Construction Quality Assurance Report

Davidson County MSW Landfill - Phase 1B Closure
Davidson County, North Carolina

Prepared For:

Davidson County Integrated Solid Waste Management
1242 Old Highway 29
Thomasville, North Carolina 27360

Prepared By:

RICHARDSON SMITH GARDNER & ASSOCIATES
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14 N. BOYLAN AVENUE
RALEIGH, NORTH CAROLINA 27603
NC LIC. NO. C-0828 (ENGINEERING)

May 2011

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CONSTRUCTION QUALITY ASSURANCE REPORT

Davidson County MSW Landfill - Phase 1B Closure
Davidson County, North Carolina

Prepared for:
Davidson County Integrated Solid Waste Management Department
Thomasville, North Carolina

RSG Project No. DAVDCO-10-3

Pieter K. Scheer, P.E. 5/19/2011
Principal, Project Manager

May 2011

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DAVIDSON COUNTY MSW LANDFILL
PHASE 1B CLOSURE

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DAVIDSON COUNTY MSW LANDFILL
PHASE 1B CLOSURE

CONSTRUCTION QUALITY ASSURANCE REPORT

1.0 INTRODUCTION

This Construction Quality Assurance (CQA) Report has been prepared to document the CQA activities performed during the closure of Phase 1B (approximately 16.8 acres) of the Davidson County MSW Landfill. The landfill facility is located off of Davidson County Landfill Road near Lexington, North Carolina and is owned and operated by Davidson County under State Solid Waste Permit No. 29-06. The most recent Permit to Operate was issued by the North Carolina Division of Waste Management (NCDWM) on December 8, 2008.

2.0 PROJECT DESCRIPTION

2.1 General

The Phase 1B closure consists of the closure of the western portion of the Phase 1 landfill unit. The Phase 1 unit (approximately 32 acres) is a Subtitle D landfill unit consisting of 3 contiguous sub-units (Areas 1 and 3, which were designed by CDM and Area 2, which was designed by Joyce Engineering). The eastern portion of Phase 1 (Phase 1A) was closed in 2005. This closure was designed and certified by Joyce Engineering, Inc. The components of the Phase 1B final cover system include the following components (bottom-up):

- prepared intermediate cover;
- textured 30 mil LLDPE geomembrane;
- drainage geocomposite; and
- 24-inch thick (min.) vegetative soil layer.

In addition to the final cover system, the Phase 1B closure also includes associated landfill gas, drainage, and erosion and sedimentation control measures.

2.2 Reference Documents

The Phase 1B closure was constructed in accordance with the following documents with clarifications and modifications as described in **Section 2.3**.

Construction Documents - Davidson County MSWLF - Phase 1B Closure: Includes general and technical specifications, CQA manual, LFG system modifications (Davidson Gas Producers), and contract addenda prepared by Richardson Smith Gardner & Associates and dated June, 2010.

Construction Drawings - Davidson County MSWLF - Phase 1B Closure:
Includes construction drawings prepared by Richardson Smith Gardner & Associates and dated June, 2010.

Permit Modification - Davidson County MSWLF - Phase 1:
Includes calculations and drawings prepared by Richardson Smith Gardner & Associates as revised through June, 2008 (Permit to Operate issued by NCDWM on December 8, 2008 (copy provided in **Appendix A**)).

2.3 Design Clarifications and Modifications

Clarifications and modifications to the above documents are provided in **Appendix B**. A listing of each is as follows:

Design Clarifications:

1. Interface Shear Strength Test Requirements

Design Modifications:

1. Final Cover Termination

2.4 Project Participants

The following parties were involved in the construction and CQA of the Phase 1B Closure:

2.4.1 Owner

Davidson County Integrated Solid Waste Management Department
1242 Old Highway 29
Thomasville, NC 27360
Phone: (336) 242-2284
Fax: (336) 249-7524

Contacts: Charlie Brushwood, Director
Steven Sink, Landfill Manager
Jim Gilreath, Safety Manager

2.4.2 Engineer/CQA Engineer

Richardson Smith Gardner & Associates, Inc. (RSG)
14 N. Boylan Ave.
Raleigh, NC 27603
Phone: (919) 828-0577
Fax: (919) 828-3899

Contacts: Pieter Scheer, P.E., Project Manager
Byron Hackney, Field Technician
Randy Berarducci, Field Technician

2.4.3 CQA Testing - Soils & Geosynthetics

Geotechnics

Raleigh Office:
2200 Westinghouse Blvd., Suite 103
Raleigh, NC 27604
Phone: (919) 876-0405
Fax: (919) 876-0460

Contacts: Mike Smith, Regional Manager

Pittsburgh Office:
544 Braddock Ave.
East Pittsburgh, PA 15112
Phone: (412) 823-7600
Fax: (412) 823-8999

Contacts: J.P. Kline, P.E., Lab Director

2.4.4 Contractor

J.T. Russell & Sons, Inc. (J.T. Russell)
1721 US 52 North
Albemarle, NC 28001
Phone: (704) 982-2225
Fax: (704) 986-2270

Contacts: Nathan Russell, Project Manager
Michelle Brown, Project Coordinator
Brian Cody, Site Superintendent

2.4.5 Geosynthetics Installer

Comanco Environmental Corp. (Comanco)
4301 Sterling Commerce Drive
Plant City, FL 33566
Phone: (813) 988-8829
Fax: (813) 988-8779

Contacts: Clayton Lung, Project Manager
Tony Sanchez, Project Superintendent

2.4.6 Landfill Gas Subconsultant

SCS Field Services
2520 Whitehall Park Drive, Suite 450
Charlotte, NC 28273
Phone: (704) 504-3170
Fax: (704) 504-3174

Contacts: Tony Cartee, Project Manager

2.4.7 Contractor's Surveyor

Wright & Fields Land Surveying
1340 Albemarle Road, Suite C
Troy, NC 27371
Phone: (910) 572-2449

Contacts: Tommy Fields, PLS, Project Manager

3.0 SUMMARY OF CONSTRUCTION ACTIVITIES

Major elements of the project are discussed below. Photos documenting the construction can be found in **Appendix C**. Prior to J.T. Russell beginning work, a project Pre-Construction Meeting was held on June 25, 2010.

3.1 Site Preparation

The Phase 1B closure construction began in July, 2010 with surveying/staking activities and clearing limits and the stripping of existing vegetation by J.T. Russell.

3.2 Erosion and Sedimentation Control Measures

The construction of erosion and sedimentation control measures took place in conjunction with project activities. Permanent drainage features (rain gutters, down pipes, perimeter channels, etc.) were added as areas were brought to grade. Once areas reached final grade, the areas were vegetated in accordance with project requirements.

3.3 Earthwork

Once portions of the closure area were stripped of existing vegetation, additional soil was placed and tracked in as needed to repair the existing intermediate cover. As anticipated, during surface preparation activities, a few areas had to be overexcavated and backfilled due to the presence of soft areas. Additionally, excess waste was removed from some areas along the toe of the slope in order to complete the final cover termination above the existing anchor trench for the base liner system. Excess waste was placed on top of Phase 1B in an area that was below permitted grades.

Also, just prior to the installation of the geomembrane, the surface of the intermediate cover was smooth drum rolled.

3.4 Landfill Gas (LFG) Management System

As the intermediate cover was being prepared, J.T. Russell began construction of LFG surface collector trenches. These trenches were completed in accordance with the approved design plans. After completion of the final cover, these trenches were connected with the emergency gas relief valves (5 locations).

A significant portion of the project involved the relocation of existing LFG header piping from the surface of the pre-existing intermediate cover to within the vegetative soil layer component of the final cover system (including the previously closed Phase 1A area). Booted penetrations for LFG wells were installed and adjustments were made as needed to the piping layout such that the entire Phase 1 LFG collection system was connected to Davidson Gas Producer's (DTE Energy) electrical generation facility (including permanent blower/flare system) located just to the southwest of the Phase 1B closure area. The work on the Phase 1 LFG collection system was performed incrementally by SCS Field Services under subcontract to J.T. Russell.

3.5 Down Pipes

Also upon preparation of the intermediate cover, J.T. Russell installed the down pipes for removal of stormwater and flow in the drainage geocomposite (upon later connection with the rain gutters). These pipes were completed in accordance with the approved design plans.

3.6 30 Mil LLDPE Geomembrane

Prior to the placement of geosynthetics, a geosynthetics CQA meeting was held in accordance with the requirements of the project CQA manual. A summary of this meeting can be found in **Appendix D**.

In accordance with project requirements, textured LLDPE geomembrane was placed over the Phase 1B subgrade and tied into the LLDPE geomembrane previously installed over the area to the east. Comanco visually accepted the subgrade surface in advance of material placement.

An as-built drawing showing the orientation of geomembrane panels as well as destructive sample and repair locations is provided in **Appendix J**.

3.7 Drainage Geocomposite/Vegetative Soil Layer

As the 30 mil HDPE geomembrane installation began, placement of drainage geocomposite followed closely behind. Once a portion of the drainage geocomposite had been placed, placement of the vegetative soil layer was initiated by J.T. Russell

beginning on the southeast end of Phase 1B and proceeding around the western end to the north side. In order to protect the underlying geosynthetics from damage, trucks operated on at least 3 feet of cover and low ground pressure dozers were used to push out the material. Only minor wrinkling of the geomembrane was observed during placement (as is typical) and good contact between the LLDPE geomembrane and the underlying intermediate cover was apparent.

Once portions of the vegetative soil layer was in-place, J.T. Russell constructed the rain gutters within the vegetative soil layer.

4.0 CQA PROGRAM

4.1 Scope of Services

In satisfying the requirements of the Project CQA Manual, the following activities were performed:

- Observation and documentation of construction of prepared intermediate cover, LFG management system, LLDPE geomembrane, drainage geocomposite, and vegetative soil layer.
- Field and/or laboratory testing of geosynthetics, drainage aggregate, and vegetative soil layer materials.
- Review of submittals from the Contractor for conformance with project specification and CQA requirements.
- Review/preparation of record drawings.
- Preparation of the final CQA report.

5.0 FINAL COVER SYSTEM CQA

5.1 Material Approval

RSG reviewed and approved the leachate management system product submittals provided by J.T. Russell. The selected materials included the following:

Drainage Aggregate: - No. 57 Stone (LFG Trenches/Seep Collection Drains/Toe Drains) - 1.5" to 3" Stone (Rain Gutters)	J.T. Russell & Sons - Self Processed
HDPE Pipe/Fittings: - LFG Trenches - Down Pipes - Rain Gutters	ISCO Industries 6" Diam. (DR 26) 12", 14", 16", & 18" Diam. (DR 26) 6", 8", 10", & 12" Diam. (DR 26)
CPE Pipe/Fittings: - Seep Collection Drains - Toe Drains	ADS N-12 4" Diam. 6" Diam.

Emergency Gas Relief Valve:	Groth Corp. Model 1260A
Geomembrane:	See **Section 6**
Drainage Geocomposite:	See **Section 7**
Geotextiles: - Type GT-S (LFG Trenches/Toe Drains) - Type GT-T (Rain Gutters)	See **Section 8**

Copies of selected product submittals for these products can be found in **Appendix E1**.

5.2 Material Control Testing

A sample of the No. 57 stone provided from J.T. Russell was tested for gradation (ASTM C 136). The results of this test, which met project criteria, can be found in **Appendix E2**. RSG visually reviewed and approved the larger 1.5" to 3" stone, which was used in the construction of the rain gutters.

5.3 Vegetative Soil Layer

The criteria for construction of vegetative soil layer per the project specifications included the following:

- Materials: CL, ML, SM-SC, SM, or SC (ASTM D 2487) with no deleterious material;
- Gradation: Max. = 3 inches;
- Lift Thickness: 12-inch min.;
- Density: Tracked In Only; and
- Thickness: 24 inches min.

Information on the borrow area (including boring logs, test pit data, and laboratory test results) used during the Phase 1B project was performed by RSG prior to construction. This information, which can be found in **Appendix E3**, shows that the borrow area had the appropriate soil types. A visual classification of soils (ASTM D 2488) was performed on an on-going basis during placement of protective cover. Final thickness of the protective cover was verified by hand auger (measurements shown on as-built topographic survey drawing (**Appendix J**)).

5.4 Contractor CQC Testing

During construction of the down pipes and the re-installed LFG piping, J.T. Russell and SCS Field Services performed low pressure air testing. The pressure testing was conducted in accordance with ASTM F 1417. Documentation of the successful testing, which includes six tests on the down pipes and 3 tests on the LFG piping, can be found in **Appendix E4**.

6.0 30 MIL LLDPE GEOMEMBRANE CQA

6.1 Material Approval

RSG reviewed and approved the 30 mil LLDPE geomembrane product submittals provided by J.T. Russell. The selected material was Ultraflex Textured 30 mil LLDPE geomembrane as manufactured by GSE Lining Technology, Inc. of Houston, Texas. Copies of selected product submittal information for this product can be found in **Appendix G1**.

Note that, as part of the submittal information for all geosynthetics, interface shear strength testing was performed for the geosynthetic/soil or geosynthetic/geosynthetic interfaces within the final cover system. This testing was performed on representative material samples by Geotechnics of Pittsburgh, PA under contract to J.T. Russell. A summary of this testing performed is provided in **Appendix F**. The results for each interface were found to exceed project design requirements.

6.2 Manufacturer's Quality Control Certificates

RSG reviewed and approved GSE's quality control certificates upon delivery to the site. Copies of these certificates can be found in **Appendix G1**.

6.3 Material Control Testing

The number and results of material control tests performed on the 30 mil LLDPE geomembrane is summarized in **Table 1**. Note that the number of tests required was based on a quantity of 872,666 SF (46 rolls/2 lots) of material received. A geosynthetics inventory log for LLDPE geomembrane can be found in **Appendix G2**. This log identifies the rolls which were sampled for material control testing. The results of material control testing of LLDPE geomembrane can be found in **Appendix G3**.

6.4 Field Seam Control Tests

The results of trial welds performed by Comanco can be found in **Appendix G4**.

6.5 Field Seam Record Tests

Panel placement and seaming forms can be found in **Appendices G5 and G6**, respectively. The results of nondestructive and destructive CQC and CQA testing can be found in **Appendices G6 through G8**. A repair log documenting all repairs of defects and destructive sample locations can be found in **Appendix G9**. Record testing of LLDPE geomembrane seams is summarized in **Table 2**.

7.0 DRAINAGE GEOCOMPOSITE CQA

7.1 Material Approval

RSG reviewed and approved the drainage geocomposite product submittals provided by J.T. Russell. The selected material was 6-300-6 geocomposite as manufactured by AGRU America of Georgetown, SC. Copies of selected product submittal information for this product can be found in **Appendix H1**.

7.2 Manufacturer's Quality Control Submittals

RSG reviewed and approved AGRU America's quality control certificates upon delivery to the site. Copies of these certificates can be found in **Appendix H1**.

7.3 Material Control Testing

The number and results of material control tests performed on the drainage geocomposite is summarized in **Table 3**. Note that the number of tests required was based on a quantity of 831,793 SF (348 rolls/5 lots) of material received. A geosynthetics inventory log for the drainage geocomposite can be found in **Appendix H2**. This log identifies the rolls which were sampled for material control testing. The results of material control testing of drainage geocomposite can be found in **Appendix H3**.

8.0 GEOTEXTILE CQA

8.1 Material Approval

RSG reviewed and approved the geotextile product submittals provided by J.T. Russell. The selected materials were TerraTex N06 (Type GT-S geotextile) and TerraTex N04.5 (Type GT-T geotextile) as manufactured by Hanes Geo Components. Copies of selected product submittal information for this product can be found in **Appendix I1**.

8.2 Material Control Testing

The number and results of material control tests performed on the geotextiles is summarized in **Table 4**. Note that the number of tests required was based on quantities of 90,000 SF (20 rolls/1 lot) (Estimated) of Type GT-S geotextile and 54,000 SF (12 rolls/1 lot) (Estimated) of Type GT-T geotextile material received. The results of material control testing of geotextiles can be found in **Appendix I2**.

9.0 RECORD DRAWINGS

The following record (as-built) drawings depicting the construction of the Phase 1B closure can be found in **Appendix J**:

- As-Built 30 Mil Textured LLDPE Geomembrane Panel Layout with Destructive Test and Repair Locations (prepared by RSG using survey information from Wright & Fields);
- As-Built HDPE Pipe (LFG, Down Pipes, & Rain Gutters) (prepared by Wright and Fields); and
- As-Built Topographic Survey showing thickness test locations (prepared by Wright & Fields).

10.0 PROJECT CERTIFICATION

Based on the observations and results of the CQA program documented herein, it is our professional opinion that the closure of Phase 1B of the Davidson County MSW Landfill was completed in accordance with the following:

i. The Project CQA Manual;
ii. The conditions of the Permit to Construct/Permit to Operate;
iii. The requirements of 15A NCAC 13B.1624; and
iv. Acceptable engineering practices.

RICHARDSON SMITH GARDNER & ASSOCIATES, INC.

Pieter K. Scheer, P.E.
Project Manager

TABLE 1
SUMMARY OF MATERIAL CONTROL TESTS
LLDPE GEOMEMBRANE

	Property									
	Thickness	Density	Carbon Black Content	Carbon Black Dispersion[1]	Tensile Properties				Tear Resistance	
					Tensile Strength at Break		Elongation at Break			
					MD	CD	MD	CD	MD	CD
Units	mils	g/cm^3	%	Category	lb/inch		%		lbs	
Test Method	ASTM D 5994	ASTM D 1505	ASTM D 1603	ASTM D 5596	ASTM D 6693 (Type IV)				ASTM D 1004	
Required Test Frequency	100,000 ft^2 or 1 per Lot	100,000 ft^2 or 1 per Lot	100,000 ft^2 or 1 per Lot	100,000 ft^2 or 1 per Lot	100,000 ft^2 or 1 per Lot				100,000 ft^2 or 1 per Lot	
No. of Tests Required	9	9	9	9	9		9		9	
No. of Tests Performed	9	9	9	9	9		9		9	
Specified Value	30 (See Note 3)	$\leq$ 0.939	2.0 - 3.0	1, 2, or 3	$\geq$ 45		$\geq$ 250		$\geq$ 16	
Sample I.D.	**Results**									
105153832	39	0.931	2.3	Pass	109	126	597	646	25	24
105153837	40	0.931	2.4	Pass	127	103	633	551	25	24
105153842	40	0.931	2.4	Pass	135	98	644	518	26	25
105153847	40	0.930	2.4	Pass	114	105	564	555	25	24
105153857	30	0.931	2.5	Pass	123	96	609	517	27	26
105153863	40	0.930	2.4	Pass	131	110	635	570	24	25
105153868	40	0.930	2.4	Pass	123	105	602	542	24	25
105153873	40	0.930	2.3	Pass	121	104	605	545	23	25
105153878	40	0.930	2.1	Pass	124	106	599	563	25	25
Minimum Value	30	0.930	2.1	Pass	109	96	564	517	23	24
Maximum Value	40	0.931	2.5	Pass	135	126	644	646	27	26
Average Value	39	0.930	2.3	Pass	123	106	610	556	25	25

Quantity of LLDPE Geomembrane Received: 872,666 ft^2
2 Lots

Notes:

1. Carbon black dispersion for 10 different views: Min. 9 of 10 in Categories 1 or 2; All 10 in Categories 1, 2, or 3.
2. MD = Machine Direction; CD = Cross Machine Direction
3. Thickness value is a nominal value. Minimum average can be -5% (28.5 mils).

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TABLE 2
SUMMARY OF MATERIAL RECORD TESTS
LLDPE GEOMEMBRANE SEAMS

	Property					
	Peel Strength[1]				Shear Strength[1]	
	Peak Load Outside Track (Weld "A")	Locus of Break & Incursion	Peak Load Inside Track (Weld "B")	Locus of Break & Incursion	Peak Load	Locus of Break & Incursion
Units	lbs/inch	-----	lbs/inch	-----	lbs/inch	-----
Test Method	ASTM D 6392					
CQC Field Destructive Seam Testing						
Required Test Frequency	500 LF					
No. of Tests Required	78					
No. of Tests Performed	84					
Specified Value	≥ 38 (Hot Wedge) ≥ 34 (Ex. Fillet)	(See Note 2)	≥ 38 (Hot Wedge) ≥ 34 (Ex. Fillet)	(See Note 2)	≥ 45	(See Note 2)
	Results - See Appendix G					
CQA Laboratory Destructive Seam Testing						
Required Test Frequency	1 per day of Production Seaming					
No. of Tests Required	13					
No. of Tests Performed	84					
Specified Value (See Note 2)	≥ 38 (Hot Wedge) ≥ 34 (Ex. Fillet)	(See Note 2)	≥ 38 (Hot Wedge) ≥ 34 (Ex. Fillet)	(See Note 2)	≥ 45	(See Note 2)
Sample I.D.	**Results**					
DS-1	57	Pass	56	Pass	58	Pass
DS-2	56	Pass	57	Pass	58	Pass
DS-3	58	Pass	56	Pass	69	Pass
DS-4	59	Pass	57	Pass	57	Pass
DS-5	57	Pass	57	Pass	59	Pass
DS-6	58	Pass	57	Pass	61	Pass
DS-7	57	Pass	58	Pass	57	Pass
DS-8	57	Pass	57	Pass	60	Pass
DS-9	56	Pass	56	Pass	60	Pass
DS-10	56	Pass	54	Pass	56	Pass
DS-11	57	Pass	55	Pass	57	Pass
DS-12	56	Pass	55	Pass	58	Pass
DS-13	56	Pass	55	Pass	56	Pass
DS-14	57	Pass	57	Pass	57	Pass
DS-15	57	Pass	56	Pass	56	Pass
DS-16	55	Pass	55	Pass	56	Pass
DS-17	56	Pass	56	Pass	57	Pass
DS-18	58	Pass	57	Pass	56	Pass
DS-19	58	Pass	58	Pass	57	Pass
DS-20	57	Pass	57	Pass	58	Pass

TABLE 2
SUMMARY OF MATERIAL RECORD TESTS
LLDPE GEOMEMBRANE SEAMS

CQA Laboratory Destructive Seam Testing (Continued)						
Specified Value (See Note 2)	≥ 38 (Hot Wedge) ≥ 34 (Ex. Fillet)	(See Note 2)	≥ 38 (Hot Wedge) ≥ 34 (Ex. Fillet)	(See Note 2)	≥ 45	(See Note 2)
Sample I.D.	**Results**					
DS-21	58	Pass	57	Pass	57	Pass
DS-22	58	Pass	58	Pass	56	Pass
DS-23	58	Pass	56	Pass	58	Pass
DS-24	58	Pass	56	Pass	57	Pass
DS-25	58	Pass	56	Pass	70	Pass
DS-26	56	Pass	56	Pass	56	Pass
DS-27	56	Pass	58	Pass	57	Pass
DS-28	57	Pass	56	Pass	58	Pass
DS-29	57	Pass	55	Pass	57	Pass
DS-30	56	Pass	55	Pass	56	Pass
DS-31	58	Pass	57	Pass	59	Pass
DS-32	58	Pass	56	Pass	57	Pass
DS-33	55	Pass	57	Pass	57	Pass
DS-34	57	Pass	57	Pass	56	Pass
DS-35	58	Pass	57	Pass	57	Pass
DS-36	57	Pass	57	Pass	58	Pass
DS-37	58	Pass	56	Pass	60	Pass
DS-38	58	Pass	57	Pass	59	Pass
DS-39	57	Pass	56	Pass	58	Pass
DS-40	58	Pass	57	Pass	56	Pass
DS-41	55	Pass	55	Pass	58	Pass
DS-42	55	Pass	53	Pass	56	Pass
DS-43	54	Pass	56	Pass	57	Pass
DS-44	57	Pass	58	Pass	57	Pass
DS-45	56	Pass	57	Pass	56	Pass
DS-46	55	Pass	55	Pass	54	Pass
DS-47	56	Pass	55	Pass	58	Pass
DS-48	54	Pass	54	Pass	57	Pass
DS-49	56	Pass	56	Pass	56	Pass
DS-50	57	Pass	56	Pass	59	Pass
DS-51	59	Pass	57	Pass	58	Pass
DS-52	55	Pass	58	Pass	59	Pass
DS-53	53	Pass	54	Pass	53	Pass
DS-54	56	Pass	54	Pass	56	Pass
DS-55	57	Pass	58	Pass	58	Pass
DS-56	56	Pass	56	Pass	57	Pass
DS-57	56	Pass	57	Pass	57	Pass
DS-58	56	Pass	58	Pass	56	Pass
DS-59	56	Pass	56	Pass	58	Pass

TABLE 2
SUMMARY OF MATERIAL RECORD TESTS
LLDPE GEOMEMBRANE SEAMS

CQA Laboratory Destructive Seam Testing (Continued)						
Specified Value (See Note 2)	≥ 38 (Hot Wedge) ≥ 34 (Ex. Fillet)	(See Note 2)	≥ 38 (Hot Wedge) ≥ 34 (Ex. Fillet)	(See Note 2)	≥ 45	(See Note 2)
Sample I.D.	**Results**					
DS-60	54	Pass	56	Pass	57	Pass
DS-61	57	Pass	56	Pass	58	Pass
DS-62	56	Pass	55	Pass	57	Pass
DS-63	55	Pass	55	Pass	57	Pass
DS-64	53	Pass	55	Pass	58	Pass
DS-65	55	Pass	55	Pass	54	Pass
DS-66	56	Pass	57	Pass	59	Pass
DS-67	58	Pass	59	Pass	59	Pass
DS-68	56	Pass	58	Pass	55	Pass
DS-69	56	Pass	59	Pass	59	Pass
DS-70	60	Pass	58	Pass	61	Pass
DS-71	58	Pass	63	Pass	61	Pass
DS-72	59	Pass	57	Pass	61	Pass
DS-73	59	Pass	56	Pass	61	Pass
DS-74	54	Pass	57	Pass	58	Pass
DS-75	57	Pass	57	Pass	58	Pass
DS-76	56	Pass	56	Pass	58	Pass
DS-77	56	Pass	55	Pass	58	Pass
DS-78	57	Pass	58	Pass	58	Pass
DS-79	56	Pass	57	Pass	58	Pass
DS-80	54	Pass	55	Pass	67	Pass
DS-81	55	Pass	55	Pass	58	Pass
DS-82	54	Pass	55	Pass	58	Pass
DS-83	53	Pass	55	Pass	56	Pass
DS-84	64	Pass	-----	-----	59	Pass
Minimum Value	53	Pass	53	Pass	53	Pass
Maximum Value	64	Pass	63	Pass	70	Pass
Average Value	57	Pass	56	Pass	58	Pass

Quantity of Geomembrane Seams: 39,000 LF (+/-)

Number of Production Seaming Days: 13 Days

Notes:

1. Values 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 specified values.
2. Regarding the locus-of-break patterns of the different seaming methods in shear and peel, refer to the project specifictions.

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TABLE 3
SUMMARY OF MATERIAL CONTROL TESTS
DRAINAGE GEOCOMPOSITE

	Property				
	Geonet Thickness	Geonet Density	Ply Adhesion		Transmissivity
			Side A	Side B	
			MD[1]	MD	
Units	inches	g/cm^3	lbs		m^3/m/sec
Test Method	ASTM D 5199	ASTM D 1505	ASTM D 413 or GRI GC7		ASTM D 4716
Required Test Frequency	100,000 ft^2 or 1 per Lot	100,000 ft^2 or 1 per Lot	100,000 ft^2 or 1 per Lot		1 per Lot
No. of Tests Required	9	9	9		5
No. of Tests Performed	9	9	9		5
Specified Value	$\geq$ 0.25	$\geq$ 0.94	$\geq$ 2.0 (Typ.)/ $\geq$ 1.0 (Min. Avg.)		$\geq$ 1.0 x 10^{-3}
Sample I.D.	**Results**				
533613-10	0.36	0.952	10.0	9.5	1.13E-03
533757-10	0.33	0.952	4.0	5.9	
535589-10	0.34	0.956	5.3	3.0	1.03E-03
535647-10	0.34	0.956	6.9	5.0	
536569-10	0.33	0.958	6.7	5.7	1.01E-03
536616-10	0.33	0.953	5.3	8.4	
536664-10	0.35	0.954	2.9	3.4	1.08E-03
536712-10	0.33	0.953	4.4	3.8	
538110-10	0.36	0.956	9.2	9.7	1.63E-03
Minimum Value	0.33	0.952	2.9	3.0	1.01E-03
Maximum Value	0.36	0.958	10.0	9.7	1.63E-03
Average Value	0.34	0.954	6.1	6.0	1.18E-03
Quantity of Drainage Geocomposite Received:				831,793	ft^2
				5	Lots

Notes:

1. MD = Machine Direction

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TABLE 4
SUMMARY OF MATERIAL CONTROL TESTS
GEOTEXTILES

	Property							
	Tensile Properties				Puncture Resistance	Trapezoidal Tear Strength		Apparent Opening Size (AOS)
	Grab Strength		Grab Elongation					
	MD[1]	CD[1]	MD	CD		MD	CD	
Units	lbs		%		lbs	lbs		U.S. Sieve
Test Method	ASTM D 4632		ASTM D 4632		ASTM D 4833	ASTM D 4533		ASTM D 4751
Required Test Frequency	100,000 ft^2 or 1 per Lot		100,000 ft^2 or 1 per Lot		100,000 ft^2 or 1 per Lot	100,000 ft^2 or 1 per Lot		100,000 ft^2 or 1 per Lot[2]
Type GT-T Geotextile								
No. of Tests Required	1		1		1	1		1
No. of Tests Performed	1		1		1	1		1
Specified Value	≥ 115		≥ 50		≥ 40	≥ 40		≥ 70
Sample I.D.	**Results**							
L10073-18-01	136	130	96	87	72	73	65	100
Minimum Value	136	130	96	87	72	73	65	100
Maximum Value	136	130	96	87	72	73	65	100
Average Value	136	130	96	87	72	73	65	100
Quantity of Type GT-T Geotextile Received:						54,000 SF (Approx.)		
						1 Lots		
Type GT-S Geotextile								
No. of Tests Required	1		1		1	1		1
No. of Tests Performed	0		0		0	0		0
Specified Value	≥ 160		≥ 50		≥ 55	≥ 55		≥ 70
Sample I.D.	**Results**							
L10073-11-01	172	192	83	104	92	84	99	80
Minimum Value	172	192	83	104	92	84	99	80
Maximum Value	172	192	83	104	92	84	99	80
Average Value	172	192	83	104	92	84	99	80
Quantity of Type GT-S Geotextile Received:						90,000 SF (Approx.)		
						1 Lots		

Notes:

1. MD = Machine Direction; CD = Cross Machine Direction

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