, 4		O1180
Site Location:	Morgantown, PA		
Owner:	Browning Ferris Industries		
Products:	GES UltraFrictionFlex 40 mil	1,333,000	sq. ft.
	GSE FabriNet 6 oz	1,265,000	sq. ft.
Date completed:	Jun-98		

Project Name:	Browning Ferris Industries / Glenwillow Landfill		O1364
Site Location:	Glenwillow, OH		
Owner:	Browning Ferris Industries		
Products:	GSE UltraFlex 40 mil	2,769,919	sq. ft.
	GSE FabriCap Single-Sided 6 oz	2,722,465	sq. ft.
Date completed:	Oct-98		

SECTION 02622 GEOCOMPOSITE DRAINAGE LAYER

1.04.B.1 & 2
Installers Experience

GSI PROJECTS
2001 to 2004

Job Name	Location	Date of Install	Type, Thickness HDPE liner and Surface area	Quantity	Unit
D. .rt Basin Generating Sta. Owner: Reliant Energy Engineer: Black & Veatch 913-458-3902	Casa Grande, AZ	2001/2002	60 mil Geonet GCL Piping	14,700,000	SF
Tri-County Superfund Site Owner: Waste Management, Inc. 402-478-5196 Engineer: HDR 816-360-2710	Elgin, IL	2001/2002	40 mil LLDPE Geonet Geotextile	5,700,000	SF
Woodstock Municipal Superfund Sit Owner: PRP Group Client: Environmental Contractors Illinois Daryl Streed, 815-654-4726 Engineer: CRA 651-639-0913	Rockford, IL	2001/2002	40 mil HDPE Geocomposite	3,900,000	SF
Keystone Power Plant Owner: Reliant Energy Engineer: Parsons 610-855-2000 Client: R & L Development Rich Myers, 724-668-2223	Shelocta, PA	2001	60 mil HDPE GCL Geocomposite Geotextile	4,950,000	SF
Homer City Generating Sta Owner: Penn Power Engineer: Parsons, 610-855-2000 C R & L Development Ri.. Myers, 724-668-2223	Homer City, PA	2001	60 mil HDPE Geocomposite Geotextile	4,010,000	SF
Taum Sauk Reservoir Owner/Client: Ameren UE One Ameren Plaza 1901 Chouteau Avenue St. Louis, MO 63166 314-554-3524	Farmington, MO	2004	80 mil textured HDPE 80 mil textued LLDPE Geocomposite	956,316 93,470 819,208	SF SF SF
Los Reales Landfill Owner: City of Tucson Client: RE Monks Construction Engineer: Geo Syntec	Tucson, AZ	2002	60 mil HDPE Geotextile GCL	2,700,000	SF
Shawville Power Station Owner: Reliant Energy Engineer: Kimble & Associates Client: R & L Development Rich Myers, 724-668-2223	Shawville, PA	2002	60 mil HDPE Geocomposite GCL	3,465,000	SF

GSI PROJECTS
2001 to 2004

Sherburne County **Generating plant** Owner: Excel Energy Becker 13999 Industrial Blvd Becker, MN 55308 763-261-3133 Engineer: Utility Engineering 901 Marquette Avenue Minneapolis, MN 55402	Becker, MN	2003	60 mil smooth HDPE 60 mil textured HDPE	1,521,188 SF 720,252 SF
Wayne Disposal Phase 1 Owner: Wayne Disposal Engineer: Abeltech Client: Wayne Disposal	Belleville, MI	2003	80 mil HDPE GCL Gecomposite	2,560,000 SF
SWA W Palm Beach Owner: West Palm Beach County Engineer: CDM	W Palm Beach, FL	2004	60 mil HDPE GCL Geocomposite	1,937,350 SF
			Total Square Feet	**48,032,784** SF

SECTION 02622 GEOCOMPOSITE DRAINAGE LAYER

1.04.B.3
Supervisors Resume
Available After Crew Determination

SECTION 02622 GEOCOMPOSITE DRAINAGE LAYER

1.06.A
Manufactures Warranty
Available After Project Completion

NON-PRO RATA LIMITED WARRANTY
FOR GSE LINING TECHNOLOGY, INC.
(GEOSYNTHETIC MANUFACTURED MATERIALS)
(U.S.A.)

SAMPLE

Date:		Warranty No.:	
Purchaser Name:		Project No.:	
Address:		Effective Date:	
City, State:		Project Name:	
Product Type/Description:	GSE Geocomposite	Project Address:	

GSE Lining Technology, Inc. ("GSE") warrants the geonet component of each GSE product described above to be free from material manufacturing defects (as described by the contract's material specifications) and to be able to withstand normal weathering for a period of one (1) year from the above effective date for "normal use" in approved applications. This limited warranty does not include damages or defects in the GSE product resulting from acts of God, casualty or catastrophe, including but not limited to: earthquakes, floods, piercing hail, tornadoes or force majeure. The term "normal use" does not include, among other things, the exposure of GSE's product to harmful chemicals, abuse by machinery, equipment or people; improper site preparation or placement of cover materials; excessive pressures or stresses from any source. This warranty is intended for commercial use only and is not in effect for the consumer as defined in the Magnuson-Moss Warranty Act.

Should defects or premature loss of use within the scope of this warranty occur, GSE will, at its option, repair or replace the GSE product. GSE shall have the right to inspect and determine the cause of the alleged defect in the product and to take appropriate steps to repair or replace the product if a defect exists that is covered under this warranty. This limited warranty only extends to the geosynthetic portion of this product manufactured by GSE and does not apply to any third-party manufactured materials attached to GSE's product. The third-party portion of the product will carry the original manufacturer's warranty that will be passed through to the Purchaser.

Any claim for any alleged breach of this warranty must be made in writing, by certified mail or courier, to GSE Lining Technology Co., 19103 Gundle Road, Houston, TX 77073, with the words "Warranty Claim" clearly marked on the face of the envelope, within ten (10) days of Purchaser becoming aware of the alleged defect. Should the required notice not be given, the defect and all warranties are waived by the Purchaser, and Purchaser shall not have rights under this warranty. GSE shall not be obligated to perform any inspection or obligated to perform any repair or replacement under this warranty until the area is made available free from all obstructions, water, dirt, sludge, residuals and liquids of any kind. If after inspection it is determined that there is no claim under this warranty, Purchaser shall reimburse GSE for its costs associated with the site inspection.

In the event the exclusive remedy provided herein fails in its essential purpose, and in that event only, the Purchaser shall be entitled to a return of the purchase price for so much of the product as GSE determines to have violated the warranty provided herein. GSE shall not be liable for direct, indirect, special, consequential or incidental damages resulting from a breach of this warranty including, but not limited to: damages for loss of production, lost profits, personal injury or property damage. GSE shall not be obligated to reimburse Purchaser for any repairs, replacement, modifications or alterations made by Purchaser to GSE's product, unless GSE specifically authorized, in writing, said repairs, replacements, modifications or alterations in advance. GSE liability under this warranty shall in no event exceed the replacement cost of the product sold to the Purchaser for the particular installation in which it failed.

GSE neither assumes nor authorizes any person other than an officer of GSE to assume for it any other or additional liability in connection with the GSE product made on the basis of the Limited Warranty. **GSE MAKES NO WARRANTY OF ANY KIND OTHER THAN THAT GIVEN HEREIN AND HEREBY DISCLAIMS ALL WARRANTIES, INCLUDING BOTH EXPRESS OR IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, AND BY ACCEPTING DELIVERY OF THE PRODUCT, PURCHASER WAIVES ALL OTHER POSSIBLE WARRANTIES. GSE's WARRANTY BECOMES AN OBLIGATION OF GSE TO PERFORM UNDER THE WARRANTY ONLY UPON RECEIPT OF FINAL PAYMENT.**

This warranty is extended to the Purchaser and is non-transferable and non-assignable, i.e. there are no third-party beneficiaries to this warranty.

SECTION 02622 GEOCOMPOSITE DRAINAGE LAYER

1.06.B
Installation Warranty
Available After Project Completion

GEO-SYNTHETICS, INC.

ONE YEAR INSTALLATION WARRANTY FOR
GEO-SYNTHETICS, INC. MEMBRANE LINERS

PROJECT:_____ **SAMPLE**

_____

Subject to the terms and conditions set forth below, Geo-Synthetics, Inc., warrants to Purchaser, _____, that the _____ installed at the _____, was installed by Geo-Synthetics, Inc., in accordance with specifications in a good and workmanlike manner and that the installation of the liner is free from defects in workmanship for a period of 1 year(s) from the date upon which the material was installed.

This warranty covers only defects in workmanship occurring during the installation of the liner. This warranty does not cover any damage to, or defects in the liner found to have been a result of misuse, abuse or conditions existing after it was installed, including, but not limited to, rough handling; malicious mischief; vandalism; sabotage; fire; acts of God; acts of the public enemy; acts of war, public rebellion, severe weather conditions of all types; damage due to ice; excessive stress from any source; floating debris; damage due to machinery; foreign objects or animals. Nor does this warranty cover any defects which are found to have been a result of improper of defective design or engineering unless the design or engineering was performed by Geo-Synthetics, Inc.

In the event circumstances are found to exist which purchaser believes may give rise to a claim under this warranty, the following procedure shall be followed.

a) Purchaser shall give Geo-Synthetics, Inc. written notice of the facts and circumstances of said claim within ten (10) days of becoming aware of said facts and circumstances.

Said notice shall be by registered or certified mail, return receipt requested, postage prepaid, addressed to Construction Manager, Geo-Synthetics, Inc., 428 N. Pewaukee Road, Waukesha, WI 53188. The words "WARRANTY CLAIM" shall be clearly marked on the face of envelope in the lower right hand corner. Said notice shall contain, at a minimum, the name and address of the owner, the name and address of the installation, the name and address of the installer, the date upon which the material was purchased and the facts known to Purchaser upon which the claim is based. Failure to strictly comply with all the requirements of this paragraph shall void this warranty.

b) Within twenty days after receipt of the notice described in paragraph a., above, Geo-Synthetics, Inc. shall notify Purchaser either that it will send a representative to inspect the allegedly defective liner or that it does not wish to do so. Purchaser shall pay the expenses incurred by Geo-Synthetics, Inc. in making the inspection, including current per diem rates for personnel involved in making the inspection, in the event Geo-Synthetics, Inc. determines that the claim is not covered by this warranty.

c) Purchaser SHALL NOT REPAIR, REPLACE, REMOVE, ALTER OR DISTURB ANY LINER, NOR SHALL Purchaser ALLOW ANYONE ELSE TO REPAIR, REPLACE, REMOVE, ALTER, OR DISTURB ANY LINER PRIOR TO SUCH INSPECTION OR RECEIPT OF GEO-SYNTHETICS INC.'S NOTICE THAT IT ELECTS NOT TO INSPECT. A FAILURE TO STRICTLY COMPLY WITH THIS PARAGRAPH SHALL VOID THIS WARRANTY OR MAY LEAD TO A DETERMINATION THAT THE ALLEGED DEFECTS ARE NOT WITHIN THE SCOPE OF THIS WARRANTY.

d) If Geo-Synthetics, Inc. determines that the alleged defects are covered by this warranty, Geo-Synthetics, Inc. shall, in its sole discretion, either repair the defective liner or provide Purchaser with replacement liner. THE REMEDIES PROVIDED HEREIN ARE THE EXCLUSIVE REMEDIES AVAILABLE UNDER THIS WARRANTY. Any determination as to whether a particular defect is covered by this warranty will be made by Geo-Synthetics, Inc. in its sole and complete discretion.

e) Purchaser agrees that it shall provide Geo-Synthetics, Inc. with clean, dry and unobstructed access to the liner in order for Geo-Synthetics, Inc. to perform the inspections and warranty work which may be required pursuant to this warranty.

THE REMEDIES PROVIDED TO Purchaser HEREIN ARE THE EXCLUSIVE REMEDIES AVAILABLE UNDER THIS WARRANTY AND ARE INTENDED FOR THE SOLE BENEFIT OF Purchaser. NEITHER THIS WARRANTY NOR ANY RIGHTS HEREUNDER SHALL BE ASSIGNABLE. GEO-SYNTHETICS, INC. SHALL HAVE NO LIABILITY UNDER THIS WARRANTY TO THIRD PARTIES OR STRANGERS TO THIS AGREEMENT. THE WARRANTY SET FORTH ABOVE IS THE ONLY WARRANTY APPLICABLE TO THE LINER AND ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE ARE DISCLAIMED. IN NO EVENT SHALL GEO-SYNTHETICS, INC. BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL OR CONSEQUENTIAL DAMAGES FOR, RESULTING FROM, OR IN CONNECTION WITH, ANY LOSS RESULTING FROM THE USE OF THE LINER. IN THE EVENT THE EXCLUSIVE REMEDY PROVIDED HEREIN FAILS IN IT ESSENTIAL PURPOSE, AND IN THAT EVENT ONLY, Purchaser SHALL BE ENTITLED TO RETURN OF THE PURCHASE PRICE FOR SO MUCH OF THE MATERIAL AS
GEO-SYNTHETICS, INC. DETERMINES IN ITS SOLE DISCRETION, TO HAVE VIOLATED THE WARRANTY PROVIDED HEREIN. EXCEPT FOR THE WARRANTY SET FORTH ABOVE, NO REPRESENTATION OR WARRANTY MADE BY ANY SALES OR OTHER REPRESENTATIVE GEO-SYNTHETICS, INC., OR ANY OTHER PERSON, CONCERNING THE LINER SHALL BE BINDING UPON GEO-SYNTHETICS, INC.

SAMPLE

Any waiver of the terms and conditions of this warranty shall be in writing signed by GEO-SYNTHETICS, INC. the failure to insist upon strict compliance with any of the terms and conditions contained herein shall not act as a waiver of strict compliance with all of the remaining terms and conditions or this warranty and shall not operate as a waiver as to any of the terms and conditions of this warranty as to future claims under this warranty.

GEO-SYNTHETICS INC

BY:_____
Robert F. Groh / President

I have read and agree to be bound
by the terms and conditions of the
foregoing warranty.

By: _____

Title: _____

Company: _____

Date: _____

SAMPLE

SECTION 02622 GEOCOMPOSITE DRAINAGE LAYER

2.02.A
Manufactures Quality Control Plan

GSE Geonets & Geocomposites

Geomembranes ▪ Geonets ▪ Geocomposites ▪ GCLs ▪ Geotextiles ▪ Concrete Protection ▪ Installation Services ▪ Fabrications

Manufacturing Quality Assurance Manual

www.gseworld.com

Foreword

This manual contains proprietary information belonging to GSE Lining Technology, Inc. This information is intended to provide a summary of standard quality procedures practiced by GSE's Manufacturing Quality Assurance Laboratories in Houston, Texas; and Kingstree, South Carolina. These procedures apply to standard drainage materials only and do not explicitly address non-conforming materials.

This manual replaces in its entirety and supersedes all earlier versions issued by GSE Lining Technology, Inc. We suggest you maintain contact with your GSE representative to confirm the validity of this version at future dates.

GSE Lining Technology, Inc. reserves the right to change, modify, or discontinue the use of the policies and procedures described herein without notice or prior consent except as contractually obligated otherwise.

This information is provided for reference purposes only and is not intended as a warranty or guarantee. GSE assumes no liability in connection with the use of this information. Please check with GSE for current, standard minimum quality assurance procedures and specifications.

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I. QUALITY MANIFEST

GSE Lining Technology, Inc. is committed to providing the highest quality products and services to our customers. This requires a firm, total quality commitment from all individuals within our organization that we will only supply materials that meet or exceed the requirements and specifications of GSE and our customers.

GSE's commitment to quality starts with the highest quality raw materials. The quality of incoming raw materials is controlled at the supplier level with a complete vendor evaluation program in place. This means purchasing only from suppliers who are committed to statistical process control thereby providing a consistent, high level of quality assurance of their products.

II. MANUFACTURING QUALITY ASSURANCE

GSE Lining Technology, Inc. has an on-site Manufacturing Quality Assurance Laboratory at each manufacturing plant. Having a fully equipped, well staffed, dedicated laboratory at each of the manufacturing facilities allows GSE to maintain a high level of quality and up-to-the-minute results on finished products. Each facility follows the same guidelines for evaluating the quality of GSE products and is capable of adapting to market-driven requirements.

A. Objective

The objective of the GSE Quality Assurance program is to define implementation of basic manufacturing quality assurance (MQA) procedures necessary to ensure consistent production of quality products supplied to the geosynthetic market. Note that at this time, these procedures are limited to polyethylene drainage products including geonets and geocomposites.

B. Scope

In order to achieve GSE's stated purpose, a rigorous set of minimum standards and an effective test program to assure compliance has been established. These procedures and requirements are frequently reviewed and adjusted to assure compliance with current market demands and/or predetermined project specifications. These procedures assure that raw materials and process parameters are controlled to provide products complying with GSE's pre-defined minimum characteristics.

III. MANUFACTURING QUALITY ASSURANCE ORGANIZATION

This organization consists of the Manufacturing Quality Assurance Laboratories as well as the manufacturing personnel. The combination of expertise and experience from these groups provides GSE with the proper tools to maintain the highest level of quality and customer service in the industry.

The Quality Assurance Department at GSE is charged by the President to assure that only products meeting both GSE's and the customer's requirements are released for shipment. The Quality Assurance personnel are directly responsible for monitoring testing and providing feedback to the manufacturing department to ensure the production of the specified product quality. Each member of the Quality Assurance team must participate in detailed training that includes factory exposure.

IV. STAFF AND SCHEDULING

The Quality Assurance Laboratories are staffed whenever manufacturing is occurring; this is usually 24 hours per day, 365 days per year. This minimizes the amount of potentially inferior product produced before a manufacturing problem is identified.

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V. PRODUCT IDENTIFICATION AND DOCUMENTATION

A. Roll Numbering

Each roll of geonet and geocomposite is assigned a unique roll number. The Quality Assurance Laboratory maintains records documenting the raw materials and resulting product quality information.

B. Approval Procedure

Results for each tested roll of product are checked against both GSE and customer specifications for compliance. The Quality Assurance Laboratory approves those materials that meet both of these requirements for shipment.

C. Non-Conformance

Material that does not meet GSE minimum standards is given a roll number but is rejected and not placed into inventory. The material is identified as scrap and will not be utilized.

Material that meets GSE minimum standards but does not meet a stricter customer specification is not allocated to that customer but is placed into inventory as GSE standard material.

D. Documentation

Individual Quality Assurance Certificates are generated and supplied for each roll of geonet and geocomposite product to include all relevant quality assurance information about the material(s). The geotextile components of the drainage geocomposite materials are tracked throughout the manufacturing process. Therefore, "traceability reports" are available.

VI. RECORDS RETENTION

GSE maintains reports and/or samples for products produced and sold. Records and/or samples are maintained according to GSE's standard retention policy according to the item.

MATERIAL	ITEM	YEARS
Raw materials	Resin Supplier Test Reports and Certifications GSE Resin Test Reports Resin Sample Retain (Archive)	≥2 ≥2 ≥2
Geonet and Geocomposite	Raw Test Data (in computer database) Quality Control Certificates (in computer database) Sample Retain (approximately one square foot)	≥5 ≥5 ≥5

VII. TESTING CAPABILITIES

GSE maintains high capacity, state-of-the-art laboratory equipment suitable for performing the procedures listed in Appendix A and B. GSE's Houston and Kingstree laboratories are accredited by the GAI-LAP program. GSE's Houston and Kingstree Quality Assurance Laboratories, as part of GSE's Product Division, also hold ISO certification. The appropriate certificates are maintained for review upon request by authorized parties.

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A. Routine Testing

Through careful investigation, GSE has developed a strict and thorough Quality Assurance program that exceeds the vast majority of customer specifications. The testing program covers raw materials (see Appendix A) and finished goods (see Appendix B) and is adhered to at all GSE laboratories. The laboratory equipment used by GSE represents the most modern equipment available and meets or exceeds the requirements of all the test standards used. Test frequencies and number of test specimen per sample are established based on statistical analysis and complexity of procedures.

B. Other Testing Capabilities

In addition to routine testing, GSE laboratories are equipped to perform a wide variety of other tests as required for unusual requests or product development. Further, although the GSE Quality Assurance Laboratories are fully equipped and able to perform most routinely specified tests in the industry, there are some tests that are more economically performed by a dedicated testing facility. GSE believes requirements for such testing should be carefully considered and defined in terms of specific design requirements if they are found to be necessary.

VIII. MATERIAL QUALITY ASSURANCE

GSE Lining Technology, Inc. has established strict specifications for all raw materials and finished products. Test results must fall within the acceptable limits of GSE and customer specifications.

A. Raw Material

GSE primarily uses two types of raw materials, "natural resin" and "masterbatch" in the manufacture of geonet products. Natural resin is the base material that is used to make a geonet. It contains stabilizers to prevent degradation from occurring during and after extrusion. "Masterbatch" is the term referring to the concentrated carbon black material used with the natural resin to produce the finished product. The natural resin and masterbatch are blended at the appropriate ratio at the manufacturing stage. The masterbatch can contain other additives depending upon the geonet product to be produced. GSE verifies the properties of each lot of raw material prior to their utilization.

When natural resin is received, samples are taken and subjected to the tests outlined in Appendix A. All test data are entered into the computer database and checked for accuracy, consistency and compliance with GSE specifications. The material is not accepted unless all standard test requirements are met and the GSE test values meet the requirements set forth in the raw material specifications.

Copies of the supplier's certificate of analysis (COA) for each lot of resin utilized in the production of the materials supplied to a specific project are supplied as standard documentation. In addition, the GSE test results for each lot of resin are provided in a separate report upon request.

Virgin resin is normally received in rail car lots. If resin is received by other transport and/or in other quantities, an equivalent suitable sampling procedure is provided (i.e. not less than one sample per shipment or one sample for each 50,000 lb., 23,000 kg)

B. Geonet Products

Geonet drainage products with bi-planar geometry are produced. Tables containing GSE properties and test frequencies for all GSE geonet and geocomposite products are located in Appendix B.

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1. Sampling

A one-foot by roll width sample is cut for Quality Assurance testing from every tenth roll produced. An archive sample is cut from each tested roll. This sample is taken from a random location then labeled and stored for future reference (see Section VI). Test frequencies and number of test specimen per sample are established based on statistical analysis of the available data and complexity of the test procedures.

2. Evaluation of Results

All data are entered into a computer database for calculation and comparison to established order specifications. If materials do not meet the required GSE standards and/or the customer specifications the manufacturing personnel are immediately notified in order for the appropriate adjustments to be made. Only products meeting GSE standards and customer specifications will be approved for shipment.

3. Reporting

A Quality Assurance Certificate is issued for every roll of finished product. This report identifies the standards on which the GSE approval is based along with the actual test results demonstrated by the material.

C. Geocomposite Products

Geocomposite products are produced with a geonet and a nonwoven geotextile(s). This product is manufactured by heat bonding a geotextile to one or both sides of a geonet product. Sampling, evaluation of results and reporting practices are the same as for geonet products (Section B. above).

D. Third Party Conformance Sampling

Some specifications require independent Quality Assurance and/or conformance testing. GSE can provide assistance with the sampling of products by arranging for the conformance samples to be taken during production. By taking samples during production rather than on site, the customer can be assured that the samples are clean and available for conformance testing in a timely manner.

GSE encourages customers to audit GSE manufacturing and manufacturing quality assurance operations and/or to collect samples and conduct independent conformance testing prior to shipment of materials.

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MINIMUM TESTING FREQUENCIES FOR GSE RAW MATERIALS

Property	Test Method[1]	Natural Resin
Density	ASTM D 1505	once per rail car compartment
Melt Flow Index	ASTM D 1238 (190/2.16)	once per rail car compartment
Carbon Black Content	ASTM D 1603, modified	N/A
Carbon Black Dispersion	ASTM D 5596	NA

[1] GSE utilizes test equipment and procedures that enable effective and economical confirmation that the product will conform to specifications based on the noted procedures. Some test procedures have been modified for application to geosynthetics. All procedures and values are subject to change without prior notification.

MINIMUM PROPERTIES FOR GSE RAW MATERIALS

Property	Test Method[1]	HDPE
Density [g/cm³]	ASTM D 1505	≥ 0.932
Melt Flow Index [g/10 min]	ASTM D 1238 (190/2.16)	≤ 1.0

[1] GSE utilizes test equipment and procedures that enable effective and economical confirmation that the product will conform to specifications based on the noted procedures. Some test procedures have been modified for application to geosynthetics. All procedures and values are subject to change without prior notification.

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Appendix B - Minimum Testing Frequencies and Properties for GSE Geonets and Geocomposites

MINIMUM AVERAGE PROPERTIES FOR GSE HYPERNET GEONETS

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM AVERAGE ROLL VALUE[c]			
			HyperNet	HyperNet HF	HyperNet HS	HyperNet UF
Product Code			XL4000N004	XL5000N004	XL7000N004	XL8000N004
Transmissivity[a], gal/min/ft (m^2/sec)	ASTM D 4716-00	1/540,000 ft^2	9.66 (2×10^{-3})	14.49 (3×10^{-3})	28.98 (6×10^{-3})	38.64 (8×10^{-3})
Thickness, mil (mm)	ASTM D 5199	1/50,000 ft^2	200 (5)	250 (6.3)	275 (7)	300 (7.6)
Density, g/cm^3	ASTM D 1505	1/50,000 ft^2	0.94	0.94	0.94	0.94
Tensile Strength (MD), lb/in (N/mm)	ASTM D 5035	1/50,000 ft^2	45 (7.9)	55 (9.6)	65 (11.5)	75 (13.3)
Carbon Black Content, %	ASTM D 1603, modified	1/50,000 ft^2	2.0	2.0	2.0	2.0
Roll Width, ft (m)			15 (4.6)	15 (4.6)	15 (4.6)	15 (4.6)
Roll Length, ft (m)[b]			300 (91)	250 (76)	220 (67)	200 (60)
Roll Area, ft^2 (m^2)			4,500 (418)	3,750 (348)	3,300 (305)	3,000 (278)

NOTES:

- [a]Gradient of 0.1, normal load of 10,000 psf, water at 70° F (20° C), between steel plates for 15 minutes.
- [b]Please check with GSE for other available roll lengths.
- [c]These are MARV values that are based on the cumulative results of specimens tested by GSE.

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Appendix B - Minimum Testing Frequencies and Properties for GSE Geonets and Geocomposites

MINIMUM AVERAGE PROPERTIES FOR GSE FABRINET

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM AVERAGE ROLL VALUE[d]		
			6 oz/yd²	8 oz/yd²	10 oz/yd²
Geocomposite					
Product Code			F420600605	F420800805	F421001005
Transmissivity[a], gal/min/ft (m²/sec)	ASTM D 4716-00	1/540,000 ft²	0.48 (1 x 10^{-4})	0.48 (1 x 10^{-4})	0.43 (9 x 10^{-5})
Ply Adhesion, lb/in (g/cm)	GRI GC-7	1/50,000 ft²	1.0 (178)	1.0 (178)	1.0 (178)
Roll Width, ft (m)			14.5 (4.4)	14.5 (4.4)	14.5 (4.4)
Roll Length, ft (m)			230 (70.1)	200 (60.9)	190 (58.0)
Roll Area, ft² (m²)			3,335 (310)	2,900 (269)	2,755 (256)
Geonet core[b,c]					
Transmissivity,[a] gal/min/ft (m²/sec)	ASTM D 4716-00		9.66 (2 x 10^{-1})	9.66 (2 x 10^{-1})	9.66 (2 x 10^{-1})
Thickness, mil (mm)	ASTM D 5199	1/50,000 ft²	200 (5)	200 (5)	200 (5)
Density, g/cm³	ASTM D 1505	1/50,000 ft²	0.94	0.94	0.94
Tensile Strength (MD), lb/in (N/mm)	ASTM D 5035	1/50,000 ft²	45 (7.9)	45 (7.9)	45 (7.9)
Carbon Black Content, %	ASTM D 1603	1/50,000 ft²	2.0	2.0	2.0
Geotextile (prior to lamination)[b,c]					
Mass per Unit Area, oz/yd² (g/m²)	ASTM D 5261	1/90,000 ft²	6 (200)	8 (270)	10 (335)
Grab Tensile, lb (N)	ASTM D 4632	1/90,000 ft²	170 (755)	220 (975)	260 (1,155)
Puncture Strength, lb (N)	ASTM D 4833	1/90,000 ft²	90 (395)	120 (525)	165 (725)
AOS, US sieve (mm)	ASTM D 4751	1/540,000 ft²	70 (0.212)	80 (0.180)	100 (0.150)
Permittivity, (sec⁻¹)	ASTM D 4491	1/540,000 ft²	1.5	1.5	1.2
Flow Rate, gpm/ft² (lpm/m²)	ASTM D 4491	1/540,000 ft²	110 (4,480)	110 (4,480)	85 (3,460)
UV Resistance, % retained	ASTM D 4355 (after 500 hours)	once per formulation	70	70	70

NOTES:

- [a]Gradient of 0.1, normal load of 10,000 psf, water at 70° F between steel plates for 15 minutes.
- [b]Component properties prior to lamination.
- [c]Several geotextiles are available and may be supplied as determined by GSE.
- [d]These are MARV values that are based on the cumulative results of specimens tested and determined by GSE. AOS in mm is maximum average roll value.

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MINIMUM AVERAGE PROPERTIES FOR GSE FABRINET HF

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM AVERAGE ROLL VALUE[d]		
			6 oz/yd²	8 oz/yd²	10 oz/yd²
Geocomposite					
Product Code:			F520600605	F520800805	F521001005
Transmissivity[a], gal/min/ft (m²/sec)	ASTM D 4716-00	1/540,000 ft²	2.41 ($5x10^{-4}$)	2.41 ($5x10^{-4}$)	2.41 ($5x10^{-4}$)
Ply Adhesion, lb/in (g/cm)	GRI GC-7	1/50,000 ft²	1.0 (178)	1.0 (178)	1.0 (178)
Roll Width, ft (m)			14.5 (4.4)	14.5 (4.4)	14.5 (4.4)
Roll Length, ft (m)			200 (60)	190 (57.9)	180 (54.9)
Roll Area, ft² (m²)			2,900 (269)	2,755 (256)	2,610 (242)
Geonet core[b]					
Transmissivity[a], gal/min/ft (m²/sec)	ASTM D 4716-00		14.49 ($3x10^{-1}$)	14.49 ($3x10^{-1}$)	14.49 ($3x10^{-1}$)
Thickness, mil (mm)	ASTM D 5199	1/50,000 ft²	250 (6.3)	250 (6.3)	250 (6.3)
Density, g/cm³	ASTM D 1505	1/50,000 ft²	0.94	0.94	0.94
Tensile Strength (MD), lb/in (N/mm)	ASTM D 5035	1/50,000 ft²	55 (9.6)	55 (9.6)	55 (9.6)
Carbon Black Content, %	ASTM D 1603	1/50,000 ft²	2.0	2.0	2.0
Geotextile (prior to lamination)[b,c]					
Mass per Unit Area, oz/yd² (g/m²)	ASTM D 5261	1/90,000 ft²	6 (200)	8 (270)	10 (335)
Grab Tensile, lb (N)	ASTM D 4632	1/90,000 ft²	170 (755)	220 (975)	260 (1,155)
Puncture Strength, lb (N)	ASTM D 4833	1/90,000 ft²	90 (395)	120 (525)	165 (725)
AOS, US Sieve (mm)	ASTM D 4751	1/540,000 ft²	70 (0.212)	80 (0.180)	100 (0.150)
Permittivity, (sec⁻¹)	ASTM D 4491	1/540,000 ft²	1.5	1.5	1.2
Flow Rate, gpm/ft² (l/min/m²)	ASTM D 4491	1/540,000 ft²	110 (4,480)	110 (4,480)	85 (3,460)
UV Resistance, % Retained	ASTM D 4355 (after 500 hours)	once per formulation	70	70	70

NOTES:

- [a]Gradient of 0.1, normal load of 10,000 psf, water at 70° F between stainless steel plates for 15 minutes.
- [b]Component properties prior to lamination.
- [c]Several geotextiles are available and may be supplied as determined by GSE.
- [d]These are MARV values and are based on the cumulative results of specimens tested and as determined by GSE. AOS in mm is a maxumum average roll value.

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Appendix B - Minimum Testing Frequencies and Properties for GSE Geonets and Geocomposites

MINIMUM AVERAGE PROPERTIES FOR GSE FABRINET HS

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM AVERAGE ROLL VALUE[d]		
			6 oz/yd²	8 oz/yd²	10 oz/yd²
Geocomposite					
Product Code:			F72060060S	F72080080S	F72100100S
Transmissivity[a], gal/min/ft (m²/sec)	ASTM D 4716-00	1/540,000 ft²	3.38 (7.0 x 10^{-4})	3.38 (7.0 x 10^{-4})	3.38 (7.0 x 10^{-4})
Ply Adhesion, lb/in (g/cm)	GRI GC-7	1/50,000 ft²	1.0 (178)	1.0 (178)	1.0 (178)
Roll Width, ft (m)			14.5 (4.4)	14.5 (4.4)	14.5 (4.4)
Roll Length, ft (m)			180 (54)	170 (51)	160 (48)
Roll Area, ft² (m²)			2,610 (242)	2,465 (229)	2,320 (215)
Geonet core[b]					
Transmissivity[a], gal/min/ft (m²/sec)	ASTM D 4716-00		28.98 (6 x 10^{-1})	28.98 (6 x 10^{-1})	28.98 (6 x 10^{-1})
Thickness, mil (mm)	ASTM D 5199	1/50,000 ft²	275 (7)	275 (7)	275 (7)
Density, g/cm³	ASTM D 1505	1/50,000 ft²	0.94	0.94	0.94
Tensile Strength (MD), lb/in (N/mm)	ASTM D 5035	1/50,000 ft²	65 (11.5)	65 (11.5)	65 (11.5)
Carbon Black Content, %	ASTM D 1603	1/50,000 ft²	2.0	2.0	2.0
Geotextile (prior to lamination)[b,c]					
Mass per Unit Area, oz/yd² (g/m²)	ASTM D 5261	1/90,000 ft²	6 (200)	8 (270)	10 (335)
Grab Tensile, lb (N)	ASTM D 4632	1/90,000 ft²	170 (755)	220 (975)	260 (1,155)
Puncture Strength, lb (N)	ASTM D 4833	1/90,000 ft²	90 (395)	120 (525)	165 (725)
AOS, US Sieve (mm)	ASTM D 4751	1/540,000 ft²	70 (0.212)	80 (0.180)	100 (0.150)
Permittivity, (sec⁻¹)	ASTM D 4491	1/540,000 ft²	1.5	1.5	1.2
Flow Rate, gpm/ft² (l/min/m²)	ASTM D 4491	1/540,000 ft²	110 (4,480)	110 (4,480)	85 (3,460)
UV Resistance, % Retained	ASTM D 4355 (after 500 hours)	once per formulation	70	70	70

NOTES:

- [a]Gradient of 0.1, normal load of 10,000 psf, water at 70° F (20° C), between stainless steel plates for 15 minutes.
- [b]Component properties prior to lamination.
- [c]Several geotextiles are available and may be supplied as determined by GSE.
- [d]These are MARV values and are based on the cumulative results of specimens tested by GSE. AOS in mm is a maxumum average roll value.

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Appendix B - Minimum Testing Frequencies and Properties for GSE Geonets and Geocomposites

MINIMUM AVERAGE PROPERTIES FOR GSE FABRINET UF

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM AVERAGE ROLL VALUE[d]		
Geocomposite			6 oz/yd²	8 oz/yd²	10 oz/yd²
Product Code:			F82060060S	F820800805	F82100100S
Transmissivity[a], gal/min/ft (m²/sec)	ASTM D 4716-00	1/540,000 ft²	4.35 (9.0 x 10^{-4})	4.35 (9.0 x 10^{-4})	4.35 (9.0 x 10^{-4})
Ply Adhesion, lb/in (g/cm)	GRI GC-7	1/50,000 ft²	1.0 (178)	1.0 (178)	1.0 (178)
Roll Width, ft (m)			14.5 (4.4)	14.5 (4.4)	14.5 (4.4)
Roll Length, ft (m)			160 (48)	150 (45)	140 (42)
Roll Area, ft² (m²)			2,320 (215)	2,175 (202)	2,030 (188)
Geonet core[b]					
Transmissivity[a], gal/min/ft (m²/sec)	ASTM D 4716-00		38.64 (8 x 10^{-3})	38.64 (8 x 10^{-3})	38.64 (8 x 10^{-3})
Thickness, mil (mm)	ASTM D 5199	1/50,000 ft²	300 (7.6)	300 (7.6)	300 (7.6)
Density, g/cm³	ASTM D 1505	1/50,000 ft²	0.94	0.94	0.94
Tensile Strength (MD), lb/in (N/mm)	ASTM D 5035	1/50,000 ft²	75 (13.3)	75 (13.3)	75 (13.3)
Carbon Black Content, %	ASTM D 1603	1/50,000 ft²	2.0	2.0	2.0
Geotextile (prior to lamination)[b,c]					
Mass per Unit Area, oz/yd² (g/m²)	ASTM D 5261	1/90,000 ft²	6 (200)	8 (270)	10 (335)
Grab Tensile, lb (N)	ASTM D 4632	1/90,000 ft²	170 (755)	220 (975)	260 (1,155)
Puncture Strength, lb (N)	ASTM D 4833	1/90,000 ft²	90 (395)	120 (525)	165 (725)
AOS, US Sieve (mm)	ASTM D 4751	1/540,000 ft²	70 (0.212)	80 (0.180)	100 (0.150)
Permittivity, (sec⁻¹)	ASTM D 4491	1/540,000 ft²	1.5	1.5	1.2
Flow Rate, gpm/ft² (l/min/m²)	ASTM D 4491	1/540,000 ft²	110 (4,480)	110 (4,480)	85 (3,460)
UV Resistance, % Retained	ASTM D 4355 (after 500 hours)	once per formulation	70	70	70

NOTES:

- [a]Gradient of 0.1, normal load of 10,000 psf, water at 70° F (20° C), between stainless steel plates for 15 minutes.
- [b]Component properties prior to lamination. Net thickness is a typical value.
- [c]Several geotextiles are available and may be supplied as determined by GSE.
- [d]These are MARV values and are based on the cumulative results of specimens tested by GSE. AOS in mm is a maximum average roll value.

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GSE

Americas	GSE Lining Technology, Inc.	Houston, Texas	800-435-2008	281-443-8564	Fax: 281-230-8650
Europe/Middle East/Africa	GSE Lining Technology GmbH	Hamburg, Germany		49-40-767420	Fax: 49-40-7674233
Asia/Pacific	GSE Lining Technology Company Ltd.	Bangkok, Thailand		66-2-937-0091	Fax: 66-2-937-0097

www.gseworld.com

Madison Co. MSWLF Closure
SUBMITTAL PACKAGE

Note: Individual items are separated by bright colored sheet

SECTION 02623 LLDPE GEOMEMBRANE LINER

SECTION I.D.	SUBMITTAL DESCRIPTION	Comments
	Manufactures Clarifications	
	Material Data Sheet	
02623.2	Panel Layout Drawing	
02623.3	Installers Experience	
02623.3	Record Drawing	Available After Project Completion
02623.22	Quality Control Manuals	

CONTRACTOR

Bob Stout Construction Co., Inc.

A -- Certified to comply with contract drawings and specifications.

B -- Certified to comply with contract drawings and specifications as noted on shop drawings and/or attached sheet(s). (Resubmission not required provided installation conforms as noted).

Signature Bob Stout

Title: President

Date: 10/3/05

SECTION 02623 LLDPE GEOMEMBRANE LINER

Manufactures Clarifications

GSE

GSE Internal Specification Review

Clarifications

Date 22 July 2005

Project No. 518117
Project: Madison County Landfill
Products: 1) 40 mil Min. Double Side Textured HDPE Geomembrane; 2) 6 oz. Double Side 200 mil FabriNet Geocomposite
Sections: 02622 – pages 1 to 7; 02623 – page 4, 5 & 10

Level 1 Exceptions

02623-6, Table 1

GSE asks that the project specifications be amended to standard GSE specifications.

Geomembrane Property	Project Specifications	GSE Specifications
Carbon Black Dispersion	Category 1 or 2	Note 1

Note:

1. As per GRI GM 13, Carbon black dispersion test shall satisfy that 9 of 10 views shall be from Category 1 or 2. No more than 1 view shall be from Category 3.

02622-6, Section 3.01.A

GSE asks that this section be amended with the following statement:

- Direct Shear testing (ASTM D 5321 and D 6243) is a performance test, not an index test. As such, GSE does not perform or certify to direct shear results since the test relies on site-specific conditions. Interface values are greatly affected by (1) the material interface, (2) the rate of displacement, and (3) the normal load applied. However, GSE understands that this test is critical to design confirmation and can supply material to a laboratory of the customer's choice for testing or GSE can have the test performed at an outside laboratory for an additional cost if requested.

Level 2 Exceptions

02622–

GSE asks that the project specifications be amended to standard GSE specifications.

Geocomposite Property	Project Specifications	GSE Specifications
Geonet Component		
Thickness	1/25,000 sf	1/50,000 sf
Carbon Black Content	1/25,000 sf per ASTM D 4218	1/50,000 sf per ASTM D 1603
Tensile Strength	1/25,000 sf per ASTM D 4595	1/50,000 sf per ASTM D 5035
Geocomposite		
Ply Adhesion	1/25,000 sf	1/50,000 sf

Level 3 Exceptions

None

SECTION 02623 LLDPE GEOMEMBRANE LINER

Material Data Sheet

GSE

GSE STANDARD PRODUCTS

Product Data Sheet

GSE UltraFlex Textured

GSE UltraFlex Textured is the coextruded textured version of GSE UltraFlex. It is a high quality, linear low density polyethylene (LLDPE) geomembrane with one or two coextruded, textured surfaces, and consisting of approximately 97.5% polyethylene, 2.5% carbon black and trace amounts of antioxidants and heat stabilizers; no other additives, fillers or extenders are used. The resin used is a specially formulated, proprietary virgin polyethylene and is designed specifically for flexible geomembrane applications. GSE UltraFlex Textured has excellent resistance to UV radiation and is suitable for exposed conditions. This product allows projects with greater slopes to be designed since frictional characteristics are enhanced. *These product specifications meet or exceed GRI GM17.*

Product Specifications

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM VALUE		
Product Code			LUT040A000	LUT060A000	LUT080A000
Thickness, mils (mm) or per project specs	ASTM D 5994	every roll	36 (0.91)	54 (1.4)	72 (1.8)
Density, g/cm³	ASTM D 1505	200,000 lb	0.92	0.92	0.92
Tensile Properties (each direction)[1]	ASTM D 6693, Type IV	20,000 lb			
Strength at Break, lb/in-width (N/mm)	Dumbell, 2 ipm		100 (18)	132 (23)	176 (30)
Elongation at Break, %	G.L. = 2.0 in (51 mm)		500	500	500
Tear Resistance, lb (N)	ASTM D 1004	45,000 lb	22 (98)	33 (147)	44 (200)
Puncture Resistance, lb (N)	ASTM D 4833	45,000 lb	48 (214)	73 (325)	97 (432)
Carbon Black Content, %	ASTM D 1603	20,000 lb	2.0	2.0	2.0
Carbon Black Dispersion	ASTM D 5596	45,000 lb	+Note 1	+Note 1	+Note 1
Asperity Height	GRI GM 12	second roll	+Note 2	+Note 2	+Note 2
REFERENCE PROPERTY	**TEST METHOD**	**FREQUENCY**	**NOMINAL VALUE**		
Oxidative Induction Time, minutes	ASTM D 3895, 200° C O_2, 1 atm	200,000 lb	>100	>100	>100
Roll Length (approximate), ft (m)			700 (213)	520 (158)	400 (122)
Roll Width, ft (m)			22.5 (6.9)	22.5 (6.9)	22.5 (6.9)
Roll Area, ft² (m²)			15,750 (1,463)	11,700 (1,087)	9,000 (836)

Notes:

- +Note 1: Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.
- +Note 2: 10 mil average. 8 of 10 readings ≥7 mils. Lowest individual ≥ 5 mils.
- GSE UltraFlex Textured is available in rolls weighing about 3,900 lb (1,769 kg).
- [1]The combination of stress concentrations due to coextrusion texture geometry and the small specimen size results in large variation of test results. Therefore, these tensile properties are average roll values.
- All GSE geomembranes have dimensional stability of ±2% when tested with ASTM D 1204 and LTB of <-77° C when tested with ASTM D 746.

DS016 R03/10/04

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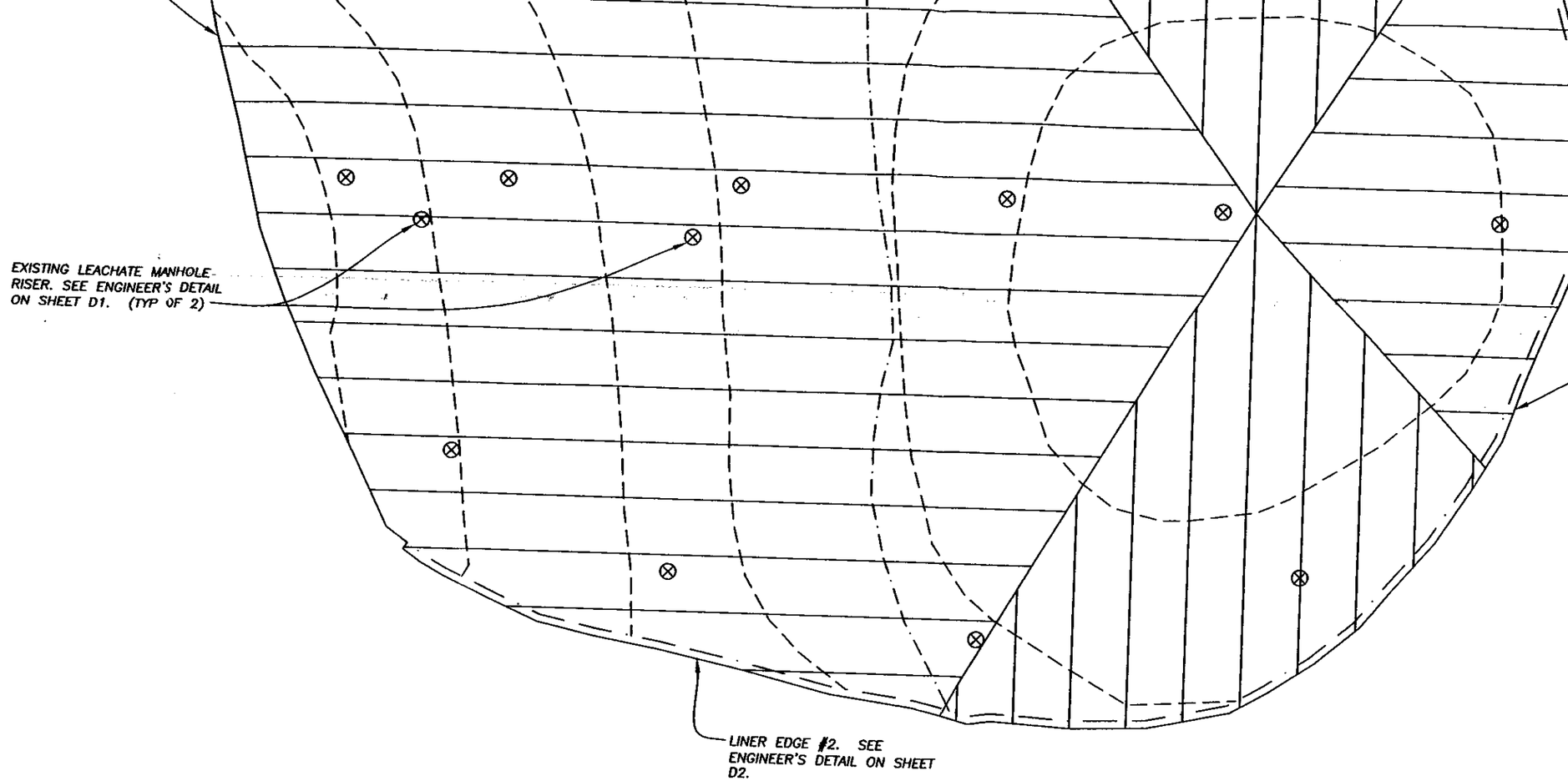
Europe/Middle East/Africa	GSE Lining Technology GmbH	Hamburg, Germany		49-40-767420	Fax: 49-40-7674233
Asia/Pacific	GSE Lining Technology Company Ltd.	Bangkok, Thailand		66-2-937-0091	Fax: 66-2-937-0097

This product data sheet is also available on our website at:

www.gseworld.com

SECTION 02623 LLDPE GEOMEMBRANE LINER

02623.2
Panel Layout Drawing



NOTES:

1. PROPOSED PANEL LAYOUT IS FOR SCHEMATIC PURPOSES ONLY. LAYOUT MAY CHANGE DUE TO VARIATIONS IN FIELD CONDITIONS.
2. GEOMEMBRANE TO BE PROVIDED IN 22 FOOT WIDE MASTER ROLLS.

LEGEND

- CELL OUTLINE
- PANEL OUTLINE
- ⊗ PIPE BOOT
- TERRACE TOE DRAIN

SCALE

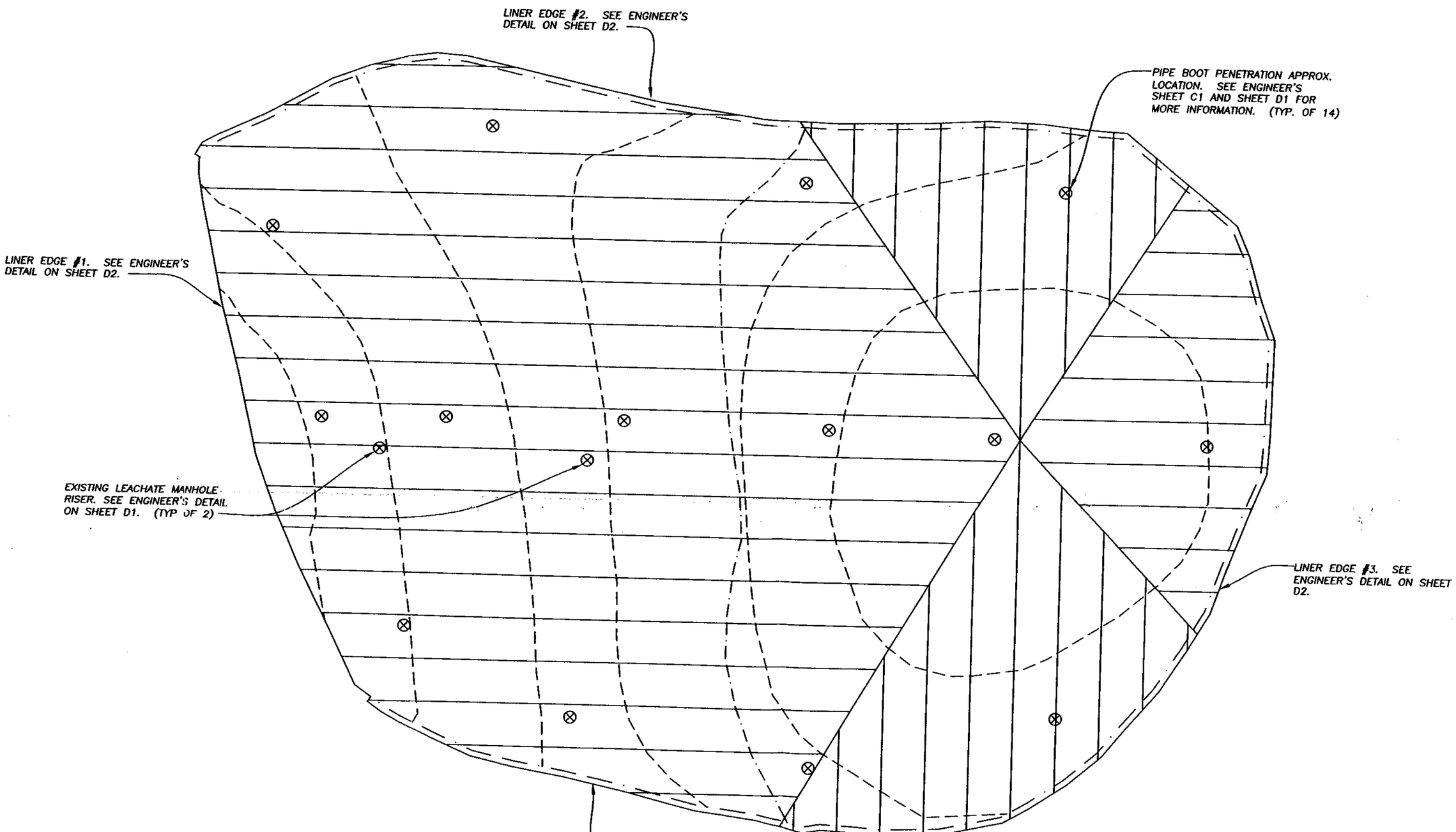
0 25 50

DRAWN BY: ESW	DATE: 09/19/05				
CHKD BY:	DATE:				
SCALE: 1" = 50'-0"					
JOB #: 25084	EST #: L050267	NO.	REVISION DESCRIPTION	DATE	BY

GEO-SYNTHETICS, INC

GEO-SYNTHETICS, INC.
W239 N428 PEWAUKEE ROAD
WAUKESHA, WI 53188
262-524-7979

CLOSURE PLAN
MADISON COUNTY MSW LANDFILL
MADISON COUNTY, NORTH CAROLINA



MATIC
DUE TO

FOOT

SECTION 02623 LLDPE GEOMEMBRANE LINER

02623.3
Installers Experience

GSI PROJECTS
2001 to 2004

Job Name	Location	Date of Install	Type, Thickness HDPE liner and Surface area	Quantity	Unit
Desert Basin Generating Sta. Owner: Reliant Energy Engineer: Black & Veatch 913-458-3902	Casa Grande, AZ	2001/2002	60 mil Geonet GCL Piping	14,700,000	SF
Tri-County Superfund Site Owner: Waste Management, Inc. 402-478-5196 Engineer: HDR 816-360-2710	Elgin, IL	2001/2002	40 mil LLDPE Geonet Geotextile	5,700,000	SF
Woodstock Municipal Superfund Sit Owner: PRP Group Client: Environmental Contractors Illinois Daryl Streed, 815-654-4726 Engineer: CRA 651-639-0913	Rockford, IL	2001/2002	40 mil HDPE Geocomposite	3,900,000	SF
Keystone Power Plant Owner: Reliant Energy Engineer: Parsons 610-855-2000 Client: R & L Development Rich Myers, 724-668-2223	Shelocta, PA	2001	60 mil HDPE GCL Geocomposite Geotextile	4,950,000	SF
Homer City Generating Sta Owner: Penn Power Engineer: Parsons, 610-855-2000 Cli[illegible] R & L Development Rich Myers, 724-668-2223	Homer City, PA	2001	60 mil HDPE Geocomposite Geotextile	4,010,000	SF
Taum Sauk Reservoir Owner/Client: Ameren UE One Ameren Plaza 1901 Chouteau Avenue St. Louis, MO 63166 314-554-3524	Farmington, MO	2004	80 mil textured HDPE 80 mil textued LLDPE Geocomposite	956,316 93,470 819,208	SF SF SF
Los Reales Landfill Owner: City of Tucson Client: RE Monks Construction Engineer: Geo Syntec	Tucson, AZ	2002	60 mil HDPE Geotextile GCL	2,700,000	SF
Shawville Power Station Owner: Reliant Energy Engineer: Kimble & Associates Client: R & L Development Rich Myers, 724-668-2223	Shawville, PA	2002	60 mil HDPE Geocomposite GCL	3,465,000	SF

GSI PROJECTS
2001 to 2004

Sherburne County Generating plant Owner: Excel Energy Becker 13999 Industrial Blvd Becker, MN 55308 763-261-3133 Engineer: Utility Engineering 901 Marquette Avenue Minneapolis, MN 55402	Becker, MN	2003	60 mil smooth HDPE 60 mil textured HDPE	1,521,188 SF 720,252 SF
Wayne Disposal Phase 1 Owner: Wayne Disposal Engineer: Abeltech Client: Wayne Disposal	Belleville, MI	2003	80 mil HDPE GCL Gecomposite	2,560,000 SF
SWA W Palm Beach Owner: West Palm Beach County Engineer: CDM	W Palm Beach, FL	2004	60 mil HDPE GCL Geocomposite	1,937,350 SF
			Total Square Feet	**48,032,784** SF

SECTION 02623 LLDPE GEOMEMBRANE LINER

02623.3
Record Drawing
Available After Project Completion

SECTION 02623 LLDPE GEOMEMBRANE LINER

02623.22
Quality Control Manuals

GSE®

GSE Geomembranes

Geomembranes ▪ Geonets ▪ Geocomposites ▪ GCLs ▪ Geotextiles ▪ Concrete Protection ▪ Installation Services ▪ Fabrications

Manufacturing Quality Assurance Manual

www.gseworld.com

Foreword

This manual contains proprietary information belonging to GSE Lining Technology, Inc. This information is intended to provide a summary of standard quality procedures practiced by GSE's Manufacturing Quality Assurance Laboratories in Houston, Texas. These procedures apply to standard geomembrane materials only and do not explicitly address non-conforming materials.

This manual replaces in its entirety and supersedes all earlier versions issued by GSE Lining Technology, Inc. We suggest you maintain contact with your GSE representative to confirm the validity of this version at future dates.

GSE Lining Technology, Inc. reserves the right to change, modify, or discontinue the use of the policies and procedures described herein without notice or prior consent except as contractually obligated otherwise.

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I. QUALITY MANIFEST

GSE Lining Technology, Inc. is committed to providing the highest quality products and services to our customers. This requires a firm, total quality commitment from all individuals within our organization that we will only supply materials that meet or exceed the requirements and specifications of GSE and our customers.

GSE's commitment to quality starts with the highest quality raw materials. The quality of incoming raw materials is controlled at the supplier level with a complete vendor evaluation program in place. This means purchasing only from suppliers who are committed to statistical process control thereby providing a consistent, high level of quality assurance of their products.

II. MANUFACTURING QUALITY ASSURANCE

GSE Lining Technology, Inc. has an on-site Manufacturing Quality Assurance Laboratory at each manufacturing plant. Having a fully equipped, well staffed, dedicated laboratory at each of the manufacturing facilities allows GSE to maintain a high level of quality and up-to-the-minute results on finished products. Each facility follows the same guidelines for evaluating the quality of GSE products and is capable of adapting to market-driven requirements.

A. Objective

The objective of the GSE Quality Assurance program is to define implementation of basic manufacturing quality assurance (MQA) procedures necessary to ensure consistent production of quality products supplied to the geosynthetic market. Note that at this time, these procedures are limited to polyethylene geomembranes.

B. Scope

In order to achieve GSE's stated purpose, a rigorous set of minimum standards and an effective test program to assure compliance has been established. These procedures and requirements are frequently reviewed and adjusted to assure compliance with current market demands and/or predetermined project specifications. These procedures assure that raw materials and process parameters are controlled to provide products complying with GSE's pre-defined minimum characteristics.

III. MANUFACTURING QUALITY ASSURANCE ORGANIZATION

This organization consists of the Manufacturing Quality Assurance Laboratories as well as the manufacturing personnel. The combination of expertise and experience from these groups provides GSE with the proper tools to maintain the highest level of quality and customer service in the industry.

The Quality Assurance Department at GSE is charged by the President to assure that only products meeting both GSE's and the customer's requirements are released for shipment. The Quality Assurance personnel are directly responsible for monitoring testing and providing feedback to the manufacturing department to ensure the production of the specified product quality. Each member of the Quality Assurance team must participate in detailed training that includes factory exposure.

IV. STAFF AND SCHEDULING

The Quality Assurance Laboratories are staffed whenever manufacturing is occurring; this is usually 24 hours per day, 365 days per year. This minimizes the amount of potentially inferior product produced before a manufacturing problem is identified.

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V. PRODUCT IDENTIFICATION AND DOCUMENTATION

A. Roll Numbering

Each roll of geomembrane is assigned a unique roll number. The Quality Assurance Laboratory maintains records documenting the raw materials and resulting product quality information.

B. Approval Procedure

Results for each tested roll of product are checked against both GSE and customer specifications for compliance. The Quality Assurance Laboratory approves those materials that meet both of these requirements for shipment.

C. Non-Conformance

Material that does not meet GSE minimum standards is given a roll number but is rejected and not placed into inventory. The material is identified as scrap and will not be utilized.

Material that meets GSE minimum standards but does not meet a stricter customer specification is not allocated to that customer but is placed into inventory as GSE standard material.

D. Documentation

Individual Quality Assurance Certificates are generated and supplied for each roll of geomembrane product to include all relevant quality assurance information about the material(s).

VI. RECORDS RETENTION

GSE maintains reports and/or samples for products produced and sold. Records and/or samples are maintained according to GSE's standard retention policy according to the item.

MATERIAL	ITEM	YEARS
Raw materials	Resin Supplier Test Reports and Certifications	≥2
	GSE Resin Test Reports	≥2
	Resin Sample Retain (Archive)	≥2
Geomembrane	Raw Test Data (in computer database)	≥5
	Quality Control Certificates (in computer database)	≥5
	Sample Retain (approximately one square foot)	≥5

VII. TESTING CAPABILITIES

GSE maintains high capacity, state-of-the-art laboratory equipment suitable for performing the procedures listed in Appendices A-D. GSE's Houston laboratories are accredited by the GAI-LAP program. GSE's Houston laboratories, as part of GSE's Product Division, also hold ISO certification. The appropriate certificates are maintained for review upon request by authorized parties.

A. Routine Testing

Through careful investigation, GSE has developed a strict and thorough Quality Assurance program that exceeds the vast majority of customer specifications including GRI GM13, "Test Properties, Testing

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Frequency and Recommended Warranty for High Density Polyethylene (HDPE) Smooth and Textured Geomembranes" and GRI GM17 "Test Properties, Testing Frequency and Recommended Warranty for Linear Low Density Polyethylene (LLDPE) Smooth and Textured Geomembranes". The testing program covers raw materials (see Appendix A) and finished goods (see Appendix B) and is adhered to at all GSE laboratories. The laboratory equipment used by GSE represents the most modern equipment available and meets or exceeds the requirements of all the test standards used.

B. *Other Testing Capabilities*

In addition to routine testing, GSE laboratories are equipped to perform a wide variety of other tests as required for unusual requests or product development. Further, although the GSE Quality Assurance Laboratories are fully equipped and able to perform most routinely specified tests in the industry, there are some tests that are more economically performed by a dedicated testing facility. GSE believes requirements for such testing should be carefully considered and defined in terms of specific design requirements if they are found to be necessary.

VIII. MATERIAL QUALITY ASSURANCE

GSE Lining Technology, Inc. has established strict specifications for all raw materials and finished products. Test results must fall within the acceptable limits of GSE and customer specifications.

A. *Raw Material*

GSE primarily uses two types of raw materials, "natural resin" and "masterbatch" in the manufacture of geomembrane products. Natural resin is the base material that is used to make a geomembrane. It contains stabilizers to prevent degradation from occurring during and after extrusion. "Masterbatch" is the term referring to the concentrated carbon black material used with the natural resin to produce the finished product. The natural resin and masterbatch are blended at the appropriate ratio at the manufacturing stage. The masterbatch can contain other additives depending upon the geomembrane product to be produced. GSE verifies the properties of each lot of raw material prior to their utilization.

When natural resin is received, samples are taken and subjected to the tests outlined in Appendix A. All test data are entered into the computer database and checked for accuracy, consistency and compliance with GSE specifications. The material is not accepted unless all standard test requirements are met and the GSE test values meet the requirements set forth in the raw material specifications.

Copies of the supplier's certificate of analysis (COA) for each lot of resin utilized in the production of the materials supplied to a specific project are supplied as standard documentation. In addition, the GSE test results for each lot of resin are provided in a separate report upon request.

Virgin resin is normally received in rail car lots. If resin is received by other transport and/or in other quantities, an equivalent suitable sampling procedure is provided (i.e. not less than one sample per shipment or one sample for each 50,000 lb., 23,000 kg)

B. *Geomembrane Products*

GSE has implemented a strict and thorough Quality Assurance program for all geomembrane products. The geomembrane product line can be broken into two primary categories: smooth and textured products. Tables containing GSE minimum properties and test frequencies for all GSE geomembrane products includ-

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ing specialty products such as GSE White (light-reflective geomembrane) and GSE Conductive (field spark-testable geomembrane) are in Appendix B.

1. *On-Line Manufacturing Quality Assurance*

The Quality Assurance program for finished product begins during the manufacturing process. Each manufacturing line is equipped with state-of-the-art monitoring devices that provide feedback on the physical quality of the materials being produced. Each geomembrane production line is equipped with both a thickness gage and spark-testing device.

a) Thickness Measurement

As geomembrane is being produced, thickness readings are taken continuously over the length and width of the roll. These data are used to establish the minimum, maximum and average thickness values for each roll and are verified by thickness testing upon sampling of the finished goods.

b) Spark Testing

An electrical spark detector is in place on each manufacturing sheet line. This apparatus provides immediate notification of holes in the finished product. If a hole is detected, an alarm is triggered and the hole is identified. Rolls containing holes are rejected from standard product inventory.

2. *Smooth Geomembrane Materials*

Smooth geomembrane products available include high density and linear low density polyethylene materials with 2-3% carbon black. Specialty materials include White, electrically conductive, green surfaced, and smooth edge textured geomembranes.

a) Sampling

Geomembrane rolls are sampled for QA testing according to the frequencies in Appendix B. An approximate one-foot by roll width sample is cut for Quality Assurance testing. Specimens for testing are taken from five predetermined positions across the width of the roll. Specimens are cut for testing the machine direction and transverse direction. A "retain" or archive sample approximately 12 x 12 inch (30 x 30 cm) is taken from the corresponding transverse direction position from the laboratory sample. The retain is labeled and kept for future reference (see Section VI).

b) Evaluation of Results

All data are entered into a computer database for calculation and comparison to GSE and customer-specific specifications. If materials do not meet GSE minimums and/or the customer specifications, the manufacturing personnel are immediately notified in order for the appropriate adjustments to be made. Only products meeting GSE minimums and customer specifications will be approved for shipment.

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c) Reporting

Every roll of material has a quality assurance roll certificate or Roll Test Data Report (RTDR). This report identifies the standards on which the GSE approval is based along with the actual test results demonstrated by the material.

3. *Coextruded Textured Geomembranes*

Textured geomembrane is produced utilizing a round die with coextrusion technology. The texture is produced in a process in which one or two of the outer layers of a three-layer extrusion are blended with nitrogen gas. Nitrogen bubbles form in the molten resin and escape upon exiting the die, creating a rough, textured surface. Regular, White, green surfaced, and conductive geomembranes are available with coextruded texturing.

a) Sampling

Geomembrane rolls are sampled for QA testing according to the frequencies in Appendix B. An approximate one-foot by roll width sample is cut for Quality Assurance testing. Specimens for testing are taken from five predetermined positions across the width of the roll. Specimens for testing the machine and transverse direction tensile are cut from each of the five positions. A "retain" or archive sample approximately 12 x 12 inch (30 x 30 cm) is taken from the corresponding transverse direction position from the laboratory sample. The retain is labeled and kept for future reference (see Section VI).

Evaluation of results and reporting practices are the same as for smooth geomembranes.

C. *Third Party Conformance Sampling*

Some specifications require independent Quality Assurance and/or conformance testing. GSE can provide assistance with the sampling of products by arranging for the conformance samples to be taken during production. By taking samples during production rather than on site, the customer can be assured that the samples are clean and available for conformance testing in a timely manner.

GSE encourages customers to audit GSE manufacturing and manufacturing quality assurance operations and/or to collect samples and conduct independent conformance testing prior to shipment of materials.

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Appendix A - Minimum Testing Frequencies and Properties for GSE Raw Materials

MINIMUM TESTING FREQUENCIES FOR GSE RAW MATERIALS

Property	Test Method[1]	Natural Resin
Density	ASTM D 1505	once per rail car compartment
Melt Flow Index	ASTM D 1238 (190/2.16)	once per rail car compartment
OIT	ASTM D 3895 (1 ATM at 200° C)	once per resin lot
Carbon Black Content	ASTM D 1603, modified	N/A
Carbon Black Dispersion	ASTM D 5596	NA

[1] GSE utilizes test equipment and procedures that enable effective and economical confirmation that the product will conform to specifications based on the noted procedures. Some test procedures have been modified for application to geosynthetics. All procedures and values are subject to change without prior notification.

MINIMUM PROPERTIES FOR GSE RAW MATERIALS

Property	Test Method[1]	HDPE	LLDPE
Density [g/cm³]	ASTM D 1505	0.932	0.915
Melt Flow Index [g/10 min]	ASTM D 1238 (190/2.16)	≤ 1.0	≤ 1.0
OIT [minutes]	ASTM D 3895 (1 ATM at 200° C)	100	100

[1] GSE utilizes test equipment and procedures that enable effective and economical confirmation that the product will conform to specifications based on the noted procedures. Some test procedures have been modified for application to geosynthetics. All procedures and values are subject to change without prior notification.

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Appendix B - Minimum Testing Frequencies and Properties for GSE Geomembranes

MINIMUM PROPERTIES FOR GSE HD

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM VALUE				
Product Code			HDE 030A000	HDE 040A000	HDE 060A000	HDE 080A000	HDE 100A000
Thickness, mils (mm) or per project specs	ASTM D 5199	every roll	27 (0.69)	36 (0.91)	54 (1.4)	72 (1.8)	90 (2.3)
Density, g/cm³	ASTM D 1505	200,000 lb	0.94	0.94	0.94	0.94	0.94
Tensile Properties (each direction)	ASTM D 6693, Type IV	20,000 lb					
Strength at Break, lb/in-width (N/mm)	Dumbell, 2 ipm		122 (21)	162 (28)	243 (43)	324 (57)	405 (71)
Strength at Yield, lb/in-width (N/mm)			63 (11)	84 (15)	130 (23)	173 (30)	216 (38)
Elongation at Break, %	G.L. 2.0 in (51 mm)		700	700	700	700	700
Elongation at Yield, %	G.L. 1.3 in (33 mm)		13	13	13	13	13
Tear Resistance, lb (N)	ASTM D 1004	45,000 lb	21 (93)	28 (125)	42 (187)	56 (249)	70 (311)
Puncture Resistance, lb (N)	ASTM D 4833	45,000 lb	59 (263)	79 (352)	119 (530)	158 (703)	180 (800)
Carbon Black Content, %	ASTM D 1603	20,000 lb	2.0	2.0	2.0	2.0	2.0
Carbon Black Dispersion	ASTM D 5596	45,000 lb	+Note 1	+Note 1	+Note 1	+Note 1	+Note 1
Notched Constant Tensile Load, hrs	ASTM D 5397, Appendix	200,000 lb	400	400	400	400	400
REFERENCE PROPERTY	TEST METHOD	FREQUENCY	NOMINAL VALUE				
Oxidative Induction Time, minutes	ASTM D 3895, 200° C; O_2, 1 atm	200,000 lb	>100	>100	>100	>100	>100
Roll Length (approximate), ft (m)			1,120 (341)	870 (265)	560 (171)	430 (131)	340 (104)
Roll Width, ft (m)			22.5 (6.9)	22.5 (6.9)	22.5 (6.9)	22.5 (6.9)	22.5 (6.9)
Roll Area, ft² (m²)			25,200 (2,341)	19,575 (1,819)	12,600 (1,171)	9,675 (899)	7,650 (711)

NOTES:

- +Note 1: Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.
- GSE HD is available in rolls weighing about 3,900 lb (1,769 kg)
- All GSE geomembranes have dimensional stability of ±2% when tested with ASTM D 1204 and LTB of <-77° C when tested with ASTM D 746.

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Appendix B - Minimum Testing Frequencies and Properties for GSE Geomembranes

MINIMUM PROPERTIES FOR GSE WHITE

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM VALUE				
Product Code			HDE 030A010	HDE 040A010	HDE 060A010	HDE 080A010	HDE 100A010
Thickness, mils (mm) or per project specs	ASTM D 5199	every roll	27 (0.69)	36 (0.91)	54 (1.4)	72 (1.8)	90 (2.3)
Density, g/cm³	ASTM D 1505	200,000 lb	0.94	0.94	0.94	0.94	0.94
Tensile Properties (each direction)	ASTM D 6693, Type IV	20,000 lb					
Strength at Break, lb/in-width (N/mm)	Dumbell, 2 ipm		122 (21)	162 (28)	243 (43)	324 (57)	405 (71)
Strength at Yield, lb/in-width (N/mm)			63 (11)	84 (15)	130 (23)	173 (30)	216 (38)
Elongation at Break, %	G.L. = 2.0 in (51 mm)		700	700	700	700	700
Elongation at Yield, %	G.L. = 1.3 in (33 mm)		13	13	13	13	13
Tear Resistance, lb (N)	ASTM D 1004	45,000 lb	21 (93)	28 (125)	42 (187)	56 (249)	70 (311)
Puncture Resistance, lb (N)	ASTM D 4833	45,000 lb	59 (263)	79 (352)	119 (530)	158 (703)	180 (800)
Carbon Black Content[1], %	ASTM D 1603, black layer	20,000 lb	2.0	2.0	2.0	2.0	2.0
Carbon Black Dispersion	ASTM D 5596	45,000 lb	+Note 1	+Note 1	+Note 1	+Note 1	+Note 1
Notched Constant Tensile Load, hrs	ASTM D 5397, Appendix	200,000 lb	400	400	400	400	400
REFERENCE PROPERTY	**TEST METHOD**	**FREQUENCY**	**NOMINAL VALUE**				
Oxidative Induction Time, minutes	ASTM D 3895, 200° C; O_2, 1 atm	200,000 lb	>100	>100	>100	>100	>100
Roll Length (approximate), ft (m)			1,120 (341)	870 (265)	560 (171)	430 (131)	340 (104)
Roll Width, ft (m)			22.5 (6.9)	22.5 (6.9)	22.5 (6.9)	22.5 (6.9)	22.5 (6.9)
Roll Area, ft² (m²)			25,200 (2,341)	19,575 (1,819)	12,600 (1,171)	9,675 (899)	7,650 (711)

Notes:

- +Note 1: Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.
- GSE White is available in rolls weighing about 3,900 lb (1,769 kg).
- [1] GSE White may have an overall ash content greater than 3.0% due to the white layer.
- All GSE geomembranes have dimensional stability of ±2% when tested with ASTM D 1204 and LTB of <-77° C when tested with ASTM D 746.

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Appendix B - Minimum Testing Frequencies and Properties for GSE Geomembranes

MINIMUM PROPERTIES FOR GSE CONDUCTIVE

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM VALUE			
Product Code			HDC 040A000	HDC 060A000	HDC 080A000	HDC 100A000
Thickness, mils (mm) or per project specs	ASTM D 5199	every roll	36 (0.91)	54 (1.4)	72 (1.8)	90 (2.3)
Density, g/cm³	ASTM D 1505	200,000 lb	0.94	0.94	0.94	0.94
Tensile Properties (each direction)[1]	ASTM D 6693, Type IV	20,000 lb				
Strength at Break, lb/in-width (N/mm)	Dumbell, 2 ipm		162 (28)	243 (43)	324 (57)	405 (71)
Strength at Yield, lb/in-width (N/mm)			84 (15)	130 (23)	173 (30)	216 (38)
Elongation at Break, %	G.L. = 2.0 in (51 mm)		700	700	700	700
Elongation at Yield, %	G.L. = 1.3 in (33 mm)		13	13	13	13
Tear Resistance, lb (N)	ASTM D 1004	45,000 lb	28 (125)	42 (187)	56 (249)	70 (311)
Puncture Resistance, lb (N)	ASTM D 4833	45,000 lb	79 (352)	119 (530)	158 (703)	180 (800)
Carbon Black Content[2], %	ASTM D 1603	20,000 lb	2.0	2.0	2.0	2.0
Carbon Black Dispersion	ASTM D 5596	45,000 lb	+Note 1	+Note 1	+Note 1	+Note 1
Notched Constant Tensile Load, hrs	ASTM D 5397, Appendix	200,000 lb	400	400	400	400
REFERENCE PROPERTY	**TEST METHOD**	**FREQUENCY**	**NOMINAL VALUE**			
Oxidative Induction Time, minutes	ASTM D 3895, 200° C; O_2, 1 atm	200,000 lb	>100	>100	>100	>100
Roll Length (approximate), ft (m)			870 (265)	560 (171)	430 (131)	340 (104)
Roll Width, ft (m)			22.5 (6.9)	22.5 (6.9)	22.5 (6.9)	22.5 (6.9)
Roll Area, ft² (m²)			19,575 (1,819)	12,600 (1,171)	9,675 (899)	7,650 (711)

NOTES:

- +Note 1: Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.
- GSE Conductive is available in rolls weighing about 3,900 lb (1,769 kg).
- [1]Due to surface effects caused by the conductive layer, these tensile properties are minimum average values.
- [2]GSE Conductive may have an overall carbon black percentage above 3.0% due to the high carbon black loadings in the conductive layer.
- All GSE geomembranes have dimensional stability of ±2% when tested with ASTM D 1204 and LTB of <-77° C when tested with ASTM D 746.

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MINIMUM PROPERTIES FOR GSE CONDUCTIVE WHITE

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM VALUE			
Product Code			HDC 040A010	HDC 060A010	HDC 080A010	HDC 100A010
Thickness, mils (mm) or per project specs	ASTM D 5199	every roll	36 (0.91)	54 (1.4)	72 (1.8)	90 (2.3)
Density, g/cm³	ASTM D 1505	200,000 lb	0.94	0.94	0.94	0.94
Tensile Properties (each direction)[1]	ASTM D 6693, Type IV	20,000 lb				
Strength at Break, lb/in-width (N/mm)	Dumbell, 2 ipm		162 (28)	243 (43)	324 (57)	405 (71)
Strength at Yield, lb/in-width (N/mm)			84 (15)	130 (23)	173 (30)	216 (38)
Elongation at Break, %	G.L. = 2.0 in (51 mm)		700	700	700	700
Elongation at Yield, %	G.L. = 1.3 in (33 mm)		13	13	13	13
Tear Resistance, lb (N)	ASTM D 1004	45,000 lb	28 (125)	42 (187)	56 (249)	70 (311)
Puncture Resistance, lb (N)	ASTM D 4833	45,000 lb	79 (352)	119 (530)	158 (703)	180 (800)
Carbon Black Content[2], %	ASTM D 1603	20,000 lb	2.0	2.0	2.0	2.0
Carbon Black Dispersion	ASTM D 5596	45,000 lb	+Note 1	+Note 1	+Note 1	+Note 1
Notched Constant Tensile Load, hrs	ASTM D 5397, Appendix	200,000 lb	400	400	400	400
REFERENCE PROPERTY	**TEST METHOD**	**FREQUENCY**	**NOMINAL VALUE**			
Oxidative Induction Time, minutes	ASTM D 3895, 200° C; O_2, 1 atm	200,000 lb	>100	>100	>100	>100
Roll Length (approximate), ft (m)			870 (265)	560 (171)	430 (131)	340 (104)
Roll Width, ft (m)			22.5 (6.9)	22.5 (6.9)	22.5 (6.9)	22.5 (6.9)
Roll Area, ft² (m²)			19,575 (1,819)	12,600 (1,171)	9,675 (899)	7,650 (711)

NOTES:

- +Note 1: Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.
- GSE Conductive White is available in rolls weighing about 3,900 lb (1,769 kg).
- [1]Due to surface effects caused by the conductive layer, these tensile properties are minimum average values.
- [2]GSE Conductive White may have an overall ash content greater than 3.0% due to the white and conductive outer layers.
- All GSE geomembranes have dimensional stability of ±2% when tested with ASTM D 1204 and LTB of <-77° C when tested with ASTM D 746.

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Appendix B - Minimum Testing Frequencies and Properties for GSE Geomembranes

MINIMUM PROPERTIES FOR GSE HD TEXTURED

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM VALUE				
Product Code			HDT 030A000	HDT 040A000	HDT 060A000	HDT 080A000	HDT 100A000
Thickness, mils (mm) or per project specs	ASTM D 5994	every roll	27 (0.69)	36 (0.91)	54 (1.4)	72 (1.8)	90 (2.3)
Density, g/cm³	ASTM D 1505	200,000 lb	0.94	0.94	0.94	0.94	0.94
Tensile Properties (each direction)[1]	ASTM D 6693, Type IV Dumbell, 2 ipm	20,000 lb					
Strength at Break, lb/in-width (N/mm)			45 (8)	60 (11)	90 (16)	120(21)	150 (27)
Strength at Yield, lb/in-width (N/mm)			63 (11)	84 (15)	130 (23)	173 (30)	216 (38)
Elongation at Break, %	G.L. = 2.0 in (51 mm)		150	150	150	150	150
Elongation at Yield, %	G.L. = 1.3 in (33 mm)		13	13	13	13	13
Tear Resistance, lb (N)	ASTM D 1004	45,000 lb	21 (93)	28 (125)	42 (187)	56 (249)	70 (311)
Puncture Resistance, lb (N)	ASTM D 4833	45,000 lb	54 (240)	72 (320)	108 (480)	144 (641)	150 (667)
Carbon Black Content, %	ASTM D 1603	20,000 lb	2.0	2.0	2.0	2.0	2.0
Carbon Black Dispersion	ASTM D 5596	45,000 lb	+Note 1	+Note 1	+Note 1	+Note 1	+Note 1
Asperity Height	GRI GM 12	second roll	+Note 2	+Note 2	+Note 2	+Note 2	+Note 2
Notched Constant Tensile Load[2], hrs	ASTM D 5397, Appendix	200,000 lb	400	400	400	400	400
REFERENCE PROPERTY	**TEST METHOD**	**FREQUENCY**	**NOMINAL VALUE**				
Oxidative Induction Time, minutes	ASTM D 3895, 200° C; O_2, 1 atm	200,000 lb	>100	>100	>100	>100	>100
Roll Length (approximate), ft (m)	Standard Textured		830 (253)	700 (213)	520 (158)	400 (122)	330 (101)
Roll Width, ft (m)			22.5 (6.9)	22.5 (6.9)	22.5 (6.9)	22.5 (6.9)	22.5 (6.9)
Roll Area, ft² (m²)			18,674 (1,735)	15,750 (1,463)	11,700 (1,087)	9,000 (836)	7,425 (690)

NOTES:

- +Note 1: Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.
- +Note 2: 10 mil average. 8 of 10 readings ≥7 mils. Lowest individual ≥ 5 mils.
- GSE HD Standard Textured is available in rolls weighing about 4,000 lb (1,800 kg).
- [1]The combination of stress concentrations due to coextrusion texture geometry and the small specimen size results in large variation of test results. Therefore, these tensile properties are minimum average values.
- [2]NCTL for HD Textured is conducted on representative smooth membrane samples.
- All GSE geomembranes have dimensional stability of ±2% when tested with ASTM D 1204 and LTB of <-77° C when tested with ASTM D 746.

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Appendix B - Minimum Testing Frequencies and Properties for GSE Geomembranes

MINIMUM PROPERTIES FOR GSE WHITE TEXTURED

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM VALUE			
Product Code			HDT 040A010	HDT 060A010	HDT 080A010	HDT 100A010
Thickness, mils (mm) or per project specs	ASTM D 5994	every roll	36 (0.91)	54 (1.4)	72 (1.8)	90 (2.3)
Density, g/cm³	ASTM D 1505	200,000 lb	0.94	0.94	0.94	0.94
Tensile Properties (each direction)[1]	ASTM D 6693, Type IV Dumbell, 2 ipm	20,000 lb				
Strength at Break, lb/in-width (N/mm)			60 (11)	90 (16)	120 (21)	150 (27)
Strength at Yield, lb/in-width (N/mm)			84 (15)	130 (23)	173 (30)	216 (38)
Elongation at Break, %	G.L. = 2.0 in (51 mm)		150	150	150	150
Elongation at Yield, %	G.L. = 1.3 in (33 mm)		13	13	13	13
Tear Resistance, lb (N)	ASTM D 1004	45,000 lb	28 (125)	42 (187)	56 (249)	70 (311)
Puncture Resistance, lb (N)	ASTM D 4833	45,000 lb	72 (320)	108 (480)	144 (641)	150 (667)
Carbon Black Content[2], %	ASTM D 1603	20,000 lb	2.0	2.0	2.0	2.0
Carbon Black Dispersion	ASTM D 5596	45,000 lb	+Note 1	+Note 1	+Note 1	+Note 1
Asperity Height	GRI GM 12	second roll	+Note 2	+Note 2	+Note 2	+Note 2
Notched Constant Tensile Load[3], hrs	ASTM D 5397, Appendix	200,000 lb	400	400	400	400
REFERENCE PROPERTY	**TEST METHOD**	**FREQUENCY**	**NOMINAL VALUE**			
Oxidative Induction Time, minutes	ASTM D 3895, 200° C; O_2, 1 atm	200,000 lb	>100	>100	>100	>100
Roll Length (approximate), ft (m)			700 (213)	520 (158)	400 (122)	330 (101)
Roll Width, ft (m)			22.5 (6.9)	22.5 (6.9)	22.5 (6.9)	22.5 (6.9)
Roll Area, ft² (m²)			15,750 (1,463)	11,700 (1,087)	9,000 (836)	7,425 (690)

NOTES:

- +Note 1: Dispersion only applies to near spherical agglomerates. 9 or 10 views shall be Category 1 or 2. No more than 1 view from Category 3.
- +Note 2: 10 mil average. 8 of 10 readings ≥7 mils. Lowest individual ≥ 5 mils.
- GSE White Textured is available in rolls weighing about 4,000 lb (1,800 kg).
- [1]The combination of stress concentrations due to coextrusion texture geometry and the small specimen size results in large variation of test results. Therefore, these tensile properties are minimum average values.
- [2]GSE White Textured may have an overall ash content greater than 3.0% due to the white layer.
- [3]NCTL is conducted on representative smooth membrane samples.
- All GSE geomembranes have dimensional stability of ±2% when tested with ASTM D 1204 and LTB of <-77° C when tested with ASTM D 746.

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MINIMUM PROPERTIES FOR GSE ULTRAFLEX

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM VALUE			
Product Code			LLD 030A000	LLD 040A000	LLD 060A000	LLD 080A000
Thickness, mils (mm) or per project specs	ASTM D 5199	every roll	27 (0.69)	36 (0.91)	54 (1.4)	72 (1.8)
Density, g/cm³	ASTM D 1505	200,000 lb	0.92	0.92	0.92	0.92
Tensile Properties (each direction)	ASTM D 6693, Type IV	20,000 lb				
Strength at Break, lb/in-width (N/mm)	Dumbell, 2 ipm		114 (20)	152 (27)	228 (40)	304 (53)
Elongation at Break, %	G.L. = 2.0 in (51 mm)		850	850	850	850
Tear Resistance, lb (N)	ASTM D 1004	45,000 lb	16 (71)	22 (98)	33 (147)	44 (200)
Puncture Resistance, lb (N)	ASTM D 4833	45,000 lb	46 (205)	62 (276)	92 (409)	123 (547)
Carbon Black Content, %	ASTM D 1603	20,000 lb	2.0	2.0	2.0	2.0
Carbon Black Dispersion	ASTM D 5596	45,000 lb	+Note 1	+Note 1	+Note 1	+Note 1
REFERENCE PROPERTY	**TEST METHOD**	**FREQUENCY**	**NOMINAL VALUE**			
Oxidative Induction Time, minutes	ASTM D 3895, 200° C 1 ATM	200,000 lb	>100	>100	>100	>100
Roll Length (approximate), ft (m)			1,120 (341)	870 (265)	560 (171)	430 (131)
Roll Width, ft (m)			22.5 (6.9)	22.5 (6.9)	22.5 (6.9)	22.5 (6.9)
Roll Area, ft² (m²)			25,200 (2,341)	19,575 (1,819)	12,600 (1,171)	9,675 (899)

NOTES:

- +Note 1: Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.
- GSE UltraFlex is available in rolls weighing about 3,800 lb (1,724 kg) respectively.
- All GSE geomembranes have dimensional stability of ±2% when tested with ASTM D 1204 and LTB of <-77° C when tested with ASTM D 746.

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MINIMUM PROPERTIES FOR GSE ULTRAFLEX WHITE

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM VALUE	
Product Code			LLD040A010	LLD060A010
Thickness, mils (mm) or per project specs	ASTM D 5199	every roll	36 (0.91)	54 (1.4)
Density, g/cm³	ASTM D 1505	200,000 lb	0.92	0.92
Tensile Properties (each direction)	ASTM D 6693, Type IV	20,000 lb		
Strength at Break, lb/in-width (N/mm)	Dumbell, 2 ipm		152 (27)	228 (40)
Elongation at Break, %	G.L. = 2.0 in (51 mm)		850	850
Tear Resistance, lb (N)	ASTM D 1004	45,000 lb	22 (98)	33 (147)
Puncture Resistance, lb (N)	ASTM D 4833	45,000 lb	62 (276)	92 (409)
Carbon Black Content[1], %	ASTM D 1603	20,000 lb	2.0	2.0
Carbon Black Dispersion	ASTM D 5596	45,000 lb	+Note 1	+Note 1
REFERENCE PROPERTY	**TEST METHOD**	**FREQUENCY**	**NOMINAL VALUE**	
Oxidative Induction Time (minutes)	ASTM D 3895 200° C O_2 1 atm.	200,000 lb	>100	>100
Roll Length (approximate), ft (m)			870 (265)	560 (171)
Roll Width, ft (m)			22.5 (6.9)	22.5 (6.9)
Roll Area, ft² (m²)			19,575 (1,819)	12,600 (1,171)

NOTES:

- +Note 1: Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.
- GSE UltraFlex White is available in rolls weighing about 3,800 lb (1,724 kg).
- [1]GSE UltraFlex White may have an overall ash content greater than 3.0% due to the white layer.
- All GSE geomembranes have dimensional stability of ±2% when tested with ASTM D 1204 and LTB of <-77° C when tested with ASTM D 746.

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Appendix B - Minimum Testing Frequencies and Properties for GSE Geomembranes

MINIMUM PROPERTIES FOR GSE ULTRAFLEX TEXTURED

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM VALUE		
Product Code			LUT040A000	LUT060A000	LUT080A000
Thickness, mils (mm) or per project specs	ASTM D 5994	every roll	36 (0.91)	54 (1.4)	72 (1.8)
Density, g/cm³	ASTM D 1505	200,000 lb	0.92	0.92	0.92
Tensile Properties (each direction)[1]	ASTM D 6693, Type IV	20,000 lb			
Strength at Break, lb/in-width (N/mm)	Dumbell, 2 ipm		100 (18)	132 (23)	176 (30)
Elongation at Break, %	G.L. = 2.0 in (51 mm)		500	500	500
Tear Resistance, lb (N)	ASTM D 1004	45,000 lb	22 (98)	33 (147)	44 (200)
Puncture Resistance, lb (N)	ASTM D 4833	45,000 lb	48 (214)	73 (325)	97 (432)
Carbon Black Content, %	ASTM D 1603	20,000 lb	2.0	2.0	2.0
Carbon Black Dispersion	ASTM D 5596	45,000 lb	+Note 1	+Note 1	+Note 1
Asperity Height	GRI GM 12	second roll	+Note 2	+Note 2	+Note 2
REFERENCE PROPERTY	**TEST METHOD**	**FREQUENCY**	**NOMINAL VALUE**		
Oxidative Induction Time, minutes	ASTM D 3895, 200° C O_2, 1 atm	200,000 lb	>100	>100	>100
Roll Length (approximate), ft (m)			700 (213)	520 (158)	400 (122)
Roll Width, ft (m)			22.5 (6.9)	22.5 (6.9)	22.5 (6.9)
Roll Area, ft² (m²)			15,750 (1,463)	11,700 (1,087)	9,000 (836)

Notes:

- +Note 1: Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.
- +Note 2: 10 mil average. 8 of 10 readings ≥7 mils. Lowest individual ≥ 5 mils.
- GSE UltraFlex Textured is available in rolls weighing about 3,900 lb (1,769 kg).
- [1]The combination of stress concentrations due to coextrusion texture geometry and the small specimen size results in large variation of test results. Therefore, these tensile properties are average roll values.
- All GSE geomembranes have dimensional stability of ±2% when tested with ASTM D 1204 and LTB of <-77° C when tested with ASTM D 746.

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Appendix B - Minimum Testing Frequencies and Properties for GSE Geomembranes

MINIMUM PROPERTIES FOR GSE ULTRAFLEX WHITE TEXTURED

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM VALUE		
Product Code			LUT040A010	LUT060A010	LUT080A010
Thickness, mils (mm) or per project specs	ASTM D 5994	every roll	36 (0.91)	54 (1.4)	72 (1.8)
Density, g/cm³	ASTM D 1505	200,000 lb	0.92	0.92	0.92
Tensile Properties (each direction)[1]	ASTM D 6993, Type IV	20,000 lb			
Strength at Break, lb/in-width (N/mm)	Dumbell, 2 ipm		100 (18)	132 (23)	176 (30)
Elongation at Break, %	G.L. = 2.0 in (51 mm)		500	500	500
Tear Resistance, lb (N)	ASTM D 1004	45,000 lb	22 (98)	33 (147)	44 (200)
Puncture Resistance, lb (N)	ASTM D 4833	45,000 lb	48 (214)	73 (325)	97 (432)
Carbon Black Content[2], %	ASTM D 1603	20,000 lb	2.0	2.0	2.0
Carbon Black Dispersion	ASTM D 5596	45,000 lb	+Note 1	+Note 1	+Note 1
Asperity Height	GRI GM 12	second roll	+Note 2	+Note 2	+Note 2
REFERENCE PROPERTY	**TEST METHOD**	**FREQUENCY**	**NOMINAL VALUE**		
Oxidative Induction Time (minutes)	ASTM D 3895 200° C, O_2, 1 atm	200,000 lb	>100	>100	>100
Roll Length (approximate), ft (m)			700 (213)	520 (158)	400 (122)
Roll Width, ft (m)			22.5 (6.9)	22.5 (6.9)	22.5 (6.9)
Roll Area, ft² (m²)			15,750 (1,463)	11,700 (1,087)	9,000 (836)

NOTES:

- +Note 1: Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.
- +Note 2: 10 mil average. 8 of 10 readings ≥7 mils. Lowest individual ≥ 5 mils.
- GSE UltraFlex White Textured is available in rolls weighing about 3,900 lb (1,769 kg).
- [1]The combination of stress concentrations due to coextrusion texture geometry and the small specimen size results in large variation of test results. Therefore, these tensile properties are average roll values.
- [2]GSE UltraFlex White Textured may have an overall ash content greater than 3.0% due to the white layer.
- All GSE geomembranes have dimensional stability of ±2% when tested with ASTM D 1204 and LTB of <-77° C when tested with ASTM D 746.

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Appendix C - Minimum Weld Properties for GSE Geomembrane Products

MINIMUM WELD PROPERTIES FOR STANDARD HDPE GEOMEMBRANES[1]

Property	Test Method	30 (0.75)	40 (1.0)	60 (1.5)	80 (2.0)	100 (2.5)	120 (3.0)
Peel Strength (fusion), ppi (kN/m)	ASTM D 6392	49 (8.6)	65 (11.4)	98 (17.2)	130 (22.8)	162 (28.4)	196 (34.3)
Peel Strength (extrusion), ppi (kN/m)	ASTM D 6392	39 (6.8)	52 (9.1)	78 (13.7)	104 (18.2)	130 (22.8)	157 (27.5)
Shear Strength (fusion & ext), ppi (kN/m)	ASTM D 6392	61 (10.7)	81 (14.2)	121 (21.2)	162 (28.4)	203 (35.5)	242 (42.4)

[1] These values apply to both coextruded and flat cast produced geomembranes and white-surfaced and conductive products.

MINIMUM WELD PROPERTIES FOR STANDARD LLDPE GEOMEMBRANES[1]

Property	Test Method	30 (0.75)	40 (1.0)	60 (1.5)	80 (2.0)	100 (2.5)
Peel Strength (extrusion) ppi (kN/m)	ASTM D 6392	36 (6.3)	48 (8.4)	72 (12.6)	96 (16.8)	120 (21.0)
Peel Strength (fusion), ppi (kN/m)	ASTM D 6392	38 (6.7)	50 (8.8)	75 (13.1)	100 (17.5)	125 (21.9)
Shear Strength (fusion & ext), ppi (kN/m)	ASTM D 6392	45 (7.9)	60 (10.5)	90 (15.8)	120 (21.0)	150 (26.3)

[1] These values apply to both coextruded and flat cast produced geomembranes to include white-surfaced products.

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GEO-SYNTHETICS, INC.

GEO-SYNTHETICS, INC. FIELD QUALITY CONTROL MANUAL

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1.0 INTRODUCTION

1.1 Purpose

This manual addresses the Quality Control Program developed and utilized by Geo-Synthetics, Inc. Installation personnel are present to assure the quality of workmanship and the installation integrity of geomembranes and other Geosynthetic products.

1.2 Scope

All Geo-Synthetics components of lining systems will be addressed in this manual, including geomembranes, geotextiles, geonets and bentonite mats. Geo-Synthetics, Inc. recognizes that careful and specific documentation of the installation is required to substantiate this Quality Control Program.

2.0 MATERIAL DELIVERY

2.1 Documentation of Material Delivery

A QAQC Technician shall be present, whenever possible, to observe and assist in material delivery and unloading on site. The QAQC Technician shall:

- Verify the equipment used on site is adequate and does not risk damage to the geomembrane or other materials.
- Mark rolls or portions of rolls, which appear, damaged.
- Verify that storage of materials ensures adequate protections against dirt, theft, vandalism and passage of vehicles.
- Ensure that rolls are properly labeled and that labeling corresponds with Quality Control documentation and Shipping Bills of Lading.
- Assist Third Party QA Representative, if present, with material sampling or record keeping.
- Maintains Material Delivery Checklist, to include roll numbers, date, truck number, bill of lading number, roll size, storage method and any damage noted.

2.2 Storing and Stacking

Geosynthetic materials should be stored in a well drained area adjacent to the work area. Synthetic materials may be staked, but should not be stacked to a height that would damage the roll cores.

3.0 GEOMEMBRANE INSTALLATION

3.1 EARTH WORK

3.1.1 Standard Responsibilities

The general and/or earthwork contractor shall be responsible for preparing and maintaining the subgrade in a condition suitable for installation of the liner unless specifically agreed otherwise.

3.1.2 Minimum QC Guidelines

In cases where no site-specific earthwork quality control guidelines exist, the following guidelines shall be followed.

- Surfaces to be lined shall be smooth and free of debris, roots, angular or sharp rocks, and rocks larger than one half (1/2") inch diameter. All fill shall consist of well-graded material free of organics, trash, clay balls, or other deleterious material that may cause damage to the liner. The subgrade shall be compacted in accordance with design specifications but in no event less than is required to provide a firm unyielding foundation sufficient to permit the movement of vehicles and welding equipment over the subgrade without causing rutting or other deleterious effects. The subgrade shall have no sudden or abrupt changes in grade.

- The earthwork contractor shall protect the subgrade from desiccation, flooding and freezing. Protection, if required, may consist of a thin plastic protective cover (or other material as approved by the engineer) installed over the completed subgrade.

3.2 CREST ANCHORAGE SYSTEM

The anchor trench shall be excavated by the general or earthwork contractor to lines and widths shown on the design drawing prior to geomembrane placement. Corners in the anchor trench shall be slightly rounded where the geomembrane adjoins the trench to minimize sharp bends in the geomembrane.

3.3 PREPARATION FOR GEOMEMBRANE DEPLOYMENT

3.3.1 Panel Layout

Prior to commencement of liner deployment, layout drawings shall be produced to indicate the panel configuration and approximate location of seams for the project to be approved by the project engineer.

3.3.2 Identification

Each panel used for the installation shall be given a numeric or alphanumeric identifier consistent with the layout drawing

3.4 FIELD PANEL PLACEMENT

3.4.1 Location

Geo-Synthetics, Inc. will attempt to install field panels at the location indicated on the layout drawing. If the panels are deployed in a location other than that indicated on the drawing, the revised location shall be noted in the field as an "as-built" drawing, which will be modified at the completion of the project to reflect actual panel locations. GSI and or third party QA consultants as determined on a site-specific basis will maintain as-Built drawings.

3.4.2 Weather Conditions

Geomembrane deployment will generally not be done during any precipitation, in the presence of excessive moisture (i.e. fog, dew), in an area of standing water or during high winds.

3.4.3 Documentation of Panel Placement

Information relating to geomembrane panel placement including date, time, panel number, panel dimensions and location will be maintained on the Panel Placement

form. If a portion of a roll is set back to be used at another time, the roll number will be written on the remainder of the roll in several places on the outside of the roll. And at least once on the inside to prevent numbers from being scrapped off during shipment.

3.4.4 Method of Deployment

The method and equipment used to deploy the panels must not damage the geomembrane or the supporting subgrade surface. No personnel working on the geomembrane will wear shoes that can damage the geomembrane or engage in action that could result in damage to the geomembrane. Adequate temporary loading and / or anchoring, (i.e. sand bags, tires) which will not damage the liner, will be placed to prevent uplift of the geomembrane by wind.

3.4.5 Damage Repairs

Any damage to a panel of geomembrane will be repaired in accordance with paragraph 3.7

3.5 GEOMEMBRANE FIELD SEAMING

3.5.1 General Requirements

3.5.1.1 Layout

In general, seams shall be oriented parallel to the slope, i.e., oriented along, not across the slope for any slope greater than 10 to 1. Whenever possible, horizontal seams should be located on the base of the cell, not less than five (5) feet from the toe of the slope. Each seam made in the field shall be numbered in a manner that is compatible with the panel layout drawing. Seaming information to include seam number, welder ID, machine number, temperature setting and weather conditions will be maintained on GSI Panel Seaming form.

3.5.1.2 Personnel

All personnel performing seaming operations shall be trained in the operation of the specific seaming equipment being used and will qualify by successfully welding a test seam as described in paragraph 3.5.3. The project superintendent or master seamer will provide direct supervision of all personnel seaming to verify proper welding procedures are followed.

3.5.1.3 Equipment

- Fusion Welding

Fusion welding consists of placing a heated wedge, mounted on a self-propelled vehicular unit, between two (2) overlapped sheets which are heated above the polyethylene's melting point. After being heated by the wedge, the overlapped panels pass through a set of preset pressure wheels which compress the two (2) panels together to form a weld. The fusion welder is equipped with a temperature readout device that continuously monitors the temperature of the wedge.

- Extrusion fillet welding

Extrusion fillet welding consists of introducing a ribbon of molten resin along the edge if the seam overlap of the two (2) sheets to be welded. A hot air preheat and a molten polymer causes some of the material of each sheet to be liquefied resulting in a homogeneous bond between the molten weld bead and the surfaces of the sheets. The extrusion welder is

equipped with gauges giving the temperature in the apparatus and the preheat temperature at the nozzle.

3.5.1.4 Weather Conditions

Geo-Synthetics, Inc. relies on the experience of the Project Superintendent and the results of the test seams to determine seaming restrictions by weather. Many factors, such as ambient temperature, humidity, wind, sunshine, etc. can affect the integrity of deciding whether or not seaming should proceed. Test seams, as described paragraph 3.5.3 are required prior to daily production seaming to determine if the weather conditions will effect GSI's ability to produce quality seams.

3.5.2 Seam Preparation

3.5.2.1 Fusion Welding

- Overlap the panels of Geomembrane approximately four (4) to six (6) inches prior to welding.
- Adjust the panels so those seams are aligned with the fewest possible number of wrinkles.
- A protective layer may be used, at the discretion of the GSI Project Superintendent, directly below the overlap of geomembrane that is to be seamed.
- Clean the seam area prior to seaming to assure the area is clean and free of moisture, dust, dirt, and debris of any kind. No grinding is required for fusion welding.

3.5.2.2 Extrusion Fillet Welding

- Overlap the panels of geomembrane a minimum of three (3) inches.
- Temporarily bond the panels of geomembrane to be welded taking care not to damage the geomembrane.
- Clean seam area prior to seaming to assure the area is clean and free of moisture, dust, dirt, and debris of any kind.
- Grind seam overlap prior to welding within one (1) hour of the welding operation in a manner that does not damage the membrane. Grind marks should be covered with extradite whenever possible. In all cases grinding should not extend more than one quarter(1/4") inch past the edge of the area covered by the extrudate during welding.
- Purge the extruder prior to beginning the seam to remove all heat-degraded extrudate from the barrel. The purged extrudate will be placed on scrap material so as to prevent contact with good liner.
- Keep welding rods clean and dry.

3.5.3 Trial Welds

3.5.3.1 General

Welding technicians prior to each seaming period shall conduct trial welds, every five- (5) hours as weather conditions dictate or as requested by QAQC Technicians if welding problems are suspected. All trial welds will be conducted under the same conditions as will be encountered during actual seaming for each mil thickness. Unless authorized, once qualified by a passing trial weld, welding technicians will not change parameters (temperature, speed, and wheel adjustment).

3.5.3.2 Trial Weld Length

The trial weld shall be at least five (5) feet long and should be made by joining two (2) pieces of geomembrane at least nine (9) inches in width.

3.5.3.3 Sample Procedure

- Visually inspect the seam for squeeze out, footprints, pressure and general appearance.
- Cut three (3) one-inch wide specimens, one from the middle of the seam. The specimens shall then be tested in peel using a field tensiometer and shall exhibit a film-tearing bond (FTB). If any specimen fails, the entire procedure shall be repeated. In the case of double track fusion welded seams, both welds must exhibit a FTB in order to be considered passing.
- If repeat tests performed utilizing reasonable sets of welding parameters also fails, the seaming apparatus shall not be accepted and shall not be used for seaming until the deficiencies are corrected and a passing test seam is achieved.

3.5.3.4 Trial weld documentation

- QAQC Technician and / or assistant will be present during peel testing and will record date, time, operator, machine number, ambient and operating temperatures, speed setting, peel values and pass / repair designation.
- All test result records shall be maintained on GSI's Trail Weld form.
- The GSI's QAQC Technician will give final approval to proceed with welding after observing trial welds.

3.5.4 General Seaming Procedures

- Seaming shall extend to the outside edge of panels to be placed in the anchor trench.
- While welding a seam, monitor and maintain the proper overlap.
- Inspect seam area to assure area is clean and free of moisture, dust, dirt and debris of any kind.
- Welding technicians will periodically check operating temperature and speed.
- Align panels at the seam overlap to minimize wrinkles.
- Fish mouths or wrinkles at seam overlaps that cannot be welded through shall be cut along the ridge in order to achieve a flat overlap. The cut fish mouth or wrinkles shall be patched with an oval or round patch of the same geomembrane extending a minimum of six (6) inches beyond the cut in all directions.
- All seams between two (2) rows of seamed panels shall be welded during the coolest time of the day to allow for contraction of the geomembrane.
- Prior to welding seams, the top and bottom overlap of intersecting fusion welded seams will be trimmed six (6) inches. Intersecting extrusion fillet welded seams will be ground to flatten the extrusion bead prior to welding butt seams.
- All "T" joints produced as a result of cross / butt seams shall be extrusion fillet welded. Overlap on each "leg" of the "T" joint will be trimmed back six (6) inches. Then grind four- (4) inches minimum on each of the three legs of the "T" and extrusion weld all of the area prepared by grinding.
- Welding technicians will cut a test strip at the beginning and end of every seam. Prior to welding the next seam, the test strip will be tested for peel. These results are to be logged on the Panel Seaming form (FTB or NFTB). The QAQC Technician will observe all test strips and may request additional test strips, based on observations.

- In the event failing seam test strips are encountered, the welding machine will be taken out of service until a passing trial weld is obtained, and additional test strips will be taken to localize the flaw.
- The QAQC Technician may, after consulting with GSI's Project Superintendent, take destructive samples from any seam, if defects are suspected.

3.5.5 Seaming Documentation

- The QAQC Coordinator or a designated assistant will document all seaming operations. Welding technicians will mark on the liner with a permanent marker at the start and end of all seams the information regarding date, time, welder initials, machine number and set temperature. QAQC technician or assistant will record date, time, seam number welder ID, machine ID, set temperature, weather conditions and speed as determined from trial welds on the Seaming Information Form.
- Welding technicians will periodically check operating temperature and speed and mark the information along the seam.
- QAQC Technician will make periodic checks on welding operations to verify overlap, cleanliness, etc.

3.6 GEOMEMBRANE SEAM TESTING

3.6.1 Concept

The welded seam created by the fusion welding process is composed of a primary seam and a secondary track that creates an unwelded channel. The presence of an unwelded channel permits GSI fusion seams to be tested by inflating the sealed channel with air to a predetermined pressure and observing the stability of the pressurized channel over time.

3.6.2 Air Pressure Testing

3.6.2.1 Equipment for Air Testing

- An air pump (manual or motor driven) capable of generating and sustaining a pressure between 25 to 30 psi.
- A rubber hose with fittings and connections.
- A sharp, hollow needle or other approved pressure feed device with a pressure gauge capable of reading and sustaining a pressure between 25 to 30 psi.

3.6.2.2 Procedure for Air Testing

- Seal both ends of the seam to be tested.
- Insert needle or other approved pressure feed device into the sealed channel created by the fusion weld.
- Inflate the test channel to a pressure of approximately 30-psi, and maintain the pressure with the range listed in Initial Pressure Schedule. Close valve, observe and record initial pressure after approximately 2 minutes.
- Observe and record the air pressure five (5) minutes after "relaxing period" ends and initial pressure setting is recorded. If loss of pressure does not stabilize, locate faulty area and repair in accordance with paragraph 3.6.2.3.
- At the conclusion of the pressure test, the end of the air-channel opposite the pressure gauge is cut. A decrease in gauge pressure must be observed or the air channel will be considered "blocked" and the test will have to be repeated

from the point of the blockage. If the point of blockage cannot be found cut the air channel In the middle of the seam and treat each half as a separate test.

INITIAL PRESSURE SCHEDULE *

MATERIAL (MIL)	MIN. PSI	MAX. PSI
40	24	30
60	27	35
80	30	35
100	30	35

*Initial pressure settings are read after a two-minute "relaxing period." The purpose of this "relaxing period" is to permit the air temperature and pressure to stabilize.

MAXIMUM PERMISSIBLE DIFFERENTIAL AFTER 5 MINUTES – HDPE

MATERIAL (MIL)	PRESSURE DIFF.
40	4 psi
60	3 psi
80	2 psi
100	2 psi

3.6.2.3 Procedures for Non-Complying Tests

In the event of a Non-Complying Air Pressure Test, the following procedure shall be followed:

- Check seam and re-test seams.
- If a seam will not maintain the specified pressure, the seam should be visually inspected to localize the flaw. If this method is unsuccessful, cut one (1) inch samples from each end of the seam.
- Perform destructive peel tests on the samples using the field tensiometer.
- If all samples pass destructive peel testing, remove the overlap left by the wedge welder and vacuum test the entire length of seam in accordance with paragraph 3.6.3. If a leak is located by the vacuum test, repair by extrusion fillet welding. Test the repair by vacuum testing. If vacuum testing discovers no leak, the seam will be considered as passing non-destructive testing.
- If one or more samples fail the destructive peel test, additional samples will be taken in accordance with paragraph 3.6.4.3 or at the Site Superintendents discretion. When two (2)-passing samples are located, the seam between these two (2) locations will be considered non-complying. The overlap left by the wedge welder will be heat tacked in place along the entire length of seam and the non-complying portion of seam will be extrusion fillet welded and test vacuum testing in accordance with paragraph 3.6.3.

3.6.2.4 Air Pressure Testing Documentation

All information regarding air-pressure testing (date, initial time and pressure, final time and pressure, pass / repair designation and technicians initials) will be written at both ends of the seam or portion of seam tested. All of the above information will also be logged on the GSI Non-Destructive Testing form.

3.6.3 Vacuum Testing

This test is used when the geometry of the weld makes air pressure testing impossible or impractical or when attempting to locate the precise location of a defect believed to exist after air pressure testing.

3.6.3.1 Equipment for Vacuum Testing

- Vacuum box assembly consisting of a rigid housing, a transparent viewing window, soft neoprene gasket attached to the bottom, port hole or valve assembly and a vacuum gauge.
- A rubber pressure / vacuum hose with fittings and connections.
- A bucket and means to apply a soapy solution.
- A soapy solution.

3.6.3.2 Procedure for Vacuum Testing

- Trim excess overlap from the seam, if any.
- Turn on the vacuum pump to reduce the vacuum box to a maximum of 5-psi.
- Apply a generous amount of a strong solution of liquid detergent and water to the area to be tested.
- Place the vacuum box over the area to be tested and apply sufficient downward pressure to "seat" the seal strip against the liner.
- Close the bleed valve and open the vacuum valve.
- Apply a minimum of 5-psi vacuum to the area as indicated by the gauge on the vacuum box.
- Ensure that a leak tight seal is created.
- Observe area for leaks, close the vacuum valve and open the bleed valve, move the box over the next adjoining area with a minimum of three (3) inch overlap and repeat the process.

3.6.3.3 Procedure for non-complying test

- Mark all areas where soap bubbles appear and repair the marked areas in accordance with paragraph 3.7.3.
- Re-test repaired areas.

3.6.3.4 Vacuum testing Documentation

- Vacuum testing crew will use a permanent markers to write on liner indicating tester's initials, date and pass / repair designation on all areas tested.
- The QAQC Technician or testing crew on GSI Non-destructive Testing form will maintain records of vacuum testing.

3.6.4 Destructive Testing

3.6.4.1 Concept

The purpose of destructive testing is to determine and evaluate seam strength. These test require direct sampling and thus subsequent patching. Therefore, destructive testing should be held to a minimum to reduce the amount of repairs to the geomembrane.

3.6.4.2 Procedure for Destructive Testing

- Destructive Test samples shall be marked and cut out randomly at a minimum average frequency of one test location every 500 feet of seam length.

- Location of destructive samples will be selected by QAQC Technician (or third party QA), with samples to be cut by GSI construction personnel.
- Destructive samples should be taken and tested as soon as possible after the seams are welded in order to detect possible problems in a timely manner.
- QAQC Technician will observe all destructive testing and record date, time, seam number, location, and test results on GSI Destructive Testing form.
- All destructive test locations with pass / repair designation will be marked on liner with a permanent markers.
- The destructive samples should be twelve (12) inches wide with a seam eighteen (18) inches long centered lengthwise in the sample. The sample may be increased in size to accommodate independent laboratory testing by the owner's request or by specific project specifications.
- A one- (1) inch specimen shall be cut from each end of the test seam for field-testing. The two one- (1) inches wide specimens shall be tested in the field on a tensiometer for peel. If either field specimen fails to pass, it will be assumed the sample fails destructive testing. The procedure outlined in paragraph 3.6.4.3 shall be followed to locate passing samples to send to the laboratory.
- Independent Laboratory Destructive samples will be tested for "Shear Strength" and "Peel Adhesion". Four (4) of Five (5) specimens must exhibit FTB for each test and the value must meet or exceed that listed on the table below in order for the seam to pass the destructive test.

Minimum Weld Properties for Standard HDPE Geomembranes (1)(2)

Property	Test Method	30	40	60	80	100	120
Peel Strength ppi (fusion)	ASTM D 6392	49	65	98	130	162	196
Peel Strength ppi (extrusion)	ASTM D 6392	39	52	78	104	130	157
Shear Strength ppi (fusion & extrusion)	ASTM D 6392	61	81	121	162	203	242

(1) These values apply to both co extruded and flat cast produced geomembranes and white – surfaced and conductive products. (2) Tested at 2 inches / minute.

Minimum Weld Properties for Standard LLDPE Geomembranes (1)(2)

Property	Test Method	30	40	60	80	100	120
Peel Strength ppi (fusion & extrusion)	ASTM D 6392	36	48	72	96	120	N/A
Shear Strength ppi (fusion & extrusion)	ASTM D 6392	40	56	84	112	140	N/A

(1) These values apply to both co extruded and flat cast produced geomembranes and white – surfaced and conductive products. (2) Tested at 2 inches / minute.

3.6.4.3 Procedure in the event of Destructive Test Failure

- Cut additional field samples for testing. In the case of a field production seam, the samples must lay a minimum of ten (10) feet in each direction from the location of the failed seam sample. Perform a field test for peel strength. If these field samples pass, then laboratory samples can be cut and forwarded to the laboratory for full testing.
- If the laboratory samples pass, reconstruct the seam between the two- (2) passing sample locations according to procedures detailed in Section 3.7
- If either of the samples fail, then additional samples are taken in accordance with the above procedure until two (2) passing samples are found to establish the zone in which the seam should be reconstructed.
- All passing seams must be bounded by two (2) locations from which samples passing laboratory destructive tests have been taken.
- In cases of reconstructed seam exceed 150 feet, a destructive samples must be taken and pass destructive testing from within the zone in which the seam has been reconstructed.

3.7 Defects and Repairs

3.7.1 Superintendent's Review

Geo-Synthetics, Inc. QAQC Technician and Project Superintendent shall conduct a detailed walk through and visually check all seams and non-seam areas of the geomembrane for defects, holes, blisters and signs of damage during installation.

3.7.2 Technician's Responsibilities

All other Geo-Synthetics, Inc. installation personnel shall, at all times, be on the lookout for damaged areas. Damaged areas shall be marked and repaired.

3.7.3 Repair Procedures

Any portions of the geomembrane or geomembrane seam showing a flaw, or failing a destructive or non-destructive test shall be repaired. Several procedures exist for repair and GSI Project Superintendent shall make the decision as to the appropriate repair procedure. Procedures available for repair:

3.7.3.1 Patching

Patching used to repair large holes, tears and destructive sample locations. All patched shall extend at least six (6) inches beyond the edges of the defect and all corners of the patches shall be rounded.

3.7.3.2 Grinding and Welding

Grinding and welding - used to repair sections of extruded fillet seams.

3.7.3.3 Spot Welding or Seaming

Spot-welding or seaming - used to repair small tears, pinholes or other minor localized flaws.

3.7.3.4 Capping

Capping - used to repair lengths of failed extrusion of fusion welded seams.

3.7.3.5 Extruding Overlap

Extrude overlap along the length of failed fusion welded seams.

3.7.3.6 Removal of a Bad Seam

Removal of a bad seam and replacement with a strip of new material seamed into place.

3.7.4 Verification of Repairs

Every repair shall be non-destructively tested using the methods set out in paragraph 0 which pass the non-destructive test, shall be deemed adequate. Repairs in excess of 150 feet require a destructive test. Repair test results shall be logged on GSI Repair Report form. The repair location shall be recorded on an as-built drawing.

4.0 GEOTEXTILES

4.1 Handling and Placement

All geotextiles shall be handled in a manner to ensure they are not damaged. The following special handling requirements shall be adhered to.

- On slopes, the geotextiles shall be secured in the anchor trench and then rolled down the slope in such a manner as to continually keep the Geotextile sheet in sufficient tension to preclude folds and wrinkles.
- In presence of wind, all geotextiles shall be weighted with sand bags or an equivalent.
- Geotextiles shall be cut using an approved cutter (i.e., hook blade, scissors, etc.). If the material is being cut in place, special care must be taken to protect other geosynthetic materials from damage.
- Care shall be taken not to entrap stones or excessive dust that could damage the geomembrane, or generate clogging of drains or filters.

4.2 Seams and Overlaps

All geotextiles shall be handled in a manner to ensure they are not damaged. The following special handling requirements shall be adhered to:

- On slopes steeper than ten (10) horizontal to 1 vertical, it is recommended that geotextiles be continuously sewn or thermally bonded along the entire length of the seam. Geotextiles shall be overlapped a minimum of four (4) inches prior to sewing.

4.3 Repairs

- On slopes - A patch made from the same geotextile shall continuously be seamed with a minimum of 12 inches overlap in all directions into place.
- Horizontal areas - A patch made from the same Geotextile shall be spot-seamed in place with a minimum of 12 inches overlap in all directions.

5.0 GEONETS

5.1 Handling and Placement

The geonets shall be handled in such a manner as to ensure that the geonets are not damaged in any way.

- On slopes, the geonets shall be secured in the anchor trench and then led down the slope in such a manner as to continually keep the geonet sheet in tension. If necessary, the geonet shall be positioned by hand after being unrolled to minimize wrinkles. Geonets can be placed in the horizontal direction (i.e., across the slope) in some special locations (e.g., at the toe of slope, or where an extra layer of geonet is required). The Design Engineer in the project drawings shall identify such locations.
- Geonets shall not be welded to geomembrane with extrusion welders. Geonets shall be cut using approved cutter (i.e., hook blade, scissors, etc.). Care should be taken to prevent damage to underlying layers.
- Care must be taken not to entrap in the geonet anything that could cause clogging of the drainage system, and / or stones that could damage the adjacent geomembrane.

5.2 Layering and Tying of Geonet

When several layers of geonets are installed, care should be taken to prevent the strands of one layer form penetrating the channels of the next layer, thereby significantly reducing the transitivity. Layered geonets must be placed in the same directions and where laid perpendicular to the underlying geonet. Adjacent geonets shall be joined according to the following requirements.

- Adjacent rolls shall be overlapped by at least four (4) inches and securely tied.
- Plastic fasteners can achieve tying. Tying devices shall be white or yellow for easy inspections. Metallic devices are not allowed.
- Tying shall be a minimum five (5) feet on center, every two (2) feet on butt seams.

5.3 Repairs

Any holes or tears in the geonet shall be repaired by placing a patch extending two (2) feet beyond edges of the hole or tear. The patch shall be secured to the original geonet by tying every six (6) inches. If the hole or tear width across the roll is more than 50% the width of the roll, the damaged area shall be cut out and the two (2) portions of the geonet shall be joined.

6.0 BENTONITE MAT

6.1 Handling and Placement

- All wrinkles shall be pulled out and overlaps shall be free of obstructions, debris and rocks.
- Seams shall be a simple overlap unless the intended function determines the need for the addition of granular bentonite.
- Overlap seams shall be placed so that the edge of the upper panel aligns with the matchline on the lower panel.
- The GCL shall be secured in and anchor trench at the top of the slope as per the contract drawings.
- Material will be deployed from the high elevation to the low elevation to protect against the adverse effect of precipitation during deployment.
- All seams shall be parallel with the direction of the slope. Horizontal seams shall not be allowed on slopes unless approved by the engineer.
- In general, the amount of GCL that should be deployed in a given day is the amount that can be covered during that day, either by a geomembrane or confining soil layer.
- Placing a patch of the same material over the damaged area extending at least one foot (12 inches) beyond the damaged area in every direction will make repairs.

DIMENSIONS AND WEIGHTS

PVC and CPVC Schedule 40 Pipe

Nominal Pipe Size (in.)	Outside Diameter	Min. Wall	Approximate Wt. (lbs/100 ft)	
			PVC	CPVC
1/2	.840	.109	16.2	17.3
3/4	1.050	.113	21.4	23.0
1	1.315	.133	31.5	34.2
1 1/4	1.660	.140	42.6	46.3
1 1/2	1.900	.145	50.8	55.3
2	2.375	.154	68.2	74.3
2 1/2	2.875	.203	107.0	117.9
3	3.500	.216	140.8	154.2
4	4.500	.237	200.5	219.6
5	5.563	.258	272.5	—
6	6.625	.280	353.3	386.1
8	8.625	.322	538.6	581.1
10	10.750	.365	755.0	823.8
12	12.750	.406	1001.0	1089.2
14	14.000	.438	1180.1	—
16	16.000	.500	1543.1	—

PVC and CPVC Schedule 80 Pipe

Nominal Pipe Size (in.)	Outside Diameter	Min. Wall	Approximate Wt. (lbs/100 ft)	
			PVC	CPVC
1/2	.540	.119	10.0	10.9
3/4	.675	.126	13.8	15.0
1/2	.840	.147	20.4	22.1
3/4	1.050	.154	27.0	30.0
1	1.315	.179	41.0	44.2
1 1/4	1.660	.191	52.2	61.0
1 1/2	1.900	.200	66.8	73.9
2	2.375	.218	94.5	102.2
2 1/2	2.875	.276	144.5	155.9
3	3.500	.300	194.2	208.6
4	4.500	.337	275.2	304.9
5	5.563	.375	387.3	—
6	6.625	.432	541.5	581.5
8	8.625	.500	805.2	882.9
10	10.750	.593	1200.0	1309.1
12	12.750	.687	1650.0	1801.2
14	14.000	.750	1930.0	—
16	16.000	.843	2544.1	—

Note: All dimensions are in inches.

RECOMMENDED PRODUCT SPECIFICATION

Suggested Specification

System: **PVC Schedule 80 Pressure Pipe and Fitting System**

Scope: This specification covers PVC Schedule 80 pipe and fittings for pressure applications. This system is intended for pressure applications where the operating temperature will not exceed 140°F.

Specification: Pipe and fittings shall be manufactured from virgin rigid PVC (polyvinyl chloride) vinyl compounds with a Cell Class of 12454 as identified in ASTM D 1784.

PVC Schedule 80 pipe shall be Iron Pipe Size (IPS) conforming to ASTM D 1785. PVC Schedule 80 fittings shall conform to ASTM D 2467. PVC Schedule 80 threaded fittings shall conform to ASTM D 2464. Pipe and fittings shall be manufactured as a system and be the product of one manufacturer. All pipe and fittings shall be manufactured in the United States. Pipe and fittings shall conform to National Sanitation Foundation (NSF) Standard 61 or the health effects portion of NSF Standard 14.

Installation shall comply with the latest installation instructions published by Charlotte Pipe and Foundry and shall conform to all local plumbing, building, and fire code requirements. Solvent cement joints shall be made in a two step process with primer manufactured for thermoplastic piping systems and solvent cement conforming to ASTM D 2564. The system shall be protected from chemical agents, fire stopping materials, thread sealant, plasticized vinyl products, or other aggressive chemical agents not compatible with PVC compounds. Systems shall be hydrostatically tested after installation. Testing with compressed air or gas is not recommended.

Referenced Standards:

ASTM D 1784	Rigid Vinyl Compounds
ASTM D 1785	PVC Plastic Pipe, Schedule 80
ASTM D 2464	PVC Threaded Fittings, Schedule 80
ASTM D 2467	PVC Plastic Fittings, Schedule 80
ASTM D 2564	Solvent Cements for PVC Pipe and Fittings
NSF Standard 14	Plastic Piping Components and Related Materials
NSF Standard 61	Drinking Water System Components – Health Effects

Note: Latest revision of all standards apply.

CONTRACTOR
Bob Stout Construction Co., Inc.
A – Certified to comply with contract drawings and specifications.
B – Certified to comply with contract drawings and specifications as noted on shop drawings and/or attached sheet(s). (Resubmission not required provided installation conforms as noted).

Signature: [signature]
Title: President
Date: 4/3/06

McGILL ASSOCIATES, P.A.
Consulting Engineers
Asheville, North Carolina

☑ Approved ☐ Revise and Resubmit
☐ Approved As Noted ☐ Not Approved

Name: Mark Cathey [signature]
Title: Proj. Engr. Date: 4/6/06

Review is for General Arrangement only and does not release the contractor from the responsibility of quantities, dimension, performance or other requirements of the contract documents.

TOE DRAIN PIPING SUBMITTAL

Product Notes

Product Note 3.106
Re: Standard Pipe Perforations (4"-60" N-12 Pipe)
Date: December 2003

60°

ADS

Introduction
Perforated pipe plays an integral role in many applications of ADS HDPE pipe. Generally, perforated pipe is used to accelerate the removal of subsurface water in soils or to allow storm water to percolate into the soil. Currently, two classifications of perforations are specified in the AASHTO material specifications for HDPE pipe: Class I, and Class II. Class I perforations are commonly used in combination storm/underdrain systems while Class II incorporates subsurface drainage and detention/retention systems. Both classes are explained in more detail in the AASHTO materials specifications (M294 and M252). AASHTO M252 covers pipe size 3 - 10 inch (75 - 250 mm) while M294 covers 12 – 60 inch (300 - 1500 mm). ADS manufactures pipe to meet the perforations specified for the project using the patterns indicated as follows.

ADS STANDARD PERFORATION PATTERN (AASHTO Class II Perforation)
The following terminology for perforations is derived from the applicable AASHTO specification. Differences between the specifications are covered in Table I. The perforations shall be circular and/or slotted. The perforations shall be located in the outside valleys of the corrugations. The water inlet area shall be no less than 0.945 in^2/ft (20 cm^2/m) for pipe sizes 4 - 10 inch (100 - 250mm), 1.42 in^2/ft (30 cm^2/m) for pipe sizes 12 - 18 inch (300 - 450 mm) and 1.89 in^2/ft (40 cm^2/m) for pipe sizes larger than and equal to 24 inches (450 mm). Table 1 and Figure A below represent ADS standard perforation patterns for AASHTO Class II. Patterns indicated with an asterisk are a made-to-order product and additional lead-time should be allowed when ordering.

Pipe shall be HDPE corrugated pipe, AASHTO Type "S" (ADS N12)

Table I

	100	Slot		25		3	CD		20
	150	Slot		25		3	CD		20
	200	Slot		30		3	CD		20
	250	Slot		30		3	CD		20
	300	Circular		10		-	E		30
	375	Circular		10		-	E		30
	450	Circular		10		-	E		30
	600	Circular		10		-	F		40
	750	Circular		10		-	H		40
	900	Circular		10		-	H		40
	1050	Circular		10		-	H		40
	[illegible]	Circular		10		-	**F		40
	1200	Circular		10		-	H		40
	[illegible]	Circular		10		-	**F		40
	1500	Circular		10		-	H		40
	1500	Circular		10		-	**F		40

[illegible] PRODUCTS, P.A.
Engineers
[illegible] Carolina

☐ Approved ☐ Revise and Resubmit
☑ Approved As Noted ☐ Not Approved

Name [signature]
Title Project Engineer Date 10/21/05

[illegible] for General Arrangement only and does not

* Denotes perforation pattern made to order
** Spaced at 5" longitudinally for 42" and 48" and 5.5" longitudinally for 60" diameter

PRO RATA LIMITED WARRANTY
FOR GSE LINING TECHNOLOGY, INC.
(GEOSYNTHETIC MANUFACTURED MATERIALS)
(U.S.A.)

Date:	December 16, 2005	Warranty No.:	518117-001
Purchaser Name:	Madison County Solid Waste Dept.	Project No.:	518117
Address:	271 Craig Rudisill Road	Effective Date:	December 6, 2005
City, State:	Marshall, North Carolina 28753	Project Name:	Madison County
Product Type/Description:	GSE HD 40 mil Double-sided UltraFlex	Project Address:	Madison County, Tennessee

GSE Lining Technology, Inc. ("GSE") warrants each GSE product described above to be free from material manufacturing defects (as described by the contract's material specifications) and to be able to withstand normal weathering for a period of five (5) years from the above effective date for "normal use" in approved applications. This limited warranty does not include damages or defects in the GSE product resulting from acts of God, casualty or catastrophe, including but not limited to: earthquakes, floods, piercing hail, tornadoes or force nature. The term "normal use" does not include, among other things, the exposure of GSE's product to harmful chemicals, abuse by machinery, equipment or people; improper site preparation or placement of cover materials; excessive pressures or stresses from any source. This warranty is intended for commercial use only and is not in effect for the consumer as defined in the Magnuson-Moss Warranty Act.

Should defects or premature loss of use within the scope of this warranty occur, GSE will, at its option, repair or replace the GSE product on a pro rata basis at the current price in such manner as to charge the Purchaser only for that portion of the warranted life which has elapsed since the purchase of the product. GSE shall have the right to inspect and determine the cause of the alleged defect in the product and to take appropriate steps to repair or replace the product if a defect exists that is covered under this warranty. This limited warranty only extends to the geosynthetic portion of this product manufactured by GSE and does not apply to any third-party manufactured materials attached to GSE's product. The third-party portion of the product will carry the original manufacturer's warranty that will be passed through to the Purchaser.

Any claim for any alleged breach of this warranty must be made in writing, by certified mail or courier, to GSE Lining Technology, ıc., 19103 Gundle Road, Houston, Texas 77073, with the words "Warranty Claim" clearly marked on the envelope, within ten (10) days of Purchaser becoming aware of the alleged defect. Should the required notice not be given, the defect and all warranties are waived by the Purchaser, and Purchaser shall not have rights under this warranty. GSE shall not be obligated to perform any inspection or obligated to perform any repair or replacement under this warranty until the area is made available free from all obstructions, water, dirt, sludge, residuals and liquids of any kind. If after inspection it is determined that there is no claim under this warranty, Purchaser shall reimburse GSE for its costs associated with the site inspection.

In the event the exclusive remedy provided herein fails in its essential purpose, and in that event only, the Purchaser shall be entitled to a return of the purchase price for so much of the product as GSE determines to have violated the warranty provided herein. GSE shall not be liable for direct, indirect, special, consequential or incidental damages resulting from a breach of this warranty including, but not limited to: damages for loss of production, lost profits, personal injury or property damage. GSE shall not be obligated to reimburse Purchaser for any repairs, replacement, modifications or alterations made by Purchaser to GSE's product, unless GSE specifically authorized, in writing, said repairs, replacements, modifications or alterations in advance. GSE liability under this warranty shall in no event exceed the replacement cost of the product sold to the Purchaser for the particular installation in which it failed.

GSE neither assumes nor authorizes any person other than an officer of GSE to assume for it any other or additional liability in connection with the GSE product made on the basis of the Limited Warranty. **GSE MAKES NO WARRANTY OF ANY KIND OTHER THAN THAT GIVEN HEREIN AND HEREBY DISCLAIMS ALL WARRANTIES, INCLUDING BOTH EXPRESS OR IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, AND BY ACCEPTING DELIVERY OF THE PRODUCT, PURCHASER WAIVES ALL OTHER POSSIBLE WARRANTIES. GSE's WARRANTY BECOMES AN OBLIGATION OF GSE TO PERFORM UNDER THE WARRANTY ONLY UPON RECEIPT OF FINAL PAYMENT.**

This warranty is extended to the Purchaser and is non-transferable and non-assignable, i.e. there are no third-party beneficiaries to this warranty.

GEOMEMBRANE5p

NON-PRO RATA LIMITED WARRANTY
FOR GSE LINING TECHNOLOGY, INC.
(GEOSYNTHETIC MANUFACTURED MATERIALS)
(U.S.A.)

Date:	December 16, 2005	Warranty No.:	518117-002
Purchaser Name:	Madison County Solid Waste Dept.	Project No.:	518117
Address:	271 Craig Rudisill Road	Effective Date:	December 6, 2005
City, State:	Marshall, North Carolina 28753	Project Name:	Madison County
Product Type/Description:	GSE Geocomposite	Project Address:	Madison County, Tennessee

GSE Lining Technology, Inc. ("GSE") warrants the geonet component of each GSE product described above to be free from material manufacturing defects (as described by the contract's material specifications) and to be able to withstand normal weathering for a period of one (1) year from the above effective date for "normal use" in approved applications. This limited warranty does not include damages or defects in the GSE product resulting from acts of God, casualty or catastrophe, including but not limited to: earthquakes, floods, piercing hail, tornadoes or force majeure. The term "normal use" does not include, among other things, the exposure of GSE's product to harmful chemicals, abuse by machinery, equipment or people; improper site preparation or placement of cover materials; excessive pressures or stresses from any source. This warranty is intended for commercial use only and is not in effect for the consumer as defined in the Magnuson-Moss Warranty Act.

Should defects or premature loss of use within the scope of this warranty occur, GSE will, at its option, repair or replace the GSE product. GSE shall have the right to inspect and determine the cause of the alleged defect in the product and to take appropriate steps to repair or replace the product if a defect exists that is covered under this warranty. This limited warranty only extends to the geosynthetic portion of this product manufactured by GSE and does not apply to any third-party manufactured materials attached to GSE's product. The third-party portion of the product will carry the original manufacturer's warranty that will be passed through to the Purchaser.

Any claim for any alleged breach of this warranty must be made in writing, by certified mail or courier, to GSE Lining Technology, ıc., 19103 Gundle Road, Houston, Texas 77073, with the words "Warranty Claim" clearly marked on the envelope, within ten (10) days of Purchaser becoming aware of the alleged defect. Should the required notice not be given, the defect and all warranties are waived by the Purchaser, and Purchaser shall not have rights under this warranty. GSE shall not be obligated to perform any inspection or obligated to perform any repair or replacement under this warranty until the area is made available free from all obstructions, water, dirt, sludge, residuals and liquids of any kind. If after inspection it is determined that there is no claim under this warranty, Purchaser shall reimburse GSE for its costs associated with the site inspection.

In the event the exclusive remedy provided herein fails in its essential purpose, and in that event only, the Purchaser shall be entitled to a return of the purchase price for so much of the product as GSE determines to have violated the warranty provided herein. GSE shall not be liable for direct, indirect, special, consequential or incidental damages resulting from a breach of this warranty including, but not limited to: damages for loss of production, lost profits, personal injury or property damage. GSE shall not be obligated to reimburse Purchaser for any repairs, replacement, modifications or alterations made by Purchaser to GSE's product, unless GSE specifically authorized, in writing, said repairs, replacements, modifications or alterations in advance. GSE liability under this warranty shall in no event exceed the replacement cost of the product sold to the Purchaser for the particular installation in which it failed.

GSE neither assumes nor authorizes any person other than an officer of GSE to assume for it any other or additional liability in connection with the GSE product made on the basis of the Limited Warranty. **GSE MAKES NO WARRANTY OF ANY KIND OTHER THAN THAT GIVEN HEREIN AND HEREBY DISCLAIMS ALL WARRANTIES, INCLUDING BOTH EXPRESS OR IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, AND BY ACCEPTING DELIVERY OF THE PRODUCT, PURCHASER WAIVES ALL OTHER POSSIBLE WARRANTIES. GSE's WARRANTY BECOMES AN OBLIGATION OF GSE TO PERFORM UNDER THE WARRANTY ONLY UPON RECEIPT OF FINAL PAYMENT.**

This warranty is extended to the Purchaser and is non-transferable and non-assignable, i.e. there are no third-party beneficiaries to this warranty.

GEO-SYNTHETICS, INC.

1 YEAR INSTALLATION WARRANTY FOR GEO-SYNTHETICS, INC. MEMBRANE LINERS

PROJECT:

Madison County Municipal Solid Waste Landfill Closure

25084

Subject to the terms and conditions set forth below, Geo-Synthetics, Inc., warrants to Purchaser , Madison County Solid Waste Dept. that the 40 mil Textured LLDPE Geomembrane and the Geocomposite installed at Marshall, North Carolina were installed by Geo-Synthetics, Inc., in accordance with specifications in a good and workmanlike manner and that the installation of the liner is free from defects in workmanship for a period of 1 year(s) from the date upon which the material was installed.

This warranty covers only defects in workmanship occurring during the installation of the liner. This warranty does not cover any damage to, or defects in the liner found to have been a result of misuse, abuse or conditions existing after it was installed, including, but not limited to, rough handling; malicious nischief; vandalism; sabotage; fire; acts of God; acts of the public enemy; acts of war, public rebellion, severe weather conditions of all types; damage due to ice; excessive stress from any source; floating debris; damage due to machinery; foreign objects or animals. Nor does this warranty cover any defects which are found to have been a result of improper of defective design or engineering unless the design or engineering was performed by Geo-Synthetics, Inc.

In the event circumstances are found to exist which purchaser believes may give rise to a claim under this warranty, the following procedure shall be followed.

a) Purchaser shall give Geo-Synthetics, Inc. written notice of the facts and circumstances of said claim within ten (10) days of becoming aware of said facts and circumstances.

   Said notice shall be by registered or certified mail, return receipt requested, postage prepaid, addressed to Construction Manager, Geo-Synthetics, Inc., W239 N428 Pewaukee Road, Waukesha, WI 53188. The words "WARRANTY CLAIM" shall be clearly marked on the face of envelope in the lower right hand corner. Said notice shall contain, at a minimum, the name and address of the owner, the name and address of the installation, the name and address of the installer, the date upon which the material was purchased and the facts known to Purchaser upon which the claim is based. Failure to strictly comply with all the requirements of this paragraph shall void this warranty.

b) Within twenty days after receipt of the notice described in paragraph a., above, Geo-Synthetics, Inc. shall notify Purchaser either that it will send a representative to inspect the allegedly defective liner or that it does not wish to do so. Purchaser shall pay the expenses incurred by Geo-Synthetics, Inc. in

making the inspection, including current per diem rates for personnel involved in making the inspection, in the event Geo-Synthetics, Inc. determines that the claim is not covered by this warranty.

c) Purchaser SHALL NOT REPAIR, REPLACE, REMOVE, ALTER OR DISTURB ANY LINER, NOR SHALL Purchaser ALLOW ANYONE ELSE TO REPAIR, REPLACE, REMOVE, ALTER, OR DISTURB ANY LINER PRIOR TO SUCH INSPECTION OR RECEIPT OF GEO-SYNTHETICS INC.'S NOTICE THAT IT ELECTS NOT TO INSPECT. A FAILURE TO STRICTLY COMPLY WITH THIS PARAGRAPH SHALL VOID THIS WARRANTY OR MAY LEAD TO A DETERMINATION THAT THE ALLEGED DEFECTS ARE NOT WITHIN THE SCOPE OF THIS WARRANTY.

d) If Geo-Synthetics, Inc. determines that the alleged defects are covered by this warranty, Geo-Synthetics, Inc. shall, in its sole discretion, either repair the defective liner or provide Purchaser with replacement liner. THE REMEDIES PROVIDED HEREIN ARE THE EXCLUSIVE REMEDIES AVAILABLE UNDER THIS WARRANTY. Any determination as to whether a particular defect is covered by this warranty will be made by Geo-Synthetics, Inc. in its sole and complete discretion.

e) Purchaser agrees that it shall provide Geo-Synthetics, Inc. with clean, dry and unobstructed access to the liner in order for Geo-Synthetics, Inc. to perform the inspections and warranty work which may be required pursuant to this warranty.

THE REMEDIES PROVIDED TO Purchaser HEREIN ARE THE EXCLUSIVE REMEDIES AVAILABLE UNDER THIS WARRANTY AND ARE INTENDED FOR THE SOLE BENEFIT OF Purchaser. NEITHER THIS WARRANTY NOR ANY RIGHTS HEREUNDER SHALL BE ASSIGNABLE. GEO-SYNTHETICS, INC. SHALL HAVE NO LIABILITY UNDER THIS WARRANTY TO THIRD PARTIES OR STRANGERS TO THIS AGREEMENT. THE WARRANTY SET FORTH ABOVE IS THE ONLY WARRANTY APPLICABLE TO THE LINER AND ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE ARE DISCLAIMED. IN NO EVENT SHALL GEO-SYNTHETICS, INC. BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL OR CONSEQUENTIAL DAMAGES FOR, RESULTING FROM, OR IN CONNECTION WITH, ANY LOSS RESULTING FROM THE USE OF THE LINER. IN THE EVENT THE EXCLUSIVE REMEDY PROVIDED HEREIN FAILS IN IT ESSENTIAL PURPOSE, AND IN THAT EVENT ONLY, Purchaser SHALL BE ENTITLED TO RETURN OF THE PURCHASE PRICE FOR SO MUCH OF THE MATERIAL AS
GEO-SYNTHETICS, INC. DETERMINES IN ITS SOLE DISCRETION, TO HAVE VIOLATED THE WARRANTY PROVIDED HEREIN. EXCEPT FOR THE WARRANTY SET FORTH ABOVE, NO REPRESENTATION OR WARRANTY MADE BY ANY SALES OR OTHER REPRESENTATIVE GEO-SYNTHETICS, INC., OR ANY OTHER PERSON, CONCERNING THE LINER SHALL BE BINDING UPON GEO-SYNTHETICS, INC.

Any waiver of the terms and conditions of this warranty shall be in writing signed by GEO-SYNTHETICS, INC. the failure to insist upon strict compliance with any of the terms and conditions contained herein shall not act as a waiver of strict compliance with all of the remaining terms and conditions or this warranty and shall not operate as a waiver as to any of the terms and conditions of this warranty as to future claims under this warranty.

GEO-SYNTHETICS INC

BY: _____
Robert Groh / President

I have read and agree to be bound
by the terms and conditions of the
foregoing warranty.

By: _____

Title: _____

Company: _____

Date: _____

GEO-SYNTHETICS, INC.

1 YEAR INSTALLATION WARRANTY FOR GEO-SYNTHETICS, INC. MEMBRANE LINERS

PROJECT:

Madison County Municipal Solid Waste Landfill Closure

25084

Subject to the terms and conditions set forth below, Geo-Synthetics, Inc., warrants to Purchaser , Madison County Solid Waste Dept. that the 40 mil Textured LLDPE Geomembrane and the Geocomposite installed at Marshall, North Carolina were installed by Geo-Synthetics, Inc., in accordance with specifications in a good and workmanlike manner and that the installation of the liner is free from defects in workmanship for a period of 1 year(s) from the date upon which the material was installed.

This warranty covers only defects in workmanship occurring during the installation of the liner. This warranty does not cover any damage to, or defects in the liner found to have been a result of misuse, abuse or conditions existing after it was installed, including, but not limited to, rough handling; malicious mischief; vandalism; sabotage; fire; acts of God; acts of the public enemy; acts of war, public rebellion, severe weather conditions of all types; damage due to ice; excessive stress from any source; floating debris; damage due to machinery; foreign objects or animals. Nor does this warranty cover any defects which are found to have been a result of improper of defective design or engineering unless the design or engineering was performed by Geo-Synthetics, Inc.

In the event circumstances are found to exist which purchaser believes may give rise to a claim under this warranty, the following procedure shall be followed.

a) Purchaser shall give Geo-Synthetics, Inc. written notice of the facts and circumstances of said claim within ten (10) days of becoming aware of said facts and circumstances.

   Said notice shall be by registered or certified mail, return receipt requested, postage prepaid, addressed to Construction Manager, Geo-Synthetics, Inc., W239 N428 Pewaukee Road, Waukesha, WI 53188. The words "WARRANTY CLAIM" shall be clearly marked on the face of envelope in the lower right hand corner. Said notice shall contain, at a minimum, the name and address of the owner, the name and address of the installation, the name and address of the installer, the date upon which the material was purchased and the facts known to Purchaser upon which the claim is based. Failure to strictly comply with all the requirements of this paragraph shall void this warranty.

b) Within twenty days after receipt of the notice described in paragraph a., above, Geo-Synthetics, Inc. shall notify Purchaser either that it will send a representative to inspect the allegedly defective liner or that it does not wish to do so. Purchaser shall pay the expenses incurred by Geo-Synthetics, Inc. in

making the inspection, including current per diem rates for personnel involved in making the inspection, in the event Geo-Synthetics, Inc. determines that the claim is not covered by this warranty.

c) Purchaser SHALL NOT REPAIR, REPLACE, REMOVE, ALTER OR DISTURB ANY LINER, NOR SHALL Purchaser ALLOW ANYONE ELSE TO REPAIR, REPLACE, REMOVE, ALTER, OR DISTURB ANY LINER PRIOR TO SUCH INSPECTION OR RECEIPT OF GEO-SYNTHETICS INC.'S NOTICE THAT IT ELECTS NOT TO INSPECT. A FAILURE TO STRICTLY COMPLY WITH THIS PARAGRAPH SHALL VOID THIS WARRANTY OR MAY LEAD TO A DETERMINATION THAT THE ALLEGED DEFECTS ARE NOT WITHIN THE SCOPE OF THIS WARRANTY.

d) If Geo-Synthetics, Inc. determines that the alleged defects are covered by this warranty, Geo-Synthetics, Inc. shall, in its sole discretion, either repair the defective liner or provide Purchaser with replacement liner. THE REMEDIES PROVIDED HEREIN ARE THE EXCLUSIVE REMEDIES AVAILABLE UNDER THIS WARRANTY. Any determination as to whether a particular defect is covered by this warranty will be made by Geo-Synthetics, Inc. in its sole and complete discretion.

e) Purchaser agrees that it shall provide Geo-Synthetics, Inc. with clean, dry and unobstructed access to the liner in order for Geo-Synthetics, Inc. to perform the inspections and warranty work which may be required pursuant to this warranty.

THE REMEDIES PROVIDED TO Purchaser HEREIN ARE THE EXCLUSIVE REMEDIES AVAILABLE UNDER THIS WARRANTY AND ARE INTENDED FOR THE SOLE BENEFIT OF Purchaser. NEITHER THIS WARRANTY NOR ANY RIGHTS HEREUNDER SHALL BE ASSIGNABLE. GEO-SYNTHETICS, INC. SHALL HAVE NO LIABILITY UNDER THIS WARRANTY TO THIRD PARTIES OR STRANGERS TO THIS AGREEMENT. THE WARRANTY SET FORTH ABOVE IS THE ONLY WARRANTY APPLICABLE TO THE LINER AND ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE ARE DISCLAIMED. IN NO EVENT SHALL GEO-SYNTHETICS, INC. BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL OR CONSEQUENTIAL DAMAGES FOR, RESULTING FROM, OR IN CONNECTION WITH, ANY LOSS RESULTING FROM THE USE OF THE LINER. IN THE EVENT THE EXCLUSIVE REMEDY PROVIDED HEREIN FAILS IN IT ESSENTIAL PURPOSE, AND IN THAT EVENT ONLY, Purchaser SHALL BE ENTITLED TO RETURN OF THE PURCHASE PRICE FOR SO MUCH OF THE MATERIAL AS
GEO-SYNTHETICS, INC. DETERMINES IN ITS SOLE DISCRETION, TO HAVE VIOLATED THE WARRANTY PROVIDED HEREIN. EXCEPT FOR THE WARRANTY SET FORTH ABOVE, NO REPRESENTATION OR WARRANTY MADE BY ANY SALES OR OTHER REPRESENTATIVE GEO-SYNTHETICS, INC., OR ANY OTHER PERSON, CONCERNING THE LINER SHALL BE BINDING UPON GEO-SYNTHETICS, INC.

Any waiver of the terms and conditions of this warranty shall be in writing signed by GEO-SYNTHETICS, INC. the failure to insist upon strict compliance with any of the terms and conditions contained herein shall not act as a waiver of strict compliance with all of the remaining terms and conditions or this warranty and shall not operate as a waiver as to any of the terms and conditions of this warranty as to future claims under this warranty.

GEO-SYNTHETICS INC

BY: _____
Robert Groh / President

I have read and agree to be bound
by the terms and conditions of the
foregoing warranty.

By: _____

Title: _____

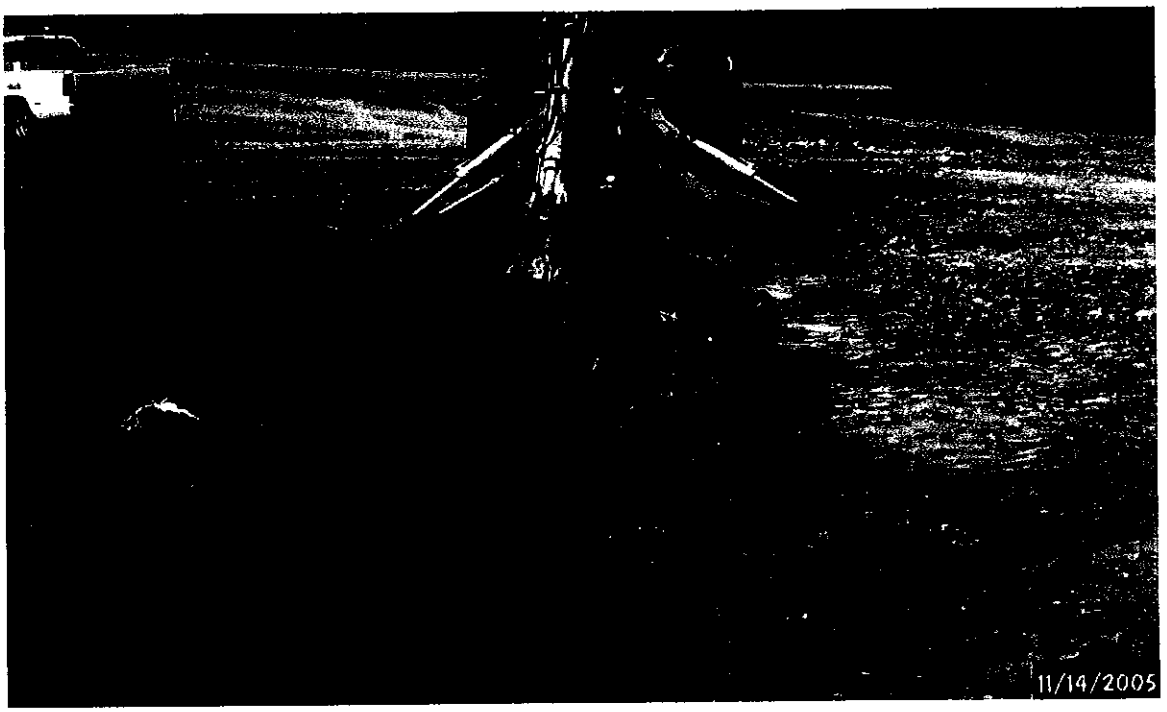
Company: _____

Date: _____

SECTION XII

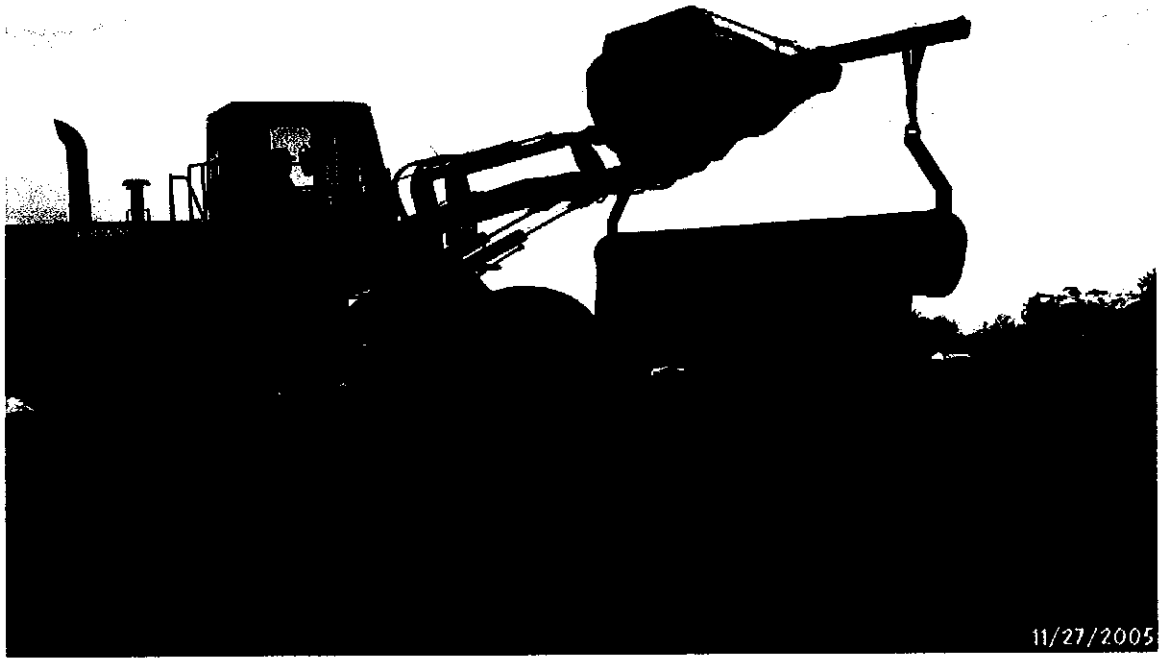
Subgrade placement and compaction

Delivery and conditioning/compacting clay soils



Excavation for methane vent placement

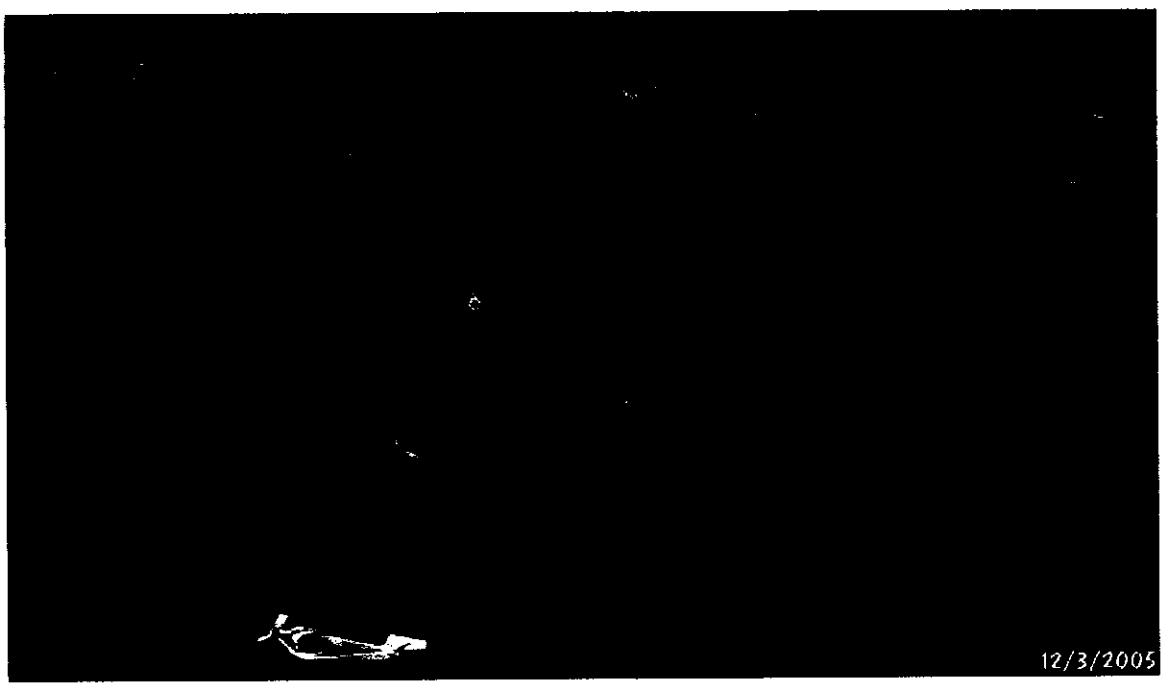
Stone and geotextile placement around methane vent



LLDPE placement

LLDPE fusion seaming

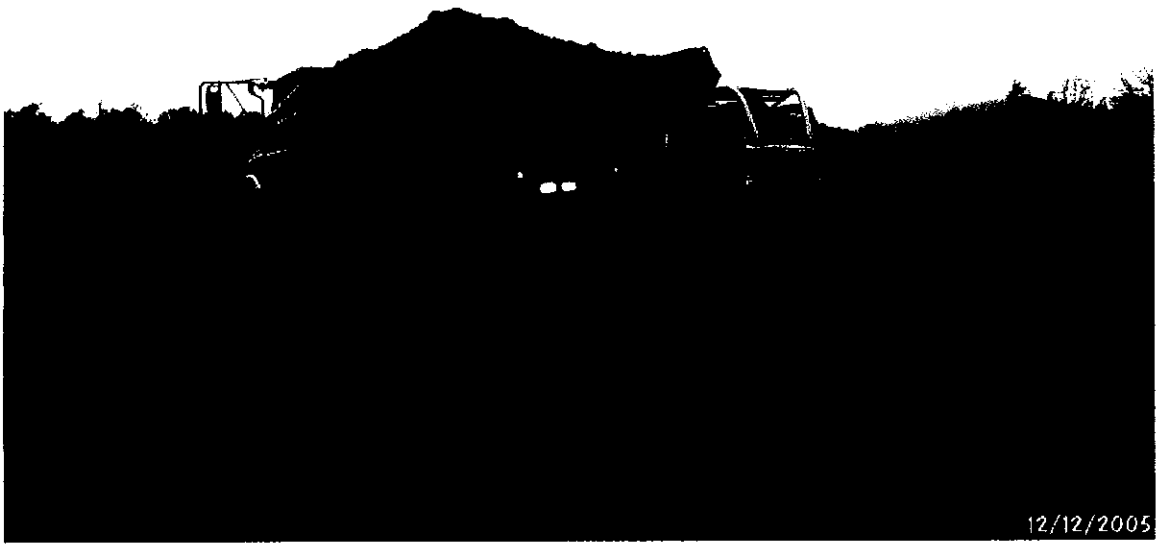
Gas vent boot installation



Tying of geocomposite panels

Installation of perimeter drain

Geocomposite flipped back over perimeter drain and tied



Low permeability vegetative support layer placement utilizing five feet (5') of cushion beneath loaded trucks

Low permeability vegetative support layer placement

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Construction Photo Log

Project: Madison County Landfill

Roll No.: _____

Project No.: CTC # 70001

	Date	Description
1	26-Oct	Sheepsfoot compaction of subgrade
2	26-Oct	Site overview, southern area
3	26-Oct	Subgrade placement, compaction
4	26-Oct	Subgrade placement, compaction
5	28-Oct	Subgrade material
6	28-Oct	Site overview, southern area
7	31-Oct	Borrow area
8	31-Oct	Subgrade placement, compaction
9	31-Oct	Subgrade delivery
10	1-Nov	Corrugated pipe placement around manhole
11	1-Nov	Corrugated pipe placement around manhole
12	1-Nov	Subgrade placement, compaction
13	2-Nov	Delivery and offloading LLDPE liner
14	2-Nov	Borrow site excavation
15	2-Nov	Test pad construction
16	2-Nov	Conditioning test pad
17	4-Nov	Supplemental fill placement
18	4-Nov	Supplemental fill placement
19	7-Nov	Borrow site excavation, clay liner material
20	7-Nov	Additional compactaion of subgrade prior to clay placement
21	7-Nov	Placement/compaction of clay material
22	9-Nov	Conditioning clay liner
23	9-Nov	Delivery and conditioning/compacting clay
24	10-Nov	Borrow area and haul road
25	10-Nov	Compacting clay material
26	14-Nov	Excavating trench for methane vent placement.

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Construction Photo Log

Project: Madison County Landfill

Roll No.: _____

Project No.: CTC # 70001

	Date	Description
27	14-Nov	Geofabric placement and corrugated pipe
28	14-Nov	Pinning fabric to sidewall prior to stone placement
29	14-Nov	Overview of methane pipe work, vents and manhole
30	14-Nov	Rock placement in trench
31	14-Nov	Constructing PVC methane vents
32	14-Nov	Stone placement around vent
33	14-Nov	Hand grading stone
34	14-Nov	Capping stone with fabric to fully enclose (overlap 2')
35	14-Nov	Additional stone placement and grading
36	14-Nov	Overlapping and enclosing stone and pipe
37	26-Nov	Project overview
38	26-Nov	Project overview 2
39	26-Nov	Project overview 3
40	26-Nov	Cell from west
41	26-Nov	Geosynthetic deployment bar on loader
42	26-Nov	Testing deployment setup
43	26-Nov	Testing load
44	27-Nov	Placement and seaming of LLDPE liner
45	27-Nov	Seam ID with time and date
46	27-Nov	Overview of deployment
47	27-Nov	Fusion welder
48	27-Nov	Cleaning panels ahead of welder
49	27-Nov	Destruct ID
50	27-Nov	Seaming, cleaning
51	27-Nov	Deploying LLDPE
52	27-Nov	Smooth rolling indentations prior to LLDPE placement

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Construction Photo Log

Project: Madison County Landfill

Roll No.:

Project No.: CTC # 70001

	Date	Description
53	27-Nov	Placing boot around methane vent
54	27-Nov	Vent boot construction
55	27-Nov	Heat tacking boot to liner prior to extrusion welding
56	27-Nov	Project overview
57	27-Nov	Extrusion welding patch on T-joint
58	27-Nov	Air test information
59	27-Nov	Project overview from west
60	27-Nov	Vacuum testing extrusion welds
61	30-Nov	Vacuum testing extrusion welds
62	30-Nov	Vacuum test information
63	30-Nov	Vent boot construction
64	30-Nov	Constructing vent boot riser
65	1-Dec	Junction chamber of outlet pipe on SW corner of cell
66	1-Dec	Corrugated pipe outlet placement
67	1-Dec	Grading clay liner after rain event with box grader
68	2-Dec	LLDPE deployment
69	2-Dec	Outlet pipe concrete endwall
70	2-Dec	Batton placement around manhole
71	2-Dec	Bolting steel battons to concrete around manhole
72	2-Dec	Grinding bolts on batton
73	2-Dec	Top batton placement
74	3-Dec	Heat welding Geonet
75	3-Dec	Seam of geonet after welding
76	3-Dec	Nylon zip-tie connecting 2 panels
77	3-Dec	Zip-tie placement
78	3-Dec	Deployment of geonet using 2 ATVs

Clayton, Sr., P.E., Inc.
C.T. Clayton, Sr., Professional Engineer

Construction Photo Log

Project: Madison County Landfill

Roll No.:

Project No.: CTC # 70001

	Date	Description
79	6-Dec	Finished batton
80	6-Dec	Surveying as-built LLDPE panels, joints, and repairs
81	6-Dec	Final seal of vent boot
82	6-Dec	Placement of corrugated drain pipe for cell perimeter
83	6-Dec	Pipe placed on edge of cell in anchor trench depression
84	6-Dec	Folding back geonet over pipe to enclose
85	6-Dec	Zip-tie placement on drain pipe enclosure
86	6-Dec	Zip-tie
87	6-Dec	Overview of pipe enclosure
88	6-Dec	Anchor trench preparation
89	6-Dec	Heat welding geonet at drain pipe
90	6-Dec	Capping endseam with 6oz fabric
91	6-Dec	Testing strength of weld between ties
92	6-Dec	Cap welding
93	6-Dec	Geonet wrap around methane vent
94	6-Dec	Cross-seam cap with 6oz fabric
95	6-Dec	Placement of zip-ties on cross-seam
96	12-Dec	Vegetative cover placement
97	12-Dec	Vegetative cover material going on geonet
98	12-Dec	Final result of drainpipe placement
99	13-Dec	Vegetative cover progress to date
100	19-Dec	Vegetative cover progress to date

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DEERE
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JOHN DEERE
650E LC
11/2/2005

NEW HOLLAND
11/2/2005

250D
11/2/2005

CAT
11/2/2005

DEERE
11/4/2005

815
CAT
11/4/2005

NEW HOLLAND
11/7/2005

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CATERPILLAR
Stowers
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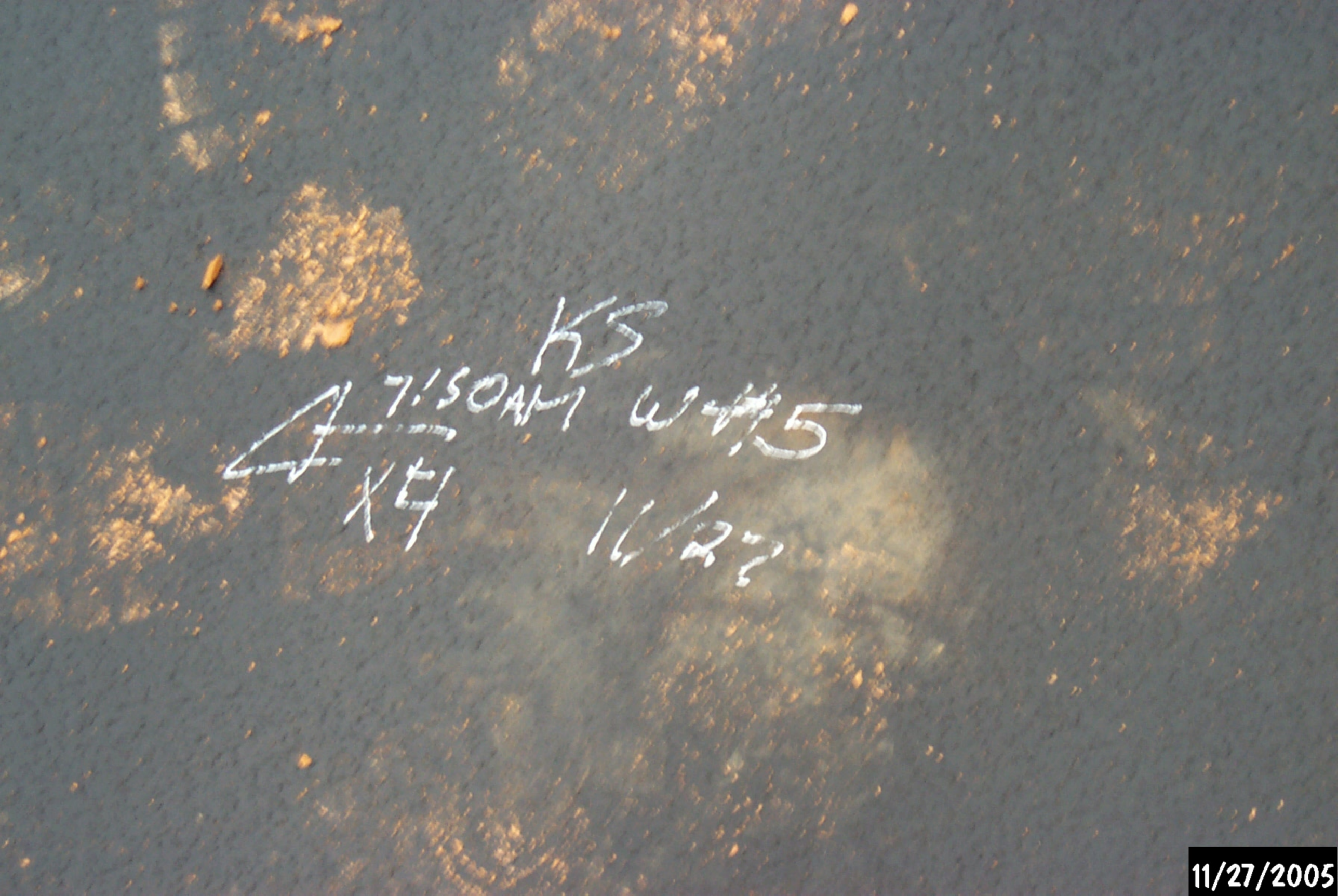

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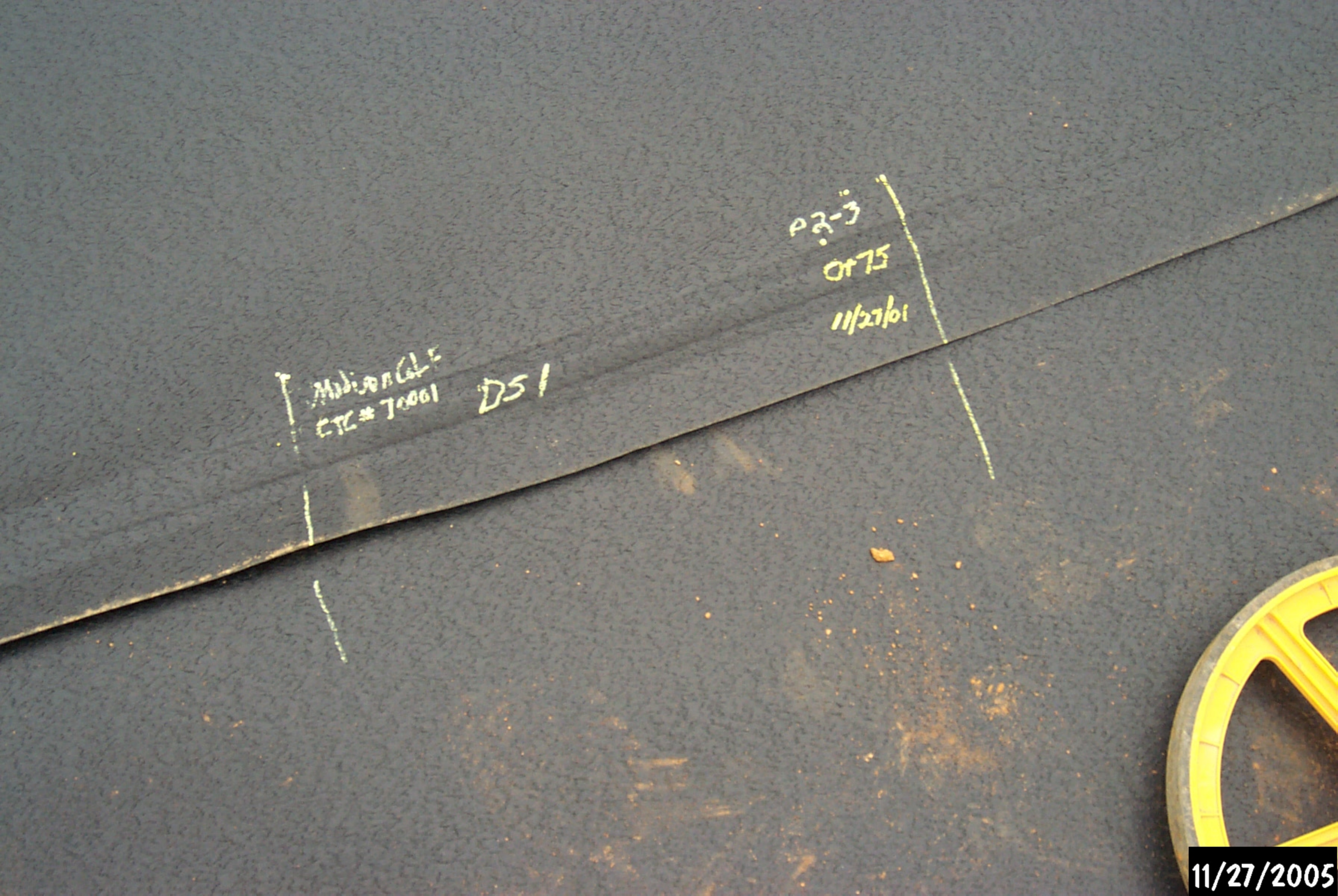
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NEW HOLLAND
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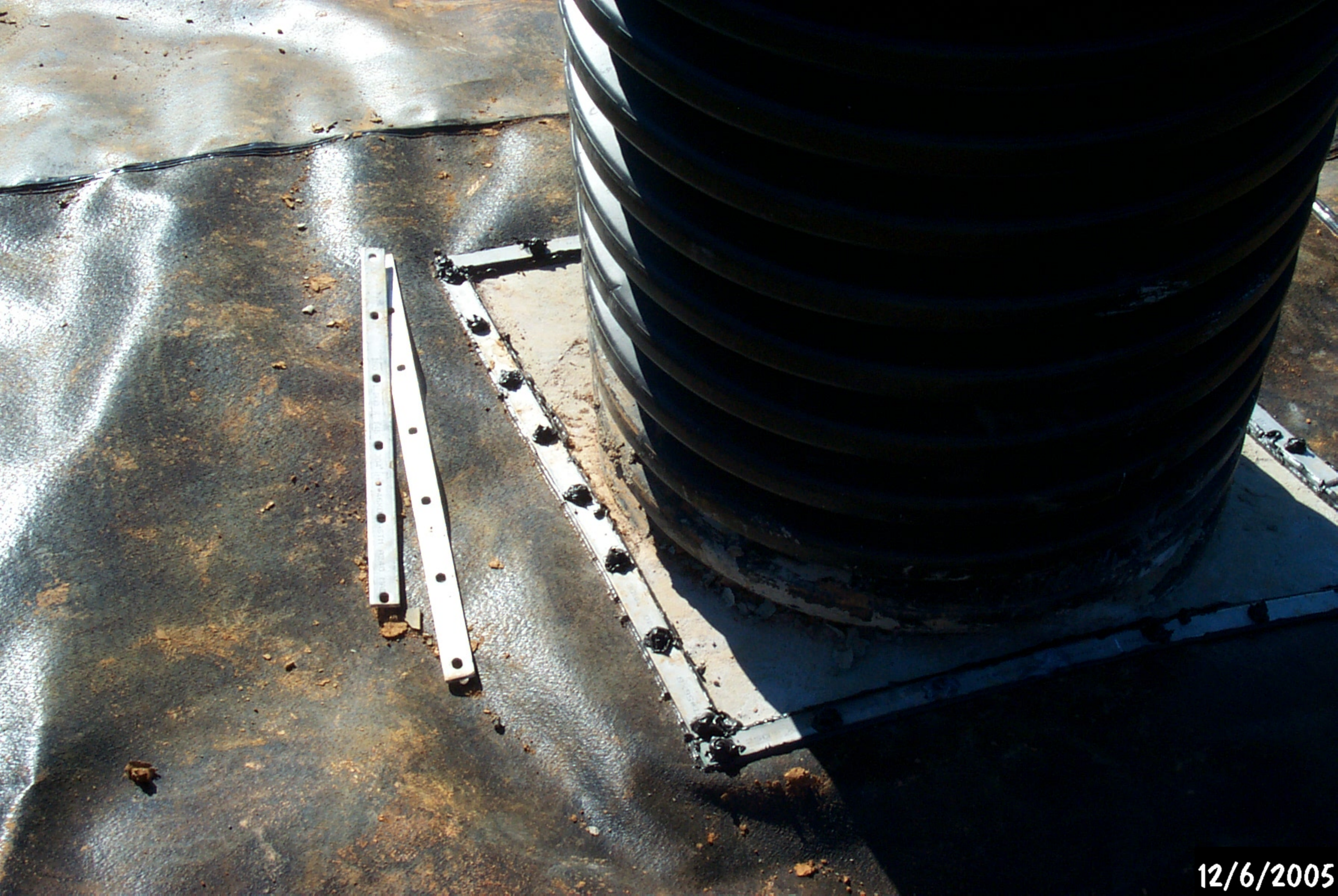
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SECTION XIII

BID DOCUMENTS

MADISON COUNTY MSW LANDFILL CLOSURE

MADISON COUNTY, NORTH CAROLINA

Mark D. Cathey, P.E.

McGill ASSOCIATES

Engineering • Planning • Finance
Post Office Box 2259
Asheville, North Carolina 28802

NORTH CAROLINA PROFESSIONAL SEAL 24993 ENGINEER MARK D. CATHEY

July 2005

04302

02200.1 SCOPE

This work consists of the building the landfill cap system. The work includes:

A. Site clearing and off-site disposal of all debris and unsuitable material as needed (paid under Item #2).

B. Installing structural fill to obtain the required base grades (paid under Item #4).

C. Proofrolling and grading the clay liner to the required elevations (paid under Item #8).

D. Proofrolling and grading the soil vegetative layer to the required elevations (paid under Item #12).

E. Construction of drainage ditches.

02200.2 SITE INFORMATION

The earthwork for the landfill cap shall include structural fill as needed to obtain the prescribed base grades, an 18-inch compacted clay liner with a maximum permeability of 1.0×10^{-5} cm/sec, a vegetative support soil layer with a minimum thickness of 24 inches and a maximum permeability of 1.0×10^{-5} cm/sec, and drainage ditches. The Contractor shall furnish all labor, material, supervision, and equipment to complete the necessary earthwork for the landfill, including hauling, sieving, raking, discing, compacting, drying, wetting, removal of rainwater and removal of all previously placed material rendered unsuitable due to weather conditions or construction operations, final grading and sealing and all necessary and incidental items as detailed or required to complete the landfill cap, all in accordance with the Contract Documents, and the Site Specific Construction Quality Assurance Plan.

A summary of the Construction Quality Assurance (CQA) constant head permeability test from the construction of the MSW landfill clay base liner has been attached as part of Appendix 2. This clay material, which was used for constructing the base liner of the MSW cell, was borrowed from on-site sources, although the exact location is not known. The boring logs from the proposed C&D landfill (potential borrow area), along with a drawing showing their locations, has been attached as part of Appendix 2. The boring logs, CQA test results, and related information depict approximate

subsurface conditions only at these specific locations and at the particular time designated on the logs. Subsurface conditions at other locations may differ from those reported at the boring locations. It is expressly understood that neither the Owner nor the Engineer will be responsible for interpretations or conclusions drawn from the boring data by the Contractor. The data are made available for the convenience of the Contractor. Additional test borings and other exploratory operations may be undertaken by the Contractor at his own expense provided such operations are acceptable to the Owner.

02200.3 UNSTABLE MATERIAL

Organically contaminated soils must be removed from the area of grading operations. At the discretion of the Engineer, topsoil within the area to be stripped shall be stockpiled in a convenient area, selected by the Engineer, for later use in planting area. All topsoil shall be identified by the Engineer as suitable and shall be stockpiled separately as directed by the Engineer in the field.

Soft or excessively yielding material shall be removed and replaced with inert controlled fill.

02200.4 FILL MATERIAL

Material to be used for structural fill shall be approved by the Engineer prior to placement.

All roots, organic matter, trash, debris, and other unsuitable materials which may find their way into otherwise acceptable fill material shall be removed during the dumping and spreading operations.

Broken rock and boulders larger than 6 inches in any dimension may not be used as fill without the specific approval of the Engineer.

Frozen soil shall not be used for fill.

Fill material shall have a maximum laboratory dry weight, ASTM D-698, of at least 95% maximum dry weight, unless specifically exempted from this requirement by the Engineer.

02200.5 PREPARATION

After removal of all existing debris and other undesirable material, the areas which are to receive fill should be proofrolled to locate any soft or yielding area. Proofrolling outside the waste limits of the landfill shall be done with at least four overlapping passes of a heavy duty flat wheel vibratory roller, at

least 20 tons, or by its approved equivalent. Proofrolling on the landfill surface shall be as directed by the Engineer.

Any soft, or excessively yielding material revealed by the proofrolling shall be removed and replaced with inert controlled fill. The Engineer shall be the sole judge of what constitutes soft or excessively yielding material.

02200.6 FILLING AND COMPACTION

After a stable non-yielding surface has been established, the surface of the area to be filled shall be scarified with a disc or harrow to a depth of 4 to 6 inches. An initial three inch layer of fill material shall then be spread over the scarified surface and the entire area compacted as specified below.

No fill shall be placed on any area until that area has been inspected and approved by the Engineer. Fill shall not be placed on a snow covered or frozen surface. Fill materials shall be spread in uniform horizontal layers not exceeding 8 inches in uncompacted thickness. Alternating layers of cohesive and granular fill soils shall not be permitted. Spreading and compacting of fill material should be started at the lowest portion of the site. All fill must be placed in horizontal layers.

Before compaction begins, the fill shall be brought to a water content that will permit proper compaction. This may require aerating the material if it is too wet, or the addition of water if it is too dry. If additional water is required, it should be uniformly distributed through the use of approved water wagons, and shall be thoroughly incorporated into the material by means of discs or other suitable mixing equipment. Care shall be taken to avoid trapping water within the fill.

The Standard Proctor method of moisture-density relationship test, ASTM D 698 or AASHTO T-99, shall be used to determine the maximum laboratory dry density and the optimum moisture content of the material which is to be used for fill. Each layer of fill material shall be compacted until its density is not less than 95% of the maximum laboratory dry density for the same material. The top 12 inches of fill beneath roadways shall be compacted to 98 percent of the maximum laboratory dry density. The moisture content of compacted cohesive materials shall not vary by more than four (4) percentage points from the optimum moisture content for the same material, providing excessive yielding is not produced within this range of moisture contents. Where, in the opinion of the Engineer, proposed fill material is too wet to permit drying in a reasonable length of time, the Engineer may reject the material and it must be removed from the work area.

At a minimum, the above compaction requirements are to be satisfied for all soil.

At the close of each day's work, or where work is to be interrupted for a period of time, the surface of the site shall be shaped to drain freely, and sealed. If after a prolonged rainfall, the surface of the area to be filled or cut is too wet to work properly, the unsuitable material shall be removed to expose workable soil. The wet material removed may be dried and reused. Construction traffic shall be controlled so as to prevent rutting of graded areas and to avoid overrolling of any section.

All cut areas shall be rolled and compacted to produce a compaction equal to that of the filled area. If soft or yielding material is encountered in cuts, or fills as a result of trapping water, overrolling or improper control of construction traffic, and cannot be satisfactorily stabilized by moisture control, compaction or other means approved by the Engineer, the unstable material shall be excavated to the depth required by the Engineer. The excavation shall then be filled with suitable compacted material in accordance with the requirements outlined above.

02200.7 GRADING

Elevations shown on the plans are finished ground unless otherwise noted. Grading shall be maintained in such a manner as to provide free surface drainage of the site at all times without any ponding of water.

Provide ditches and swales to the cross-sections and grades shown on the drawings. Cut ditch subgrades four inches below the grades shown and provide four inches of topsoil where the plans call for seeding or sodding of the ditch. Keep ditches and swales free of accumulations of debris or washed in material until final acceptance of work by the Engineer.

Shape all surfaces to within not more than 0.10 feet above or below the required subgrade elevations and free from irregular surface changes.

02200.9 SUBGRADE

Prior to placing the clay liner on the intermediate cover or structural fill, the project engineer shall visually inspect the subgrade surface to evaluate its suitability and to document that the surface is prepared properly and that elevations are consistent with the Division approved engineering plans. The subgrade shall be proof-rolled using equipment approved by the engineer. The subgrade shall be tested for field moisture content at a minimum frequency of one (1) test per 10,000 ft^2/lift. The subgrade shall be tested for field density at a minimum frequency of one (1) test per 40,000 ft^2/lift.

02200.10 CONTROL AND TESTING

The services of qualified soils testing personnel will be engaged by the Owner for performing tests to determine the moisture-density relationships, relative densities, plastic and liquid limits and suitability of materials for compaction and for inspection and control of the site preparation, selection, placing and compaction of the fill. A copy of the testing personnel's daily field report including results of in-place density and moisture content tests should be forwarded to the Owner and the Engineer at the end of each working day. If an independent testing firm is hired by the Contractor for the purpose of testing soil used in the construction of the landfill, the testing firm shall submit a field report to the owner and Engineer at least once each week.

The Contractor shall cooperate with the testing personnel so as to permit proper inspection and control of the work without unnecessary delays.

02200.11 MAINTENANCE

The Contractor shall be responsible during construction and until final acceptance for the maintenance of all embankments made under the Contract.

During construction and until final acceptance; the Contractor shall construct temporary or permanent earth berms along the outer edges of the landfill cap, construct temporary ditches, shape the embankment surface to provide for the drainage of surface runoff along and throughout the length of the embankments, and use any other methods necessary to maintain the work covered by this section so that the work will not contribute to excessive soil erosion. The Contractor shall construct brush dikes, or install temporary or permanent slope drains or other drainage features to assist in controlling erosion.

The Contractor shall replace, at no cost to the Owner, any portion of embankment which have become displaced or damaged due to carelessness or neglect on the part of the Contractor. Where the work has been properly constructed, completely drained and properly maintained, and damage occurs due to natural causes, the Contractor will be paid at the Contract unit price for the excavated material required to make necessary repairs to such damage.

All embankments shall be brought to the grade and cross section shown on the plans or established by the Engineer, prior to final inspection and acceptance by the Engineer.

END OF SECTION

02202.1 SCOPE

The work of this section consists of locating, hauling, and processing the soil material used to construct the 24-inch vegetative support soil layer as shown on the construction drawings. The purpose of the vegetative soil layer is to protect the geomembrane component of the cap system and to provide a layer for vegetative growth to reduce erosion on the landfill cap. The hydraulic conductivity, or permeability, of the vegetative support soil layer must be a maximum of 1×10^{-5} cm/sec. Borrow soils shall meet the requirements of Section 02212 and placement of the select backfill shall be in strict accordance with Section 02200 and the construction drawings.

02202.2 SOIL MATERIALS

The vegetative soil layer will be the soil placed on top of the geosynthetic component of the landfill cap system. This material will have the same preconstruction and testing requirements as the subgrade, with the exception that preconstruction and construction testing will have to be performed to show conformance with the permeability or hydraulic conductivity requirements. The testing requirements are as follows.

Preconstruction Qualification		
Test	**ASTM Method**	**Quantity**
Permeability, Hydraulic Conductivity	D2434, D3385 or D5126	1/5,000 YD^3
*** Preconstruction test samples shall be taken from the borrow source and or stockpile prior to construction.**		
Construction Testing		
Test	**ASTM Method**	**Quantity**
Field Density	D2922, D1556, D2167	1/ACRE
Field Moisture	D2216, D3017, D4643	1/ACRE
Permeability	D5084	1/ACRE
Testing Criteria		
Permeability, Hydraulic Conductivity		Maximum of 1×10^{-5} cm/sec

Maximum Particle Size Classification: CH,CH,ML or MH		3-inch diameter (lower 18 inches) ¼-inch diameter (top 6 inches)

02202.3 EXECUTION

The contractor is required to provide soil material for constructing the vegetative layer of the landfill cap system in accordance with the material requirements described in 2202.2. The vegetative layer shall be placed in accordance with Section 02200.

The friction angle between the vegetative soil layer and the geocomposite shall be a minimum of 24 degrees. The Contractor shall verify prior to beginning construction. The test method used to verify the interface friction angle between the 6-ounce geocomposite and the vegetative soil layer shall be ASTM D5321 *Standard Test Method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by Direct Shear Method*. Test parameters are to provide 3 points to range over minimum and maximum expected normal loads. Maximum will be a construction load of 260 psf.

02202.4 MEASUREMENT AND PAYMENT

See Section 01300.

END OF SECTION

PART 1: GENERAL

1.01 SCOPE OF WORK

A. Clearing and grubbing shall consist of the removal and satisfactory disposal of all trees, brush, stumps, logs, grass, weeds, roots, decayed vegetable matter, posts, fences, stubs, rubbish and all other objectionable matter resting on or protruding through the original ground surface and occurring within the construction limits or right-of-way of any excavation, borrow area, or embankment.

PART 2: NOT USED

PART 3: EXECUTION

3.01 GENERAL

A. Clearing and grubbing operations shall be completed sufficiently in advance of grading operations as may be necessary to prevent any of the debris from the clearing and grubbing operations from interfering with the excavation or embankment operations. All work under this section shall be performed in a manner which will cause minimum soil erosion. The Contractor shall perform such erosion control work, temporary or permanent, as may be directed by the Engineer in order to satisfactorily minimize erosion resulting from clearing and grubbing operations.

1. Clearing

a. The work of clearing shall be performed within the limits established by the plans, specifications, or the Engineer.

b. Clearing shall consist of the felling and cutting up, or the trimming of trees, and the satisfactory disposal of the trees and other vegetation together with the down timber, snags, brush and rubbish occurring within the areas to be cleared. Trees and other vegetation, except such individual trees, groups of trees, and vegetation, as may be indicated on the plans to be left standing, and all stumps, roots and brush in the areas to be cleared shall be cut off six inches above the original ground surface.

c. Individual trees and groups of trees designated to be left standing within cleared areas shall be trimmed of all branches to such heights and in such manner as may be necessary to prevent interference with construction operations. All limbs and branches required to be trimmed shall be neatly cut close to the whole of the tree or to main branches, and the cuts thus made shall be painted with an approved tree wound paint. Individual trees, groups of trees, and other vegetation, to be left standing shall be thoroughly protected from damage incident to construction operations by the erection of barriers or by such other means as the circumstances require.

d. The Engineer will designate all areas of growth or individual trees which are to be preserved due to their desirability for landscape or erosion control purposes. When the trees to be preserved are located within the construction limits, they will be shown on the plans or designated by the Engineer.

e. Clearing operations shall be conducted so as to prevent damage by falling trees to trees left standing, to existing structures and installations, and to those under construction, and so as to provide for the safety of employees and others. When such damages occur, all damaged areas shall be repaired, removed or otherwise resolved utilizing generally accepted practices at the Contractor's expense.

2. Grubbing

a. Grubbing shall consist of the removal and disposal of all stumps, roots and matted roots from all cleared areas, except as herein specified.

b. In embankment areas, when the depth of embankment exceeds 3'-6" in height sound stumps shall be cut off not more than 6" above the existing ground level and not grubbed. Unsound or decayed stumps shall be removed to a depth of approximately two feet below the natural ground surface.

c. All depressions excavated below the natural ground surface for or by the removal of stumps and roots shall be refilled with suitable material and compacted to make the surface conform to the surrounding ground surface.

3. Disposal of Cleared and Grubbed Material

Saw logs, pulp wood, cord wood or other merchantable timber removed incidental to clearing and grubbing shall remain the property of the Owner. All combustible matter shall be deposited at locations approved by the Engineer. Combustible matter may be burned or may be disposed of as stated above. Debris shall not be burned unless written permission or permit is issued by the Fire Marshall having jurisdiction in the area if applicable. The Contractor shall adhere to all limitations and conditions set forth in the permit. Burning shall be done at such time and such manner as to prevent fire from spreading and to prevent any damage to adjacent cover and shall further be subject to all requirements of State or Federal Governments pertaining to the burning. Disposal by burning shall be kept under constant attendance until all fires have burned out or have been extinguished.

PART 4: MEASUREMENT AND PAYMENT

See Section 01300.

END OF SECTION

02212.1 SCOPE

The work of this section consists of furnishing, loading, and hauling of borrow material used in the construction of the 24 inch vegetative soil layer, structural fill and the clay liner portion of the landfill cap system, as shown and specified herein.

02212.2 GENERAL

Borrow soils shall be selected to meet the requirements and conditions of the particular fill for which its use is intended. Borrow soils will be required for construction of the vegetative soil layer, structural fill, berms, raising the dike, access road and the clay liner portion of the landfill cap system. The borrow area is located on Madison County property and is available to the Contractor. The borrow area is located to the south of the MSW landfill above the cemetery. The location of the available borrow area is shown on sheet C2 of the construction drawings. The Owner does not certify the available material will meet the project specifications, but only that the material is available for the Contractor's convenience. The Contractor is responsible for providing borrow material which meets the project specifications. All borrow soils shall be free of roots, trash, and other deleterious material.

A. Borrow shall consist of material obtained from sources provided by the Contractor and shall meet the requirements of the classifications in accordance with USCS listed below:

   1. Acceptable Classifications: SC, CL, OL, CH, MH, OH and ML.

   2. Unacceptable Classifications: SW, SP, SM, and PT.

B. Cohesionless Materials: Cohesionless materials include poorly and well-graded gravels (GP and GW) and poorly and well graded sands (SP and SW). Cohesionless soils are generally regarded as free draining.

C. Cohesive Materials: Clayey gravels (GC), clayey sands (SC), lean clays (CL), fat clays (CH), silts (ML and MH), and organic (GM) and silty sands (SM) will be considered cohesionless only when the fines have a plastic index of 0. Otherwise they will be considered cohesive.

02212.3 RESTORATION

All borrow areas shall be graded to drain properly. The Contractor shall provide the owner with a proposed borrow area grading plan prior to beginning construction. The condition of the borrow areas, after construction has been completed, shall be approved by the Owner.

All borrow areas shall be seeded in accordance with Section 02931 of these specifications. Topsoil replacement will not be required for on-site borrow areas prior to seeding. Erosion control methods used at the borrow areas shall be approved by the Engineer.

02212.4 MEASUREMENT AND PAYMENT

No direct payment will be made for the work covered by this section. Payment at the contract prices for the various items in the contract will be full compensation for all work covered by this section including but not limited to furnishing any borrow areas; any right of access to borrow areas; and dressing and shaping of fill areas.

END OF SECTION

PART 1: GENERAL

1.01 SCOPE OF WORK

A. GENERAL

1. The work covered by this section shall consist of furnishing all materials, labor, equipment and services for the excavation and backfill at all areas within the limits of the project. Work is limited to the areas of construction, and includes (but is not necessarily limited to) stockpiling of topsoil, site grading, excavation of footings and trenches, filling, backfilling, compaction, finish grading, spreading of topsoil, disposal of waste material, and proof rolling.

2. Perform all excavation, dewatering, sheeting, bracing, and backfilling in such a manner as to eliminate all possibility of undermining or disturbing the foundations of existing structures.

3. Requirements of the General and Supplemental Conditions apply to all work in this section. Provide all labor, materials, equipment, and services indicated on the drawings, or specified herein, or reasonably necessary for or incidental to a complete job.

4. Excavations shall provide adequate working space and clearances for the work to be performed therein and for installation and removal of concrete forms. In no case shall excavation faces be undercut for extended footings.

5. Subgrade surfaces shall be clean and free of loose material of any kind when concrete is placed thereon.

6. Backfilling during freezing weather shall not be done except by permission of the Engineer. No backfill, fill, or embankment materials shall be installed on frozen surfaces, nor shall frozen materials, snow, or ice be placed in any backfill, fill, or embankment.

1.02 SYSTEM DESCRIPTION

A. EXCAVATION, GENERAL

Excavation consists of the removal and disposal of all materials encountered for footings, foundations, pipework, and other construction as shown on the drawings. Perform all excavation work in compliance with applicable requirements of governing authorities having jurisdiction.

1.03 QUALITY ASSURANCE

A. REFERENCED STANDARDS

Unless otherwise indicated, all referenced standards shall be the latest edition available at the time of bidding. Any requirements of these specifications shall in no way invalidate the minimum requirements of the referenced standards. Comply with the provisions of the following codes and standards, except as otherwise shown or specified.

1. ASTM C33: Standard Specifications for Concrete Aggregate

2. ASTM D698: Standard Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 5.5 lb. Rammer and 12" Drop.

3. ASTM D3282: Standard Recommended Practice for Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes.

4. Standard Specifications for Roads and Structures, North Carolina Department of Transportation, January 1, 2002 edition.

5. Erosion and Sediment Control Planning and Design Manual.

B. UNAUTHORIZED EXCAVATION

Except where otherwise authorized, indicated, or specified, all materials excavated below the bottom of concrete walls, footings, slabs on grade, and foundations shall be replaced, by and at the expense of the Contractor, with concrete placed at the same time and monolithic with the concrete above.

C. EXISTING UTILITIES

1. Locate existing underground utilities in the area of work. If utilities are to remain in place, provide adequate means of protection during earthwork operations.

2. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, consult the Engineer immediately for directions as to procedure. Cooperate with Owner and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to the satisfaction of utility companies.

1.04 SITE CONDITIONS

A. SITE INFORMATION

No test borings or related subsurface information is available for the project area. Test borings and other exploratory operations may be undertaken by the Contractor at his own expense provided such operations are acceptable to the Owner.

PART 2: PRODUCTS

2.01 MATERIALS

A. CLASSIFICATION OF EXCAVATED MATERIALS

Classification of excavated materials will be made as follows:

1. All materials excavated for this project, regardless of its nature or composition shall be classified as Unclassified Excavation, and shall be part of the lump sum price. No separate payment will be made for the excavation of rock or any unsuitable materials.

B. CLASSIFICATION OF OTHER MATERIALS

1. Satisfactory Subgrade Soil Materials: Soils complying with ASTM D 3282, soil classification Groups A-l, A-2-4, A-2-5, and A-3.

2. Unsatisfactory Subgrade Soil Materials: Soils described in ASTM D 3282, soil classification groups A-2-6, A-2-7, A-4, A-5, A-6, and A-7; also peat and other highly organic soils, unless otherwise acceptable to the Engineer.

3. Cohesionless Soil Materials: Gravels, sand-gravel mixtures, sands, and gravelly-sands.

4. Cohesive Soil Materials: Clayey and silty gravels, sand-clay mixtures, gravel-silt mixtures, clayey and silty sands, sand-silt mixtures, clays, silts, and very fine sands.

5. Backfill and Fill Materials: Provide satisfactory soil materials for backfill and fill, free of masonry, rock, or gravel larger than 4" in any dimension, and free of metal, gypsum, lime, debris, waste, frozen materials, vegetable, and other deleterious matter. Use only excavated material that has been sampled, tested, and certified as satisfactory soil material.

6. Select Backfill – Select backfill is defined as backfill and fill material that is transported to the site from outside the project limits, and which meets the soil requirements specified above under "Backfill and Fill Materials." Material excavated in conjunction with the construction of this project cannot be considered as "select backfill" for payment purposes.

7. Pipe Bedding: Crushed stone or crushed gravel meeting the requirements of ASTM C 33, Gradation 67.

8. Inundated Sand: Sand for inundated sand backfill shall be clean with not more than 25% retained on a No. 4 sieve and not more than 7% passing a No. 200 sieve and shall have an effective size between 0.10 mm and 0.30 mm. Sand shall be deposited in, or placed simultaneously with application of, water so that the sand shall be compacted by a mechanical probe type vibrator. Inundated sand shall be compacted to 70% relative density as determined by ASTM D4253 and D4254.

9. Graded Gravel: Gravel for compacted backfill shall conform to the following gradation:

Sieve Size	Percent Passing by Weight
1"	100
3/4"	85 - 100
3/8"	50 - 80
No. 4	35 - 60
No. 40	15 - 30
No. 200	05 - 10

The gravel mixture shall contain no clay lumps or organic matters. The fraction passing the No. 4 sieve shall have a liquid limit not greater than 25 and a plasticity index not greater than 5. Gravel

backfill shall be deposited in uniform layers not exceeding 12" in uncompacted thickness. The backfill shall be compacted by a suitable vibratory roller or platform vibrator to not less than 70% relative density as determined by ASTM D4253 and D4254.

2.01 EQUIPMENT

A. MECHANICAL EXCAVATION

1. The use of mechanical equipment will not be permitted in locations where its operation would cause damage to trees, buildings, culverts, or other existing property, utilities, or structures above or below ground. In all such locations, hand excavating methods shall be used.

2. Mechanical equipment used for trench excavation shall be of a type, design, and construction and shall be controlled, that uniform trench widths and vertical sidewalls are obtained at least from an elevation one foot above the top of the installed pipe to the bottom of the trench, and that trench alignment is such that pipe when accurately laid to specified alignment will be centered in the trench with adequate clearance between the pipe and sidewalls of the trench. Undercutting the trench sidewall to obtain clearance will not be permitted.

PART 3: EXECUTION

3.01 PREPARATION

A. DEWATERING

1. The Contractor shall provide and maintain adequate dewatering equipment to remove and dispose of all surface water and groundwater entering excavations, trenches, or other parts of the work. Each excavation shall be kept dry during subgrade preparation and continually thereafter until the structure to be built, or the pipe to be installed therein, is completed to the extent that no damage from hydrostatic pressure, flotation, or other cause will result.

2. All excavations for concrete structures or trenches that extend down to or below groundwater shall be dewatered by lowering and keeping the groundwater level beneath such excavations 12" or more below the bottom of the excavation.

3. Surface water shall be diverted or otherwise prevented from entering excavated areas or trenches without causing damage to adjacent property.

4. The Contractor is responsible for obtaining any required permits or permissions necessary for the disposal of groundwater that is removed. Any discharged groundwater shall be clean and free of sediment.

5. The Contractor shall be responsible for the condition of any pipe or conduit which he may use for drainage purposes, and all such pipes or conduits which he may use for drainage purposes, and all such pipes or conduits shall be left clean and free of sediment.

6. Where trench sheeting is left in place, such sheeting shall not be braced against the pipe, but shall be supported in a manner which will preclude concentrated loads or horizontal thrusts on the pipe. Cross braces installed above the pipe to support sheeting may be removed after pipe embedment has been completed.

B. STABILIZATION

1. Subgrades for concrete structures and trench bottoms shall be firm, dense, and thoroughly compacted and consolidated; free from mud and muck; and sufficiently stable to remain firm and intact under the feet of the workmen.

2. Subgrades for concrete structures or trench bottoms, which are otherwise solid but which become mucky on top due to construction operations, shall be reinforced with one or more layers of crushed rock or gravel. The stabilizing material shall be spread and compacted to a depth of not less than 6" below the bottom of the structure or pipe. Not more than 1/2" depth of mud or muck shall be allowed to remain on stabilized trench bottoms when the pipe bedding material is placed thereon. The finished elevation of stabilized subgrades for concrete structures shall not be above subgrade elevations indicated on the drawings.

C. CUTTING CONCRETE OR ASPHALT SURFACE CONSTRUCTION

1. All pavement cutting and repair shall be done in accordance with local ordinances. Cuts in concrete and asphaltic concrete shall be no larger than necessary to provide adequate working space for proper installation of pipe and appurtenances. Cutting shall be performed with a concrete saw in a manner which will provide a clean groove the complete thickness of the surface material along

each side of the trench and along the perimeter of cuts for structures.

2. Concrete and asphaltic concrete over trenches excavated for pipelines shall be removed so that a shoulder not less than 12" in width at any point is left between the cut edge of the surface and the top edge of the trench. Trench width at the bottom shall not be greater than at the top and no undercutting will be permitted. Cuts shall be made to and between straight or accurately marked curved lines which, unless otherwise required, shall be parallel to the center line of the trench.

3. Pavement or other surfaces removed for connections to existing lines or structures shall not be of greater extent that necessary for the installation.

4. Where the trench parallels the length of concrete walks and the trench location is all or partially under the walk, the entire walk shall be removed and replaced. Where the trench crosses drives, walks, curbs, or other surface construction, the surface construction shall be removed and replaced between existing joints or between saw cuts as specified for payment.

D. SITE GRADE

1. General: Uniformly grade areas within limits of grading under this section, including adjacent transition areas. Smooth finish the surface within specified tolerances; compact with uniform levels or slopes between points where elevations are shown, or between such points and existing grades.

2. Ground Surface Preparation: Remove vegetation, debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface prior to placement of fills. Plow, strip, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so that fill material will bond with existing surface. Shape the subgrade as indicated on the drawings by forking, furrowing, or plowing so that the first layer of new material placed thereon will be well bonded to it.

3.02 FIELD MEASUREMENTS

A. ALIGNMENT, GRADE, AND MINIMUM COVER

1. Vertical and horizontal alignment of pipes, and the maximum joint deflection used in connection therewith, shall be in conformity with requirements of the section covering installation of pipe.

2. Where pipe grades or elevations are not definitely fixed by the contract drawings, trenches shall be excavated to a depth sufficient to provide a minimum depth of backfill cover over the top of the pipe cover depths may be necessary on vertical curves or to provide necessary clearance beneath existing pipes, conduits, drains, drainage structures, or other obstructions encountered at normal pipe grades. Measurement of pipe cover depth shall be made vertically from the outside top of pipe to finished ground or pavement surface elevation except where future surface elevations are indicated on the drawings.

B LIMITING TRENCH WIDTHS

Trenches shall be excavated to a width that will provide adequate working space and sidewall clearances for proper pipe installation, jointing, and embedment. For the purposes of quantity measurements and payments, maximum trench widths shall be no greater than the pipe outside diameter plus 24" (12" either side of pipe).

3.03 PROTECTION

A. TEMPORARY PROTECTION

Protect structures, utilities, sidewalks, pavements, and other facilities from damages caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

B. SHEETING AND BRACING

Make all excavations in accordance with Federal, State, and Local health and safety rules and regulations, including those promulgated by the Department of Labor, Occupation Safety and Health Administration, "Safety and Health Regulations for Construction". Furnish, put in place, and maintain such sheeting, bracing, etc., as may be necessary to support the sides of the excavation to comply with the above mentioned rules and regulations.

C. BLASTING

1. The Contractor shall be responsible for all damage caused by blasting operations. Suitable methods shall be employed to confine all materials lifted by blasting within the limits of the excavation or trench.

2. All rock which cannot be handled and compacted as earth shall be kept separate from other excavated materials and shall not be mixed with backfill or embankment materials except as specified or directed.

D. CARE AND RESTORATION OF PROPERTY

1. Enclose the trunks of trees which are to remain adjacent to the work with substantial wooden boxes of such height as may be necessary to protect them from piled material, equipment or equipment operation. Use excavating machinery and cranes of suitable type and operate the equipment with care to prevent injury to remaining tree trunks, roots, branches and limbs.

2. Do not cut branches, limbs, and roots except by permission of the Engineer. Cut smoothly and neatly without splitting or crushing. In case of cutting or unavoidable injury to branches, limbs, and trunks of trees, neatly trim the cut or injured portions and cover with an application of grafting wax and tree healing paint as directed.

3. Protect by suitable means all cultivated hedges, shrubs and plants that might be injured by the Contractor's operations. Promptly heel in any such trees or shrubbery necessary to be removed and replanted. Perform heeling in and replanting under the direction of a licensed and experienced nurseryman. Replant in their original position all removed shrubbery and trees after construction operations have been substantially completed and care for until growth is reestablished.

4. Replace cultivated hedges, shrubs, and plants injured to such a degree as to affect their growth or diminish their beauty or usefulness, by items of kind and quality at least equal to the kind and quality existing at the start of the work.

5. Do not operate tractors, bulldozers or other power-operated equipment on paved surfaces if the treads or wheels of the equipment are so shaped as to cut or otherwise injure the surfaces.

6. Restore all surfaces, including lawns, grassed, and planted areas that have been injured by the Contractor's operations, to a condition at least equal to that in which they were found immediately before the work was begun. Use suitable materials and methods for such restoration. Maintain all restored plantings by cutting, trimming, fertilizing, etc., until acceptance. Restore existing property or structures as promptly as practicable and do not leave until the end of construction period.

E. PROTECTION OF STREAMS

Exercise reasonable precaution to prevent the silting of streams. Provide at Contractor's expense temporary erosion and sediment control measures to prevent the silting of streams and existing drainage facilities. The Contractor shall size structures and conform fully with the North Carolina Sedimentation Pollution Control Act.

F. AIR POLLUTION

1. Comply with all pollution control rules, regulations, ordinances, and statutes which apply to any work performed under the Contract, including any air pollution control rules, regulations, ordinances and statutes, or any municipal regulations pertaining to air pollution.

2. During the progress of the work, maintain the area of activity, including sweeping and sprinkling of streets as necessary, so as to minimize the creation and dispersion of dust. If the Engineer decides that it is necessary to use calcium chloride or more effective dust control, furnish and spread the material, as directed, and without additional compensation.

3.04 TRENCH EXCAVATION

A. LENGTH OF TRENCH

1. No more trenches shall be opened in advance of pipe laying than is necessary to expedite the work. One block or 400 feet (whichever is the shorter) shall be the maximum length of open trench on any line under construction.

2. Except where tunneling is indicated on the drawings, is specified, or is permitted by the Engineer, all trench excavation shall be open cut from the surface.

B. TRENCH EXCAVATION

1. General Perform all excavation of every description and of whatever substance encountered so that the pipe can be laid to the alignment and depth shown on the drawings.

2. Brace and shore all trenches, where required, in accordance with Federal, State, and Local health and safety rules and regulations, including those promulgated by the Department of Labor, Occupation Safety and Health Administration, "Safety and Health Regulations for Construction".

3. Make all excavations by open cut unless otherwise specified or indicated on the drawings.

4. Width of Trenches: Excavate trenches sufficiently wide to allow proper installation of pipe, fittings and other materials. Measurement and payment quantities will be based on a maximum trench width of not more than 12" clear of pipe on either side at any point. Do not widen trenches by scraping or loosening materials from the sides.

5. Trench Excavation in Earth: Earth excavation includes all excavation of whatever substance encountered. In locations where pipe is to be bedded in earth excavated trenches, fine grade the bottoms of such trenches to allow firm bearing for the bottom of the pipe on undisturbed earth. Where any part of the trench has been excavated below the grade of the pipe, fill the part excavated below such grade with pipe bedding material and compact at the Contractor's expense.

6. Trench Excavation in Fill: If pipe is to be laid in embankments or other recently filled material, first place the fill material to the finish grade or to a height of at least one foot above the top of the pipe, whichever is the lesser. Take particular care to ensure maximum consolidation of material under the pipe location. Excavate the pipe trench as though in undisturbed material.

7. Trench Bottom in Poor Soil: Excavate and remove unstable or unsuitable soil to a width and depth, as directed by the Engineer, and refill with a thoroughly compacted gravel bedding.

8. Bell Holes: Provide bell holes at each joint to permit the joint to be made properly and to provide a continuous bearing and support for the pipe.

C. TRENCH BACKFILL

1. General: Unless otherwise specified or indicated on the drawings, use suitable material for backfill which was removed in the course of making the construction excavations. Do not use frozen material for the backfill and do not place backfill on frozen material. Remove previously frozen material before new backfill is placed. Start backfilling as soon as practicable after the pipes have been laid, or the structures have been built and are structurally adequate to support the loads, including construction loads to which they will be subjected, and proceed until its completion.

2. With the exception mentioned below in this paragraph, do not backfill trenches at pipe joints until after that section of the pipeline has successfully passed any specified tests required. Should the Contractor wish to minimize the maintenance of lights, and barricades, and the obstruction of traffic, he may, at his own risk, backfill the entire trench as soon as practicable after installation of pipe, and the related structures have acquired a suitable degree of strength. He shall, however, be responsible for removing and later replacing such backfill, at his own expense, should he be ordered to do so in order to locate and repair or replace leaking or defective joints or pipe.

3. Material: The nature of the materials will govern both their acceptability for backfill and the methods best suited for their placement and compaction in the backfill. Both are subject to the approval of the Engineer. Do not place stone or rock fragments larger than 4" in greatest dimension in the backfill. Do not drop large masses of backfill material into the trench in such a manner as to endanger the pipeline. Use a timber grillage to break the fall of material dropped from a height of more than 5 feet. Exclude pieces of bituminous pavement from the backfill unless their use is expressly permitted.

4. Zone Around Pipe: Place bedding material to the level shown on the Drawings and work material carefully around the pipe to insure that all voids are filled, particularly in bell holes. For backfill up to a level of 2 feet over the top of the pipe, use only selected materials containing no rock, clods or organic materials. Place the backfill and compact thoroughly under the pipe haunches and up to the mid-line of the pipe in layers not exceeding 6" in depth. Place each layer and tamp carefully and uniformly so as to eliminate the possibility of lateral displacement. Place and compact the remainder of the zone around the pipe and to a height of one foot above the pipe in layers not exceeding 6" and compact to a

maximum density of at least 100 % as determined by ASTM D0698.

5. Tamping: Deposit and spread backfill materials in uniform, parallel layers not exceeding 12" thick before compaction. Tamp each layer before the next layer is placed to obtain a thoroughly compacted mass. Furnish and use, if necessary, an adequate number of power driven tampers, each weighing at least 20 pounds for this purpose. Take care that the material close to the bank, as well as in all other portions of the trench, is thoroughly compacted. When the trench width and the depth to which backfill has been placed are sufficient to make it feasible, and it can be done effectively and without damage to the pipe, backfill may, on approval of the Engineer, be compacted by the use of suitable rollers, tractors, or similarly powered equipment instead of by tamping. For compaction by tamping (or rolling), the rate at which backfilling material is deposited in the trench shall not exceed that permitted by the facilities for its spreading, leveling and compacting as furnished by the Contractor.

6. Wet the material by sprinkling, if necessary, to insure proper compaction by tamping (or rolling). Perform no compaction by tamping (or rolling) when the material is too wet either from rain or applied water to be compacted properly.

7. Trench Compaction: Compact backfill in pipe trenches to the maximum density as shown on the drawings, or as listed in the subsection entitled COMPACTION, with a moisture content within the range of values of maximum density as indicated by the moisture-density relationship curve.

3.05 SITE GRADE

A. PLACEMENT AND COMPACTION

1. Place backfill and fill material in layers not more than 8" in loose depth. Before compaction, moisten or aerate each layer as necessary to provide the optimum moisture content. Compact each layer to the required percentage of maximum density for each area classification. Do not place backfill or material on surfaces that are muddy, frozen, or contain frost or ice.

2. In areas not accessible to rollers or compactors, compact the fill with mechanical hand tampers. If the mixture is excessively moistened by rain, aerate the material by means of blade graders, harrows, or other approved equipment, until the moisture content of

the mixture is satisfactory. Finish the surface of the layer by blading or rolling with a smooth roller, or a combination thereof, and leave the surface smooth and free from waves and inequalities.

3. Place backfill and fill materials evenly adjacent to structures, to the required elevations. Take care to prevent wedging action of backfill against structures. Carry the material uniformly around all parts of the structure to approximately the same elevation in each lift.

4. When existing ground surface has a density less than that specified under the subsection entitled COMPACTION for the particular area classification, break up the ground surface, pulverize, moisture-condition to the optimum moisture content, and compact to required depth and percentage of maximum density.

B. GRADING OUTSIDE BUILDING LINES

Grade to drain away from structures to prevent ponding of water. Finish surface free from irregular surface changes.

C. PLANTING AREAS

Finish areas to receive topsoil to within not more than one inch (1") above or below the required subgrade elevations, compacted as specified, and free from irregular surface changes.

D. WALKS

Shape the surface of areas under walks to line, grade, and cross-section, with the finish surface not more than 0" above or 1" below the required subgrade elevation, compacted as specified, and graded to prevent ponding of water after rains.

E. PAVEMENTS

1. Shape the surface of the areas under pavement to line, grade and cross section, with finish surface not more than 1/2" above or below the required subgrade elevation, compacted as specified, and graded to prevent ponding of water after rains. Include such operations as plowing, discing, and any moisture or aerating required to provide the optimum moisture content for compaction.

2. Fill low areas resulting from removal of unsatisfactory soil materials, obstructions, and other deleterious materials, using satisfactory soil material.

3. Shape to line, grade, and cross section as shown on the drawings.

F. PROTECTION OF GRADED AREAS

Protect newly graded areas from traffic and erosion, and keep free of trash and debris. Repair and re-establish grades in settled, eroded, and rutted areas to specified tolerances.

G. RECONDITIONING COMPACTED AREAS

Where completed compacted areas are disturbed by subsequent construction operations or adverse weather prior to acceptance of work, scarify surface, reshape, and compact to required density prior to further construction.

H. UNAUTHORIZED EXCAVATION

1. Unauthorized excavation consists of the removal of materials beyond indicated elevations without the specific direction of the Engineer. Under footings, foundations, bases, etc., fill unauthorized excavation by extending the indicated bottom elevation of the concrete to the bottom of the excavation, without altering the required top elevation. Lean concrete fill may be used to bring elevations to proper position only when acceptable to the Engineer.

2. For pipe trenches and elsewhere, backfill and compact unauthorized excavations as specified for authorized excavations of the same classification, unless otherwise directed by the Engineer.

3.06 BACKFILL AROUND STRUCTURES

A. GENERAL

Unless otherwise specified or indicated on the drawings, use suitable material for backfill which was removed in the course of making the backfill and do not place backfill which was removed in the course of making the construction excavations. Do not use frozen material for the backfill and do not place backfill upon frozen material. Remove previously frozen material before new backfill is placed.

B. MATERIAL

Approved selected materials available from the excavations may be used for backfilling around structures. Obtain material needed in addition to that of construction excavations from off-site borrow pits selected by the Contractor. Furnish all borrow material needed on the work. Place and compact all material, whether from the excavation or borrow, to make a dense, stable fill. Use fill material which contains no vegetation, masses of roots, individual roots over 18" long or more than 1/2" in diameter, stones over 4" in diameter, or porous matter. Organic matter must not exceed negligible quantities.

C. PLACING BACKFILL

Do not place backfill against or on structures until they have attained sufficient strength to support the loads (including construction loads) to which they will be subjected, without distortion, cracking, or other damage. Make special leakage tests, if required, as soon as practicable after the structures are structurally adequate and other necessary work has been done. Use the best of the excavated materials in backfilling within 2 feet of the structure. Avoid unequal soil pressures by depositing the material evenly around the structure.

3.07 COMPACTION

A. GENERAL

Control soil compaction during construction providing at least the minimum percentage of density specified for each area classification.

B. PERCENTAGE OF MAXIMUM DENSITY REQUIREMENTS

After compaction, all fill will be tested in accordance with Method "C" of ASTM D-698, unless specified otherwise. Except as noted otherwise for the zone around pipe, provide not less than the following percentages of maximum density of soil material compacted at optimum moisture content, for the actual density of each layer of soil material-in-place:

UNPAVED AREAS	Compact Full Depth to 92%
DRIVES AND PARKING	Top 24" - 100%
TRENCH BACKFILL (PAVED AREAS)	Compact full depth to 100%
TRENCH BACKFILL (UNPAVED AREAS)	Compact full depth to 95%
ALL OTHER BACKFILL	Compact full depth to 95%

C. MOISTURE CONTROL

Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water to surface of subgrade, or layer of soil material, to prevent free water appearing on surface during or subsequent to compaction operations. Remove and replace, or scarify and air dry, soil material that is too wet to permit compaction to specified density. Soil material that has been removed because it is too wet to permit compaction may be stockpiled or spread and allowed to dry. Assist drying by discing, harrowing or pulverizing, until moisture content is reduced to a satisfactory value, as determined by moisture-density relation tests.

D. DISPOSAL OF SURFACE MATERIAL

Upon approval of the Engineer, haul all surplus materials not needed or acceptable for backfill off-site.

3.08 FIELD QUALITY CONTROL

A. SOIL TESTING AND INSPECTION SERVICE:

Compaction tests of all fill areas will be made by an independent testing laboratory. Such tests will be provided and paid for by the Owner, except that tests that reveal non-conformance with the specifications and all succeeding tests for the same area shall be at the expense of the Contractor until conformance with the specifications is established. The Owner will be responsible for paying for only the successful tests.

END OF SECTION

PART 1: GENERAL

1.01 SCOPE OF WORK

The work covered by this section consists of the excavation and satisfactory disposal of all material excavated in the construction of ditches.

1.02 QUALITY ASSURANCE

A. The excavation shall be done to the lines, grades, typical sections and details shown on the plans or established by the Engineer. All work covered by this section shall be coordinated with the grading, and shall be maintained in a satisfactory condition so that adequate drainage is provided at all times. Ditches shall be landscaped in accordance with Section 02931.

B. The ditches shall be maintained by the Contractor until the final acceptance of the project.

PART 2: NOT USED

PART 3: EXECUTION

3.01 PREPARATION

A. SILT DETENTION

When directed by the Engineer or shown on the drawings, the Contractor shall excavate silt detention basins and silt ditches to the dimensions and at the locations established by the Engineer for the purpose of siltation control. Silt detention basins shall be cleaned out, when so directed by the Engineer, if necessary to maintain their effectiveness. Silt detention basins and silt ditches shall be backfilled and shaped for seeding and mulching prior to the completion of the project unless otherwise directed by the Engineer.

B. All roots, stumps, and other foreign matter in the sides and bottom of ditches shall be cut one foot below finish grade. Care shall be taken not to over-excavate ditches below the grades indicated. Any excessive ditch excavation due to removal of roots, stumps, etc., or due to over-excavation shall be backfilled to grade either with suitable material, thoroughly compacted, or with suitable stone or cobble to form an

adequate invert, as directed. The Contractor shall maintain all ditches excavated under this specification free from detrimental quantities of leaves, sticks, and other debris until final acceptance of the work.

3.02 DISPOSAL OF MATERIALS

All excavated materials shall be utilized in the construction of embankments except where otherwise directed by the Engineer. Materials which are excess to the needs of the project must be stockpiled at an on-site location approved by the Owner and Engineer.

END OF SECTION

PART 1: GENERAL

1.01 SCOPE OF WORK

Furnish all labor, materials, supervision, and equipment necessary to complete the Methane Gas Collection System including trench excavation, installation and all necessary and incidental items required to complete the Work, all in accordance with the Contract Drawings and these Contract Specifications.

PART 2: PRODUCTS

2.01 HDPE PIPE PROPERTIES

A. Pipe for the Methane Gas Collections System shall be High Density Polyethylene (HDPE) corrugated pipe with an integrally formed smooth interior pipe designated as AASHTO Type 'S' (ADS N12 or approved equivalent).

1. HDPE piping shall have nominal diameters as noted on the Contract Drawing.

2. The HDPE pipe shall be manufactured from first quality virgin polyethylene with the following nominal properties.

Diameter (nominal)	Pipe Stiffness (minimum)	Diameter (nominal)	Pipe Stiffness (minimum)
4"	50 psi	24"	34 psi
6"	50 psi	30"	28 psi
8"	50 psi	36"	22 psi
10"	50 psi	42"	20 psi
12"	50 psi	48"	18 psi
15"	42 psi	60"	14 psi
18"	40 psi		

B. The HDPE pipe section to be perforated shall be as follows or approved by the Engineer:

1) Four rows of perforations; Two rows on each side of pipe at approximately 45° and between 75° and 90° from bottom of pipe.

2) Each row of perforations shall have holes approximately 6 inches on center; and

3) Each hole shall be 3/8-inch diameter.

C. The chemical resistance of the HDPE pipe and all fittings shall be in keeping with typical properties of high quality polyethylene products currently available through commercial sources. All mechanical fasteners or fittings shall be stainless steel.

D. Gravel surrounding the perforated HDPE piping shall be No. 57 stone. The Contractor shall be responsible for providing the pipe bedding material.

E. Only fittings supplied or recommended by the pipe manufacturer should be used. Fittings shall be installed in accordance with the manufacturer's recommendations.

F. Water-tight joints shall be used and must prevent the infiltration of soil and storm water. Bell-and-spigot couplers and bell-bell couplers are examples of typical designs and shall incorporate an ASTM F-477 elastomeric rubber gasket. Couplers shall meet a laboratory pressure test of 10.8 psi per ASTM D-3212.

2.02 NONWOVEN FILTER GEOTEXTILE

A. The geotextile used shall be ultraviolet stabilized 1) a non-woven, needlepunched, continuous filament polyester material or, 2) a non-woven, needlepunched continuous filament polypropylene material or, 3) a non-woven, needlepunched staple fiber polypropylene material.

B. The geotextile will be used to wrap the methane gas collection lines and the #57 stone bedding.

C. The non-woven material shall meet or exceed the following criteria using Minimum Average Values:

Tested Property	Test Method	Unit	MINIMUM AVERAGE VALUES[a]
Grab Tensile Strength	ASTM D 4632	Lbs (kN)	120 (0.53)
Grab Tensile Elongation	ASTM D 4632	%	50
Trapezoid Tear Strength	ASTM D 4533	Lbs (kN)	50 (0.22)
Mullen Burst Strength	ASTM D 3786	psi (kPa)	225 (1550)
Puncture Strength	ASTM D 4833	Lbs (kN)	65 (0.30)
Apparent Opening Size (AOS)	ASTM D 4751	U. S. Sieve (mm)	70 (0.212)
Permittivity	ASTM D 4491	sec^{-1}	1.8

Tested Property	Test Method	Unit	MINIMUM AVERAGE VALUES[a]
Permeability	ASTM D 4491	cm/sec	0.21
Flow Rate	ASTM D 4491	gal/min/ft^2 (l/min/m^2)	135 (5500)
UV Resistance (at 500 hours)	ASTM D 4355	% strength retained	70
Weight	ASTM D 5261	oz/yd^2 (g/m^2)	4.8 (163)
Thickness	ASTM D 5199	mils (mm)	55 (1.4)

(a) These are MARV values that are based on the cumulative results of specimens tested.

PART 3: EXECUTION

A. The perforated high density polyethylene collector pipe shall be as shown on the Contract Drawings.

1.) The pipe section connections shall be made by:

A. Heat fusion weld;
B. Material extrusion weld;
C. Threaded connection;
D. Snap-couplings (approved mechanical); and/or
E. Combination of any two or more of the above. No solvent or glued joints are allowed.
F. Joints shall be water-tight.

B. The sections of the geotextile shall be installed with a minimum overlap of 4 inches and field sewn together;

C. The overlapped edges of the geotextile shall be temporarily secured during periods of windy weather;

PART 4: MEASUREMENT AND PAYMENT

See Section 01300.

END OF SECTION

PART 1: GENERAL

1.01 SCOPE OF WORK

This section covers providing and installing HDPE piping. Piping shall be constructed as shown on the Contract drawings and as specified herein.

1.02 DELIVERY, STORAGE AND HANDLING

A. UNLOADING AND HANDLING

All pipe and storm drainage material shall be unloaded and handled with reasonable care. Pipe shall not be rolled or dragged over gravel or rock during handling. When any joint or section of pipe is damaged during unloading or handling, the undamaged portions of the joint or section may be used where partial lengths are needed, or if damaged sufficiently, the Engineer will reject the joint or section as being unfit for installation and the Contractor shall remove such rejected pipe from the project.

1.03 QUALITY ASSURANCE

A. Pipe and drainage materials shall meet the following reference requirements:

1. AASHTO M252 & M294 .....HDPE Pipe

1.04 SUBMITTALS

A. The Contractor shall submit for approval of the Engineer shop drawings which describe in detail the materials to be utilized. Six (6) copies of shop drawings shall be submitted. Prior to submittal all shop drawings are to be reviewed by the Contractor, and shall be stamped and signed as to compliance with the referenced specification. Any variance to the specification shall be noted.

The following shop drawings shall be submitted:

1. Drainage Pipe
2. Underdrain Pipe
3. Underdrain or Pipe Bedding
4. Drainage Structure Castings
5. Precast Drainage Structures

1.05 WARRANTY

All pipe and materials shall be warranted for a period of one (1) year following installation and acceptance by the Owner.

PART 2: PRODUCTS

2.01 HDPE PIPE

A. HDPE pipe shall conform to AASHTO M252 or M294, latest revision. Pipe shall be AASHTO Type 'S', unless otherwise noted. All pipes shall have interior surfaces free from roughness, projection, indentations, offset or irregularities of any kind and be water-tight.

B. Only fittings supplied or recommended by the pipe manufacturer should be used. Fittings shall be installed in accordance with the manufacturer's recommendations.

C. Where designated on plans, water-tight joints shall be used and must prevent the infiltration of soil and the exfiltration of storm water. Bell-and-spigot couplers and bell-bell couplers are examples of typical designs and shall incorporate an ASTM F-477 elastomeric rubber gasket. Couplers shall meet a laboratory pressure test of 10.8 psi per ASTM D-3212.

D. The HDPE pipe shall be manufactured from first quality virgin polyethylene with the following nominal properties:

Diameter (nominal)	Pipe Stiffness (minimum)	Diameter (nominal)	Pipe Stiffness (minimum)
4"	50 psi	24"	34 psi
6"	50 psi	30"	28 psi
8"	50 psi	36"	22 psi
10"	50 psi	42"	20 psi
12"	50 psi	48"	18 psi
15"	42 psi	60"	14 psi
18"	40 psi		

D. The HDPE pipe section to be perforated shall be as follows or approved by the Engineer:

1. Four rows of perforations; two rows on each side of pipe at approximately 45° and between 75° and 90° from bottom of pipe.

2. Each row of perforations shall have holes approximately 6 inches on center; and

3. Each hole shall be 3/8-inch diameter.

E. The chemical resistance of the HDPE pipe and all fittings shall be in keeping with typical properties of high quality polyethylene products currently available through commercial sources. All mechanical fasteners or fittings shall be stainless steel.

2.04 CASTINGS

Castings shall be sound and free from warp, holes and other defects that impair their strength or appearance. Exposed surfaces shall have a smooth finish and sharp, well defined lines and arises. Machined joints, where required, shall be milled to a close fit. Provide all necessary lugs and brackets so that work can be assembled in a neat, substantial manner.

2.05 AGGREGATE FOR UNDERDRAINS

Aggregate for underdrains shall be washed stone, standard size number 67 per North Carolina Department of Transportation specifications, Section 905.

PART 3: EXECUTION

3.01 PREPARATION OF PIPE FOUNDATION

A. LINES AND GRADES

The pipe foundation shall be prepared to be uniformly firm and shall be true to the lines and grades as shown on the plans. Any deviation or field adjustments will require the approval of the Engineer. When an Inspector is present on the site and is so requested by the Contractor, he shall check the position of grades and lines; but the Contractor shall be responsible for the finished drain line being laid to exact and proper line and grade.

B. PIPE FOUNDATION

1. Whenever the nature of the ground will permit, the excavation at the bottom of the trench shall have the shape and dimensions of the outside lower third of the circumference of the pipe, care being taken to secure a firm bearing support uniformly throughout the length of the pipe. A space shall be excavated under and around each bell to sufficient depth to relieve it of any load and to allow ample space for filling and finishing the joint. The pipe, when thus bedded firmly, shall be on the exact grade. In case the bed shaped in the bottom of the trench is too low, the pipe shall be completely removed from position, and earth of suitable quality shall be placed and thoroughly tamped to prepare a new foundation for the pipe.

2. In no case shall the pipe be brought to grade by blocking up under the barrel or bell of same, but a new and uniform support must be provided for the full length of the pipe. Where rock or boulders are

encountered in the bottom of the trench, the same shall be removed to such depth that no part of the pipe, when laid to grade, will be closer to the rock or boulders than 6". A suitably tamped and shaped foundation of suitable earth shall be placed to bring the bottom of the trench to proper subgrade over rock or boulders.

3. Where the foundation material is found to be of poor supporting value, the Engineer may make minor adjustment in the location of the pipe to provide a more suitable foundation. Where this is not practical, the foundation shall be conditioned by removing the existing foundation material by undercutting to the depth as directed by the Engineer, within the limits established on the plans, and backfilling with either a suitable local material secured from unclassified excavation or borrow excavation at the nearest accessible location along the project, or foundation conditioning material consisting of crushed stone or gravel or a combination of sand and crushed stone or gravel approved by the Engineer as being suitable for the purpose intended. The selection of the type of backfill material to be used for foundation conditioning will be made by the Engineer.

C. WATER IN TRENCHES

The Contractor shall remove all water which may be encountered or which may accumulate in the trenches by pumping or bailing; and no pipes shall be laid until the water has been removed from the trench. The Contractor will not be permitted to drain water through the storm drain within a period of twenty-four (24) hours after the pipe has been laid, and the open end of the pipe in the trench shall be kept closed with a tight fitting plug to prevent washing of dirt or debris into the line. Water so removed from the trench must be disposed of in such manner as not to cause injury to work completed or in progress.

D. SPECIAL FOUNDATIONS

Whenever the bottom of the trench shall be of such nature as to provide unsatisfactory foundation for the pipe, the Engineer will require the pipe to be laid on timber or concrete cradle foundations. Such foundations, whether of single plank, plank cradle, plank cradle supported on piles, or poured concrete cradle, shall be placed by the Contractor; and compensation will be allowed the Contractor for the materials so used.

3.02 LAYING PIPE

A. GENERAL

All piping is to be installed in strict accordance with the manufacturer's recommendations. Installation manuals from various material suppliers shall be furnished the Engineer for his review and approval prior to

installation of any material. The Engineer may augment any manufacturer's installation recommendations, if in his opinion it will best serve the interest of the Owner.

B. LAYING PIPE

1. No pipe shall be laid except in the presence of the Engineer, or his inspector, or without special permission from the Engineer. Proper tools, implements, and facilities satisfactory to the Engineer shall be provided and used for the safe and convenient prosecution of pipe laying. All pipe, fittings, valves, and other materials used in the laying of pipe will be lowered into the trench piece by piece by means of suitable equipment in such a manner to prevent damage to the pipe materials, to the protective coating on the pipe materials, and to provide a safe working condition to all personnel in the trench. Each piece of pipe being lowered into the trench shall be carefully given a final inspection to see that it is clean, sound and free of defects. It shall be laid on the prepared foundation to produce a straight line on a uniform grade, each pipe being laid as to form a close abutted joint with a preceding pipe, so as to form a smooth and straight inside flow line. Each pipe will be tested for its exact position after it is in its final position. The pipes shall be fitted together in order to insure sufficient space for joint gaskets, and other jointing material. Pipe shall be removed at any time if broken, injured or displaced in the process of laying same, or of backfilling the trench.

2. When cutting short lengths of pipe, a pipe cutter as approved by the Engineer will be used, and care will be taken to make the cut at right angles to the center line of the pipe, or on the exact skew as shown on the plans. In the case of push-on pipe, the cut ends shall be tapered with a portable grinder, of course file to match the manufactured taper.

3. When coupling bands for annular or helical corrugated metal pipe are used, the pipe sections shall be joined and fully bolted so that the circumferencial and longitudinal strength will be sufficient to preserve the alignment, prevent separation of the sections, and to prevent infiltration of backfill material.

3.03 BACKFILLING

A. The backfill around the pipe shall be placed in layers not to exceed 6" loose and compacted to 95% Standard Proctor test for all areas directly beneath subgrade (100% for the top two (2) feet of subgrade beneath pavements). From the bottom of the trench to the centerline of the pipe the backfill material shall be compacted by approved hand tamps. From the centerline of the pipe to the top of the trench other mechanical tamps as approved by the Engineer may be used. All backfill material shall have

been approved by the Engineer. Select backfill material shall be used when called for on the plans.

B. Care shall be taken during backfill and compaction operations to maintain alignment and prevent damage to the joints. The backfill shall be kept free from stones, frozen lumps, chunks of highly plastic clay, or other objectionable materials.

C. All pipe backfill areas shall be graded and maintained in such a condition that erosion or saturation will not damage the pipe bed or backfill.

D. Heavy equipment shall not be operated over any pipe until it has been properly backfilled and has a minimum cover as required by the plans. Where any part of the required cover is above the proposed finish grade, the Contractor shall place, maintain, and finally remove such material at no cost to the Owner. Pipe which becomes misaligned, shows excessive settlement, or has been otherwise damaged by the Contractor's operations shall be removed and replaced by the Contractor at no cost to the Owner.

3.04 TESTING

A. Upon completion, installed lines shall show a full circle of light when "Lamped" between catch basins. This test shall be performed by the Engineer.

B. Other tests may be required by the Engineer, such as exfiltration. In this event the results shall meet the minimum standards that the manufacturer states are obtainable.

PART 4: MEASUREMENT AND PAYMENT

See Section 01300.

END OF SECTION

PART 1: GENERAL

1.01 SCOPE OF WORK

A. The work covered by this section consists of the construction of plain rip rap in accordance with the requirements of the plans and these specifications and at the locations designated by the Engineer.

PART 2: PRODUCTS

2.01 DEFINITIONS

A. PLAIN RIP RAP

Plain rip rap shall consist of quarry run stone, or field stone or granite stone, etc., and shall be classified by size into Class 1, or Class 2. The class and thickness to be used will be called for on the plans.

B. CLASS 1 RIP RAP

Stone shall vary in weight from 5 to 200 pounds. At least 30% of the total weight of the rip rap shall be in individual pieces weighing a minimum of 60 pounds each. Not more than 10% of the total weight of the rip rap may be in individual pieces weighing less than 15 pounds each.

C. CLASS 2 RIP RAP

Stone shall vary in weight from 25 to 250 pounds. At least 60% of the total weight shall be in individual pieces weighing a minimum of 100 pounds each and not more than 100 pounds each and not more than 5% of the total weight may be individual pieces weighing less than 50 pounds each.

PART 3: EXECUTION

3.01 PLACEMENT OF RIP RAP

A. Unless otherwise indicated or directed by the Engineer, the stone shall be placed upon a slope which shall be no steeper than the angle of repose. The stone shall be graded so that the smaller stones are uniformly distributed throughout the mass. The area and thickness shall be as shown on the plans or as designated by the Engineer.

The Contractor may place the stone by mechanical methods, augmented by hand placing where necessary, provided that when the rip rap is completed it forms a properly graded, dense, neat layer of stone.

PART 4: MEASUREMENT AND PAYMENT

See Section 01300.

END OF SECTION

02300.1 Scope of Work

The landfill cap shall include a 18-inch compacted clay liner. The Contractor shall furnish all labor, material, supervision, and equipment to complete the Compacted Clay Liner for the landfill, including hauling, sieving, raking, discing, compacting, drying, wetting, removal of rainwater and removal of all previously placed material rendered unsuitable due to weather conditions or construction operations, final grading and sealing and all necessary and incidental items as detailed or required to complete the compacted liner, all in accordance with the Contract Documents, and the Site Specific Construction Quality Assurance Plan.

02300.2 Materials

Soil that meets the requirements of clay liner fill shall be used for construction of the compacted clay liner. The clay liner material shall have a Plasticity Index (PI) greater than 10. The clay liner material shall be raked or sieved by the Contractor to remove all aggregate greater than 3 inches in the lower 18-inches and 1/4-inch in the top 6-inches. No more than 5 percent material greater than the No. 4 sieve will be allowed in the soil liner. All clay clods will be broken down with tillers and discs to provide a homogeneous clay soil.

The Clay Liner may consist of fill material modified by the addition of powdered bentonite in sufficient quantity to meet the specifications. Clay liner modified with bentonite will be subject to the exact same testing criteria and frequencies as natural clay, with the addition of percentage of bentonite used. If a bentonite admix is used, the mixing procedure shall be approved by the Engineer prior to construction. Material to be placed as part of the landfill cap, either natural or augmented, shall have a minimum effective internal friction angle of twenty-four (24) degrees between the clay liner and LLDPE liner. The internal friction angle of the clay liner material shall be verified by the Contractor prior to beginning construction. The test method used to verify the internal friction angle of the clay liner material shall be ASTM D4767 *Standard Test Method for Consolidated Undrained Triaxial Compression Test on Cohesive Soils.* The specimens must be compacted to design criteria for dry density and moisture content as determined by preconstruction testing. Test parameters require stepped confinement @ 1, 3, and 5ksf (nominally 5, 15 and 30 psi effective confining pressure.

Continuous and repeated visual inspection of the materials will be performed by the Contractor to ensure proper soils are being used. In addition, the Engineer will make frequent inspections of the clay liner

placement operations and materials, and will consult with the site personnel on suitable liner fill and locations of such. All soil liner fill proposed shall be inspected by the Engineer prior to actual use.

The compacted clay liner material when tested in accordance with ASTM D 5084 shall have a permeability not greater than 1.0×10^{-5} cm/sec. Confining pressure during permeability test shall be 3 psi +/- 1 psi. Bulk samples will be taken from stockpile or borrow source at intervals given in the construction quality assurance plan. The samples will be transported to the laboratory for compaction and permeability testing. The samples will be compacted to at least 95 percent of Standard Proctor at moisture contents similar to field conditions.

02300.3 Construction

Test pads 20 ft x 50 ft in area shall be constructed prior to beginning installation of the compacted clay liner and whenever there is a significant change in soil material properties or the borrow source is changed. The equipment used, liner thickness, subgrade slope, and all other conditions shall be representative of full scale construction. For each lift of the test pad, a minimum of three (3) test locations shall be established for testing moisture content and density. At least one (1) shelby tube sample for lab permeability testing and one (1) composite sample for recompacted lab permeability shall be obtained per lift. Compaction and soil moisture content shall be in accordance with Table 1 and the previously approved moisture-density-permeability relationship. Field moisture and density tests and laboratory permeability tests will be performed by the CQA Engineer for each lift placed on the test pads to verify the construction method, equipment, and material necessary to achieve the required permeability not greater than 1.0×10^{-5} cm/sec for the clay liner. The Contractor shall allow sufficient time for construction and testing of the test pad prior to placement of the Compacted Clay Liner.

TABLE 1 - QA TESTING FREQUENCIES AND CRITERIA FOR SOIL LINER LAYER

PRECONSTRUCTION QUALIFICATION		
TEST	ASTM METHOD	QUANTITY
Moisture Content	D2216	1/1,000 YD^3
Grain Size	D422 or D1140	1/5,000 YD^3
Atterberg Limits	D4318	1/5,000 YD^3
Laboratory Compaction	D698 - Standard	1/5,000 YD^3
Permeability	D5084	1/5,000 YD^3

TABLE 1 (continued)

CONSTRUCTION TESTING		
TEST	ASTM METHOD	QUANTITY
Field Density	D2922, D1556, D2167	1/10,000 FT^2/LIFT
Field Moisture	D2216, D3017, D4643	1/10,000 FT^2/LIFT
Permeability	D5084	1/40,000 FT^2/LIFT
TESTING CRITERIA		
Classification	CL, CH, ML, or MH	
Maximum Particle Size		3-inch dia. (lower 18 inches) 1/4-inch dia. (top 6 inches)

Construction methods, sampling and testing will be recommended by the Engineer. Typical tests to be included will be moisture content, in-place density, Atterberg limits and permeability testing.

Prior to fill placement, the prepared subgrade shall be proofrolled. Proofrolling shall be conducted at the discretion of the Engineer or his representative. Any soft, saturated or yielding areas exhibited by pumping and/or rutting will require removal and replacement with the appropriate soil at no additional cost to the Owner.

02300.4 Final clay liner lift thickness, after compaction, shall be a maximum of six (6) inches. Thinner lifts are permissible to achieve design grade.

02300.5 Equipment or truck traffic shall not be permitted during the period between scarifying and compaction of a lift unless approved by the Engineer.

02300.6 After the lift to be compacted is conditioned, representative samples will be taken by the Engineer and tested for moisture content prior to any compactive efforts. If the moisture content is within the range specified by the moisture-density-permeability relation, compaction may begin. If the moisture content is outside of this range, the clay liner fill will be wetted or dried and reworked accordingly. The soil fill should be sprinkled or sprayed with water utilizing equipment creating a uniform application and dozed, wind-rowed, and/or disc-plowed to uniformly increase the moisture content of the soil if the material moisture content is too low. The soil fill shall be dozed, wind-rowed, and/or disc-plowed to help air dry the soil if the moisture content is too high.

02300.7 Each lift shall be thoroughly compacted to satisfy moisture and density controls through field testing before a subsequent lift is placed.

02300.8 Compaction of lifts shall be as follows:

1) Compaction of lifts shall be performed with an appropriately heavy, properly ballasted compactor. The compactor used shall be subject to approval of the Engineer. A minimum of four (4) passes will be required on each lift regardless of whether the lift meets density specifications. A pass is defined as one trip of the compacting equipment over the lift and back to the starting point by a single drum roller or one trip across the lift surface from one side to the other if the compacting equipment has front and back compacting rollers. This requirement is to allow thorough remolding of the soil by kneading action. Compaction methods may be modified with prior approval from the Engineer.

2) The daily work area shall extend a distance so as to maintain moist soil conditions (facilitate bonding) and continuous operations. Desiccation and crusting of the lift surface shall be avoided as much as possible. Each lift shall be protected, at all times after placement, from desiccation and crusting.

3) If desiccation and crusting of the lift surface occurs before placement of the next lift, this area shall be scarified to a sufficient depth to mix with moist materials, or sprinkled with water and then scarified at the direction of the Engineer.

4) Dozer equipment shall not be used for primary compaction efforts.

5) The surface of the underlying lift shall be scarified a minimum of 2 inches prior to compaction of each subsequent lift (i.e., Lift 2 to Lift 3) to facilitate bonding of the lifts.

02300.9 During compaction of the soil liner material, the soil moisture content and dry density shall be maintained within the limits specified below.

1) To assure the moisture content and dry density requirements of the compacted soil are being satisfied, field and laboratory tests shall be made at intervals and locations designated by the Engineer.

2) The clay liner shall be compacted to a minimum dry density of 95 percent of the maximum dry density determined from the Standard Proctor Test (ASTM D-698). Where densities less than 95 percent of the maximum dry density determined from the Standard Proctor Test are measured, the soil liner shall be recompacted and/or removed and reworked to meet density objectives.

02300.10 The clay liner, in addition to the other provisions of this section, shall have a permeability not greater than 1.0 $x10^{-5}$ cm/s on thin wall tube samples taken from the completed clay liner. If representative permeability tests do not achieve the required permeability, the clay liner shall be reworked to meet permeability requirements regardless of its previously achieved density. Representative soil samples taken from the clay liner that fail laboratory permeability testing must be re-sampled until passing results are achieved. Each failing sample must be replaced by one successful sample. The Owner will pay for the permeability testing at the frequency required by the site specific Construction Quality Assurance Plan. The Contractor will be responsible for all costs associated with re-sampling and re-testing for failing samples beyond a 5% failure rate by quantity. This includes the cost of lab and Construction Quality Assurance personnel. The minimum charge for re-sampling and re-testing for failing permeability tests exceeding 5% failure rate will be $300.00 per occurrence.

02300.11 Soil fill shall not be placed or compacted during sustained periods with air temperature below 32°F. Soil fill may be placed and compacted during periods of early morning and early evening freezing temperatures with warming trends above 45°F during the day. No fill shall be placed on frozen subgrade. If the clay liner or structural fill freezes or ices the fill section shall be rescarified and recompacted, at the discretion of the Engineer.

02300.12 During construction, finished lifts or sections of compacted clay liner shall be sprinkled with water twice a day if needed.

02300.13 At the end of each construction day's activities, completed lifts or sections of compacted clay liner shall be sealed by rolling with a rubber tired or smooth drum rollers and sprinkled with water as needed.

02300.14 The compacted clay liner shall be a minimum of eighteen (18) inches thick in the cell.

02300.15 The as-built thickness of the compacted clay liner shall be determined by survey methods (non-destructive) as described below. An individual lift may be sampled upon completion (but prior to subsequent lift placement) with an approved sampler or other investigative tool. Any penetration within any portion or lift of the clay liner shall be promptly backfilled by the Contractor with hand tamped soil and bentonite fill. Samples of the in place compacted soil liner shall be tested and evaluated in accordance with provisions of the Construction Quality Assurance Plan. All test locations shall be filled with a homogeneous mixture of one part bentonite and three parts soil.

02300.16 After completion of a segment of compacted clay liner, but before installation of the geomembrane liner, the surface of the clay liner shall be surveyed by the Contractor to ensure the specified thickness of Compacted Clay Liner (18 inches) has been achieved. The survey must be performed and stamped by a registered Professional Land Surveyor in the State of North Carolina. The survey information shall be provided to the Engineer in a format pre-approved by the Engineer and acceptable to the North Carolina Solid Waste Division.

02300.17 The surface of the compacted clay liner shall be smooth drum rolled and maintained free of rocks, organics, voids and sharp edges.

No vehicles other than a smooth-drum roller will be allowed on the clay liner once the clay liner has been approved. This includes equipment used to deploy geomembrane material. Any exceptions should have prior approval from the project engineer.

02300.18 The minimum interface friction angle between the clay liner and the 40 mil textured geomembrane shall be twenty-four (24) degrees. This shall be verified by the Contractor prior to beginning construction.

The test method used to verify the internal friction angle between the clay liner and the 40-mil textured geomembrane shall be ASTM D5321 *Standard Test Method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by Direct Shear Method*. Soil specimens must be compacted to design criteria for dry density and moisture content as determined by preconstruction testing. Test parameters are to provide 3 points to range over minimum and maximum expected normal loads. Minimum will be a construction load of 260 psf.

END OF SECTION

PART 1: GENERAL

1.01 SCOPE OF WORK

Furnish all labor, equipment, materials and incidentals necessary to install and complete installation of the geocomposite drainage layer for the landfill cap system. This Section includes Specifications and guidelines for manufacturing and installing geocomposite.

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM)
   1. D 1505-98 Standard Test Method for Density of Plastics by the Density-Gradient Technique
   2. D 1603-94 Standard Test Method for Carbon Black in Olefin Plastics
   3. D 4533-91 (1996) Standard Test Method for Trapezoid Tearing Strength of Geotextiles
   4. D 4595-86 (1994) Standard Test Method for Tensile Properties of Geotextiles by the Wide Width Strip Method
   5. D 4632-91 (1997) Standard Test Method for Grab Breaking Load and Elongation of Geotextiles
   6. D 4716-00 Standard Test Method for Determining the (In-Plane) Flow Rate Per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head
   7. D 4751-99 Standard Test Method for Determining Apparent Opening Size of a Geotextile
   8. D 4833-88 (1996) Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes and Related Products
   9. D 5035-95 Standard Test Method for Breaking Force and Elongation of Textile Fabrics (Strip Method)
   10. D 5199-99 Standard Test Method for Measuring Nominal Thickness of Geotextiles and Geomembranes

B. Geosynthetic Research Institute (GRI)
   1. GRI GC-7 Determination of Adhesion and Bond Strength of Geocomposites.

C. Relevant publications from the Environmental Protection Agency (EPA):
   1. Daniel, D.E. and R.M. Koerner, (1993), *Technical Guidance Document: Quality Assurance and Quality Control for Waste Containment Facilities*, EPA/600/R-93/182.

1.03 DEFINITIONS

A. Construction Quality Assurance Consultant (CONSULTANT) – Party, Independent from MANUFACTURER and INSTALLER that is responsible for observing and documenting activities related to quality assurance during the lining system construction.

B. ENGINEER- McGill Associates

C. Geocomposite Manufacturer (MANUFACTURER)- The party responsible for manufacturing the geocomposite rolls.

D. Geosynthetic Quality Assurance Laboratory (TESTING LABORATORY)- Party, independent from the MANUFACTURER and INSTALLER, responsible for conducting laboratory tests on samples of geosynthetics obtained at the site or during manufacturing, usually under the direction of the OWNER.

E. INSTALLER- Party responsible for field handling, transporting, storing and deploying the geocomposite.

F. Lot- A quantity of resin (usually the capacity of one rail car) used to manufacture polyethylene geocomposite rolls. The finished rolls will be identified by a roll number traceable to the resin lot.

1.04 QUALIFICATIONS

A. MANUFACTURER

1. Manufacturer shall be experienced with the manufacture of geocomposite material for a minimum of five (5) years.

2. Manufacturer shall have manufactured a minimum of 20,000,000 square feet of polyethylene geocomposite material during the last year.

B. INSTALLER

1. Installer shall have installed a minimum of 4,000,000 square feet of geocomposite in the last 2 years.

2. Installer shall have worked in a similar capacity on at least 2 projects similar in complexity to the project described in the contract documents, with at least 175,000 square feet of geocomposite installation on each project.

3. The Installation Supervisor shall have worked in a similar capacity on at least 2 projects similar in size and complexity to the project described in the Contract Documents.

1.05 MATERIAL LABELING, DELIVERY, STORAGE AND HANDLING

A. Labeling - Each roll of geocomposite delivered to the site shall be wrapped and labeled by the manufacturer. The label will identify:
   1. manufacturer's name
   2. product identification
   3. length
   4. width
   5. roll number

B. Delivery- Rolls of geocomposite will be prepared to ship by appropriate means to prevent damage to the material and to facilitate off-loading.

C. Storage- The on-site storage location for the geocomposite, provided by the Contractor to protect the geocomposite from abrasions, excessive dirt and moisture shall have the following characteristics:
   1. level (no wooden pallets)
   2. smooth
   3. dry
   4. protected from theft and vandalism
   5. adjacent to the area being lined

D. Handling
   1. The Contractor and Installer shall handle all geocomposite in such a manner as to ensure it is not damaged in any way.
   2. The Installer shall take any necessary precautions to prevent damage to underlying layers during placement of the geocomposite.

1.06 WARRANTY

A. Material shall be warranted for a period of 1-year from the date of the geocomposite installation.

B. Installation shall be warranted against defects in workmanship for a period of 1-year from the date of geocomposite completion.

C. Damage due to foreign matter such as needles shall be warranted against indefinitely.

PART 2: PRODUCTS

2.01 GEOCOMPOSITE PROPERTIES

A. A geocomposite shall be manufactured by extruding two crossing strands to form a bi-planar drainage net structure with a non-woven geotextile bonded to one or both sides.

B. The geocomposite specified shall have properties that meet or exceed the values listed in Table 02622-1.

Table 02622-1

Standard Property Drainage Sheet		
Tested Property	**Test Method**	**MINIMUM AVERAGE VALUES[c]**
Transmissivity[a], m^2/sec	ASTM D4716-00	1.0×10^{-4}
Ply Adhesion, lb/in (N/m)	GRI GC-7	1.0 (178) [b]
Roll Width, ft (m)		14.5 (4.4)
Roll Length [d], ft (m)		230 (70.1)
Net Component [b]		
Transmissivity[a], m^2/sec	ASTM D4716-00	2×10^{-3}
Thickness, mil (mm)	ASTM D 5199	200 (5.0)
Density, g/cm^3	ASTM D 1505	0.94
Tensile Strength (MD), lb/in (N/mm)	ASTM D 5035	45 (7.9)
Carbon Black Content, %	ASTM D 1603	2.0
Geotextile Component [b]		
Mass Per Unit Area, oz/yd^2 (g/m^2)	ASTM D 5261	6 (200)
AOS, US Sieve (mm)	ASTM D 4751	70 (0.212)
Flow Rate, gpm/ft^2 (lpm/m^2)	ASTM D 4491	110 (4480)
UV Resistance, % retained	ASTM D 4355 (after 500 hours)	70

(a) Gradient of 0.1, normal load of 10,000 psf, water at 70°, between stainless steel plates and a 15-minute seat time.
(b) Component properties prior to lamination.
(c) These are MARV values that are based on the cumulative results of specimens tested.

C. Resin
1. Resin shall be new first quality, compounded polyethylene resin.
2. Natural resin (without carbon black) shall meet the following additional minimum requirements:

Table 02622-2

Property	Test Method	Value
Density (g/cm3)	ASTM D 1505	>0.94
Melt Flow Index (g/10 min)	ASTM D 1238	$\leq$1.0

2.02 MANUFACTURING QUALITY CONTROL

A. The geocomposite shall be manufactured in accordance with the Manufacturer's Quality Control Plan submitted to and approved by the Engineer.

B. The geocomposite shall be continuously inspected for the presence of needles using a metal detector.

C. The geocomposite shall be tested according to the test methods and frequencies listed below:

Manufacturing Quality Control Test Frequencies			
Characteristics	**Test Method**	**Units**	**FREQUENCY**
			Bi-Planar
Resin			
Polymer Density	ASTM D 1505	g/cm^3	Once Per Lot
Melt Flow Index	ASTM D 1238	g/10 min	Once Per Lot
Geonet Test			
Thickness	ASTM D 5199	mil	25,000 ft^2
Carbon Black	ASTM D 4218	%	25,000 ft^2
Tensile Strength, MD	ASTM D 4595	lbs/ ft	25,000 ft^2
Geotextile Tests			
Mass per Unit Area	ASTM D 5261	oz/yd^2	Every 90,000 ft^2
Grab Tensile	ASTM D 4632	lbs.	Every 90,000 ft^2
Puncture	ASTM D 4833	lbs.	Every 90,000 ft^2
AOS, US Sieve	ASTM D 4751	mm	Every 540,000 ft^2
Water Flow Rate	ASTM D 4491	gpm/ft^2	Every 540,000 ft^2
Geocomposite Tests			
Ply Adhesion	GRI GC-7	lbs/ in.	25,000 ft^2
Transmissivity	ASTM D 4716-00	m^2/sec	672,000 ft^2

PART 3: EXECUTION

3.01 FAMILIARIZATION

A. Inspection

1. Prior to implementing any of the work in the Section to be lined, the Installer shall carefully inspect the installed work of all other Sections and verify that all work is complete to the point where the installation of the Section may properly commence without adverse impact.

2. If the Installer has any concerns regarding the installed work of other Sections, he shall notify the Project Engineer.

A. Confirmation Testing

The friction angle between the vegetative soil layer and the geocomposite shall be a minimum of 24 degrees. The friction angle between the LLDPE liner and the geocomposite shall be a minimum of 14 degrees. The Contractor shall verify prior to beginning construction.

The test method used to verify the interface friction angle between the 6-ounce geocomposite and the vegetative soil layer shall be ASTM D5321 *Standard Test Method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by Direct Shear Method.* Test parameters are to provide 3 points to range over minimum and maximum expected normal loads. Maximum will be a construction load of 260 psf.

3.02 MATERIAL PLACEMENT

A. The geocomposite roll should be installed in the direction of the slope and in the intended direction of flow unless otherwise specified by the Engineer.

B. If the project contains long, steep slopes, special care should be taken so that only full length rolls are used at the top of the slope.

C. 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.

D. If the project includes an anchor trench at the top of the slopes, the geocomposite shall be properly anchored to resist sliding. Anchor trench compacting equipment shall not come into direct contact with the geocomposite.

Table 02622-2

Property	Test Method	Value
Density (g/cm3)	ASTM D 1505	>0.94
Melt Flow Index (g/10 min)	ASTM D 1238	$\leq$1.0

2.02 MANUFACTURING QUALITY CONTROL

A. The geocomposite shall be manufactured in accordance with the Manufacturer's Quality Control Plan submitted to and approved by the Engineer.

B. The geocomposite shall be continuously inspected for the presence of needles using a metal detector.

C. The geocomposite shall be tested according to the test methods and frequencies listed below:

Manufacturing Quality Control Test Frequencies			
Characteristics	**Test Method**	**Units**	**FREQUENCY**
			Bi-Planar
Resin			
Polymer Density	ASTM D 1505	g/cm^3	Once Per Lot
Melt Flow Index	ASTM D 1238	g/10 min	Once Per Lot
Geonet Test			
Thickness	ASTM D 5199	mil	25,000 ft^2
Carbon Black	ASTM D 4218	%	25,000 ft^2
Tensile Strength, MD	ASTM D 4595	lbs/ ft	25,000 ft^2
Geotextile Tests			
Mass per Unit Area	ASTM D 5261	oz/yd^2	Every 90,000 ft^2
Grab Tensile	ASTM D 4632	lbs.	Every 90,000 ft^2
Puncture	ASTM D 4833	lbs.	Every 90,000 ft^2
AOS, US Sieve	ASTM D 4751	mm	Every 540,000 ft^2
Water Flow Rate	ASTM D 4491	gpm/ft^2	Every 540,000 ft^2
Geocomposite Tests			
Ply Adhesion	GRI GC-7	lbs/ in.	25,000 ft^2
Transmissivity	ASTM D 4716-00	m^2/sec	672,000 ft^2

PART 3: EXECUTION

3.01 FAMILIARIZATION

A. Inspection

1. Prior to implementing any of the work in the Section to be lined, the Installer shall carefully inspect the installed work of all other Sections and verify that all work is complete to the point where the installation of the Section may properly commence without adverse impact.

2. If the Installer has any concerns regarding the installed work of other Sections, he shall notify the Project Engineer.

A. Confirmation Testing

The friction angle between the vegetative soil layer and the geocomposite shall be a minimum of 24 degrees. The friction angle between the LLDPE liner and the geocomposite shall be a minimum of 14 degrees. The Contractor shall verify prior to beginning construction.

The test method used to verify the interface friction angle between the 6-ounce geocomposite and the vegetative soil layer shall be ASTM D5321 *Standard Test Method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by Direct Shear Method.* Test parameters are to provide 3 points to range over minimum and maximum expected normal loads. Maximum will be a construction load of 260 psf.

3.02 MATERIAL PLACEMENT

A. The geocomposite roll should be installed in the direction of the slope and in the intended direction of flow unless otherwise specified by the Engineer.

B. If the project contains long, steep slopes, special care should be taken so that only full length rolls are used at the top of the slope.

C. 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.

D. If the project includes an anchor trench at the top of the slopes, the geocomposite shall be properly anchored to resist sliding. Anchor trench compacting equipment shall not come into direct contact with the geocomposite.

E. In applying fill material, no equipment can drive directly across the geocomposite. The specified fill material shall be placed and spread utilizing vehicles with a low ground pressure.

F. The cover soil shall be placed in the geocomposite in a manner that prevents damage to the geocomposite. Placement of the cover soil shall proceed immediately following the placement and inspection of the geocomposite.

3.03 SEAMS AND OVERLAPS

A. Each component of the geocomposite will be secured or seamed to the like component at overlaps.

B. Geonet Components

1. Adjacent edges of the geonet along the length of the geocomposite roll shall be placed with the edges of each geonet butted against each other.

2. The overlaps shall be joined by tying the geonet structure with cable ties. These ties shall be spaced every 3 feet along the roll length.

3. Adjoining geocomposite 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 a minimum of 12 inches across the roll width.

4. The geonet portion should be tied every 6 inches in anchor trenches or as specified by the Engineer.

3.04 REPAIR

A. Prior to covering the deployed geocomposite, each roll shall be inspected for damage resulting from construction.

B. 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 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 joined in accordance with Subsection 3.03.

PART 4: MEASUREMENT AND PAYMENT

See Section 01300.

END OF SECTION

02623.1 Scope of Work

The Installer shall furnish all labor, materials, supervision and equipment to complete the LLDPE Geomembrane Liner including, but not limited to, anchor trench excavation and backfill, liner layout, seaming, patching, and all necessary and incidental items required to complete the Work, in accordance with the Contract Drawings and these Specifications.

02623.2 Materials

The geomembrane liner shall be made of linear low density polyethylene (LLDPE) that has an absolute minimum thickness of 40 mils. This means that the geomembrane shall have a thickness of 40 mils at any point measured on the sheet. An average minimum thickness will not be considered. If during conformance testing or on-site testing and inspection, a thickness measurement is found to be less than 40 mils, the material will be rejected for use during construction.

The geomembrane used shall meet, at a minimum, the standards included in Tables 1 and 2 located at the end of this section.

The chemical resistance of the geomembrane liner shall be in keeping with typical properties of high quality polyethylene products currently available through commercial sources.

Geomembrane liner shall be shipped rolled with a protective wrap around each roll, labeled with roll number and manufacturer's batch number. Manufacturer's quality control documentation shall be included with each roll.

The geomembrane shall be free of holes, blisters, undispersed raw materials, or any sign of contamination by foreign matter. Any such defect shall be repaired in accordance with the geomembrane manufacturer's recommendations. The Engineer may reject all or portions of units (or rolls) of the geomembrane if in his opinion significant quantities of production or transporting flaws are observed.

The Installer shall submit proposed geomembrane panel layouts to the Engineer at least 14 days prior to mobilization of crews (2 copies). Once the panel layout is approved, the Installer may not change the layout without permission of the Engineer.

02623.3 **Construction**

The geomembrane liner shall be installed by a specialty contractor, and that specialty contractor must have installed a minimum of 4,000,000 square feet of geomembrane liner since June, 2003.

The geomembrane liner shall be constructed as soon as practical after completion and approval of the compacted clay liner or portion thereof. The top of the compacted clay liner will be surveyed to ensure adequate thickness of clay material and proper grades. The Contractor shall be responsible for providing survey information for the purpose of depth verification. The Contractor shall be responsible for providing a panel layout survey of the geomembrane, including all destructive testing locations, defects, and repairs. All survey information must be performed and stamped by a registered Professional Land Surveyor in the State of North Carolina. The survey information shall be provided to the Engineer in a format pre-approved by the Engineer and acceptable to the North Carolina Solid Waste Division. The geomembrane is to cover the bottom of the cell and the side slopes in accordance with the Contract Drawings.

Areas to receive liner installation shall be relatively smooth and even, free of ruts, voids, etc., to the extent required by the Engineer. This shall be accomplished by final dressing of the compacted liner with smooth drum rollers. No vehicles are permitted on final dressed surfaces unless authorized by the Engineer.

A ditch, labeled as liner edge and illustrated on the Contract Drawings, will be required to secure the geomembrane in certain areas of the landfill cap. No loose soil will be allowed to underlie the geomembrane on the liner edges. The time schedule for excavation and backfilling of the liner edges is to be approved by the Engineer so that desiccation of trench soils does not occur prior to backfilling.

02623.4 Installation of the geomembrane shall be as follows:

All geomembrane installed on the landfill cap will be 40 mil textured material.

Unroll only those sections that are to be seamed together in one day. Panels should be positioned with the overlap recommended by the manufacturer, but not less than 4 inches. The side slope geomembrane will be placed in an anchor trench that is then backfilled with soil and compacted as shown on the Contract Drawings.

After panels are initially in place, remove wrinkles as directed by the Engineer. Unroll several panels and allow the liner to "relax" before

beginning field seaming. The purpose of this is to make the edges, which are to be bonded, as smooth and free of wrinkles as possible.

Once panels are in place and smooth, commence field seaming operations.

The Installer's Field Superintendent will complete a Daily Report at the end of each day and submit the form daily to the engineer.

Field seaming shall be in accordance with EPA Technical Guidance document: "The Fabrication of Polyethylene FML Field Seams" EPA/530/SW-89/069 or as follows. Where conflicts exist between the two guidance specifications, the most stringent specification prevails or as directed by the Engineer.

02623.6 All foreign matter (dirt, water, oil, etc.) shall be removed from the edges to be bonded. For extrusion welds, the bonding surfaces must be thoroughly cleaned by mechanical abrasion or alternate methods approved by the Engineer to remove surface cure and prepare the surfaces for bonding. All abrasive buffing shall be performed using No. 80 grit or finer sandpaper. The grinding shall be performed so that any and all grind marks are perpendicular to the edge of sheet. No grinding greater than 1/8 inch outside the welds is permitted or the Engineer can require patching. No solvents shall be used to clean the geomembrane liner.

02623.7 As much as practical, field seaming shall start from the top of the slope down. This will minimize large wrinkles from becoming trapped, which requires cutting and patching. Tack welds (if used) shall use heat only; no double sided tape, glue, or other method will be permitted. The geomembrane should be seamed completely to the ends of all panels to minimize the potential of tear propagation along the seam.

The completed liner shall not exhibit <u>any</u> "trampolining" during any daylight hours (6:00 a.m. to 8:00 p.m.). All areas exhibiting trampolining must be repaired as directed by the Engineer.

02623.8 At the end of each day or installation segment, all unseamed edges shall be anchored by sand bags or other approved device. If high winds are expected, boards along the edge of unseamed panels, with weighted sand bags on top, may be used to anchor the geomembrane. Staples, U-shaped rods or other penetrating anchors shall not be used to secure the geomembrane. Any damage to the liner or clay liner including damage due to wind, rain, hail, or other weather shall be the sole responsibility of the Contractor.

02623.9 Field seaming may be extrusion or fusion welding or a combination of these methods. Solvent welding is not acceptable. The Engineer reserves the right to reject any proposed seaming method it believes unacceptable. Double hot wedge fusion welding shall be the predominant seaming method and shall be used when possible. Additional concepts and requirements of proper field seaming include the following.

02623.10 Extrusion welding applies a molten bead of material to preheated sheets of geomembrane. The sheets are then joined by pressure.

02623.11 The fusion welding process heats the area to be joined to the melting point and then applies pressure to join the melted surfaces.

02623.12 The sheets to be joined shall be overlapped at least four (4) inches after the necessary cleaning, aligning and cutting.

02623.13 The seams should be oriented parallel to the line of maximum slope, i.e., oriented up and down, not across, the slope. In corners and odd shaped geometric locations, the number of field seams shall be minimized.

02623.14 No horizontal seams shall be within ten (10) feet from the toe of the slope.

02623.15 No seaming shall be attempted above 40°C (104°F) ambient air temperature. Below 5°C (41°F) ambient air temperature, preheating of the geomembrane will be required, unless it is demonstrated that this is not necessary (i.e., acceptable test (start-up) seams which duplicate, as closely as possible, actual field conditions can be achieved). Preheating may be achieved by natural and/or artificial means (shelters and heating devices). Ambient temperature is measured 18 inches above the liner surface. The Installer shall supply instrumentation for measurement of ambient temperature.

02623.16 A moveable protective layer of plastic or approved material may be placed directly below each overlap of geomembrane that is to be seamed. This is to prevent any moisture build-up between the sheets to be welded. The protective layer must be removed after welding.

02623.17 Seaming will extend to the outside edge of panels to be placed in anchor trenches.

02623.18 If required, a firm substrata should be provided by using a flat board, a conveyor belt, or similar hard surface directly under the seam overlap to achieve proper support.

02623.19 Grinding prior to welding shall be done perpendicular to the sheet edge. Overgrind greater than 1/8 inch beyond the welded seam or improperly ground areas shall be replaced at the Installer's expense.

02623.20 **Seams at the Panel Corners**

Seams at the panel corners of 3 or 4 sheets shall be completed with a circular patch approximately 12 inches in diameter, extrusion welded to the parent sheets.

02623.21 **Quality Control**

All geomembrane sheet, seams, and patches will be tested and evaluated prior to acceptance. In general, testing of the sheet will be conducted by the manufacturer. Testing of the seams will be conducted by the Installer under observation by the Engineer. The Engineer or a designated, independent geosynthetics laboratory may perform additional testing, as required by these detailed Specifications or as required in the judgment of the Engineer or Authorized Representative to verify that the LLDPE sheet and seams meet the specifications. The geosynthetics installer will be required to adhere to the requirements of the Site Specific Construction Quality Assurance Plan. Testing requirements are detailed in the following subsections:

02623.22 **Pre-shipping Sheet Tests**

The Installer or supplier (manufacturer) will be required to submit his Quality Control program to the Owner prior to initiating field work. At a minimum, the Manufacturer will perform the tests, at the frequencies given in Table 3, on the LLDPE sheet prior to shipping LLDPE material to the site.

02623.23 **Test Seams (Destructive Tests)**

The Installer shall maintain and use equipment and personnel at the site to perform testing of test seams. These seams will be made on fragment pieces of geomembrane liner to verify that seaming conditions are adequate. At a minimum, test seams shall be made upon each start of work for each seaming crew, upon every four hours of continuous seaming, every time seaming equipment is changed or if significant changes in geomembrane temperature and weather conditions are observed. The technician shall complete the Test Seam Form provided by the Engineer immediately after each test. Requirements for test seams are as follows:

02623.24 The test seam sample will be at least 1.8m (6 feet) long by 0.3m (1 foot) wide with the seam centered lengthwise. Six adjoining specimens 25mm (1 inch) wide each will be cut from the test seam sample. At the Engineer's option, the shear tests may be eliminated for test seams. These specimens will be tested in the field with a tensiometer and/or manual seam tester for both shear (3 specimens) and peel (3 specimens). For dual wedge both inside and outside welds should be tested in the peel. Test seams will be tested by the Installer under approval of the Engineer. The specimens should not fail in the weld. The Installer shall supply all necessary knowledgeable personnel and testing equipment. Quantitative strength measurements from a calibrated field tensiometer, supplied by the Installer, shall be obtained for all three (3) specimens in shear and peel for the test seams. A passing test seam will be achieved when the criteria described in Table 1 (located at the end of this section) are satisfied. If a test seam fails, the entire operation will be repeated. If the additional test seam fails, the seaming apparatus or seamer will not be accepted and will not be used for seaming until the deficiencies are corrected and two consecutive successful full test seams are achieved. Test seam failure is defined as failure of any one of the specimens tested in shear or peel.

02623.25 The Engineer will approve all test seam procedures and results. The six (6) test specimens shall be labeled with initials of the technician, date, and A.M. or P.M. as appropriate; bound together with electrical tape; and retained by the Engineer until the project is over. The Engineer will transfer these specimens to the Owner following the Engineer's acceptance of the geomembrane materials and installation.

02623.26 **Production Seams**

One hundred percent of the production seams will be tested by the Installer continuously using non-destructive techniques and at specified intervals using destructive tests.

All areas failing nondestructive test procedures described below shall be clearly marked both on the liner itself and on the Seam Inspection Quality Control Form.

02623.27 **Non-Destructive Testing**

Single Weld Seams: The Contractor shall maintain and use equipment and personnel at the site to perform continuous vacuum box testing on all single weld production seams except those corner seams where vacuum box testing is impossible. The system shall be capable of applying a vacuum of at least 3 psi. The vacuum shall be held for a minimum of 15 seconds for each section of seam. All vacuum boxes to be used at this

job site shall have new gaskets installed prior to reaching the job site. The geosynthetics installer shall also be required to have backup vacuum testing equipment at the job site. If the geosynthetics installer fails to provide the backup equipment, and it results in delays of the project, the geosynthetics installer will be liable for all costs associated with the delay.

Double Weld Seams: The Contractor shall maintain and use equipment and personnel to perform air pressure testing of all double weld seams. The system shall be capable of applying a pressure of at least 30 psi for not less than 5 minutes. All channels between the double weld seam must first be verified that the channel is open throughout the entire test area. The air pressure test results shall be documented. Pressure loss tests shall be conducted in accordance with the procedures outlined in "Pressurized Air Channel Test for Dual Seamed Geomembranes," Geosynthetic Research Institute Test Method GM-6. As outlined by the test method, following a 2 minute pressurized stabilization period, pressure losses over a measurement period of 5 minutes shall not exceed 3 psi.

Double weld seams will also be visually inspected on 100 percent of the seam. If necessary, the outside flap can be pulled back to aid in the visual inspection.

02623.28 <u>Destructive Testing</u>

Laboratory destructive testing (LDT) is defined as 12" X 48" samples cut on 500 foot centers for both extrusion and double welded seams. Field destructive testing (FDT) is defined as 3" X 6" samples cut at the end of each seamed area exceeding 200 feet. Both are described below:

Laboratory destructive testing will be performed on an average of every 500 linear feet of production seam. The locations will be selected by the Engineer. Samples will be 12" X 48" in order to provide one sample to the archive, one sample to the Engineer for laboratory testing, and one sample to be retained by the Installer for possible field and/or additional laboratory testing at the option of the Installer.

Before the sample is sent to the laboratory, two specimens, one from each end of the specimen will be tested in peel in a calibrated field tensiometer, supplied by the Installer. Both specimens must meet the qualitative and quantitative criteria listed in Tables 1 and 2. Testing requirements are as follows: Each sample shall be large enough to test five specimens in peel and five specimens in shear. The average values of each set of five specimens must meet the values shown in Tables 1 and 2. If the average of the five specimens is adequate, but one of the specimens is below the required value, values for the specimen must be

at least 90% of the values required for the sample to pass. All samples must fail in film tear bond (FTB). Samples which do not pass the shear and peel tests will be re-sampled 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 the entire seam represented by the test shall be capped. Tests shall be conducted using a calibrated tensiometer and must meet the criteria outlined in Tables 1 and 2 located at the end of this section. The Owner will pay for destructive testing of the original destructive samples. The geosynthetics installer will be responsible for all costs associated with resampling and retesting for failing destructive samples beyond a 5% failure rate by quantity. This includes the cost of lab and CQA personnel. The minimum charge for each destructive re-test exceeding the 5% failure rate will be $500.00 per occurrence.

Field Destructive Testing (FDT) shall be small 2" X 6" samples cut out at the beginning and end of each seam exceeding 200 feet in length. Three 1" X 6" specimens will be tested in peel from each sample using the Installer's Field Tensiometer or qualitative peel tester at the option of the Installer. No qualitative peel strength values need to be determined with the Field Destructive test, but each specimen must be all qualitative criteria listed in Tables 1 and 2.

The Engineer will approve all seam field and laboratory test procedures and results. All laboratory destructive test specimens will be marked with the seam number and letters then bound together for a particular seam and stored in the Owner's archives. The specimens for the FDT need not be retained.

Each sample area will be clearly marked both on the liner itself (LDT or FDT).

All areas cut out for testing shall be immediately patched by the Installer.

02623.29 Repair of Damaged and Sampled Areas

Damaged and sample coupon areas of geomembrane shall be repaired by the Installer by construction of an extrusion welded cap strip. No repairs shall be made to seams by application of an extrusion bead to a seam edge previously welded by fusion or extrusion methods. Repaired areas will be tested for seam integrity as outlined in Section 02623.27 of this specification. Damaged materials are the property of the Contractor and will be removed from the site at the Contractor's expense. The Contractor will retain all ownership and responsibility for the geomembrane until acceptance by the Engineer. The geomembrane shall

be accepted by the Engineer after the installation and repair are complete, and after the Engineer has received documentation for the installation.

02623.30 Potentially Damaging Activities

No support equipment of any type, which may be used by the Contractor, shall be allowed on the geomembrane. Personnel working on the geomembrane shall not smoke, wear damaging shoes, or engage in any activity that could damage the geomembrane. No glass or sharp objects shall be allowed on the geomembrane.

02623.31 Protection of Leading Edges

Between construction of partial sections of the membrane liner, excluding temporary phaselines, leading edges of the membrane may be exposed or buried for extended periods of time prior to their joining to adjacent, subsequent membrane sections. The combined action of abrasive soil and equipment impact stresses may "etch" unprotected membrane surfaces sufficiently to affect seam strengths. Therefore, it is necessary to protect leading edges in high activity areas with sacrificial layers of geotextile and LLDPE sheet until they are ready for final seaming. As a minimum, each leading edge to be seamed that must be buried or which must be exposed for periods of one month or longer shall be continuously covered by a layer of LLDPE sheet. The geotextile shall be nonwoven and have a minimum weight of 8 oz. per square yard. The sacrificial LLDPE sheet shall have a minimum thickness equal to that of the membrane liner to be protected. Both protective layers shall have a minimum width of 2 feet. The protective cover sheets shall be either covered with soil or weighted with sand bags to prevent displacement by wind. The edge of the sheet to be protected shall be approximately centered beneath the overlying protective layers prior to burial or weighing with sandbags. Leading edges located in areas expected to receive direct traffic from construction equipment shall be buried under a minimum thickness of one foot of buffer soil.

Table 1

Required Physical Properties of Textured Membrane Liner (LLDPE) Sheet

Property	Test Method	Required Values (40 Mil LLDPE)
Thickness	ASTM D-5994	40 mil nominal min.
Sheet Density	ASTM D-1505	0.939 g/ml max
% Elongation at Break	ASTM D-6693 Type IV	250
Tensile Strength at Break	ASTM D-6693 Type IV	60 lb/in. min
Carbon Black Content	ASTM D-1603	2% min. - 3% max.
Carbon Black Dispersion	ASTM D-5596	1, 2, Category
Puncture Resistance	ASTM D-4833	44 lb. min.
Tear Resistance	ASTM D 1004	22 lb. min.

Seam Strengths

Shear Strength	ASTM D4437, NSF Modified	120 psi
Shear Strain @ Yield	ASTM D4437, NSF Modified	10% (min.)
Peel Strength (Fusion Weld)	ASTM D4437, NSF Modified	90 psi
Peel Strength (Extrusion Weld)	ASTM D4437, NSF Modified	78 psi

Non-Destructive Testing

Single Weld	Continuous Vacuum Box; Impact	Maintain vacuum of 3 psi, hold vacuum for 15 seconds.
Double Weld	Air Testing	Maintain 30 psi for no less than 5 min.; pressure loss not greater than 3 psi for last 3 minutes.

Table 2

Required Pre-Shipping Sheet Testing of Membrane Liner (LLDPE)

Property	Test Method	Frequency
Thickness	ASTM D-5994	Each Roll
Sheet Density	ASTM D-1505	Every 200,000 lb
Tensile Properties	ASTM D-6693 Type IV	Every 20,000 lb
Tear Resistance	ASTM D-1004	Every 45,000 lb
Puncture Resistance	ASTM D-4833	Every 45,000 lb
Carbon Black Content	ASTM D-1603	Every 45,000 lb
Carbon Black Dispersion	ASTM D-5596	Every 45,000 lb

END OF SECTION

PART 1: GENERAL

1.01 SCOPE OF WORK

Furnish all labor, equipment, materials and incidentals necessary to install and complete installation of the nonwoven geotextile (Mirafi 140N or equal) for protection of rip rap drainage features and methane gas collection piping. This Section includes Specifications and guidelines for manufacturing and installing geotextiles.

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM)
   1. D 1505-98 Standard Test Method for Density of Plastics by the Density-Gradient Technique
   2. D 1603-94 Standard Test Method for Carbon Black in Olefin Plastics
   3. D 4533-91 (1996) Standard Test Method for Trapezoid Tearing Strength of Geotextiles
   4. D 4595-86 (1994) Standard Test Method for Tensile Properties of Geotextiles by the Wide Width Strip Method
   5. D 4632-91 (1997) Standard Test Method for Grab Breaking Load and Elongation of Geotextiles
   6. D 4716-00 Standard Test Method for Determining the (In-Plane) Flow Rate Per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head
   7. D 4751-99 Standard Test Method for Determining Apparent Opening Size of a Geotextile
   8. D 4833-88 (1996) Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes and Related Products
   9. D 5035-95 Standard Test Method for Breaking Force and Elongation of Textile Fabrics (Strip Method)
   10. D 5199-99 Standard Test Method for Measuring Nominal Thickness of Geotextiles and Geomembranes

B. Relevant publications from the Environmental Protection Agency (EPA):
   1. Daniel, D.E. and R.M. Koerner, (1993), *Technical Guidance Document: Quality Assurance and Quality Control for Waste Containment Facilities,* EPA/600/R-93/182.

1.03 DEFINITIONS

A. Construction Quality Assurance Consultant (CONSULTANT) – Party, Independent from MANUFACTURER and INSTALLER that is responsible for observing and documenting activities related to quality assurance during the

lining system construction.

B. ENGINEER- McGill Associates

C. Geotextile Manufacturer (MANUFACTURER) - The party responsible for manufacturing the geotextile rolls.

D. Geosynthetic Quality Assurance Laboratory (TESTING LABORATORY)- Party, independent from the MANUFACTURER and INSTALLER, responsible for conducting laboratory tests on samples of geosynthetics obtained at the site or during manufacturing, usually under the direction of the OWNER.

E. INSTALLER- Party responsible for field handling, transporting, storing and deploying the geotextile.

F. Lot- A quantity of resin (usually the capacity of one rail car) used to manufacture polyethylene geocomposite rolls. The finished rolls will be identified by a roll number traceable to the resin lot.

1.04 QUALIFICATIONS

A. MANUFACTURER
1. Manufacturer shall be experienced with the manufacture of geotextile material for a minimum of five (5) years.

2. Manufacturer shall have manufactured a minimum of 4,000,000 square feet of polyethylene geotextile material during the last year.

1.05 MATERIAL LABELING, DELIVERY, STORAGE AND HANDLING

A. Labeling - Each roll of geotextile delivered to the site shall be wrapped and labeled by the manufacturer. The label will identify:
1. manufacturer's name
2. product identification
3. length
4. width
5. roll number

B. Delivery- Rolls of geotextile will be prepared to ship by appropriate means to prevent damage to the material and to facilitate off-loading.

C. Storage- The on-site storage location for the geotextile, provided by the Contractor to protect the geocomposite from abrasions, excessive dirt and moisture shall have the following characteristics:
1. level (no wooden pallets)

2. smooth
3. dry
4. protected from theft and vandalism
5. adjacent to the area being lined

D. Handling
1. The Contractor and Installer shall handle all geotextile in such a manner as to ensure it is not damaged in any way.
2. The Installer shall take any necessary precautions to prevent damage to underlying layers during placement of the geocomposite.

1.06 WARRANTY

A. Material shall be warranted for a period of 1-year from the date of the geotextile installation.

B. Installation shall be warranted against defects in workmanship for a period of 1-year from the date of geotextile completion.

PART 2: PRODUCTS

2.01 GEOTEXTILE PROPERTIES

A. The geotextile shall be a nonwoven geotextile comprised of polypropylene staple fibers.

B. The geotextile specified shall have properties that meet or exceed the values listed in Table 02624-2.

Table 02624-2

Standard Property			
Tested Property	**Test Method**	**Unit**	**MINIMUM AVERAGE VALUES[a]**
Grab Tensile Strength	ASTM D 4632	Lbs (kN)	120 (0.53)
Grab Tensile Elongation	ASTM D 4632	%	50
Trapezoid Tear Strength	ASTM D 4533	Lbs (kN)	50 (0.22)
Mullen Burst Strength	ASTM D 3786	psi (kPa)	225 (1550)
Puncture Strength	ASTM D 4833	Lbs (kN)	65 (0.30)
Apparent Opening Size (AOS)	ASTM D 4751	U. S. Sieve (mm)	70 (0.212)

Permittivity	ASTM D 4491	sec^{-1}	1.8
Permeability	ASTM D 4491	cm/sec	0.21
Flow Rate	ASTM D 4491	gal/min/ft^2 (l/min/m^2)	135 (5500)
UV Resistance (at 500 hours)	ASTM D 4355	% strength retained	70
Weight	ASTM D 5261	oz/yd^2 (g/m^2)	4.8 (163)
Thickness	ASTM D 5199	mils (mm)	55 (1.4)

(a) These are MARV values that are based on the cumulative results of specimens tested.

2.02 MANUFACTURING QUALITY CONTROL

A. The geotextile shall be manufactured in accordance with the Manufacturer's Quality Control Plan submitted to and approved by the Engineer.

B. The geotextile shall be tested according to the test methods and frequencies listed below:

Manufacturing Quality Control Test Frequencies			
Characteristics	**Test Method**	**Units**	**FREQUENCY**
			Bi-Planar
Mass per Unit Area	ASTM D 5261	oz/yd^2	Every 90,000 ft^2
Grab Tensile	ASTM D 4632	lbs.	Every 90,000 ft^2
Puncture	ASTM D 4833	lbs.	Every 90,000 ft^2
AOS, US Sieve	ASTM D 4751	mm	Every 540,000 ft^2
Water Flow Rate	ASTM D 4491	gpm/ft^2	Every 540,000 ft^2

PART 3: EXECUTION

3.01 FAMILIARIZATION

A. Inspection

1. Prior to implementing any of the work in the Section to be lined, the Installer shall carefully inspect the installed work of all other Sections and verify that all work is complete to the point where the installation of the Section may properly commence without adverse impact.

2. If the Installer has any concerns regarding the installed work of other Sections, he shall notify the Project Engineer.

3.02 MATERIAL PLACEMENT

A. In applying fill material, no equipment can drive directly across the geotextile. The specified fill material shall be placed and spread utilizing vehicles with a low ground pressure.

B. The cover soil shall be placed on the geotextile in a manner that prevents damage to the geotextile. Placement of the cover soil shall proceed immediately following the placement and inspection of the geotextile.

3.03 SEAMS AND OVERLAPS

The geotextile will be secured or seamed at overlaps.

3.04 REPAIR

A. Prior to covering the deployed geotextile, each roll shall be inspected for damage resulting from construction.

B. Any rips, tears or damaged areas on the deployed geotextile shall be removed and patched. 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 geotextile shall be joined in accordance with Subsection 3.03.

PART 4: MEASUREMENT AND PAYMENT

See Section 01300.

END OF SECTION

PART 1: GENERAL

1.01 SCOPE OF WORK

The work covered by this section consists of the construction of reinforced concrete or brick masonry inlets, catch basins, junction boxes, and other minor drainage structures, excluding headwalls, together with all necessary metal grates, covers, frames, and other hardware, in accordance with the requirements shown on the plans and the provisions of these specifications.

1.02 QUALITY ASSURANCE

All precast concrete structures and other fabricated materials shall be manufactured by suppliers with at least five (5) years of experience in the manufacture of similar materials.

1.03 SUBMITTALS

SHOP DRAWINGS

The Contractor shall submit at least six (6) copies of shop drawings to the Engineer, including dimensional drawings, materials of construction, catalogue cut sheets, and other pertinent information.

1.04 DELIVERY, STORAGE AND HANDLING

All materials shall be delivered, stored and handled in strict accordance with the manufacturer's recommendations, and in a manner which preserves the structural integrity of the materials.

1.05 WARRANTY

All materials and equipment shall be warranted to be free from defects in workmanship and materials for one (1) year after final acceptance.

PART 2: PRODUCTS

2.01 MATERIALS

A. CONCRETE AND MASONRY

1. All concrete shall be Class B 4000 psi unless otherwise indicated on the plans.

2. Where necessary to fit field conditions, the dimensions of the structure and footings shall be varied as directed by the Engineer.

B. FITTINGS AND CONNECTIONS

1. Where fittings enter the masonry, they shall be placed as the work is built up, thoroughly bonded, and accurately spaced and aligned.

2. Pipe connections shall be cut off flush with the inside wall of the drainage structure and grouted as necessary to make smooth and uniform surfaces on the inside of the structure.

3. Metal frames for grates and covers shall be set in full mortar beds or secured by methods approved by the Engineer.

C. BACKFILL

After the structure has been completed, and all forms, falsework, sheeting, and bracing have been removed, the excavation shall be backfilled with approved material compacted to a density of 95% standard proctor. Backfilling shall not be done until the concrete or brick masonry has cured for at least seven (7) curing days, unless otherwise permitted by the Engineer.

D. PIPE COLLARS AND PIPE PLUGS

Pipe collars and pipe plugs shall be constructed in accordance with the details shown on the plans or as directed by the Engineer.

PART 3: EXECUTION

3.01 INSTALLATION

A. Drainage structures shall be built to the lines, grades and dimensions as shown on the plans. The Contractor shall adjust the final grades in the field as necessary to provide positive drainage to the structures or to match final pavement or grade elevation.

B. Excavations for drainage structures shall be made with care so as not to disturb the surrounding areas more than necessary. All excavations shall be maintained water free until completion of the drainage structure, including backfilling. The Contractor shall provide adequate pumping capacity as required.

C. Where the foundation material is found to be of poor supporting value, the existing foundation material shall be removed by undercutting to the depth directed by the Engineer and backfilled with suitable material secured from locations along the project or from a borrow pit. The backfill placed in the undercut area shall be compacted to a degree satisfactory to the Engineer.

D. For cast-in-place structures the Contractor shall use care in placing rebar and concrete. Unless otherwise approved, the bottom slabs shall be poured separate from the walls. A minimum of seven (7) days cure time shall be provided between completion of pouring the bottom and the walls.

E. When drainage structures are constructed with concrete brick, only new, sound brick shall be used. Mortar mix shall be mixed on site using an approved mortar mix consisting of Portland Cement (Type S), and clean sand. Following construction of the drainage boxes, both the interior and exterior shall be plastered with a minimum 1/2" thick coat of Portland Cement and sand mixture.

3.02 QUALITY CONTROL AND FIELD TESTING

The Contractor shall demonstrate to the Owner and Engineer that all drainage structures operate as intended and designed. All drainage structures shall be field tested by the Contractor in the presence of the Engineer prior to final acceptance.

END OF SECTION

PART 1: GENERAL

1.01 SCOPE OF WORK

A. This section covers the furnishing of all labor, equipment and materials necessary for the landscaping of all areas of the site disturbed by construction operations and all earth surfaces of embankments including rough and fine grading, topsoil if required, fertilizer, lime, seeding and mulching. The Contractor shall adapt his operations to variations in weather or soil conditions as necessary for the successful establishment and growth of the grasses or legumes.

PART 2: PRODUCTS

2.01 MATERIALS

A. FERTILIZER

1. The quality of fertilizer and all operations in connection with the furnishing of this material shall comply with the requirements of the North Carolina Fertilizer Law and regulations adopted by the North Carolina Board of Agriculture.

2. Fertilizer shall be 10-10-10 grade. Upon written approval of the Engineer a different grade of fertilizer may be used, provided the rate of application is adjusted to provide the same amounts of plant food.

3. During handling and storing, the fertilizer shall be cared for in such a manner that it will be protected against hardening, caking, or loss of plant food values. Any hardened or caked fertilizer shall be pulverized to its original conditions before being used.

B. LIME

1. The quality of lime and all operations in connection with the furnishing of this material shall comply with the requirements of the North Carolina Lime Law and regulations adopted by the North Carolina Board of Agriculture.

2. During the handling and storing, the lime shall be cared for in such a manner that it will be protected against hardening and caking.

Any hardened or caked lime shall be pulverized to its original condition before being used.

3. Lime shall be agriculture grade ground dolomitic limestone. It shall contain not less than 85% of the calcium and magnesium carbonates and shall be of such fineness that at least 90% will pass a No. 10 sieve and at least 50% will pass a No. 100 sieve.

C. SEED

1. The quality of seed and all operations in connection with the furnishing of this material shall comply with the requirements of the North Carolina Seed Law and regulations adopted by the North Carolina Board of Agriculture.

2. Seed shall have been approved by the North Carolina Department of Agriculture or any agency approved by the Engineer before being sown, and no seed will be accepted with a date of test more than nine (9) months prior to the date of sowing. Such testing however, will not relieve the Contractor from responsibility for furnishing and sowing seed that meets these specifications at the time of sowing. When a low percentage of germination causes the quality of the seed to fall below the minimum pure live seed specified, the Contractor may elect, subject to the approval of the Engineer, to increase the rate of seeding sufficiently to obtain the minimum pure live seed contents specified, provided that such an increase in seeding does not cause the quantity of noxious weed seed per square yard to exceed the quantity that would be allowable at the regular rate of seed.

3. During handling and storing, the seed shall be cared for in such a manner that it will be protected from damage by heat, moisture, rodents, or other causes.

4. Seed shall be entirely free from bulblets or seed of Johnson Grass, Nutgrass, Sandbur, Wild Onion, Wild Garlic, and Bermuda Grass. The specifications for restricted noxious weed seed refers to the number per pound, singly or collectively, of Blessed Thistle, Wild Radish, Canada Thistle, Corncockle, Field Bindweed, Quackgrass, Dodders, Dock, Horsenettle, Bracted Plantain, Buckhorn or Wild Mustard; but in no case shall the number of Blessed Thistle or Wild Radish exceed 27 seeds of each per pound. No tolerance on weed seed will be allowed.

D. MULCH

Straw mulch shall be threshed straw of oats, rye or wheat free from matured seed of obnoxious weeds or other species which would grow and be detrimental to the specified grass.

E. TACKIFIER

Emulsified asphalt or organic tackifier such as Reclamare R2400 shall be sprayed uniformly on mulch as it is ejected from blower or immediately thereafter. Tackifier shall be applied evenly over area creating uniform appearance. Rates of application will vary with conditions. Asphalt shall not be used in freezing weather.

PART 3: EXECUTION

3.01 PREPARATION

A. PROTECTION OF EXISTING TREES AND VEGETATION

1. Protect existing trees and other vegetation indicated to remain in place against unnecessary cutting, breaking or skinning of roots, skinning and bruising of bark, smothering of trees by stockpiling construction materials or excavated materials within drip line, excess foot or vehicular traffic, or parking of vehicles within drip line. Provide temporary guards to protect trees and vegetation to be left standing.

2. Provide protection for roots over 1-1/2" diameter cut during construction operations. Coat cut faces with an emulsified asphalt, or other acceptable coating, formulated for use on damaged plant tissues. Temporarily cover exposed roots with wet burlap to prevent roots from drying out and cover with earth as soon as possible.

3. The Contractor shall not remove or damage trees and shrubs which are outside the Clearing Limits established by the Owner or those within the Clearing Limits designated to remain.

4. Repair trees scheduled to remain and damaged by construction operations in a manner acceptable to the Engineer. Repair damaged trees promptly to prevent progressive deterioration caused by damage.

5. Replace trees scheduled to remain and damaged beyond repair by construction operations, as determined by the Engineer with trees

of similar size and species. Repair and replacement of trees scheduled to remain and damaged by construction operations or lack of adequate protection during construction operations shall be at the Contractor's expense.

B. GRADING

1. Rough grading shall be done as soon as all excavation required in the area has been backfilled. The necessary earthwork shall be accomplished to bring the existing ground to the desired finish elevations as shown on the Contract Drawings or otherwise directed.

2. Fine grading shall consist of shaping the final contours for drainage and removing all large rock, clumps of earth, roots and waste construction materials. It shall also include thorough loosening of the soil to a depth of 6" by plowing, discing, harrowing or other approved methods until the area is acceptable as suitable for subsequent landscaping operations. The work of landscaping shall be performed on a section by section basis immediately upon completion of earthwork.

3. Upon failure or neglect on the part of the Contractor to coordinate his grading with seeding and mulching operations and diligently pursue the control of erosion and siltation, the Engineer may suspend the Contractor's grading operations until such time as the work is coordinated in a manner acceptable to the Engineer.

C. SEEDBED PREPARATION

1. The Contractor shall cut and satisfactorily dispose of weeds or other unacceptable growth on the areas to be seeded. Uneven and rough areas outside of the graded section, such as crop rows, farm contours, ditches and ditch spoil banks, fence line and hedgerow soil accumulations, and other minor irregularities which cannot be obliterated by normal seedbed preparation operations, shall be shaped and smoothed as directed by the Engineer to provide for more effective seeding and for ease of subsequent mowing operations.

2. The soil shall then be scarified or otherwise loosened to a depth of not less than 6" except as otherwise provided below or otherwise directed by the Engineer. Clods shall be broken and the top 2" to 3" of soil shall be worked into an acceptable seedbed by the use of soil pulverizers, drags, or harrows; or by other methods approved by the Engineer.

3. On 2:1 slopes a seedbed preparation will be required that is the same depth as that required on flatter areas, although the degree of smoothness may be reduced from that required on the flatter areas if so permitted by the Engineer.

4. On cut slopes that are steeper than 2:1, both the depth of preparation and the degree of smoothness of the seedbed may be reduced as permitted by the Engineer, but in all cases the slope surface shall be scarified, grooved, trenched, or punctured so as to provide pockets, ridges, or trenches in which the seeding materials can lodge.

5. On cut slopes that are either 2:1 or steeper, the Engineer may permit the preparation of a partial or complete seedbed during the grading of the slope. If at the time of seeding and mulching operations such preparation is still in a condition acceptable to the Engineer, additional seedbed preparation may be reduced or eliminated.

6. The preparation of seedbeds shall not be done when the soil is frozen, extremely wet, or when the Engineer determines that it is in an otherwise unfavorable working condition.

D. APPLICATION RATES

Seed shall be applied by means of a hydro-seeder or other approved methods. The rates of application of seed, fertilizer and limestone shall be as stated below.

1. Lime and Fertilizer

In the absence of a soil test, the following rates of application of limestone and fertilizer shall be:

a. 4,000 pounds limestone per acre
b. 1000 pounds 10-10-10 (N-P_2O_5-K_2O) fertilizer per acre and the remaining quantity applied when vegetation is three inches in height or 45 days after seeding, whichever comes first.

2. Mulch

Mulch shall be applied at the following rates per acre:

a. 60-80 bales straw mulch, or
b. 1,000 pounds wood cellulose fiber.

3. Seed

The kinds of seed and the rates of application shall be as contained in this table. All rates are in pounds per acre. *See Notes 1 and 2.*

Fall and Winter (Normally August 1 to June 1)

100 pounds of Ky-31 tall fescue and 15 pounds of rye grain

Summer (Normally May 1 to September 1)

100 pounds of Ky-31 tall fescue, 20 pounds of German millet, and 15 pounds of Sudan grass.

NOTE:

1. On cut and fill slopes having 2:1 or steeper slopes, add 40 pounds of sericea lespedeza per acre to the planned seeding (hulled in spring and summer unhulled in fall and winter)..

2. These seeding rates are prescribed for all sites with less than 50% ground cover and for sites with more than 50% ground cover where complete seeding is necessary to establish effective erosion control vegetative cover. On sites having 50% to 80% ground cover where complete seeding is not necessary to establish vegetative cover, reduce the seeding rate at least one-half the normal rate.

E. APPLICATION

1. Equipment to be used for the application, covering or compaction of limestone, fertilizer, and seed shall have been approved by the Engineer before being used on the project. Approval may be revoked at any time if equipment is not maintained in satisfactory working condition, or if the equipment operation damages the seed.

2. Limestone, fertilizer, and seed shall be applied within 24 hours after completion of seedbed preparation unless otherwise permitted by the Engineer, but no limestone or fertilizer shall be distributed and no seed shall be sown when the Engineer determines that weather and soil conditions are unfavorable for such operations.

3. Limestone may be applied as a part of the seedbed preparation, provided it is immediately worked into the soil. If not so applied, limestone and fertilizer shall be distributed uniformly over the prepared seedbed at the specific rate of application and then harrowed, raked, or otherwise thoroughly worked or mixed into the seedbed.

4. Seed shall be distributed uniformly over the seedbed at the required rate of application, and immediately harrowed, dragged, raked, or otherwise worked so as to cover the seed with a layer of soil. The depth of covering shall be as directed by the Engineer. If two kinds of seed are to be used which require different depths of covering, they shall be sown separately.

5. When a combination seed and fertilizer drill is used, fertilizer may be drilled in with the seed after limestone has been applied and worked into the soil. If two kinds of seed are being used which require different depths of covering, the seed requiring the lighter covering may be sown broadcast or with a special attachment to the drill, or drilled lightly following the initial drilling operation.

6. When a hydraulic seeder is used for application of seed and fertilizer, the seed shall not remain in water containing fertilizer for more than 30 minutes prior to application unless otherwise permitted by the Engineer.

7. Immediately after seed has been properly covered the seedbed shall be compacted in the manner and degree approved by the Engineer.

8. When adverse seeding conditions are encountered due to steepness of slope, height of slope, or soil conditions, the Engineer may direct or permit that modifications be made in the above requirements which pertain to incorporating limestone into the seedbed; covering limestone, seed, and fertilizer; and compaction of the seedbed.

9. Such modifications may include but not be limited to the following:

   a. The incorporation of limestone into the seedbed may be omitted on

      i. cut slopes steeper than 2:1;

      ii. on 2:1 cut slopes when a seedbed has been prepared during the excavation of the cut and is still in an acceptable condition; or

      iii. on areas of slopes where the surface of the area is too rocky to permit the incorporation of the limestone.

b. The rates of application of limestone, fertilizer, and seed on slopes 2:1 or steeper or on rocky surfaces may be reduced or eliminated.

c. Compaction after seeding may be reduced or eliminated on slopes 2:1 or steeper, on rocky surfaces, or on other areas where soil conditions would make compaction undesirable.

F. MULCHING

1. All seeded areas shall be mulched unless otherwise indicated in the special provisions or directed by the Engineer.

2. It shall be spread uniformly at a rate of two tons per acre in a continuous blanket over the areas specified.

3. Before mulch is applied on cut or fill slopes which are 3:1 or flatter, and ditch slopes, the Contractor shall remove and dispose of all exposed stones in excess of 3" in diameter and all roots or other debris which will prevent proper contact of the mulch with the soil.

4. Mulch shall be applied within 24 hours after the completion of the seeding unless otherwise permitted by the Engineer. Care shall be exercised to prevent displacement of soil or seed or other damage to the seeded area during the mulching operations.

5. Mulch shall be uniformly spread by hand or by approved mechanical spreaders or blowers which will provide an acceptable application. An acceptable application will be that which will allow some sunlight to penetrate and air to circulate but also partially shade the ground, reduce erosion, and conserve soil moisture.

6. Mulch shall be held in place by applying a sufficient amount of asphalt or other approved binding material to assure that the mulch is properly held in place. The rate and method of application of binding material shall meet the approval of the Engineer. Where the binding material is not applied directly with the mulch it shall be applied immediately following the mulch operation.

7. The Contractor shall take sufficient precautions to prevent mulch from entering drainage structures through displacement by wind, water, or other causes and shall promptly remove any blockage to drainage facilities which may occur.

G. MAINTENANCE

1. The Contractor shall keep all seeded areas in good condition, reseeding and mowing if and when necessary as directed by the Engineer, until a good lawn is established over the entire area seeded and shall maintain these areas in an approved condition until final acceptance of the Contract.

2. Grassed areas will be accepted when a 95% cover by permanent grasses is obtained and weeds are not dominant. On slopes, the Contractor shall provide against washouts by an approved method. Any washouts which occur shall be regraded and reseeded until a good sod is established.

3. Areas of damage or failure due to any cause shall be corrected by being repaired or by being completely redone as may be directed by the Engineer. Areas of damage or failure resulting either from negligence on the part of the Contractor in performing subsequent construction operations or from not taking adequate precautions to control erosion and siltation as required throughout the various sections of the specifications, shall be repaired by the Contractor as directed by the Engineer at no cost to the Owner.

PART 4: PAYMENT

See Section 01300 under "Grassing".

END OF SECTION

SECTION 03301 MISCELLANEOUS CONCRETE CONSTRUCTION

PART 1: GENERAL

1.01 SCOPE OF WORK

A. This section covers concrete construction, complete, including reinforcement therefore.

PART 2: PRODUCTS

2.01 MATERIALS

A. REINFORCING

Bar reinforcement shall be intermediate grade new billet steel conforming to the requirements of ASTM A-615. Unless otherwise noted, all reinforcing bars shall be grade 60. Wire fabric reinforcement shall consist of steel wire conforming to the requirements of ASTM A-185, latest revision.

B. CONCRETE

All concrete shall be equivalent to ready mix concrete manufactured and delivered in accordance with the requirements of ASTM C-94, latest revision and having a compressive strength at 28 days of 4000 psi, except as noted herein. The concrete manufacturer shall assume the responsibility of the design of the concrete mix in accordance with Alternate No. 2 of ASTM C-94. Air entrained concrete shall be used for all concrete exposed to the elements.

a. Cement shall be Type 1 or Type 1A "Portland" cement conforming to ASTM C-150, latest revision or ASTM C-175, latest revision respectively.

b. Aggregates shall conform to ASTM C-33, latest revision. Coarse aggregate shall be crushed rock or gravel and graded from 3/4" to #4 sieve for walls and slabs and from 2" to #4 sieve for mass or foundation concrete. Fine aggregate shall be natural sand.

c. Mixing water shall be proportioned so that slump when measured with standard slump cone does not exceed the following:

i. Slabs in grade.....Max. 4", Min. 3"

ii. Footings.....Max. 5", Min. 3"

iii. All others.....Max. 6", Min. 3"

d. Premolded joint filler strips shall be resilient compressive, bituminous and fiber material saturated, with at least 35% and not over 50% by weight of asphalt. Poured type joint composition for expansion joints shall be elastic compound made up of asphalt and colloidal mineral fillers.

PART 3: EXECUTION

3.01 FORMS

A. Forms shall be wood, metal, structural hardboard or other suitable material that will produce the required surface finish. Forms placed for successive pours for continuous surfaces shall be fitted to accurate alignment to assure a smooth completed surface free from irregularities, and shall be sufficiently tight to prevent the loss of mortar. No forms shall be left permanently in place without approval of the Engineer. Holes resulting from removal of form ties shall be filled solid within 12 hours after removal of forms with cement mortar.

3.02 PLACEMENT

A. Concrete shall be placed as nearly as possible in its final position. Runways for wheeled equipment shall not be supported on the reinforcement. Concrete shall be placed and compacted in layers not over 18 inches deep. Vibrators may be used provided they are used under experienced supervision and the mixture is dry enough to prevent segregation. Form vibrators shall not be used. Vibration shall not be used for transporting or moving concrete inside the forms. No more concrete shall be placed than can be consolidated and finished the same day as placed. Free fall of concrete shall be limited so that no segregation of materials occurs.

3.03 JOINTS

A. Construction of joints not indicated on drawing shall be approved by the Engineer in advance of pour. Joints in foundation walls shall be keyed. Before depositing of concrete is resumed, the hardened surface shall be roughened, cleaned and wetted surfaces shall be slushed with a coating

of neat cement grout against which the new concrete shall be placed before the new grout has attained its set.

3.03 FINISHING

A. After stripping forms, all voids and honeycombs shall be patched by chipping and scarifying the defective area and treating it with an approved bonding tended that all such voids be patched, not merely plastered. Grout mixture shall consist of one part Portland cement and one part sand. Immediately following removal of forms, all fins and irregular projections shall be removed from all surfaces except from those which are not to be exposed or waterproofed.

B. Slabs shall be struck off and consolidated by approved machine or hand methods, so that upon completion, the surface shall be true to grade as shown on drawings and free of surface voids. All floors shall have monolithic steel trowel finish unless otherwise indicated on the drawings. Exterior walks shall be compacted, screeded and floated to a true even surface with wood floats and then broomed.

PART 4: PAYMENT

A. Payment shall be based on the actual number of cubic yards of reinforced concrete incorporated into the completed and accepted work. Measurement shall be based on the form dimensions unless otherwise agreed upon with the Engineer.

END OF SECTION

APPENDIX 1

SITE SPECIFIC CONSTRUCTION QUALITY ASSURANCE PLAN

SITE SPECIFIC CONSTRUCTION QUALITY ASSURANCE PLAN

Madison County MSW Landfill
Madison County, North Carolina
MSW Closure

This Construction Quality Assurance Plan has been prepared as required under 15A NCAC 13B .1617 and in accordance with 15A NCAC 13B .1621 of Section 15A NCAC 13B of the North Carolina Solid Waste Management Rules.

1.0 INTRODUCTION

1.1 Project Background

The Madison County MSW Landfill Site has been utilized for disposal of Municipal Solid Wastes. The current project involves the construction of a closure cap on the municipal solid waste landfill. This project will include using structural fill to achieve the desired gradients followed by a compacted, 18" thick low-permeability clay liner layer, a 40-mil linear low density polyethylene (LLDPE) textured geomembrane liner, a 6-ounce double-sided geocomposite, and 24" of vegetative supportive soil. The site is located in Madison County.

1.2 Project Scope

The purpose of this Site Specific Construction Quality Assurance Plan (SSCQAP) is to provide guidance to McGill Associates and sub-contractor personnel on required documentation activities during the construction of the engineered closure cap. This guidance is intended to ensure that construction meets the requirements of Madison County and the Project Construction Quality Assurance (CQA) Plan and project drawings and specifications.

The overall goals of the SSCQAP are to ensure that proper construction techniques and procedures are used to verify that the materials and installation techniques used meet Project CQA Plan and project drawings and specifications. Additionally, the program will identify and define problems that may occur during construction and ensure that these problems are corrected before the construction is complete. At completion of work, the program will culminate in a certification report, which will document that the clay liner, geosynthetic liners and vegetative supportive soils have been constructed in substantial compliance with this SSCQAP and project drawings and specifications. The primary emphasis of the SSCQAP is careful documentation during the preparation and placement of the clay and the geosynthetic liner, with a secondary emphasis on placement of the vegetative supportive soil. The vegetative supportive soil is not considered less important than the other components, but it will be visually inspected over time and can be repaired if problems are identified. The vegetative supportive soil will be tested, but at a lower frequency than the other cap components.

1.2.1 Scope of Services

The Scope of Services provided by McGill Associates and sub-contractor personnel for the construction of engineered cap is as follows:

1. Pre-Construction materials evaluation (structural fill, clay liner, geosynthetics, vegetative supportive soil).
2. Structural Fill observation, testing, documentation, and verification of construction procedures.
3. Clay liner observation, testing, documentation, and verification of construction procedures.
4. Geosynthetic observation, testing, documentation, and verification of construction procedures.
5. Vegetative supportive soil observation, testing, documentation, and verification of construction procedures.
6. Provide CQA Report and CQA Certification that cap was constructed in accordance with this SSCQAP.

1.2.2 Construction Schedule

Construction of the cap shall be completed within 90 consecutive calendar days.

Description
Preconstruction Meeting
Structural Fill Installation
Clay Liner Installation
Geomembrane Liner Installation
Geocomposite Installation
Installation of Vegetative Supportive Soil Layer
Submit CQA Report and CQA Certification

2.0 Parties Involved

2.1 Madison County

Contact: Mr. Jim Huff (828) 649-2311

Title: Solid Waste Director

2.2 McGill Associates, P.A.

Contact: Mark D. Cathey, P.E. (828) 252-0575

Title: Project Engineer

2.3 General Contractor

Contact: Unknown

Title:

2.3.1 Surveyor

Contact: Unknown

Title:

2.3.2 Geosynthetic Manufacturer

Contact: Unknown

Title:

2.3.3 Geosynthetic Installer

Contact: Unknown

2.5 Construction Quality Assurance Consulting Firm

Contact: Unknown

Title:

2.5.1 CQA Certifying Engineer

Name: Unknown

Title:

2.5.2 CQA Resident Engineer

Name: Unknown

Title:

2.5.3 Geosynthetic Testing Laboratory

Contact: Unknown

Title:

2.5.4 Soils Laboratory (permeability testing)

Contact: Unknown

Title:

3.0 Preconstruction Meeting

A Preconstruction meeting will be held prior to the beginning of construction. The following people shall be present: Owner representative, Solid Waste Section representative, Design Engineer, Certifying CQA Engineer/CQA Project Manager, Resident CQA Engineer, General Contractor, Geosynthetics Installer, and all other subcontractors.

The following items will be discussed at a minimum:

- Any questions about the SSCQAP will be addressed and any modifications that result will be documented. Any modifications to the approved SSCQAP must be approved by the Division of Solid Waste.
- Special permits and state and/or federal regulations.
- Responsibilities, expectations, and roles of each party.
- Lines of authority and proper lines of communication.
- Procedures for documenting and reporting information.
- Distribution and storage of documents and reports.
- Protocol for testing and geosynthetic sample management.
- Protocol for handling construction deficiencies.
- Protocol for repairs and re-testing.
- Conduct site walk through:
  - a) Discuss work plans
  - b) Inspect material handling and storage locations
  - c) Review office facilities (copy machine, mailing, etc.)
- Review detailed time schedule for all operations.
- Review work area security, check-in procedure, and safety protocol.
- Establish procedures for material processing.
- Review site health and safety requirements.

McGill Associates will document the Preconstruction Meeting and a copy of the meeting minutes will be distributed to all parties who attend.

4.0 Definitions

4.1 Construction Quality Assurance

A planned and systematic application of all means and actions designed to provide adequate confidence that items or services meet design and specifications requirements and will perform satisfactorily in service. In the context of the geosynthetic liner system, construction quality assurance refers to means and actions employed by the CQA Resident Engineer, CQA Senior Lead Technician, and the CQA Monitors to ensure conformity of the liner system installation with guidelines set forth in the SSCQAP, construction plans, and construction specifications.

4.2 Construction Quality Control

Those actions that provide a means to measure and regulate the characteristics of an item or services to design and specifications requirements. In the context of the geosynthetic liner system installation, quality control refers to those actions taken by the Geosynthetic Contractor/Manufacturer to ensure that the product and the workmanship meets the requirements set forth in the SSCQAP, construction plans, and construction specifications.

4.3 Design Engineer

The individual or firm responsible for the implementation of this SSCQAP, construction drawings, and construction specifications.

4.4 General Contractor

The firm responsible for the complete construction of the soil and geosynthetic components of the landfill as specified in this SSCQAP and as shown on the construction drawings and construction specifications.

4.5 Construction Quality Assurance Consultant

The firm responsible for observing, testing and documenting activities related to construction quality assurance during the installation of the clay liner, geomembrane liner, and the leachate collection system. The CQA Certifying Engineer is responsible for issuing a summary certification and documentation report bearing his/her Professional Engineering Seal. The CQA Resident Engineer is responsible for the management of on-site CQA personnel and providing the Project Engineer and Owner with a daily report of the construction activities.

5.0 DOCUMENTATION PROCEDURES

5.1 Standard Reporting Procedures

The CQA Technicians shall issue a daily report of construction activities. These reports shall include, as a minimum, the following information:

1. An identifying sheet number for cross-referencing and documentation control.
2. Date, project name, location and other identification.
3. Weather conditions.
4. Problems encountered and resolutions.
5. Descriptions and locations of ongoing construction.
6. Equipment and personnel in each work area, including subcontractors.
7. Descriptions and specific locations of areas or units of work being tested and/or observed and documented (identified by coordinates or seam/panel numbers).
8. Locations where samples were taken.
9. A summary of test results, failures, and re-tests.

5.2 Geosynthetic Installation Monitoring

The monitors of geosynthetic installation shall perform and/or provide the following information and services:

1. Record information about material delivery (time, date, and physical condition of material).
2. Observe unloading and on-site storage and transport.
3. Perform sampling for conformance testing.
4. Observe deployment operations and record needed information (roll #, panel #, approved QA\QC cert, thickness, overlap, defects, etc.).
5. Observe seam preparation (proper overlap and cleanliness).

6. Observe seaming operations and record needed information (seaming method, seam#, welding technician, welding apparatus #, welder settings, ambient temperature, chronological order of seams welded, seam length, etc.).

7. Observe conditions of panel before and after placement.

8. Locate and document all defects in the geosynthetic material.

9. Observe repairs (location, method, technician, date, etc.).

10. Observe trial seams (monitor preparation and testing).

11. Observe nondestructive testing (visual observation and documentation).

12. Observe sampling for destructive seam testing (locating test location).

13. Conduct final walkovers (confirm defect repairs).

5.3 Applicable Forms

As a minimum, the CQA monitors will utilize the following forms for the project:

1. Daily Field Report
2. Weekly Progress Report
3. Nuclear Density Testing
4. Drive Cylinder Test Report
5. Soil Testing Tracking Log
6. Certificate of Acceptance of Soil Subgrade
7. Geosynthetic Materials Inventory Checklist
8. Weather Log
9. Trial Weld Form
10. Panel Deployment

11. Panel Seaming

12. Nondestructive Seam Testing

13. Destructive Sample Test Log

14. Geosynthetic Defect Log

15. Geosynthetic Repair Log

16. Construction Site Safety Form

17. Construction Photo Log

18. Certificate of Completion

5.4 Problem/Deficiency Identification and Corrective Action Report

The CQA Monitor is required to inform the General Contractor and/or the Geosynthetic Contractor, or their representatives, in a timely manner, of any difference between the interpretation of the SSCQAP, the construction plans and construction specifications by the contractor versus the CQA Monitor's interpretation. In addition, any actual or suspect work deficiencies shall be brought to the Project Engineer and Owner's attention.

A special meeting shall be held when and if a problem or deficiency is present. At a minimum, the meeting shall be attended by the General Contractor, the Owner, the CQA Resident Engineer, and the CQA Monitor. If the problem involves a possible design modification, the Project Engineer shall be notified. The purpose of the meeting is to define and resolve the problem or work deficiency as follows:

1. Define and discuss the problem or deficiency
2. Review alternative solutions
3. Implement an action plan to resolve the problem or deficiency

The CQA Resident Engineer or his representative will document all proceedings.

The CQA Resident Engineer and the Design Engineer shall be authorized to stop work at the construction site.

The Owner, Project Engineer, CQA Certifying Engineer, and the Division of Solid Waste must approve any changes and/or modifications to the SSCQAP.

5.5 Plan Modifications

Design and/or specification changes shall be made only with written approval of the Owner and the Project Engineer. Substantial design changes shall also require approval from the Division of Solid Waste.

5.6 Scope Change

The CQA Resident Engineer shall notify the Project Engineer whenever additional engineering services are requested by Owner that exceeds the original scope of services.

5.7 Photographic Documentation

Photographs taken to document observations, problems, and/or deficiencies, or work in progress will include identification of the date, location, direction of view, and time period. Photographs will be filed in chronological order in a permanent protective file by the CQA team. One set of prints shall be turned over to both the Owner and Project Engineer at the conclusion of the project.

The permanent file will also contain a comprehensive index of each photo, which the CQA Monitor is responsible for preparing and maintaining. This index will include the following information:

1. Date of photograph
2. Provide a location and scale where photographed, including information regarding the orientation of the photograph itself for proper viewing
3. Subject description
4. Photo file number

The following is a list of minimum photographs to be taken during cell construction:

1. Subgrade/subbase proof rolling
2. Geosynthetic conformance sampling
3. Geomembrane deployment
4. Fusion welding devices

5. Extrusion welding devices
6. Air testing
7. Vacuum box testing
8. Anchor trenches
9. Manhole risers
10. LLDPE boots
11. Anchor bolt and battens
12. Gas Vents
13. Monitoring Wells
14. Seaming
15. Destructive sample location and removal
16. Trial welds
17. Tensiometer testing
18. Geotextile deployment
19. On-site lab soil testing
20. Soil layer construction
21. Progress photographs
22. Design modifications
23. Construction deficiencies
24. Completed construction

5.8 Final Construction Documentation Report

During placement of the soil layer, the CQA Resident Engineer shall prepare a final certification-documentation report covering the installation and testing of the clay and geosynthetic lining system. This report shall certify that the clay and geosynthetic liner system has been constructed in substantial accordance with this SSCQAP, the construction drawings, and the construction specifications. A Draft Copy of this report shall be issued to the Project Engineer following completion of the lining system. The final report shall be issued to the Project Engineer following completion of the cap. For this project, two (2) copies of the draft version and five (5) copies of the final version of the report shall be issued.

5.9 Format of CQA Report

As a minimum, the certification report will contain the following items for discussion in the narrative portion of the report. The proposed table of contents is:

5.9.1 Table of Contents

Section

1.0 Summary of Information

- 1.1 Narrative
- 1.2 Reference Information

2.0 Soil Preconstruction Data (embankment and clay liner)

- 2.1 Proctors
- 2.2 Soil Density/Moisture
- 2.3 Soil Classification

3.0 Subgrade Field Data

- 3.1 Moisture Content
- 3.2 Field Density Testing

3.0 Clay Liner Field Data

- 3.1 Moisture Content
- 3.2 Field Density Testing
- 3.3 Permeability Testing

4.0 Soil Laboratory Data

4.1 Construction Proctors
4.2 Soil Classification
4.3 Permeability

5.0 Geosynthetic Quality Control

5.1 Manufacturer's Q.C.
5.2 Installer Resumes
5.3 Material Conformance Testing

6.0 Geosynthetic Liner Field Data

6.1 Weather Log
6.2 Trial Welds
6.3 Panel Placement
6.4 Panel Seaming
6.5 Non-Destruct Test
6.6 Destruct Test
6.7 Repair Log
6.8 Installed Quantities
6.9 Defect Location Map

7.0 Vegetative Supportive Soil Layer Data

7.1 Preconstruction testing

7.2 Field and laboratory testing

7.2.1 Sieve analysis
7.2.2 Permeability testing

8.0 Project Meeting Minutes

9.0 Construction Photographs

10.0 Pertinent Information

5.9.2 Draft List of Drawings

As a minimum, the certification will include in an appendix the following proposed list of drawings:

- Geomembrane Panel Layout
- Defect Location Map
- Map giving elevation of subgrade, clay liner, and soil layer at a minimum frequency of every fifty (50) feet.

5.10 Site Surveying Requirements

The CQA Resident Engineer shall coordinate all survey activities with the surveyor. Survey services will be required for initial site layout, final grade verification, and primary geomembrane as-built survey. All grade surveying shall be conducted on a 50-foot grid. The certification surveys will be as directed by the CQA Resident Engineer and shall include the following items:

- Initial site layout
- Topographic survey of base grades
- Topographic survey of top of clay liner
- Panel placement and seaming locations
- Location of destructive testing samples
- Location of all significant repairs
- Topographic survey of top of vegetative supportive soil layer

6.0 LANDFILL CONSTRUCTION-EARTHWORK

6.1 Subgrade Preparation

Subgrade preparation shall be performed by the General Contractor and in accordance with the construction drawings and construction specifications. See Appendix A for CQA monitoring and testing requirements.

6.2 Structural Fill Placement

Structural fill shall be the soil placed to achieve the design subgrade contours. The subgrade will be tested for field density and field moisture content at a minimum frequency of one (1) test per 5,000 cubic yards placed. Testing will also consist of visual observation and documentation of proofrolling with loaded rubber-tired earthmoving equipment. If a nuclear gauge is used as the primary means of construction testing, the instrument shall be calibrated properly and test data shall be verified using alternate test methods such as drive cylinders. An alternate test method shall be used at least once for every hundred tests performed with the nuclear gauge. The alternate test method should be performed in the same area as an instrument reading in order to allow accurate comparison of the data resulting from the two tests.

6.3 Clay Liner Material

The clay liner shall consist of low-permeability soils placed on the subgrade.

Clay liner material generally consists of cohesive soils with low hydraulic conductivity used as barriers in lining systems. Soils used in clay liners shall consist of clean, select material free of debris, excessive coarse particles or other deleterious matter. Soils with a visibly identifiable organic content, or soils classified according to the Unified Soil Classification System as organic silt or organic clay (OL, OH) shall not be used.

Table 1 - QA Testing Frequencies and Criteria for Clay Liner Layer

Preconstruction Qualification		
Test	**ASTM Method**	**Quantity**
Moisture Content	D2216	1/1,000 YD^3
Grain Size	D422 or D1140	1/5,000 YD^3
Atterberg Limits	D4318	1/5,000 YD^3
Laboratory Compaction	D698 - Standard	1/5,000 YD^3
Permeability	D5084	1/5,000 YD^3
*** Preconstruction test samples shall be taken from the borrow source and or clay stockpiled prior to construction.**		
Construction Testing		
Test	**ASTM Method**	**Quantity**
Field Density	D2922, D1556, D2167	1/10,000 FT^2/Lift
Field Moisture	D2216, D3017, D4643	1/10,000 FT^2/Lift
Permeability	D5084	1/40,000 FT^2/Lift
Atterberg Limits	D4318	1/5,000 YD^3
Grain Size	D422 or D1140	1/5,000 YD^3
Testing Criteria		
Classification	CL, CH, ML or MH	
Maximum Particle Size		3-inch diameter (lower 18 inches) 1/4-inch diameter (top 6 inches)

If a nuclear gauge is used as the primary method for construction testing of the clay liner, the test data shall be verified by alternate test methods at least once for every 25 tests performed.

Any modifications made to these testing frequencies will require prior approval from the Division of Solid Waste.

6.4 Clay Liners

Prior to the construction of a clay liner, soil evaluation tests shall be performed to confirm the adequacy of clay liner materials procured from each on-site or off-site source area. All tests shall be performed in a geotechnical laboratory, which may be the Soil QAL or another laboratory approved by the Project Engineer. The Earthwork Contractor shall submit the results of source

evaluation tests to the Project Engineer. Previous testing and evaluations of the soil sources may also be used to evaluate the soil material. The material shall be accepted or rejected by the Project Manager according to these results. The acceptance and rejection criteria for the clay liner material will be verified by the construction of a test pad in accordance with the construction specifications

6.4.1 Quality Control Acceptance Criteria

The following tests and/or information shall be conducted and provided prior to acceptance of clay liner material:

1. Moisture content (ASTM D2216)
2. Particle size distribution analysis (ASTM D1140, D422)
3. Atterberg limits (ASTM D4318)
4. Laboratory compaction (ASTM D698)
5. Triaxial cell laboratory permeability (ASTM D5084)
6. Percent bentonite admixed with soil, if applicable
7. Moisture-density-permeability relation

* Refer to Section 6.3, Table 1 for testing frequencies.
* Acceptance of the clay liner will be based on the material's ability to achieve a permeability not greater than 1.0×10^{-5} cm/sec.

The project engineer shall approve the materials prior to construction and verify that testing was performed according to Division approved plans and specifications.

If identification of additional clay liner material sources becomes necessary during construction, the same material qualification and testing procedures shall be applied to each new source. Additional testing may be required by the project specifications. Project specifications may modify testing frequencies if the clay liner material has been previously evaluated or used.

6.4.2 Quality Assurance Testing

Each lift of the compacted clay liner shall be tested for moisture content, density, and permeability at the frequencies shown in the technical specifications. Permeability tests shall be performed at a confining pressure of 3 psi +/- 1 psi and with a gradient in accordance with ASTM method D5084. Samples taken from each location shall be compared to the approved moisture-density-permeability relation. Test frequencies for construction testing are given in Table 1 of section 6.3. The project engineer shall certify that the clay liner was constructed using

the same methods and acceptance criteria consistent with test pad construction and tested according to the Division approved plans. Index tests will be performed during construction at a frequency of one (1) test/5,000 YD^3. The index tests will consist of an Atterberg Limits test and Grain Size test performed from the same bulk sample taken from the field.

6.4.3 Test Pad Construction

The test pad shall be constructed in accordance with the technical specifications. The results of the test pad testing shall be in accordance with Table 1 in section 6.3 and the previously approved moisture-density-permeability relationship established from preconstruction testing. Field moisture and density tests and laboratory permeability tests will be performed by the CQA Engineer for each lift placed on the test pads to verify the construction method, equipment, and material achieve a permeability not greater than 1.0×10^{-5} cm/sec for the clay liner. If the contractor chooses to construct the test pads within the cell, all lifts of the test pads must pass to enable them to remain as part of the clay liner. The Contractor shall allow sufficient time for construction and testing of the test pad prior to placement of the Compacted Clay Liner.

6.4.4 Clay Liner Placement

The clay liner shall be placed in accordance with Section 02300 of the technical specifications.

6.4.5 Clay liner Acceptance

The Resident CQA Engineer must approve the condition of the clay liner prior to the geosynthetic installer deploying the geomembrane.

The soil components of the lining system will be approved by the Resident CQA Engineer when:

1. The installation of the soil components is finished.
2. Verification of the adequacy of the constructed components, including repairs, if any, is completed in accordance with this SSCQAP and the technical specifications.
3. All documentation of installation is completed.
4. The depth and grade of the clay liner has been verified by a licensed surveyor and has been approved by the project engineer.
5. The appropriate frequency of permeability tests has been performed and the results have been approved by the Certifying CQA Engineer.
6. The Soil CQA monitors are able to recommend acceptance.

The Soil CQA Monitors shall certify that installation of the soil components has proceeded in accordance with this SSCQAP and the technical specifications.

6.5 Permeability Testing

Permeability testing shall be performed in accordance with section 6.4.2 of this document and the technical specifications.

6.6 Vegetative Supportive Layer

6.6.1 Materials and Construction

The final layer of the cap will be composed of 24" of soil. The hydraulic conductivity, or permeability, must be a maximum of 1×10^{-5} cm/sec. The bottom 18" of the soil layer may be constructed of native soils with no stones larger than 2" in diameter. The soil is not required to have a specific classification, however, it should be a cohesive soil.

The final cover will be a minimum of 24-inches thick including at least 6-inches of soil suitable for sustaining native plant growth. The soil cover will provide support for a vegetative cover and protect the low-permeability barrier.

The friction angle between the geocomposite and the vegetative supportive soil layer shall be a minimum of 24 degrees. Direct Shear Box testing prior to construction shall verify this friction angle. The tests shall be performed using representative bulk samples of the proposed construction materials.

The bottom soil layer shall be placed with a minimum compacted thickness of 18 inches. Equipment used during placement of the soil layer shall not be allowed to operate directly on the geomembrane. Equipment will not be allowed on any portion of the geomembrane without the protective geocomposite and a minimum of 18 inches of soil layer material in place. Soil layer material shall not be pushed along the surface of the geomembrane under any circumstances. Pushing of the soil layer material will only be allowed on areas where the material has a depth greater than 18 inches, and the required 18-inch depth shall be maintained at all times.

Table 2 - QA Testing Frequencies and Criteria for Vegetative Supportive Soil Layer

Preconstruction Qualification		
Test	**ASTM Method**	**Quantity**
Moisture Content	D2216	1/5,000 YD^3
Laboratory Compaction	D698 - Standard	1/5,000 YD^3
Permeability	D5084	1/5,000 YD^3
*** Preconstruction test samples shall be taken from the borrow source and or material stockpiled prior to construction.**		
Construction Testing		
Test	**ASTM Method**	**Quantity**
Field Density	D2922, D1556, D2167	1/ACRE
Field Moisture	D2216, D3017, D4643	1/ACRE
Permeability	D5084	1/ACRE
Testing Criteria		
Classification	CL, CH, ML or MH	
Maximum Particle Size		3-inch diameter (lower 18 inches) 1/4-inch diameter (top 6 inches)

If a nuclear gauge is used as the primary method for construction testing of the clay liner, the test data shall be verified by alternate test methods at least once for every 25 tests performed.

Any modifications made to these testing frequencies will require prior approval from the Division of Solid Waste.

6.6.2 Placement

Placement of the vegetative supportive soil layer shall be performed by a light tracked dozer or light dump truck not in direct contact with the geomembrane. A minimum depth of 18 inches of soil layer material must be maintained at all times during placement activities when vehicles other than the light tracked dozer are needed. High traffic areas, such as access roads constructed to transport material into the landfill, should have a minimum depth of three (3) feet. This depth may be changed by written approval from Owner or an engineered design approved by the Design Engineer.

The soil layer shall be placed in the coolest part of the day when possible in order to reduce the potential for wrinkles forming in the geomembrane. See Sections 1.4.2 and 1.1.5 of Appendix C for information on evaluating and repairing wrinkles in the geomembrane.

McGill Associates and/or the Resident CQA Engineer will observe placement activities. The General Contractor is to provide laborers ahead of soil material placement to assist in minimizing wrinkle formation of the geomembrane. Temperature variations may impact the Contractor's ability to place this material.

6.6.3 Depth Verification

CQA Monitor(s) will randomly verify soil layer depth utilizing test pits or survey means. A Licensed Surveyor will survey the top of the soil layer to certify proper depth was achieved. The General Contractor may use depth markers (i.e., painted tubes, flags, traffic cones, etc.) during placement to provide depth control and minimize possible damage to geomembrane. Depth markers shall be removed as the soil layer is completed. Depth markers shall not be constructed of a material that could potentially puncture the geomembrane and shall be approved by the Project Engineer.

7.0 LANDFILL CAP-GEOMEMBRANE

7.1 Geomembrane Liner

The geosynthetic components of the lining system will be approved by the Resident CQA Engineer when:

1. The installation of the geosynthetic components has been completed in accordance with this SSCQAP and the technical specifications.

2. Verification of the adequacy of all seams including associated testing and repairs, if any, is completed in accordance with this SSCQAP and the technical specifications.

3. All documentation of installation is completed.

4. The Geosynthetic CQA Monitor(s) are able to recommend acceptance.

7.2 Geomembrane Quality Control

The Geosynthetic Contractor/Manufacturer will provide geosynthetic quality control in accordance with Appendix B.

7.3 Geomembrane Quality Assurance

7.3.1 Conformance Sampling

Conformance testing will be done on-site as material arrives and is inventoried. Conformance sampling procedures will be in accordance with Appendix B.

7.4 Geomembrane Seaming

Field seaming will be done in accordance with Appendix C.

7.4.1. Double Tracked Fusion Welding

All seaming performed shall utilize the double-tracked fusion process when possible. Detailing and repairs do not require double tracked fusion welding.

7.4.2 Extrusion Welding

Extrusion welding shall only be used when double-tracked fusion welding is not possible. The extrusion process will be utilized for repair or detail work, attaching the boots around the methane wells, capping a failed seam, or completion of other appurtenances that cannot be performed with fusion welding.

7.5 Geomembrane/Seam Repairs

All repairs to the geomembrane or seams shall be done utilizing the extrusion welding process. All repair work shall be conducted in accordance with Appendix C.

7.6 Geotextile Quality Control

The Geosynthetic Contractor/Manufacturer shall provide quality control information in accordance with Appendix D.

7.7 Geotextile Quality Assurance

Conformance sampling will be performed on-site as material arrives and is inventoried. All conformance sampling will be in accordance with Appendix D.

8.0 METHANE GAS COLLECTION PIPING

8.1 Materials

Materials for the methane gas collection piping shall be in accordance with the technical specifications. Pipe for the methane gas collection system shall be ACS N12 perforated High-Density Polyethylene (HDPE) pipe, or approved equal.

1. HDPE piping shall have nominal diameters as noted on the Contract Drawing.

2. The HDPE pipe shall be manufactured from first quality virgin polyethylene with the following nominal properties:

Nominal Diameter	6 inches
Pipe Stiffness (minimum)	50 psi

1. The pipe placed in the methane collection trenches shall be perforated.

2. Piping that penetrates the landfill cap at the vent locations should be solid HDPE pipe.

8.2 Construction

The perforated high density polyethylene pipe shall be as shown on the Construction Drawings and technical specifications.

a) The pipe section connections shall be made by:

(1) Threaded connection;

(2) Snap-couplings (approved mechanical); and/or

(3) Combination of any two or more of the above. No solvent or glued joints are allowed.

APPENDIX A

1.0 Subgrade Preparation

1.1 Surface Preparation

The Earthwork Contractor shall be responsible for preparing the subgrade prior to placement of the cap liner system and is responsible for constructing the subgrade in accordance with the technical specifications.

Before beginning placement of the compacted clay liner:

1. The project engineer shall document that a licensed land surveyor has verified that all grades and elevations are consistent with Division approved engineering plans.

2. The project engineer shall document that he/she has visually inspected the subgrade surface to evaluate its suitability and that the subgrade meets the criteria specified in the project specifications.

3. The subgrade shall be proof-rolled using a procedures and equipment specified by the project engineer.

4. The project engineer shall document that the subgrade has been tested for conformance to the construction specifications at the following minimum frequencies:

SUBGRADE TESTING FREQUENCIES			
TEST	ASTM METHOD	QUANTITY	ACCEPTABLE VALUES
Field Density	D2922, D1556, D2937 D2216, D3017,	1/40,000 ft^2/lift	95% maximum dry density
Field Moisture	D4643	1/10,000 ft^2/lift	+/- 4% optimum

APPENDIX B

1.0 Geomembranes

1.1 Description and Applicability

Geomembranes are low permeability geosynthetic barriers used in lining systems. This Section is applicable to smooth and textured linear low density polyethylene (LLDPE) geomembranes. This Section may need to be modified when using other geomembranes.

1.2 Manufacturing Plant Inspection

The Owner or other appropriate representative will conduct an annual inspection of the Manufacturer's plant. In addition, the Project Engineer, or his designated representative, may visit the manufacturing plant for a project-specific inspection if deemed necessary. If possible, the project-specific inspection shall be prior to or during the manufacturing of the geomembrane rolls for that particular project. The purpose of the plant inspection is to review the manufacturing process and quality control procedures.

The manufacturing plant inspection shall include:

1. Verification that properties guaranteed by the manufacturer are met and meet all the project specifications.

2. Verification that the measurement of properties by the Manufacturer is properly documented and test methods used are acceptable.

3. Spot inspection of the rolls and verification that they are free of imperfections or any sign of contamination by foreign matter.

4. Review of handling, storage, and transportation procedures, and verification that these procedures will not damage the geomembrane.

5. Verification that roll packages have a label indicating the name of the manufacturer, type of geomembrane, thickness, roll number, and roll dimensions.

6. Verification that extrusion rods and/or beads are produced from the same base resin type as the geomembrane.

A report describing the inspection shall be retained by the Owner for annual inspections and by the Project Engineer for project-specific inspections.

1.3 Quality Control Documentation

Prior to the installation of any geomembrane, the Manufacturer or Installer shall provide the Resident CQA Engineer with the following information:

1. The origin (supplier's name and production plant) and identification (brand name and number) of the resin used to manufacture the geomembrane.

2. Copies of dated quality control certificates issued by the resin supplier.

3. Results of tests conducted by the Manufacturer to verify that the resin used to manufacture the geomembrane meet the project specifications.

4. A statement indicating that the amount of reclaimed polymer added to the resin during manufacturing was done with appropriate cleanliness.

5. A list of the materials that comprise the geomembrane, expressed in the following categories as percent by weight: polyethylene, carbon black, and other additives.

6. A specification for the geomembrane that includes all properties contained in the project specifications measured using the appropriate test methods.

7. Written certification that minimum values given in the specification are guaranteed by the Manufacturer.

8. Quality control certificates, signed by a responsible party employed by the Manufacturer. Each quality control certificate shall include roll identification numbers, testing procedures, and results of quality control tests. At a minimum, results shall be given for the following:

Property	Test Method	Frequency
Thickness	ASTM D-5994	Each Roll
Sheet Density	ASTM D-1505	Every 200,000 lb
Tensile Properties	ASTM D-6693 Type IV	Every 20,000 lb
Tear Resistance	ASTM D-1004	Every 45,000 lb
Puncture Resistance	ASTM D-4833	Every 45,000 lb
Carbon Black Content	ASTM D-1603	Every 45,000 lb
Carbon Black Dispersion	ASTM D-5596	Every 45,000 lb

The Manufacturer shall identify all rolls of geomembranes with the following:

1. Manufacturer's name
2. Product identification
3. Thickness
4. Roll number
5. Roll dimensions

The Resident CQA Engineer shall review these documents and shall report any discrepancies with the above requirements to the Project Engineer. The Resident CQA Engineer shall verify that:

1. Property values certified by the Manufacturer meet all of its guaranteed specifications.

2. Measurements of properties by the Manufacturer are properly documented and that the test methods used are acceptable.

3. Quality control certificates have been provided at the specified frequency for all rolls, and that each certificate identifies the rolls related to it.

4. Rolls are appropriately labeled.

5. Certified minimum properties meet the project specifications.

1.3.1 Quality Control Test Results

All conformance test results shall be reviewed and accepted or rejected by the Certifying CQA Engineer prior to shipping the geomembrane to the project site. The Certifying CQA Engineer shall examine all results from manufacturer's testing and shall report any non-conformance to the Design Engineer. The Certifying CQA Engineer shall be responsible for checking that all test results meet or exceed the property values listed in the project specifications.

If a test result is in nonconformance, all material from the lot represented by the failing test shall be considered out-of-specification and rejected. Alternatively, at the option of the Design Engineer, additional conformance test samples may be taken to "bracket" the portion of the lot not meeting the project specification. This procedure is valid only when all rolls in the lot are consecutively produced and numbered from one manufacturing line. To isolate the out-of-specification material, additional samples must be taken from rolls that have roll numbers immediately adjacent to the roll that was sampled and failed. If additional tests pass, the roll that represents the initial failed test and the roll manufactured immediately after that roll (next large roll number) shall be rejected. If one or both of the additional tests fail, then the entire lot shall be rejected or the procedure repeated with two additional tests that bracket a greater number of rolls within the lot.

1.4 Geomembrane Specifications

1.4.1 Materials

The geomembrane materials used for construction shall be in strict accordance with the technical specifications.

1.4.2 Construction

The geomembrane liner shall be constructed as soon as practical after completion and approval of the compacted clay liner or portion thereof. The top of the compacted clay liner will be surveyed to ensure adequate thickness of clay material and proper grades have been achieved. The geomembrane is to cover the cap in accordance with the Contract Drawings.

Areas to receive liner installation should be relatively smooth and even, free of ruts, voids, etc., to the extent required by the Engineer. This shall be accomplished by final dressing of the compacted liner with smooth drum rollers. No vehicles are permitted on final dressed surfaces unless authorized by the Engineer.

No loose soil will be allowed to underlie the geomembrane in anchor trenches. The time schedule for excavation and backfilling of anchor trenches is to be approved by the Engineer so that desiccation of trench soils does not occur prior to backfilling.

Before the geomembrane installation begins, the Resident CQA Engineer shall verify that:

1) A licensed Professional Land Surveyor has verified all lines and grades of the compacted clay liner.

2) A qualified and licensed Professional Engineer has verified that the clay liner surface meets the criteria specified in the project specifications.

3) The clay liner surface to be lined has been rolled, compacted, or hand-worked so as to be free of irregularities, protrusions, loose soil, and abrupt changes in grade.

4) The surface of the clay liner does not contain stones, which may be damaging to the geomembrane.

5) There is no area excessively softened by high water content.

6) There is no area where the clay liner surface contains desiccation cracks, which may damage the geomembrane.

7) The clay liner has sufficient thickness and that all permeability tests have not exceeded a permeability of 1.0×10^{-5} cm/sec.

8) The geomembrane to be deployed has an absolute minimum thickness of 40 mils and passing Quality Control testing, at the frequencies specified in section 1.3.1 of this Appendix can be documented.

The Installer shall certify in writing that the surface on which the geomembrane will be installed is acceptable. The Installer shall give a certificate of acceptance to the Resident CQA Engineer prior to commencement of geomembrane deployment in the area under consideration. The Resident CQA Engineer shall give the Certifying CQA Engineer a copy of this certificate.

After the underlying soil has been accepted by the Installer, it is the Installer's responsibility to indicate to the General Contractor any change in the underlying soil condition that may require repair work. The General Contractor will consult with the Resident CQA Engineer regarding the need for repairs. If the Resident CQA Engineer concurs with the Installer, the General Contractor shall ensure that the underlying soil is repaired.

At any time before or during the geomembrane installation, the Resident CQA Engineer shall indicate to the General Contractor any locations that may not be adequately prepared for the geomembrane.

The Resident CQA Engineer shall verify that the anchor trench is constructed in accordance with the following:

1) The anchor trench has been constructed according to the project plans and specifications.

2) If the anchor trench is excavated in a clay material susceptible to desiccation, the amount of trench open at any time is minimized. The Resident CQA Engineer shall inform the Contractor and Project Engineer of any signs of significant desiccation associated with the anchor trench construction.

3) Rounded corners are provided in the trench so as to avoid sharp bends in the geomembrane.

4) Excessive amounts of loose soil are not allowed to underlie the geomembrane in the anchor trench.

5) The anchor trench is adequately drained to prevent ponding or softening of the adjacent soils while the trench is open.

6) The anchor trench is backfilled and compacted as outlined in the project specifications.

Care shall be taken when backfilling the trenches to prevent any damage to the geosynthetic components. The Resident CQA Engineer shall observe the backfilling operation and advise the

Contractor and Design Engineer of any problems. The Resident CQA Engineer shall document any problems in his daily report.

APPENDIX C

1.0 Field Seaming

1.1.1 Seam Layout

Before installation begins, the Installer shall provide the Resident CQA Engineer and the Design Engineer with a panel layout drawing. This drawing shall present all the proposed seams of the lining system at the facility. The Design Engineer and the Resident CQA Engineer shall review the panel layout drawing and verify that it is consistent with the technical specifications and the Division approved plans. No panels may be seamed until the Design Engineer has provided written approval of the panel layout drawing. In addition, panels not specifically shown on the panel layout drawing may not be used without the Design Engineer's prior approval.

In general, seams should be oriented parallel to the line of maximum slope, thus, oriented along, not across, the slope. In corners and odd-shaped geometric locations, the number of seams should be minimized. No horizontal seam should be less than 10 feet (3.0 meter) from the toe or crest of the slope, or areas of potential stress concentrations, unless otherwise authorized by the Design Engineer.

The Resident CQA Engineer and the CQA monitors shall use a seam numbering system compatible with the panel numbering system.

1.1.2 Accepted Seaming Methods

Approved processes for field seaming are fusion welding and extrusion welding. Proposed alternate processes shall be documented and submitted by the Installer to the Design Engineer for approval. Only apparatuses that have been specifically approved by make and model shall be used. The Contractor shall submit all documentation regarding seaming methods to be used to the Resident CQA Engineer for review.

1.1.2.1 *Fusion Process*

The CQA monitor shall log ambient temperature, seaming apparatus, and geomembrane surface temperatures at appropriate intervals and report any noncompliances to the Resident CQA Engineer.

The Resident CQA Engineer shall verify that:

1. The Installer maintains on-site the number of spare operable seaming apparatuses agreed upon at the pre-construction meeting.

2. Equipment used for seaming is not likely to damage the geomembrane.

3. The electric generator is placed on a smooth base such that no damage occurs to the geomembrane.

4. A smooth insulating plate or fabric is placed beneath the hot welding apparatus after usage such that no damage occurs to the geomembrane.

5. A movable protective layer is used as required by the Installer directly below each overlap of geomembrane that is to be seamed to prevent buildup of moisture between the sheets and to prevent debris from collecting around the pressure rollers.

6. In general, the geomembrane panels are aligned to have an overlap of 4 to 6 inches (100 mm to 150 mm) for fusion welding. In any event, the final overlap shall be sufficient to allow peel tests to be performed on the seam.

7. No solvent or adhesive is used.

8. The geomembrane is protected from damage in heavy traffic areas.

1.1.2.2 *Extrusion Process*

The CQA monitor shall log ambient temperature, seaming apparatus, and geomembrane surface temperatures at appropriate intervals and report any noncompliances to the Design Engineer.

The Resident CQA Engineer shall verify that:

1. The Installer maintains on-site the number of spare operable seaming apparatuses agreed upon at the pre-construction meeting.

2. Equipment used for seaming is not likely to damage the geomembrane.

3. Prior to beginning a seam, the extruder is purged until all heat-degraded extrudate has been removed from the barrel.

4. Clean and dry welding rods or extrudate pellets are used.

5. The electric generator is placed on a smooth base such that no damage occurs to the geomembrane.

6. Grinding is completed no more than one hour prior to seaming.

7. A smooth insulating plate or fabric is placed beneath the hot welding apparatus after usage such that no damage occurs.

8. The geomembrane is protected from damage in heavy traffic areas.

9. Exposed grinding marks adjacent to an extrusion weld shall be minimized. In no instance shall exposed grinding marks extend more than 1/8 inch (6 mm) from the finished seamed area.

10. In general, the geomembrane panels are aligned to have a nominal overlap of 3 inches (75 mm) for extrusion welding. In any event, the final overlap shall be sufficient to allow peel tests to be performed on the seam.

11. No solvent or adhesive is used.

12. The procedure used to temporarily bond adjacent panels together does not damage the geomembrane; in particular, the temperature of hot air at the nozzle of any temporary welding apparatus is controlled such that the geomembrane is not damaged

1.1.3 Seam Preparation

The CQA monitors shall verify that prior to seaming, the seam area is clean and free of moisture, dust, dirt, debris or foreign material of any kind. If seam overlap grinding is required, the CQA monitors must ensure that the process is completed according to the Manufacturer's instruction within one hour of the seaming operation, and in a way that does not damage the geomembrane. The CQA monitors shall also verify that seams are aligned with the fewest number of wrinkles and "fishmouths".

1.1.4 Test Seams

Trial seams shall be made on fragment pieces of geomembrane liner to verify that conditions are adequate for production seaming. Trial seams shall be performed in accordance with section 02623 of the technical specifications.

1.1.5 General Seaming Procedures

During general seaming, the CQA monitors shall ensure the following:

1. Fishmouths or wrinkles at the seam overlaps shall be cut along the ridge of the wrinkle in order to achieve a flat overlap. The cut fishmouths or wrinkles shall be seamed and any portion where the overlap is inadequate shall then be patched with an oval or round patch of the same geomembrane extending a minimum of 6 inches (150 mm) beyond the cut in all directions.

2. If seaming operations are carried out at night, adequate illumination shall be provided.

3. Seaming shall extend to the outside edge of panels placed in the anchor trench.

4. All cross seam tees should be extrusion welded to a minimum distance of 4 inches (100 mm) on each side of the tee.

5. No field seaming shall take place without the Master Seamer being present.

6. A firm substrate may be required to be provided by using a flat board, a conveyor belt, or similar hard surface directly under the seam overlap to achieve proper support.

The Resident CQA Engineer shall verify that the above seaming procedures or any other procedures agreed upon and indicated in the Preconstruction Meeting or construction progress meetings are followed, and shall inform the Design Engineer of any nonconformance.

1.1.6 Seaming Weather Conditions

1.1.6.1 Cold Weather Conditions

To ensure a quality installation, if seaming is conducted when the ambient temperature is below 40°F (5°C), the following conditions shall be met:

1. Geomembrane surface temperatures shall be determined by the Resident CQA Engineer at intervals of at least once per 100 feet (30 meter) of seam length to determine if preheating is required. For extrusion welding, preheating is required if the surface temperature of the geomembrane is below 41°F (5°C).

2. For fusion welding, preheating may be waived by the Design Engineer based on a recommendation from the Resident CQA Engineer, if the Installer demonstrates to the their satisfaction that welds of equivalent quality may be obtained without preheating at the expected temperature of installation.

3. If preheating is required, the CQA monitors shall observe all areas of geomembrane that have been preheated by a hot air device prior to seaming, to ensure that they have not been overheated.

4. Care shall be taken to confirm that the surface temperatures are not lowered below the minimum surface temperatures specified for welding due to winds or other adverse conditions. It may be necessary to provide wind protection for the seam area.

5. The Resident CQA Engineer shall approve all preheating devices prior to use.

6. Additional destructive tests shall be taken at an interval between 250 feet and 500 feet (75 to 150 meter) of seam length, at the discretion of the Resident CQA Engineer.

7. Sheet grinding may be performed before preheating, if applicable.

8. Test seams shall be conducted under the same ambient temperature and preheating conditions as the production seams. Under cold weather conditions, additional trial seams shall be conducted if the ambient temperature drops by more than 10°F from the

initial trial seam test conditions. Such new seams shall be conducted upon completion of seams in progress during temperature drop.

1.1.6.2 Warm Weather Conditions

At ambient temperatures above 104°F, no seaming of the geomembrane shall be permitted unless the Installer can demonstrate to the satisfaction of the Resident CQA Engineer that geomembrane seam quality is not compromised. Test seams shall be conducted under the same ambient temperature conditions as the production seams. At the option of the Resident CQA Engineer, additional destructive tests may be required for any suspect areas.

1.2 Nondestructive Seam Testing

1.2.1 Concept

The Installer shall nondestructively test all field seams over their full length using an air pressure test (for double fusion seams only), a vacuum test or other approved method. Air pressure testing and vacuum testing are described elsewhere respectively. The purpose of nondestructive tests is to check the continuity of seams. It does not provide quantity information on seam strength. Nondestructive testing shall be carried out as the seaming work progresses, not at the completion of all field seaming.

For all seams, the CQA monitors shall:

1. Observe nondestructive testing procedures.

2. Record location, data, test unit number, name of tester, and outcome of all testing.

3. Inform the Installer and Resident CQA Engineer of any required repairs.

Any seams that cannot be nondestructively tested shall be cap-stripped. The cap-stripping operations shall be observed by the Resident CQA Engineer and Installer for uniformity and completeness.

1.2.2 Air Pressure Testing

Air pressure testing is applicable to double fusion welding which produces a double seam with an enclosed space.

1. The Equipment for air pressure testing shall consist of the following:

    a. An air pump (manual or motor driven), equipped with pressure gauge and capable of generating and sustaining a pressure between 25 and 30 psi (160 and 200 kPa) and mounted on a cushion to protect the geomembrane.

b. A rubber hose with fittings and connections.

c. A sharp hollow needle, or other pressure feed device, approved by the Resident CQA Engineer.

2. The following procedures shall be followed:

a. Seal both ends of the seam to be tested.

b. Insert needle or other approved pressure feed device into the air channel created by the fusion weld.

c. Insert a protective cushion between the air pump and the geomembrane.

d. Pressurize the air channel to a pressure of approximately 30 psi (200 Kpa). Close valve, allow 2 minutes for pressure to stabilize, and sustain pressure for at least 5 minutes. Pressure loss over the 5-minute period should not exceed 3psi.

e. If loss of pressure exceeds the maximum permissible pressure differential as outlined in the project specifications or does not stabilize, locate fault area and repair in accordance with Section 1.4.3.

f. Cut opposite end of tested seam area once testing is complete to verify continuity of the air channel. If air does not escape, locate blockage and retest unpressurized area.

g. Remove needle or other approved pressure feed device and grind and weld or patch the hole in the geomembrane.

1.2.3 Vacuum Testing

Vacuum testing is applicable to extrusion welding.

1. The equipment shall consist of the following:

a. A vacuum box assembly consisting of a rigid housing, a transparent viewing window, a soft neoprene gasket attached to the bottom, a porthole or valve assembly, and a vacuum gauge.

b. A pump assembly equipped with a pressure controller and pipe connections.

c. A rubber pressure/vacuum hose with fittings and connections.

d. A soapy solution. (CQA monitors shall ensure solution makes bubbles when air is passed through.)

e. A bucket and wide paintbrush, rag, or other means of applying the soapy solution.

2. The following procedures shall be followed:

a. Wet a strip of geomembrane approximately 12 inches X 48 inches (0.3 m X 1.2 meter) with the soapy solution.

b. Place the box over the wetted area.

c. Close the bleed valve and open the vacuum valve.

d. Ensure that a leak-tight seal is created.

e. Energize the vacuum pump and reduce the applied pressure to approximately 5-psi (10 inches of Hg/35kPa) on the gauge.

f. For a minimum of 10 seconds, apply vacuum with the box placed and maintaining a seal, examine the geomembrane through the viewing window for the presence of soap bubbles.

g. If no bubble appears after 10 seconds, close the vacuum valve and open the bleed valve, move the box over the next adjoining area with a minimum 3 inches (75 mm) overlap, and repeat the process.

h. All areas where soap bubbles appear shall be marked and repaired in accordance with Section 1.4.3.

1.2.4 Test Failure Procedures

The Installer shall complete any required repairs in accordance with Section 1.4.3. For repairs, the CQA monitor shall:

1. Observe the repair and testing of the repair.

2. Mark on the geomembrane that the repair has been made.

3. Document the repair procedures and test results.

1.3 Destructive Seam Testing

1.3.1 Concept

The purpose of destructive tests is to evaluate seam strength. Destructive seam tests shall be performed at selected locations. Seam strength testing shall be done as the seaming work progresses, not at the completion of all field seaming.

1.3.2 Location and Frequency

The Resident CQA Engineer shall select where seam samples will be cut out for laboratory testing. The frequency and locations shall be established as follows:

1. A minimum frequency of one test location per 500 feet (150 meter) of seam length shall be performed by each welding machine. This frequency is to be determined as an average taken throughout the entire facility.

2. Test locations shall be determined during seaming at the discretion of the Resident CQA Engineer or the Design Engineer. Special consideration shall be given to locations where the potential for imperfect welding, such as overheating, contamination, and offset welds exists.

1.3.3 Sampling Procedures

Samples shall be cut by the Installer at locations chosen by the Resident CQA Engineer as the seaming progresses so that laboratory test results are available before the geomembrane is covered by another material. The Resident CQA Engineer shall:

1. Observe sample cutting.

2. Assign a number to each sample, and mark it accordingly.

3. Record sample location on layout drawing.

4. Record reason for taking the sample at this location (e.g., statistical routine, suspicious feature of the geomembrane).

All holes in the geomembrane resulting from destructive seam sampling shall be repaired in accordance with repair procedures described in Section 1.4.3 immediately following receipt of successful test results. The continuity of the new seams in the repaired area shall be tested according to Section 1.2.3. All holes in the geomembrane shall be temporarily patched or repaired in accordance with section 1.4.3 before the end of each workday in order to protect the clay liner from inclement weather.

1.3.4 Sampling Procedure

Destructive sampling shall be performed in accordance with section 02623 of the technical specifications.

1.3.5 Field Testing

Destructive field-testing shall be performed in accordance with section 02623 of the technical specifications.

1.3.6 Destructive Test Failure

Destructive test failures shall be handled in accordance with section 02623 of the technical specifications.

1.4 Defects and Repairs

1.4.1 Identification

All seams and non-seam areas of the geomembrane shall be examined by the CQA monitors for identification of defects, holes, blisters, undispersed raw materials, large wrinkles and any sign of contamination by foreign matter. The geomembrane surface shall be cleaned by the Installer prior to examination if the CQA monitor determines that the amount of dust or mud inhibits examination.

1.4.2 Evaluation

Each suspect location both in seam and non-seam areas shall be nondestructively tested using the methods described in Section 1.2. Each location that fails the nondestructive testing shall be marked by the CQA monitor and repaired by the Installer. Work shall not proceed with any materials that will cover locations that have been repaired until successful nondestructive and/or laboratory tests are obtained.

When seaming of the geomembrane is completed, and prior to placing overlying materials, the Resident CQA Engineer shall indicate to the General Contractor any large wrinkles that should be cut and reseamed by the Installer. The number of wrinkles to be repaired should be kept to an absolute minimum. Therefore, wrinkles should be located during the coldest part of the installation period, while keeping in mind the forecasted weather to which the undercover geomembrane may be exposed. Wrinkles are considered to be large when the geomembrane can be folded over onto itself, which is generally a wrinkle that extends 12 inches (0.3 meter) from the subgrade. Seams produced while repairing wrinkles shall be nondestructively tested.

When placing overlying material on the geomembrane, every effort must be made to minimize wrinkle development. If possible, cover should be placed during the coolest weather. In

addition, small wrinkles should be isolated and covered as quickly as possible to prevent their growth. The placement of cover materials shall be observed by McGill Associates or a CQA monitor to ensure that wrinkle formation is minimized and that, in all cases, the geomembrane is not folded over on itself.

1.4.3 Repair Procedures

Any portion of the geomembrane exhibiting a flaw, or failing a destructive or nondestructive test, shall be repaired. Several procedures exist for the repair of these areas. The final decision as to the appropriate repair procedure shall be determined by the Design Engineer and the Resident CQA Engineer.

1. The repair procedures available include:

    a. Patching, used to repair holes, tears, undispersed raw materials, and contamination by foreign matter.

    b. Spot welding used to repair pinholes, or other minor, localized flaws.

    c. Capping, used to repair large lengths of failed seams.

    d. Removing bad seam and replacing with a strip of new material welded into place.

    NOTE: Extrusion welding the flap to repair inadequate fusion seams which have an exposed edge shall not be allowed under any circumstances.

2. For any repair method, the following provisions shall be satisfied:

    a. Surfaces of the geomembrane that are to be repaired using extrusion methods shall be ground no more than one hour prior to the repair.

    b. All surfaces shall be clean and dry at the time of the repair.

    c. All seaming equipment used in repairing procedures shall meet the requirements of this SSCQAP.

    d. Patches or caps shall extend at least 6 inches (150 mm) beyond the edge of the defect, and all corners of patches shall be rounded with a radius of approximately 3 inches (75 mm).

1.4.4 Repair Verification

The CQA monitors shall observe all nondestructive testing of repairs and shall record the number of each repair, date and test outcome. Each repair shall be nondestructively tested using the

method described in Section 1.2 as appropriate. Repairs that pass the nondestructive test shall be taken as an indication of an adequate repair. Repairs more than 500 feet (50 meter) long require destructive test sampling. Failed tests require that the repair shall be redone and re-tested until a passing test results.

1.5 Geomembrane Protection

The quality assurance procedures indicated in this Section are intended only to assure that the installation of adjacent materials does not damage the geomembrane. The quality assurance of the adjacent materials themselves is covered in separate Sections of this manual.

1.5.1 Soils

1. Placement of soil on the geomembrane shall not proceed at an ambient temperature below 32 degrees F (0 degrees C) nor above 104 degrees F (40 degrees C) unless otherwise specified.

2. Placement of soil on the geomembrane should be done during the coolest part of the day to minimize the development of wrinkles in the geomembrane.

3. Equipment used for placing soil shall not be driven directly on the geomembrane.

4. A minimum thickness of 18 inches of soil shall be maintained between the geocomposite and a light dozer, ground pressure of 5 psi (35 kPa) or lighter, and the geomembrane. Trucks shall have a minimum thickness of 2 feet between them and the geomembrane.

5. In any areas traversed by heavy construction, any vehicles other than low ground pressure vehicles shall be approved by the Design Engineer, and the soil layer shall have a minimum thickness of 3 feet (0.9 meter). This requirement may be waived if provisions are made to protect the geomembrane through an engineered design approved by the Design Engineer. Drivers shall proceed with caution when traveling on the overlying soil and prevent spinning of tires or sharp turns.

6. Methane gas collection pipes shall not be crossed with construction equipment without the full two (2) feet of soil in place. In areas where trucks must repeatedly cross the methane gas piping, a temporary soil road shall be build to bridge over the pipe and maintain a minimum thickness of three (3) feet.

7. Care shall be taken to avoid creating wrinkles in the geomembrane during placement of the soil layer.

1.5.2 Appurtenances

The appurtenances shall be constructed in accordance with the technical specifications and the Resident CQA Engineer shall certify the following:

1. Installation of the geomembrane, equipment, and appurtenant areas has been performed properly, and connections of geomembrane to appurtenances have been made according to project specifications.

2. Extreme care is taken while welding around appurtenances since nondestructive testing will be difficult in these areas.

3. The geomembrane has not been visibly damaged while making connections to appurtenances.

4. The Resident CQA Engineer or his representative shall be present at all times when the Installer is welding geomembrane to appurtenant structures.

The Resident CQA Engineer shall inform the Design Engineer in writing if the above conditions are not fulfilled.

APPENDIX D

1.0 Geotextile

1.1 Definition and Applicability

Geotextile are used in protection and filtering applications in lining systems. This Section does not describe procedures for other applications such as erosion control or reinforcement. This Section is applicable to nonwoven geotextiles made of polyester of polypropylene and not applicable to geotextiles made of other materials or woven geotextiles.

1.2 Manufacturing Plant Inspection

The Owner or an appropriate representative may conduct a periodic inspection of the Manufacturer's plant. In addition, the Design Engineer or his designated representative may visit the manufacturing plant for a project-specific inspection if deemed necessary. If possible, the project-specific inspection shall be prior to or during the manufacturing of the geotextile rolls for that particular project. The purpose of the plant inspections is to review the manufacturing process and quality control procedures.

The manufacturing plant inspection shall include:

1. Verification that properties of the geotextile guaranteed by the Manufacturer are met and meet the project specifications.

2. Verification that the measurement of properties by the manufacturer is properly documented and test methods used is acceptable.

3. Inspection of the rolls and verification that they are free of imperfections or any sign of contamination by foreign matter.

4. Review of packaging, handling, storage, and transportation procedures and verification that these procedures will not damage the geotextile.

5. Verification that roll packages have a label indicating the name of the manufacturer, type of geotextile, roll number and roll dimensions.

6. Verification that the geotextiles are inspected continuously for the presence of needles using a metal detector.

A report describing the inspection will be retained by the Owner for periodic inspections and by the Design Engineer for project-specific inspections.

1.3 Quality Control Documentation

Prior to the installation of any geotextile, the Manufacturer or Installer shall provide the Design Engineer with the following information:

1.4 Roll Dimensions

The Resident CQA Engineer shall review these documents and shall report any discrepancies with the above requirements to the Design Engineer. The Certifying CQA Engineer shall verify that:

1. Property values certified by the Manufacturer meet all of its guaranteed specifications.

2. Measurements of properties by the Manufacturer are properly documented and that the test methods used are acceptable.

3. Quality control certificates have been provided at the specified frequency for all rolls, and that each certificate identifies the rolls related to it.

4. Roll packages are appropriately labeled.

5. Certified minimum roll properties meet the project specifications.

6. Project specifications and a copy of the QAP were submitted by the Design Engineer to the Installer.

1.5 Geotextile Deployment

During shipment and storage, the geotextile shall be protected from ultraviolet light exposure, moisture, mud, dirt, dust, puncture, cutting, or any other damaging or deleterious conditions. Geotextile rolls shall be shipped and stored in relatively opaque and watertight wrappings. Wrapping shall not be removed until shortly before deployment.

The CQA monitors shall observe rolls upon delivery at the site. Any apparently damaged or improperly wrapped rolls shall be reported to the Resident CQA Engineer.

The installer shall ensure that geotextiles are not damaged during handling. The geotextile shall be deployed as described below:

1. On slopes, the geotextile shall be securely anchored and then rolled down the slope in such a manner as to continually keep the geotextile sheet in tension.

2. In the presence of wind, all geotextiles shall be weighted with sandbags or the equivalent. Such sand bags shall be installed during deployment and shall remain until replaced with cover material.

3. Geotextiles shall be cut using a geotextile cutter (hook blade) only. If in place, special care shall be taken to protect other materials from damage that could be caused by the cutting of the geotextile.

4. The Installer shall take any necessary precautions to prevent damage to underlying layers during placement of the geotextile.

5. During placement of geotextile, care shall be taken not to entrap, in or beneath the geotextile, stones, excessive dust, or moisture that could damage the geomembrane, cause clogging of drains or filters, or hamper subsequent seaming.

6. A visual examination of the geotextile shall be carried out over the entire surface, after installation, to ensure that no potentially harmful foreign objects, such as needles, are present.

The Resident CQA Engineer shall note any noncompliance and report it to the Design Engineer.

1.6 Geotextile Material Specification and Seaming Procedures

Non-woven Filter Geotextile shall be as indicated below:

Non-woven Geotextile

The geotextile used shall be ultraviolet stabilized 1) a non-woven, needlepunched, continuous filament polyester material or, 2) a non-woven, needlepunched continuous filament polypropylene material or, 3) a non-woven, needlepunched staple fiber polypropylene material.

A 6 oz. geotextile will be placed between the geomembrane and the vegetative supportive soil layer via installation of an integrated double-sided drainage net (geocomposite).

The minimum angle of friction between the 6 oz. geotextile geocomposite and the textured geomembrane shall be twenty-four (24) degrees.

The non-woven material shall meet or exceed the following criteria using Minimum Average Values:

		6 oz. Geotextile
Grab Tensile	ASTM D4632	170 lbs.
Puncture Strength	ASTM D4833	90 lbs.
Fabric Weight		6.0 oz.
Apparent Opening Size (AOS)	ASTM D4751	0.212 mm (70 Sieve max.)

Seaming

The geotextile for the cap shall be installed as follows:

1. Panels of geotextile shall be 6' and overlapped continuously sewn along the entire length of the seams.

1.7 Geotextile Protection

All soil materials located on top of a geotextile shall be deployed in such a manner as to ensure:

1. The geotextile and underlying lining materials are not damaged.
2. Minimal slippage of the geotextile on underlying layers occurs.
3. No excess tensile stresses occur in the geotextile.

All noncompliance with these guidelines or the project specifications shall be noted by the Geosynthetic QAC and reported to the Design Engineer.

2.0 Geonets

2.1 Definition and Applicability

Geonets are geosynthetic nets used as a drainage medium in lining systems. This Section is applicable to geonets made of high density polyethylene (HDPE), including "foamed" HDPE products but is not applicable to geonets made of other polymers.

2.2 Manufacturing Plant Inspection

The Owner or appropriate representative may conduct a periodic inspection of the Manufacturer's plant. In addition, the Design Engineer, or his designated representative may visit the manufacturing plant for a project-specific inspection if deemed necessary. If possible, the project-specific inspection shall be prior to or during the manufacturing of the geonet rolls for that particular project. The purpose of the inspection is to review the manufacturing process and quality control procedures.

The manufacturing plant inspection shall include:

Verification that properties guaranteed by the Manufacturer are met and meet all project specifications.

1. Verification that the measurement of properties by the Manufacturer is properly documented and test methods used are acceptable.

2. Spot inspection of the rolls and verification that they are free of imperfections or any sign of contamination by foreign matter.

3. Review of packaging, handling, storage, and transportation procedures and verification that these procedures will not damage the geonet.

4. Verifications that roll packages have a label indicating the name of the manufacturer, type of geonet, roll number and roll dimensions.

A report describing the inspection will be retained by the Owner for periodic inspections and by the Design Engineer for project-specific inspections.

2.3 Quality Control Documentation

Prior to the installation of any geonet, the Manufacturer or Installer shall provide the Resident CQA Engineer with the following information:

1. The origin (supplier's name and production plant) and identification (brand name and number) of the resin.

2. Copies of dated quality control certificates issued by the resin supplier.

3. Quality control certificates have been provided at the specified frequency for all rolls, and that each certificate identifies the rolls related to it.

4. Roll packages are appropriately labeled.

5. Certified minimum properties meet the project specifications.

6. Project specifications and a copy of the QAP were submitted by Design Engineer to the Installer.

2.4 Geonet Installation

1. On slopes, the geonet shall be secured and rolled down the slope in such a manner as to continually keep the geonet sheet in tension. If necessary, the geonet shall be positioned by hand after being unrolled to minimize wrinkles.

2. In the presence of wind, all geonet shall be weighted with sandbags or the equivalent. Such sandbags shall be installed during deployment and shall remain until replaced with cover material.

3. Unless otherwise specified, geonet shall not be welded to geomembrane.

4. Geonet shall only be cut using scissors or other cutting tools approved by the Resident CQA Engineer that will not damage the underlying geosynthetics. Care shall be taken not to leave tools in the geonet.

5. The Installer shall take any necessary precautions to prevent damage to underlying layers during placement of the geonet.

6. During placement of geonet, care shall be taken not to entrap dirt, excessive dust, or fugitive bentonite clay in the geonet that could cause clogging of the drainage system, and/or stones that could damage the adjacent geomembrane. If dirt or excessive dust is entrapped in the geonet, it should be cleaned prior to placement of the next material on top of it. In this regard, care shall be taken with the handling of sandbags, to prevent puncturing the sandbag.

The Resident CQA Engineer shall note any noncompliance and report it to the Design Engineer.

2.5 Seams and Overlaps

At a minimum, the following requirements for joining the adjacent geonet shall be met:

1. Adjacent rolls shall be overlapped by at least 4 inch (100 mm).

2. The geonet overlaps shall be tied with plastic fasteners. Tying devices shall be white or yellow for easy inspection. Metallic devices are not allowed.

3. Tying shall be every 5 feet (1.5 meters) along the length at the adjacent rolls, every 6 inches (0.25 meter) in the anchor trench and every 6 in (0.15 meter) along end-to-end seams.

The Resident CQA Engineer shall observe any repair and report any noncompliance with the above requirements in writing to the Design Engineer.

3.0 Geocomposites

3.1 Definition and Applicability

Geocomposites are geosynthetic nets with geotextile heat bonded to the surface. The geocomposite can be single-sided or double-sided depending on the application. They are used as drainage medium in lining systems, where the properties of the geotextile can either serve as a filter media from clogging the geonet or increase stability of the lining system. This Section is applicable to geocomposites where the geonet portion is made of high density polyethylene (HDPE), including "foamed" HDPE products but is not applicable to geocomposites where the geonet is made of other polymers.

3.2 Manufacturing Plant Inspection

The Owner or appropriate representative may conduct a periodic inspection of the Manufacturer's plant. In addition, the Design Engineer, or his designated representative may visit the manufacturing plant for a project-specific inspection if deemed necessary. If possible, the project-specific inspection shall be prior to or during the manufacturing of the geocomposite rolls for that particular project. The purpose of the inspection is to review the manufacturing process and quality control procedures.

The manufacturing plant inspection shall include:

Verification that properties guaranteed by the Manufacturer is met and meets all project specifications.

1. Verification that the measurement of properties by the Manufacturer is properly documented and test methods used is acceptable.

2. Spot inspection of the rolls and verification that they are free of imperfections or any sign of contamination by foreign matter.

3. Review of packaging, handling, storage, and transportation procedures and verification that these procedures will not damage the geocomposite.

4. Verifications that roll packages have a label indicating the name of the manufacturer, type of geocomposite, roll number and roll dimensions.

A report describing the inspection will be retained by the Owner for periodic inspections and by the Design Engineer for project-specific inspections.

3.3 Production

The geocomposite shall be manufactured by heat bonding the geotextile to the HDPE drainage net on one or both sides. No burn through geotextiles shall be permitted. No glue or adhesive shall be permitted.

The geonet portion of the geocomposite shall be manufactured by extruding two sets of strands to form a three (3) dimensional structure to provide planar water flow.

3.4 Quality Control Documentation

Prior to the installation of any geocomposite, the Manufacturer or Installer shall provide the Resident CQA Engineer with the following information:

1. The origin (supplier's name and production plant) and identification (brand name and number) of the resin used for geonet.

2. Copies of dated quality control certificates issued by the geonet resin supplier.

3. Quality control certificates have been provided at the specified frequency for all rolls, and that each certificate identifies the rolls related to it.

4. Roll packages are appropriately labeled.

5. Certified minimum properties meet the project specifications.

6. Project specifications and a copy of the QAP were submitted by Design Engineer to the Installer.

At a minimum, the geotextile used to produce the geocomposite shall be tested in accordance with section 1.0. The geonet used to produce the geocomposite shall be tested in accordance with section 2.0. The bond between the geotextile and the HDPE drainage net shall be tested at a minimum rate of one (1) test per 25,000 square feet of geocomposite produced. The bond shall exhibit a minimum average peel strength of 1 lbs per inch as per GRI GC-7.

3.5 Geocomposite Installation

1. On slopes, the geocomposite shall be secured and rolled down the slope in such a manner as to continually keep the geocomposite sheet in tension. If necessary, the geocomposite shall be positioned by hand after being unrolled to minimize wrinkles.

2. In the presence of wind, all geocomposite shall be weighted with sandbags or the equivalent. Such sandbags shall be installed during deployment and shall remain until replaced with cover material.

3. Unless otherwise specified, geocomposite shall not be welded to geomembrane.

4. Geocomposite shall only be cut using scissors or other cutting tools approved by the Resident CQA Engineer that will not damage the underlying geosynthetics. Care shall be taken not to leave tools in the geocomposite.

5. The Installer shall take any necessary precautions to prevent damage to underlying layers during placement of the geocomposite.

6. During placement of geocomposite, care shall be taken not to entrap dirt, excessive dust, or fugitive bentonite clay in the geocomposite that could cause clogging of the drainage system, and/or stones that could damage the adjacent geomembrane. If dirt or excessive dust is entrapped in the geocomposite, it should be cleaned prior to placement of the next material on top of it. In this regard, care shall be taken with the handling of sandbags, to prevent puncturing the sandbag.

The Resident CQA Engineer shall note any noncompliance and report it to the Design Engineer.

3.6 Seams and Overlaps

At a minimum, the following requirements for joining the adjacent geocomposite shall be met:

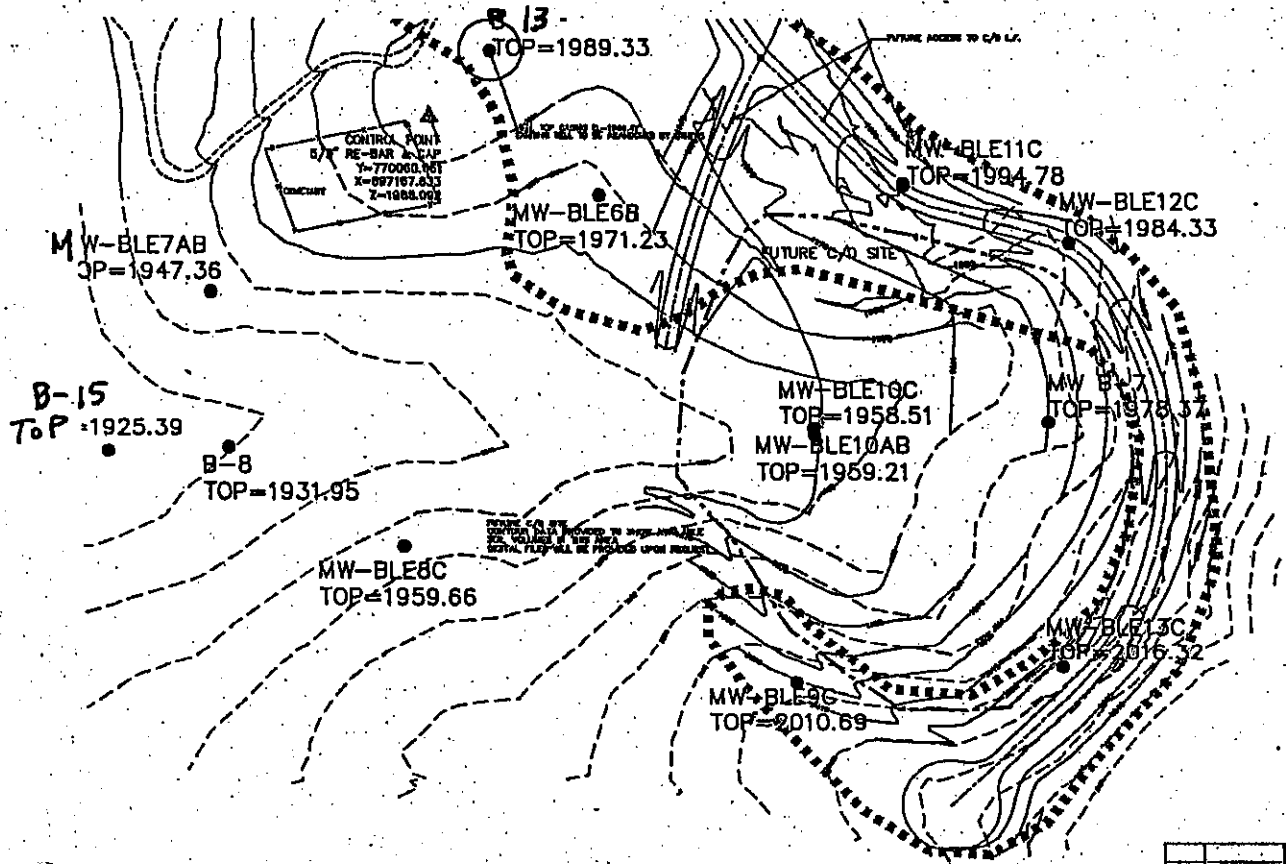
1. Adjacent rolls shall be overlapped by at least 4 inches (100 mm).
2. The geocomposite overlaps shall be tied with plastic fasteners. Tying devices shall be white or yellow for easy inspection. Metallic devices are not allowed.
3. Tying shall be every 5 feet (1.5 meters) along the length at the adjacent rolls, every 6 inches (0.25 meter) in the anchor trench and every 6 in (0.15 meter) along end-to-end seams.
4. Any areas where the geotextile portion of the geocomposite was damaged for the purpose of tying shall be covered by an extra geotextile prior to backfilling. The geotextile used to patch the geocomposite can be thermally bonded to the geotextile on the geocomposite.

The Resident CQA Engineer shall observe any repair and report any noncompliance with the above requirements in writing to the Design Engineer.

04302\ cqaplan.doc

APPENDIX 2

PROPOSED C&D BORING LOGS AND MSW BASE LINER CQA DATA



GAS VENT #	NORTHING	EASTING
GV 1	770,605	896,912
GV 2	770,607	896,975
GV 3	770,608	897,065
GV 4	770,608	897,169
GV 5	770,604	897,251
GV 6	770,604	897,358
GV 7	770,461	897,283
GV 8	770,431	897,159
GV 9	770,454	897,039
GV 10	770,498	896,955
GV 11	770,705	896,867
GV 12	770,759	896,996
GV 13	770,735	897,155
GV 14	770,735	897,285

1"=200'

FOR CONSTRUCTION

1	7/22/05	DP	ADDENDUM #1 - ADDED BORINGS INF.

CLOSURE

MADISON COUNTY

JOB NO.: 04302
DATE: JULY 2005
SCALE: 1" = 80'
DESIGNED BY: DAP
CADD BY: DAP
DESIGN REVIEW: ____
CONST. REVIEW: ____

OVERALL SITE PLAN

SHEET
C2

BLE INC.

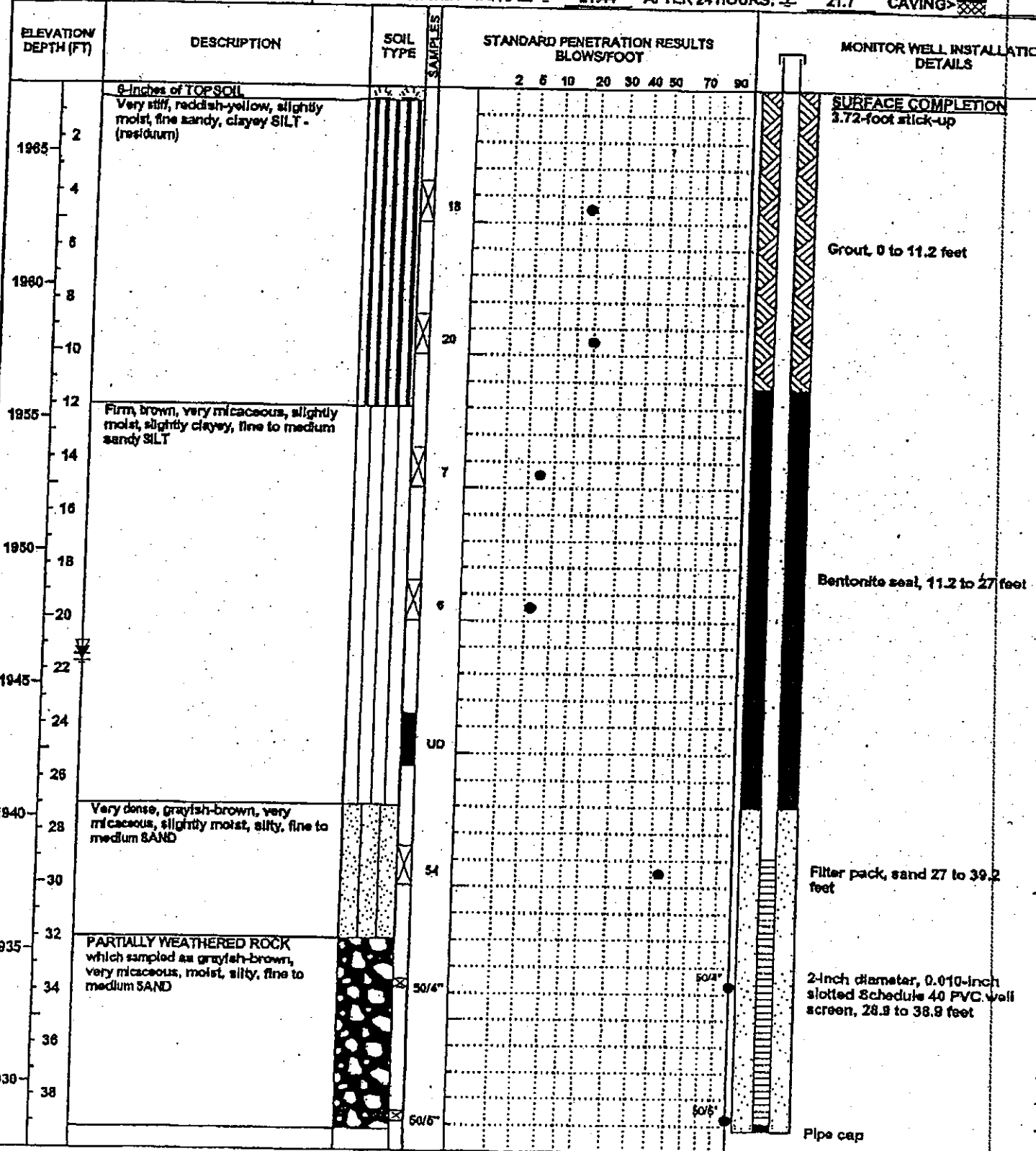
BUNNELL-LAMMONS ENGINEERING, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

PIEZOMETER NO. BLE-6B

PROJECT: Madison County C & D Landfill
CLIENT: McGill/Madison County
LOCATION: Madison County, North Carolina
DRILLER: BLE, Inc., J. Gorman
DRILLING METHOD: CME 750 ATV Hollow stem auger
DEPTH TO - WATER> INITIAL: 21.44 AFTER 24 HOURS: 21.7 CAVING>

PROJECT NO.: J04-2225-04
START: 10-26-04 END: 10-26-04
ELEVATION: 1967.51
LOGGED BY: M. Preddy

ELEVATION/ DEPTH (FT)	DESCRIPTION
	6-inches of TOPSOIL
	Very stiff, reddish-yellow, slightly moist, fine sandy, clayey SILT - (residuum)
	Firm, brown, very micaceous, slightly moist, slightly clayey, fine to medium sandy SILT
	Very dense, grayish-brown, very micaceous, slightly moist, silty, fine to medium SAND
	PARTIALLY WEATHERED ROCK which sampled as grayish-brown, very micaceous, moist, silty, fine to medium SAND



OLD GEOT WELL 2225-04.GPJ 7/20/05

BLE INC.

BUNNELL-LAMMONS ENGINEERING, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

PIEZOMETER NO. BLE-6B

PROJECT: Madison County C & D Landfill
PROJECT NO.: J04-2225-04
CLIENT: McGill/Madison County
START: 10-26-04 END: 10-26-04
LOCATION: Madison County, North Carolina
ELEVATION: 1967.51
DRILLER: BLE, Inc., J. Gorman
LOGGED BY: M. Preddy
DRILLING METHOD: CME 750 ATV Hollow stem auger
DEPTH TO - WATER> INITIAL: 21.44 AFTER 24 HOURS: 21.7 CAVING>

ELEVATION/ DEPTH (FT)	DESCRIPTION	SOIL TYPE	SAMPLES	STANDARD PENETRATION RESULTS BLOWS/FOOT (2 5 10 20 30 40 50 70 90)	MONITOR WELL INSTALLATION DETAILS
1925, 42, 44, 46, 1920, 48, 50, 52, 1915, 54, 56, 1910, 58, 60, 62, 1905, 64, 66, 1900, 68, 70, 72, 1895, 74, 76, 1890, 78	Auger refusal at 39.2 feet. Ground water encountered at 21.44 feet at time of drilling and at 21.7 feet after 24 hours.				Total well depth, 39.2 feet

20/05
OLD GEOT WELL 2225-04

BLE INC.

BUNNELL-LAMMONS ENGINEERING, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

PIEZOMETER NO. BLE-7AB

PROJECT: Madison County C & D Landfill — PROJECT NO.: J04-2225-04
CLIENT: McGill/Madison County — START: 10-27-04 END: 10-2
LOCATION: Madison County, North Carolina — ELEVATION: 1944.17
DRILLER: BLE, Inc., J. Gorman — LOGGED BY: M. Preddy
DRILLING METHOD: CME 750 ATV Hollow stem auger
DEPTH TO - WATER> INITIAL: 22.78 AFTER 24 HOURS: 22.55 CAVING>

ELEVATION/ DEPTH (FT)	DESCRIPTION	SOIL TYPE	SAMPLES	STANDARD PENETRATION RESULTS BLOWS/FOOT (2 5 10 20 30 40 50 70 90)	MONITOR WELL INSTALLATION DETAILS
	6-inches of TOPSOIL				SURFACE COMPLETION 3.19-foot stick-up
1940 (2, 4, 6)	Firm, yellowish-red, slightly moist, fine sandy, clayey SILT - (residuum)		8		
1935 (8, 10, 12)	Firm, reddish-brown, slightly moist, very micaceous, slightly clayey, fine sandy SILT		UD		Grout, 0 to 16.95 feet
1930 (14, 16)			5		
1925 (18, 20)	Firm, reddish-brown, slightly moist, very micaceous, slightly clayey, fine sandy SILT with black slicken-sided fracture surfaces		7		Bentonite seal, 16.95 to 19.2 feet
1920 (22, 24, 26, 28)	Firm to very dense, olive and yellowish-brown, slightly moist, micaceous, silty, fine to coarse SAND with gravel size rock fragments		19		Filter pack, sand 19.2 to 31.05 feet; 2-inch diameter, 0.010-inch slotted Schedule 40 PVC well screen, 20.75 to 30.75 feet
1915 (30, 32)			64		Pipe cap
1910 (34, 36, 38)	Auger refusal at 31.05 feet. Ground water encountered at 22.78 feet at time of drilling and at 22.55 feet after 24 hours.				Total well depth, 31.05 feet
1905					

OLD GEOT WELL 2225-04.GPJ 7/20/05

BLE INC.

BUNNELL-LAMMONS ENGINEERING, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

PIEZOMETER NO. BLE-8B

PROJECT: Madison County C & D Landfill
PROJECT NO.: J04-2225-04
CLIENT: McGill/Madison County
START: 10-27-04 END: 10-27-04
LOCATION: Madison County, North Carolina
ELEVATION: 1956.14
DRILLER: BLE, Inc., J. Gorman
LOGGED BY: M. Preddy
DRILLING METHOD: CME 750 ATV Hollow stem auger
DEPTH TO - WATER> INITIAL: ▽ 20.7 AFTER 24 HOURS: ▼ 20.5 CAVING>

ELEVATION/ DEPTH (FT)	DESCRIPTION	SOIL TYPE	SAMPLES	STANDARD PENETRATION RESULTS BLOWS/FOOT (2 5 10 20 30 40 50 70 90)	MONITOR WELL INSTALLATION DETAILS
	6-inches of TOPSOIL				SURFACE COMPLETION 3.52-foot stick-up
1955 / 2	Soft, reddish-brown, moist, slightly micaceous, clayey SILT - (residuum)				
4			X	4	
1950 / 6					
8	Stiff, yellowish-brown, slightly moist, slightly micaceous, clayey, fine sandy SILT		X	9	
10					Grout, 0 to 22.64 feet
1945 / 12					
14			X	12	
1940 / 16					
18	Loose, grayish-brown, slightly moist, very micaceous, silty, fine to medium SAND		X	10	
20 ▽					
1935 / 22	Firm to very firm, grayish-brown, moist, very micaceous, silty, fine to coarse SAND				
24			X	18	Bentonite seal, 22.64 to 25.5 feet
1930 / 26					Filter pack, sand 25.5 to 40 feet
28			X	26	
30					
1925 / 32	PARTIALLY WEATHERED ROCK which sampled as grayish-brown, moist, silty, fine to coarse SAND		X	50/5.5"	2-inch diameter, 0.010-inch slotted Schedule 40 PVC well screen, 28.6 to 38.6 feet
34					
1920 / 36					
38			X	50/2"	Pipe cap

PIEZOMETER NO. BLE-8B
Sheet 1 of 2

OLD GEOT WELL 2225-04 .005

BLE INC.

BUNNELL-LAMMONS ENGINEERING, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

PIEZOMETER NO. BLE-8B

PROJECT: Madison County C & D Landfill — PROJECT NO.: J04-2225-04
CLIENT: McGill/Madison County — START: 10-27-04 END: 10-2
LOCATION: Madison County, North Carolina — ELEVATION: 1956.14
DRILLER: BLE, Inc., J. Gorman — LOGGED BY: M. Preddy
DRILLING METHOD: CME 750 ATV Hollow stem auger
DEPTH TO - WATER> INITIAL: ▽ 20.7 AFTER 24 HOURS: ▼ 20.5 CAVING>

ELEVATION/ DEPTH (FT)	DESCRIPTION	SOIL TYPE	SAMPLES	STANDARD PENETRATION RESULTS BLOWS/FOOT (2 5 10 20 30 40 50 70 90)	MONITOR WELL INSTALLATION DETAILS
1915 / 42	Boring terminated at 40 feet. Ground water encountered at 20.7 feet at time of drilling and at 20.5 feet after 24 hours.				Total well depth, 38.9 feet
44					
1910 / 46					
48					
50					
1905 / 52					
54					
1900 / 56					
58					
60					
1895 / 62					
64					
1890 / 66					
68					
70					
1885 / 72					
74					
1880 / 76					
78					

BLE INC.

BUNNELL-LAMMONS ENGINEERING, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

PIEZOMETER NO. BLE-9C

PROJECT: Madison County C & D Landfill — PROJECT NO.: J04-2225-04
CLIENT: McGill/Madison County — START: 10-28-04 END: 11-11-04
LOCATION: Madison County, North Carolina — ELEVATION: 2007.43
DRILLER: BLE, Inc., J. Gorman — LOGGED BY: M. Preddy
DRILLING METHOD: CME 750 ATV Hollow stem auger
DEPTH TO - WATER> INITIAL: ▽ 45.2 AFTER 24 HOURS: ▼ CAVING>

ELEVATION/ DEPTH (FT)	DESCRIPTION	SAMPLES
2005 / 2	Firm, reddish-brown, moist, slightly micaceous, clayey SILT - (residuum) (Bag sample taken from 1 to 10 feet)	
4		5
6		
2000 / 8		
10		5
1995 / 12	Stiff, brown, slightly moist, micaceous, slightly clayey, fine sandy SILT	
14		9
16		
1990 / 18	Firm, brown, slightly moist, very micaceous, silty, fine to medium SAND	
20		UD
1985 / 22	Firm, olive and reddish-brown, moist, micaceous, clayey, silty, fine to medium SAND	
24		19
26		
1980 / 28	Dense, gray and brown, slightly moist, micaceous, silty, fine to coarse SAND with gravel	
30		45
1975 / 32	no recovery	
34		50/2"
36	Moderately hard, moderately weathered, gray and white, coarse grained amphibole GNEISS; with very close to closely spaced, horizontal to moderately dipping and widely spaced steeply dipping, iron-stained fractures; and steeply dipping well-developed foliation	
970 / 38		R-1

STANDARD PENETRATION RESULTS BLOWS/FOOT: 2 5 10 20 30 40 50 70 90

MONITOR WELL INSTALLATION DETAILS

SURFACE COMPLETION
3.26-foot stick-up

Bentonite seal, 0 to 42.4 feet

PIEZOMETER NO. BLE-9C
Sheet 1 of 2

BLE INC.

BUNNELL-LAMMONS ENGINEERING, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

PIEZOMETER NO. BLE-9C

PROJECT: Madison County C & D Landfill
PROJECT NO.: J04-2225-04
CLIENT: McGill/Madison County
START: 10-28-04 END: 11-11
LOCATION: Madison County, North Carolina
ELEVATION: 2007.43
DRILLER: BLE, Inc., J. Gorman
LOGGED BY: M. Freddy
DRILLING METHOD: CME 750 ATV Hollow stem auger
DEPTH TO - WATER> INITIAL: ▽ 45.2 AFTER 24 HOURS: ▼ CAVING>

ELEVATION/ DEPTH (FT)	DESCRIPTION	SOIL TYPE	SAMPLES	STANDARD PENETRATION RESULTS BLOWS/FOOT (2 5 10 20 30 40 50 70 90)	MONITOR WELL INSTALLATION DETAILS
1965 – 42, 44, 46, 1960 – 48, 50	Moderately hard, moderately weathered, gray and white, coarse grained amphibole GNEISS; with very close to closely spaced, horizontal to moderately dipping and widely spaced steeply dipping, iron-stained fractures; and steeply dipping well-developed foliation R-1 recovery = 95%, RQD = 39 R-2 recovery = 88%, RQD = 36 R-3 recovery = 78%, RQD = 0		R-2, R-3		Filter pack, sand 42.4 to 54.9 feet 1-inch diameter, 0.010-inch slotted Schedule 40 PVC well screen, 44.9 to 54.9 feet
1955 – 52, 54	Very hard, fresh, gray and white, coarse-grained amphibole GNEISS with widely spaced horizontal and steeply dipping iron-stained fractures; and steeply dipping well-developed foliation R-4 recovery = 100%, RQD = 76		R-4		
1950 – 56, 58, 60, 1945 – 62, 64, 66, 1940 – 68, 70, 72, 1935 – 74, 76, 1930 – 78	Auger refusal at 35.0 feet. Ground water encountered at 45.2 feet at time of drilling.				Total well depth, 54.9 feet Core hole diameter, 3-inches

BLE INC.

BUNNELL-LAMMONS ENGINEERING, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

PIEZOMETER NO. BLE-10AB

PROJECT: Madison County C & D Landfill
PROJECT NO.: J04-2225-04
CLIENT: McGill/Madison County
START: 11-3-04 END: 11-3-04
LOCATION: Madison County, North Carolina
ELEVATION: 1955.21
DRILLER: BLE, Inc., J. Gorman
LOGGED BY: M. Preddy
DRILLING METHOD: CME 750 ATV Hollow stem auger
DEPTH TO - WATER> INITIAL: 5.63 AFTER 24 HOURS: 4.3 CAVING>

ELEVATION/ DEPTH (FT)	DESCRIPTION	SOIL TYPE	SAMPLES	STANDARD PENETRATION RESULTS BLOWS/FOOT (2 5 10 20 30 40 50 70 90)	MONITOR WELL INSTALLATION DETAILS
1955	Firm, brown, moist, silty CLAY - (alluvium)				SURFACE COMPLETION 4.0-foot stick-up
2					
4			6		Bentonite seal, 0 to 9.1 feet
1950 6					
8	Very stiff, grayish-green, moist, micaceous, fine sandy, silty CLAY with quartz gravel				
1945 10			22		Filter pack, sand 9.1 to 21.3 feet
12	Stiff, yellowish-red, slightly moist, micaceous, fine sandy, clayey SILT - (residuum)				
14			10		
1940 16					2-inch diameter, 0.010-inch slotted Schedule 40 PVC well screen, 11 to 21 feet
18	PARTIALLY WEATHERED ROCK which sampled as dark gray, very moist, micaceous, clayey, silty, fine to coarse SAND with gravel		50/4"	50/4"	
1935 20					Pipe cap
22	Auger refusal at 21.3 feet. Ground water encountered at 5.63 feet at time of drilling and at 4.3 feet after 24 hours.				Total well depth, 21.3 feet
24					
1930 26					
28					
1925 30					
32					
34					
1920 36					
38					

PJ 7/20/05
OLD GEOT WELL

BLE INC.

BUNNELL-LAMMONS ENGINEERING, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

PIEZOMETER NO. BLE-10C

PROJECT: Madison County C & D Landfill — PROJECT NO.: J04-2225-04
CLIENT: McGill/Madison County — START: 11-8-04 END: 11-8
LOCATION: Madison County, North Carolina — ELEVATION: 1955.27
DRILLER: BLE, Inc., J. Gorman — LOGGED BY: M. Preddy
DRILLING METHOD: CME 750 ATV Hollow stem auger
DEPTH TO - WATER> INITIAL: ▽ 3.25 AFTER 24 HOURS: ▼ 4.25 CAVING>

ELEVATION/ DEPTH (FT)	DESCRIPTION	SOIL TYPE	SAMPLES	STANDARD PENETRATION RESULTS BLOWS/FOOT (2 5 10 20 30 40 50 70 90)	MONITOR WELL INSTALLATION DETAILS
1955	Firm, brown, moist, silty CLAY - (alluvium)				SURFACE COMPLETION 3.24-foot stick-up
2					
4			6		
1950 6					
8	Very stiff, grayish-green, moist, micaceous, fine sandy, silty CLAY with quartz gravel		22		
1945 10					
12	Stiff, yellowish-red, slightly moist, micaceous, fine sandy, clayey SILT - (residuum)				Bentonite seal, 0 to 26.1 feet
14			10		
1940 16					
18	PARTIALLY WEATHERED ROCK which sampled as dark gray, very moist, micaceous, clayey, silty, fine to coarse SAND with gravel		50/4"	50/4"	
1935 20	Moderately hard, severely weathered, gray, white and brown, amphibole GNEISS; severely fractured to gravel size rock fragments R-1 recovery = 86%, RQD = 52				
22	Very hard, fresh, gray and white, coarse grained, amphibole GNEISS; with widely spaced, steep and shallow dipping, iron-stained fractures; and steeply-dipping well-developed foliation R-2 recovery = 98%, RQD = 98 R-3 recovery = 100%, RQD = 100 R-4 recovery = 98%, RQD = 98		R-1		
24					
1930 26					Filter pack, sand 26.1 to 39.9 feet
28			R-2		
1925 30					
32			R-3		
34					1-inch diameter, 0.010-inch slotted Schedule 40 PVC well screen, 29.15 to 39.15 feet
1920 36					
38			R-4		
					Pipe cap

OLD GEOT WELL 2225-04.GPJ 7/20/05

BLE INC.

BUNNELL-LAMMONS ENGINEERING, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

PIEZOMETER NO. BLE-10C

PROJECT: Madison County C & D Landfill — PROJECT NO.: J04-2225-04
CLIENT: McGill/Madison County — START: 11-8-04 END: 11-8-04
LOCATION: Madison County, North Carolina — ELEVATION: 1955.27
DRILLER: BLE, Inc., J. Gorman — LOGGED BY: M. Preddy
DRILLING METHOD: CME 750 ATV Hollow stem auger
DEPTH TO - WATER> INITIAL: 3.25 AFTER 24 HOURS: 4.25 CAVING>

ELEVATION/ DEPTH (FT)	DESCRIPTION	SOIL TYPE	SAMPLES	STANDARD PENETRATION RESULTS BLOWS/FOOT (2 5 10 20 30 40 50 70 90)	MONITOR WELL INSTALLATION DETAILS
1915	Auger refusal at 20.1 feet. Ground water encountered at 5.63 feet at time of drilling and at 4.3 feet after 24 hours.				Total well depth, 39.45 feet Core hole diameter, 3-inches
42					
44					
1910					
46					
48					
1905					
50					
52					
54					
1900					
56					
58					
1895					
60					
62					
64					
1890					
66					
68					
1885					
70					
72					
74					
1880					
76					
78					

OLD GEOT WELL 222 I 7/20/05

BLE INC.

BUNNELL-LAMMONS ENGINEERING, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

PIEZOMETER NO. BLE-11C

PROJECT: Madison County C & D Landfill
PROJECT NO.: J04-2225-04
CLIENT: McGill/Madison County
START: 10-29-04 END: 11-2
LOCATION: Madison County, North Carolina
ELEVATION: 1991.47
DRILLER: BLE, Inc., J. Gorman
LOGGED BY: M. Preddy
DRILLING METHOD: CME 750 ATV Hollow stem auger
DEPTH TO - WATER> INITIAL: ▽ 16.85 AFTER 24 HOURS: ▼ 28.85 CAVING>

ELEVATION/ DEPTH (FT)	DESCRIPTION	SOIL TYPE	SAMPLES	STANDARD PENETRATION RESULTS BLOWS/FOOT (2 5 10 20 30 40 50 70 90)	MONITOR WELL INSTALLATION DETAILS
1990 – 2, 4	No topsoil (cut area) Firm, brown, slightly moist, slightly micaceous, fine sandy, clayey SILT - (residuum) (Bag sample taken from 2 to 10 feet)		6		SURFACE COMPLETION 3.31-foot stick-up
1985 – 6, 8	Loose to firm, grayish-brown, slightly moist, very micaceous, slightly clayey, silty, fine to medium SAND		9		
1980 – 10, 12					
1975 – 14, 16			16		
1970 – 16, 20, 22	Firm to loose, brown, slightly moist, micaceous, slightly clayey, silty, fine to medium SAND		16		Bentonite seal, 0 to 36.1 feet
1965 – 24, 26			10		
1960 – 28, 30	PARTIALLY WEATHERED ROCK which sampled as gray, slightly moist, micaceous, silty, fine to coarse SAND with gravel		50/5"	50/5"	
1955 – 32, 34	PARTIALLY WEATHERED ROCK which sampled as gray GNEISS rock fragments		50/1"	50/1"	
36, 38	Hard to very hard, slight to very slightly weathered, gray and white, coarse-grained, amphibole GNEISS; with shallow and steeply dipping, close to moderately closely spaced, iron-stained fractures; and steeply dipping, well-developed foliation. R-1 recovery = 90%, RQD = 90 R-2 recovery = 94%, RQD = 78 R-3 recovery = 88%, RQD = 52 R-4 recovery = 100%, RQD = 100		R-1 R-2		Filter pack, sand 36.1 to 50 feet

OLD GEOT WELL 2225-04.GPJ 7/20/05

BLE INC.

BUNNELL-LAMMONS ENGINEERING, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

PIEZOMETER NO. BLE-11C

PROJECT: Madison County C & D Landfill
PROJECT NO.: J04-2225-04
CLIENT: McGill/Madison County
START: 10-29-04 END: 11-2-04
LOCATION: Madison County, North Carolina
ELEVATION: 1991.47
DRILLER: BLE, Inc., J. Gorman
LOGGED BY: M. Preddy
DRILLING METHOD: CME 750 ATV Hollow stem auger
DEPTH TO - WATER> INITIAL: ▽ 16.85 AFTER 24 HOURS: ▼ 28.65 CAVING>

ELEVATION/ DEPTH (FT)	DESCRIPTION	SOIL TYPE	SAMPLES	STANDARD PENETRATION RESULTS BLOWS/FOOT (2 5 10 20 30 40 60 70 90)	MONITOR WELL INSTALLATION DETAILS
1950 – 42 – 44 – 46 – 1945 – 48 – 50	Hard to very hard, slight to very slightly weathered, gray and white, coarse-grained, amphibole GNEISS; with shallow and steeply dipping, close to moderately closely spaced, iron-stained fractures; and steeply dipping, well-developed foliation. R-1 recovery = 90%, RQD = 90 R-2 recovery = 94%, RQD = 78 R-3 recovery = 88%, RQD = 52 R-4 recovery = 100%, RQD = 100		R-3 R-4		1-inch diameter, 0.010-inch slotted Schedule 40 PVC well screen, 39.6 to 49.5 feet
1940 – 52 – 54 – 56 – 1935 – 58 – 60 – 1930 – 62 – 64 – 66 – 1925 – 68 – 70 – 1920 – 72 – 74 – 76 – 1915 – 78	Auger refusal at 34 feet. Ground water encountered at 16.85 feet at time of drilling and at 28.65 feet after 24 hours.				Total well depth, 49.5 feet Corehole diameter, 3-inches

OLD GEOT WELL .GPJ 7/20/05

BLE INC.

BUNNELL-LAMMONS ENGINEERING, INC.

GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

PIEZOMETER NO. BLE-12A

PROJECT: Madison County C & D Landfill — PROJECT NO.: J04-2225-04

CLIENT: McGill/Madison County — START: 4-19-05 END: 4-19-

LOCATION: Madison County, North Carolina — ELEVATION: 1981.13

DRILLER: BLE, Inc., C. Brown — LOGGED BY: C. Brown

DRILLING METHOD: Hand auger

DEPTH TO - WATER> INITIAL: ▽ AFTER 24 HOURS: ▼ CAVING>

ELEVATION/ DEPTH (FT)	DESCRIPTION	SOIL TYPE	SAMPLES	STANDARD PENETRATION RESULTS BLOWS/FOOT (2 5 10 20 30 40 50 70 90)	MONITOR WELL INSTALLATION DETAILS
1980 – 2	4-inches of brown and dark brown, silty, sandy TOPSOIL with grass roots. Brown and gray, slightly clayey, fine sandy SILT with some thin banding (horizontal) of brown and light brown, silty, fine SAND - (slightly moist)				SURFACE COMPLETION: 1.88-foot stick-up. Ground surface elev. = 1981.13'. Top of casing elev. = 1983.01'. Bentonite seal, 0 to 2.33 feet. Filter pack, sand 2.33 to 6.25 feet. 1-inch diameter, 0.010-inch slotted Schedule 40 PVC well screen, 3.25 to 6.25 feet. Pipe cap. Total well depth, 6.25 feet
4	Brown and gray to brown, moist, fine sandy, silty CLAY. Clay was fairly dense		13	●	
1975 – 6					
8	Auger refusal at 6.25 feet, no recovery. No ground water encountered at time of drilling. Possible water at bottom of boring after 15 minutes.				
10			UD		
1970 – 12					
14			R-1		
1965 – 16					
18			R-2		
20					
1960 – 22					
24			R-3		
1955 – 26					
28			R-4		
30					
1950 – 32					
34					
1945 – 36					
38					

OLD GEOT WELL 2225-04.GPJ 7/20/05

BLE INC.

BUNNELL-LAMMONS ENGINEERING, INC.

GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

PIEZOMETER NO. BLE-12C

PROJECT: Madison County C & D Landfill — PROJECT NO.: J04-2225-04

CLIENT: McGill/Madison County — START: 10-25-04 END: 11-10-04

LOCATION: Madison County, North Carolina — ELEVATION: 1981.13

DRILLER: BLE, Inc., J. Gorman — LOGGED BY: M. Preddy

DRILLING METHOD: CME 750 ATV Hollow stem auger

DEPTH TO - WATER> INITIAL: ▽ AFTER 24 HOURS: ▼ 2.95 CAVING>

ELEVATION/ DEPTH (FT)	DESCRIPTION	SAMPLES
1980 / 2	6-inches of TOPSOIL. Stiff, brown and gray, slightly moist, clayey SILT - (alluvium)	
4		13
1975 / 6		
8	Firm, gray, moist, silty CLAY - (alluvium)	
10		UD
1970 / 12		
14	Hard to very hard, very slightly weathered to fresh, gray and white, coarse-grained, amphibole GNEISS; with shallow dipping, close to moderately closely spaced fractures; and steeply dipping well-developed foliation. R-1 recovery = 77%, RQD = 65 R-2 recovery = 95%, RQD = 98 R-3 recovery = 98%, RQD = 95 R-4 recovery = 100%, RQD = 100	R-1
1965 / 16		
18		R-2
20		
1960 / 22		
24		R-3
1955 / 26		
28		R-4
30		
1950 / 32	Auger refusal at 12.5 feet. Ground water was not encountered at time of drilling but was encountered at 2.95 feet after 24 hours.	
34		
1945 / 36		
38		

STANDARD PENETRATION RESULTS BLOWS/FOOT: 2 6 10 20 30 40 50 70 90

MONITOR WELL INSTALLATION DETAILS

SURFACE COMPLETION
3.20-foot stick-up

Bentonite seal, 0 to 17 feet

Filter pack, sand 17 to 30.5 feet

1-inch diameter, 0.010-inch slotted Schedule 40 PVC well screen, 20.17 to 30.17 feet

Total well depth, 30.17 feet

Core hole diameter, 3-inches

J 7/20/05

OLD GEOT WELL 22

BLE INC.

BUNNELL-LAMMONS ENGINEERING, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

PIEZOMETER NO. BLE-13C

PROJECT: Madison County C & D Landfill — PROJECT NO.: J04-2225-04
CLIENT: McGill/Madison County — START: 10-25-04 END: 11-9-
LOCATION: Madison County, North Carolina — ELEVATION: 2013.05
DRILLER: BLE, Inc., J. Gorman — LOGGED BY: M. Preddy
DRILLING METHOD: CME 750 ATV Hollow stem auger
DEPTH TO - WATER> INITIAL: ▽ 11.65 AFTER 24 HOURS: ▼ 19.65 CAVING>

ELEVATION/ DEPTH (FT)	DESCRIPTION	SOIL TYPE	SAMPLES	STANDARD PENETRATION RESULTS BLOWS/FOOT (2 5 10 20 30 40 50 70 90)	MONITOR WELL INSTALLATION DETAILS
	6-inches of TOPSOIL				SURFACE COMPLETION 3.27-foot stick-up
2010	Firm, yellowish-brown, slightly moist, clayey SILT - (residuum)		6		
2005	Stiff, brown, moist, micaceous, fine sandy, clayey SILT. (bag sample taken from 1 to 10 feet)		10		
2000	PARTIALLY WEATHERED ROCK which sampled as gray, slightly moist, micaceous, silty, fine to coarse SAND		50/3"	50/3"	Bentonite seal, 0 to 26.75 feet
1995	PARTIALLY WEATHERED ROCK which sampled as gray GNEISS rock fragments		50/2"	50/2"	
1990	Hard to very hard, slightly weathered to fresh, gray and white, coarse-grained, amphibole GNEISS; with shallow to moderately dipping, close to widely spaced fractures; and steeply dipping, well-developed foliation. R-1 recovery = 100%, RQD = 100; R-2 recovery = 100%, RQD = 100; R-3 recovery = 100%, RQD = 76; R-4 recovery = 83%, RQD = 82		R-1		
1985			R-2		Filter pack, sand 26.75 to 40.15 feet
1980			R-3		
1975			R-4		1-inch diameter, 0.010-inch slotted Schedule 40 PVC well screen, 29.85 to 39.85 feet

OLD GEOTWELL 2225-04.GPJ 7/20/05

BLE INC.

BUNNELL-LAMMONS ENGINEERING, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

PIEZOMETER NO. BLE-13C

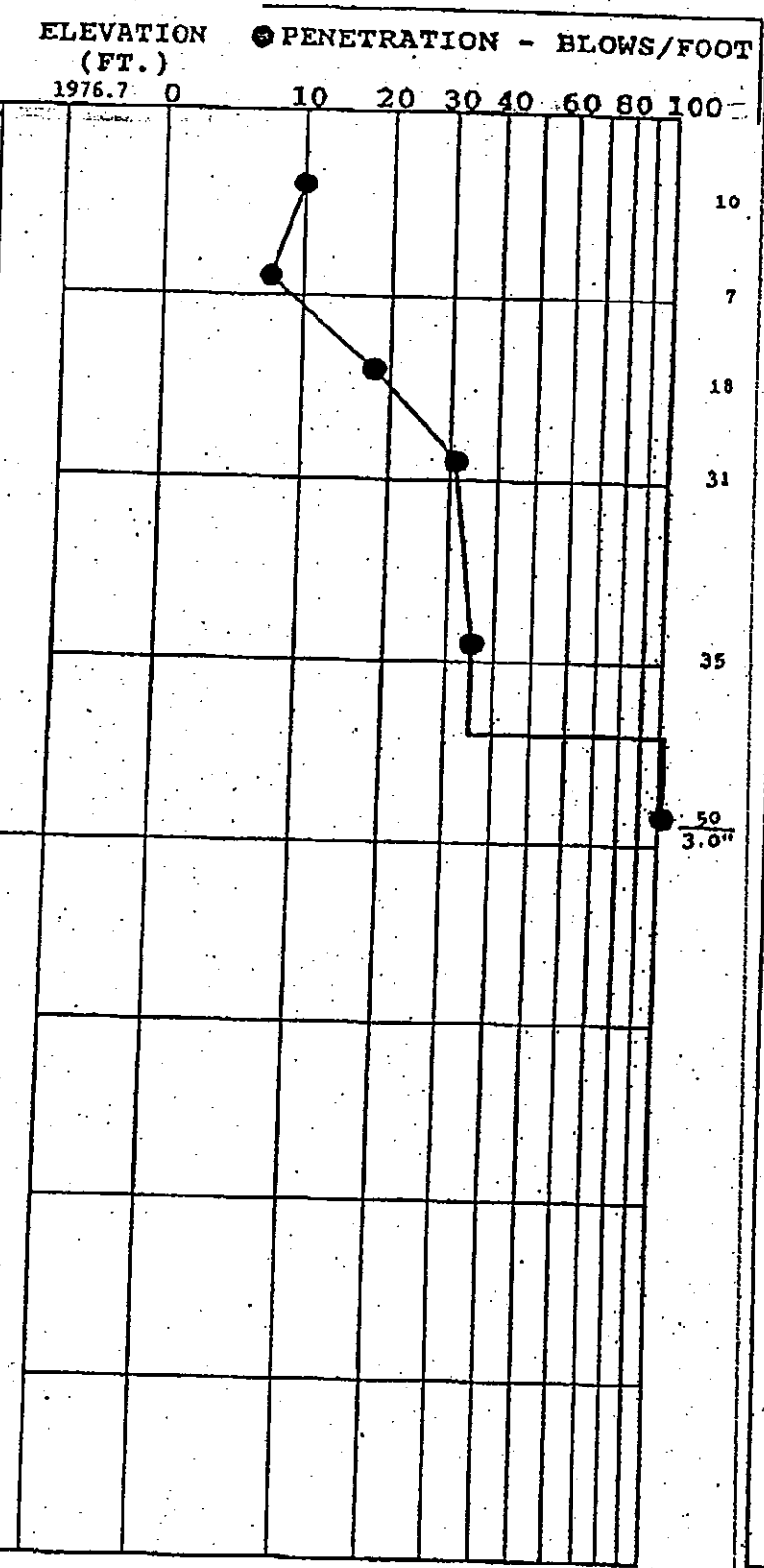
PROJECT: Madison County C & D Landfill — PROJECT NO.: J04-2225-04
CLIENT: McGill/Madison County — START: 10-25-04 END: 11-9-04
LOCATION: Madison County, North Carolina — ELEVATION: 2013.05
DRILLER: BLE, Inc., J. Gorman — LOGGED BY: M. Preddy
DRILLING METHOD: CME 750 ATV Hollow stem auger
DEPTH TO - WATER> INITIAL: 11.65 AFTER 24 HOURS: 19.65 CAVING>

ELEVATION/ DEPTH (FT)	DESCRIPTION	SOIL TYPE	SAMPLES	STANDARD PENETRATION RESULTS BLOWS/FOOT (2 5 10 20 30 40 50 70 90)	MONITOR WELL INSTALLATION DETAILS
42, 1970, 44, 46, 1965, 48, 50, 52, 1960, 54, 56, 1955, 58, 60, 62, 1950, 64, 66, 1945, 68, 70, 72, 1940, 74, 76, 1935, 78	Auger refusal at 22 feet. Ground water encountered at 11.65 feet at time of drilling and at 19.65 feet after 24 hours.				Pipe cap Total well depth, 40.15 feet Core hole diameter, 3-inches

GPJ 7/20/05

OLD GEOT WELL

DEPTH (FT.)	DESCRIPTION	ELEVATION (FT.)
0.0		1976.7
0.3	Topsoil	
	Residuum - Firm to Hard Red Brown Micaceous Fine to Coarse Sandy SILT Some Gravel - Wet	
17.0	Partially Weathered Rock That Becomes Black Gray Micaceous Silty Fine to Coarse SAND with Gravel When Sampled - Moist	
20.0	Boring Terminated at 20.0 Feet. Ground Water at 11.1 Feet on 7-18-90.	



TEST BORING RECORD

BORING NUMBER B-7
DATE DRILLED 5-6-90
PROJECT NUMBER 56-8550
PROJECT MADISON CO. LANDFILL
PAGE 1 OF 1

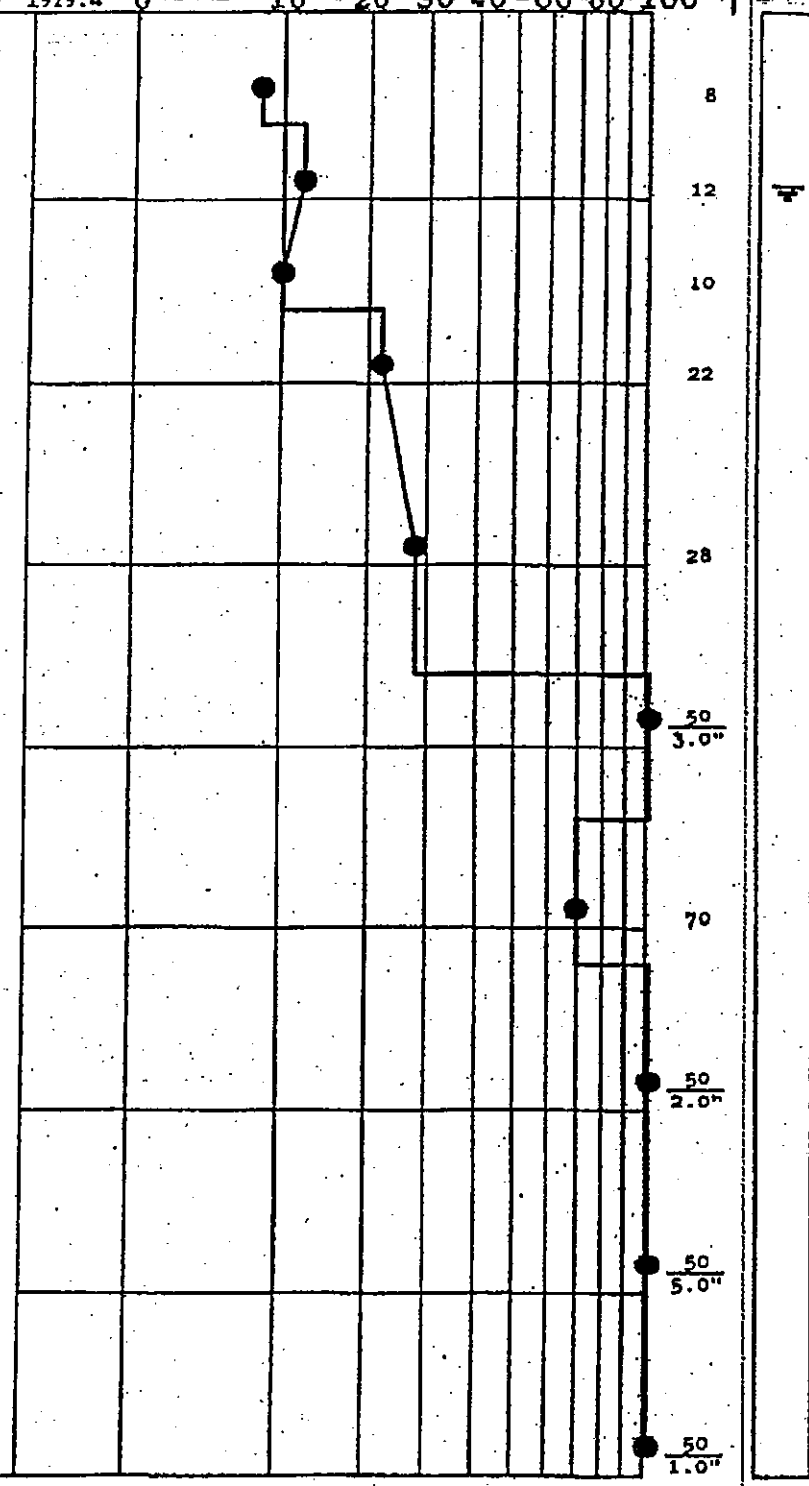
LAW ENGINEERING

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVATIONS USED ABOVE

DEPTH (FT.)	DESCRIPTION
0.0	
0.3	Topsoil
3.0	Alluvium - Firm Red Brown Micaceous Slightly Fine Sandy Clayey SILT - Moist
8.0	Residuum - Stiff to Very Stiff Slightly Clayey Silty Fine to Coarse SAND - Moist
18.0	Very Firm Red Gray to Gray Micaceous Silty Fine to Coarse SAND - Wet
22.0	Partially Weathered Rock That Becomes Brown Gray Micaceous Very Silty Fine to Medium SAND When Sampled - Wet
26.0	Residuum - Very Dense Black Gray Micaceous Silty Fine to Medium SAND - Wet
40.0	Partially Weathered Rock That Becomes Black Gray Micaceous Silty Fine to Coarse SAND With Gravel When Sampled - Wet

ELEVATION (FT.) 1929.4

● PENETRATION - BLOWS/FOOT



Boring Terminated at 40.0 Feet.
Ground Water at 4.6 Feet on 7-18-90.

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVATIONS USED ABOVE

TEST BORING RECORD

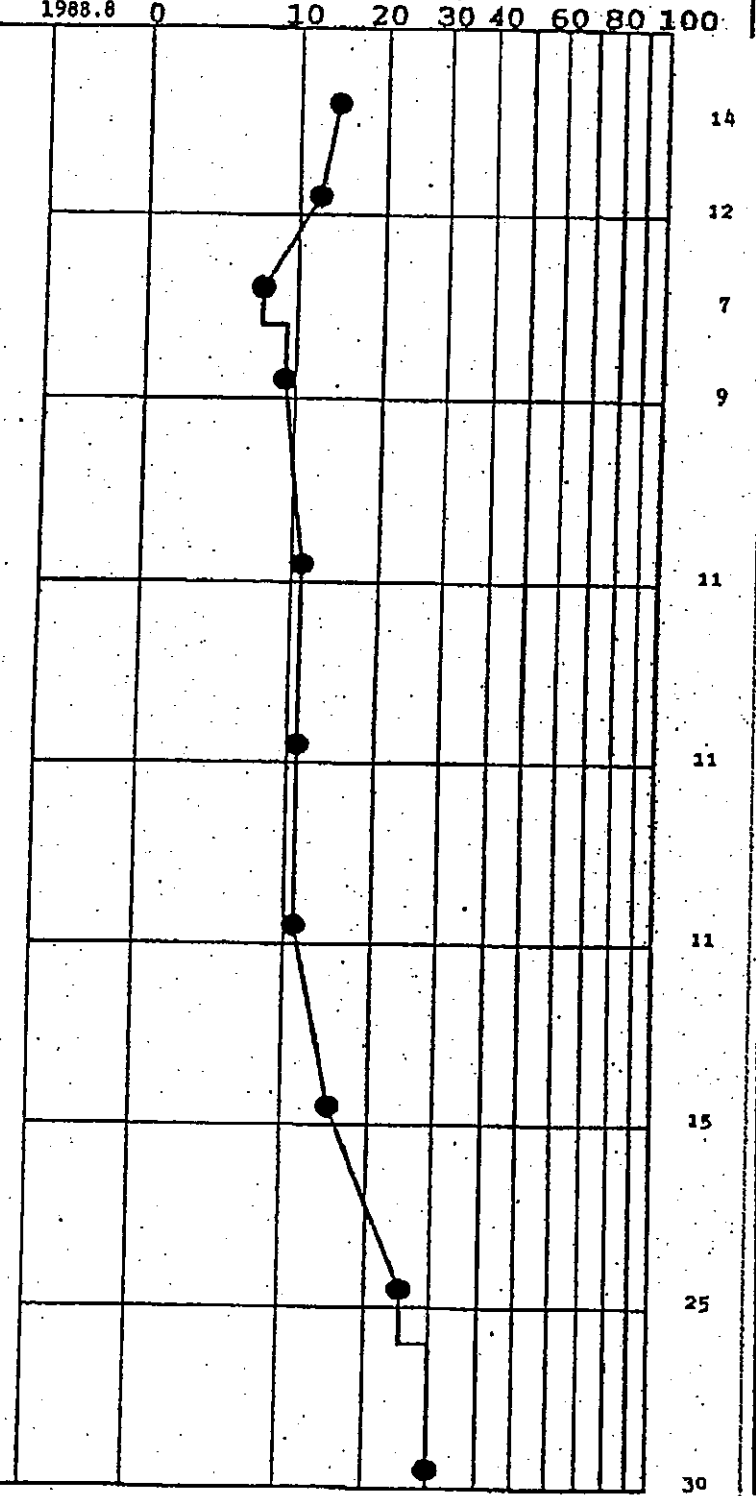
BORING NUMBER B-8
DATE DRILLED 5-6-90
PROJECT NUMBER 56-8550
PROJECT MADISON CO. LANDFILL
PAGE 1 OF 1

LAW ENGINEERING

DEPTH (FT.)	DESCRIPTION
0.0	
0.3	Topsoil
	Residuum - Stiff to Firm Red Brown Micaceous Slightly Fine to Medium Sandy Clayey SILT
8.0	Stiff to Very Stiff Red Brown Very Micaceous Fine to Medium Sandy SILT
36.0	Very Stiff to Hard Gray Brown to Red Gray Very Micaceous Fine to Coarse Sandy SILT With Gravel - Moist
40.0	

ELEVATION (FT.) 1988.8

● PENETRATION - BLOWS/FOOT



TEST BORING RECORD

BORING NUMBER B-13
DATE DRILLED 5-2/3-90
PROJECT NUMBER 56-8550
PROJECT MADISON CO. LANDFILL
PAGE 1 OF 2

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVATIONS USED ABOVE

LAW ENGINEERING

DEPTH (FT.)	DESCRIPTION	ELEVATION (FT.)	● PENETRATION - BLOWS/FOOT (0 10 20 30 40 60 80 100)	NQ REC	RQD	
40.0	Very Stiff to Hard Gray Brown to Red Gray Very Micaceous Fine to Coarse Sandy SILT with Gravel - Moist	1948.8	30 46			
52.0	Partially Weathered Rock That Becomes Red Gray to Green Gray Micaceous Silty Fine to Coarse SAND with Gravel When Sampled - Moist		50/1.5" 50/3.0" 50/3.0" 50/2.5"			
70.0	Very Soft to Moderately Hard Bluish Gray to Black Hornblende - Biotite Gneiss			92%	86%	70.0 TO 71.1 Very Close Joints - Low Dip Complete to Severe Weathering 71.1 - 80 Moderately Close to Wide Joints Moderate to Very Slight Weathering
80.0						

Drilling Terminated at 80.0 Feet.
Ground Water at 51.2 Feet on 7-18-90.

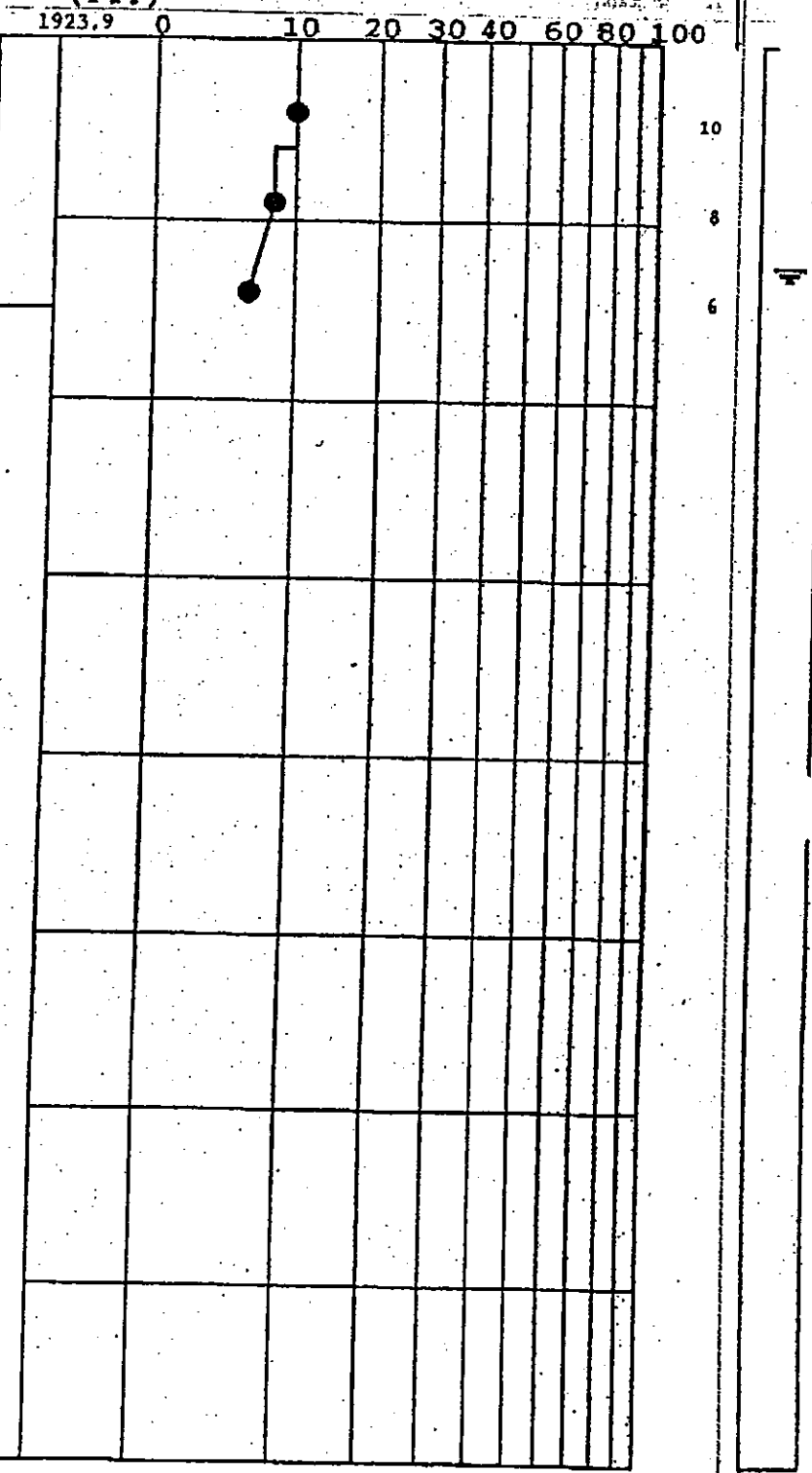
SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVATIONS USED ABOVE

TEST BORING RECORD

BORING NUMBER B-13
DATE DRILLED 5-2/3-90
PROJECT NUMBER 56-8550
PROJECT MADISON CO. LANDFILL
PAGE 2 OF 2

LAW ENGINEERING

DEPTH (FT.)	DESCRIPTION	ELEVATION (FT.)
0.0		1923.9
0.3	Topsoil	
	Alluvium - Stiff Red Brown Slightly Fine Sandy Very Clayey SILT	
3.0	Residuum - Firm Red Brown Micaceous Clayey Fine to Medium Sandy SILT	
8.0	Boring Terminated at 8.0 Feet. Ground Water at 6.1 Feet on 7-18-90.	



TEST BORING RECORD

BORING NUMBER B-15
DATE DRILLED 7-17-90
PROJECT NUMBER 56-8550
PROJECT MADISON CO. LANDFILL
PAGE 1 OF 1

LAW ENGINEERING

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVATIONS USED ABOVE

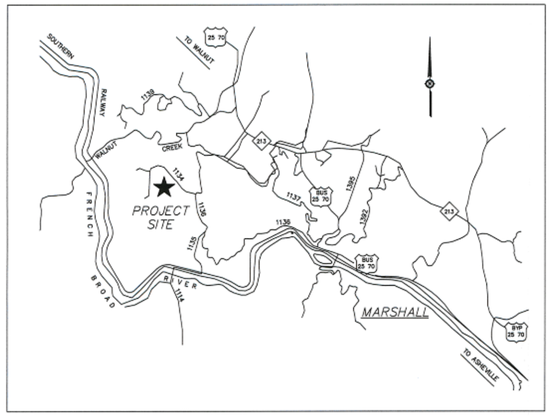
Summary of Laboratory Testing for the Madison County MSW Landfill Base Clay Liner
Law Environmental Job No. 56-8550.40
Performed October 1992 - May 1993

Constant Head Permeability Test

Date of Test	Test Location	Dry Density (pcf)	Initial Moisture Content %	Final Moisture Content %	Sample Length (cm)	Sample Area (cm2)	Quantity of H20 Passing Through Sample (cm3)	Elapsed Time (sec)	Coeff. Of Permeability k (cm/sec)
10/19-21/92	L-1	79.1	41.9	42.9	4.98	40.60	10.1	108,480	7.6E-08
12/14-19/92	Boring #7	84.4	39.5	41.8	5.44	40.94	3.2	175,980	1.6E-08
12/14-21/92	Boring #8	79.6	42.8	45.3	5.00	41.51	21.0	844,820	4.9E-08
5/1-10/93	Cell Bottom	87.2	36	39	4.88	40.83	30.2	407,640	5.9E-08
5/1-10/93	Side	84.6	37.2	40	5.21	40.83	23.3	464,760	4.2E-08
5/1-6/93	Bottom	86.4	35.7	38.9	4.95	40.83	7.4	249,960	2.4E-08
5/1-6/93	Side W	80.5	41.1	44.2	5.13	40.83	36.1	213,720	1.4E-07

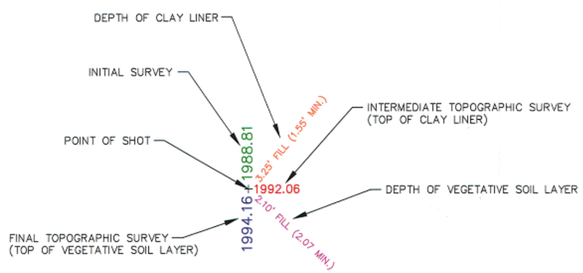
Comments:
Consolidated and tested at 2 psi head difference.
All test run with a head of 140.68 cm and a temperature of 73°F with a viscosity correction factor of 0.931.

SECTION X IV



VICINITY MAP

NTS



TYPICAL TOPOGRAPHIC INFORMATION

DATE: FEBRUARY 8, 2006

THIS PLAT REPRESENTS AN ACTUAL FIELD SURVEY THAT MEETS OR EXCEEDS THE REQUIREMENTS FOR A CLASS "A" TOPOGRAPHIC SURVEY IN ACCORDANCE WITH THE STANDARDS OF PRACTICE FOR LAND SURVEYING IN NORTH CAROLINA.

NORTH CAROLINA PROFESSIONAL SEAL L-1382 LAND SURVEYOR HURLEY T. KING

Hurley T. King

HURLEY T. KING, PLS
N.C. NO. L-1382

NOTES:

THE INITIAL POSITIONS FOR THIS PROJECT WERE PRODUCED FROM STATIC GPS OBSERVATIONS (MIN. 4 HOUR SESSIONS) UTILIZING TRIMBLE DUAL FREQUENCY 4700 RECEIVERS AND WERE COMPUTED BY NGS UTILIZING THE ONLINE POSITIONING USER SERVICE (OPUS) AND ARE RELATIVE TO THE FOLLOWING NGS CORS BASE STATIONS.

REF FRAME: NAD83(CORS96)(EPOCH:2002.0000) NSRS

DATE: August 10, 2004

TIME: 22:44:40 UTC

CORS BASE STATIONS USED

PID	DESIGNATION	LATITUDE	LONGITUDE	DISTANCE
DE8228	HAYW HAYWOOD CORS ARP	N35~31'35.396"	W082~55'30.127"	36421.6(m)
DG5311	NCSW SWANNANOA CORS AR	N35~35'46.038"	W082~25'24.230"	35788.0(m)
DE8230	MARI MARION CORS ARP	N35~39'13.385"	W081~57'16.172"	71404.7(m)

POSITIONAL ACCURACY: X= 0.003(m), Y=0.019(m), Z=0.018(m)

ELEVATIONS ARE NGVD 1988 (GEOID MODEL=GEOID03)

AVERAGE COMBINED GRID FACTOR = 0.99982488.

COORDINATE UNITS ARE IN U.S. SURVEY FEET UNLESS DESIGNATED OTHERWISE

BENCH MARKS	ELEVATION
NCGS JENKINS	2076.41
NCGS N 133	1624.18

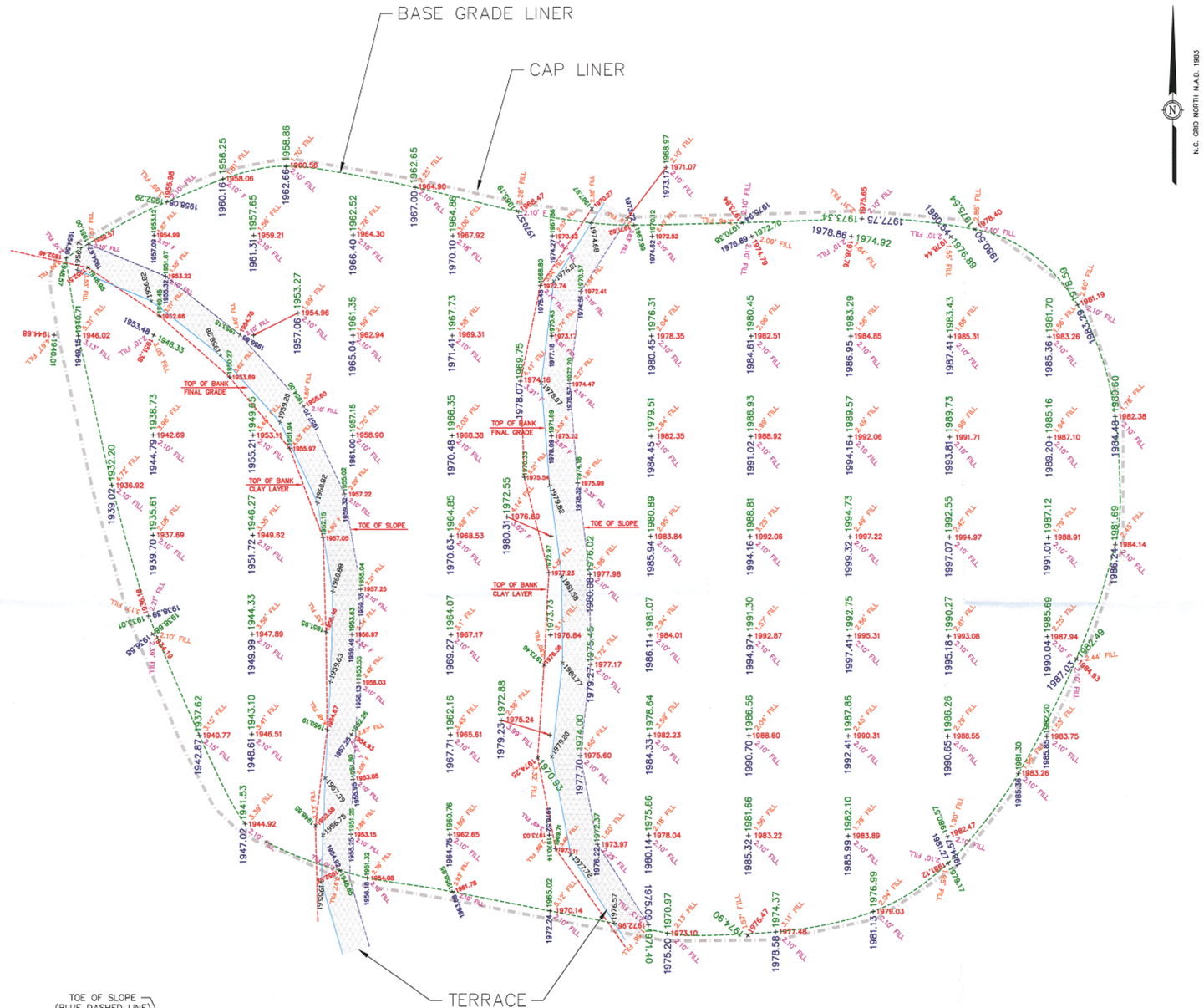
ALL ELEVATIONS ARE NGVD 1929

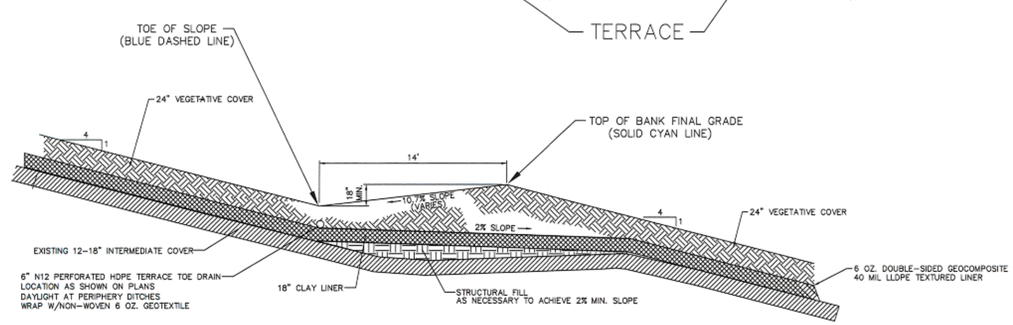
DISTANCES SHOWN ON THIS PLAT ARE GRID LENGTHS. TO OBTAIN HORIZONTAL GROUND DISTANCES THEY MUST BE DIVIDED BY A COMBINED SCALE AND SEA LEVEL FACTOR OF 0.99982488.

ALL SPOT ELEVATION ARE AT GROUND LEVEL.

NO BOUNDARY LINES ARE SHOWN HEREON.

SURVEYOR'S CERTIFICATION





TERRACE DETAIL

NTS

NO.	DATE	BY	REVISION DESCRIPTION

McGill ASSOCIATES
ENGINEERING·PLANNING·FINANCE
55 BROAD STREET ASHEVILLE, NC PH. (828) 252-0575

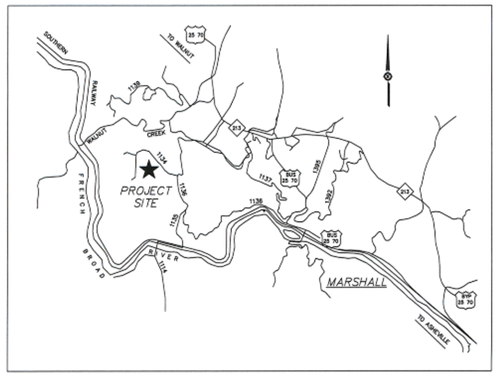
MADISON COUNTY MSW LANDFILL

MADISON COUNTY, NORTH CAROLINA

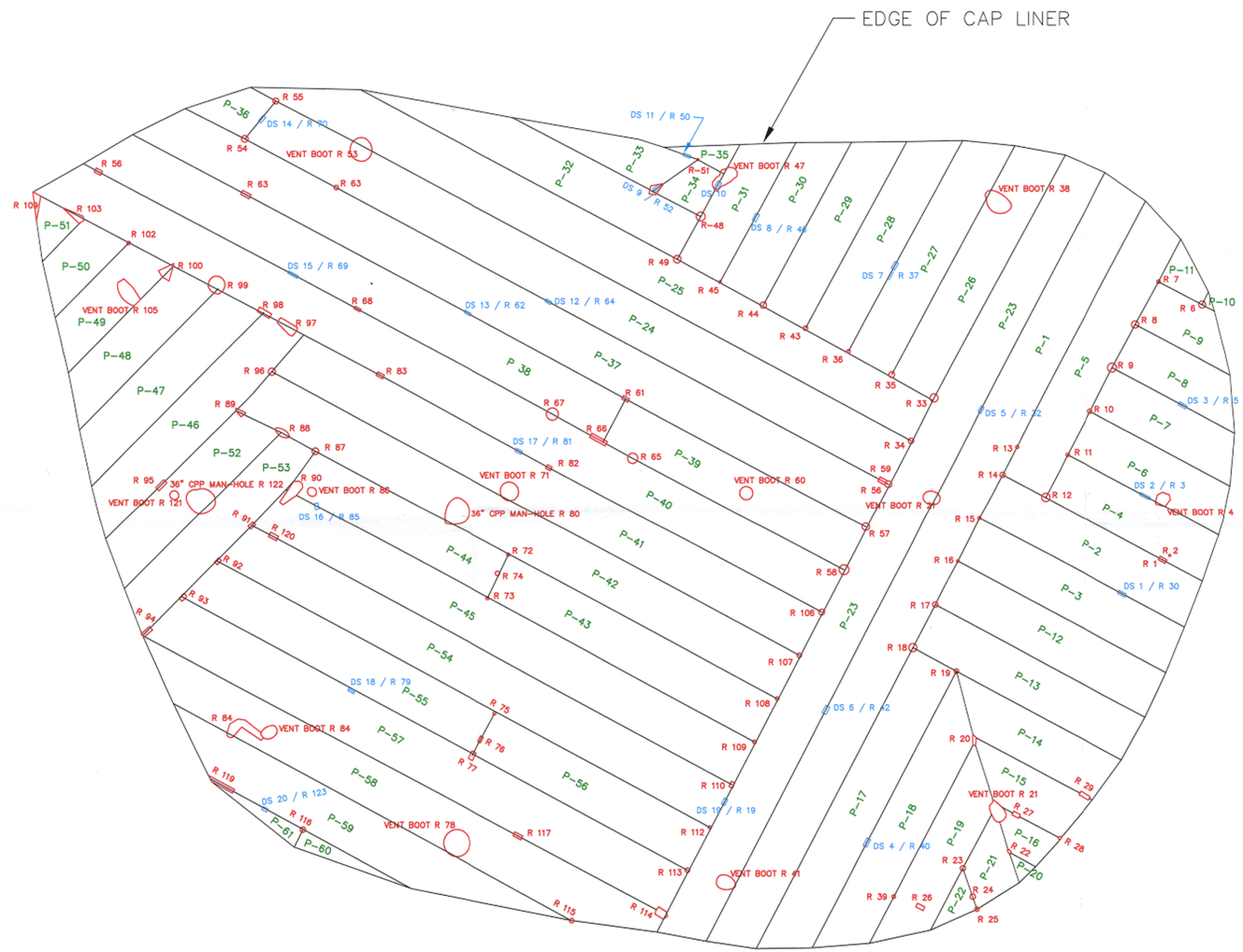
JOB NO.: 04302
DATE: FEBRUARY 2006
SCALE: 1" = 30'
DESIGNED BY: GB
CADD BY: KS
DESIGN REVIEW: _____
CONST. REVIEW: _____
04302\from CD\Final-Clay-Liner.dwg

DEPTH VERIFICATION PLAN
MSW CAP

SHEET
C2



VICINITY MAP
NTS



DATE: FEBRUARY 8, 2006

THIS PLAT REPRESENTS AN ACTUAL FIELD SURVEY THAT MEETS OR EXCEEDS THE REQUIREMENTS FOR A CLASS "A" TOPOGRAPHIC SURVEY IN ACCORDANCE WITH THE STANDARDS OF PRACTICE FOR LAND SURVEYING IN NORTH CAROLINA.

Hurley T. King

HURLEY T. KING, PLS
N.C. NO. L-1382

NORTH CAROLINA PROFESSIONAL SEAL L-1382 LAND SURVEYOR HURLEY T. KING

NOTES:

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REF FRAME: NAD83(CORS96)(EPOCH:2002.0000) NSRS

DATE: August 10, 2004

TIME: 22:44:40 UTC

CORS BASE STATIONS USED

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DG5311	NCSW SWANNANOA CORS AR	N35~35'46.038"	W082~25'24.230"	35788.0(m)
DE8230	MARI MARION CORS ARP	N35~39'13.385"	W081~57'16.172"	71404.7(m)

POSITIONAL ACCURACY: X= 0.003(m), Y=0.019(m), Z=0.018(m)

ELEVATIONS ARE NGVD 1988 (GEOID MODEL=GEOID03)

AVERAGE COMBINED GRID FACTOR = 0.99982488.

COORDINATE UNITS ARE IN U.S. SURVEY FEET UNLESS DESIGNATED OTHERWISE

BENCH MARKS	ELEVATION
NCGS JENKINS	2076.41
NCGS N 133	1624.18

ALL ELEVATIONS ARE NGVD 1929

DISTANCES SHOWN ON THIS PLAT ARE GRID LENGTHS. TO OBTAIN HORIZONTAL GROUND DISTANCES THEY MUST BE DIVIDED BY A COMBINED SCALE AND SEA LEVEL FACTOR OF 0.99982488.

ALL SPOT ELEVATION ARE AT GROUND LEVEL.

NO BOUNDARY LINES ARE SHOWN HEREON.

SURVEYOR'S CERTIFICATION

NO.	DATE	BY	REVISION DESCRIPTION

McGill ASSOCIATES
ENGINEERING·PLANNING·FINANCE
55 BROAD STREET ASHEVILLE, NC PH. (828) 252-0575

MADISON COUNTY MSW LANDFILL

MADISON COUNTY, NORTH CAROLINA

JOB NO.: 04302
DATE: JANUARY 2006
SCALE: 1" = 30'
DESIGNED BY: GB
CADD BY: KS
DESIGN REVIEW: ———
CONST. REVIEW: ———
04302\From CD\Geomembrane-Panel-Layout-dwg.

GEOMEMBRANE PANEL LAYOUT
MSW CAP

SHEET
C1

SECTION XVI