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| Permit No. | Date | Document ID No. |
| 55-03 | March 5, 2010 | 9952 |

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SOLID WASTE SECTION
ASHEVILLE REGIONAL OFFICE

**CONSTRUCTION CERTIFICATION REPORT
FOR
STORMWATER PIPE REMOVAL, PHASE III, CELL 3**

**LINCOLN COUNTY LANDFILL
PERMIT NO. 55-03
CROUSE, NORTH CAROLINA
S&ME Project No. 1356-09-018**

Prepared for:



**North Carolina Department of Environment and Natural Resources
Division of Waste Management – Solid Waste Section
2090 U.S. Highway 70
Swannanoa, NC 28778**

Prepared by:



**S&ME, Inc.
9751 Southern Pine Blvd
Charlotte, North Carolina 28273**

February 24, 2010



February 24, 2010

North Carolina Department of Environment and Natural Resources
Division of Waste Management
Solid Waste Section
2090 U.S. Highway 70
Swannanoa, NC 28778

Attention: Mr. Larry Frost
Regional Engineer

**Reference: CONSTRUCTION CERTIFICATION REPORT
STORMWATER PIPE REMOVAL, PHASE III, CELL 3**
Lincoln County Landfill, Permit No. 55-03
Crouse, North Carolina
S&ME Project No. 1356-09-018

Dear Mr. Frost:

On behalf of Lincoln County, S&ME, Inc. (S&ME) is pleased to submit this Construction Certification Report to the North Carolina Department of Environment and Natural Resources (NCDENR) for the stormwater pipe removal in the Phase III, Cell 3 area of the Lincoln County Landfill. The Certification Report for the above referenced project certifies that the project has been completed in general accordance with the project specifications and construction drawings prepared by S&ME, Inc. and in accordance with the "Plan Approval" letter issued by NCDENR dated May 20, 2009. This letter summarizes the field observation and testing services performed by S&ME during stormwater pipe removal performed by Earnhardt Grading between January 12, 2010 and January 14, 2010. The following documents are also included with this report:

- Construction Certification Statement;
- Submittal Information;
- Results of Construction Testing;
- Geosynthetic Installation Forms and MQC Data;
- Field Reports; and
- Construction Photographs.

INTRODUCTION

Lincoln County Landfill is currently placing municipal solid waste (MSW) within Phase III of the landfill. The Phase III landfill is subdivided into three cells, identified as Cells 1 through 3. Cell 3 is located on the west side of Phase III. Cell 3 is sloped to drain to the southwest corner of the cell, where a gravity leachate sump and stormwater conveyance pipe are located. The gravity stormwater conveyance pipe is positioned at the protective soil cover level. The pipe drained stormwater from the Cell 3 prior to waste placement. The stormwater pipe was abandoned in-place by grouting, consistent with the Operations Plan on October 14, 2008. The stormwater pipe was capped by welding an HDPE cover over it on April 3, 2009. Since that time, stormwater had been observed dripping at the outlet end of the stormwater pipe from the hole made in the end of the pipe to grout it closed. At that time, Lincoln County requested that S&ME prepare a plan to remove the stormwater pipe from Phase III, Cell 3.

The proposed plan for stormwater pipe removal was communicated to NCDENR in our letter dated May 19, 2009. NCDENR approved the plan in their letter dated May 20, 2009. Stormwater pipe removal activities were observed by S&ME on January 12 and 14, 2010. Photographs of the construction process (Photos 1 through 15) were taken and are included as an attachment to this report. The general sequence of stormwater pipe removal activities is summarized as follows:

1. stormwater run-on was isolated by building a soil diversion berm up grade of the pipe location;
2. the existing protective soil cover was removed and stockpiled to expose the underlying geosynthetics (from top to bottom: geocomposite drainage layer; 60 mil HDPE geomembrane; and geosynthetic clay liner);
3. the geosynthetics were cut and peeled back to expose the underlying compacted soil liner;
4. the compacted soil liner and structural fill from around the pipe was excavated and stockpiled, with care taken to minimize the quantity of excavation;
5. the pipe was removed;
6. the structural fill and compacted soil liner was replaced and restored;
7. the existing GCL was patched with new GCL;
8. the HDPE geomembrane and geocomposite drainage layer was laid back and patched with new material; and
9. the protective soil cover was replaced.

STORMWATER PIPE REMOVAL

Activities for the stormwater pipe removal can generally be divided into three main tasks: pipe removal and backfill (activities 1 through 6 above); geosynthetics repair (activities 7 and 8 above); and closeout (activity 9). The activities for stormwater pipe removal are described in greater detail below.

Pipe Removal and Backfilling

Following construction of the soil diversion berm, S&ME observed pipe removal and backfill on January 12, 2010. Earnhardt Grading excavated the soil cover material and exposed the geosynthetics prior to S&ME's arrival on site. After S&ME's arrival, the following activities were observed:

- Cutting of the existing geosynthetics;
- Excavation of the clay liner and compacted fill;
- Removal of the stormwater pipe to the anchor trench;
- Backfill of the compacted soil liner and structural fill.

S&ME monitored and performed five (5) field density tests during the placement of the compacted soil liner and structural fill. The field density tests performed by S&ME on January 12, 2010 indicate that the backfilled materials met the project specifications of relative compactions of 95 percent or greater of the Standard Proctor maximum dry density relative to the materials. Survey information provided by the contractor indicates that the compacted soil liner was placed with a thickness of two feet or greater.

Please refer to the "Results of Construction Testing" attachment for laboratory and field density test information; the "Field Reports" attachment for documentation of S&ME's field observations; and the "Construction Photographs" attachment for photo-documentation of the pipe removal and backfilling operations.

Geosynthetics Repair

S&ME observed geosynthetic repairs made on January 14, 2010. After S&ME's arrival, the following activities were observed:

- Installation of the geosynthetic clay liner (GCL);
- Installation of the geomembrane patch; and
- Installation of the geocomposite drainage layer (GCDL).

Results of our monitoring indicate that the geosynthetics repair was performed in accordance with the project specifications.

Please refer to the "Geosynthetic Installation Forms and MQC Data" attachment for documentation of geosynthetics installation and manufacturer's quality control data; the "Field Reports" attachment for documentation of S&ME's observations; and the "Construction Photographs" attachment for photo-documentation of the pipe removal and backfilling operations.

AS-BUILT CONDITIONS

S&ME understands that the construction activities after January 14, 2010 consisted of replacement of the protective cover material and removal of the remainder of the stormwater piping outside of the repair area. Construction activities after January 14, 2010 were not observed by S&ME.

CLOSURE

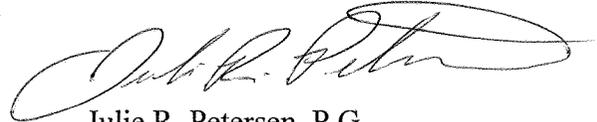
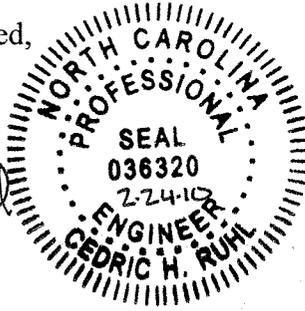
S&ME, Inc. appreciates the opportunity to provide this construction certification letter report. If you have any questions or need additional information regarding this report, please contact us.

Respectfully submitted,

S&ME, Inc.



Cedric H. Ruhl, P.E.
Project Engineer



Julie R. Petersen, P.G.
Project Manager

Senior Reviewed by Jason S. Reeves, P.E., Senior Engineer

- Attachments:
- Construction Certification Statement
 - Submittal Information
 - Results of Construction Soil Testing
 - Geosynthetic Installation Forms and MQC Data
 - Field Reports
 - Construction Photographs

CONSTRUCTION CERTIFICATION STATEMENT



**CONSTRUCTION CERTIFICATION STATEMENT
FOR
LINCOLN COUNTY LANDFILL
STORMWATER PIPE REMOVAL – PHASE III, CELL 3
CERTIFICATION REPORT**

OWNER: LINCOLN COUNTY
OPERATOR: LINCOLN COUNTY

by:

S&ME, Inc.
9751 Southern Pine Boulevard
Charlotte, North Carolina 28273-5560

I hereby certify that the results of construction quality assurance activities conducted by S&ME Inc., as summarized in this report, indicate that the stormwater pipe removal and geosynthetics repair within the Phase III, Cell 3 portion of the Lincoln County Landfill was constructed in general accordance with the requirements of the approved construction documents.

Cedric H. Ruhl



Cedric H. Ruhl,
N.C. Registration No. 036320

SUBMITTAL INFORMATION





SUBMITTAL COVER SHEET

| | | | |
|------------|-----------------|----------------------------------|------------------------------------|
| TO: | Mark LeGrand | Date: 12/3/09 | Job No.: 1356.09.018 |
| | ADDRESS: | Earnhardt Grading, Inc. | Stormwater Pipe Removal, Phase III |
| | | 7525 Old Plank Road | Lincoln County Landfill |
| | | Stanley, NC 28164 | Crouse, North Carolina |
| | | Email: Mark@earnhardtgrading.com | |

| | | |
|--------------------------|-----------------|---------------------------------|
| Submittal Log ID No.: 01 | Revision No.: 0 | Contractor Transmittal No.: N/A |
|--------------------------|-----------------|---------------------------------|

| | |
|--|-----------------------------------|
| Specification Section: 02670, 02675, 02677 | Date of Submittal Report: 12/3/09 |
|--|-----------------------------------|

Submittal Subject: HDPE Geomembrane, Geonet Composite Drainage Layer, and Geosynthetic Clay Liner (GCL)

| | | |
|------------|--|---|
| Notations: | <input checked="" type="checkbox"/> No Exception Taken | <input type="checkbox"/> Revise and Resubmit |
| | <input type="checkbox"/> Corrected as Noted | <input type="checkbox"/> Submit Specified Items |
| | <input type="checkbox"/> Rejected | <input type="checkbox"/> As Noted Herein |

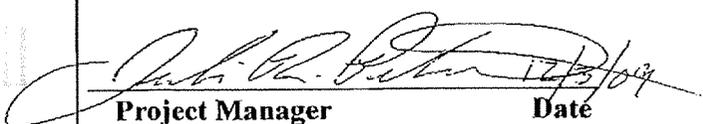
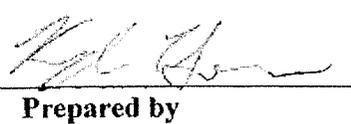
Remarks:

The properties reported in the product data sheets in Attachment 1 for Agru America High Density Polyethylene Micro Spike Liner, Engineered Synthetic Products Transnet 300-2-8 geocomposite, and Cetco Bentomat SDN GCL are consistent with project specifications in Attachment 2.

The GCL grab (tensile) strength shall be greater than 22.5 lb/in and the GCL peel strength shall be greater than 2.5 lb/in consistent with the supplemental information from Cetco in Attachment 3. The GCL index flux shall be less than $1 \times 10^{-8} \text{ m}^3/\text{m}^2/\text{sec}$ consistent with the supplemental information from GRI-GCL3 in Attachment 3.

Attachments: 1 – Submittal Information
 2 – Project Specifications
 3 – Supplemental Information

Review of this submittal does not relieve the Contractor from their responsibility for deviations from the Contract Documents nor from their responsibility for errors or omissions in the submittal. Contractor is, and Engineer is not, responsible for matters relating to fabrication, shipping, handling, storage, assembly, installation, construction (including safety), and coordination for performing the Work.

| | | |
|--|--|-------------|
|  |  | 12/3/09 |
| Project Manager Julie R. Petersen, P.G. | Prepared by Kyle Baucom, E.I. | Date |

| | |
|-------------------|---|
| Copies to: | <input checked="" type="checkbox"/> Nancy Rickard, Lincoln County, nrickard@lincolncounty.org |
| | <input checked="" type="checkbox"/> Burns Whittaker, Lincoln County, bwhittaker@lincolncounty.org |
| | <input checked="" type="checkbox"/> S&ME File No. 1356-09-018 |

ATTACHMENT 1

Submittal Information:

Agru America HDPE Micro Spike Liner

Cetco Bentomat SDN

Engineered Synthetic Product Transet 300-2-8

Paul Elliott

From: Grant Palmer [gp@agruamerica.com]
Sent: Tuesday, December 01, 2009 3:46 PM
To: PFF Paul Elliott
Cc: Dee Strong; Rick Cannon
Subject: Lincoln Cty LF, NC 11-09 lin spec clar
Importance: High

Upon review of the geomembrane specifications received for the above project: Section 02670 (no date)
Items: 60 HDPE textured(Black)

Table 02670-C (freqs, textured) and 02670-D (props, textured)

- GRI GM12 has been replaced with ASTM D7466. D7466 was created specifically to replace GRI GM12, and essentially duplicates the method.
- Carbon Black Content will be tested via ASTM D4218, not D1603 as listed. Both of these Carbon Content methods are listed as acceptable in the GRI GM13& 17 Standards.
- The Note for Carbon Content does not match the description.

Grant Palmer
Quality Control Manager, Agru America
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www.agruamerica.com

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High Density Polyethylene Micro Spike® Liner



Product Data

| Property | Test Method | Values | | | | |
|---|--|--|-----------|-------------|------------|------------|
| Thickness, nominal (mm) | | 30 (.75) | 40 (1.0) | 60 (1.5)✓ | 80 (2.0) | 100 (2.5) |
| Thickness (min. ave.), mil (mm) | ASTM D5994* | 29 (.71) | 38 (.95) | 57 (1.43)✓ | 76 (1.90) | 95 (2.38) |
| Thickness (lowest indiv. for 8 of 10 spec.), mil (mm) | ASTM D5994* | 27 (.68) | 36 (.90) | 54 (1.35)✓ | 72 (1.80) | 90 (2.25) |
| Thickness (lowest indiv. for 1 of 10 spec.), mil (mm) | ASTM D5994* | 26 (.64) | 34 (.85) | 51 (1.28)✓ | 68 (1.70) | 85 (2.13) |
| *The thickness values may be changed due to project specifications (i.e., absolute minimum thickness) | | | | | | |
| Asperity Height (min. ave.), mil (mm) | GRI GM12 | 16 (.41) | 16 (.41) | 16 (.41)✓ | 16 (.41) | 16 (.41) |
| Density, g/cc, minimum | ASTM D792, Method B | 0.94 | 0.94 | 0.94 ✓ | 0.94 | 0.94 |
| Tensile Properties (ave. both directions) | ASTM D6693, Type IV | | | | | |
| Strength @ Yield (min. ave.), lb/in width (N/mm) | 2 in/minute | 66 (11.6) | 88 (15.4) | 132 (23.1)✓ | 176 (30.8) | 220 (38.5) |
| Elongation @ Yield (min. ave.), % (GL=1.3in) | 5 specimens in each direction | 13 | 13 | 13 ✓ | 13 | 13 |
| Strength @ Break (min. ave.), lb/in width (N/mm) | | 66 (11.6) | 88 (15.4) | 132 (23.1)✓ | 176 (30.8) | 220 (38.5) |
| Elongation @ Break (min. ave.), % (GL=2.0in) | | 350 | 350 | 350 ✓ | 350 | 350 |
| Tear Resistance (min. ave.), lbs. (N) | ASTM D1004 | 23 (102) | 30 (133) | 45 (200)✓ | 60 (267) | 72 (320) |
| Puncture Resistance (min. ave.), lbs. (N) | ASTM D4833 | 60 (267) | 90 (400) | 120 (534)✓ | 150 (667) | 180 (801) |
| Carbon Black Content (range in %) | ASTM D4218 | 2 - 3 | 2 - 3 | 2 - 3 ✓ | 2 - 3 | 2 - 3 |
| Carbon Black Dispersion (Category) | ASTM D5596 | Only near spherical agglomerates for 10 views: 9 views in Cat. 1 or 2, and 1 view in Cat. 3 ✓ | | | | |
| Stress Crack Resistance (Single Point NCTL), hours | ASTM D5397, Appendix | 300 | 300 | 300 | 300 | 300 |
| Oxidative Induction Time, minutes | ASTM D3895, 200°C, 1 atm O ₂ | ≥100 | ≥100 | ≥100 ✓ | ≥100 | ≥100 |
| Melt Flow Index, g/10 minutes | ASTM D1238, 190°C, 2.16kg | ≤1.0 | ≤1.0 | ≤1.0 | ≤1.0 | ≤1.0 |
| Oven Aging | ASTM D5721 | 80 | 80 | 80 | 80 | 80 |
| with HP OIT, (% retained after 90 days) | ASTM D5885, 150°C, 500psi O ₂ | | | | | |
| UV Resistance | GRI GM11 | 20hr. Cycle @ 75°C/4 hr. dark condensation @ 60°C | | | | |
| with HP OIT, (% retained after 1600 hours) | ASTM D5885, 150°C, 500psi O ₂ | 50 | 50 | 50 | 50 | 50 |

These product specifications meet or exceed GRI's GM13

Supply Information (Standard Roll Dimensions)

| Thickness | | Width | | Length | | Area (approx.) | | Weight (average) | |
|-----------|-----|-------|---|--------|-------|-----------------|----------------|------------------|-------|
| mil | mm | ft | m | ft | m | ft ² | m ² | lbs | kg |
| 30 | .75 | 23 | 7 | 600.1 | 182.9 | 13,782 | 1,280 | 3,325 | 1,510 |
| 40 | 1.0 | 23 | 7 | 600.1 | 182.9 | 13,782 | 1,280 | 3,325 | 1,510 |
| 60 | 1.5 | 23 | 7 | 410.1 | 125 | 9,419 | 875 | 3,356 | 1,522 |
| 80 | 2.0 | 23 | 7 | 328.1 | 100 | 7,535 | 700 | 3,306 | 1,500 |
| 100 | 2.5 | 23 | 7 | 246.1 | 75 | 5,651 | 525 | 3,167 | 1,436 |

Notes:

All rolls are supplied with two slings. All rolls are wound on a 6 inch core. Special roll lengths are available on request.
All roll lengths and widths have a tolerance of ±1%

All information, recommendations and suggestions appearing in this literature concerning the use of our products are based upon tests and data believed to be reliable; however, it is the users responsibility to determine the suitability for their own use of the products described herein. Since the actual use by others is beyond our control, no guarantee or warranty of any kind, expressed or implied, is made by Agru/America as to the effects of such use or the results to be obtained, nor does Agru/America assume any liability in connection herewith. Any statement made herein may not be absolutely complete since additional information may be necessary or desirable when particular or exceptional conditions or circumstances exist or because of applicable laws or government regulations. Nothing herein is to be construed as permission or as a recommendation to infringe any patent.



November 24, 2009

Re: Lincoln County Landfill Repair
Crouse, North Carolina
GCL Specification Review

To whom it may concern:

Based on our review of the project specifications, CETCO proposes to supply the following products to this project:

- Bentomat SDN

GEOSYNTHETIC CLAY LINER

Bentomat SDN, a reinforced GCL consisting of a layer of sodium bentonite between two nonwoven geotextiles, which are needlepunched together, will meet or exceed the project specifications, with the following clarifications:

- **Tensile Strength.** CETCO certifies Bentomat SDN will meet or exceed the project requirement of 90 lbs, when tested by ASTM Method 4632, modified with 100-mm (4 inch) wide grips.
- **Peel Strength.** CETCO certifies Bentomat SDN will meet or exceed the project requirement of 15 lbs, when tested by ASTM Method 4632, modified with 100-mm (4 inch) wide grips.

We appreciate your interest in CETCO products. Please call me at (706) 377-3809 if you have any questions.

Sincerely,

Gerri Ortiz
Technical Sales Manager
CETCO Lining Technologies Group



BENTOMAT® SDN CERTIFIED PROPERTIES

| MATERIAL PROPERTY | TEST METHOD | TEST FREQUENCY ft ² (m ²) | REQUIRED VALUES |
|---|----------------------------|---|--|
| Bentonite Swell Index ¹ | ASTM D 5890 | 1 per 50 tonnes ✓ | 24 mL/2g min. ✓ |
| Bentonite Fluid Loss ¹ | ASTM D 5891 | 1 per 50 tonnes ✓ | 18 mL max. ✓ |
| Bentonite Mass/Area ² | ASTM D 5993 | 40,000 ft ² (4,000 m ²) ✓ | 0.75 lb/ft ² (3.6 kg/m ²) min ✓ |
| GCL Grab Strength ³ | ASTM D 6768 | 200,000 ft ² (20,000 m ²) ✓ | 25 lbs/in (44 N/cm) MARV. ✓ |
| GCL Peel Strength ³ | ASTM D 6496 | 40,000 ft ² (4,000 m ²) ✓ | 3.0 lbs/in (5.2 N/cm) min ✓ |
| GCL Index Flux ⁴ | ASTM D 5887 | Weekly ✓ | 1 x 10 ⁻⁸ m ³ /m ² /sec max ✓ |
| GCL Hydraulic Conductivity ⁴ | ASTM D 5887 | Weekly ✓ | 5 x 10 ⁻⁹ cm/sec max ✓ |
| GCL Hydrated Internal Shear Strength ⁵ | ASTM D 5321 ASTM D 6243 | Periodic ✓ | 500 psf (24 kPa) typ @ 200 psf ✓ |

Bentomat SDN is a reinforced GCL consisting of a layer of sodium bentonite between two nonwoven geotextiles, which are needlepunched together.

Notes

- ¹ Bentonite property tests performed at a bentonite processing facility before shipment to CETCO's GCL production facilities.
- ² Bentonite mass/area reported at 0 percent moisture content.
- ³ All tensile strength testing is performed in the machine direction using ASTM D 6768. All peel strength testing is performed using ASTM D 6496. Upon request, tensile and peel results can be reported per modified ASTM D 4632 using 4 inch grips.
- ⁴ Index flux and permeability testing with deaired distilled/deionized water at 80 psi (551kPa) cell pressure, 77 psi (531 kPa) headwater pressure and 75 psi (517 kPa) tailwater pressure. Reported value is equivalent to 925 gal/acre/day. This flux value is equivalent to a permeability of 5x10⁻⁹ cm/sec for typical GCL thickness. Actual flux values vary with field condition pressures. The last 20 weekly values prior the end of the production date of the supplied GCL may be provided.
- ⁵ Peak values measured at 200 psf (10 kPa) normal stress for a specimen hydrated for 48 hours. Site-specific materials, GCL products, and test conditions must be used to verify internal and interface strength of the proposed design.

CETCO has developed an edge enhancement system that eliminates the need to use additional granular sodium bentonite within the overlap area of the seams. We call this edge enhancement, SuperGroove™, and it comes standard on both longitudinal edges of Bentomat® SDN. It should be noted that SuperGroove™ does not appear on the end-of-roll overlaps and recommend the continued use of supplemental bentonite for all end-of-roll seams.

KB

ENGINEERED SYNTHETIC PRODUCTS, INC.

212 North Way
Birmingham, AL 35242
Phone (205)981-1900

DRAINAGE PRODUCT DESCRIPTION SHEET Lincoln County Landfill, Crouse, NC TRANSNET 300-2-8

Transnet 300-2-8 is a superior quality drainage media made by extruding two sets of HDPE strands together to form a diamond shaped net. The net is then heat laminated to an 8 ounce non-woven fabric on each side. This three dimensional structure provides excellent planar liquid flow. The Transnet 300-2-8 conforms to the physical property values listed below:

| NET PROPERTY | TEST METHOD | UNITS | MINIMUM AVERAGE ROLL VALUE |
|------------------------------|-------------|---------------------|------------------------------|
| Polymer Composition | | | 97% polyethylene by weight ✓ |
| Thickness | ASTM D-5199 | mils | 270 ✓ |
| Density of Polymer | ASTM D-1505 | g/cm ² | 0.94 ✓ |
| Melt Index | ASTM D-1238 | g/10 min. | 1.0 max. ✓ |
| Carbon Black | ASTM D-1603 | % | 2 - 3 ✓ |
| Creep Reduction Factor | GRI-GC8 | | 1.2 @15,000 psf ✓ |
| Transmissivity (composite) | ASTM D-4716 | m ² /sec | 1 x 10 ⁻³ * ✓ |
| Tensile Strength (MD) | ASTM D-5035 | lbs/in. | 75 ✓ |
| Ply Adhesion (composite) | ASTM D-7005 | lbs/in | 1.0 ✓ |

*Transmissivity of the geocomposite measured using water at 20 Degrees C with a gradient of 0.03, 7,200 psf confining pressure, between soil and geomembrane after a 100 hour seating time. Values may vary based on dimension of the transmissivity specimen and specific laboratory.

STYLE GE180

GE180 is a superior quality, nonwoven geotextile produced by needlepunching together 100% polypropylene staple fibers in a random network to form a high strength dimensionally stable fabric. The polypropylene fibers are specially formulated to resist ultraviolet light deterioration, and are inert to commonly encountered soil chemicals. The fabric will not mildew, is non-biodegradable, and is resistant to damage from insects and rodents. Polypropylene is stable within a ph range of 2 to 13. GE180 conforms to the physical property values below:

| FABRIC PROPERTY | TEST METHOD | UNITS | MINIMUM AVERAGE ROLL VALUE |
|-------------------|-------------|--------------------|----------------------------|
| Weight | ASTM D-5261 | oz/yd ² | 8.0 |
| Grab Tensile | ASTM D-4632 | lbs | 200 |
| Grab Elongation | ASTM D-4632 | % | 50 |
| Puncture Strength | ASTM D-4833 | lbs | 80 |
| AOS | ASTM D-4751 | US sieve | 80 |
| Permeability | ASTM D-4491 | cm/s | 5 x 10 ⁻⁵ |

ATTACHMENT 2

Project Specifications:

HDPE Geomembrane: Table 02670-D

Geonet Composite Drainage Layer: Table 02675-B

Geosynthetic Clay Liner (GCL): Table 02677-A

TABLE 02670-D
REQUIRED PHYSICAL PROPERTIES OF HDPE GEOMEMBRANE – TEXTURED

| <u>Property</u> | <u>Test Method</u> | <u>Required Value</u> | <u>Required Value</u> |
|---|--------------------------|---|---|
| Liner Size (Nominal) | | 40 mil | 60 mil |
| Thickness (min. ave.) | ASTM D5994 | 38 mil | 57 mil |
| • lowest individual for 8 out of 10 values | | 36 mil | 54 mil |
| • lowest individual for any of the 10 values | | 34 mil | 51 mil |
| Asperity Height mils (min. ave.) (1) | GM 12 | 10 mil | 10 mil |
| Density (min.) | ASTM D1505/ ASTM D792 | 0.940 g/cc | 0.940 g/cc |
| Tensile Properties (min. ave.) | ASTM D6693, Type IV | | |
| - Yield Stress | | 84 lb./in. | 126 lb./in. |
| - Break Stress | | 60 lb./in. | 90 lb./in. |
| - Yield Elongation | | 12% | 12% |
| - Break Elongation | | 100% | 100% |
| Tear Resistance (min. ave.) | ASTM D1004 | 28 lb. | 42 lb. |
| Puncture Resistance (min. ave.) | ASTM D4833 | 60 lb. | 90 lb. |
| Stress Crack Resistance | ASTM D5397 (App.) | 300 hr. | 300 hr. |
| Carbon Black Content (range) | ASTM D1603(5) | 2.0 – 3.0 % | 2.0 – 3.0 % |
| Carbon Black Dispersion | ASTM D5596 | 9 in Categories 1 or 2 and 1 in Category 3 | 9 in Categories 1 or 2 and 1 in Category 3 |
| Oxidative Induction Time (OIT) | | | |
| (a) Standard OIT (min. ave.) or | ASTM D3895 | 100 minutes | 100 minutes |
| (b) High Pressure OIT (min. ave.) | ASTM D5885 | 400 minutes | 400 minutes |
| Oven Aging at 85°C | ASTM D5721 | | |
| (a) Standard OIT(min. ave.) - % retained after 90 days Or | ASTM D3895 | 55% | 55% |
| (b) High Pressure OIT (min. ave.) – % retained after 90 days | ASTM D5885 | 80% | 80% |
| Seam Strengths (2) | | | |
| 1. Shear Strength: Hot Wedge Seam | ASTM D6392 | 80 lb/in (min.) | 120 lb/in (min.) |
| Extrusion Fillet Seam | | 80 lb/in (min.) | 120 lb/in (min.) |
| 2. Peel Strength: Hot Wedge Seam | ASTM D6392 | 60 lb/in (min.) | 91 lb/in (min.) |
| Extrusion Fillet Seam | | 52 lb/in (min.) | 78 lb/in (min.) |
| 3. Peel Separation: Hot Wedge Seam | ASTM D6392 | 25% | 25% |
| Extrusion Fillet Seam | | 25% | 25% |
| Non-Destructive Testing | | | |
| 1. Extrusion Fillet Seam (Single Weld) | Continuous Vacuum Box | Maintain vacuum of at least 5-psi for at least 15 seconds | Maintain vacuum of at least 5-psi for at least 15 seconds |
| 2. Hot Wedge Seam (Double Weld) | Air Testing | Maintain 30-psi for at least 5 minutes, with a drop in pressure not greater than 3-psi for the last 3 minutes | Maintain 30-psi for at least 5 minutes, with a drop in pressure not greater than 3-psi for the last 3 minutes |

1. Of 10 readings; 8 out of 10 must be ≥ 7 mils, and lowest individual reading must be ≥ 5 mils.

2. Value listed for shear and peel strengths are for 4 out of 5 test specimens; the 5th specimen can be as low as 80% of the listed values.

**TABLE 02675-B
GEOCOMPOSITE REQUIRED PHYSICAL PROPERTIES**

| Property | Test Method | Qualifier ¹ | Minimum Average Value |
|---|-------------|------------------------|----------------------------|
| Geonet | | | |
| Polymer Composition, % | | | 95% polyethylene by weight |
| Thickness, mil | ASTM D5199 | MAV | 270 |
| Density, g/cm ³ | ASTM D1505 | MAV | 0.94 |
| Tensile Strength, lb/in | ASTM D5035 | MAV | 75 |
| Carbon Black Content, % | ASTM D1603 | range | 2.0 – 3.0 |
| Creep Reduction Factor | GRI-GC8 | MAV | 1.2 @ 15,000 psf |
| Resin | | | |
| Polymer Density, g/cm ³ | ASTM D1505 | MAV | > 0.94 |
| Melt Flow Index, g/10 min | ASTM D1238 | MAX | ≤ 1.0 |
| Geotextile | | | |
| Mass per Unit Area, oz/yd ² | ASTM D5261 | MAV | 8 |
| Grab Tensile, lb | ASTM D4632 | MAV | 200 |
| Puncture Strength, lb | ASTM D4833 | MAV | 80 |
| AOS, US Sieve | ASTM D4751 | MAV | 70 |
| Permeability, cm/s | ASTM D4491 | MAV | 5 x 10 ⁻⁵ |
| Geocomposite | | | |
| Transmissivity ^{2,3} , m ³ /m ² /sec | ASTM D4716 | MAV | 1.0x 10 ⁻³ |
| Ply Adhesion, lb/in | ASTM D7005 | MAV | 1.0 |
| Roll Width, ft | - | MAV | 15 |
| Roll Length, ft | - | MAV | 160 |

Notes:

1. MAV = Minimum Average Value, MAX = Maximum Value
2. Liner System: Gradient of 0.03, normal load of 7,200 psf, between soil and geomembrane at seat time of 100 hours.
3. Cover System: Gradient 0.33, normal load of 1,000 psf, between soil and geomembrane at seat time of 100 hours.

2.2 ACCESSORIES

- A. Geonet Ties: Plastic fasteners recommended by Manufacturer for tying geonet panels together. Metallic ties shall not be used for joining the geonet strips.

G. Table 02677-A: Manufacturer's Required Pre-Shipping Testing and Properties of GCL:

| Material Property | Test Method | Test Frequency | Required Values |
|----------------------------------|-------------|-------------------------|--|
| Bentonite | | | |
| Bentonite Swell Index | ASTM D5890 | 1 per 50 tons | >24mL/2g |
| Bentonite Fluid Loss | ASTM D5891 | 1 per 50 tons | <18 mL |
| Composite | | | |
| Bentonite Mass/Area ¹ | ASTM D5993 | 40,000 ft ² | > 0.75 lb/ft ² MARV ² |
| Tensile Strength | ASTM D6768 | 200,000 ft ² | > 90 lbs MARV ² |
| Peel Strength (Reinforced) | ASTM D6496 | 40,000 ft ² | > 15 lbs |
| Index Flux | ASTM D5887 | Periodic | < 1 x 10 ⁻⁹ m ³ /m ² /sec |
| Hydraulic Conductivity | ASTM D5887 | Periodic | < 5 x 10 ⁻⁹ cm/sec |
| Hydrated Internal Shear Strength | ASTM D5321 | Periodic | > 500 psf |

¹ Bentonite mass/unit area shall be computed at 0 percent moisture content. Moisture content shall be determined by ASTM D2216 or ASTM D 4643. Bentonite mass/unit area is exclusive of glues added to the bentonite.

² MARV = Minimum Average Roll Value.

H. Tests, Inspections, and Verifications

1. GCL and its components shall be sampled and tested in accordance with the Manufacturer's approved QC Manual.
2. The Manufacturer's QC procedures shall be in accordance with ASTM D 5889.
3. Test results not meeting the requirements specified in Table 2677-A of this Section 02677 shall result in the rejection of applicable rolls.
4. The Manufacturer's QC Manual shall describe procedures used to determine rejection of applicable rolls.
5. As a minimum, rolls produced immediately prior to and immediately after the failed roll shall be tested for the same failed parameter.
6. Testing shall continue until a minimum of three successive rolls on both sides of the original failing roll pass the failed parameter.

2.2 ACCESSORIES

- A. Accessory Bentonite: The granular bentonite or bentonite sealing compound used for seaming, penetration sealing and repairs shall be made from the same natural sodium bentonite as used in the GCL and shall be as recommended by the GCL Manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify anchor trench excavation, where GCL is to be secured, is in correct location and configuration.
- B. Verify compacted soil liner upon which the GCL is to be installed is prepared and compacted in accordance with these Specifications and Drawings.
- C. Verify subgrade and anchor trench excavation are smooth, firm, unyielding and free from angular and sharp rocks, rubble, roots, sticks, vegetation, debris, ice, voids, protrusions, abrupt elevation changes, cracks larger than ¼ - inch in width, and standing water; and other conditions or foreign matter that could contact and affect the performance of GCL.

ATTACHMENT 3

Supplemental Information:

Cetco GCL Performance & Design References

GRI-GCL3 – Table 1(a)



UNDERSTANDING THE NEW CETCO GCL CERTIFIED PROPERTY SHEETS

The CETCO GCL certified property sheets have been revised to include new test methods developed by ASTM. The new test methods are ASTM D 6496 ***“Standard Test Method for Determining Average Bonding Peel Strength Between the Top and Bottom Layers of Needle-Punched Geosynthetic Clay Liners”*** and ASTM D 6768 ***“Standard Test Method for Tensile Strength of Geosynthetic Clay Liners”*** were developed specifically for GCL’s.

The ASTM D 6496 standard for peel strength utilizes 4” wide grips to test 4” wide GCL specimens with computer data acquisition to average numerous data points during separation. This reports the **average** peel strength in units of lbs/in in contrast to the previous standard for peel strength, ASTM D 4632, which reports **peak** peel strength in units of pounds force. Comparison testing performed at CETCO’s GAI-accredited laboratories demonstrates that a GCL peak peel strength value 15 pounds per ASTM D 4632 is equivalent to an average GCL peel strength of 2.5 lbs/in per ASTM D 6496.

ASTM D 6768 for determining the tensile strength of GCL’s also utilizes a 4” wide grip to test 4” wide GCL specimens. GCL tensile strength values are also reported in units of lbs/in. Please refer to Table 1 below for a direct comparison of the new certified values vs. the previous certified values for Bentomat.

Table 1. Comparison of certified values for Peel Strength and Tensile Strength

| GCL | Peel Strength | | Grab Strength | |
|--------------|---------------|-------------|---------------|-------------|
| | ASTM D 4632 | ASTM D 6496 | ASTM D 4632 | ASTM D 6768 |
| Bentomat ST | 15 lbs | 2.5 lbs/in | 90 lbs | 22.5 lbs/in |
| Bentomat SDN | 15 lbs | 2.5 lbs/in | 90 lbs | 22.5 lbs/in |
| Bentomat DN | 15 lbs | 2.5 lbs/in | 150 lbs | 37.5 lbs/in |

The certified property sheets for CETCO GCLs will continue to list the values for peel strength and grab strength per ASTM D 4632 for approximately one year until project specifications begin using requiring GCL properties per ASTM D 6496 and ASTM D 6768.

Also included on the new CETCO certified property sheets is an internal shear strength value for Bentomat under high normal load, representative of loading conditions for landfill liner systems. Bentomat ST and Bentomat DN have typical shear strength values of 6,500 psf @ 10,800 psf normal load. Bentomat SDN has a typical internal shear strength of 5,500 psf @ 10,800 psf normal load. These internal shear strength values are based upon historical internal shear strength testing of Bentomat. CETCO still recommends specific testing with actual expected loading conditions for each project.



REFERENCES

ASTM D4632-96, *Standard Test Method for Grab Breaking Load and Elongation of Geotextiles*, Vol. 04.09, ASTM International, W. Conshohocken, PA.

ASTM 6496-99, *Standard Test Method for Determining Average Bonding Peel Strength between the Top and Bottom Layers of Needle-punched GCLs*, Vol. 04.09, ASTM International, W. Conshohocken, PA.

ASTM 6768-02, *Standard Test Method for tensile strength of GCLs*, Vol. 04.09, ASTM International, W. Conshohocken, PA.

AN EXPLANATION OF CHANGES MADE TO CETCO GCL CERTIFIED PROPERTIES SHEETS

CETCO is pleased to announce some important changes to key physical properties and test methods for several of our GCL products. These changes are summarized in the following table and will appear in all certified properties sheets issued after 1 May 2007.

Summary of Changes to CETCO GCL Certified Properties
(Effective 1 May 2007)

| Product | Tensile Strength | | Peel Strength | |
|--------------|--|--------------------------------------|--|---------------------------------------|
| | Old Value (Method) | New Value (Method) | Old Value (Method) | New Value (Method) |
| Bentomat ST | 90 lbs (D 4632) 22.5 lbs/in (D 6768) | 30 lbs/in (D 6768) (33% increase) | 15 lbs (D 4632) 2.5 lbs/in (D 6496) | 3.5 lbs/in (D 6496) (40% increase) |
| Bentomat DN | 150 lbs (D 4632) 37.5 lbs/in (D 6768) | 50 lbs/in (D 6768) (33% increase) | 15 lbs (D 4632) 2.5 lbs/in (D 6496) | 3.5 lbs/in (D 6496) (40% increase) |
| Bentomat SDN | 90 lbs (D 4632) 22.5 lbs/in (D 6768) | 30 lbs/in (D 6768) (33% increase) | 15 lbs (D 4632) 2.5 lbs/in (D 6496) | 2.5 lbs/in (D 6496) (no change) |
| Bentomat CL | 120 lbs (D 4632) 30 lbs/in (D 6768) | 45 lbs/in (D 6768) (50% increase) | 15 lbs (D 4632) 2.5 lbs/in (D 6496) | 2.5 lbs/in (D 6496) (no change) |
| Claymax 200R | 100 lbs (D 4632) 25 lbs/in (D 6768) | 40 lbs/in (D 6768) (60% increase) | N/A | N/A |

Two general types of changes have been made. First, we are completing the transition from the old test method (ASTM D 4632) which was used for measuring both tensile strength and peel strength, to the new test methods (ASTM D 6768 and D 6496) for tensile and peel strength, respectively. For several years CETCO has been publishing both the old and new test methods in our GCL certified properties sheets. This is an unnecessary and confusing redundancy, and so we are taking the final transitional step which eliminates reference to the old test methods. For a more detailed description of the differences between the "old" and "new" methods, please refer to CETCO's TR-334, "Understanding the New CETCO GCL Certified Property Sheets."

The other major change reflects a significant increase in the tensile strength and peel strength properties of most of our GCL products. This increase is not related to the transition in test methods. Instead, based on a comprehensive analysis of historical tensile strength and peel strength data from our two North American production facilities, it was concluded that the values shown on our certified properties sheets were overly conservative. We have therefore increased the tensile strength and peel strength values of several products in order to more accurately reflect their true strength characteristics.

The effective date of the changes listed above is 1 May 2007. New certified properties sheets will be made available through our website www.cetco.com/LT or by contacting CETCO at 800-527-9948.

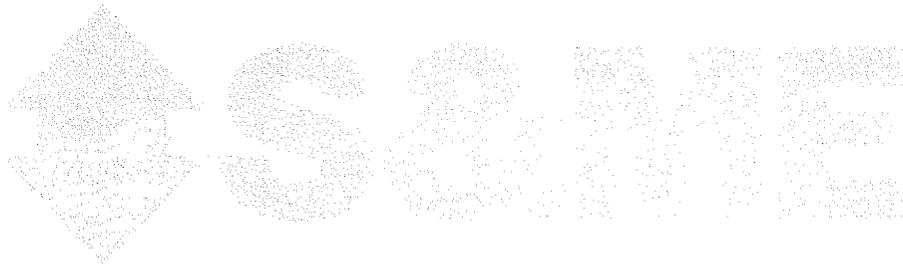
Table 1(a) – Specification for Geosynthetic Clay Liners (GCLs)

| Property | ASTM Test Method | Reinforced GCL | | Non-Reinforced GCL | | Testing Frequency |
|---|-----------------------|-----------------------|-------------------|------------------------|-----------------------|-----------------------|
| | | GT-Related | GT Polymer Coated | GM-GF Related | GT-Related | |
| <u>Clay (as received)</u> swell index (ml/2g) fluid loss (ml) ⁽¹⁾ | D5890 | 24 | 24 | 24 | 24 | 50 tonnes |
| | D5891 | 18 | 18 | 18 | 18 | 50 tonnes |
| <u>Geotextiles (as received)</u> cap fabric (nonwoven) - mass/unit area (g/m ²) ⁽²⁾ cap fabric -(woven) - mass/unit area (g/m ²) carrier fabric (nonwoven composite) - mass/(g/m ²) ⁽²⁾ carrier fabric (woven) - mass/unit area (g/m ²) coating - mass/unit area (g/m ²) ⁽³⁾ | D5261 | 200 | 200 | 200 | 70 | 20,000 m ² |
| | D5261 | 100 | 100 | 100 | - | 20,000 m ² |
| | D5261 | 240 | 240 | 240 | 90 | 20,000 m ² |
| | D5261 | 100 | 100 | 100 | - | 20,000 m ² |
| | D5261 | n/a | 100 | n/a | n/a | 4,000 m ² |
| <u>Geomembrane/Geofilm (as received)</u> thickness ⁽⁵⁾ (mm) density (g/cc) break tensile strength, MD&XMD (kN/m) break tensile strength, MD (kN/m) | D5199/D5994 | n/a | n/a | 0.40/0.50/0.10 | n/a | 20,000 m ² |
| | D1505/D792 | n/a | n/a | 0.92 | n/a | 20,000 m ² |
| | D6693 | n/a | n/a | n/a | n/a | 20,000 m ² |
| | D882 | n/a | n/a | 2.5 | n/a | 20,000 m ² |
| <u>GCL (as manufactured)</u> mass of GCL (g/m ²) ⁽⁶⁾ mass of bentonite (g/m ²) ⁽⁶⁾ moisture content ⁽¹⁾ (%) tensile str., MD (kN/m) peel strength (N/m) permeability ⁽¹⁾ (m/sec), "or" flux ⁽¹⁾ (m ³ /sec-m ²), GCL permeability ⁽¹⁾⁽⁷⁾ (m/sec) (max. at 35 kPa) GCL permeability ⁽¹⁾⁽⁷⁾ (m/sec) (max. at 500 kPa) | D5993 | 4000 | 4050 | 4100 | 4000 | 4,000 m ² |
| | D5993 | 3700 | 3700 | 3700 | 3700 | 4,000 m ² |
| | D5993 | (4) | (4) | (4) | (4) | 4,000 m ² |
| | D6768 | 4.0 | 4.0 | 4.0 | 4.0 | 20,000 m ² |
| | D6496 | 360 | 360 | 360 | n/a | 4,000 m ² |
| | D5887 | 5 × 10 ⁻¹¹ | n/a | n/a | 5 × 10 ⁻¹¹ | 25,000 m ² |
| | D5887 | 1 × 10 ⁻⁸ | n/a | n/a | 1 × 10 ⁻⁸ | 25,000 m ² |
| | D6766 | 1 × 10 ⁻⁸ | n/a | n/a | 1 × 10 ⁻⁸ | yearly |
| D6766 mod. | 5 × 10 ⁻¹⁰ | n/a | n/a | 5 × 10 ⁻¹⁰ | yearly | |
| <u>Component Durability</u> geotextile and reinforcing yarns ⁽⁸⁾ (% strength retained) geomembrane geofilm/polymer treated ⁽⁸⁾ (% strength retained) | See § 5.6.2 | 65 | 65 | n/a | 65 | yearly |
| | See § 5.6.3 | n/a | n/a | GM Spec ⁽⁹⁾ | n/a | yearly |
| | See § 5.6.4 | n/a | 85 | 80 | n/a | yearly |

n/a = not applicable with respect to this property

- These values are maximum (all others are minimum)
- For both cap and carrier fabrics for nonwoven reinforced GCLs; one, or the other, must contain a scrim component of mass ≥ 100 g/m² for dimensional stability
- Calculated value obtained from difference of coated fabric to as-received fabric
- Value is both site-specific and product-specific and is currently being evaluated
- First value is for smooth geomembrane; second for textured geomembrane; third for geofilm
- Mass of the GCL and bentonite is measured after oven drying per the stated test method
- Value represents GCL permeability after permeation with a 0.1 M calcium chloride solution (11.1 g CaCl₂ in 1-liter water)
- Value represents the minimum percent strength retained from the as-manufactured value after oven aging at 60°C for 50 days
- Durability criteria should follow the appropriate specification for the geomembrane type used; i.e., GRI GM-13 for HDPE, GRI GM-17 for LLDPE or GRI GM-18 for FPP

RESULTS OF CONSTRUCTION SOIL TESTING





Summary of Density Test Results

Project Name: LCLF Stormwat. Pipe Remo. Ph III
 Client: Lincoln County, 5291 Crouse Road, Crouse, North Carolina 28033

| Test No. | Date | In-Place Density Test | | Check Plug Data | | Reference Standard | | | Compaction | | Location | Elevation or Stone Depth | | |
|----------|----------|-----------------------|-------------|------------------|-------------|--------------------|-------|------------|------------|--------------------------|----------|--------------------------|-----------------------|------------------|
| | | Type | Dry Density | Moisture Content | Dry Density | Moisture Content | Type | Ref. Curve | MDD | Optimum Moisture Content | | | Percent Specified | Percent In-Place |
| 1 | 01/12/10 | D 2937 | 97.1 | 26.4 | 97.6 | 20.2 | D 698 | BLK1 | 101.0 | 22.0 | 95 | 96 | 5'N of Anchor Trench | -1' |
| 2 | 01/12/10 | D 2937 | 96.2 | 25.2 | | | D 698 | BLK1 | 101.0 | 22.0 | 95 | 95 | 15'N of Anchor Trench | SG |
| 3 | 01/12/10 | D 2937 | 97.0 | 25.6 | | | D 698 | BLK1 | 101.0 | 22.0 | 95 | 96 | 20'N of Anchor Trench | Lift 1 |
| 4 | 01/12/10 | D 2937 | 96.6 | 24.0 | | | D 698 | BLK1 | 101.0 | 22.0 | 95 | 96 | 10'N of Anchor Trench | Lift 2 |
| 5 | 01/12/10 | D 2937 | 97.6 | 27.0 | | | D 698 | BLK1 | 101.0 | 22.0 | 95 | 97 | 5'N of Anchor Trench | Lift 3 |

* = Failed Specified Compaction, ** = Failed Specified Moisture Content

All Test Locations and Elevations are Approximate

Notes:

References: ASTM D 2937: Density of Soil In Place by the Drive Cylinder Method, ASTM D 698: Laboratory Compaction Characteristics of Soil Using Standard Effort

Distribution: Nancy Rickard/Lincoln County

Julie Peterson/S&ME, Inc.

Name (Technical Responsibility)

Signature

Project Manager

Position



Revision No. 0

Liquid Limit, Plastic Limit, and Plastic Index

Revision Date: 11/20/07

Another code

ASTM D 4318

AASHTO T 89

AASHTO T 90

Quality Assurance

S&ME, Inc. ~ 9751 Southern Pine Boulevard ~ Charlotte, NC 28273

Project #: 1356-03-255B PH002 Report Date: 8/3/09

Project Name: LCLF Phase III Stormwater Pipe Removal Test Date(s): 7/28-8/3/09

Client Name: Lincoln County

Client Address:

Boring #: Sample #: Bulk-1 Sample Date: 7/24/09

Location: Top of Stormwater Pipe Offset: Elevation: 2'

Sample Description: Red Coarse to Fine Sandy Silt (ML)

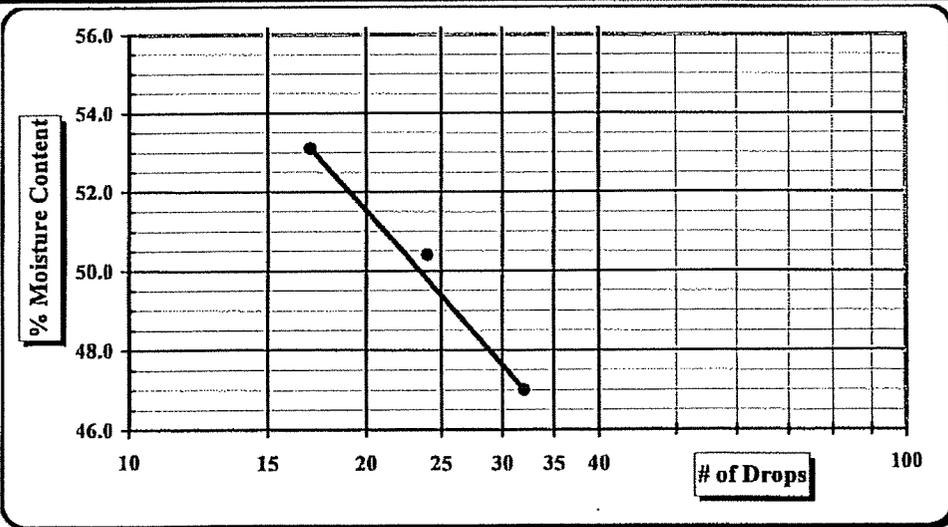
Type and Specification S&ME ID # Cal Date: Type and Specification S&ME ID # Cal Date:

Balance (0.01 g) Grooving tool

LL Apparatus Grooving tool

Oven Grooving tool

| Pan # | Tare #: | Liquid Limit | | | | Plastic Limit | |
|-------|-----------------------|--------------|-------|-------|---|---------------|--|
| | | 25 | 52 | 16 | WN | 56 | |
| A | Tare Weight | 14.38 | 15.68 | 15.72 | 16.57 | 15.71 | |
| B | Wet Soil Weight + A | 25.67 | 24.96 | 25.12 | 22.75 | 22.10 | |
| C | Dry Soil Weight + A | 22.06 | 21.85 | 21.86 | 21.35 | 20.61 | |
| D | Water Weight (B-C) | 3.61 | 3.11 | 3.26 | 1.40 | 1.49 | |
| E | Dry Soil Weight (C-A) | 7.68 | 6.17 | 6.14 | 4.78 | 4.90 | |
| F | % Moisture (D/E)*100 | 47.0% | 50.4% | 53.1% | 29.3% | 30.4% | |
| N | # OF DROPS | 32 | 24 | 17 | Moisture Contents determined by ASTM D 2216 | | |
| LL | LL = F * FACTOR | | | | | | |
| Ave. | Average | | | | 29.9% | | |



| One Point Liquid Limit | | | |
|------------------------|--------|----|--------|
| N | Factor | N | Factor |
| 20 | 0.974 | 26 | 1.005 |
| 21 | 0.979 | 27 | 1.009 |
| 22 | 0.985 | 28 | 1.014 |
| 23 | 0.99 | 29 | 1.018 |
| 24 | 0.995 | 30 | 1.022 |
| 25 | 1.000 | | |

NP, Non-Plastic
 Liquid Limit 49
 Plastic Limit 30
 Plastic Index 19
 Group Symbol ML
 Multipoint Method
 One-point Method

Wet Preparation Dry Preparation Air Dried Estimate the % Retained on the #40 Sieve:

Notes / Deviations / References:

ASTM D 4318: Liquid Limit, Plastic Limit, & Plastic Index of Soils

Karen Warner
Technician Name

Date

Julie Petersen
Julie Petersen
Technical Responsibility

8/3/09
Date

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Moisture - Density Relationship



ASTM D558, D698, D1557, AASHTO T99, T180

Quality Assurance

S&ME, Inc. ~ 9751 Southern Pine Boulevard ~ Charlotte, NC 28273

| | |
|---|---------------------------------|
| Project #: 1356-03-255B PH002 | Report Date: 8/3/09 |
| Project Name: LCLF Phase III Stormwater Pipe Removal | Test Date(s): 7/27-31/09 |
| Client Name: Lincoln County Landfill | |
| Client Address: | |

| | | |
|---|-------------------------|-------------------------------|
| Boring #: | Sample #: Bulk-1 | Sample Date: 7/24/2009 |
| Location: Top of stormwater pipe | Offset: | Depth: 2' |
| Sample Description: Red Coarse to Fine Sandy Silt (ML) | | |
| Type and Specification | S&ME ID # | Cal Date: |
| Balance (0.1 g) | | Compaction Mold |
| Balance | | Compaction Hammer |
| Straightedge | | Oven |
| Sieve | | |

| Water Content | | Water Content requires GP 2 Balance (0.1 gram Readability). | | | | Check: | |
|--|---------|---|--------------|-------------------------------------|--------------|-------------------------------------|----|
| ASTM D2216 <input checked="" type="checkbox"/> | | AASHTO T265 <input type="checkbox"/> | | ASTM D4959 <input type="checkbox"/> | | ASTM D4643 <input type="checkbox"/> | |
| Water Added: | | | | | | | |
| Tare #: | | | DJ | L-10 | 76 | C | 81 |
| A. Tare Weight | A. | 107.9 | 84.8 | 71.5 | 84.0 | 73.9 | |
| B. Wet Wt + Tare Wt | B. | 844.6 | 860.0 | 694.1 | 845.3 | 718.9 | |
| C. Dry Wt. + Tare Wt. | C. | 734.0 | 737.2 | 585.3 | 695.9 | 579.7 | |
| D. Water Weight | B-C | 110.6 | 122.8 | 108.8 | 149.4 | 139.2 | |
| E. Dry Weight | C-A | 626.1 | 652.4 | 513.8 | 611.9 | 505.8 | |
| F. Moisture Content | 100*D/E | 17.7% | 18.8% | 21.2% | 24.4% | 27.5% | |

| Compaction Data | | Requires a GP 5 Balance for ASTM (1 gram or .0022 Lb. readability). | | | | Check: 1000/1000 | |
|--|--------------|---|-------------|-------------------------------------|-------------|---|--|
| ASTM D558 <input type="checkbox"/> | | ASTM D 698 <input checked="" type="checkbox"/> | | ASTM D1557 <input type="checkbox"/> | | AASHTO T99 <input type="checkbox"/> | |
| Method A <input checked="" type="checkbox"/> | | Method B <input type="checkbox"/> | | Method C <input type="checkbox"/> | | Method D (ASTM 1978) <input type="checkbox"/> | |
| G. Wt of Soil + Mold | G. | 5879 | 5951 | 6010 | 6011 | 5958 | |
| H. Wt. of Mold | H. | 4162 | 4162 | 4162 | 4162 | 4162 | |
| I. Wt. of Soil (g. or lbs.) | G-H | 1717 | 1789 | 1848 | 1849 | 1796 | |
| J. Wt of Soil (Lbs.) | 1/453.6 or I | 3.785 | 3.944 | 4.074 | 4.076 | 3.959 | |
| K. Mold Volume Factor | K. | 30.07 | 30.07 | 30.07 | 30.07 | 30.07 | |
| L. Wet Density (PCF) | J*K | 113.8 | 118.6 | 122.5 | 122.6 | 119.0 | |
| M. Dry Density (PCF) | L/(1+F) | 96.7 | 99.8 | 101.1 | 98.6 | 93.3 | |

Sieve Size used to separate the Oversize Fraction: #4 Sieve 3/8 inch Sieve 3/4 inch Sieve
 Mechanical Rammer Manual Rammer Moist Preparation Dry Preparation

References / Comments / Deviations: ASTM D 4318, D 854, D 2487, C 127

Karen Warner
Technician Name

Signature

NICET 117900
Certification Type/No.

Date

Julie Petersen
Technical Responsibility

Signature

Project Manager
Position

8/3/09
Date

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Moisture - Density Report



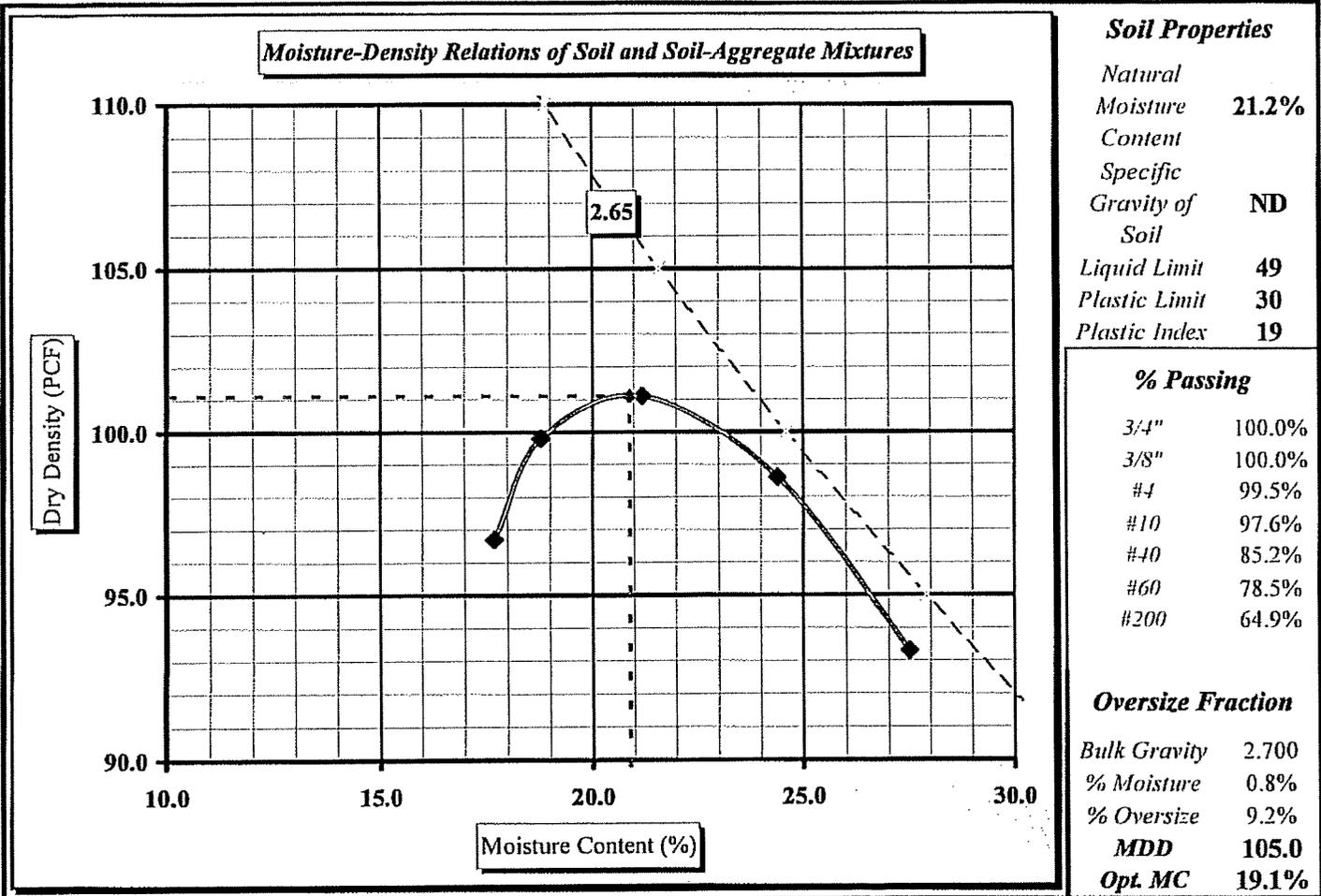
Quality Assurance

S&ME, Inc. ~ 9751 Southern Pine Boulevard ~ Charlotte, NC 28273

| | | | | |
|---------------------|--|---------------|--------------|-----------|
| S&ME Project #: | 1356-03-255B PH002 | Report Date: | 8/3/09 | |
| Project Name: | LCLF Phase III Stormwater Pipe Removal | Test Date(s): | 7/27-31/09 | |
| Client Name: | Lincoln County Landfill | | | |
| Client Address: | | | | |
| Boring #: | Sample #: | Bulk-1 | Sample Date: | 7/24/2009 |
| Location: | Top of stormwater pipe | Offset: | Depth: | 2' |
| Sample Description: | Red Coarse to Fine Sandy Silt (ML) | | | |

Maximum Dry Density 101.1 PCF. Optimum Moisture Content 20.9%

ASTM D 698 -- Method A



Moisture-Density Curve Displayed: Fine Fraction Corrected for Oversize Fraction (ASTM D 4718)
 Sieve Size used to separate the Oversize Fraction: #4 Sieve 3/8 inch Sieve 3/4 inch Sieve
 Mechanical Rammer Manual Rammer Moist Preparation Dry Preparation

References / Comments / Deviations:

ASTM D 2216: Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
 ASTM D 698: Laboratory Compaction Characteristics of Soil Using Standard Effort

Julie Petersen
 Technical Responsibility

Julie Petersen
 Signature

Project Manager
 Position

8/3/09
 Date

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Sieve Analysis of Soils

ASTM D 422



Quality Assurance

S&ME, Inc. ~ 9751 Southern Pine Boulevard ~ Charlotte, NC 28273

Project #: 1356-03-255B Phase 002 **Report Date:** 7/30/09
Project Name: LCLF Phase III Stormwater Pipe Removal **Test Date(s):** 7/27/09
Client Name: Lincoln County Landfill
Client Address:

Sample Id. Bulk-1 **Type:** Bulk **Sample Date:** 7/24/09
Location: Top of stormwater pipe **Sample:** **Elevation:** 2'

Sample Description: Red Coarse to Fine Sandy Silt (ML)

Description of Sand & Gravel Particles: Rounded Angular
 Hard & Durable Soft Weathered & Friable

| Particle Size Analysis / Without Hydrometer Analysis | | | | Material Excluded: | | |
|--|-------------------------------|-----------------|---------------------------|--------------------------------------|----------------------------------|-------|
| Tare No. | KW | Tare Wt. | 85.6 | Mass of Sample after Wash + Tare Wt. | 183.3 | |
| Total Sample Wet Wt. + Tare Wt. | | | 402.5 | Mass of Sample after Wash | 97.6 | |
| Total Sample Dry Wt. + Tare Wt. | | | 362.6 | Mass passing #200 | 179.3 | |
| Total Sample Dry Weight | | | 276.9 | % Passing #200 (D1140) | 64.7% | |
| Sieve Size | | Retained Weight | % Retained Between Sieves | % Retained | % Passing | SPECS |
| Standard | mm. | Cumulative | Individual | Cumulative Total Sample | | |
| 2.0" | 50.00 | 0.0 | 0.0% | 0.0% | 100.0% | |
| 1.5" | 37.50 | 0.0 | 0.0% | 0.0% | 100.0% | |
| 1.0" | 25.00 | 0.0 | 0.0% | 0.0% | 100.0% | |
| 3/4" | 19.00 | 0.0 | 0.0% | 0.0% | 100.0% | |
| 1/2" | 12.50 | 0.0 | 0.0% | 0.0% | 100.0% | |
| 3/8" | 9.50 | 0.0 | 0.0% | 0.0% | 100.0% | |
| #4 | 4.75 | 1.3 | 0.5% | 0.5% | 99.5% | |
| #10 | 2.000 | 6.7 | 2.0% | 2.4% | 97.6% | |
| #20 | 0.850 | 20.6 | 5.0% | 7.4% | 92.6% | |
| #40 | 0.425 | 41.0 | 7.4% | 14.8% | 85.2% | |
| #60 | 0.250 | 59.6 | 6.7% | 21.5% | 78.5% | |
| #100 | 0.150 | 76.1 | 5.9% | 27.5% | 72.5% | |
| #200 | 0.075 | 97.2 | 7.6% | 35.1% | 64.9% | |
| Pan | <0.075 | 97.6 | | % Passing #200 (C136) = | | 64.9% |
| D2487 | Maximum Particle Size | | | Medium Sand | < 2.00 mm and > 0.425 mm (#40) | 12.4% |
| Gravel | < 75 mm and > 4.75 mm (#4) | | 0.5% | Fine Sand | < 0.425 mm and > 0.075 mm (#200) | 20.3% |
| Coarse Sand | < 4.75 mm and > 2.00 mm (#10) | | 2.0% | % Silt & Clay | < 0.075 mm | 64.9% |

Notes / Deviations / References:

Julie Petersen
 Technical Responsibility

Julie Petersen
 Signature

Project Manager
 Position

8/3/09
 Date

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Sieve Analysis of Soils



ASTM D 422

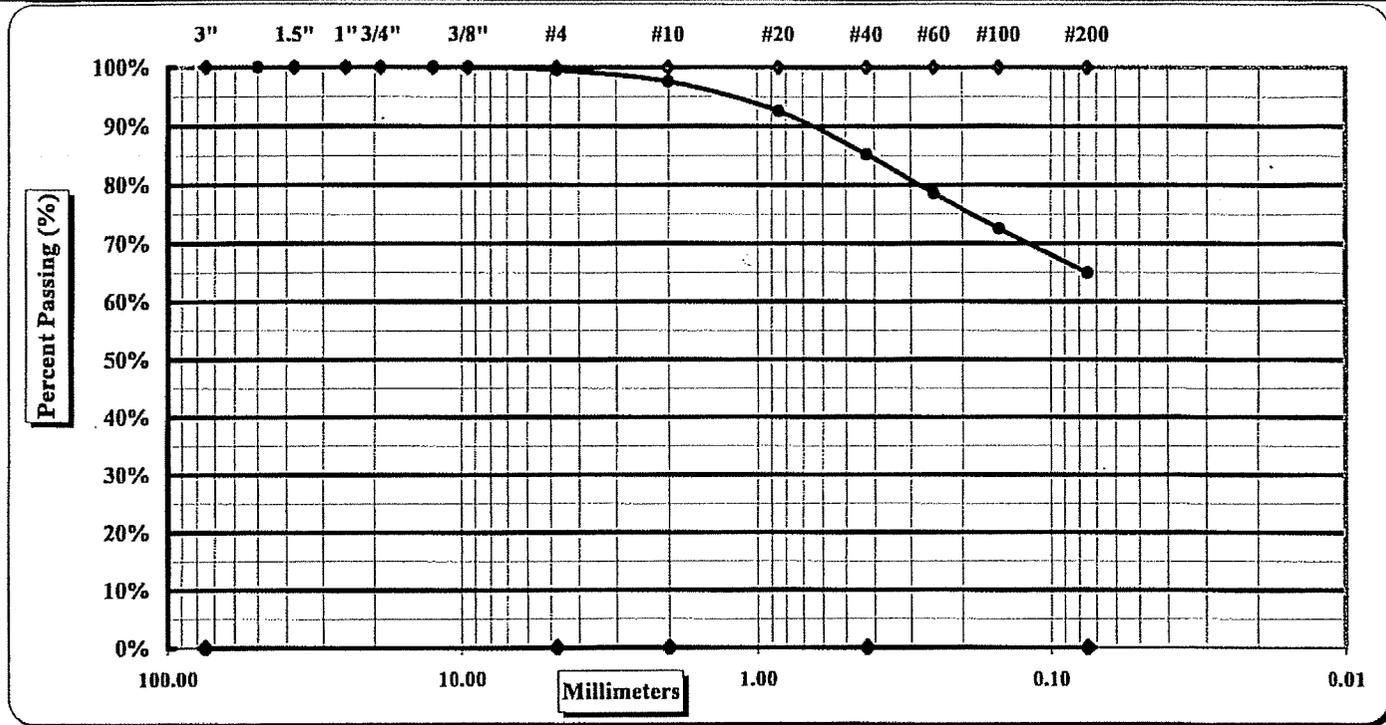
Quality Assurance

S&ME, Inc. ~ 9751 Southern Pine Boulevard ~ Charlotte, NC 28273

Project #: 1356-03-255B Phase 002 **Report Date:** 7/30/09
Project Name: LCLF Phase III Stormwater Pipe Removal **Test Date(s):** 7/27/09
Client Name: Lincoln County Landfill
Client Address:

Sample Id: Bulk-1 **Type:** Bulk **Sample Date:** 7/24/09
Location: Top of stormwater pipe **Sample:** **Elevation:** 2'

Sample Description: Red Coarse to Fine Sandy Silt (ML)



| | | | |
|-------------|---------------------------------|-----------|----------------------------------|
| Cobbles | < 300 mm (12") and > 75 mm (3") | Fine Sand | < 0.425 mm and > 0.075 mm (#200) |
| Gravel | < 75 mm and > 4.75 mm (#4) | Silt | < 0.075 and > 0.005 mm |
| Coarse Sand | < 4.75 mm and > 2.00 mm (#10) | Clay | < 0.005 mm |
| Medium Sand | < 2.00 mm and > 0.425 mm (#40) | Colloids | < 0.001 mm |

| | | | | | |
|-----------------------|-------------|------------------|-----------|---------------|-------|
| Maximum Particle Size | Coarse Sand | 2.0% | Fine Sand | 20.3% | |
| Gravel | 0.5% | Medium Sand | 12.4% | Silt & Clay | 64.9% |
| Liquid Limit | 49 | Plastic Limit | 30 | Plastic Index | 19 |
| Specific Gravity | ND | Moisture Content | 21.2% | | |
| Coarse Sand | 2.0% | Medium Sand | 12.4% | Fine Sand | 20.3% |

Description of Sand & Gravel Particles: Rounded Angular
 Hard & Durable Soft Weathered & Friable

Notes / Deviations / References:

Julie Petersen
 Technical Responsibility

Julie Petersen
 Signature

Project Manager
 Position

7/30/09
 Date

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GEOSYNTHETIC INSTALLATION FORMS AND MQC DATA





SUBGRADE CERTIFICATION

Material: 60 mil Microspike
Manufacturer: Agro America
Installer: Plastic Fusion

Date: 1/14/10
S&ME Project No.: 1356-09-018
Project Name: Lincoln County Landfill SW Pipe Removal
Project Location: Lincoln County, North Carolina

R-1A through R-1C

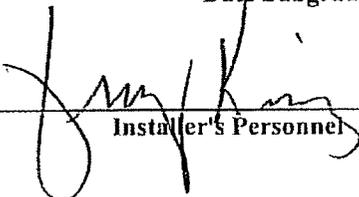
THE SUBGRADE THAT THE ABOVE LISTED PANELS ARE TO BE DEPLOYED UPON WAS INSPECTED AND DETERMINED TO BE SUITABLE IN ACCORDANCE WITH THE PROJECT SPECIFICATIONS.

IF THE SUBGRADE IS NOT SUITABLE, STATE REASONS:

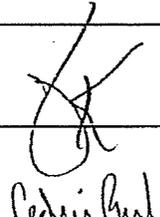
CORRECTIVE ACTION:

Date Corrective Action was Implemented: _____

Date Subgrade was Accepted by Installer: 1-14-10



Installer's Personnel



CQA Personnel



quality certificate

ROLL # **244347-09**

Lot #: **8190643**

Liner Type: **MICROSPIKE™ HDPE**

| Measurement | METRIC | ENGLISH | Thickness..... | 1.5 mm | 60 mil |
|---------------------------------------|---------------------|---------------|---------------------|----------------|-------------------|
| ASTM D5994 | MIN: 1.53 mm | 60 mil | Length..... | 125 m | 410.1 feet |
| (Modified) | MAX: 1.60 mm | 63 mil | Width..... | 7.00 m; | 23.0 feet |
| Asperity ASTM D7466: 29/31 mil | AVE: 1.57 mm | 62 mil | TEST RESULTS | | |

ODD #: TOP EVEN #: BOTTOM OIT(Standard) ASTM D3895 minutes **179**

| | | | |
|-------------------------------|---------|------|-------------|
| Specific Gravity ASTM D792 | Density | g/cc | .943 |
|-------------------------------|---------|------|-------------|

| | | | |
|---|-------------------------------|----------|------------|
| MFI ASTM D1238 COND. E GRADE: K307 | Melt Flow Index 190°C /2160 g | g/10 min | .27 |
|---|-------------------------------|----------|------------|

| | | | |
|------------------------------------|-------|---|-------------|
| Carbon Black Content ASTM D4218 | Range | % | 2.54 |
|------------------------------------|-------|---|-------------|

| | | |
|---------------------------------------|----------|--------------------|
| Carbon Black Dispersion ASTM D5596 | Category | 10 In Cat 1 |
|---------------------------------------|----------|--------------------|

| | | | | |
|---|--------------------------|-----------------------|----------------|------------------|
| Tensile Strength ASTM D6693 ASTM D638 (Modified) (2 inches / minute) | Average Strength @ Yield | 28 N/mm (kN/m) | 157 ppi | 2,543 psi |
| | Average Strength @ Break | 29 N/mm (kN/m) | 164 ppi | 2,650 psi |

| | | | |
|--|----------------------------|---|--------------|
| Elongation ASTM D6693 ASTM D638 (Modified) (2 inches / minute) Lo = 1.3" Yield Lo = 2.0" Break | Average Elongation @ Yield | % | 15.37 |
| | Average Elongation @ Break | % | 417.9 |

| | | | |
|--|----------------------------|---|--------------|
| Dimensional Stability ASTM D1204 (Modified) | Average Dimensional change | % | -0.45 |
|--|----------------------------|---|--------------|

| | | | |
|---|-------------------------|----------------|-------------------|
| Tear Resistance ASTM D-1004 (Modified) | Average Tear Resistance | 258.1 N | 58.034 lbs |
|---|-------------------------|----------------|-------------------|

| | | | |
|--|------|----------------|-------------------|
| Puncture Resistance FTMS 101 Method 2065 (Modified) | Load | 475.3 N | 106.85 lbs |
|--|------|----------------|-------------------|

| | | | |
|--|------|----------------|-------------------|
| Puncture Resistance ASTM D4833 (Modified) | Load | 627.8 N | 141.14 lbs |
|--|------|----------------|-------------------|

| | | | |
|--------------------|--------------------------|----------|------------------|
| ESCR ASTM D1693 | Minimum Hrs w/o Failures | 1500 hrs | CERTIFIED |
|--------------------|--------------------------|----------|------------------|

| | | | |
|---|-------------------|---------|-------------|
| Notched Constant Tensile Load ASTM D5397 | pass / fail @ 30% | 300 hrs | PASS |
|---|-------------------|---------|-------------|

Customer: **Plastic Fusion**
 PO: **P12648 Lincoln County Landfill**
 Destination: **Crouse, NC**

Date: **10-28-09**
 Signature: *[Handwritten Signature]*
 Quality Control Department

60HDmic.FRM
 REV 03
 12/23/05

Certificate of Analysis

Shipped To: AGRU AMERICA : RAINS
MILEPOST SH317
RAINS SC 29589
USA

Recipient: PALMER
Fax:

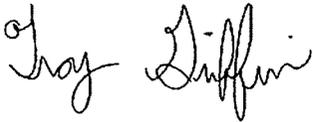
CPC Delivery #: 87874707
PO #: 5067
Weight: 188500 LB
Ship Date: 06/17/2009
Package: BULK
Mode: Hopper Car
Car #: PSPX007173
Seal No: 261504

Product:
MARLEX POLYETHYLENE K307 BULK

Lot Number: 8190643

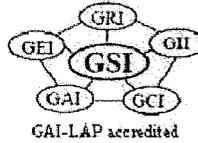
| Property | Test Method | Value | Unit |
|-----------------|-------------|------------|--------|
| Melt Index | ASTM D1238 | 0.270 | g/10mi |
| HLMI Flow Rate | ASTM D1238 | 20.00 | g/10mi |
| Density | ASTM D1505 | 0.9370 | g/cm3 |
| Pellet Count | P02.08.03 | 27.000 | pel/g |
| Production Date | | 06/14/2009 | |

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.



Troy Griffin
Quality Systems Coordinator

For CoA questions contact Customer Service Representative at +1-832-813-4637



Date: 1/6/2010
Purchase Order: P12649
ORDER NUMBER: 000257655

Paul Elliott
Plastic Fusion

Huntsville, AL 35811
pelliot@plasticfusion.com

To Whom it May Concern:

Please find enclosed the MQA/MQC test data package for Geosynthetic Clay Liner shipments to Plastic Fusion.

The enclosed data package includes results of all the MQC tests required by ASTM D5889, with the exception of index flux/hydraulic conductivity. This test, which is run according to ASTM D5887, is normally performed once per production lot (once per week), unless a higher frequency is required by the project specifications. Because of the GCL's low permeability, this test can take several weeks to complete. The index flux/hydraulic conductivity results associated with this lot of material will be provided under separate cover as soon as they are available.

Although the index flux/hydraulic conductivity test results are not yet available, CETCO accepts responsibility for our GCL should the index flux/hydraulic conductivity tests produce unacceptable results. If, upon delivery and prior to installation, individual rolls of GCL are found to be nonconforming to accepted project specifications, CETCO will replace the nonconforming material at no charge.

Questions regarding this information should be directed to Chris Athanassopoulos, Technical Support Engineer, at (847) 851-1831.

Sincerely,

Melanie King
Quality Assurance Coordinator
CETCO Cartersville Plant



**GEOSYNTHETIC CLAY LINER
MANUFACTURING QUALITY ASSURANCE DATA PACKAGE**

PROJECT NAME: Lincoln County LF

CUSTOMER P.O.: P12649

ORDER NUMBER: 000257655

PREPARED FOR: Plastic Fusion

CONTENTS:

- Product Certifications
- GCL Order packing list and MQA tracking form
- GCL manufacturing quality control test data
- Bentonite clay certification
- Raw material test results

PREPARED BY: Melanie King
Quality Assurance Coordinator
CETCO
218 Industrial Park

Cartersville, GA 30121
Telephone: (770) 387-7773
E-Mail: melanie.king@cetco.com



PRODUCT CERTIFICATIONS

PROJECT NAME: Lincoln County LF
CUSTOMER P.O.: P12649
ORDER NUMBERS: 000257655
PREPARED FOR: Plastic Fusion

The GCL manufactured for the above-referenced order number(s) is certified to meet the values listed in the tables below:

GCL PROPERTY SPECIFICATIONS FOR BENTOMAT SDN

| Test Method | Test Method Property | Test Frequency | Certified Value |
|-------------|--------------------------------------|-----------------------------|-----------------------------------|
| ASTM D 5891 | Bentonite Fluid Loss | 1 per 50 Tons | 18 ml Max |
| ASTM D 5993 | Bentonite Mass/Area | 40,000 sq ft (4000 sq m) | 0.75 lb /sq ft Min |
| ASTM D 5890 | Bentonite Swell Index | 1 per 50 Tons | 24 ml/2g Min |
| ASTM D 6768 | GCL Grab Strength | 200,000 sq ft (20,000 sq m) | 25 lbs/in MARV |
| ASTM D 6243 | GCL Hydrated Internal Shear Strength | Periodic | 500 psf typ @ 200 psf normal load |
| ASTM D 5887 | GCL Hydraulic Conductivity | Weekly | 5.0E-9 cm/s Max |
| ASTM D 5887 | GCL Index Flux | Weekly | 1.0E-8 m3/m2/s Max |
| ASTM D 6496 | GCL Peel Strength | 40,000 sq ft (4000 sq m) | 3.0 lbs/in Min |

SPECIALY REQUESTED CERTIFIED PROPERTIES FOR THIS ORDER OF BENTOMAT SDN

| Test Method | Test Method Property | Requested Frequency | Requested Value | Requested Conditions |
|-------------|--|---------------------|-----------------|----------------------|
| ASTM D4632* | Grab Strength*modified with 4-inch grips | 1/200,000sf | 90lbs | Standard |
| ASTM D4632* | Peel Strength*modified with 4-inch grips | 1/40,000sf | 15lbs | Standard |

Bentonite property tests are performed at a bentonite processing facility before shipment to CETCO's production facility. All tensile testing is in the machine direction using ASTM D 6768. All peel strength testing is performed using ASTM D 6496. Upon request tensile and peel results can be reported per modified ASTM D 4632 using 4 inch grips.

NEEDLE DETECTION AND REMOVAL PROCEDURE

CETCO hereby affirms that all Bentomat® geosynthetic clay liner material manufactured for this project is continually passed under a magnet for needle removal and then screened with a metal detection device. CETCO certifies Bentomat® to be essentially free of broken needles and fragments of needles that would negatively effect the performance of the final product.

Melanie King
Quality Assurance Coordinator



GCL PACKING LIST AND MQA TRACKING FORM

Listing of finished and raw materials used to produce certification package number 000257655

| GCL | | | | | | | | Geotextiles | | | Clay | |
|-----------------|-----------|------------|--------|-------|--------|-------|---------------|---|------------|---------------|------------------|------------|
| CV-BENTOMAT SDN | | | | | | | | N/W-WHITE | | | BLK N/W-2.7 WIDE | CV-CG 50 |
| Order | GCL Lot # | GCL Roll # | Length | Width | weight | sq ft | Roll # Tested | Cap Lot # | Cap Roll # | Roll # Tested | Base Roll # | Clay Lot # |
| 000257655 | 200949CV | 4312 | 150 | 14.5 | 2853 | 2175 | 4307 | 200949CV | 00004772 | 00004770 | 2020472055 | 938740A |
| 000257655 | 200949CV | 4321 | 150 | 14.5 | 2886 | 2175 | 4307 | 200949CV | 00004774 | 00004770 | 2020472055 | 938740A |
| Total sq ft: | | | | | | | 4350 | Total Number of Rolls Certified: 2 | | | | |



GCL MANUFACTURING QUALITY CONTROL TEST DATA

The following rolls in GCL certification package number 000257655 have been tested in our production facility lab.

| Product | Lot # Tested | Roll # Tested | Mass Area | Grab Strength | Peel Strength 6496 | Grab 4632 Modified | Peel 4632 Modified |
|-------------------|--------------|---------------|--------------------|----------------|--------------------|--------------------|--------------------|
| ASTM Test Method: | | | D 5993 | D 6768 | D 6496 | D4632* | D4632* |
| Required Value: | | | 0.75 lb /sq ft Min | 25 lbs/in MARV | 3.0 lbs/in Min | 90lbs | 15lbs |
| CV-BENTOMAT SDN | 200949CV | 4307 | 0.92 | 36.4 | 6.2 | 145.7 | 31.2 |

modified ASTM D 4632 using 4 inch grips.

BENTONITE CLAY CERTIFICATION

The Bentonite Clay used to produce package 000257655

has been tested by American Colloid Company and yielded the following test results.

| Clay Lot # | Moist | Swell | Fluid Loss |
|-------------------|---------|--------------|------------|
| ASTM Test Method: | D 2216 | D 5890 | D 5891 |
| Required Value: | 12% Max | 24 ml/2g Min | 18 ml Max |
| 938740A | 9.60 | 24.00 | 14.80 |



GEOTEXTILE TEST RESULTS FROM MATERIAL SUPPLIERS

The GCL in certification package number 000257655 was manufactured with geotextiles which were tested with the following results.

| BASE GEOTEXTILE | | | | COVER GEOTEXTILE | | | |
|-----------------|-------------|---------------------------------|----------------------|------------------|-------------|---------------------------------|----------------------|
| Material | Roll Number | Mass Area oz/yd ² | Grab Strength lbs | Material | Roll Number | Mass Area oz/yd ² | Grab Strength lbs |
| PPX 311C | 2020472055 | 4.1 | 96.8 | CV-NON-WOVEN | 00004770 | 7.7 | 56.1 |

Certifications from our suppliers are on file at our production facility.

An '*' or 'PT' indicates supplier certifications were unavailable prior to shipping so testing was performed at a CETCO lab.



**Engineered Synthetic
Products, Inc.**

February 2, 2010
Plastic Fusion Fabricators
3455 Stanwood Blvd.
Huntsville, AL 35811

**Ref. : Lincoln County Landfill, NC
Customer P.O. # P12647
Transnet 300-2-8**

We certify that the Transnet 300-2-8 drainage composite, meets the project requirements as stated in the specifications. The properties listed in this section are:

| Property | Test Method | Unit | Required Value | Qualifier |
|---------------------------------------|--------------------------|---------------------|------------------------|-------------------|
| Geonet³ | | | | |
| Mass per Unit Area | ASTM D 5261 | lbs/ft ² | 0.162 | Minimum |
| Thickness | ASTM D 5199 | mil | 270 | Minimum |
| Carbon Black | ASTM D 4218 | % | 2.0 - 3.0 | Range |
| Tensile Strength | ASTM D 5035 | lbs/in | 75 | Minimum |
| Melt Flow | ASTM D 1238 ² | g/10 min | 1.0 | Maximum |
| Density | ASTM D 1505 | g/cm ³ | 0.94 | Minimum |
| Composite | | | | |
| Ply Adhesion | GRI GC7 | lb/in | 1.0 | MARV ⁵ |
| Transmissivity ¹ | ASTM D 4716 | m ² /sec | 1.0 x 10 ⁻³ | MARV |
| Geotextile^{3 & 4} | | | | |
| Fabric Weight | ASTM D 5261 | oz/yd ² | 8.0 | MARV |
| Grab Strength | ASTM D 4632 | lbs | 200 | MARV |
| Grab Elongation | ASTM D 4632 | % | 50 | MARV |
| Puncture Resistance | ASTM D 4833 | lbs | 80 | MARV |
| Permittivity | ASTM D 4491 | sec ⁻¹ | 1.0 | MARV |
| Permeability | ASTM D 4491 | cm/sec | 5.0 x 10 ⁻⁵ | MARV |
| AOS | ASTM D 4751 | US Sieve | 80 | MARV |

Notes:

- 1 Transmissivity measured using water at 21 ± 2 °C (70 ± 4 °F) with a gradient of 0.03 and a confining pressure of 7200 psf between sand and liner after 100 hours.
- 2 Condition 190/2.16
- 3 Geotextile and Geonet properties are prior to lamination.
- 4 Geotextile data is provided by the supplier.
- 5 MARV is statistically defined as mean minus two standard deviations and it is the value which is exceeded by 97.5% of all the test data.

Sincerely,
Nilay Patel
Nilay Patel
QA Manager

SKAPS Industries

**Engineered Synthetic
Products, Inc.**

Product : TN300-2-8
Project : Lincoln County Landfill, NC

We, the Geocomposite manufacturer, hereby certify the following for the material delivered to the above referenced project :

| Roll | Geocomposite Roll Number | Geonet Roll Number | Geotextile Roll Number | | Ply Adhesion (lb/in) | | Geocomposite Transmissivity* (m ² /sec) |
|------|--------------------------|--------------------|------------------------|----------|----------------------|---------|--|
| | | | Top | Bottom | Minimum | Average | |
| 1 | 351610001 | 351610001 - N | 3516.001 | 3516.002 | 1.27 | 1.97 | 1.29 x 10 ⁻³ |

* Transmissivity measured using water at 21 ± 2 °C (70 ± 4 °F) with a gradient of 0.03 and a confining pressure of 7200 psf between sand and liner after 100 hours.



SKAPS Industries

Engineered Synthetic Products, Inc.

Product : TN300-2-8
Project : Lincoln County Landfill, NC

We, the Geonet Manufacturer, hereby certify the following for the material sent to the above referenced project :

| Geonet Roll Number | Resin Lot Number | Geonet Density (gm/cc) | Mass Per Unit Area (lb/ft ²) | Thickness (mils) | Carbon Black (%) | Tensile Strength (MD) (lb/in) | Transmissivity (m ² /sec) |
|--------------------|------------------|------------------------|--|------------------|------------------|-------------------------------|--------------------------------------|
| 351610001 - N | CHVX890288 | 0.9561 | 0.297 | 303 | 2.31 | 103 | |



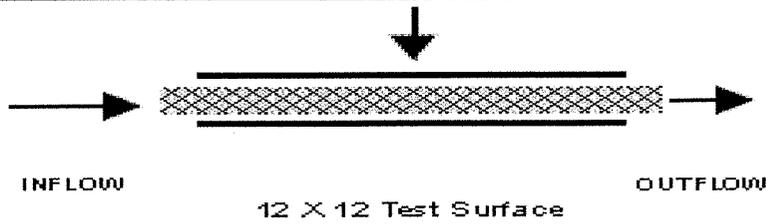
SKAPS Industries

ASTM D 4716

Client: Plastic Fusion Fabricators
Project: Lincoln County Landfill, NC
Product: TN300-2-8

Job # 3516

Test Configuration:



Test Information:

| | | |
|-----------------------------|--------------|--------------------------------|
| Boundary Conditions: | Sand | Normal Load: 7200 psf |
| | Geocomposite | Gradient: 0.03 ft |
| | Liner | Seating Time: 100 hours |
| | | Flow Direction: MD |

Test Results:

| Roll No. | Pressure (psf) | Gradient, ft | Transmissivity, m ² /sec |
|-----------|----------------|--------------|-------------------------------------|
| | | | 100 hours |
| 351610001 | 7200 | 0.03 | 1.29 x 10 ⁻³ |



POLYETHYLENE RESIN CERTIFICATION

Customer Name : Plastic Fusion Fabricators
Project Name : Lincoln County Landfill, NC
Geocomposite Manufacturer : SKAPS Industries
Geocomposite Production Plant : Commerce, GA
Geocomposite Brand Name : TN300-2-8

We, the Geonet Manufacturer, hereby certify the following for the material delivered to the above referenced project:

| Resin Supplier | Resin Production Plant | Resin Brand Name | Resin Lot Number | Property | Test Method | Units | Resin Supplier Value | Tested Value* |
|-------------------------------|------------------------|------------------|------------------|-----------------|----------------------------|-----------|----------------------|---------------|
| Chevron Phillips Chemical co. | Chevron, TX | HDPE | CHVX890288 | Density | ASTM D 1505 | gm/cc | 0.9542 | 0.9512 |
| | | | | Melt Flow Index | ASTM D 1238 ^(a) | gm/10 min | 0.35 | 0.34 |

(a) Condition 190/2.16

* Data from SKAPS Quality Control



FIELD REPORTS





51 Southern Pine Blvd
 Charlotte, NC 28273
 (704) 523-4726
 (704) 525-3953 fax

Field Report

| | |
|-------------------------------------|------------------|
| Date | Job No. |
| Jan. 12, 2010 | 1356-03-255B-002 |
| Project/Location | |
| LCLF Ph III Stormwater Pipe Removal | |
| Contractor | Weather/Temp |
| Earnhardt | Sunny - 41° |
| Present at Site | |
| Doug Kenerly Mark LeGrand | |
| Time | Mileage |
| 8.0 | 71.0 |

| Services Performed | |
|---|--|
| <input type="checkbox"/> Concrete Testing | <input type="checkbox"/> Asphalt Coring |
| <input type="checkbox"/> Cylinder Pickup | <input type="checkbox"/> Concrete Coring |
| <input type="checkbox"/> Asphalt Testing | <input type="checkbox"/> Undercut Evaluation |
| <input type="checkbox"/> Steel Testing | <input type="checkbox"/> Foundation Evaluation |
| | <input type="checkbox"/> Proofrolling |
| | <input checked="" type="checkbox"/> In-Place Density |
| <input type="checkbox"/> Other (Explain) | |

I: File _____

Observations/Remarks:

Technician onsite to observe removal of 30 inch diameter stormwater pipe in Cell 3. Upon arrival observed that contractor had already excavated the 2 feet of operational over above pipe, and 5 feet on each side out. The geocomposite - 60mil textured geomembrane and the GCL was cut down the middle of excavated area, and laid back. Contractor raised exposed end of pipe and made a perpendicular cut in the 60mil liner just beyond the HDPE stack plate which is welded to the pipe. Even tho contractor has the contact water separation berm constructed, their getting seepage over to the end of pipe. Observed excavation of the clay liner and compacted fill, exposing pipe. Observed removal of 30 inch pipe back to the ADSN-12 adasters. Monitored backfill of excavation w/ structural fill and clay liner soils from pipe excavation. Five density/moisture test performed, all test exceeded 95% compaction, and were w/in the spec. moisture criteria. Informed Doug of test results. Backfill completed today. Contractor to continue dewatering tomorrow. FF to be onsite Thur. 14th.

On-Site Representative/Company

Jimmy Adair
 S&ME Personnel

Disclaimer: The presence of S&ME at the project site shall not be construed as an acceptance or approval of activities at the site. S&ME is at the project site to perform specific services and has certain responsibilities which are limited to those specifically authorized in our agreement with our client. In no event shall S&ME be responsible for the safety or the means and methods of other parties at the project site. **The information presented in this field report has not been reviewed by an engineer and is to be considered preliminary.**



9751 Southern Pine Blvd
 Charlotte, NC 28273
 (704) 523-4726
 (704) 525-3953

Field Report

| | |
|--|-------------------------------------|
| Date 01/14/10 | Job No. 1356-09-018 |
| Project/Location Lincoln County LF SW Pipe Removal | |
| Contractor Earnhardt / Plastic Fusion | Weather/Temp Clear / 30 |
| Present at Site Cedric Ruhl, Julie Petersen (S&ME, Inc.) Doug Kinnerly (Earnhardt) Jerry King (Plastic Fusion) | |
| Time 8:00 – 14:00 | Mileage 50 mi. round trip |

| Services Performed | |
|---|--|
| <input type="checkbox"/> Concrete Testing | <input type="checkbox"/> Asphalt Coring |
| <input type="checkbox"/> Cylinder Pickup | <input type="checkbox"/> Concrete Coring |
| <input type="checkbox"/> Asphalt Testing | <input type="checkbox"/> Undercut Evaluation |
| <input type="checkbox"/> Steel Testing | <input type="checkbox"/> Foundation Evaluation |
| | <input type="checkbox"/> Proofrolling |
| | <input type="checkbox"/> In-Place Density |
| Other (Explain) Geosynthetics CQA | |

Observations/Remarks:

0800 arrived on site to perform geosynthetics CQA. Earnhardt and Plastic Fusion proceeded to dewater the liquid in the sump prior to geosynthetics installation. Following draw-down of the liquid, Plastic Fusion installed GCL material (CETCO Bentomat SDN). Two pieces of GCL one roll width wide and approximately three feet long were laid side by side down the slope to form the GCL portion of the repair. In the absence of a "Supergroove", a "bead" of granulated bentonite was placed between GCL overlaps. Plastic Fusion placed some granulated bentonite underneath the GCL at the toe of the slope in an effort to provide a dryer subgrade.

Following GCL installation, Plastic Fusion installed 60-mil double-sided textured geomembrane (Agu America microspike). Three pieces of geomembrane formed the patch (numbered 1A through 1C). The geomembrane repair was extrusion welded to the existing geomembrane. The geomembrane repair welds were vacuum-box tested prior to placing geocomposite.

Following geomembrane installation, Plastic Fusion installed geocomposite (Skaps TN 300-2-8). The existing geocomposite was cut near the bottom of the repair area and the upper portion laid back. The new geocomposite was laid on top of the existing geocomposite at the toe of the slope. The existing geocomposite was laid over the new geocomposite from the cut portion up. The new geocomposite was anchored to the existing geocomposite with plastic zip-ties.

Departed site at 1400.

END OF REPORT

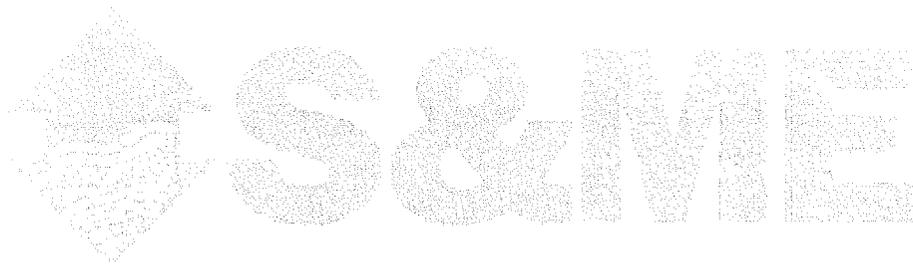
On-Site Representative/Company

Cedric Ruhl, Julie Petersen

S&ME Personnel

Disclaimer: The presence of S&ME at the project site shall not be construed as an acceptance or approval of activities at the site. S&ME is at the project site to perform specific services and has certain responsibilities which are limited to those specifically authorized in our agreement with our client. In no event shall S&ME be responsible for the safety or the means and methods of other parties at the project site. **The information presented in this field report has not been reviewed by an engineer and is to be considered preliminary.**

CONSTRUCTION PHOTOGRAPHS



LINCOLN COUNTY LANDFILL

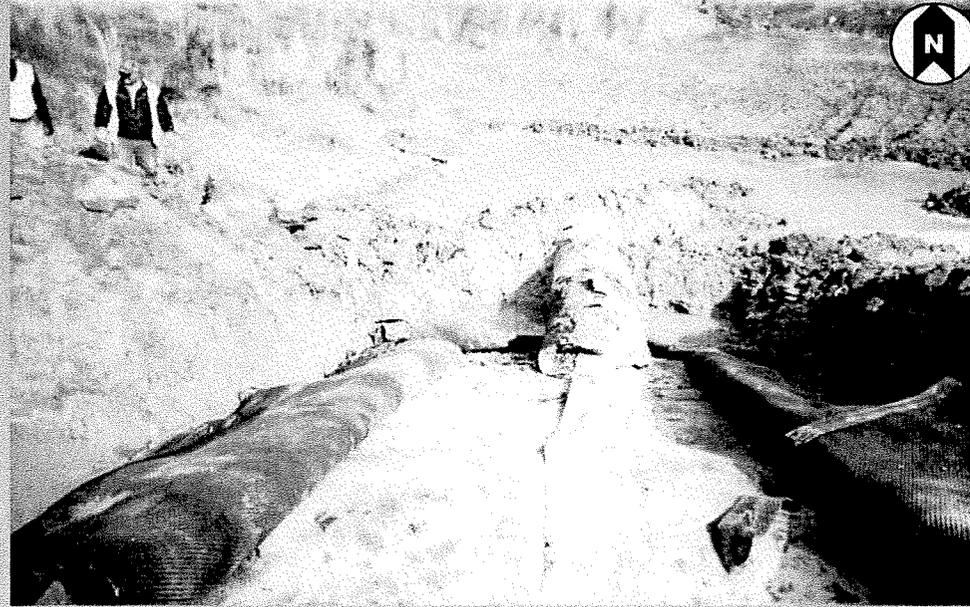
PHASE III, CELL 3 STORMWATER PIPE REMOVAL

PHOTOGRAPHS FROM EARTHWORKS OVERSITE AND GEOSYNTHETICS REPAIR

S&ME PROJECT NO. 1356-09-018



| Photo 1 | |
|--|--|
|  | Date: 01.12.10 |
| | Photographer: J. Addis |
| Location / Orientation | Looking northwest into Phase III, Cell 3 |
| Remarks | Constructed soil diversion berm. |

| Photo 2 | |
|--|---|
|  | Date: 01.12.10 |
| | Photographer: J. Addis |
| Location / Orientation | Looking north into Phase III, Cell 3 at stormwater pipe. |
| Remarks | Protective soil cover removed. Geosynthetics cut and peeled back. |

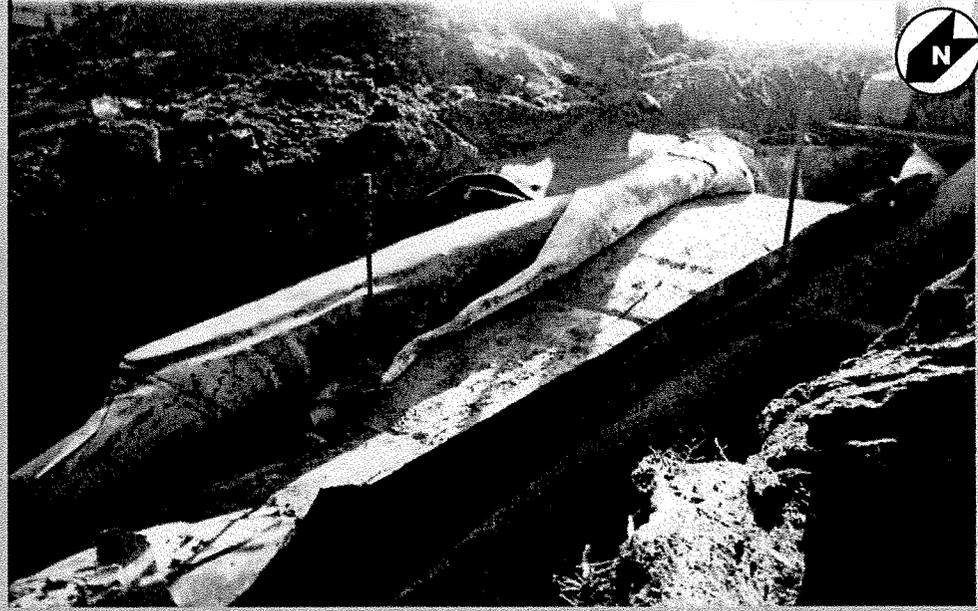
LINCOLN COUNTY LANDFILL

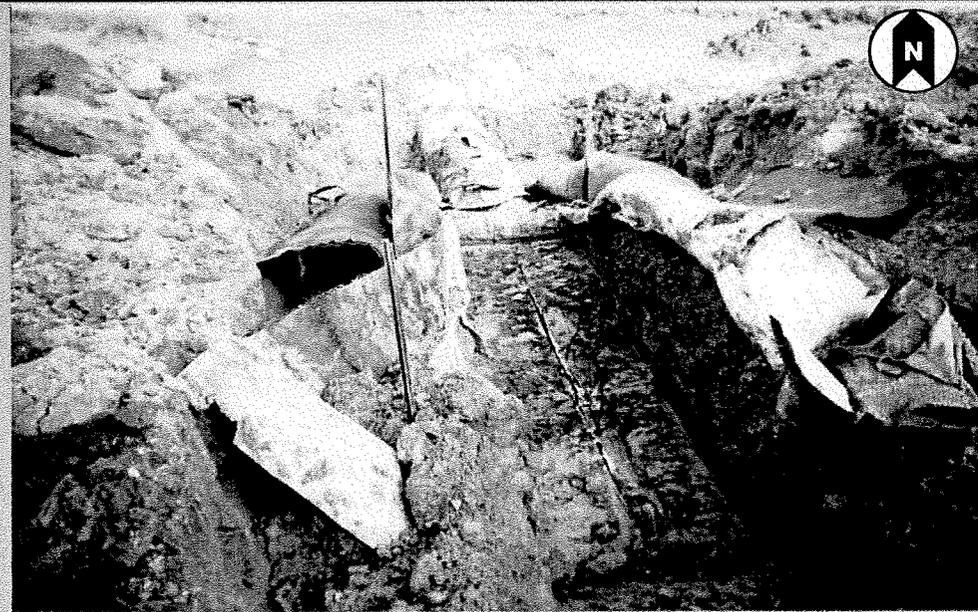
PHASE III, CELL 3 STORMWATER PIPE REMOVAL

PHOTOGRAPHS FROM EARTHWORKS OVERSITE AND GEOSYNTHETICS REPAIR

S&ME PROJECT NO. 1356-09-018



| Photo 3 | |
|--|---|
|  |  |
| | <p>Date: 01.12.10</p> |
| <p>Photographer: J. Addis</p> | |
| Location / Orientation | Looking southeast at stormwater pipe from inside Cell 3. |
| Remarks | Geosynthetics cut and peeled back to expose compacted soil liner. |

| Photo 4 | |
|--|---|
|  |  |
| | <p>Date: 01.12.10</p> |
| <p>Photographer: J. Addis</p> | |
| Location / Orientation | Looking north into Phase III, Cell 3 at stormwater pipe. |
| Remarks | Compacted soil liner removed to expose pipe. |

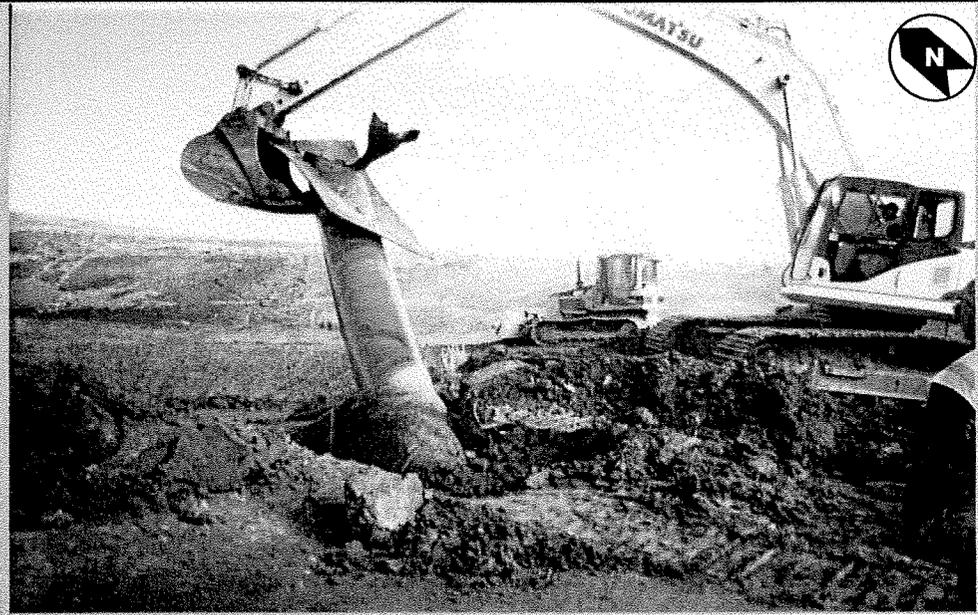
LINCOLN COUNTY LANDFILL

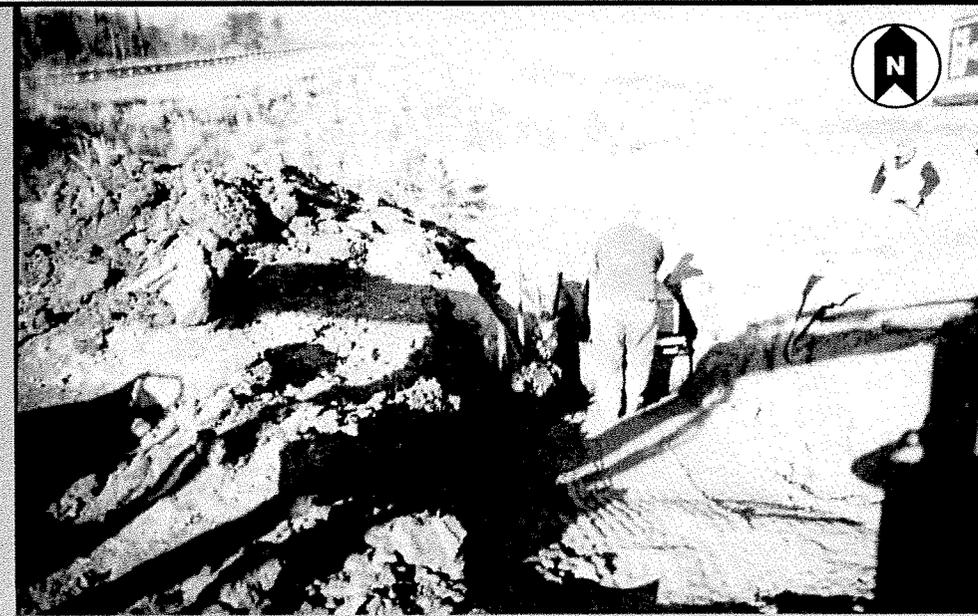
PHASE III, CELL 3 STORMWATER PIPE REMOVAL

PHOTOGRAPHS FROM EARTHWORKS OVERSITE AND GEOSYNTHETICS REPAIR

S&ME PROJECT NO. 1356-09-018



| Photo 5 | |
|--|---|
|  | |
| Date: 01.12.10 | |
| Photographer: J. Addis | |
| Location / Orientation | Looking northeast toward Phase III and stormwater pipe. |
| Remarks | Removal of stormwater pipe back to ADS N-12 adapter. |

| Photo 6 | |
|--|---------------------------------------|
|  | |
| Date: 01.12.10 | |
| Photographer: J. Addis | |
| Location / Orientation | Looking north into Phase III, Cell 3. |
| Remarks | Replacement of compacted soil liner. |

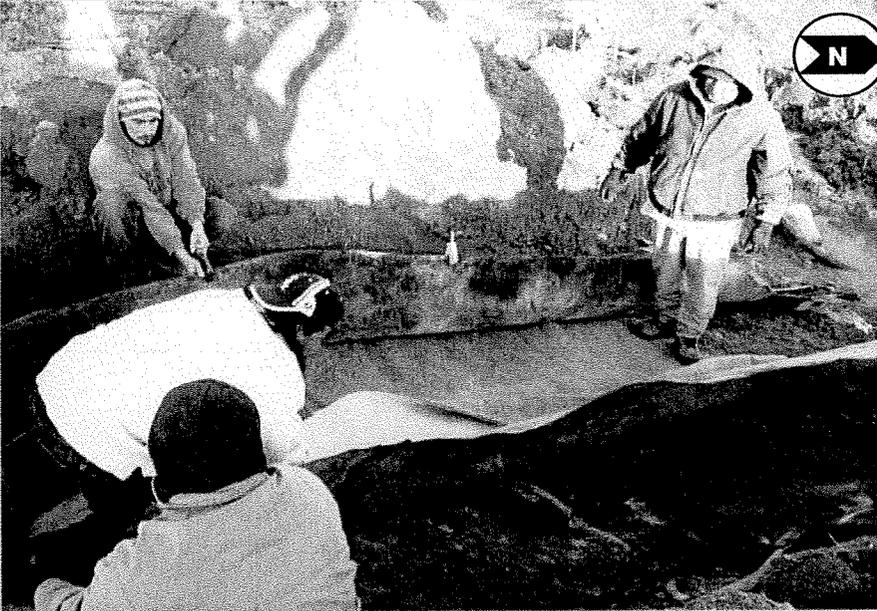
LINCOLN COUNTY LANDFILL

PHASE III, CELL 3 STORMWATER PIPE REMOVAL

PHOTOGRAPHS FROM EARTHWORKS OVERSITE AND GEOSYNTHETICS REPAIR

S&ME PROJECT NO. 1356-09-018



| Photo 7 | | |
|--|--|----------------|
|  | | Date: 01.14.10 |
| Photographer: J. Petersen | | |
| Location / Orientation | Looking west at stormwater pipe removal area. | |
| Remarks | Installation of geosynthetic clay liner (GCL) patch. | |

| Photo 8 | | |
|--|--|----------------|
|  | | Date: 01.14.10 |
| Photographer: J. Petersen | | |
| Location / Orientation | Looking west along access road south of Phase III. | |
| Remarks | Construction of trial seam using an extrusion gun. | |

LINCOLN COUNTY LANDFILL

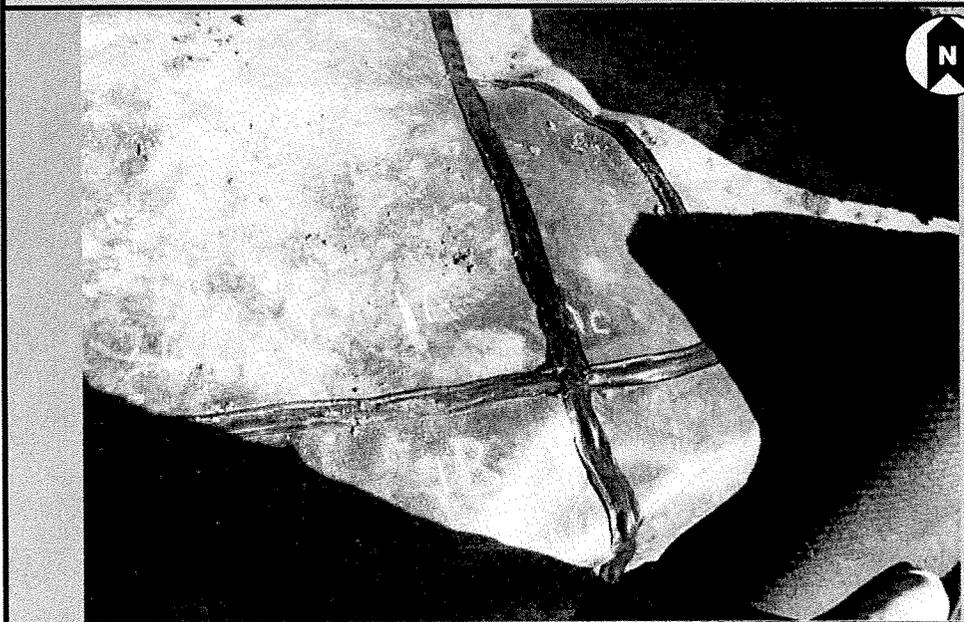
PHASE III, CELL 3 STORMWATER PIPE REMOVAL

PHOTOGRAPHS FROM EARTHWORKS OVERSITE AND GEOSYNTHETICS REPAIR

S&ME PROJECT NO. 1356-09-018



| Photo 9 | |
|--|--|
|  | |
| Date: 01.14.10 | |
| Photographer: J. Petersen | |
| Location / Orientation | Looking west at stormwater pipe removal area. |
| Remarks | Seaming of geomembrane patch to existing geomembrane using an extrusion gun. |

| Photo 10 | |
|--|--|
|  | |
| Date: 01.14.10 | |
| Photographer: J. Petersen | |
| Location / Orientation | Looking north at stormwater pipe removal area. |
| Remarks | The geomembrane repair consisted of three patches (1A, 1B, and 1C) |

LINCOLN COUNTY LANDFILL

PHASE III, CELL 3 STORMWATER PIPE REMOVAL

PHOTOGRAPHS FROM EARTHWORKS OVERSITE AND GEOSYNTHETICS REPAIR

S&ME PROJECT NO. 1356-09-018



| Photo 11 | |
|---|--|
|  | |
|  | |
| Location / Orientation | Looking east at stormwater pipe removal area. |
| Remarks | The geomembrane repair consisted of three patches (1A, 1B, and 1C) |
| Date: 01.14.10 Photographer: J. Petersen | |

| Photo 12 | |
|---|--|
|  | |
|  | |
| Location / Orientation | Looking south at stormwater pipe removal area. |
| Remarks | The geomembrane repair consisted of three patches (1A, 1B, and 1C) |
| Date: 01.14.10 Photographer: J. Petersen | |

LINCOLN COUNTY LANDFILL

PHASE III, CELL 3 STORMWATER PIPE REMOVAL

PHOTOGRAPHS FROM EARTHWORKS OVERSITE AND GEOSYNTHETICS REPAIR

S&ME PROJECT NO. 1356-09-018



| Photo 13 | | |
|--|---|----------------------------------|
|  | | Date: 01.14.10 |
| | | Photographer: J. Petersen |
| Location / Orientation | Looking west at stormwater pipe removal area. | |
| Remarks | Vacuum box testing of geomembrane repair. | |

| Photo 14 | | |
|--|---|----------------------------------|
|  | | Date: 01.14.10 |
| | | Photographer: J. Petersen |
| Location / Orientation | Looking west at stormwater pipe removal area. | |
| Remarks | Installation of new geocomposite (GCDL). The existing GCDL was laid over the new GCDL and tied to the new GCDL. | |

LINCOLN COUNTY LANDFILL

PHASE III, CELL 3 STORMWATER PIPE REMOVAL

PHOTOGRAPHS FROM EARTHWORKS OVERSITE AND GEOSYNTHETICS REPAIR

S&ME PROJECT NO. 1356-09-018



Photo 15

| | | |
|-------------------------------|--|----------------------------------|
| | | Date: 01.14.10 |
| | | Photographer: J. Petersen |
| Location / Orientation | Looking north at stormwater pipe removal area. | |
| Remarks | Completed geosynthetics repair. | |

