BLE INC.
BUNNELL-LAMMONS ENGINEERING, INC.
GEOTECHNICAL, ENVIRONMENTAL AND CONSTRUCTION MATERIALS CONSULTANTS

November 10, 2010

Mr. Mike Lambert
City of Albemarle Public Works Department
P.O. Box 190
Albemarle, North Carolina 28002-0190

Subject: **Report of Construction Quality Assurance (CQA) Services**
Storm Drain Pipe Removal and Liner Repair; MSW Phase 2
City of Albemarle Landfill
Stanley County, North Carolina
BLE Project No. J10-7013-01A (NC License C-1538)

Dear Mr. Lambert:

Bunnell-Lammons Engineering, Inc. (BLE) has completed Construction Quality Assurance (CQA) monitoring of the removal of a storm drain pipe and repair of the liner system in the MSW Phase 2 of the City of Albemarle Landfill. This CQA report provides a description of the pipe removal, liner repair and our CQA monitoring. The construction activities described in this report occurred from October 13, 2010 to October 21, 2010.

PROJECT SUMMARY

During the initial cell construction, a 24-inch diameter, 126-foot long stormwater drain pipe was placed through the southern perimeter embankment of the MSW Phase 2. The pipe was fitted with a valve on the upper end and was "booted" through the base liner system at the cell edge. Prior to waste placement in the area, a section of the pipe was to be removed and the liner penetration repaired. An approximate 40-foot section of the pipe was removed and the remainder of the pipe was filled with grout and left in place. The existing liner system was repaired after the partial removal and grouting of the pipe. The compacted soil liner (permeability, $k \leq 1.0 \times 10^{-5}$ cm/sec), geosynthetic clay liner (GCL, CETCO Bentomat ST), textured, 60-mil HDPE geomembrane liner (FML) and geosynthetic drainage media (GDM geocomposite, Skaps Transnet 270) was replaced or repaired. The 18-inch thick soil liner material and 3-foot thick protective cover native soil were salvaged from the excavation and reused in the repair.

Records of Daily Observations and photographs of the construction are attached to this report.

6004 PONDERS COURT
GREENVILLE, SOUTH CAROLINA 29615

PHONE (864) 288-1265
FAX (864) 288-4430

Storm Drain Removal:

J. T. Russell and Sons (Russell), the general contractor, excavated and stockpiled the protective cover, then cut away the geosynthetic materials to expose the compacted soil liner in an approximate 20 by 40-foot area directly above the pipe section. The soil liner in the vicinity of the storm pipe was excavated and stockpiled for reuse as compacted soil liner. Russell removed an approximately 40-foot long section of the 24-inch pipe then installed 90-degree open-ended fittings (risers) on both ends of the remaining section of pipe. The pipe was filled with cement grout.

Soil Liner and Geomembrane Repair:

After grouting the remaining section of storm drain pipe, Russell placed and compacted structural fill in 6-inch lifts to the subgrade of the soil liner. The structural fill was compacted to at least 95 percent of the standard Proctor maximum dry density using a footed compactor roller wheel attachment to a track-mounted backhoe. Density tests were performed on the structural fill to confirm the compaction.

Russell placed three nominal 6-inch thick (compacted) lifts to achieve the required minimum 18-inch soil liner thickness. The soil liner was constructed of clayey soils from the repair excavation supplemented with soil from the on-site soil liner borrow area. The loose lifts of the soil liner were compacted using a footed compactor roller wheel. Placement of the compacted soil liner was conducted in accordance with the Project Specifications and the Construction Quality Assurance Manual.

The CQA technician performed field density tests on each lift of the compacted soil liner using the drive tube method (ASTM 2937). The field density test results are attached. The field in-place density test results were compared to applicable values of the laboratory standard Proctor maximum dry density and optimum moisture content to determine the level of compaction achieved (as a percentage of the maximum dry density) and relative moisture content.

The compaction criteria for the soil liner are a minimum of 95% of the standard Proctor (ASTM D 698) maximum dry density and wet of the standard Proctor optimum moisture content. These criteria were confirmed with a permeability test of a remolded sample of soil liner from the repair excavation. All test results achieved the required density and moisture. The test results indicated that the compacted soil liner was placed in accordance with project requirements for compaction to achieve the required density and permeability.

The completed soil liner thickness was verified by the CQA technician by performance of hand auger borings. The auger borings indicated 18 inches or more of soil liner was present. Undisturbed samples of the compacted soil liner were obtained by the on-site CQA personnel and sent to our laboratory for permeability testing. The laboratory test results are attached. The laboratory test results indicated that the compacted soil liner achieved the specified permeability ($k \leq 1 \times 10^{-5}$ cm/sec). The hydraulic conductivity of the two undisturbed samples of the in-place compacted soil liner was 3.0×10^{-7} and 1.5×10^{-7} cm/sec.

In conclusion, based on the full-time observation, field testing, and laboratory testing by CQA on-site personnel under the direction of the CQA engineer, the compacted soil liner has been constructed in accordance with the project Construction Plans and Technical Specifications, the CQA Manual, and the North Carolina Solid Waste Management Rules, and is acceptable for placement of the geosynthetic clay liner and geomembrane.

Following the replacement of the compacted soil liner, the geosynthetic layers were repaired with new materials.

The geosynthetic clay liner (GCL) consisted of Bentomat ST manufactured by CETCO Lining Technologies of Arlington Heights, Illinois. The specified material properties, roll inventory, and Certificate of Quality Assurance (CQC test results) prepared by the manufacturer are attached.

Textured, 60-mil, high density polyethylene (HDPE) geomembrane, manufactured by Agru America was used to repair the flexible geomembrane liner. A Certificate of Quality Assurance for the roll used in the repair is attached.

Replacement of the GCL, geomembrane and geosynthetic drainage media by Chesapeake Containment Systems (CSS) was completed on October 21, 2010. Construction quality assurance monitoring and testing were performed by BLE on a full-time basis. The finished soil liner surface was observed and accepted by BLE and CSS for GCL placement. The panels of GCL were overlapped a minimum of 6 inches on side seams and 12 inches on end seams. The GCL overlap seams were augmented by granular bentonite. CSS then placed, welded, sampled, patched, tested, and repaired the geomembrane. The panels of geomembrane were seamed using fillet extrusion welding.

CSS performed nondestructive testing consisting of vacuum box testing of all fillet extrusion welds of the geomembrane panels and repairs. CSS also performed the specified welder prequalification field destructive tests on coupons cut from test strips. The coupons were tested on-site using a tensiometer. Our CQA personnel monitored and recorded the on-site CQC tests performed by CSS.

The geosynthetic drainage media (GDM) was then placed over the geomembrane. The panels of GDM were overlapped and zip ties used to secure the geonet seams at 5-foot intervals along the slope and 2-foot intervals across the slope. The top layer of geotextile was heat bonded at the seams.

The native soil protective cover salvaged from the repair excavation was replaced on the GDM. The thickness of the protective cover layer was confirmed to be at least 36 inches thick.

The CQA personnel, under the direction of the CQA engineer, observed the GCL and geomembrane subgrade (compacted soil liner) and monitored the deployment, welding, sampling, testing, patching, and repairs to the geomembrane on a full-time basis. The surface of the geomembrane was inspected for defects, excessive slack, and trampolining during the repair. The CQA personnel also monitored the GDM and protective cover placement. Based on our full-time observation, the above components and tasks were deemed to be in conformance with the project specifications and CQA Manual. The CQA records of our monitoring of the geomembrane placement and testing are also attached.

Conclusion

In conclusion, based on our full-time monitoring, as well as the CQC and CQA test results, the structural fill, compacted soil liner, reinforced GCL, geomembrane, GDM and the protective cover were installed in accordance with the project specifications, the CQA Manual, and in accordance with Title 15A NCAC Subchapter 13B Section .1624 of the North Carolina Solid Waste Management Rules.

We appreciate the opportunity to be of assistance to the City of Albemarle and to provide the required services for this project. If you have any questions regarding this report, please do not hesitate to contact us at (864) 288-1265.

Sincerely,

BUNNELL-LAMMONS ENGINEERING, INC.

Gary L. Weekley, P.E.
Senior Engineer
Registered, NC 8251

11-15-10

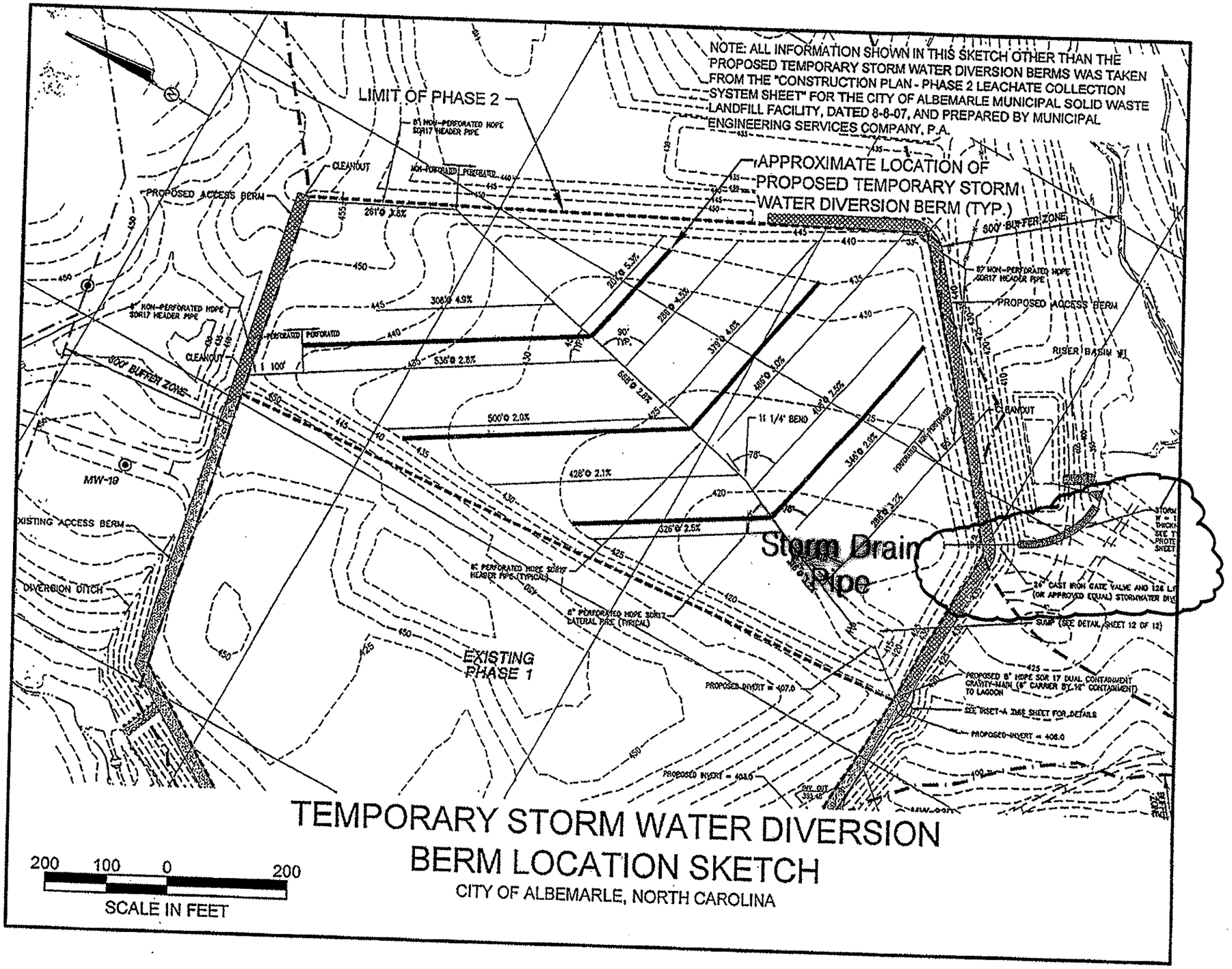
Daniel B. Bunnell, P.E.
Principal Engineer
Registered, NC 13814

11/15/10

Attachments: Site Plan Figure
Records of Daily Observations
Photographs
Laboratory Test Results
Material Conformance Sheets

Copy: Mr. R. Brant Lane, P.E.
Hodges, Harbin, Newberry & Tribble, Inc.

FIGURE


NOTE: ALL INFORMATION SHOWN IN THIS SKETCH OTHER THAN THE PROPOSED TEMPORARY STORM WATER DIVERSION BERMS WAS TAKEN FROM THE "CONSTRUCTION PLAN - PHASE 2 LEACHATE COLLECTION SYSTEM SHEET" FOR THE CITY OF ALBEMARLE MUNICIPAL SOLID WASTE LANDFILL FACILITY, DATED 8-8-07, AND PREPARED BY MUNICIPAL ENGINEERING SERVICES COMPANY, P.A.
LIMIT OF PHASE 2
APPROXIMATE LOCATION OF PROPOSED TEMPORARY STORM WATER DIVERSION BERM (TYP.)
PROPOSED ACCESS BERM
CLEANOUT
500' BUFFER ZONE
MW-19
EXISTING ACCESS BERM
DIVERSION DITCH
EXISTING PHASE 1
RISER BASIN #1
Storm Drain Pipe
TEMPORARY STORM WATER DIVERSION BERM LOCATION SKETCH
CITY OF ALBEMARLE, NORTH CAROLINA
200 100 0 200
SCALE IN FEET

RECORDS OF DAILY OBSERVATIONS

RECORD OF DAILY OBSERVATIONS

STORM DRAIN REMOVAL, RAINFLAPS, AND LEACHATE COLLECTION MODIFICATIONS

CITY OF ALBEMARLE LANDFILL
STANLY COUNTY, NORTH CAROLINA
BUNNELL-LAMMONS ENGINEERING, INC. PROJECT NO. 310-7013-01A

CLIENT: CITY OF ALBEMARLE, NC
DATE: 10·13·10
ARRIVAL TIME: 7:00 AM
DEPARTURE TIME: 5:00 PM
LUNCH BREAK: .5
WORK HOURS: 9.5
ONSITE BLE PERSONNEL: BROOKS CARLISLE

PROJECT DAY NO. 7

VISITORS:

NAME	REPRESENTING

WEATHER: SUNNY, RAIN, PTLY CLOUDY, WINDY, CLOUDY

TEMPERATURE:
MORNING LOW: 54° F
DAYTIME HIGH: 75° F

EQUIPMENT:

SITE ACTIVITIES
EXCAVATION FOR STORM DRAIN ✓
RAINFLAP ✓
LEACHATE MODIFICATIONS

CONTRACTOR ACTIVITIES:

Contractor (PLACED TEMPORARY) patched on two AREA'S OF RAIN FLAP that was damaged during flipping of RAIN FLAP ON storm drain CHANNEL #2. Began the EXCAVATION OF dirt AROUND storm drain pipe. Excavated down to GDM and back 35' FROM END OF pipe. GDM WAS damaged IN A Couple spots! FML WAS NOT damaged during EXCAVATION. (NOTE 10-15-10 EXTENDED TO 40')

TECHNICIAN ACTIVITIES:

OBSERVED patching OF two AREAS OF RAIN FLAP OF storm drain CHANNEL #2. OBSERVED EXCAVATION OF dirt AROUND storm drain pipe. GDM WAS damaged IN a couple spots. HDPE Liner WAS NOT damaged during EXCAVATION.

RECORD PREPARED BY: [signature] BROOKS CARLISLE
Signature

RECORD REVIEWED & APPROVED BY: [signature] DANIEL B. BUNNELL, P.E.
Signature

RECORD OF DAILY OBSERVATIONS

STORM DRAIN REMOVAL, RAINFLAPS, AND LEACHATE COLLECTION MODIFICATIONS

CITY OF ALBEMARLE LANDFILL
STANLY COUNTY, NORTH CAROLINA
BUNNELL-LAMMONS ENGINEERING, INC. PROJECT NO. J10-7013-01A

CLIENT: CITY OF ALBEMARLE, NC
DATE: 10-14-10
PROJECT DAY NO. 8
ARRIVAL TIME: 7:00 AM
DEPARTURE TIME: 8:30 ~~PM~~ AM
LUNCH BREAK:
WORK HOURS: 1.5
ONSITE BLE PERSONNEL: BROOKS CARLISLE

VISITORS:

NAME	REPRESENTING

WEATHER: SUNNY (RAIN) PTLY CLOUDY WINDY CLOUDY

TEMPERATURE:
MORNING LOW: ____ °F
DAYTIME HIGH: ____ °F

EQUIPMENT:

SITE ACTIVITIES
EXCAVATION FOR STORM DRAIN [✓]
RAINFLAP [ ]
LEACHATE MODIFICATIONS [ ]

CONTRACTOR ACTIVITIES:
Contractor excavated one bucket width of soil on pond side of storm drain for installment of 24" elbow, for concrete fill. Contractor was rained out the rest of the day.

TECHNICIAN ACTIVITIES:
Observed excavation on pond side of storm drain.

RECORD PREPARED BY: Signature BROOKS CARLISLE

RECORD REVIEWED & APPROVED BY: Signature DANIEL B. BUNNELL, P.E.

RECORD OF DAILY OBSERVATIONS

STORM DRAIN REMOVAL, RAINFLAPS, AND LEACHATE COLLECTION MODIFICATIONS

CITY OF ALBEMARLE LANDFILL
STANLY COUNTY, NORTH CAROLINA

BUNNELL-LAMMONS ENGINEERING, INC. PROJECT NO. J10-7013-01A

CLIENT: CITY OF ALBEMARLE, NC
DATE: 10·15·10
ARRIVAL TIME: 7:00 AM
DEPARTURE TIME: 4:00 PM
LUNCH BREAK: .5
WORK HOURS: 8.5
ONSITE BLE PERSONNEL: BROOKS CARLISLE

PROJECT DAY NO. 9

VISITORS:

NAME	REPRESENTING

WEATHER: (SUNNY) PTLY CLOUDY CLOUDY RAIN WINDY

TEMPERATURE:
MORNING LOW: 51° °F
DAYTIME HIGH: 78° °F

EQUIPMENT:

SITE ACTIVITIES
EXCAVATION FOR STORM DRAIN ☐
RAINFLAP ☐
LEACHATE MODIFICATIONS ☐

CONTRACTOR ACTIVITIES:

Contractor pulled GDM, HDPE, GCL up off of storm drain pipe. Excavated Clay And put in stock pile And Covered with Tarp. Excavated structural fill put in pile. took out 40' of storm drain pipe. placed 24" Elbow on pipe for fill of concrete

TECHNICIAN ACTIVITIES:

OBSERVED GDM, HDPE, GCL Cut And put to the side. OBSERVED Excavation of Clay And struc. Fill. And Removal of pipe.

RECORD PREPARED BY: Signature BROOKS CARLISLE

RECORD REVIEWED & APPROVED BY: Signature DANIEL B. BUNNELL, P.E.

RECORD OF DAILY OBSERVATIONS

STORM DRAIN REMOVAL, RAINFLAPS, AND LEACHATE COLLECTION MODIFICATIONS

CITY OF ALBEMARLE LANDFILL
STANLY COUNTY, NORTH CAROLINA
BUNNELL-LAMMONS ENGINEERING, INC. PROJECT NO. J10-7013-01A

CLIENT: CITY OF ALBEMARLE, NC
DATE: 10.18.10
ARRIVAL TIME: 8:00 AM
DEPARTURE TIME: 11:00 PM
LUNCH BREAK: —
WORK HOURS: 3
ONSITE BLE PERSONNEL: BROOKS CARLISLE

PROJECT DAY NO. 10

VISITORS:

NAME	REPRESENTING

WEATHER: (SUNNY) PTLY CLOUDY CLOUDY RAIN WINDY

TEMPERATURE:
MORNING LOW: 52° F
DAYTIME HIGH: 80° F

EQUIPMENT:

SITE ACTIVITIES
EXCAVATION FOR STORM DRAIN [✓]
RAINFLAP [ ]

LEACHATE MODIFICATIONS [ ]

CONTRACTOR ACTIVITIES:
Contractor Concreted Remaining Storm drain pipe under Access Rd. Pipe was Elbowed on Both ends And Concreted till Elbows over flowed And Air pockets pushed out.

TECHNICIAN ACTIVITIES:
Observed Contractor Concreting Storm drain pipe.

RECORD PREPARED BY: BROOKS CARLISLE
Signature

RECORD REVIEWED & APPROVED BY: DANIEL B. BUNNELL, P.E.
Signature

RECORD OF DAILY OBSERVATIONS

STORM DRAIN REMOVAL, RAINFLAPS, AND LEACHATE COLLECTION MODIFICATIONS

CITY OF ALBEMARLE LANDFILL
STANLY COUNTY, NORTH CAROLINA
BUNNELL-LAMMONS ENGINEERING, INC. PROJECT NO. J10-7013-01A

CLIENT: CITY OF ALBEMARLE, NC
DATE: 10.19.10
ARRIVAL TIME: 7:00 AM
DEPARTURE TIME: 5:00 PM
LUNCH BREAK: .5
WORK HOURS: 9.5
ONSITE BLE PERSONNEL: BROOKS CARLISLE

PROJECT DAY NO. 11

VISITORS:
NAME | REPRESENTING

WEATHER: (SUNNY) RAIN
PTLY CLOUDY WINDY
CLOUDY

TEMPERATURE:
MORNING LOW: 52° °F
DAYTIME HIGH: 78° °F

EQUIPMENT:

SITE ACTIVITIES
EXCAVATION FOR STORM DRAIN [✓]
RAINFLAP [ ]
LEACHATE MODIFICATIONS [ ]

CONTRACTOR ACTIVITIES:
Contractor Backfilled structural soil in area were storm drain pipe was cut back and concreted. Structural fill was placed in 6 inch lifts and compacted. After structural fill was placed, clay was placed in 6 inch lifts to 18 inches, 3 lifts and compacted.

TECHNICIAN ACTIVITIES:
Observed placement of structural fill in 6 inch lifts and compacted to 95%. Observed clay being placed in 6 inch lifts up to 18 inches 3 lifts and compacted to 95% after every lift. Hand auger down in two spots of clay. 1st hole clay was [redacted] 26" thick. 2nd hole was 20" thick. Test holes were backfilled with cuttings mixed with bentonite and rodded.

RECORD PREPARED BY: Signature BROOKS CARLISLE

RECORD REVIEWED & APPROVED BY: Signature DANIEL B. BUNNELL, P.E.

RECORD OF DAILY OBSERVATIONS

STORM DRAIN REMOVAL, RAINFLAPS, AND LEACHATE COLLECTION MODIFICATIONS

CITY OF ALBEMARLE LANDFILL
STANLY COUNTY, NORTH CAROLINA
BUNNELL-LAMMONS ENGINEERING, INC. PROJECT NO. 316-7013-01A

CLIENT: CITY OF ALBEMARLE, NC
DATE: 10.20.10
ARRIVAL TIME: 7:00 AM
DEPARTURE TIME: 3:30 PM
LUNCH BREAK: 1.5
WORK HOURS: 7
ONSITE BLE PERSONNEL: BROOKS CARLISLE

PROJECT DAY NO. 12

VISITORS:

NAME	REPRESENTING

WEATHER: SUNNY, RAIN, PTLY CLOUDY, WINDY, CLOUDY

TEMPERATURE:
MORNING LOW: 50° F
DAYTIME HIGH: 70° F

EQUIPMENT:

SITE ACTIVITIES
EXCAVATION FOR STORM DRAIN ☐
RAINFLAP ☐
LEACHATE MODIFICATIONS ☐

CONTRACTOR ACTIVITIES:

Contractor STARTED EXCAVATING TRENCH FOR 2 INCH FORCEMAIN PIPE Contractor WAS RAINED OUT FOR 1.5 hrs. Contractor Came Back to SITE AND Continued WORK ON TRENCH.

EXCAVATION FOR STORM DRAIN WAS PROTECTED FROM RAIN.

TECHNICIAN ACTIVITIES:

OBSERVED EXCAVATION OF TRENCH FOR 2" FORCEMAIN. TRENCH WAS EXCAVATED down 3 FEET. I OBTAINED TWO TUBES OF clay @ storm drain PIPE. Put Samples IN Bags FOR perm. test TRAVELED TO CHARLOTTE & Dropped SAMPLES OFF With BLE REP. FOR TRANSPORT TO LAB.

RECORD PREPARED BY: BROOKS CARLISLE
Signature

RECORD REVIEWED & APPROVED BY: DANIEL B. BUNNELL, P.E.
Signature

RECORD OF DAILY OBSERVATIONS

STORM DRAIN REMOVAL, RAINFLAPS, AND LEACHATE COLLECTION MODIFICATIONS

CITY OF ALBEMARLE LANDFILL
STANLY COUNTY, NORTH CAROLINA
BUNNELL-LAMMONS ENGINEERING, INC. PROJECT NO. J10-7013-01A

CLIENT: CITY OF ALBEMARLE, NC
DATE: 10.21.10
ARRIVAL TIME: 7:00 AM
DEPARTURE TIME: 4:30 PM
LUNCH BREAK: .5
WORK HOURS: 9
ONSITE BLE PERSONNEL: BROOKS CARLISLE

PROJECT DAY NO. 13

VISITORS:

NAME	REPRESENTING

WEATHER: SUNNY, PTLY CLOUDY, CLOUDY, RAIN, WINDY

TEMPERATURE:
MORNING LOW: 54° F
DAYTIME HIGH: 72° F

EQUIPMENT:

SITE ACTIVITIES
- EXCAVATION FOR STORM DRAIN [ ]
- RAINFLAP [ ]
- LEACHATE MODIFICATIONS [✓]

CONTRACTOR ACTIVITIES:
Contractor Continued Excavation trench for 2" Forcemain. Put protective cover back on top of liner repairs that chemrapeke made on liner @ storm drain pipe.

TECHNICIAN ACTIVITIES:
Observed the excavation of trench for 2" Forcemain pipe. Observed repairs on rain flaps for storm drain channels. Observed repairs on GCL, HDPE, GDM @ storm drain pipe.

RECORD PREPARED BY: Signature BROOKS CARLISLE

RECORD REVIEWED & APPROVED BY: Signature DANIEL B. BUNNELL, P.E.

TABLE 2: FIELD TRIAL SEAMS

STORM DRAIN REMOVAL, RAINFLAPS, AND LEACHATE COLLECTION MODIFICATIONS
CITY OF ALBEMARLE LANDFILL
STANLY COUNTY, NORTH CAROLINA
BUNNELL-LAMMONS ENGINEERING, INC. PROJECT NO. J10-7013-01A

CQA TECHNICIAN: BROOKS CARLISLE

DATE: 10·21·10

PAGE: 1

TRIAL SEAM CONFIGURATION:

Weld Strip/Weld Strip = WS/WS
Textured/Textured = TX/TX
Smooth/Smooth = SM/SM
Smooth/Textured = SM/TX
Weld Strip/Textured = WS/TX
Weld Strip/Smooth = WS/SM

* Textured geomembrane with a smooth welding strip along the roll edges noted as WS = Weld Strip.

TABLE 2
FIELD TRIAL SEAMS

Req'd Values

TRIAL SEAM NO.	GEOMEMBRANE TYPE (circle one)	TRIAL SEAM CONFIGURATION (circle one)	COMMENTS*	SEAMING METHOD (circle one)	AMBIENT TEMP (°F)	WELDER NAME	MACHINE NUMBER	MACHINE PARAMETERS TIME	PREHEAT TEMP	BARREL TEMP	SPEED	STRENGTH AT BREAK (ppi) PEEL TEST	SHEAR TEST	FTB or NON FTB (circle one)	RESULTS PASS / FAIL (circle one)
1	TEXTURED SMOOTH	WS/WS SM/TX TX/TX WS/TX SM/SM WS/SM		DBL FUSION SNG FUSION EXTRUSION	58°	JM	3	8:10	500°	550°		78 / 138 / 129 / 135 /	120 173 176	FTB NON FTB	PASS FAIL
	TEXTURED SMOOTH	WS/WS SM/TX TX/TX WS/TX SM/SM WS/SM		DBL FUSION SNG FUSION EXTRUSION								/		FTB NON FTB	PASS FAIL
	TEXTURED SMOOTH	WS/WS SM/TX TX/TX WS/TX SM/SM WS/SM		DBL FUSION SNG FUSION EXTRUSION								/		FTB NON FTB	PASS FAIL
	TEXTURED SMOOTH	WS/WS SM/TX TX/TX WS/TX SM/SM WS/SM		DBL FUSION SNG FUSION EXTRUSION								/		FTB NON FTB	PASS FAIL
	TEXTURED SMOOTH	WS/WS SM/TX TX/TX WS/TX SM/SM WS/SM		DBL FUSION SNG FUSION EXTRUSION								/		FTB NON FTB	PASS FAIL
	TEXTURED SMOOTH	WS/WS SM/TX TX/TX WS/TX SM/SM WS/SM		DBL FUSION SNG FUSION EXTRUSION								/		FTB NON FTB	PASS FAIL

* Note if field trial welds are for geomembrane "Repairs"

30 psi
10 · 15 sec

TABLES NO. 3 & 4
FIELD SEAMING LOG & NONDESTRUCTIVE TESTING LOG

CITY OF ALBEMARLE LANDFILL
STORM DRAIN REMOVAL, RAINFLAPS, AND LEACHATE COLLECTION MODIFICATIONS
STANLY COUNTY, NORTH CAROLINA
BUNNELL-LAMMONS ENGINEERING, INC. PROJECT NO. J10-7013-01A

LEAD CQA TECHNICIAN: BROOKS CARLISLE

DATE: 10 · 21 · 10

PAGE: 1 OF 2

MACHINE NUMBER: 3

WELDER NAME: JM

SEAM BETWEEN PANEL NUMBERS	SEAM LENGTH (FT)	APPROX. START TIME	AMBIENT TEMP (°F)	SECTION OF SEAM TESTED	TEST METHOD (circle)	AIR CHANNEL TESTING TIME START	AIR CHANNEL TESTING TIME END	AIR CHANNEL TESTING PRESSURE (psi) START	AIR CHANNEL TESTING PRESSURE (psi) END	AIR CHANNEL TESTING PRESSURE (psi) CHANGE	RESULTS PASS / FAIL (circle one)	DOUBLE FUSION WELD* (circle one)	TRIAL WELD (#)	DESTRUCTIVE SAMPLE (#)
P1 / Exist.	54	8:20	58°	-	AIR CHANNEL						PASS	FTB	1	
				-										
				-								NON FTB		
				-	VACUUM BOX						FAIL			
				-								NOT APPLICABLE		
/				-	AIR CHANNEL						PASS	FTB		
				-										
				-								NON FTB		
				-	VACUUM BOX						FAIL			
				-								NOT APPLICABLE		
/				-	AIR CHANNEL						PASS	FTB		
				-										
				-								NON FTB		
				-	VACUUM BOX						FAIL			
				-								NOT APPLICABLE		
/				-	AIR CHANNEL						PASS	FTB		
				-										
				-								NON FTB		
				-	VACUUM BOX						FAIL			
				-								NOT APPLICABLE		
/				-	AIR CHANNEL						PASS	FTB		
				-										
				-								NON FTB		
				-	VACUUM BOX						FAIL			
				-								NOT APPLICABLE		

Note: Seam length is recorded and calculated per machine and per welder.

* A 1-inch coupon is to be cut near the end of seam for all double fusion welded seams greater than or equal to 100 ft in continuous seam length. Cut coupons to be field tested for peel and noted as FTB or NON FTB.

54 (FEET): TOTAL LENGTH THIS PAGE

— (FEET): CUMULATIVE TOTAL LENGTH

TABLES NO. 3 & 4
FIELD SEAMING LOG & NONDESTRUCTIVE TESTING LOG

CITY OF ALBEMARLE LANDFILL
STORM DRAIN REMOVAL, RAINFLAPS, AND LEACHATE COLLECTION MODIFICATIONS
STANLY COUNTY, NORTH CAROLINA
BUNNELL-LAMMONS ENGINEERING, INC. PROJECT NO. J10-7013-01A

LEAD CQA TECHNICIAN: BROOKS CARLISLE

DATE: 10 · 21 · 10

PAGE: 2 OF 2

MACHINE NUMBER: 3

WELDER NAME: JM

SEAM BETWEEN PANEL NUMBERS	SEAM LENGTH (FT)	APPROX. START TIME	AMBIENT TEMP (°F)	SECTION OF SEAM TESTED	TEST METHOD (circle)	AIR CHANNEL TESTING TIME START	AIR CHANNEL TESTING TIME END	AIR CHANNEL TESTING PRESSURE (psi) START	AIR CHANNEL TESTING PRESSURE (psi) END	AIR CHANNEL TESTING PRESSURE (psi) CHANGE	RESULTS PASS / FAIL (circle one)	DOUBLE FUSION WELD* (circle one)	TRIAL WELD (#)	DESTRUCTIVE SAMPLE (#)
P1 / Exist.	Left 18'	9:30	58°	-	AIR CHANNEL						PASS	FTB	1	
				-								NON FTB		
				-										
				-	VACUUM BOX						FAIL			
				-								NOT APPLICABLE		
P1 / Existing	Right 18'	10:00	58°	-	AIR CHANNEL						PASS	FTB	1	
				-								NON FTB		
				-										
				-	VACUUM BOX						FAIL			
				-								NOT APPLICABLE		
/				-	AIR CHANNEL						PASS	FTB		
				-								NON FTB		
				-										
				-	VACUUM BOX						FAIL			
				-								NOT APPLICABLE		
/				-	AIR CHANNEL						PASS	FTB		
				-								NON FTB		
				-										
				-	VACUUM BOX						FAIL			
				-								NOT APPLICABLE		
/				-	AIR CHANNEL						PASS	FTB		
				-								NON FTB		
				-										
				-	VACUUM BOX						FAIL			
				-								NOT APPLICABLE		

Note: Seam length is recorded and calculated per machine and per welder.

* A 1-inch coupon is to be cut near the end of seam for all double fusion welded seams greater than or equal to 100 ft in continuous seam length. Cut coupons to be field tested for peel and noted as FTB or NON FTB.

36 (FEET): TOTAL LENGTH THIS PAGE

90 (FEET): CUMULATIVE TOTAL LENGTH

PHOTOGRAPHS

Photograph 1: Storm drain pipe penetration through liner prior to pipe section removal, GDM cut away to expose FML.

Photograph 2: Downstream end of 24-inch storm drain riser pipe grouted in-place.

Photograph 3: Compacting of clay liner repair using sheepsfoot wheel attachment to trackhoe.

Photograph 4: Augmenting GCL seams with powdered bentonite.

Photograph 5: New GCL in place over soil subgrade.

Photograph 6: Grinding and extrusion welding FML repair seam.

Photograph 7: New FML cap strip.

Photograph 8: GDM in place over storm drain repair.

Photograph 9: Protective cover in place over storm drain repair.

LABORATORY & FIELD TEST RESULTS

FIELD TEST RESULTS BY DRIVE TUBE METHOD
STRUCTURAL FILL

STORM DRAIN REMOVAL AND LINER REPAIR
CITY OF ALBEMARLE LANDFILL
STANLY COUNTY, NORTH CAROLINA

BUNNELL-LAMMONS ENGINEERING, INC. PROJECT NO. J10-7013-01A

		DRIVE TUBE				MOISTURE DETERMINATION									
Field Density Test No.	Proctor Number	Wet Weight Sample & Mold (lbs)	Weight of Mold (lbs)	Wet Weight of Soil (lbs)	Wet Density (pcf)	Oven or Field Test	Wet Weight (grams)	Dry Weight (grams)	Weight of Moisture (grams)	Moisture Content (%)	Percent Moisture +/- OMC (%)	Dry Density (pcf)	% Compaction (%)	Required Compaction (%)	Pass (P) or Fail (F)
F-1	L-1	5.04	1.30	3.7	112.3	Field	200.0	164.0	36.0	22.0	3.0	92.1	95.3	95	P
F-2	L-1	5.07	1.29	3.8	113.5	Field	200.0	168.0	32.0	19.0	0.0	95.4	98.7	95	P
F-3	L-1	5.06	1.28	3.8	113.5	Field	200.0	162.0	38.0	23.5	4.5	91.9	95.2	95	P

Proctor No.	Maximum Dry Density PCF	Optimum Moisture Content %
L-1	96.6	19.0
L-2	87.3	28.2

Drive Tube Mold Volume Factor: 30.03

Technician: Brooks Carlisle

Date: October 19, 2010

Reviewed By: Gary Weekley, PE

FIELD TEST RESULTS BY DRIVE TUBE METHOD
CLAY LINER

STORM DRAIN REMOVAL AND LINER REPAIR
CITY OF ALBEMARLE LANDFILL
STANLY COUNTY, NORTH CAROLINA

BUNNELL-LAMMONS ENGINEERING, INC. PROJECT NO. J10-7013-01A

		DRIVE TUBE				MOISTURE DETERMINATION										
Field Density Test No.	Proctor Number	Wet Weight Sample & Mold (lbs)	Weight of Mold (lbs)	Wet Weight of Soil (lbs)	Wet Density (pcf)	Oven or Field Test	Wet Weight (grams)	Dry Weight (grams)	Weight of Moisture (grams)	Moisture Content (%)	Percent Moisture +/- OMC (%)	Dry Density (pcf)	% Compaction (%)	Required Compaction (%)	Pass (P) or Fail (F)	Lift Number (1 to 3)
C-1	L-1	5.04	1.29	3.8	112.6	Field	200.0	165.0	35.0	21.2	2.2	92.9	96.2	95	P	1
C-2	L-1	5.24	1.29	4.0	118.6	Field	200.0	162.0	38.0	23.5	4.5	96.1	99.5	95	P	2
C-3	L-1	5.04	1.29	3.8	112.6	Field	200.0	164.0	36.0	22.0	3.0	92.3	95.6	95	P	2
C-4	L-1	5.04	1.29	3.8	112.6	Field	200.0	166.0	34.0	20.5	1.5	93.5	96.8	95	P	3
C-5	L-1	5.09	1.29	3.8	114.1	Field	200.0	164.0	36.0	22.0	3.0	93.6	96.9	95	P	3

Proctor No.	Maximum Dry Density PCF	Optimum Moisture Content %
L-1	96.6	19.0
L-2	87.3	28.2

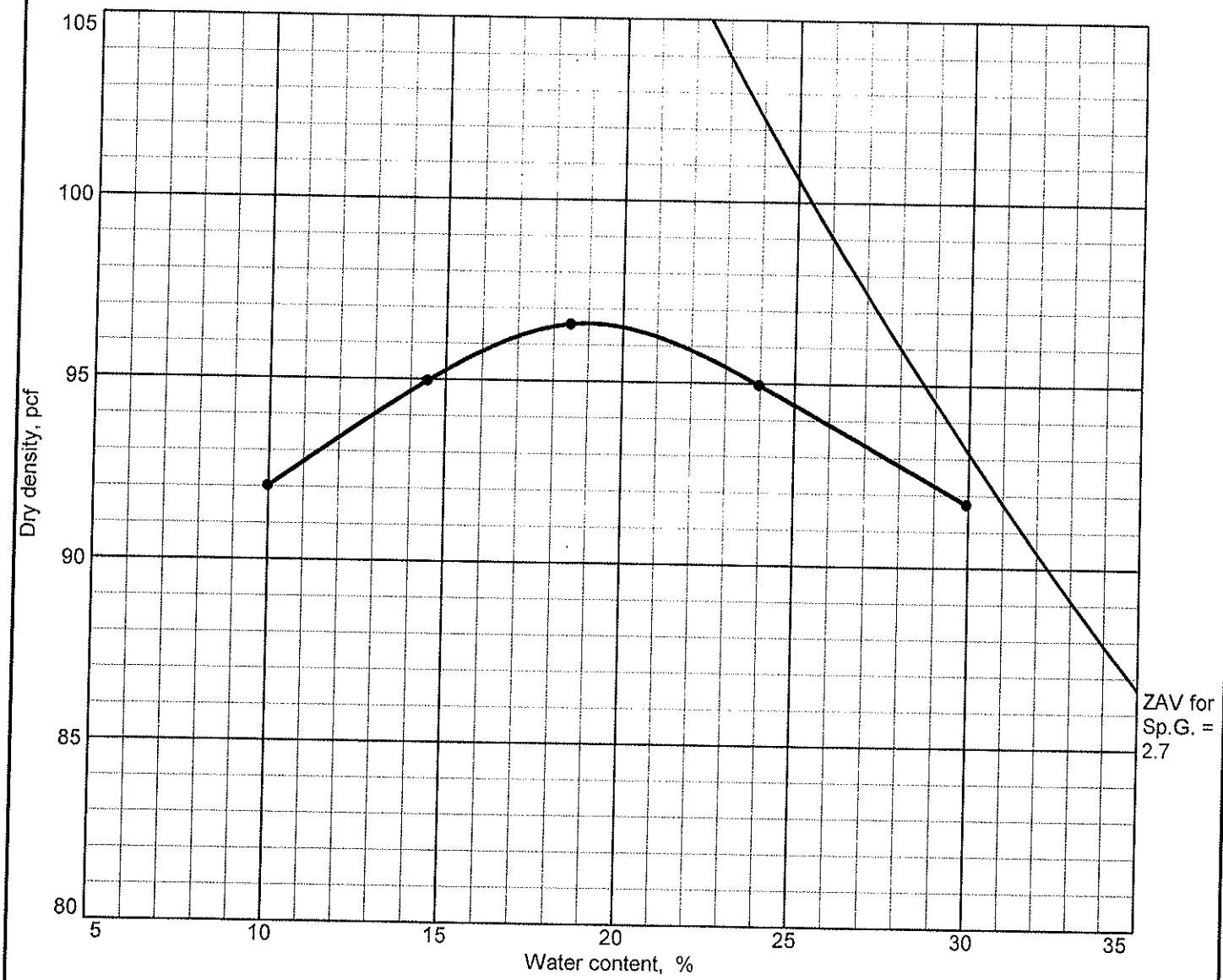
Drive Tube Mold Volume Factor: 30.03

Technician: Brooks Carlisle

Date: October 19, 2010

Reviewed By: Gary Weekley, PE

MOISTURE DENSITY RELATIONSHIP



Test specification: ASTM D 698-00a Method A Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 96.6 pcf Optimum moisture = 19.0 %	Light brown silty CLAY

Project No. J10-7013-01 **Client:** City of Albemarle, NC
Project: City of Albemarle Landfill

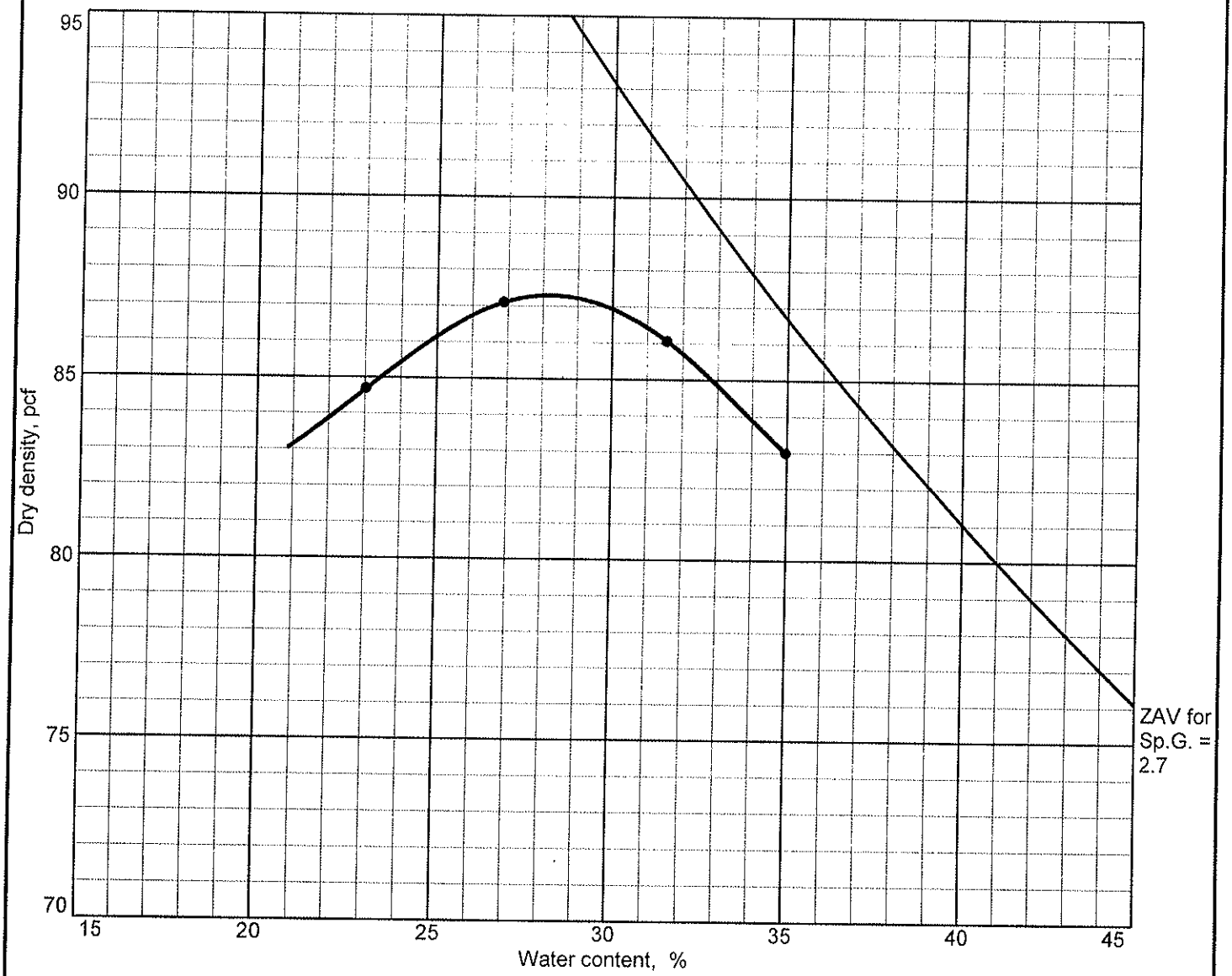
● **Source:** Borrow **Sample No.:** L-1

Remarks:

Bunnell Lammons Engineering, Inc.
Greenville, SC

Figure

MOISTURE DENSITY RELATIONSHIP



Test specification: ASTM D 698-00a Method A Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 87.3 pcf Optimum moisture = 28.2 %	Light brown silty CLAY

Project No. J10-7013-01 **Client:** City of Albemarle, NC.
Project: City of Albemarle Landfill

● **Source:** Borrow **Sample No.:** L-2

Remarks:

Bunnell Lammons Engineering, Inc.
Greenville, SC

Figure

BLE INC.

HYDRAULIC CONDUCTIVITY TEST REPORT

CONSTANT VOLUME APPARATUS (ASTM D 5084)

PROJECT:	CITY OF ALBEMARLE LANDFILL	TESTED BY:	JOHN MATHEW
PROJECT NO.:	J10-7013-01	CHECKED BY:	PAUL YARBER
DATE RECEIVED:	8-3-10		

SAMPLE NO.	L-1	SAMPLE LOCATION:	BORROW AREA
TYPE	REMOLDED	SAMPLE DESCRIPTION:	LIGHT BROWN SILTY CLAY

SAMPLE DIMENSIONS AND PROPERTIES

ITEM	INITIAL		FINAL	
	inches	centimeters	inches	centimeters
Sample Length	3.004	7.630	3.060	7.772
Sample Diameter	2.850	7.239	2.870	7.290
Length/Diameter Ratio		1.05		
Moisture Content (%)	WW= 136.9 DW= 113.1	21.0	WW= 248.2 DW= 187.7	32.2
Sample Wet Weight (grams)	558.2		620.8	
Wet Density (pcf)	111.0		119.5	
Dry Density (pcf)	91.7		90.3	
Saturation (%) ASSUMED SG= 2.7	68		101	

HYDRAULIC CONDUCTIVITY TESTING MEASUREMENT

(PERMOMETER)

Confining Pressure (psi)	80	Influent Pressure (psi)	70	Effluent Pressure (psi)	70	B-Value	0.95

Reset (Y/N)	Date	Clock Time	Elapsed Time	HA_{OUT} (cm)	HA_{IN} (cm)	Temp °C	Gradient	K (cm/sec)	Temp Correction	$K_{20°C}$ (cm/sec)
Y	9-24-10	8:37:31		7.5	1.67	22.1	10			
	9-24-10	8:43:10	0:05:39	5.6	1.75	22.1	7	5.5E-07	0.951	5.2E-07
	9-24-10	8:43:32	0:06:01	5.5	1.75	22.1	6	5.5E-07	0.951	5.2E-07
	9-24-10	8:43:58	0:06:27	5.4	1.76	22.1	6	5.4E-07	0.951	5.2E-07
	9-24-10	8:44:25	0:06:54	5.3	1.76	22.1	6	5.4E-07	0.951	5.1E-07

HYDRAULIC CONDUCTIVITY ($K_{20°C}$) 5.2E-07 cm/sec

% COMPACTION OF STD. PROCTOR MAX. DRY DENSITY (ASTM D 698): 94.9

% WETTER THAN OPTIMUM MOISTURE CONTENT (ASTM D 698): +2.0

BLE INC.

HYDRAULIC CONDUCTIVITY TEST REPORT

CONSTANT VOLUME APPARATUS (ASTM D 5084)

PROJECT:	CITY OF ALBEMARLE LANDFILL	TESTED BY:	JOHN MATHEW
PROJECT NO.:	J10-7013-01	CHECKED BY:	PAUL YARBER
DATE RECEIVED:	10-15-10		

SAMPLE NO.	LP-1-1	SAMPLE LOCATION:	SLOPE REPAIR
TYPE	UNDISTURBED	SAMPLE DESCRIPTION:	LIGHT BROWN SILTY CLAY

SAMPLE DIMENSIONS AND PROPERTIES

ITEM	INITIAL		FINAL	
	inches	centimeters	inches	centimeters
Sample Length	4.187	10.635	4.222	10.724
Sample Diameter	3.854	9.789	3.871	9.832
Length/Diameter Ratio		1.09		
Moisture Content (%)	WW= 213.1 DW= 168.0	26.8	WW= 316.8 DW= 246.5	28.5
Sample Wet Weight (grams)	1447.6		1543.0	
Wet Density (pcf)	112.9		118.3	
Dry Density (pcf)	89.0		92.0	
Saturation (%) ASSUMED SG= 2.7	81		93	

HYDRAULIC CONDUCTIVITY TESTING MEASUREMENT

(PERMOMETER)

Confining Pressure (psi)	70	Influent Pressure (psi)	60	Effluent Pressure (psi)	60	B-Value	0.96

Reset (Y/N)	Date	Clock Time	Elapsed Time	HA_{OUT} (cm)	HA_{IN} (cm)	Temp °C	Gradient	K (cm/sec)	Temp Correction	$K_{20°C}$ (cm/sec)
Y	10-21-10	8:48:20		9.8	1.58	20.4	10			
	10-21-10	9:00:17	0:11:57	6.0	1.73	20.4	5	3.1E-07	0.991	3.1E-07
	10-21-10	9:00:51	0:12:31	5.9	1.74	20.4	5	3.1E-07	0.991	3.0E-07
	10-21-10	9:01:25	0:13:05	5.8	1.74	20.4	5	3.1E-07	0.991	3.0E-07
	10-21-10	9:01:58	0:13:38	5.7	1.74	20.4	5	3.0E-07	0.991	3.0E-07

HYDRAULIC CONDUCTIVITY ($K_{20°C}$) 3.0E-07 cm/sec

BLE INC.

HYDRAULIC CONDUCTIVITY TEST REPORT

CONSTANT VOLUME APPARATUS (ASTM D 5084)

PROJECT:	CITY OF ALBEMARLE LANDFILL	TESTED BY:	JOHN MATHEW
PROJECT NO.:	J10-7013-01	CHECKED BY:	PAUL YARBER
DATE RECEIVED:	10-15-10		

SAMPLE NO.	LP-1-2	SAMPLE LOCATION:	SLOPE REPAIR
TYPE	UNDISTURBED	SAMPLE DESCRIPTION:	LIGHT BROWN SILTY CLAY

SAMPLE DIMENSIONS AND PROPERTIES

ITEM	INITIAL		FINAL	
	inches	centimeters	inches	centimeters
Sample Length	4.072	10.343	4.092	10.394
Sample Diameter	3.849	9.776	3.883	9.863
Length/Diameter Ratio		1.06		
Moisture Content (%)	WW= 107.0 DW= 87.8	21.9	WW= 253.8 DW= 196.1	29.4
Sample Wet Weight (grams)	1467.6		1532.4	
Wet Density (pcf)	118.0		120.5	
Dry Density (pcf)	96.8		93.1	
Saturation (%) ASSUMED SG= 2.7	80		98	

HYDRAULIC CONDUCTIVITY TESTING MEASUREMENT

(PERMOMETER)

Confining Pressure (psi)	70	Influent Pressure (psi)	60	Effluent Pressure (psi)	60	B-Value	0.96

Reset (Y/N)	Date	Clock Time	Elapsed Time	HA_{OUT} (cm)	HA_{IN} (cm)	Temp °C	Gradient	K (cm/sec)	Temp Correction	$K_{20°C}$ (cm/sec)
Y	10-21-10	8:27:13		9.6	1.58	20.4	10			
	10-21-10	8:31:58	0:04:45	8.6	1.63	20.4	9	1.6E-07	0.991	1.6E-07
	10-21-10	8:32:34	0:05:21	8.5	1.63	20.4	9	1.6E-07	0.991	1.6E-07
	10-21-10	8:33:10	0:05:57	8.4	1.63	20.4	8	1.5E-07	0.991	1.5E-07
	10-21-10	8:33:46	0:06:33	8.3	1.64	20.4	8	1.5E-07	0.991	1.5E-07

HYDRAULIC CONDUCTIVITY ($K_{20°C}$) 1.5E-07 cm/sec

GEOSYNTHETIC MATERIAL
PRODUCT DATA SHEETS

CETCO®

GRI GEI GII GSI GAI GCI

GAI-LAP accredited

Date: 10/5/2010
Purchase Order: P10-078
ORDER NUMBER: 000266277

Ryan Kamp
Chesapeake Containment Systems

Middle River, MD 21220
rkamp@ccsliners.com

To Whom it May Concern:

Please find enclosed the MQA/MQC test data package for Geosynthetic Clay Liner shipments to Chesapeake Containment Systems.

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

Melanie King
Quality Assurance Coordinator
CETCO Cartersville Plant

GEOSYNTHETIC CLAY LINER
MANUFACTURING QUALITY ASSURANCE DATA PACKAGE

PROJECT NAME: Albemarle City LF
CUSTOMER P.O.: P10-078
ORDER NUMBER: 000266277
PREPARED FOR: Chesapeake Containment Systems

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

CETCO®

PRODUCT CERTIFICATIONS

PROJECT NAME: Albemarle City LF
CUSTOMER P.O.: P10-078
ORDER NUMBERS: 000266277
PREPARED FOR: Chesapeake Containment Systems

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 ST

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)	30 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)	3.5 lbs/in Min

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

Melanie King
Quality Assurance Coordinator

CETCO

GCL PACKING LIST AND MQA TRACKING FORM

Listing of finished and raw materials used to produce certification package number 000266277

GCL								Geotextiles				Clay
CV-BENTOMAT ST								N/W-WHITE			WOVEN	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 #
000266277	201037CV	8691	150	15	2614	2250	8690	201036CV	00003982	00003973	WEA015940-1	978748B
Total sq ft: 2250								Total Number of Rolls Certified: 1				

CETCO

GCL MANUFACTURING QUALITY CONTROL TEST DATA

The following rolls in GCL certification package number 000266277 have been tested in our production facility lab.

Product	Lot # Tested	Roll # Tested	Mass Area	Grab Strength	Peel Strength 6496
		ASTM Test Method:	D 5993	D 6768	D 6496
		Required Value:	0.75 lb /sq ft Min	30 lbs/in MARV	3.5 lbs/in Min
CV-BENTOMAT ST	201037CV	8690	0.86	69.2	5.4

BENTONITE CLAY CERTIFICATION

The Bentonite Clay used to produce package 000266277

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
978748B	11.40	27.00	15.30

CETCO

GEOTEXTILE TEST RESULTS FROM MATERIAL SUPPLIERS

The GCL in certification package number 000266277 was manufactured with geotextiles which were tested with the following results.

BASE GEOTEXTILE			
Material	Roll Number	Mass Area oz/yd2	Grab Strength lbs
MATTEX	WEA015940-1	3.5	197.0

COVER GEOTEXTILE			
Material	Roll Number	Mass Area oz/yd2	Grab Strength lbs
CV-NON-WOVEN	00003973	6.2	42.2

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.

agru america
quality control dept

quality certificate

ROLL # **218471-10** Lot #: **7100281** **Liner Type: MICROSPIKE™ HDPE**

Measurement ASTM D5994 (Modified)		METRIC		ENGLISH		Thickness.....	1.5 mm	60 mil
	MIN:	1.54	mm	61	mil	Length.....	153.926 m	505.0 feet
	MAX:	1.74	mm	69	mil	Width.....	7.00 m;	23.0 feet
Asperity ASTM D7466: 32/34 mil TOP / BOTTOM	AVE:	1.61	mm	63	mil	OIT(Standard) ASTM D3895 minutes	190	

						TEST RESULTS
Specific Gravity ASTM D792	Density	g/cc				.946
MFI ASTM D1238 COND. E GRADE: K307	Melt Flow Index 190°C /2160 g	g/10 min				.24
Carbon Black Content ASTM D4218	Range	%				2.24
Carbon Black Dispersion ASTM D5596	Category					10 In Cat 1
Tensile Strength ASTM D6693 ASTM D638 (Modified) (2 inches / minute)	Average Strength @ Yield	27	N/mm (kN/m)	153	ppi	2,415 psi
	Average Strength @ Break	30	N/mm (kN/m)	174	ppi	2,743 psi
Elongation ASTM D6693 ASTM D638 (Modified) (2 inches / minute) Lo = 1.3" Yield	Average Elongation @ Yield	%				18.23
Lo = 2.0" Break	Average Elongation @ Break	%				456.6
Dimensional Stability ASTM D1204 (Modified)	Average Dimensional change	%				-0.31
Tear Resistance ASTM D-1004 (Modified)	Average Tear Resistance	264.5	N			59.464 lbs
Puncture Resistance FTMS 101 Method 2065 (Modified)	Load	486.3	N			109.32 lbs
Puncture Resistance ASTM D4833 (Modified)	Load	609.4	N			137.00 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: **Chesapeake Containment**
PO: **P10-059 Albermarle City LF**
Destination **Albermarle, NC**

Date: 5-6-10

Signature: H Holme
Quality Control Department

60HDmic.FRM
REV 03
12/23/05

CoA Date: 03/03/2010

Certificate of Analysis

Shipped To: AGRU AMERICA INC
500 GARRISON RD
GEORGETOWN SC 29440
USA

Recipient: PALMER
Fax:

CPC Delivery #: 88014363
PO #: 005329
Weight: 191800 LB
Ship Date: 03/03/2010
Package: BULK
Mode: Hopper Car
Car #: CHVX896280
Seal No: 265198

Product:
MARLEX POLYETHYLENE K307 BULK

Lot Number: 7100281

Property	Test Method	Value	Unit
Melt Index	ASTM D1238	0.24	g/10mi
HLMI Flow Rate	ASTM D1238	21	g/10mi
Density	D1505 or D4883	0.936	g/cm3
Pellet Count	P02.08.03	27	pel/g
Production Date		03/01/2010	

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

SKAPS Industries

Engineered Synthetic Products, Inc.

October 7, 2010
Chesapeake Containment Systems

Ref. : Albemarle City Landfill, NC
Customer P.O. # P10-079
Transnet 270-2-6

We certify that the Transnet 270-2-6 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
Geonet[3]				
Mass per Unit Area	ASTM D 5261	lbs/ft^2	0.197	Minimum
Thickness	ASTM D 5199	mil	270+/-15	Minimum
Carbon Black	ASTM D 4218	%	2.0	Minimum
Tensile Strength	ASTM D 5035	lbs/in	45	Minimum
Melt Flow	ASTM D 1238[2]	g/10 min	1.0	Maximum
Density	ASTM D 1505	g/cm^3	0.94	Minimum
Transmissivity[1]	ASTM D 4716	m2/sec	3.0×10^{-3}	MARV[5]
Composite				
Ply Adhesion	ASTM D 7005	lb/in	1.0	MARV
Geotextile[3 & 4]				
Fabric Weight	ASTM D 5261	oz/yd^2	6.0	MARV
Grab Strength	ASTM D 4632	lbs	160	MARV
Grab Elongation	ASTM D 4632	%	50	MARV
Tear Strength	ASTM D 4533	lbs	65	MARV
Puncture Resistance	ASTM D 4833	lbs	90	MARV
CBR Puncture	ASTM D 6241	lbs	475	MARV
Water Flow Rate	ASTM D 4911	gpm/ft2	125	MARV
Permittivity	ASTM D 4911	sec-1	1.63	MARV
Permeability	ASTM D 4911	cm/sec	0.3	MARV
AOS	ASTM D 4751	US Sieve	70	MARV
UV Resistance	ASTM D 4355	%/hrs	70/500	MARV

Notes:

1 Transmissivity measured using water at 21 ± 2 °C (70 ± 4 °F) with a gradient of 0.1 and a confining pressure of 10000 psf between steel plates after 15 minutes.
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

571 Industrial Parkway, Commerce, GA 30529 **Phone:** 706-336-7000 **Fax:** 706-336-7007 **Email:** skaps@skaps.com