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SMITH+GARDNER
ENGINEERS

ADDRESS 14 N. Boylan Avenue, Raleigh NC 27603 TEL 919.828.0577 WEB www.smithgardnerinc.com

Permit No.	Date	Document ID No.
32-01	March 21, 2016,	25784

March 18, 2016

Received by an e- mail
Date: **March 18, 2016**
Solid Waste Section
Raleigh Central Office

Mr. Ming-Tai Chao, P.E., Engineer
North Carolina DEQ, Division of Waste Management
217 West Jones Street
Raleigh, North Carolina 27603

RE: **Construction Record – Closed City of Durham MSW Landfill**
2015 Gas Collection System Modifications

Dear Mr. Chao:

Smith + Gardner (S+G) would like to submit documentation of the construction activities performed during modification of the landfill gas collection and control system (GCCS) at at the Closed City of Durham MSW Landfill, located in Durham, North Carolina in accordance with the submitted Landfill Gas Collection & Control System Design Plan[1], dated December 2014. To provide appropriate documentation as required by the Letter of Authorization[2] received from Ming-Tai Chao, P.E. (NCDEQ-DWM), the following is provided:

S+G performed the following Construction Quality Assurance (CQA) duties during this landfill gas (LFG) system modification project:

- Provided on-site CQA representation to ensure proper LFG extraction well re-drilling and installation.
- Provided on-site CQA representation during lateral and other conveyance pipe installation, including pressure testing and tie-ins to existing pipelines.
- Provided correspondence and approvals from the Dept. of Health and Human Services in relation to the approved asbestos work plan;
- Performed required soil-testing services through a qualified subconsultant to S+G.
- Performed surveying services through a qualified subconsultant to S+G.

MP Durham, LLC contracted with Biogas Energy Solutions, LLC (BES) to perform the LFG system modifications. A brief project description and supporting documentation is presented below. Photographic documentation of the project is provided in **Attachment A**.

[1] Authorization Request for GCCS Expansion Project - City of Durham Landfill (NC Solid Waste Permit No. 32-01. Submitted by Smith + Gardner, Inc., December 2014.

[2] Approval for Conducting Expansion of the Existing Landfill Gas Collection and Control System - City of Durham Landfill, Durham County, North Carolina, Permit No. 3201-MSWLF-1979, Document ID No. (Doc ID) 22448. By Ming-Tai Chao, P.E. (NCDEQ-DWM), December 9, 2014.

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LANDFILL GAS EXTRACTION WELLS

S+G observed the drilling and installation of one (11) re-drilled LFG extraction well and 16 new LFG extraction wells. The LFG extraction wells were drilled 36 inches in diameter and constructed using eight (8) inch diameter perforated and solid HDPE pipe. The upper ten (15) feet for each well included solid piping with two bentonite seals and soil backfill. Following well completion, an approximately three (3) foot solid pipe section was installed above ground as a stickup. Boring logs were recorded for each well location and are provided as **(Attachment B).** Well locations are provided on the As-Built Drawing presented in **(Attachment C).**

LANDFIL GAS LATERAL AND ADDITIONAL COMPONENT INSTALLATION

BES installed the following GCCS system components in the locations shown on the As-Built Drawing provided in **Attachment C**:

1. 11 4"diameter HDPE lateral connections from the new LFG extraction wells to existing LFG laterals;

2. Approximately 1,500 linear feet of 4" HDPE lateral LFG piping within the Type 2 final cover system. Required soil testing of the reinstalled cover system was performed by Geotechnics, Inc. in the trenches and associated excavation sites associated with GW-2 and EW-39. All testing passed including four (4) permeability tests, as well as, compaction testing. Testing results are provided in **Attachment D**.

3. Approximately 400 linear feet of 4" HDPE lateral LFG piping within the Type 1 final cover system. Compaction efforts by the contractor were observed by S+G. Probing of reinstalled areas with a manual probe confirmed compaction, as required.

4. Subsequent to the above work, there were seven (7) additional excavations made through the Type 2 final cover system in order to convert existing wells to remote style connections. S+G is providing certification that these areas of Type 2 final cover system were reinstalled in accordance with the project requirements. Permeability testing was performed at each of these seven (7) locations (remote wellheads for EW-1, EW-2, EW-3, EW-8, EW-9, EW-10, and EW-11). Testing results are provided in **Attachment D**.

Survey Solutions, P.C. prepared "as-built" surveys of all installations including LFG extraction wells, gas lines, and remote wellhead installation locations. It is noted that due to differential settlement and lateral shifting of the landfill topography as waste degrades, the location of surveyed components may change significantly over time. The As-Built Drawing is provided as **Attachment C**).

Gas conveyance and compressed air lines were pressure tested in accordance with ASTM F-1417. Copies of the tests are **provided as Attachment E**.

Spoils generated from excavations were inspected by an accredited asbestos inspector in accordance with the approved Asbestos Work Plan (**Attachment F**). No suspect asbestos containing materials were found.

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SUMMARY

The construction methods, materials, locations of components, and testing methods are in general agreement with the submitted Landfill Gas Collection & Control System Design Plan. Please note that S+G's acceptance of the landfill gas collection and control system is limited to the items addressed in this report. Beyond this acceptance, additional issues that arise during operations of the system shall be addressed by the system owner/operator and/or the manufacturer under system warranty.

Should you have any questions or require clarification, please contact us at (919) 828-0577 or by email below.

Sincerely,

SMITH GARDNER, INC.

DocuSigned by:
Matt Lamb
9EFF4BV46308456...
Matthew S. Lamb
Project Manager ext. 121
matt@smithgardnerinc.com

DocuSigned by:
Stacey A. Smith
27B482DF1A09438...
Stacey A. Smith, P.E.
Senior Engineer, ext. 127
stacey@smithgardnerinc.com

NORTH CAROLINA PROFESSIONAL SEAL 023002 ENGINEER STACEY A. SMITH

3/18/2016

Attachments:

A – Photographic Log
B – Boring Logs
C – As-Built Drawings
D – Soil Testing Results
E – Pressure Tests
F – Approved Asbestos Workplan

CC: Bryant Green, City of Durham
Steve Laliberty, Biogas Energy Solutions
Patrick Butler, P.E., NC DEQ, Division of Air Quality, Raleigh Regional Office

File

H:\Projects\Methane Power\MP Durham County, LLC\BES-14-1 (Durham Expansion 2014)\Record Report\report\2015 Draft Record Report-Durham-031016.docx

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ATTACHMENT A – PHOTOGRAPHIC LOG

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PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
BES	Closed City of Durham MSW Landfill	BES 14-1

Photo No.	Date:
1	2/5/15

Direction Photo Taken:

North

Description:

Drill rig set up on well location.

Photo No.	Date:
2	2/19/15

Direction Photo Taken:

N/A

Description:

Drill rig shown with 36" bucket auger..

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S+G ENGINEERS

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
BES	Closed City of Durham MSW Landfill	BES 14-1

Photo No.	Date:
3	2/19/15

Direction Photo Taken:

N/A

Description:

Excavated waste.

Photo No.	Date:
4	2/12/15

Direction Photo Taken:

West

Description:

Landfill gas extraction well being constructed with HDPE being lifted into well. Roll off containers for excavated waste can be seen.

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PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
BES	Closed City of Durham MSW Landfill	BES 14-1

Photo No.	Date:
5	2/6/15

Direction Photo Taken:

North

Description:

Stone being added during landfill gas extraction well construction.

Photo No.	Date:
6	3/10/15

Direction Photo Taken:

N/A

Description:

Excavated trench in the Type 2 final cover system area.

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S+G ENGINEERS

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
BES	Closed City of Durham MSW Landfill	BES 14-1

Photo No.	Date:
7	3/10/15

Direction Photo Taken:

South

Landfill road grossing being installed.

Photo No.	Date:
8	3/10/15

Direction Photo Taken:

North

Description:

Excavation of trench through Type 1 final cover system.

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PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
BES	Closed City of Durham MSW Landfill	BES 14-1

Photo No.	Date:
9	3/12/15

Direction Photo Taken:

N/A

Description:

Pressure testing set up.

Photo No.	Date:
10	3/18/15

Direction Photo Taken:

N/A

Description:

Installation of lateral and wellhead connection.

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PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
BES	Closed City of Durham MSW Landfill	BES 14-1

Photo No.	Date:
11	4/29/15

Direction Photo Taken:

N/A

Description:

Newly installed remote well head connection piping.

Photo No.	Date:
12	4/29/15

Direction Photo Taken:

South

Description:

Completed remote wellhead connection location

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ATTACHMENT B – BORING LOGS

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Smith Gardner, Inc.
14 North Boylan Avenue, Raleigh NC 27603
(919) 828-0577

FIELD BOREHOLE LOG

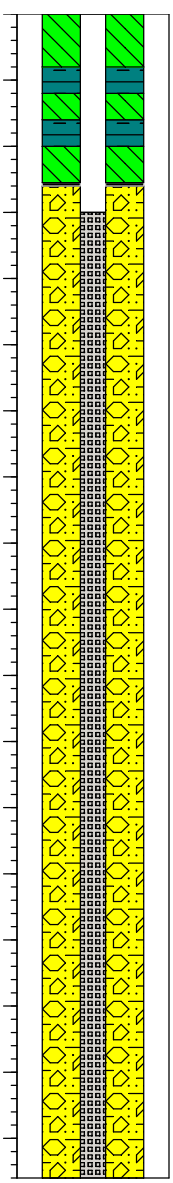
BOREHOLE NUMBER **GW-7**

PROJECT NAME: **Landfill GCCS Expansion 2015**
LOCATION: **Closed Durham MSW Landfill**
DRILLING CO: **CB&I**
DRILLING METHOD: **36" Bucket Auger**
FIELD PARTY: **Chip Freshcorn**
GEOLOGIST: **D. Misenheimer**
DATE BEGUN: **2/5/15** COMPLETED: **2/5/15**

TOTAL DEPTH: **88**
TOP OF CASING ELEV.: GROUND ELEV.:
NORTHING: **0** EASTING: **0**

STATIC WATER LEVEL (from TOC)		
Depth (ft)		
Time		
Date		

DEPTH Feet	BLOW COUNT Per 6"	SAMPLING METHOD	RECOVERY Inches	DRILL METHOD	DESCRIPTION	LITHOLOGY	DEPTH Feet	WELL INSTALLATION
0.0				Bucket Auger	Topsoil		0.0	
5.0					Clay cap and clay fill		5.0	
10.0					Low degraded MSW. Dry. Lots of wood. 60F at 10'. 88F at 20'.		10.0	
15.0							15.0	
20.0					Low to medium degraded MSW. Dry. Lots of soil mixed in. 107F at 34' 93F at 40' 75F at 65' 98F at 70' 95F at 80' 101F at 88'		20.0	
25.0							25.0	
30.0							30.0	
35.0							35.0	
40.0							40.0	
45.0					solid 8"HDPE (below ground) 15' perforated 8" HDPE 73' stick up 3'		45.0	
50.0							50.0	
55.0							55.0	
60.0							60.0	
65.0							65.0	
70.0							70.0	
75.0							75.0	
80.0							80.0	
85.0							85.0	



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FIELD BOREHOLE LOG

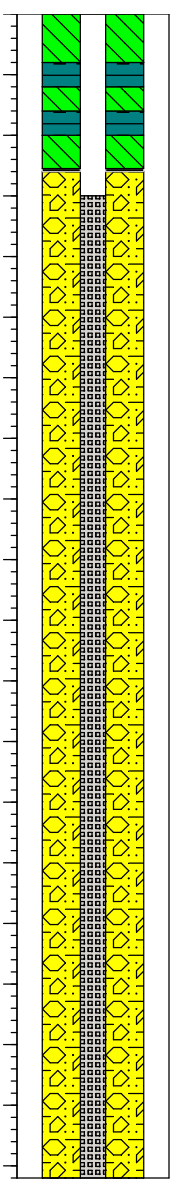
BOREHOLE NUMBER **GW-6**

PROJECT NAME: **Landfill GCCS Expansion 2015**
LOCATION: **Closed Durham MSW Landfill**
DRILLING CO: **CB&I**
DRILLING METHOD: **36" Bucket Auger**
FIELD PARTY: **Chip Freshcorn**
GEOLOGIST: **D. Misenheimer**
DATE BEGUN: **2/6/15** COMPLETED: **2/6/15**

TOTAL DEPTH: **96**
TOP OF CASING ELEV.: GROUND ELEV.:
NORTHING: **0** EASTING: **0**

STATIC WATER LEVEL (from TOC)		
Depth (ft)		
Time		
Date		

DEPTH Feet	BLOW COUNT Per 6"	SAMPLING METHOD	RECOVERY Inches	DRILL METHOD	DESCRIPTION	LITHOLOGY	DEPTH Feet	WELL INSTALLATION
0.0				Bucket Auger	Topsoil		0.0	
5.0					Clay cap and clay fill		5.0	
10.0							10.0	
15.0					Low to medium degraded MSW. Dry. Lots of soil mixed in.		15.0	
20.0							20.0	
25.0					75F at 10'		25.0	
30.0					97F at 30' 100F at 50' 105F at 60'		30.0	
35.0					102F at 80' 100F at 90' 116F at 96'		35.0	
40.0							40.0	
45.0					solid 8"HDPE (below ground) 15' perforated 8" HDPE 81' stick up 3'		45.0	
50.0							50.0	
55.0							55.0	
60.0							60.0	
65.0							65.0	
70.0							70.0	
75.0							75.0	
80.0							80.0	
85.0							85.0	
90.0							90.0	
95.0							95.0	



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FIELD BOREHOLE LOG

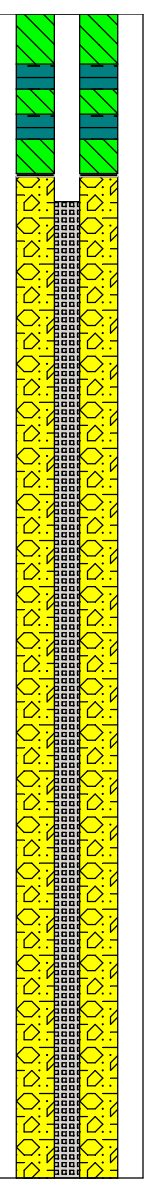
BOREHOLE NUMBER **GW-2**

PROJECT NAME: **Landfill GCCS Expansion 2015**
LOCATION: **Closed Durham MSW Landfill**
DRILLING CO: **CB&I**
DRILLING METHOD: **36" Bucket Auger**
FIELD PARTY: **Chip Freshcorn**
GEOLOGIST: **D. Misenheimer**
DATE BEGUN: **2/9/15** COMPLETED: **2/9/15**

TOTAL DEPTH: **93**
TOP OF CASING ELEV.: GROUND ELEV.:
NORTHING: **0** EASTING: **0**

STATIC WATER LEVEL (from TOC)		
Depth (ft)		
Time		
Date		

DEPTH Feet	BLOW COUNT Per 6"	SAMPLING METHOD	RECOVERY Inches	DRILL METHOD	DESCRIPTION	LITHOLOGY	DEPTH Feet	WELL INSTALLATION
0.0				Bucket Auger	Topsoil		0.0	
5.0					Clay cap and clay fill		5.0	
10.0					Low to medium degraded MSW. Dry. Lots of soil mixed in.		10.0	
15.0							15.0	
20.0					60F at 10' 74F at 20' 81F at 30' 91F at 40' 94F at 50' 101F at 60' 102F at 70' 110F at 80' 101F at 93'		20.0	
25.0							25.0	
30.0							30.0	
35.0							35.0	
40.0							40.0	
45.0					solid 8"HDPE (below ground) 15' perforated 8" HDPE 78' stick up 3'		45.0	
50.0							50.0	
55.0							55.0	
60.0							60.0	
65.0							65.0	
70.0							70.0	
75.0							75.0	
80.0							80.0	
85.0							85.0	
90.0							90.0	



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Smith Gardner, Inc.
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FIELD BOREHOLE LOG

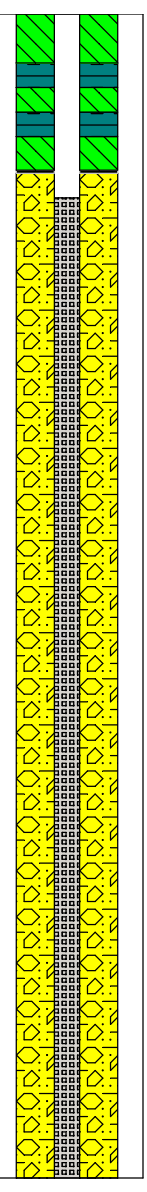
BOREHOLE NUMBER **GW-1**

PROJECT NAME: **Landfill GCCS Expansion 2015**
LOCATION: **Closed Durham MSW Landfill**
DRILLING CO: **CB&I**
DRILLING METHOD: **36" Bucket Auger**
FIELD PARTY: **Chip Freshcorn**
GEOLOGIST: **D. Misenheimer**
DATE BEGUN: **2/12/15** COMPLETED: **2/12/15**

TOTAL DEPTH: **95**
TOP OF CASING ELEV.: GROUND ELEV.:
NORTHING: **0** EASTING: **0**

STATIC WATER LEVEL (from TOC)		
Depth (ft)		
Time		
Date		

DEPTH Feet	BLOW COUNT Per 6"	SAMPLING METHOD	RECOVERY Inches	DRILL METHOD	DESCRIPTION	LITHOLOGY	DEPTH Feet	WELL INSTALLATION
0.0				Bucket Auger	Topsoil		0.0	
5.0					Clay cap and clay fill		5.0	
10.0							10.0	
15.0					Low to medium degraded MSW. Dry. Lots of soil mixed in.		15.0	
20.0							20.0	
25.0					76F at 20'		25.0	
30.0					92F at 30'		30.0	
35.0					86F at 40'		35.0	
40.0					97F at 50'		40.0	
45.0					91F at 60'		45.0	
50.0					107F at 70'		50.0	
55.0					103F at 80'		55.0	
60.0					98F at 95'		60.0	
65.0							65.0	
70.0					solid 8"HDPE (below ground) 15'		70.0	
75.0					perforated 8" HDPE 80'		75.0	
80.0					stick up 3'		80.0	
85.0							85.0	
90.0							90.0	
95.0							95.0	



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FIELD BOREHOLE LOG

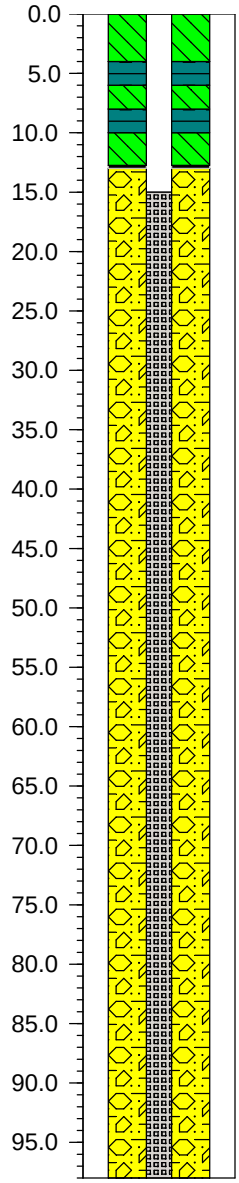
BOREHOLE NUMBER **GW-3**

PROJECT NAME: **Landfill GCCS Expansion 2015**
LOCATION: **Closed Durham MSW Landfill**
DRILLING CO: **CB&I**
DRILLING METHOD: **36" Bucket Auger**
FIELD PARTY: **Chip Freshcorn**
GEOLOGIST: **D. Misenheimer**
DATE BEGUN: **2/12/15** COMPLETED: **2/12/15**

TOTAL DEPTH: **98**
TOP OF CASING ELEV.: GROUND ELEV.:
NORTHING: **0** EASTING: **0**

STATIC WATER LEVEL (from TOC)		
Depth (ft)		
Time		
Date		

DEPTH Feet	BLOW COUNT Per 6"	SAMPLING METHOD	RECOVERY Inches	DRILL METHOD	DESCRIPTION	LITHOLOGY	DEPTH Feet	WELL INSTALLATION
0.0				Bucket Auger	Topsoil		0.0	
5.0					Clay cap and clay fill		5.0	
10.0					Low to medium degraded MSW. Dry. Lots of soil mixed in.		10.0	
15.0							15.0	
20.0					70F at 20'		20.0	
25.0					87F at 30'		25.0	
30.0					92F at 40'		30.0	
35.0					90F at 50'		35.0	
40.0					94F at 60'		40.0	
45.0					97F at 70'		45.0	
50.0					95F at 80'		50.0	
55.0					88F at 98'		55.0	
60.0					solid 8"HDPE (below ground) 15'		60.0	
65.0					perforated 8" HDPE 83'		65.0	
70.0					stick up 3'		70.0	
75.0							75.0	
80.0							80.0	
85.0							85.0	
90.0							90.0	
95.0							95.0	



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Smith Gardner, Inc.
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FIELD BOREHOLE LOG

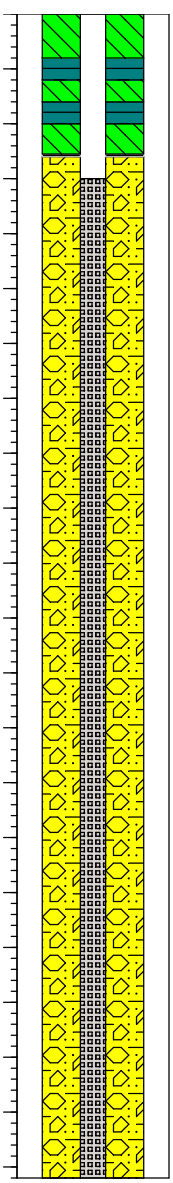
BOREHOLE NUMBER **GW-4**

PROJECT NAME: **Landfill GCCS Expansion 2015**
LOCATION: **Closed Durham MSW Landfill**
DRILLING CO: **CB&I**
DRILLING METHOD: **36" Bucket Auger**
FIELD PARTY: **Chip Freshcorn**
GEOLOGIST: **D. Misenheimer**
DATE BEGUN: **2/13/15** COMPLETED: **2/13/15**

TOTAL DEPTH: **106**
TOP OF CASING ELEV.: GROUND ELEV.:
NORTHING: **0** EASTING: **0**

STATIC WATER LEVEL (from TOC)		
Depth (ft)		
Time		
Date		

DEPTH Feet	BLOW COUNT Per 6"	SAMPLING METHOD	RECOVERY Inches	DRILL METHOD	DESCRIPTION	LITHOLOGY	DEPTH Feet	WELL INSTALLATION
0.0				Bucket Auger	Topsoil		0.0	
5.0					Clay cap and clay fill		5.0	
10.0							10.0	
15.0							15.0	
20.0							20.0	
25.0					Low to medium degraded MSW. Dry. Lots of soil mixed in.		25.0	
30.0							30.0	
35.0					72F at 20' 85F at 30' 87F at 40' 97F at 50' 108F at 60' 98F at 70' 95F at 80' 100F at 90' 94F at 106'		35.0	
40.0							40.0	
45.0							45.0	
50.0							50.0	
55.0							55.0	
60.0							60.0	
65.0					solid 8"HDPE (below ground) 15'		65.0	
70.0					perforated 8" HDPE 91' stick up 3'		70.0	
75.0							75.0	
80.0							80.0	
85.0							85.0	
90.0							90.0	
95.0							95.0	
100.0							100.0	
105.0							105.0	



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Smith Gardner, Inc.
14 North Boylan Avenue, Raleigh NC 27603
(919) 828-0577

FIELD BOREHOLE LOG

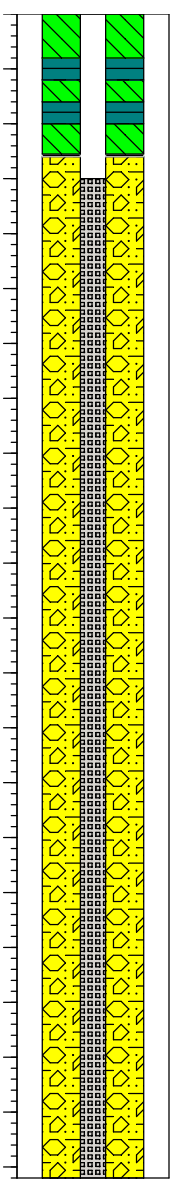
BOREHOLE NUMBER **GW-5**

PROJECT NAME: **Landfill GCCS Expansion 2015**
LOCATION: **Closed Durham MSW Landfill**
DRILLING CO: **CB&I**
DRILLING METHOD: **36" Bucket Auger**
FIELD PARTY: **Chip Freshcorn**
GEOLOGIST: **D. Misenheimer**
DATE BEGUN: **2/13/15** COMPLETED: **2/13/15**

TOTAL DEPTH: **106**
TOP OF CASING ELEV.: GROUND ELEV.:
NORTHING: **0** EASTING: **0**

STATIC WATER LEVEL (from TOC)		
Depth (ft)		
Time		
Date		

DEPTH Feet	BLOW COUNT Per 6"	SAMPLING METHOD	RECOVERY Inches	DRILL METHOD	DESCRIPTION	LITHOLOGY	DEPTH Feet	WELL INSTALLATION
0.0				Bucket Auger	Topsoil		0.0	
5.0					Clay cap and clay fill		5.0	
10.0							10.0	
15.0							15.0	
20.0							20.0	
25.0					Low to medium degraded MSW. Dry. Lots of soil mixed in.		25.0	
30.0							30.0	
35.0					82F at 30'		35.0	
40.0					86F at 40'		40.0	
45.0					91F at 50'		45.0	
50.0					95F at 60'		50.0	
55.0					92F at 70'		55.0	
60.0					91F at 80'		60.0	
65.0					96F at 90'		65.0	
70.0					91F at 106'		70.0	
75.0					solid 8"HDPE (below ground) 15'		75.0	
80.0					perforated 8" HDPE 91'		80.0	
85.0					stick up 3'		85.0	
90.0							90.0	
95.0							95.0	
100.0							100.0	
105.0							105.0	



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FIELD BOREHOLE LOG

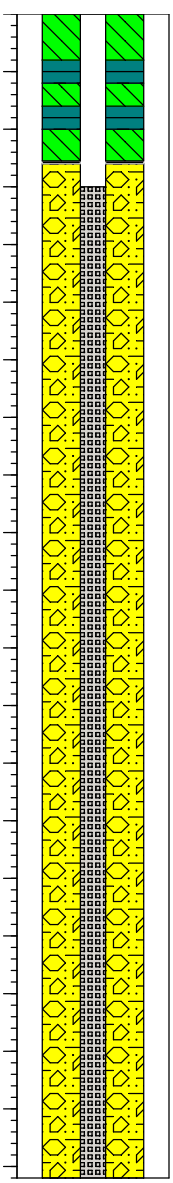
BOREHOLE NUMBER **GW-9**

PROJECT NAME: **Landfill GCCS Expansion 2015**
LOCATION: **Closed Durham MSW Landfill**
DRILLING CO: **CB&I**
DRILLING METHOD: **36" Bucket Auger**
FIELD PARTY: **Chip Freshcorn**
GEOLOGIST: **D. Misenheimer**
DATE BEGUN: **2/16/15** COMPLETED: **2/16/15**

TOTAL DEPTH: **101**
TOP OF CASING ELEV.: GROUND ELEV.:
NORTHING: **0** EASTING: **0**

STATIC WATER LEVEL (from TOC)		
Depth (ft)		
Time		
Date		

DEPTH Feet	BLOW COUNT Per 6"	SAMPLING METHOD	RECOVERY Inches	DRILL METHOD	DESCRIPTION	LITHOLOGY	DEPTH Feet	WELL INSTALLATION
0.0				Bucket Auger	Topsoil		0.0	
5.0					Clay cap and clay fill		5.0	
10.0							10.0	
15.0							15.0	
20.0							20.0	
25.0					Low to medium degraded MSW. Dry. Lots of soil mixed in. Moist at 80'-101'.		25.0	
30.0							30.0	
35.0					84F at 30' 89F at 40' 94F at 50' 92F at 60' 94F at 70' 94F at 80' 97F at 90' 95F at 101'		35.0	
40.0							40.0	
45.0							45.0	
50.0							50.0	
55.0							55.0	
60.0							60.0	
65.0					solid 8"HDPE (below ground) 15' perforated 8" HDPE 86' stick up 3'		65.0	
70.0							70.0	
75.0							75.0	
80.0							80.0	
85.0							85.0	
90.0							90.0	
95.0							95.0	
100.0							100.0	



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FIELD BOREHOLE LOG

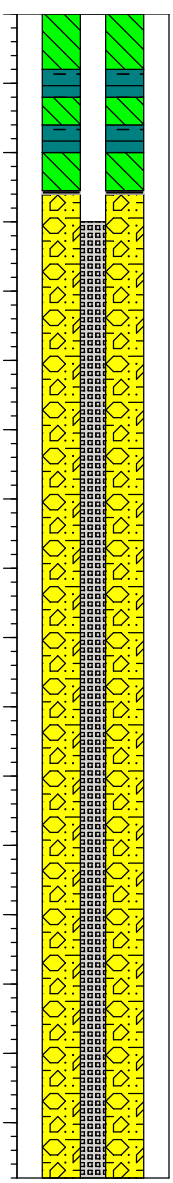
BOREHOLE NUMBER **GW-10**

PROJECT NAME: **Landfill GCCS Expansion 2015**
LOCATION: **Closed Durham MSW Landfill**
DRILLING CO: **CB&I**
DRILLING METHOD: **36" Bucket Auger**
FIELD PARTY: **Chip Freshcorn**
GEOLOGIST: **D. Misenheimer**
DATE BEGUN: **2/16/15** COMPLETED: **2/16/15**

TOTAL DEPTH: **84**
TOP OF CASING ELEV.: GROUND ELEV.:
NORTHING: **0** EASTING: **0**

STATIC WATER LEVEL (from TOC)		
Depth (ft)		
Time		
Date		

DEPTH Feet	BLOW COUNT Per 6"	SAMPLING METHOD	RECOVERY Inches	DRILL METHOD	DESCRIPTION	LITHOLOGY	DEPTH Feet	WELL INSTALLATION
0.0				Bucket Auger	Topsoil		0.0	
5.0					Clay cap and clay fill		5.0	
10.0					Low to medium degraded MSW. Dry. Lots of soil mixed in.		10.0	
15.0							15.0	
20.0					73F at 10' 91F at 20' 94F at 30' 96F at 40' 97F at 50' 98F at 60' 104F at 70' 102F at 84'		20.0	
25.0							25.0	
30.0							30.0	
35.0							35.0	
40.0							40.0	
45.0					solid 8"HDPE (below ground) 15' perforated 8" HDPE 69' stick up 3'		45.0	
50.0							50.0	
55.0							55.0	
60.0							60.0	
65.0							65.0	
70.0							70.0	
75.0							75.0	
80.0							80.0	



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FIELD BOREHOLE LOG

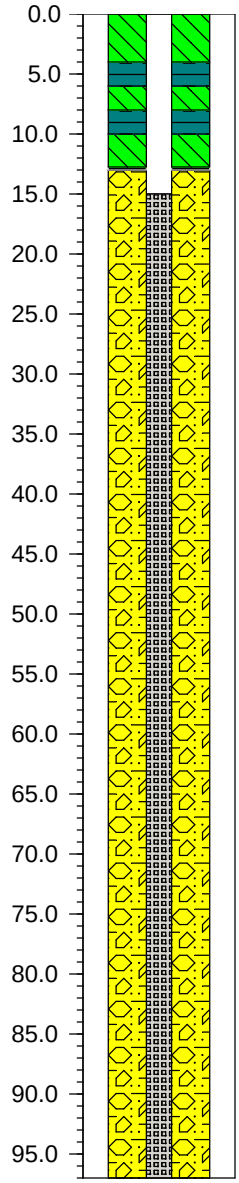
BOREHOLE NUMBER **GW-8**

PROJECT NAME: **Landfill GCCS Expansion 2015**
LOCATION: **Closed Durham MSW Landfill**
DRILLING CO: **CB&I**
DRILLING METHOD: **36" Bucket Auger**
FIELD PARTY: **Chip Freshcorn**
GEOLOGIST: **D. Misenheimer**
DATE BEGUN: **2/18/15** COMPLETED: **2/18/15**

TOTAL DEPTH: **97**
TOP OF CASING ELEV.: GROUND ELEV.:
NORTHING: **0** EASTING: **0**

STATIC WATER LEVEL (from TOC)		
Depth (ft)		
Time		
Date		

DEPTH Feet	BLOW COUNT Per 6"	SAMPLING METHOD	RECOVERY Inches	DRILL METHOD	DESCRIPTION	LITHOLOGY	DEPTH Feet	WELL INSTALLATION
0.0				Bucket Auger	Topsoil		0.0	
5.0					Clay cap and clay fill		5.0	
10.0							10.0	
15.0					Low to medium degraded MSW. Dry. Lots of soil mixed in.		15.0	
20.0							20.0	
25.0					76F at 20' 88F at 30' 85F at 40' 96F at 50' 95F at 60' 96F at 70' 98F at 80' 91F at 97'		25.0	
30.0							30.0	
35.0							35.0	
40.0							40.0	
45.0							45.0	
50.0					solid 8"HDPE (below ground) 15' perforated 8" HDPE 82' stick up 3'		50.0	
55.0							55.0	
60.0							60.0	
65.0							65.0	
70.0							70.0	
75.0							75.0	
80.0							80.0	
85.0							85.0	
90.0							90.0	
95.0							95.0	



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FIELD BOREHOLE LOG

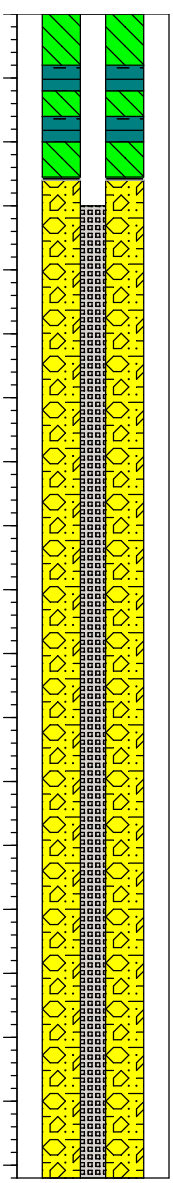
BOREHOLE NUMBER **GW-11**

PROJECT NAME: **Landfill GCCS Expansion 2015**
LOCATION: **Closed Durham MSW Landfill**
DRILLING CO: **CB&I**
DRILLING METHOD: **36" Bucket Auger**
FIELD PARTY: **Chip Freshcorn**
GEOLOGIST: **D. Misenheimer**
DATE BEGUN: **2/18/15** COMPLETED: **2/18/15**

TOTAL DEPTH: **91**
TOP OF CASING ELEV.: GROUND ELEV.:
NORTHING: **0** EASTING: **0**

STATIC WATER LEVEL (from TOC)		
Depth (ft)		
Time		
Date		

DEPTH Feet	BLOW COUNT Per 6"	SAMPLING METHOD	RECOVERY Inches	DRILL METHOD	DESCRIPTION	LITHOLOGY	DEPTH Feet	WELL INSTALLATION
0.0				Bucket Auger	Topsoil		0.0	
5.0					Clay cap and clay fill		5.0	
10.0							10.0	
15.0					Low to medium degraded MSW. Dry. Lots of soil mixed in.		15.0	
20.0							20.0	
25.0					76F at 20' 80F at 30' 84F at 40' 87F at 50' 91F at 60' 87F at 70' 78F at 80' 84F at 91'		25.0	
30.0							30.0	
35.0							35.0	
40.0							40.0	
45.0							45.0	
50.0					solid 8"HDPE (below ground) 15' perforated 8" HDPE 76' stick up 3'		50.0	
55.0							55.0	
60.0							60.0	
65.0							65.0	
70.0							70.0	
75.0							75.0	
80.0							80.0	
85.0							85.0	
90.0							90.0	



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FIELD BOREHOLE LOG

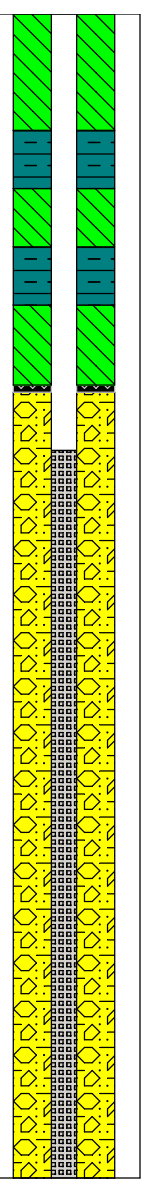
BOREHOLE NUMBER **GW-16**

PROJECT NAME: **Landfill GCCS Expansion 2015**
LOCATION: **Closed Durham MSW Landfill**
DRILLING CO: **CB&I**
DRILLING METHOD: **36" Bucket Auger**
FIELD PARTY: **Chip Freshcorn**
GEOLOGIST: **D. Misenheimer**
DATE BEGUN: **2/19/15** COMPLETED: **2/19/15**

TOTAL DEPTH: **40**
TOP OF CASING ELEV.: GROUND ELEV.:
NORTHING: **0** EASTING: **0**

STATIC WATER LEVEL (from TOC)		
Depth (ft)		
Time		
Date		

DEPTH Feet	BLOW COUNT Per 6"	SAMPLING METHOD	RECOVERY Inches	DRILL METHOD	DESCRIPTION	LITHOLOGY	DEPTH Feet	WELL INSTALLATION
0.0				Bucket Auger	Topsoil		0.0	
					Clay cap and clay fill			
5.0					Low to medium degraded MSW. Moist with lots of soil mixed in.		5.0	
10.0					58F at 10' 62F at 20' 66F at 30' 68F at 40'		10.0	
15.0					solid 8"HDPE (below ground) 15' perforated 8" HDPE 25' stick up 3'		15.0	
20.0							20.0	
25.0							25.0	
30.0							30.0	
35.0							35.0	
40.0							40.0	



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FIELD BOREHOLE LOG

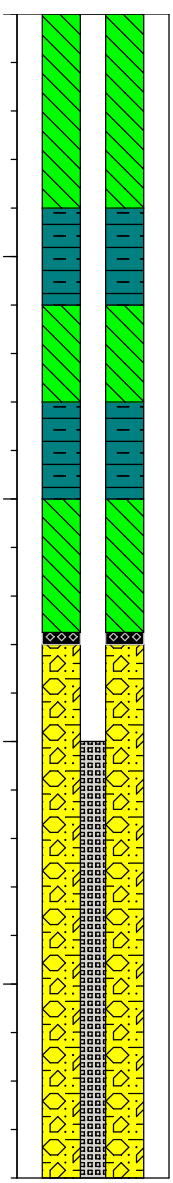
BOREHOLE NUMBER **GW-15**

PROJECT NAME: **Landfill GCCS Expansion 2015**
LOCATION: **Closed Durham MSW Landfill**
DRILLING CO: **CB&I**
DRILLING METHOD: **36" Bucket Auger**
FIELD PARTY: **Chip Freshcorn**
GEOLOGIST: **D. Misenheimer**
DATE BEGUN: **2/19/15** COMPLETED: **2/19/15**

TOTAL DEPTH: **24**
TOP OF CASING ELEV.: GROUND ELEV.:
NORTHING: **0** EASTING: **0**

STATIC WATER LEVEL (from TOC)		
Depth (ft)		
Time		
Date		

DEPTH Feet	BLOW COUNT Per 6"	SAMPLING METHOD	RECOVERY Inches	DRILL METHOD	DESCRIPTION	LITHOLOGY	DEPTH Feet	WELL INSTALLATION
0.0				Bucket Auger	Topsoil		0.0	
					Clay cap and clay fill			
					Low to medium degraded MSW. Very wet with lots of soil mixed in.			
5.0					56F at 10' 58F at 20' 61F at 24'		5.0	
10.0					solid 8"HDPE (below ground) 15' perforated 8" HDPE 9' stick up 3'		10.0	
15.0							15.0	
20.0							20.0	



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FIELD BOREHOLE LOG

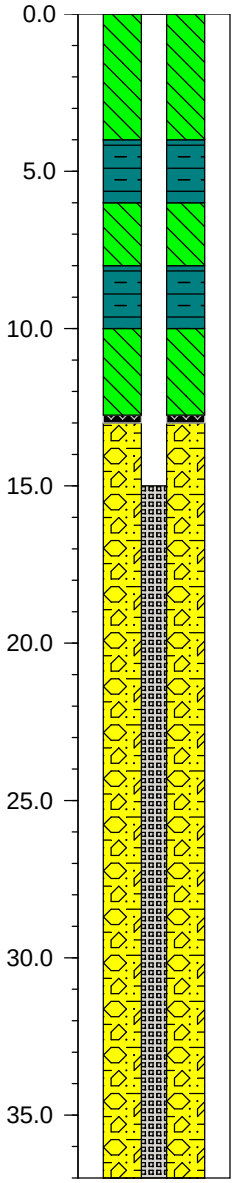
BOREHOLE NUMBER **GW-14**

PROJECT NAME: **Landfill GCCS Expansion 2015**
LOCATION: **Closed Durham MSW Landfill**
DRILLING CO: **CB&I**
DRILLING METHOD: **36" Bucket Auger**
FIELD PARTY: **Chip Freshcorn**
GEOLOGIST: **D. Misenheimer**
DATE BEGUN: **2/19/15** COMPLETED: **2/19/15**

TOTAL DEPTH: **37**
TOP OF CASING ELEV.: GROUND ELEV.:
NORTHING: **0** EASTING: **0**

STATIC WATER LEVEL (from TOC)		
Depth (ft)		
Time		
Date		

DEPTH Feet	BLOW COUNT Per 6"	SAMPLING METHOD	RECOVERY Inches	DRILL METHOD	DESCRIPTION	LITHOLOGY	DEPTH Feet	WELL INSTALLATION
0.0				Bucket Auger	Topsoil		0.0	
					Clay cap and clay fill			
5.0					Low to medium degraded MSW. Moist with lots of soil mixed in.		5.0	
10.0					61F at 10' 68F at 20' 75F at 30' 79F at 37'		10.0	
15.0					solid 8"HDPE (below ground) 15' perforated 8" HDPE 22' stick up 3'		15.0	
20.0							20.0	
25.0							25.0	
30.0							30.0	
35.0							35.0	



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FIELD BOREHOLE LOG

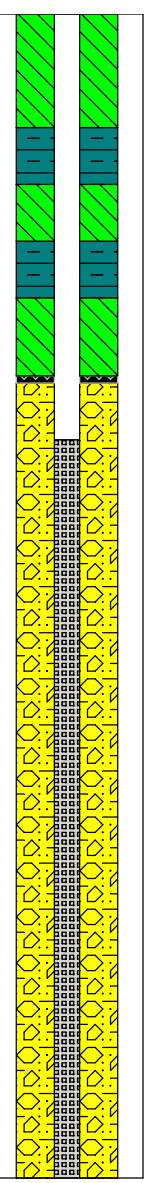
BOREHOLE NUMBER **GW-13**

PROJECT NAME: **Landfill GCCS Expansion 2015**
LOCATION: **Closed Durham MSW Landfill**
DRILLING CO: **CB&I**
DRILLING METHOD: **36" Bucket Auger**
FIELD PARTY: **Chip Freshcorn**
GEOLOGIST: **D. Misenheimer**
DATE BEGUN: **2/19/15** COMPLETED: **2/19/15**

TOTAL DEPTH: **41**
TOP OF CASING ELEV.: GROUND ELEV.:
NORTHING: **0** EASTING: **0**

STATIC WATER LEVEL (from TOC)		
Depth (ft)		
Time		
Date		

DEPTH Feet	BLOW COUNT Per 6"	SAMPLING METHOD	RECOVERY Inches	DRILL METHOD	DESCRIPTION	LITHOLOGY	DEPTH Feet	WELL INSTALLATION
0.0				Bucket Auger	Topsoil		0.0	
					Clay cap and clay fill			
5.0					Low to medium degraded MSW. Moist with lots of soil mixed in.		5.0	
10.0					59F at 10' 64F at 20' 69F at 30' 74F at 41'		10.0	
15.0					solid 8"HDPE (below ground) 15' perforated 8" HDPE 26' stick up 3'		15.0	
20.0							20.0	
25.0							25.0	
30.0							30.0	
35.0							35.0	
40.0							40.0	



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FIELD BOREHOLE LOG

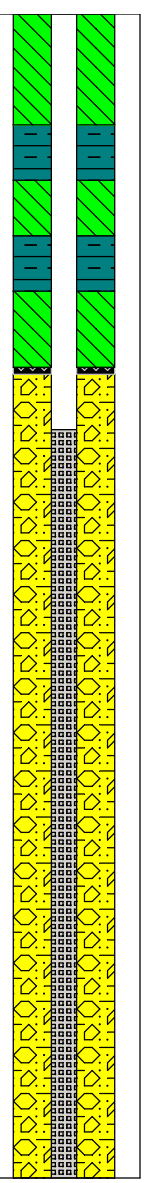
BOREHOLE NUMBER **GW-12**

PROJECT NAME: **Landfill GCCS Expansion 2015**
LOCATION: **Closed Durham MSW Landfill**
DRILLING CO: **CB&I**
DRILLING METHOD: **36" Bucket Auger**
FIELD PARTY: **Chip Freshcorn**
GEOLOGIST: **D. Misenheimer**
DATE BEGUN: **2/20/15** COMPLETED: **2/20/15**

TOTAL DEPTH: **42**
TOP OF CASING ELEV.: GROUND ELEV.:
NORTHING: **0** EASTING: **0**

STATIC WATER LEVEL (from TOC)		
Depth (ft)		
Time		
Date		

DEPTH Feet	BLOW COUNT Per 6"	SAMPLING METHOD	RECOVERY Inches	DRILL METHOD	DESCRIPTION	LITHOLOGY	DEPTH Feet	WELL INSTALLATION
0.0				Bucket Auger	Topsoil		0.0	
					Clay cap and clay fill			
5.0					Low to medium degraded MSW. Moist.		5.0	
10.0					62F at 10' 67F at 20' 71F at 30' 69F at 42'		10.0	
15.0					solid 8"HDPE (below ground) 15' perforated 8" HDPE 27' stick up 3'		15.0	
20.0							20.0	
25.0							25.0	
30.0							30.0	
35.0							35.0	
40.0							40.0	



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FIELD BOREHOLE LOG

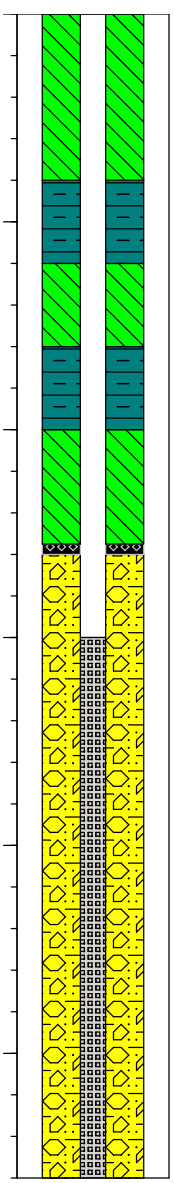
BOREHOLE NUMBER **EW-22R** Page 1 of 1

PROJECT NAME: **Landfill GCCS Expansion 2015**
LOCATION: **Closed Durham MSW Landfill**
DRILLING CO: **CB&I**
DRILLING METHOD: **36" Bucket Auger**
FIELD PARTY: **Chip Freshcorn**
GEOLOGIST: **D. Misenheimer**
DATE BEGUN: **2/20/15** COMPLETED: **2/20/15**

TOTAL DEPTH: **28**
TOP OF CASING ELEV.: GROUND ELEV.:
NORTHING: **0** EASTING: **0**

STATIC WATER LEVEL (from TOC)		
Depth (ft)		
Time		
Date		

DEPTH Feet	BLOW COUNT Per 6"	SAMPLING METHOD	RECOVERY Inches	DRILL METHOD	DESCRIPTION	LITHOLOGY	DEPTH Feet	WELL INSTALLATION
0.0				Bucket Auger	Topsoil		0.0	
					Clay cap and clay fill			
					Low to medium degraded MSW. Dry.			
5.0					57F at 10' 61F at 20' 66F at 28'		5.0	
10.0					solid 8"HDPE (below ground) 15' perforated 8" HDPE 13' stick up 3'		10.0	
15.0							15.0	
20.0							20.0	
25.0							25.0	



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ATTACHMENT C – AS-BUILT DRAWINGS

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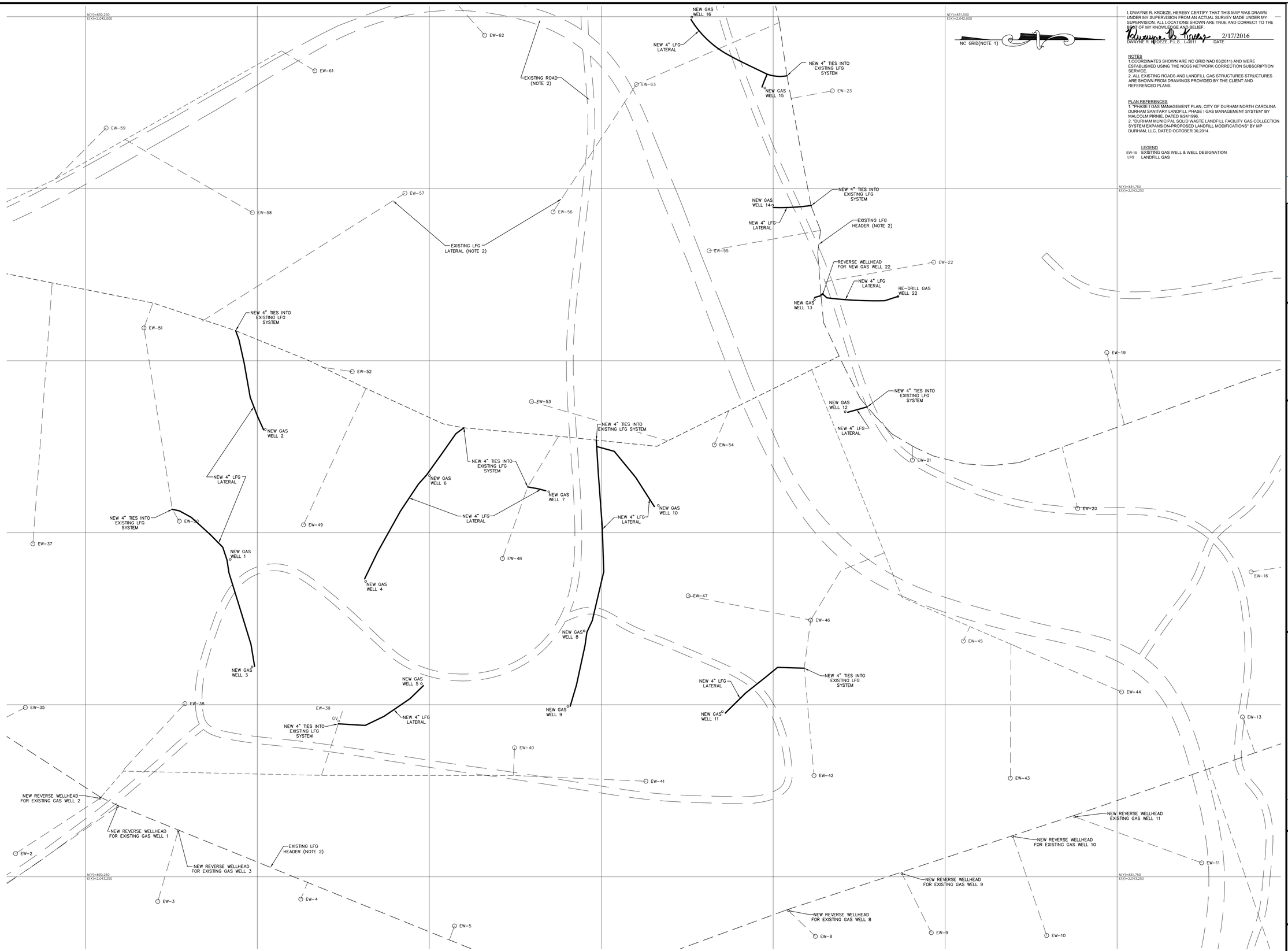

I, DWAYNE R. KROEZE, HEREBY CERTIFY THAT THIS MAP WAS DRAWN UNDER MY SUPERVISION FROM AN ACTUAL SURVEY MADE UNDER MY SUPERVISION. ALL LOCATIONS SHOWN ARE TRUE AND CORRECT TO THE BEST OF MY KNOWLEDGE AND BELIEF.

DWAYNE R. KROEZE, P.L.S. L-3911 — DATE 2/17/2016

NOTES
1.COORDINATES SHOWN ARE NC GRID NAD 83(2011) AND WERE ESTABLISHED USING THE NCGS NETWORK CORRECTION SUBSCRIPTION SERVICE.
2. ALL EXISTING ROADS AND LANDFILL GAS STRUCTURES STRUCTURES ARE SHOWN FROM DRAWINGS PROVIDED BY THE CLIENT AND REFERENCED PLANS.

PLAN REFERENCES
1. "PHASE I GAS MANAGEMENT PLAN, CITY OF DURHAM NORTH CAROLINA DURHAM SANITARY LANDFILL PHASE I GAS MANAGEMENT SYSTEM" BY MALCOLM PIRNIE, DATED 9/24/1996.
2. "DURHAM MUNICIPAL SOLID WASTE LANDFILL FACILITY GAS COLLECTION SYSTEM EXPANSION-PROPOSED LANDFILL MODIFICATIONS" BY MP DURHAM, LLC, DATED OCTOBER 30,2014.

LEGEND
EW-15 EXISTING GAS WELL & WELL DESIGNATION
LFG LANDFILL GAS

SURVEYING SOLUTIONS
precision powered by integrity
LICENSES: C-1948 (NC), C.O.A. 4197 (SC), 046500/789 (VA)
307 EAST MAIN ST. - YOUNGSVILLE, NC 27596
919-554-0502 | SSP@SURVEYPC.COM | SURVEYPC.COM

NORTH CAROLINA PROFESSIONAL SEAL L-3911 DWAYNE R. KROEZE
2/17/2016

SURVEY OF DURHAM MUNICIPAL LANDFILL GAS COLLECTION SYSTEM EXPANSION-LANDFILL MODIFICATIONS BES/MP DURHAM, LLC-CITY OF DURHAM LANDFILL FACILITY

DATE	REVISION(S)

0 60 120 180

TOWNSHIP: DURHAM
COUNTY: DURHAM
STATE: NORTH CAROLINA
SCALE: 1"=60'
SURVEY DATE: 3/24/14 TO 1/06/16
PROJECT: 14-060
DWG: 2014 LFG EXPANSION AS-BUILT SURVEY

SHEET 1 OF 1

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ATTACHMENT D – SOIL TESTS

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geotechnics
geotechnical & geosynthetic testing

March 23, 2015

Project No. 2015-617-03

Mr. Don Misenheimer
Smith + Gardner, Inc.
14 N. Boylan Ave.
Raleigh, NC 27603

don@smithgardnerinc.com
cc: stacey@smithgardnerinc.com

Transmittal
Laboratory Test Results
BES 14-1 Durham Co. Landfill GCCS

Please find attached the laboratory test results for the above referenced project. The tests were outlined on the Project Verification Form that was transmitted to your firm prior to the testing. The testing was performed in general accordance with the methods listed on the enclosed data sheets. The test results are believed to be representative of the samples that were submitted for testing and are indicative only of the specimens which were evaluated. We have no direct knowledge of the origin of the samples and imply no position with regard to the nature of the test results, i.e. pass/fail and no claims as to the suitability of the material for its intended use.

The test data and all associated project information provided shall be held in strict confidence and disclosed to other parties only with authorization by our Client. The test data submitted herein is considered integral with this report and is not to be reproduced except in whole and only with the authorization of the Client and Geotechnics. The remaining sample materials for this project will be retained for a minimum of 90 days as directed by the Geotechnics' Quality Program.

We are pleased to provide these testing services. Should you have any questions or if we may be of further assistance, please contact our office.

Respectively submitted,
Geotechnics, Inc.

Michael P. Smith
Regional Manager

We understand that you have a choice in your laboratory services and we thank you for choosing Geotechnics.

DCN: Data Transmittal Letter Date: 1/28/05 Rev.: 1

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FLEXIBLE WALL PERMEABILITY TEST

PERMOMETER METHOD

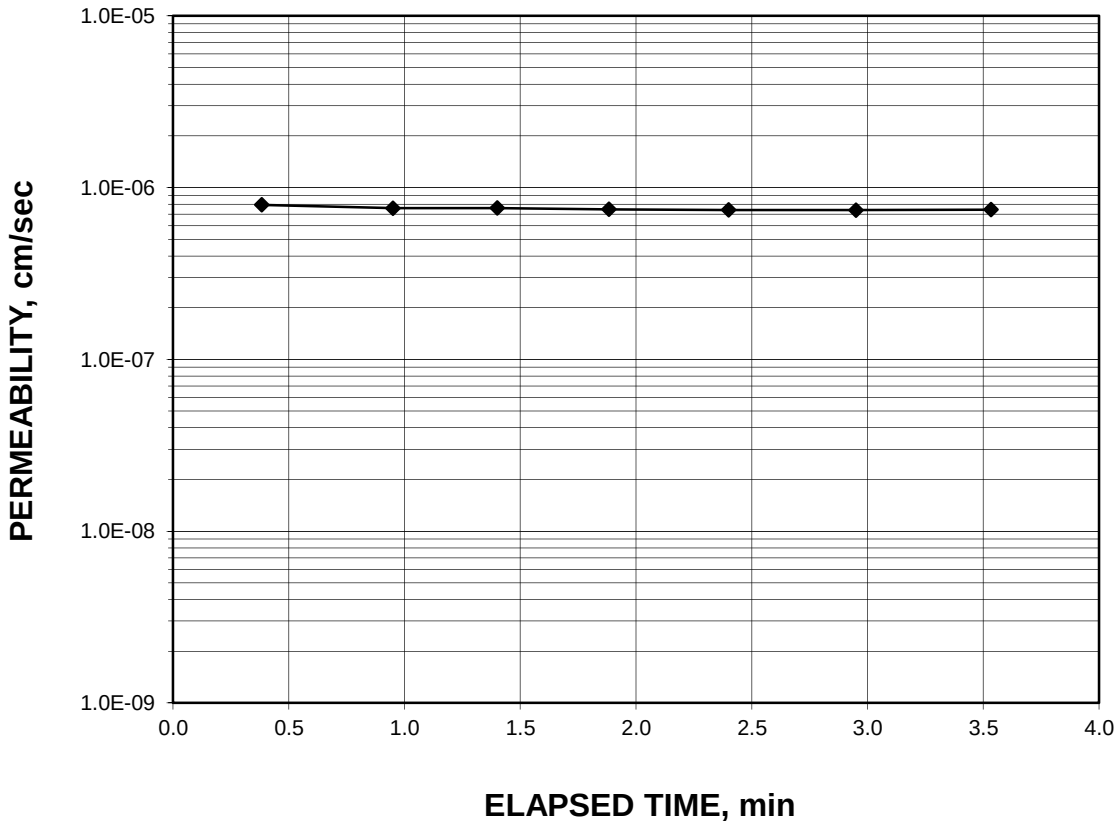
ASTM D 5084-10

Client	SMITH + GARDNER, INC.	Boring No.	GW-02
Client Project	BES 14-1 DURHAM CO LF GCCS	Depth (ft.)	N/A
Project No.	2015-617-03	Sample No.	N/A
Lab ID No.	2015-617-03-01		

Visual Description: BROWN SILTY CLAY

AVERAGE PERMEABILITY = 7.4E-07 cm/sec @ 20°C
AVERAGE PERMEABILITY = 7.4E-09 m/sec @ 20°C

PERMEABILITY vs. TIME



Tested By: SFS Date: 3/19/15 Checked By: GEM Date: 3/23/15

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FLEXIBLE WALL PERMEABILITY TEST

PERMOMETER METHOD

ASTM D 5084-10

Client	SMITH + GARDNER, INC.	Boring No.	GW-02
Client Project	BES 14-1 DURHAM CO LF GCCS	Depth (ft.)	N/A
Project No.	2015-617-03	Sample No.	N/A
Lab ID No.	2015-617-03-01		

Specific Gravity	2.70	Assumed
Sample Condition		Undisturbed

Visual Description: BROWN SILTY CLAY

MOISTURE CONTENT:	BEFORE TEST	AFTER TEST
Tare Number	805	808
Wt. of Tare & WS (gm.)	440.94	443.19
Wt. of Tare & DS (gm.)	394.93	401.06
Wt. of Tare (gm.)	102.79	103.34
Wt. of Water (gm.)	46.01	42.13
Wt. of DS (gm.)	292.14	297.72
Moisture Content (%)	**15.7**	**14.2**

SPECIMEN:	BEFORE TEST	AFTER TEST
Wt. of Tube & WS (gm.)	612.19	NA
Wt. of Tube (gm.)	0.00	NA
Wt. of WS (calc.) (gm.)	612.19	603.74
Length 1 (in.)	2.774	2.780
Length 2 (in.)	2.757	2.711
Length 3 (in.)	2.748	2.752
Top Diameter (in.)	2.826	2.757
Middle Diameter (in.)	2.814	2.804
Bottom Diameter (in.)	2.797	2.825
Average Length (in.)	2.76	2.75
Average Area (in.^{2})	6.21	6.14
Sample Volume (cm^3)	280.92	276.33
Unit Wet Wt. (gm./ cm^3)	2.179	2.185
Unit Wet Wt. (pcf)	136.0	136.4
Unit Dry Wt. (pcf)	117.5	119.5
Unit Dry Wt. (gm./ cm^3)	1.883	1.914
Void Ratio, e	0.434	0.411
Porosity, n	0.303	0.291
Pore Volume (cm^3)	85.0	80.4
Total Wt. Of Sample After Test		617.41

Tested By: SFS Date: 3/19/15 Checked By: GEM Date: 3/23/15

DCN: CT-22A DATE: 10/28/2014 REV: 0 SMT
TEST DATA\SMITH + GARDNER - BES 14-1 DURHAM CO LF GCCS\[2015-617-03-01 Permometer.xls]Sheet1

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FLEXIBLE WALL PERMEABILITY TEST
PERMOMETER METHOD

ASTM D 5084-10

Client	SMITH + GARDNER, INC.	Boring No.	GW-02
Client Project	BES 14-1 DURHAM CO LF GCCS	Depth (ft.)	N/A
Project No.	2015-617-03	Sample No.	N/A
Lab ID No.	2015-617-03-01		

Test Pressures		Final Sample Dimensions	
Cell Pressure(psi)	55.0	Sample Length (cm), L	6.98
Back Pressure(psi)	50.0	Sample Area (cm^2), A	39.59
Eff. Cons. Pressure(psi)	5.0	Pipette Area (cm^2), a_p	0.03142
Response (%)	99	Annulus Area (cm^2), a_a	0.76712
		Equilibrium Level (cm), R_{eq}	1

AVERAGE PERMEABILITY = 7.4E-07 cm/sec @ 20°C
AVERAGE PERMEABILITY = 7.4E-09 m/sec @ 20°C

DATE			TIME		ELAPSED TIME t	PIPETTE READI NG R_p	INCREMENT GRADIENT i	TEMP.	INCREMENTAL PERMEABILITY @ 20°C
(mm/dd/yy)	(hr)	(min)	(sec)	(min)	(min)	(cm)	(cm/cm)	(°C)	(cm/sec)
3/20/15	15	19	32	19.53	0.000	7.5	12.2	23.9	NA
3/20/15	15	19	55	19.92	0.383	7.2	11.6	23.9	7.9E-07
3/20/15	15	20	29	20.48	0.950	6.8	10.9	23.9	7.6E-07
3/20/15	15	20	56	20.93	1.400	6.5	10.3	23.9	7.6E-07
3/20/15	15	21	25	21.42	1.883	6.2	9.7	23.9	7.5E-07
3/20/15	15	21	56	21.93	2.400	5.9	9.2	23.9	7.4E-07
3/20/15	15	22	29	22.48	2.950	5.6	8.6	23.9	7.4E-07
3/20/15	15	23	4	23.07	3.533	5.3	8.0	23.9	7.5E-07

Tested By: SFS Date: 3/19/15 Checked By: GEM Date: 3/23/15

DCN: CT-22A DATE: 10/28/15 REV: 5 DCN: CT-22A DATE: 10/28/15 REV: 5 SMITH + GARDNER - BES 14-1 DURHAM CO LF GCCS\[2015-617-03-01 Permometer.xls]Sheet1

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FLEXIBLE WALL PERMEABILITY TEST

PERMOMETER METHOD

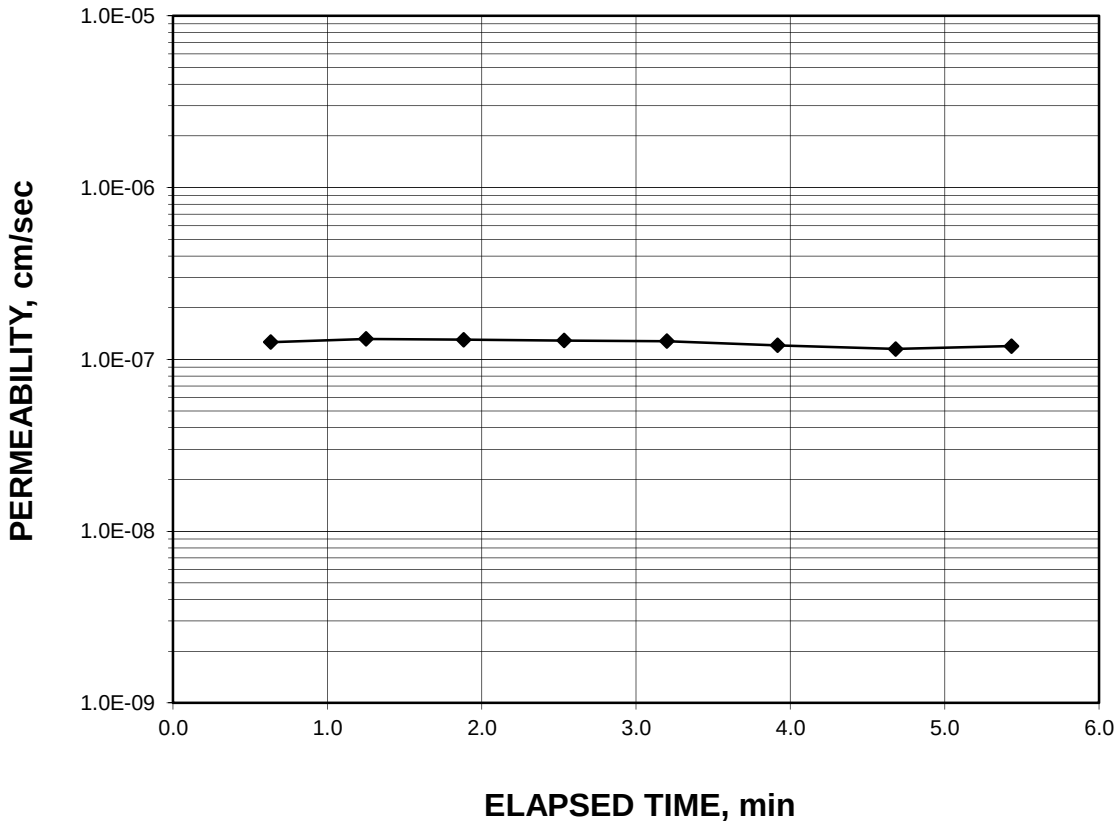
ASTM D 5084-10

Client	SMITH + GARDNER, INC.	Boring No.	GW-39
Client Project	BES 14-1 DURHAM CO LF GCCS	Depth (ft.)	N/A
Project No.	2015-617-03	Sample No.	N/A
Lab ID No.	2015-617-03-02		

Visual Description: BROWN SILTY CLAY WITH ORGANICS

AVERAGE PERMEABILITY = 1.2E-07 cm/sec @ 20°C
AVERAGE PERMEABILITY = 1.2E-09 m/sec @ 20°C

PERMEABILITY vs. TIME



Tested By: SFS Date: 3/19/15 Checked By: GEM Date: 3/23/15

DCN: CT-22A DATE: 12/08/2015 FILE: 2015-617-03 SMITH + GARDNER - BES 14-1 DURHAM CO LF GCCS\[2015-617-03-02 Permometer.xls]Sheet1

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FLEXIBLE WALL PERMEABILITY TEST

PERMOMETER METHOD

ASTM D 5084-10

Client	SMITH + GARDNER, INC.	Boring No.	GW-39
Client Project	BES 14-1 DURHAM CO LF GCCS	Depth (ft.)	N/A
Project No.	2015-617-03	Sample No.	N/A
Lab ID No.	2015-617-03-02		

Specific Gravity	2.70	Assumed
Sample Condition		Undisturbed

Visual Description: BROWN SILTY CLAY WITH ORGANICS

MOISTURE CONTENT:	BEFORE TEST	AFTER TEST
Tare Number	813	806
Wt. of Tare & WS (gm.)	395.99	562.14
Wt. of Tare & DS (gm.)	355.20	473.81
Wt. of Tare (gm.)	109.58	100.69
Wt. of Water (gm.)	40.79	88.33
Wt. of DS (gm.)	245.62	373.12
Moisture Content (%)	**16.6**	**23.7**

SPECIMEN:	BEFORE TEST	AFTER TEST
Wt. of Tube & WS (gm.)	459.38	NA
Wt. of Tube (gm.)	0.00	NA
Wt. of WS (calc.) (gm.)	459.38	487.22
Length 1 (in.)	2.295	2.252
Length 2 (in.)	2.282	2.240
Length 3 (in.)	2.276	2.244
Top Diameter (in.)	2.820	2.827
Middle Diameter (in.)	2.814	2.830
Bottom Diameter (in.)	2.830	2.820
Average Length (in.)	2.28	2.25
Average Area (in.^{2})	6.25	6.27
Sample Volume (cm^3)	234.02	230.74
Unit Wet Wt. (gm./ cm^3)	1.963	2.112
Unit Wet Wt. (pcf)	122.5	131.8
Unit Dry Wt. (pcf)	105.1	106.6
Unit Dry Wt. (gm./ cm^3)	1.683	1.707
Void Ratio, e	0.604	0.581
Porosity, n	0.377	0.368
Pore Volume (cm^3)	88.1	84.8
Total Wt. Of Sample After Test		464.24

Tested By: SFS Date: 3/19/15 Checked By: GEM Date: 3/23/15

DCN: CT-22A DATE: 10/28/2014 REV: 0 S:\PROJECTS\SMITH + GARDNER - BES 14-1 DURHAM CO LF GCCS\[2015-617-03-02 Permometer.xls]Sheet1

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FLEXIBLE WALL PERMEABILITY TEST
PERMOMETER METHOD

ASTM D 5084-10

Client	SMITH + GARDNER, INC.	Boring No.	GW-39
Client Project	BES 14-1 DURHAM CO LF GCCS	Depth (ft.)	N/A
Project No.	2015-617-03	Sample No.	N/A
Lab ID No.	2015-617-03-02		

Test Pressures		Final Sample Dimensions	
Cell Pressure(psi)	55.0	Sample Length (cm), L	5.70
Back Pressure(psi)	50.0	Sample Area (cm^2), A	40.46
Eff. Cons. Pressure(psi)	5.0	Pipette Area (cm^2), a_p	0.03142
Response (%)	100	Annulus Area (cm^2), a_a	0.76712
		Equilibrium Level (cm), R_{eq}	1

AVERAGE PERMEABILITY = 1.2E-07 cm/sec @ 20°C
AVERAGE PERMEABILITY = 1.2E-09 m/sec @ 20°C

DATE (mm/dd/yy)	TIME (hr)	(min)	(sec)	(min)	ELAPSED TIME t (min)	PIPETTE READI NG R_p (cm)	INCREMENT GRADIENT i (cm/cm)	TEMP. (°C)	INCREMENTAL PERMEABILITY @ 20°C (cm/sec)
3/20/15	15	8	41	8.68	0.000	7.5	14.9	23.9	NA
3/20/15	15	9	19	9.32	0.633	7.4	14.7	23.9	1.3E-07
3/20/15	15	9	56	9.93	1.250	7.3	14.4	23.9	1.3E-07
3/20/15	15	10	34	10.57	1.883	7.2	14.2	23.9	1.3E-07
3/20/15	15	11	13	11.22	2.533	7.1	14.0	23.9	1.3E-07
3/20/15	15	11	53	11.88	3.200	7.0	13.7	23.9	1.3E-07
3/20/15	15	12	36	12.60	3.917	6.9	13.5	23.9	1.2E-07
3/20/15	15	13	22	13.37	4.683	6.8	13.3	23.9	1.1E-07
3/20/15	15	14	7	14.12	5.433	6.7	13.1	23.9	1.2E-07

Tested By: SFS Date: 3/19/15 Checked By: GEM Date: 3/23/15

DCN: CT-22A DATE: 10/28/15 REV: 01 SMITH + GARDNER - BES 14-1 DURHAM CO LF GCCS\[2015-617-03-02 Permometer.xls]Sheet1

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Client: SMITH + GARDNER
Project Name : DURHAM CO. LF GCCS
Project Number : 2015-617

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Field Density Report

Report Number :	**FDR-01**	Geotechnics Representative :	JACOB R. BUDA
Date (s) :	**2.23.15 & 3.19.15**	Reviewed By :	JRB

Contractor :	BES	Borrow Source :	ONSITE EXCAVATION

Gauge Number	Gauge Model	Compaction Equipment :	TRENCH COMPACTOR
33577	3440		

Test Number	Test Location	Elevation/ Lift	Rod Depth	Proctor I.D. No.	Proctor Data		Measured In Place			Compaction		Comments
					MDD pcf	Opt. %M	WD (pcf)	% M	DD (pcf)	% C	% Req.	
ND 01	GW-02	LIFT 1	8"	617-02-01	117.2	13.9	**129.4**	**17.8**	**109.8**	**93.7%**	**90.0%**	
ND 02	GW-02	LIFT 3	8"	617-02-01	117.2	13.9	**134.1**	**13.6**	**118.0**	**100.7%**	**90.0%**	
ND 03	GW-39	LIFT 3	8"	617-02-01	117.2	13.9	**123.0**	**14.6**	**107.3**	**91.6%**	**90.0%**	

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MOISTURE CONTENT

ASTM D 2216 (SOP-S1)

Client	SMITH + GARDNER
Client Reference	DURHAM CO. LF GCCS
Project No.	2015-617

Test Number:	WC-01
Nuclear Test Number:	ND-01
Location:	GW-02
Depth:	LIFT 1
Tare Number	842
Wt. of Tare & WS (gm)	546.38
Wt. of Tare & DS (gm)	502.43
Wt. of Tare (gm)	256.09
Wt. of Water (gm)	43.95
Wt. of DS (gm)	246.34
Water Content (%)	**17.8**

Notes : *NA*

Tested By *JRB* *Date* *3.19.15* *Checked By* *JRB* *Date 3.24.15*

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November 23, 2015

Project No. 2015-798-001

Mr. Matt Lamb
Smith + Gardner,Inc.
14 N. Boylan Ave.
Raleigh, NC 27603

matt@smithgardnerinc.com

Transmittal
Laboratory Test Results
Durham County Landfill

Please find attached the laboratory test results for the above referenced project. The tests were outlined on the Project Verification Form that was transmitted to your firm prior to the testing. The testing was performed in general accordance with the methods listed on the enclosed data sheets. The test results are believed to be representative of the samples that were submitted for testing and are indicative only of the specimens which were evaluated. We have no direct knowledge of the origin of the samples and imply no position with regard to the nature of the test results, i.e. pass/fail and no claims as to the suitability of the material for its intended use.

The test data and all associated project information provided shall be held in strict confidence and disclosed to other parties only with authorization by our Client. The test data submitted herein is considered integral with this report and is not to be reproduced except in whole and only with the authorization of the Client and Geotechnics. The remaining sample materials for this project will be retained for a minimum of 90 days as directed by the Geotechnics' Quality Program.

We are pleased to provide these testing services. Should you have any questions or if we may be of further assistance, please contact our office.

Respectively submitted,
Geotechnics, Inc.

Michael P. Smith
Regional Manager

We understand that you have a choice in your laboratory services and we thank you for choosing Geotechnics.

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FLEXIBLE WALL PERMEABILITY TEST

PERMOMETER METHOD

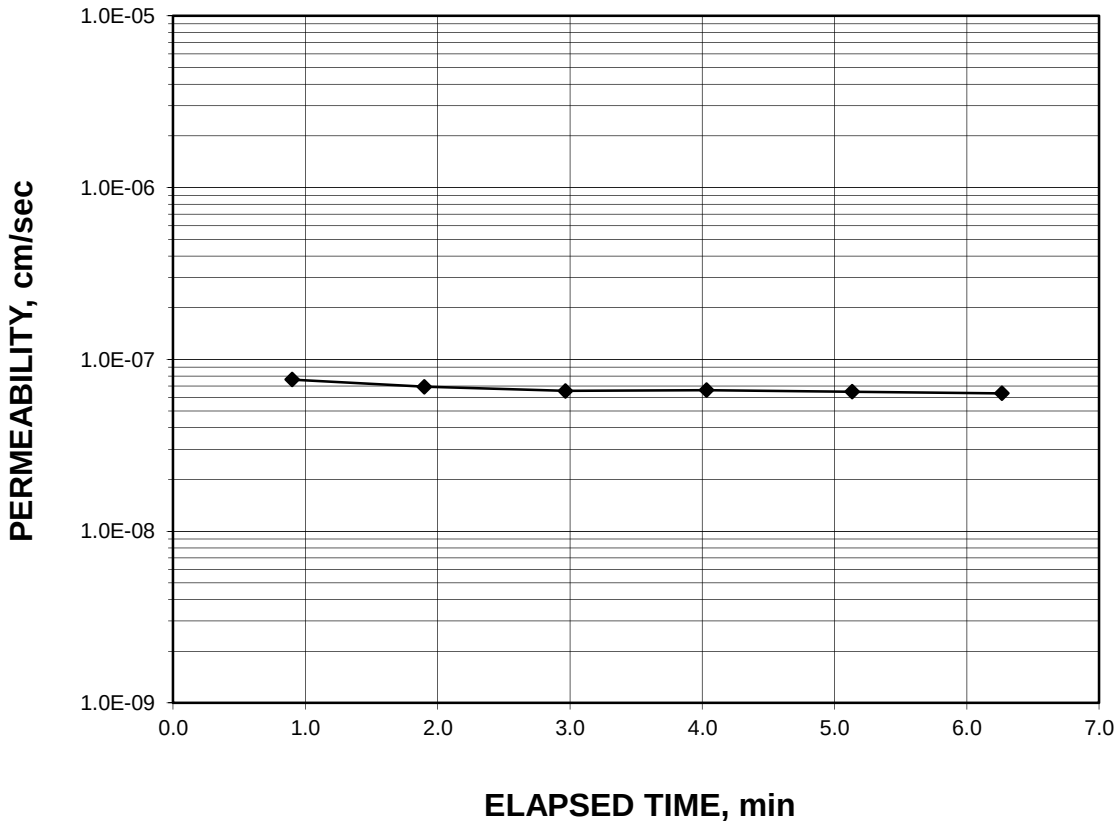
ASTM D 5084-10

Client	SMITH + GARDNER, INC.	Boring No.	GW-1/2
Client Project	DURHAM CO. LANDFILL	Depth (ft.)	LIFT 2
Project No.	2015-798-001	Sample No.	UPPER
Lab ID No.	2015-798-001-001		

Visual Description: BROWN SILTY CLAY

AVERAGE PERMEABILITY = 6.5E-08 cm/sec @ 20°C
AVERAGE PERMEABILITY = 6.5E-10 m/sec @ 20°C

PERMEABILITY vs. TIME



Tested By: AF Date: 11/19/15 Checked By: GEM Date: 11/20/15

DCN: CT-22A DATE: 02/05/08 PROJECT: 2015-798-001 SMITH + GARDNER - DURHAM CO LANDFILL\[2015-798-001-001 Permometer.xlsm]Sheet1

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FLEXIBLE WALL PERMEABILITY TEST

PERMOMETER METHOD

ASTM D 5084-10

Client	SMITH + GARDNER, INC.	Boring No.	GW-1/2
Client Project	DURHAM CO. LANDFILL	Depth (ft.)	LIFT 2
Project No.	2015-798-001	Sample No.	UPPER
Lab ID No.	2015-798-001-001		

Specific Gravity	2.70	Assumed
Sample Condition		Undisturbed

Visual Description: BROWN SILTY CLAY

MOISTURE CONTENT:	BEFORE TEST	AFTER TEST
Tare Number	819	368
Wt. of Tare & WS (gm.)	386.85	440.73
Wt. of Tare & DS (gm.)	342.34	386.96
Wt. of Tare (gm.)	130.32	111.11
Wt. of Water (gm.)	44.51	53.77
Wt. of DS (gm.)	212.02	275.85
Moisture Content (%)	**21.0**	**19.5**

SPECIMEN:	BEFORE TEST	AFTER TEST
Wt. of Tube & WS (gm.)	685.86	NA
Wt. of Tube (gm.)	0.00	NA
Wt. of WS (calc.) (gm.)	685.86	677.35
Length 1 (in.)	3.338	3.204
Length 2 (in.)	3.326	3.149
Length 3 (in.)	3.314	3.194
Top Diameter (in.)	2.859	2.825
Middle Diameter (in.)	2.872	2.780
Bottom Diameter (in.)	2.871	2.817
Average Length (in.)	3.33	3.18
Average Area (in.^{2})	6.46	6.19
Sample Volume (cm^3)	351.94	322.79
Unit Wet Wt. (gm./ cm^3)	1.949	2.098
Unit Wet Wt. (pcf)	121.6	131.0
Unit Dry Wt. (pcf)	100.5	109.6
Unit Dry Wt. (gm./ cm^3)	1.611	1.756
Void Ratio, e	0.676	0.537
Porosity, n	0.403	0.350
Pore Volume (cm^3)	142.0	112.8
Total Wt. Of Sample After Test		677.00

Tested By: AF Date: 11/19/15 Checked By: GEM Date: 11/20/15

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FLEXIBLE WALL PERMEABILITY TEST
PERMOMETER METHOD

ASTM D 5084-10

Client	SMITH + GARDNER, INC.	Boring No.	GW-1/2
Client Project	DURHAM CO. LANDFILL	Depth (ft.)	LIFT 2
Project No.	2015-798-001	Sample No.	UPPER
Lab ID No.	2015-798-001-001		

Test Pressures		Final Sample Dimensions	
Cell Pressure(psi)	60.0	Sample Length (cm), L	8.08
Back Pressure(psi)	50.0	Sample Area (cm^2), A	39.93
Eff. Cons. Pressure(psi)	10.0	Pipette Area (cm^2), a_p	0.03142
Response (%)	99	Annulus Area (cm^2), a_a	0.76712
		Equilibrium Level (cm), R_{eq}	1

AVERAGE PERMEABILITY = 6.5E-08 cm/sec @ 20°C
AVERAGE PERMEABILITY = 6.5E-10 m/sec @ 20°C

DATE		TIME			ELAPSED TIME t	PIPETTE READI NG R_p	INCREMENT GRADIENT i	TEMP.	INCREMENTAL PERMEABILITY @ 20°C
(mm/dd/yy)	(hr)	(min)	(sec)	(min)	(min)	(cm)	(cm/cm)	(°C)	(cm/sec)
11/19/15	15	18	57	18.95	0.000	11.8	17.4	24.0	NA
11/19/15	15	19	51	19.85	0.900	11.7	17.3	24.0	7.6E-08
11/19/15	15	20	51	20.85	1.900	11.6	17.1	24.0	6.9E-08
11/19/15	15	21	55	21.92	2.967	11.5	17.0	24.0	6.6E-08
11/19/15	15	22	59	22.98	4.033	11.4	16.8	24.0	6.6E-08
11/19/15	15	24	5	24.08	5.133	11.3	16.6	24.0	6.5E-08
11/19/15	15	25	13	25.22	6.267	11.2	16.5	24.0	6.4E-08

Tested By: AF Date: 11/19/15 Checked By: GEM Date: 11/20/15

DCN: CT-22A DATE: 2/16/2015 REVISION: 3 SMITH + GARDNER - DURHAM CO LANDFILL\[2015-798-001-001 Permometer.xlsm]Sheet1

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FLEXIBLE WALL PERMEABILITY TEST

PERMOMETER METHOD

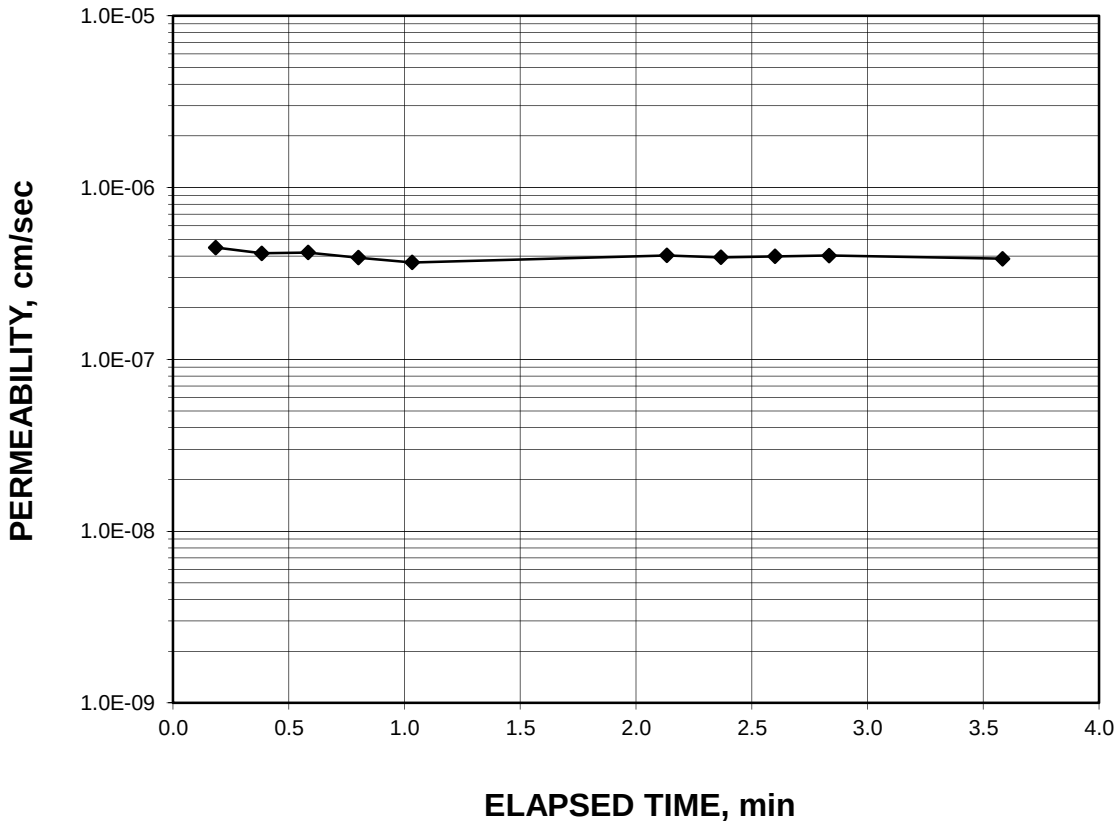
ASTM D 5084-10

Client	SMITH + GARDNER, INC.	Boring No.	GW-1/2
Client Project	DURHAM CO. LANDFILL	Depth (ft.)	LIFT 1
Project No.	2015-798-001	Sample No.	LOWER
Lab ID No.	2015-798-001-002		

Visual Description: TAN SANDY CLAY

AVERAGE PERMEABILITY = 3.9E-07 cm/sec @ 20°C
AVERAGE PERMEABILITY = 3.9E-09 m/sec @ 20°C

PERMEABILITY vs. TIME



Tested By: AF Date: 11/18/15 Checked By: GEM Date: 11/20/15

DCN: CT-22A DATE: 2/10/2015 PROJECT: 2015-798-001 SMITH + GARDNER - DURHAM CO LANDFILL\[2015-798-001-002 Permometer.xlsm]Sheet1

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FLEXIBLE WALL PERMEABILITY TEST

PERMOMETER METHOD

ASTM D 5084-10

Client	SMITH + GARDNER, INC.	Boring No.	GW-1/2
Client Project	DURHAM CO. LANDFILL	Depth (ft.)	LIFT 1
Project No.	2015-798-001	Sample No.	LOWER
Lab ID No.	2015-798-001-002		

Specific Gravity	2.70	Assumed
Sample Condition		Undisturbed

Visual Description: TAN SANDY CLAY

MOISTURE CONTENT:	BEFORE TEST	AFTER TEST
Tare Number	817	307
Wt. of Tare & WS (gm.)	342.81	499.33
Wt. of Tare & DS (gm.)	310.39	429.62
Wt. of Tare (gm.)	134.98	109.84
Wt. of Water (gm.)	32.42	69.71
Wt. of DS (gm.)	175.41	319.78
Moisture Content (%)	**18.5**	**21.8**

SPECIMEN:	BEFORE TEST	AFTER TEST
Wt. of Tube & WS (gm.)	718.45	NA
Wt. of Tube (gm.)	0.00	NA
Wt. of WS (calc.) (gm.)	718.45	738.56
Length 1 (in.)	3.491	3.463
Length 2 (in.)	3.505	3.461
Length 3 (in.)	3.495	3.456
Top Diameter (in.)	2.854	2.859
Middle Diameter (in.)	2.841	2.847
Bottom Diameter (in.)	2.845	2.863
Average Length (in.)	3.50	3.46
Average Area (in.^{2})	6.36	6.41
Sample Volume (cm^3)	364.72	363.32
Unit Wet Wt. (gm./ cm^3)	1.970	2.033
Unit Wet Wt. (pcf)	123.0	126.9
Unit Dry Wt. (pcf)	103.8	104.2
Unit Dry Wt. (gm./ cm^3)	1.663	1.669
Void Ratio, e	0.624	0.618
Porosity, n	0.384	0.382
Pore Volume (cm^3)	140.1	138.7
Total Wt. Of Sample After Test		729.36

Tested By: AF Date: 11/18/15 Checked By: GEM Date: 11/20/15

DCN: CT-22A DATE: 2015-11-18 REV: 2015-7-8 SMITH + GARDNER - DURHAM CO LANDFILL\[2015-798-001-002 Permometer.xlsm]Sheet1

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FLEXIBLE WALL PERMEABILITY TEST
PERMOMETER METHOD

ASTM D 5084-10

Client	SMITH + GARDNER, INC.	Boring No.	GW-1/2
Client Project	DURHAM CO. LANDFILL	Depth (ft.)	LIFT 1
Project No.	2015-798-001	Sample No.	LOWER
Lab ID No.	2015-798-001-002		

Test Pressures		Final Sample Dimensions	
Cell Pressure(psi)	60.0	Sample Length (cm), L	8.79
Back Pressure(psi)	50.0	Sample Area (cm^2), A	41.34
Eff. Cons. Pressure(psi)	10.0	Pipette Area (cm^2), a_p	0.03142
Response (%)	95	Annulus Area (cm^2), a_a	0.76712
		Equilibrium Level (cm), R_{eq}	1

AVERAGE PERMEABILITY = 3.9E-07 cm/sec @ 20°C
AVERAGE PERMEABILITY = 3.9E-09 m/sec @ 20°C

DATE		TIME			ELAPSED TIME t	PIPETTE READI NG R_p	INCREMENT GRADIENT i	TEMP.	INCREMENTAL PERMEABILITY @ 20°C
(mm/dd/yy)	(hr)	(min)	(sec)	(min)	(min)	(cm)	(cm/cm)	(°C)	(cm/sec)
11/19/15	15	5	51	5.85	0.000	10.5	14.1	24.0	NA
11/19/15	15	6	2	6.03	0.183	10.4	14.0	24.0	4.5E-07
11/19/15	15	6	14	6.23	0.383	10.3	13.8	24.0	4.1E-07
11/19/15	15	6	26	6.43	0.583	10.2	13.7	24.0	4.2E-07
11/19/15	15	6	39	6.65	0.800	10.1	13.5	24.0	3.9E-07
11/19/15	15	6	53	6.88	1.033	10.0	13.4	24.0	3.7E-07
11/19/15	15	7	59	7.98	2.133	9.5	12.6	24.0	4.0E-07
11/19/15	15	8	13	8.22	2.367	9.4	12.5	24.0	3.9E-07
11/19/15	15	8	27	8.45	2.600	9.3	12.3	24.0	4.0E-07
11/19/15	15	8	41	8.68	2.833	9.2	12.2	24.0	4.0E-07
11/19/15	15	9	26	9.43	3.583	8.9	11.7	24.0	3.9E-07

Tested By: AF Date: 11/18/15 Checked By: GEM Date: 11/20/15

DCN: CT-22A DATE: 2/16/2015 REVISION: 5 SMITH + GARDNER - DURHAM CO LANDFILL\[2015-798-001-002 Permometer.xlsm]Sheet1

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FLEXIBLE WALL PERMEABILITY TEST

PERMOMETER METHOD

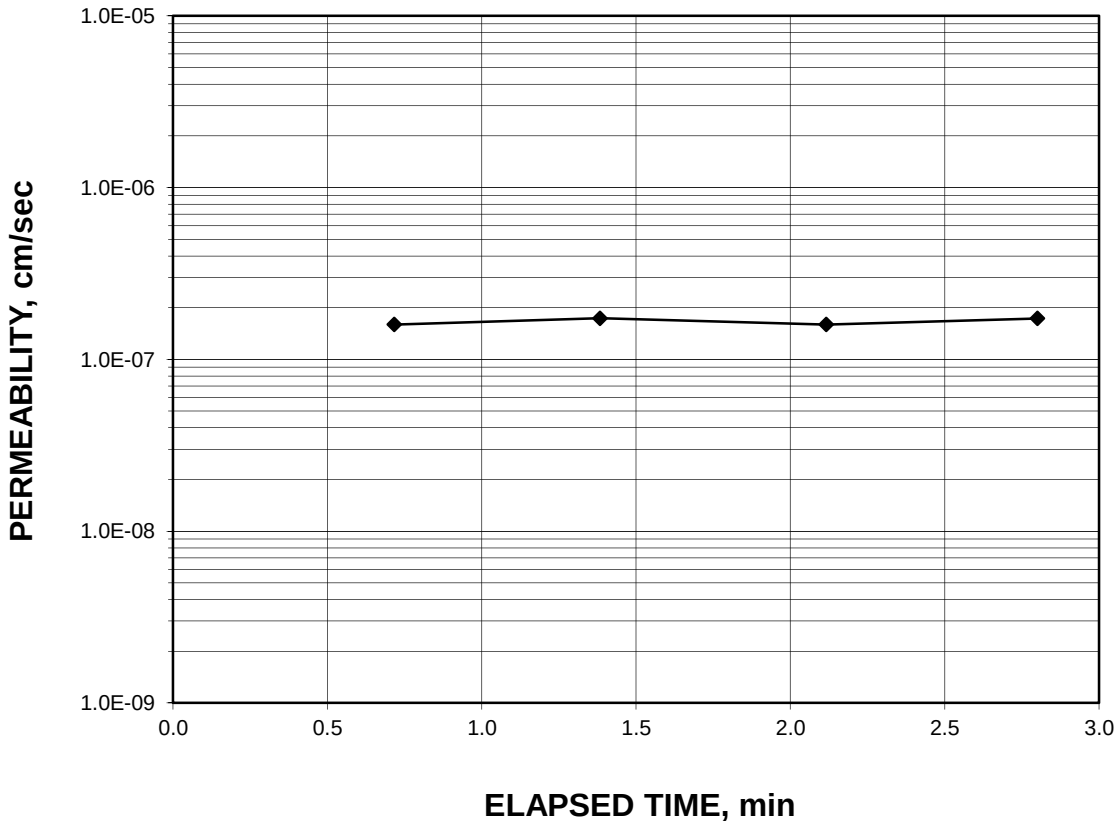
ASTM D 5084-10

Client	SMITH + GARDNER, INC.	Boring No.	GW-4
Client Project	DURHAM CO. LANDFILL	Depth (ft.)	LIFT 2
Project No.	2015-798-001	Sample No.	UPPER
Lab ID No.	2015-798-001-003		

Visual Description: TAN AND GRAY SANDY CLAY

AVERAGE PERMEABILITY = 1.7E-07 cm/sec @ 20°C
AVERAGE PERMEABILITY = 1.7E-09 m/sec @ 20°C

PERMEABILITY vs. TIME



Tested By: AF Date: 11/18/15 Checked By: GEM Date: 11/20/15

DCN: CT-22A DATE: 12/15/2015 PROJECT: 2015-798-001 SMITH + GARDNER - DURHAM CO LANDFILL\[2015-798-001-003 Permometer.xlsm]Sheet1

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PERMOMETER METHOD

ASTM D 5084-10

Client	SMITH + GARDNER, INC.	Boring No.	GW-4
Client Project	DURHAM CO. LANDFILL	Depth (ft.)	LIFT 2
Project No.	2015-798-001	Sample No.	UPPER
Lab ID No.	2015-798-001-003		

Specific Gravity	2.70	Assumed
Sample Condition		Undisturbed

Visual Description: TAN AND GRAY SANDY CLAY

MOISTURE CONTENT:	BEFORE TEST	AFTER TEST
Tare Number	815	398
Wt. of Tare & WS (gm.)	367.75	503.16
Wt. of Tare & DS (gm.)	326.04	420.12
Wt. of Tare (gm.)	137.92	83.84
Wt. of Water (gm.)	41.71	83.04
Wt. of DS (gm.)	188.12	336.28
Moisture Content (%)	**22.2**	**24.7**

SPECIMEN:	BEFORE TEST	AFTER TEST
Wt. of Tube & WS (gm.)	916.87	NA
Wt. of Tube (gm.)	0.00	NA
Wt. of WS (calc.) (gm.)	916.87	935.79
Length 1 (in.)	4.480	4.451
Length 2 (in.)	4.442	4.418
Length 3 (in.)	4.463	4.462
Top Diameter (in.)	2.840	2.857
Middle Diameter (in.)	2.853	2.843
Bottom Diameter (in.)	2.831	2.836
Average Length (in.)	4.46	4.44
Average Area (in.^{2})	6.34	6.36
Sample Volume (cm^3)	463.59	463.02
Unit Wet Wt. (gm./ cm^3)	1.978	2.021
Unit Wet Wt. (pcf)	123.5	126.2
Unit Dry Wt. (pcf)	101.1	101.2
Unit Dry Wt. (gm./ cm^3)	1.619	1.621
Void Ratio, e	0.668	0.666
Porosity, n	0.400	0.400
Pore Volume (cm^3)	185.6	185.1
Total Wt. Of Sample After Test		920.83

Tested By: AF Date: 11/18/15 Checked By: GEM Date: 11/20/15

DCN: CT-22A DATE: 2015-11-18 REVISION: 0 SMITH + GARDNER - DURHAM CO LANDFILL\[2015-798-001-003 Permometer.xlsm]Sheet1

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FLEXIBLE WALL PERMEABILITY TEST
PERMOMETER METHOD

ASTM D 5084-10

Client	SMITH + GARDNER, INC.	Boring No.	GW-4
Client Project	DURHAM CO. LANDFILL	Depth (ft.)	LIFT 2
Project No.	2015-798-001	Sample No.	UPPER
Lab ID No.	2015-798-001-003		

Test Pressures		Final Sample Dimensions	
Cell Pressure(psi)	60.0	Sample Length (cm), L	11.29
Back Pressure(psi)	50.0	Sample Area (cm^2), A	41.02
Eff. Cons. Pressure(psi)	10.0	Pipette Area (cm^2), a_p	0.03142
Response (%)	95	Annulus Area (cm^2), a_a	0.76712
		Equilibrium Level (cm), R_{eq}	1

AVERAGE PERMEABILITY = 1.7E-07 cm/sec @ 20°C
AVERAGE PERMEABILITY = 1.7E-09 m/sec @ 20°C

DATE		TIME			ELAPSED TIME t	PIPETTE READI NG R_p	INCREMENT GRADIENT i	TEMP.	INCREMENTAL PERMEABILITY @ 20°C
(mm/dd/yy)	(hr)	(min)	(sec)	(min)	(min)	(cm)	(cm/cm)	(°C)	(cm/sec)
11/19/15	15	38	57	38.95	0.000	9.8	10.2	24.1	NA
11/19/15	15	39	40	39.67	0.717	9.7	10.1	24.1	1.6E-07
11/19/15	15	40	20	40.33	1.383	9.6	10.0	24.1	1.7E-07
11/19/15	15	41	4	41.07	2.117	9.5	9.8	24.1	1.6E-07
11/19/15	15	41	45	41.75	2.800	9.4	9.7	24.1	1.7E-07

Tested By: AF Date: 11/18/15 Checked By: GEM Date: 11/20/15

DCN: CT-22A DATE: 2/16/2015 REVISION: 3 G:\2015 PROJECTS\2015-798 SMITH + GARDNER - DURHAM CO LANDFILL\[2015-798-001-003 Permometer.xlsm]Sheet1

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FLEXIBLE WALL PERMEABILITY TEST

PERMOMETER METHOD

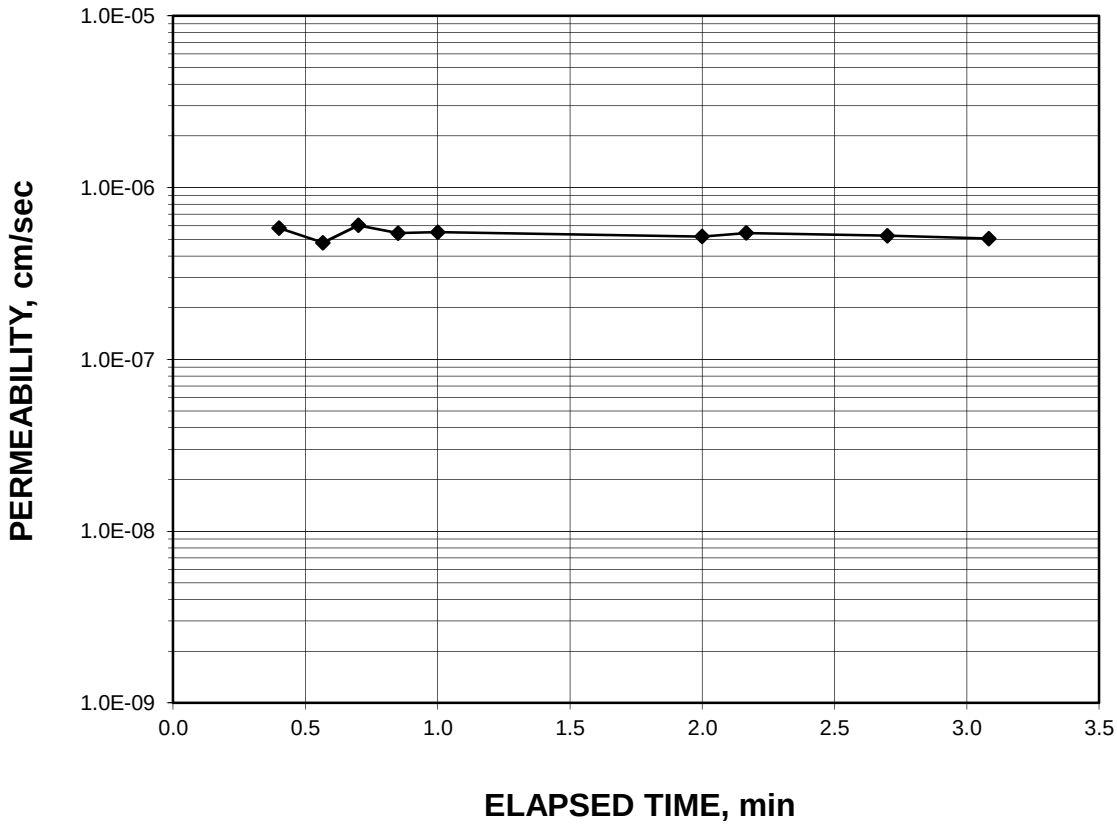
ASTM D 5084-10

Client	SMITH + GARDNER, INC.	Boring No.	GW-4
Client Project	DURHAM CO. LANDFILL	Depth (ft.)	LIFT 1
Project No.	2015-698-001	Sample No.	LOWER
Lab ID No.	2015-798-001-004		

Visual Description: TAN AND GRAY SANDY CLAY

AVERAGE PERMEABILITY = 5.2E-07 cm/sec @ 20°C
AVERAGE PERMEABILITY = 5.2E-09 m/sec @ 20°C

PERMEABILITY vs. TIME



Tested By: AF Date: 11/18/15 Checked By: GEM Date: 11/20/15

DCN: CT-22A DATE: 02/05/08 PROJECT: 2015-798-001 SMITH + GARDNER - DURHAM CO LANDFILL\[2015-798-001-004 Permometer.xlsm]Sheet1

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FLEXIBLE WALL PERMEABILITY TEST

PERMOMETER METHOD

ASTM D 5084-10

Client	SMITH + GARDNER, INC.	Boring No.	GW-4
Client Project	DURHAM CO. LANDFILL	Depth (ft.)	LIFT 1
Project No.	2015-698-001	Sample No.	LOWER
Lab ID No.	2015-798-001-004		

Specific Gravity	2.70	Assumed
Sample Condition		Undisturbed

Visual Description: TAN AND GRAY SANDY CLAY

MOISTURE CONTENT:	BEFORE TEST	AFTER TEST
Tare Number	801	832
Wt. of Tare & WS (gm.)	346.84	569.63
Wt. of Tare & DS (gm.)	301.54	508.1
Wt. of Tare (gm.)	97.79	259.04
Wt. of Water (gm.)	45.30	61.53
Wt. of DS (gm.)	203.75	249.06
Moisture Content (%)	**22.2**	**24.7**

SPECIMEN:	BEFORE TEST	AFTER TEST
Wt. of Tube & WS (gm.)	581.42	NA
Wt. of Tube (gm.)	0.00	NA
Wt. of WS (calc.) (gm.)	581.42	593.18
Length 1 (in.)	2.896	2.874
Length 2 (in.)	2.869	2.829
Length 3 (in.)	2.883	2.858
Top Diameter (in.)	2.857	2.836
Middle Diameter (in.)	2.840	2.829
Bottom Diameter (in.)	2.845	2.835
Average Length (in.)	2.88	2.85
Average Area (in.^{2})	6.37	6.31
Sample Volume (cm^3)	300.79	294.84
Unit Wet Wt. (gm./ cm^3)	1.933	2.012
Unit Wet Wt. (pcf)	120.7	125.6
Unit Dry Wt. (pcf)	98.7	100.7
Unit Dry Wt. (gm./ cm^3)	1.581	1.613
Void Ratio, e	0.707	0.674
Porosity, n	0.414	0.402
Pore Volume (cm^3)	124.6	118.7
Total Wt. Of Sample After Test		582.97

Tested By: AF Date: 11/18/15 Checked By: GEM Date: 11/20/15

DCN: CT-22A DATE: 2/16/2015 REVISION: 5 TEMPLATE: 2015-798 SMITH + GARDNER - DURHAM CO LANDFILL\[2015-798-001-004 Permometer.xlsm]Sheet1

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FLEXIBLE WALL PERMEABILITY TEST
PERMOMETER METHOD

ASTM D 5084-10

Client	SMITH + GARDNER, INC.	Boring No.	GW-4
Client Project	DURHAM CO. LANDFILL	Depth (ft.)	LIFT 1
Project No.	2015-698-001	Sample No.	LOWER
Lab ID No.	2015-798-001-004		

Test Pressures		Final Sample Dimensions	
Cell Pressure(psi)	60.0	Sample Length (cm), L	7.25
Back Pressure(psi)	50.0	Sample Area (cm^2), A	40.68
Eff. Cons. Pressure(psi)	10.0	Pipette Area (cm^2), a_p	0.03142
Response (%)	98	Annulus Area (cm^2), a_a	0.76712
		Equilibrium Level (cm), R_{eq}	1

AVERAGE PERMEABILITY = 5.2E-07 cm/sec @ 20°C
AVERAGE PERMEABILITY = 5.2E-09 m/sec @ 20°C

DATE		TIME			ELAPSED TIME t	PIPETTE READI NG R_p	INCREMENT GRADIENT i	TEMP.	INCREMENTAL PERMEABILITY @ 20°C
(mm/dd/yy)	(hr)	(min)	(sec)	(min)	(min)	(cm)	(cm/cm)	(°C)	(cm/sec)
11/19/15	15	50	8	50.13	0.000	9.5	15.3	24.1	NA
11/19/15	15	50	32	50.53	0.400	9.2	14.8	24.1	5.8E-07
11/19/15	15	50	42	50.70	0.567	9.1	14.6	24.1	4.8E-07
11/19/15	15	50	50	50.83	0.700	9.0	14.4	24.1	6.0E-07
11/19/15	15	50	59	50.98	0.850	8.9	14.2	24.1	5.4E-07
11/19/15	15	51	8	51.13	1.000	8.8	14.1	24.1	5.5E-07
11/19/15	15	52	8	52.13	2.000	8.2	13.0	24.1	5.2E-07
11/19/15	15	52	18	52.30	2.167	8.1	12.8	24.1	5.4E-07
11/19/15	15	52	50	52.83	2.700	7.8	12.3	24.1	5.2E-07
11/19/15	15	53	13	53.22	3.083	7.6	11.9	24.1	5.1E-07

Tested By: AF Date: 11/18/15 Checked By: GEM Date: 11/20/15

DCN: CT-22A DATE: 2/16/2015 REVISION: 3 SMITH + GARDNER - DURHAM CO LANDFILL\[2015-798-001-004 Permometer.xlsm]Sheet1

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PERMEABILITY TEST

ASTM D 5084-10

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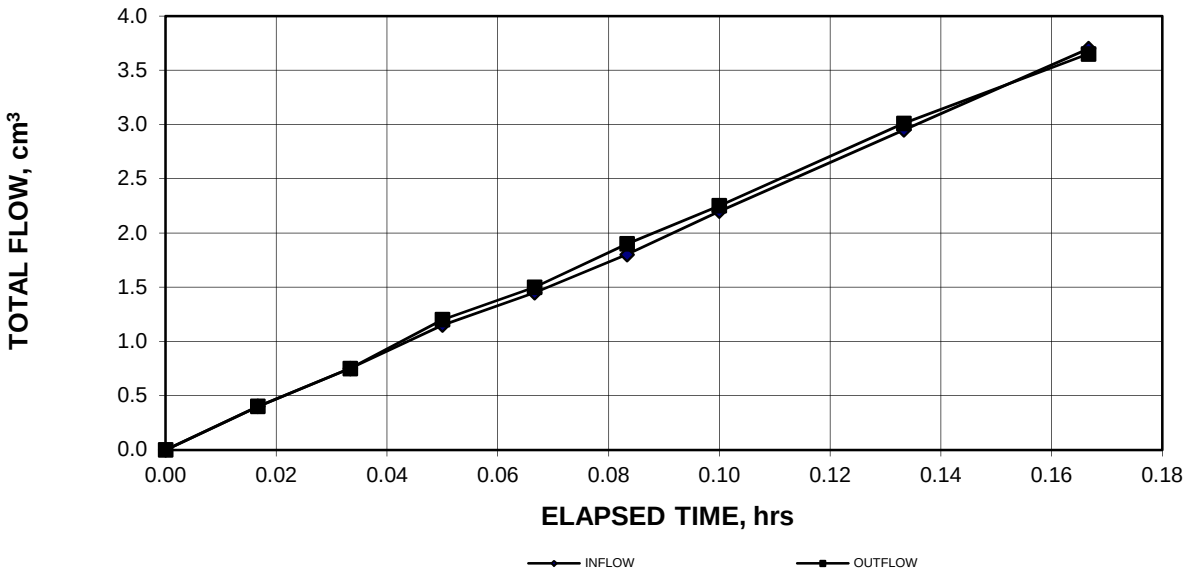
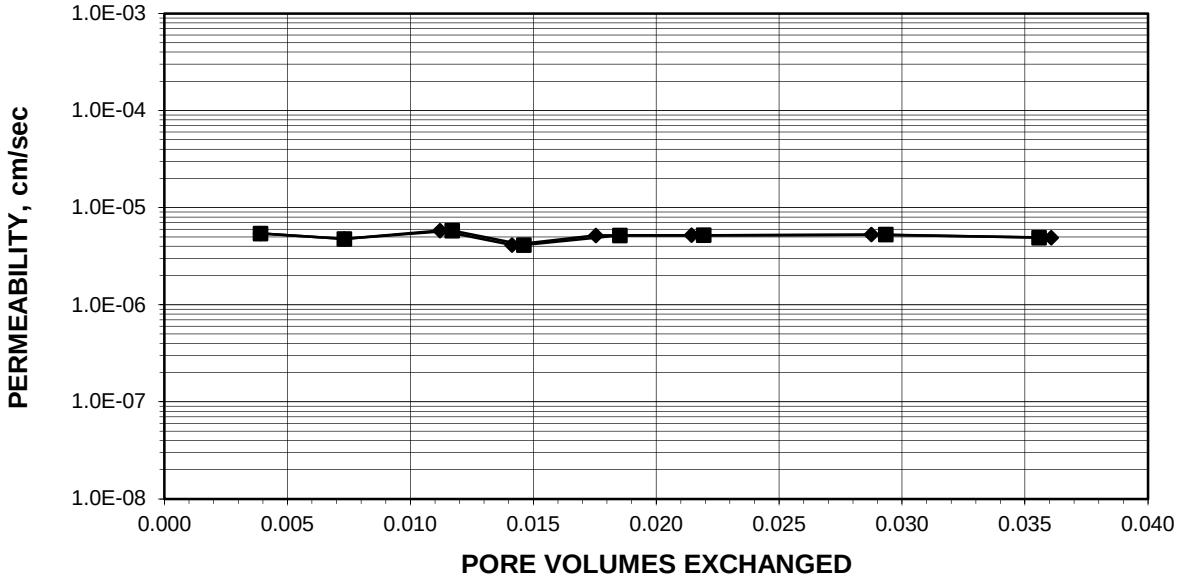
Client	SMITH + GARDNER, INC.	Boring No.	GW-8
Client Project	DURHAM CO. LANDFILL	Depth (ft.)	LIFT 2
Project No.	2015-798-001	Sample No.	UPPER
Lab ID No.	2015-798-001-005		

AVERAGE PERMEABILITY = 5.1E-06 cm/sec @ 20°C
AVERAGE PERMEABILITY = 5.1E-08 m/sec @ 20°C

TOTAL FLOW vs. ELAPSED TIME



PORE VOLUMES EXCHANGED vs. PERMEABILITY



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Client	SMITH + GARDNER, INC.	Boring No.	GW-8
Client Project	DURHAM CO. LANDFILL	Depth (ft.)	LIFT 2
Project No.	2015-798-001	Sample No.	UPPER
Lab ID No.	2015-798-001-005		

Specific Gravity	2.70	Assumed
Sample Condition		Undisturbed

Visual Description: TAN SANDY CLAY

MOISTURE CONTENT:	BEFORE TEST	AFTER TEST
Tare Number	TB-09	819
Wt. of Tare & WS (gm.)	458.48	369.55
Wt. of Tare & DS (gm.)	385.76	317.46
Wt. of Tare (gm.)	134.06	130.53
Wt. of Water (gm.)	72.72	52.09
Wt. of DS (gm.)	251.70	186.93
Moisture Content (%)	**28.9**	**27.9**

SPECIMEN:	BEFORE TEST	AFTER TEST
Wt. of Tube & WS (gm.)	440.00	NA
Wt. of Tube (gm.)	0.00	NA
Wt. of WS (calc.)(gm.)	440.00	436.50
Length 1 (in.)	2.245	2.217
Length 2 (in.)	2.245	2.253
Length 3 (in.)	2.226	2.240
Top Diameter (in.)	2.830	2.818
Middle Diameter (in.)	2.827	2.819
Bottom Diameter (in.)	2.835	2.825
Average Length (in.)	2.24	2.24
Average Area (in.^{2})	6.29	6.25
Sample Volume (cm^3)	230.86	229.03
Unit Wet Wt. (gm./ cm^3)	1.91	1.91
Unit Wet Wt. (pcf)	119.0	119.0
Unit Dry Wt. (pcf)	92.3	93.0
Unit Dry Wt. (gm./ cm^3)	1.48	1.49
Void Ratio, e	0.83	0.81
Porosity, n	0.45	0.45
Pore Volume (cm^3)	104.4	102.6
Total Wgt. Of Sample After Test		436.60

Tested By: AF Date: 11/19/15 Checked By: GEM Date: 11/23/15

DCN: CT-22 DATE: 12/7/2010 REVISION: 0 2015-798 SMITH + GARDNER - DURHAM CO LANDFILL\[2015-798-001-005 PERMflow.xlsm]Sheet1

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PERMEABILITY TEST

ASTM D 5084-10

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Client	SMITH + GARDNER, INC.	Boring No.	GW-8
Client Project	DURHAM CO. LANDFILL	Depth (ft.)	LIFT 2
Project No.	2015-798-001	Sample No.	UPPER
Lab ID No.	2015-798-001-005		

Pressure Heads (Constant)		Final Sample Dimensions	
Top Cap (psi)	49.0	Sample Length (cm), L	5.68
Bottom Cap (psi)	51.0	Sample Diameter (cm)	7.16
Cell (psi)	60.0	Sample Area (cm^2), A	40.31
Total Pressure Head (cm)	140.6	Inflow Burette Area (cm^2), a-in	0.880
Hydraulic Gradient	24.75	Outflow Burette Area (cm^2), a-out	0.865
		B Parameter (%)	95

AVERAGE PERMEABILITY = 5.1E-06 cm/sec @ 20°C

AVERAGE PERMEABILITY = 5.1E-08 m/sec @ 20°C

DATE (mm/dd/yy)	TIME (hr)	TIME (min)	ELAPSED TIME **t** (hr)	TOTAL INFLOW (cm^3)	TOTAL OUTFLOW (cm^3)	TOTAL HEAD **h** (cm)	FLOW (0 flow) (1 stop)	TEMP. (°C)	INCREMENTAL PERMEABILITY @ 20°C (cm/sec)
11/20/15	12	12	0.00	0.0	0.0	160.0	0	22.2	NA
11/20/15	12	13	0.02	0.4	0.4	159.1	0	22.2	5.4E-06
11/20/15	12	14	0.03	0.8	0.8	158.4	0	22.2	4.8E-06
11/20/15	12	15	0.05	1.2	1.2	157.4	0	22.2	5.8E-06
11/20/15	12	16	0.07	1.5	1.5	156.7	0	22.2	4.1E-06
11/20/15	12	17	0.08	1.8	1.9	155.9	0	22.2	5.2E-06
11/20/15	12	18	0.10	2.2	2.3	155.1	0	22.2	5.2E-06
11/20/15	12	20	0.13	3.0	3.0	153.4	0	22.2	5.3E-06
11/20/15	12	22	0.17	3.7	3.7	151.9	1	22.2	4.9E-06

Tested By: AF Date: 11/19/15 Checked By: GEM Date: 11/23/15

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FLEXIBLE WALL PERMEABILITY TEST

PERMOMETER METHOD

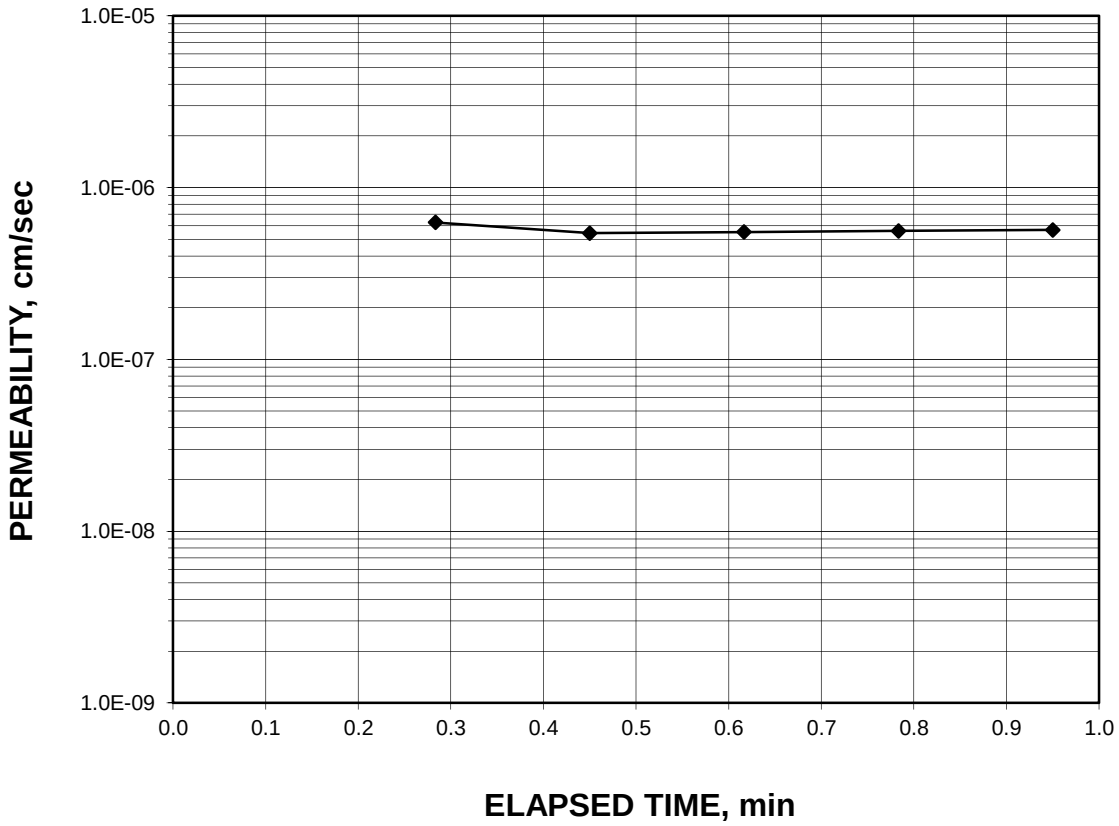
ASTM D 5084-10

Client	SMITH + GARDNER, INC.	Boring No.	GW-8
Client Project	DURHAM CO. LANDFILL	Depth (ft.)	LIFT 1
Project No.	2015-798-001	Sample No.	LOWER
Lab ID No.	2015-798-001-006		

Visual Description: TAN SANDY CLAY

AVERAGE PERMEABILITY = 5.6E-07 cm/sec @ 20°C
AVERAGE PERMEABILITY = 5.6E-09 m/sec @ 20°C

PERMEABILITY vs. TIME



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FLEXIBLE WALL PERMEABILITY TEST

PERMOMETER METHOD

ASTM D 5084-10

Client	SMITH + GARDNER, INC.	Boring No.	GW-8
Client Project	DURHAM CO. LANDFILL	Depth (ft.)	LIFT 1
Project No.	2015-798-001	Sample No.	LOWER
Lab ID No.	2015-798-001-006		

Specific Gravity	2.70	Assumed
Sample Condition		Undisturbed

Visual Description: TAN SANDY CLAY

MOISTURE CONTENT:	BEFORE TEST	AFTER TEST
Tare Number	802	815
Wt. of Tare & WS (gm.)	425.31	427.89
Wt. of Tare & DS (gm.)	360.12	365.89
Wt. of Tare (gm.)	103.00	137.99
Wt. of Water (gm.)	65.19	62.00
Wt. of DS (gm.)	257.12	227.90
Moisture Content (%)	**25.4**	**27.2**

SPECIMEN:	BEFORE TEST	AFTER TEST
Wt. of Tube & WS (gm.)	555.78	NA
Wt. of Tube (gm.)	0.00	NA
Wt. of WS (calc.) (gm.)	555.78	563.99
Length 1 (in.)	2.779	2.737
Length 2 (in.)	2.781	2.738
Length 3 (in.)	2.794	2.746
Top Diameter (in.)	2.848	2.834
Middle Diameter (in.)	2.838	2.834
Bottom Diameter (in.)	2.838	2.831
Average Length (in.)	2.78	2.74
Average Area (in.^{2})	6.34	6.30
Sample Volume (cm^3)	289.34	283.07
Unit Wet Wt. (gm./ cm^3)	1.921	1.992
Unit Wet Wt. (pcf)	119.9	124.4
Unit Dry Wt. (pcf)	95.7	97.8
Unit Dry Wt. (gm./ cm^3)	1.532	1.566
Void Ratio, e	0.762	0.724
Porosity, n	0.432	0.420
Pore Volume (cm^3)	125.1	118.9
Total Wt. Of Sample After Test		557.62

Tested By: AF Date: 11/19/15 Checked By: GEM Date: 11/23/15

DCN: CT-22A DATE: 2/16/2015 REVISION: 5 SMITH + GARDNER - DURHAM CO LANDFILL\[2015-798-001-006 Permometer.xlsm]Sheet1

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FLEXIBLE WALL PERMEABILITY TEST
PERMOMETER METHOD

ASTM D 5084-10

Client	SMITH + GARDNER, INC.	Boring No.	GW-8
Client Project	DURHAM CO. LANDFILL	Depth (ft.)	LIFT 1
Project No.	2015-798-001	Sample No.	LOWER
Lab ID No.	2015-798-001-006		

Test Pressures		Final Sample Dimensions	
Cell Pressure(psi)	60.0	Sample Length (cm), L	6.96
Back Pressure(psi)	50.0	Sample Area (cm^2), A	40.67
Eff. Cons. Pressure(psi)	10.0	Pipette Area (cm^2), a_p	0.03142
Response (%)	95	Annulus Area (cm^2), a_a	0.76712
		Equilibrium Level (cm), R_{eq}	1

AVERAGE PERMEABILITY = 5.6E-07 cm/sec @ 20°C
AVERAGE PERMEABILITY = 5.6E-09 m/sec @ 20°C

DATE		TIME			ELAPSED TIME t	PIPETTE READI NG R_p	INCREMENT GRADIENT i	TEMP.	INCREMENTAL PERMEABILITY @ 20°C
(mm/dd/yy)	(hr)	(min)	(sec)	(min)	(min)	(cm)	(cm/cm)	(°C)	(cm/sec)
11/20/15	14	2	3	2.05	0.000	8.4	13.9	22.4	NA
11/20/15	14	2	20	2.33	0.283	8.2	13.5	22.4	6.3E-07
11/20/15	14	2	30	2.50	0.450	8.1	13.3	22.4	5.4E-07
11/20/15	14	2	40	2.67	0.617	8.0	13.1	22.4	5.5E-07
11/20/15	14	2	50	2.83	0.783	7.9	12.9	22.4	5.6E-07
11/20/15	14	3	0	3.00	0.950	7.8	12.8	22.4	5.7E-07

Tested By: AF Date: 11/19/15 Checked By: GEM Date: 11/23/15

DCN: CT-22A DATE: 2/16/2015 REVISION: 3 SMITH + GARDNER - DURHAM CO LANDFILL\[2015-798-001-006 Permometer.xlsm]Sheet1

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FLEXIBLE WALL PERMEABILITY TEST

PERMOMETER METHOD

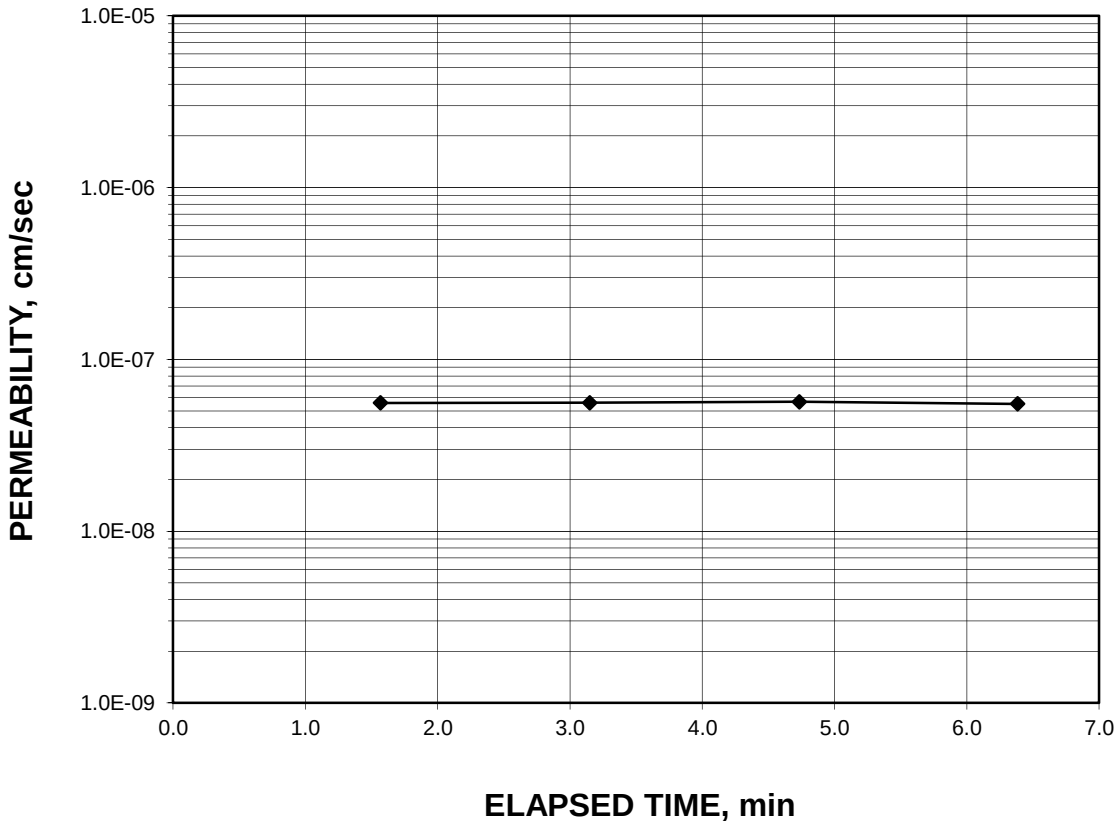
ASTM D 5084-10

Client	SMITH + GARDNER, INC.	Boring No.	GW-9
Client Project	DURHAM CO. LANDFILL	Depth (ft.)	LIFT 2
Project No.	2015-798-001	Sample No.	UPPER
Lab ID No.	2015-798-001-007		

Visual Description: BROWN SANDY CLAY

AVERAGE PERMEABILITY = 5.6E-08 cm/sec @ 20°C
AVERAGE PERMEABILITY = 5.6E-10 m/sec @ 20°C

PERMEABILITY vs. TIME



Tested By: AF Date: 11/19/15 Checked By: GEM Date: 11/23/15

DCN: CT-22A DATE: 02/05/08 PROJECT: 2015-798-001 SMITH + GARDNER - DURHAM CO LANDFILL\[2015-798-001-007 Permometer.xlsm]Sheet1

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FLEXIBLE WALL PERMEABILITY TEST

PERMOMETER METHOD

ASTM D 5084-10

Client	SMITH + GARDNER, INC.	Boring No.	GW-9
Client Project	DURHAM CO. LANDFILL	Depth (ft.)	LIFT 2
Project No.	2015-798-001	Sample No.	UPPER
Lab ID No.	2015-798-001-007		

Specific Gravity	2.70	Assumed
Sample Condition		Undisturbed

Visual Description: BROWN SANDY CLAY

MOISTURE CONTENT:	BEFORE TEST	AFTER TEST
Tare Number	806	801
Wt. of Tare & WS (gm.)	419.03	386.12
Wt. of Tare & DS (gm.)	375.27	342.96
Wt. of Tare (gm.)	100.08	97.77
Wt. of Water (gm.)	43.76	43.16
Wt. of DS (gm.)	275.19	245.19
Moisture Content (%)	**15.9**	**17.6**

SPECIMEN:	BEFORE TEST	AFTER TEST
Wt. of Tube & WS (gm.)	672.73	NA
Wt. of Tube (gm.)	0.00	NA
Wt. of WS (calc.) (gm.)	672.73	682.60
Length 1 (in.)	3.100	3.084
Length 2 (in.)	3.114	3.089
Length 3 (in.)	3.091	3.057
Top Diameter (in.)	2.855	2.845
Middle Diameter (in.)	2.838	2.843
Bottom Diameter (in.)	2.834	2.842
Average Length (in.)	3.10	3.08
Average Area (in.^{2})	6.35	6.35
Sample Volume (cm^3)	322.50	320.13
Unit Wet Wt. (gm./ cm^3)	2.086	2.132
Unit Wet Wt. (pcf)	130.2	133.1
Unit Dry Wt. (pcf)	112.3	113.2
Unit Dry Wt. (gm./ cm^3)	1.800	1.813
Void Ratio, e	0.500	0.489
Porosity, n	0.333	0.328
Pore Volume (cm^3)	107.5	105.2
Total Wt. Of Sample After Test		677.93

Tested By: AF Date: 11/19/15 Checked By: GEM Date: 11/23/15

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FLEXIBLE WALL PERMEABILITY TEST
PERMOMETER METHOD

ASTM D 5084-10

Client	SMITH + GARDNER, INC.	Boring No.	GW-9
Client Project	DURHAM CO. LANDFILL	Depth (ft.)	LIFT 2
Project No.	2015-798-001	Sample No.	UPPER
Lab ID No.	2015-798-001-007		

Test Pressures		Final Sample Dimensions	
Cell Pressure(psi)	60.0	Sample Length (cm), L	7.81
Back Pressure(psi)	50.0	Sample Area (cm^2), A	40.96
Eff. Cons. Pressure(psi)	10.0	Pipette Area (cm^2), a_p	0.03142
Response (%)	97	Annulus Area (cm^2), a_a	0.76712
		Equilibrium Level (cm), R_{eq}	1

AVERAGE PERMEABILITY = 5.6E-08 cm/sec @ 20°C
AVERAGE PERMEABILITY = 5.6E-10 m/sec @ 20°C

DATE		TIME			ELAPSED TIME t	PIPETTE READI NG R_p	INCREMENT GRADIENT i	TEMP.	INCREMENTAL PERMEABILITY @ 20°C
(mm/dd/yy)	(hr)	(min)	(sec)	(min)	(min)	(cm)	(cm/cm)	(°C)	(cm/sec)
11/20/15	13	50	25	50.42	0.000	9.3	13.9	22.4	NA
11/20/15	13	51	59	51.98	1.567	9.2	13.7	22.4	5.6E-08
11/20/15	13	53	34	53.57	3.150	9.1	13.5	22.4	5.6E-08
11/20/15	13	55	9	55.15	4.733	9.0	13.4	22.4	5.7E-08
11/20/15	13	56	48	56.80	6.383	8.9	13.2	22.4	5.5E-08

Tested By: AF Date: 11/19/15 Checked By: GEM Date: 11/23/15

DCN: CT-22A DATE: 2/16/2015 REVISION: 3 SMITH + GARDNER - DURHAM CO LANDFILL\[2015-798-001-007 Permometer.xlsm]Sheet1

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FLEXIBLE WALL PERMEABILITY TEST

PERMOMETER METHOD

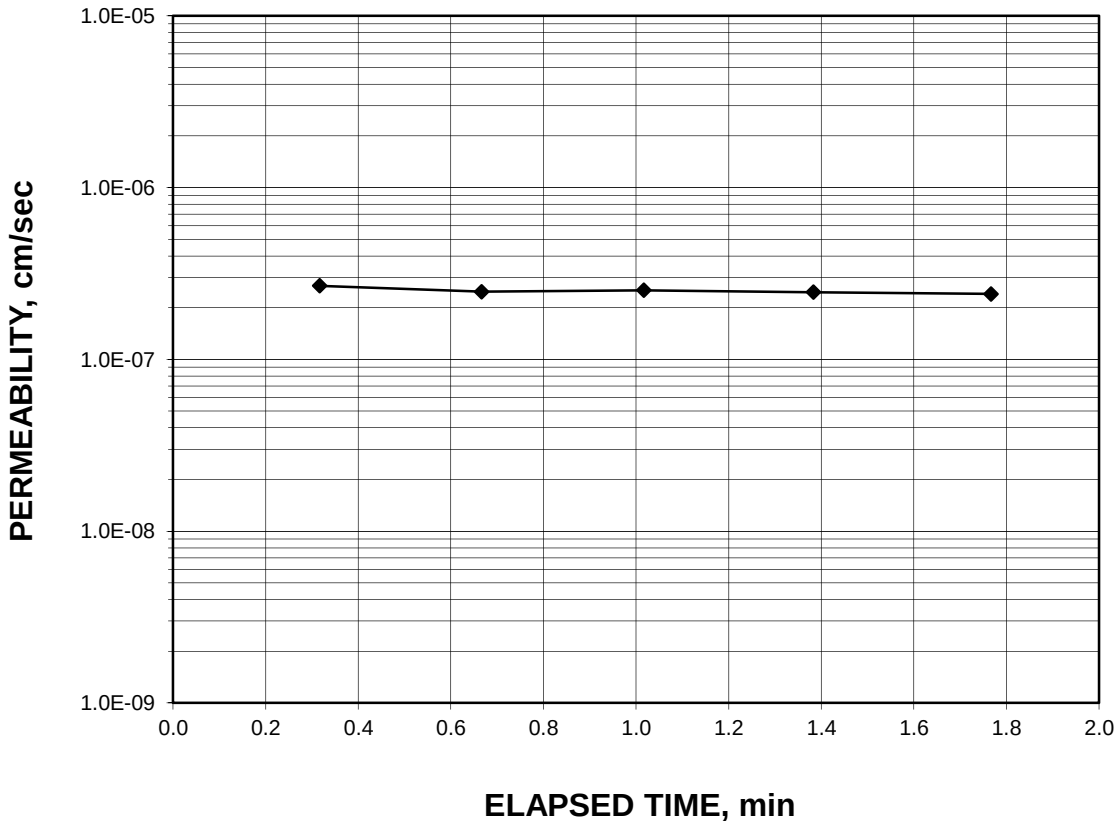
ASTM D 5084-10

Client	SMITH + GARDNER, INC.	Boring No.	GW-9
Client Project	DURHAM CO. LANDFILL	Depth (ft.)	LIFT 1
Project No.	2015-798-001	Sample No.	LOWER
Lab ID No.	2015-798-001-008		

Visual Description: BROWN SANDY CLAY

AVERAGE PERMEABILITY = 2.5E-07 cm/sec @ 20°C
AVERAGE PERMEABILITY = 2.5E-09 m/sec @ 20°C

PERMEABILITY vs. TIME



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FLEXIBLE WALL PERMEABILITY TEST

PERMOMETER METHOD

ASTM D 5084-10

Client	SMITH + GARDNER, INC.	Boring No.	GW-9
Client Project	DURHAM CO. LANDFILL	Depth (ft.)	LIFT 1
Project No.	2015-798-001	Sample No.	LOWER
Lab ID No.	2015-798-001-008		

Specific Gravity	2.70	Assumed
Sample Condition		Undisturbed

Visual Description: BROWN SANDY CLAY

MOISTURE CONTENT:	BEFORE TEST	AFTER TEST
Tare Number	800	807
Wt. of Tare & WS (gm.)	428.52	486.2
Wt. of Tare & DS (gm.)	382.87	426.63
Wt. of Tare (gm.)	103.19	102.91
Wt. of Water (gm.)	45.65	59.57
Wt. of DS (gm.)	279.68	323.72
Moisture Content (%)	**16.3**	**18.4**

SPECIMEN:	BEFORE TEST	AFTER TEST
Wt. of Tube & WS (gm.)	381.81	NA
Wt. of Tube (gm.)	0.00	NA
Wt. of WS (calc.) (gm.)	381.81	388.64
Length 1 (in.)	1.822	1.808
Length 2 (in.)	1.834	1.828
Length 3 (in.)	1.827	1.814
Top Diameter (in.)	2.836	2.834
Middle Diameter (in.)	2.839	2.816
Bottom Diameter (in.)	2.830	2.840
Average Length (in.)	1.83	1.82
Average Area (in.^{2})	6.31	6.29
Sample Volume (cm^3)	189.06	187.26
Unit Wet Wt. (gm./ cm^3)	2.020	2.075
Unit Wet Wt. (pcf)	126.1	129.6
Unit Dry Wt. (pcf)	108.4	109.4
Unit Dry Wt. (gm./ cm^3)	1.736	1.753
Void Ratio, e	0.555	0.540
Porosity, n	0.357	0.351
Pore Volume (cm^3)	67.5	65.7
Total Wt. Of Sample After Test		388.78

Tested By: AF Date: 11/19/15 Checked By: GEM Date: 11/23/15

DCN: CT-22A DATE: 2/16/2015 REV: 1 SMITH + GARDNER - DURHAM CO LANDFILL\[2015-798-001-008 Permometer.xlsm]Sheet1

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FLEXIBLE WALL PERMEABILITY TEST
PERMOMETER METHOD

ASTM D 5084-10

Client	SMITH + GARDNER, INC.	Boring No.	GW-9
Client Project	DURHAM CO. LANDFILL	Depth (ft.)	LIFT 1
Project No.	2015-798-001	Sample No.	LOWER
Lab ID No.	2015-798-001-008		

Test Pressures		Final Sample Dimensions	
Cell Pressure(psi)	60.0	Sample Length (cm), L	4.61
Back Pressure(psi)	50.0	Sample Area (cm^2), A	40.58
Eff. Cons. Pressure(psi)	10.0	Pipette Area (cm^2), a_p	0.03142
Response (%)	97	Annulus Area (cm^2), a_a	0.76712
		Equilibrium Level (cm), R_{eq}	1

AVERAGE PERMEABILITY = 2.5E-07 cm/sec @ 20°C
AVERAGE PERMEABILITY = 2.5E-09 m/sec @ 20°C

DATE			TIME		ELAPSED TIME t	PIPETTE READI NG R_p	INCREMENT GRADIENT i	TEMP.	INCREMENTAL PERMEABILITY @ 20°C
(mm/dd/yy)	(hr)	(min)	(sec)	(min)	(min)	(cm)	(cm/cm)	(°C)	(cm/sec)
11/20/15	13	32	9	32.15	0.000	6.2	14.7	21.7	NA
11/20/15	13	32	28	32.47	0.317	6.1	14.4	21.7	2.7E-07
11/20/15	13	32	49	32.82	0.667	6.0	14.2	21.7	2.5E-07
11/20/15	13	33	10	33.17	1.017	5.9	13.9	21.7	2.5E-07
11/20/15	13	33	32	33.53	1.383	5.8	13.6	21.7	2.5E-07
11/20/15	13	33	55	33.92	1.767	5.7	13.3	21.7	2.4E-07

Tested By: AF Date: 11/19/15 Checked By: GEM Date: 11/23/15

DCN: CT-22A DATE: 2/16/2015 REVISION: 3 GEOTECHNICS 2015-798 SMITH + GARDNER - DURHAM CO LANDFILL\[2015-798-001-008 Permometer.xlsm]Sheet1

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FLEXIBLE WALL PERMEABILITY TEST

PERMOMETER METHOD

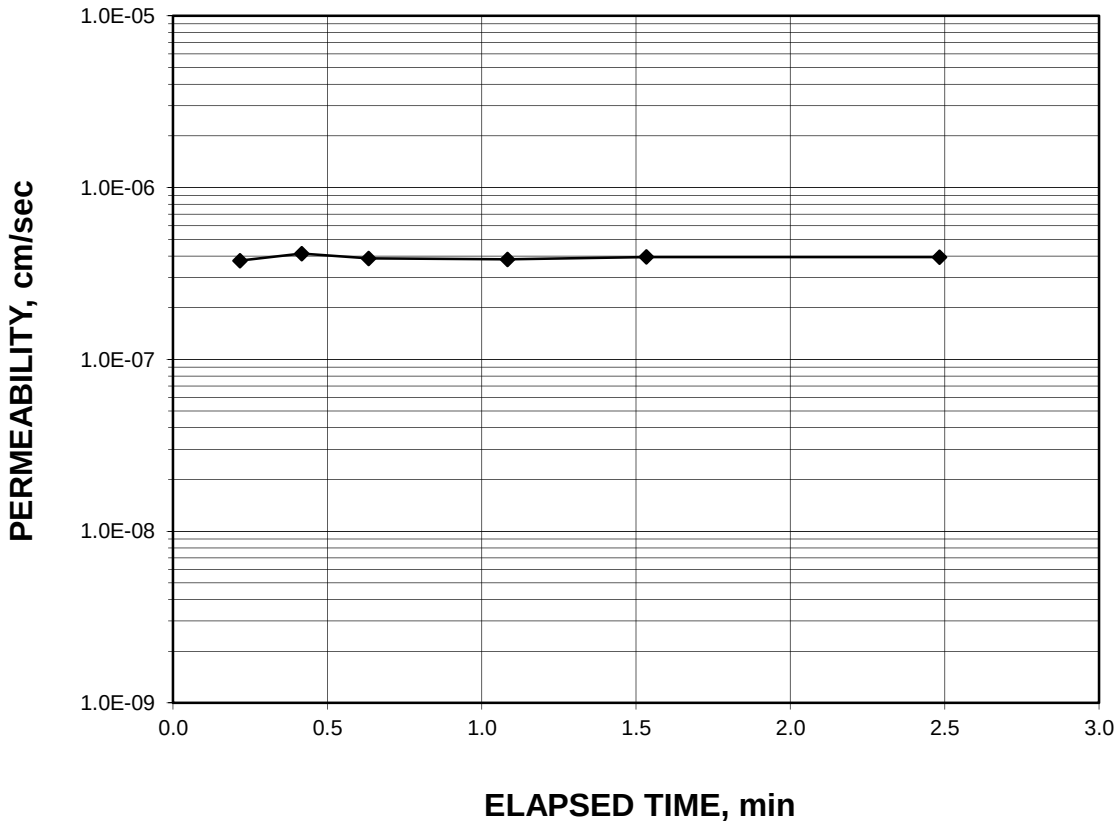
ASTM D 5084-10

Client	SMITH + GARDNER, INC.	Boring No.	GW-10
Client Project	DURHAM CO. LANDFILL	Depth (ft.)	LIFT 2
Project No.	2015-798-001	Sample No.	UPPER
Lab ID No.	2015-798-001-009		

Visual Description: BROWN SANDY CLAY

AVERAGE PERMEABILITY = 3.9E-07 cm/sec @ 20°C
AVERAGE PERMEABILITY = 3.9E-09 m/sec @ 20°C

PERMEABILITY vs. TIME



Tested By: AF Date: 11/19/15 Checked By: GEM Date: 11/23/15

DCN: CT-22A DATE: 02/05/15 PROJECT: 2015-798-001 SMITH + GARDNER - DURHAM CO LANDFILL\[2015-798-001-009 Permometer.xlsm]Sheet1

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FLEXIBLE WALL PERMEABILITY TEST

PERMOMETER METHOD

ASTM D 5084-10

Client	SMITH + GARDNER, INC.	Boring No.	GW-10
Client Project	DURHAM CO. LANDFILL	Depth (ft.)	LIFT 2
Project No.	2015-798-001	Sample No.	UPPER
Lab ID No.	2015-798-001-009		

Specific Gravity	2.70	Assumed
Sample Condition		Undisturbed

Visual Description: BROWN SANDY CLAY

MOISTURE CONTENT:	BEFORE TEST	AFTER TEST
Tare Number	817	808
Wt. of Tare & WS (gm.)	412.75	317.66
Wt. of Tare & DS (gm.)	356.33	273.23
Wt. of Tare (gm.)	134.90	103.25
Wt. of Water (gm.)	56.42	44.43
Wt. of DS (gm.)	221.43	169.98
Moisture Content (%)	**25.5**	**26.1**

SPECIMEN:	BEFORE TEST	AFTER TEST
Wt. of Tube & WS (gm.)	439.80	NA
Wt. of Tube (gm.)	0.00	NA
Wt. of WS (calc.) (gm.)	439.80	442.11
Length 1 (in.)	2.249	2.256
Length 2 (in.)	2.257	2.236
Length 3 (in.)	2.271	2.241
Top Diameter (in.)	2.839	2.850
Middle Diameter (in.)	2.823	2.816
Bottom Diameter (in.)	2.840	2.824
Average Length (in.)	2.26	2.24
Average Area (in.^{2})	6.31	6.29
Sample Volume (cm^3)	233.51	231.34
Unit Wet Wt. (gm./ cm^3)	1.883	1.911
Unit Wet Wt. (pcf)	117.6	119.3
Unit Dry Wt. (pcf)	93.7	94.6
Unit Dry Wt. (gm./ cm^3)	1.501	1.515
Void Ratio, e	0.799	0.782
Porosity, n	0.444	0.439
Pore Volume (cm^3)	103.7	101.5
Total Wt. Of Sample After Test		443.38

Tested By: AF Date: 11/19/15 Checked By: GEM Date: 11/23/15

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FLEXIBLE WALL PERMEABILITY TEST
PERMOMETER METHOD

ASTM D 5084-10

Client	SMITH + GARDNER, INC.	Boring No.	GW-10
Client Project	DURHAM CO. LANDFILL	Depth (ft.)	LIFT 2
Project No.	2015-798-001	Sample No.	UPPER
Lab ID No.	2015-798-001-009		

Test Pressures		Final Sample Dimensions	
Cell Pressure(psi)	60.0	Sample Length (cm), L	5.70
Back Pressure(psi)	50.0	Sample Area (cm^2), A	40.58
Eff. Cons. Pressure(psi)	10.0	Pipette Area (cm^2), a_p	0.03142
Response (%)	95	Annulus Area (cm^2), a_a	0.76712
		Equilibrium Level (cm), R_{eq}	1

AVERAGE PERMEABILITY = 3.9E-07 cm/sec @ 20°C
AVERAGE PERMEABILITY = 3.9E-09 m/sec @ 20°C

DATE			TIME		ELAPSED TIME t	PIPETTE READI NG R_p	INCREMENT GRADIENT i	TEMP.	INCREMENTAL PERMEABILITY @ 20°C
(mm/dd/yy)	(hr)	(min)	(sec)	(min)	(min)	(cm)	(cm/cm)	(°C)	(cm/sec)
11/20/15	13	17	13	17.22	0.000	7.6	15.1	22.3	NA
11/20/15	13	17	26	17.43	0.217	7.5	14.9	22.3	3.8E-07
11/20/15	13	17	38	17.63	0.417	7.4	14.7	22.3	4.1E-07
11/20/15	13	17	51	17.85	0.633	7.3	14.4	22.3	3.9E-07
11/20/15	13	18	18	18.30	1.083	7.1	14.0	22.3	3.8E-07
11/20/15	13	18	45	18.75	1.533	6.9	13.5	22.3	3.9E-07
11/20/15	13	19	42	19.70	2.483	6.5	12.6	22.3	3.9E-07

Tested By: AF Date: 11/19/15 Checked By: GEM Date: 11/23/15

DCN: CT-22A DATE: 2/16/2015 REVISION: 3 G:\2015 PROJECTS\2015-798 SMITH + GARDNER - DURHAM CO LANDFILL\[2015-798-001-009 Permometer.xlsm]Sheet1

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FLEXIBLE WALL PERMEABILITY TEST

PERMOMETER METHOD

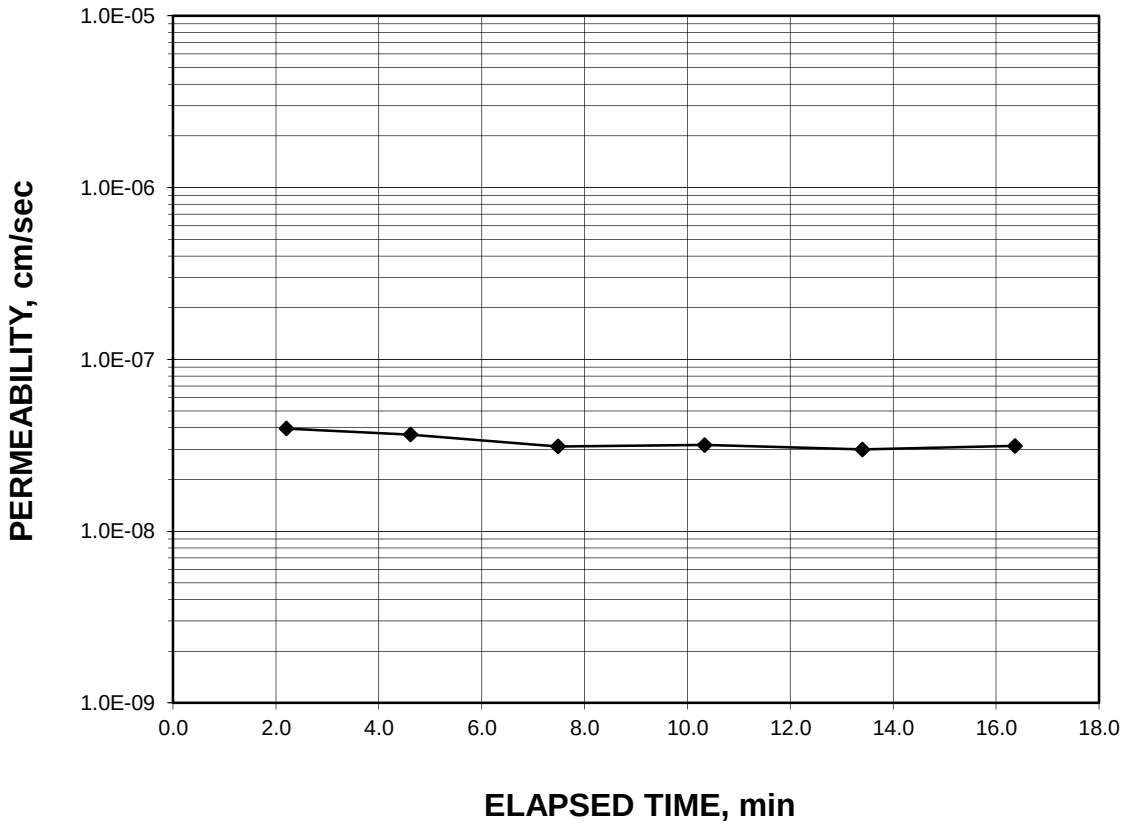
ASTM D 5084-10

Client	SMITH + GARDNER, INC.	Boring No.	GW-10
Client Project	DURHAM CO. LANDFILL	Depth (ft.)	LIFT 1
Project No.	2015-798-001	Sample No.	LOWER
Lab ID No.	2015-798-001-010		

Visual Description: TAN SANDY CLAY

AVERAGE PERMEABILITY = 3.1E-08 cm/sec @ 20°C
AVERAGE PERMEABILITY = 3.1E-10 m/sec @ 20°C

PERMEABILITY vs. TIME



Tested By: AF Date: 11/19/15 Checked By: GEM Date: 11/23/15

DCN: CT-22A DATE: 02/05/08 PROJECT: 2015-798-001 SMITH + GARDNER - DURHAM CO LANDFILL\[2015-798-001-010 Permometer.xlsm]Sheet1

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FLEXIBLE WALL PERMEABILITY TEST

PERMOMETER METHOD

ASTM D 5084-10

Client	SMITH + GARDNER, INC.	Boring No.	GW-10
Client Project	DURHAM CO. LANDFILL	Depth (ft.)	LIFT 1
Project No.	2015-798-001	Sample No.	LOWER
Lab ID No.	2015-798-001-010		

Specific Gravity	2.70	Assumed
Sample Condition		Undisturbed

Visual Description: TAN SANDY CLAY

MOISTURE CONTENT:	BEFORE TEST	AFTER TEST
Tare Number	826	SS-5
Wt. of Tare & WS (gm.)	405.79	407.4
Wt. of Tare & DS (gm.)	358.41	350.62
Wt. of Tare (gm.)	134.23	99.22
Wt. of Water (gm.)	47.38	56.78
Wt. of DS (gm.)	224.18	251.40
Moisture Content (%)	**21.1**	**22.6**

SPECIMEN:	BEFORE TEST	AFTER TEST
Wt. of Tube & WS (gm.)	632.75	NA
Wt. of Tube (gm.)	0.00	NA
Wt. of WS (calc.) (gm.)	632.75	640.33
Length 1 (in.)	2.976	2.977
Length 2 (in.)	2.966	2.929
Length 3 (in.)	2.960	2.940
Top Diameter (in.)	2.858	2.839
Middle Diameter (in.)	2.847	2.855
Bottom Diameter (in.)	2.850	2.846
Average Length (in.)	2.97	2.95
Average Area (in.^{2})	6.39	6.36
Sample Volume (cm^3)	310.57	307.53
Unit Wet Wt. (gm./ cm^3)	2.037	2.082
Unit Wet Wt. (pcf)	127.2	130.0
Unit Dry Wt. (pcf)	105.0	106.0
Unit Dry Wt. (gm./ cm^3)	1.682	1.699
Void Ratio, e	0.605	0.590
Porosity, n	0.377	0.371
Pore Volume (cm^3)	117.1	114.1
Total Wt. Of Sample After Test		634.11

Tested By: AF Date: 11/19/15 Checked By: GEM Date: 11/23/15

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FLEXIBLE WALL PERMEABILITY TEST
PERMOMETER METHOD

ASTM D 5084-10

Client	SMITH + GARDNER, INC.	Boring No.	GW-10
Client Project	DURHAM CO. LANDFILL	Depth (ft.)	LIFT 1
Project No.	2015-798-001	Sample No.	LOWER
Lab ID No.	2015-798-001-010		

Test Pressures		Final Sample Dimensions	
Cell Pressure(psi)	60.0	Sample Length (cm), L	7.49
Back Pressure(psi)	50.0	Sample Area (cm^2), A	41.06
Eff. Cons. Pressure(psi)	10.0	Pipette Area (cm^2), a_p	0.03142
Response (%)	97	Annulus Area (cm^2), a_a	0.76712
		Equilibrium Level (cm), R_{eq}	1

AVERAGE PERMEABILITY = 3.1E-08 cm/sec @ 20°C
AVERAGE PERMEABILITY = 3.1E-10 m/sec @ 20°C

DATE (mm/dd/yy)	TIME (hr)	(min)	(sec)	(min)	ELAPSED TIME t (min)	PIPETTE READING R_p (cm)	INCREMENT GRADIENT i (cm/cm)	TEMP. (°C)	INCREMENTAL PERMEABILITY @ 20°C (cm/sec)
11/20/15	12	40	21	40.35	0.000	9.0	13.9	22.3	NA
11/20/15	12	42	33	42.55	2.200	8.9	13.8	22.3	4.0E-08
11/20/15	12	44	58	44.97	4.617	8.8	13.6	22.3	3.6E-08
11/20/15	12	47	50	47.83	7.483	8.7	13.4	22.3	3.1E-08
11/20/15	12	50	41	50.68	10.333	8.6	13.3	22.3	3.2E-08
11/20/15	12	53	45	53.75	13.400	8.5	13.1	22.3	3.0E-08
11/20/15	12	56	43	56.72	16.367	8.4	12.9	22.3	3.1E-08

Tested By: AF Date: 11/19/15 Checked By: GEM Date: 11/23/15

DCN: CT-22A DATE: 2/16/2015 REVISION: 3 SMITH + GARDNER - DURHAM CO LANDFILL\[2015-798-001-010 Permometer.xlsm]Sheet1

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FLEXIBLE WALL PERMEABILITY TEST

PERMOMETER METHOD

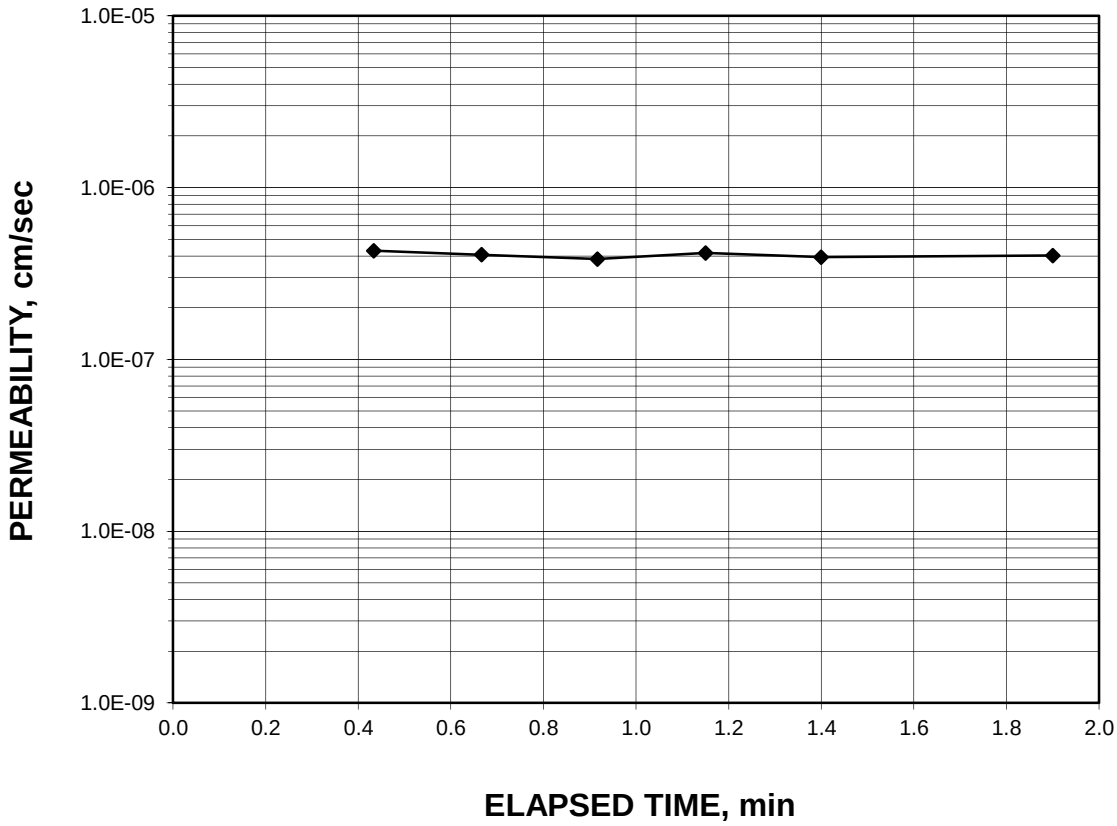
ASTM D 5084-10

Client	SMITH + GARDNER, INC.	Boring No.	GW-11
Client Project	DURHAM CO. LANDFILL	Depth (ft.)	LIFT 2
Project No.	2015-798-001	Sample No.	UPPER
Lab ID No.	2015-798-001-011		

Visual Description: BROWN SANDY CLAY

AVERAGE PERMEABILITY = 4.0E-07 cm/sec @ 20°C
AVERAGE PERMEABILITY = 4.0E-09 m/sec @ 20°C

PERMEABILITY vs. TIME



Tested By: AF Date: 11/19/15 Checked By: GEM Date: 11/23/15

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FLEXIBLE WALL PERMEABILITY TEST

PERMOMETER METHOD

ASTM D 5084-10

Client	SMITH + GARDNER, INC.	Boring No.	GW-11
Client Project	DURHAM CO. LANDFILL	Depth (ft.)	LIFT 2
Project No.	2015-798-001	Sample No.	UPPER
Lab ID No.	2015-798-001-011		

Specific Gravity	2.70	Assumed
Sample Condition		Undisturbed

Visual Description: BROWN SANDY CLAY

MOISTURE CONTENT:	BEFORE TEST	AFTER TEST
Tare Number	808	806
Wt. of Tare & WS (gm.)	365.28	411.05
Wt. of Tare & DS (gm.)	320.83	344.4
Wt. of Tare (gm.)	103.32	100.02
Wt. of Water (gm.)	44.45	66.65
Wt. of DS (gm.)	217.51	244.38
Moisture Content (%)	**20.4**	**27.3**

SPECIMEN:	BEFORE TEST	AFTER TEST
Wt. of Tube & WS (gm.)	615.27	NA
Wt. of Tube (gm.)	0.00	NA
Wt. of WS (calc.) (gm.)	615.27	650.20
Length 1 (in.)	3.147	3.103
Length 2 (in.)	3.141	3.121
Length 3 (in.)	3.147	3.114
Top Diameter (in.)	2.843	2.838
Middle Diameter (in.)	2.834	2.821
Bottom Diameter (in.)	2.825	2.809
Average Length (in.)	3.15	3.11
Average Area (in.^{2})	6.31	6.26
Sample Volume (cm^3)	325.10	319.19
Unit Wet Wt. (gm./ cm^3)	1.893	2.037
Unit Wet Wt. (pcf)	118.1	127.2
Unit Dry Wt. (pcf)	98.1	99.9
Unit Dry Wt. (gm./ cm^3)	1.571	1.601
Void Ratio, e	0.718	0.687
Porosity, n	0.418	0.407
Pore Volume (cm^3)	135.9	130.0
Total Wt. Of Sample After Test		627.37

Tested By: AF Date: 11/19/15 Checked By: GEM Date: 11/23/15

DCN: CT-22A DATE: 2/16/2015 REV: 1 TEMPLATE: 2015-798 SMITH + GARDNER - DURHAM CO LANDFILL\[2015-798-001-011 Permometer.xlsm]Sheet1

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FLEXIBLE WALL PERMEABILITY TEST
PERMOMETER METHOD

ASTM D 5084-10

Client	SMITH + GARDNER, INC.	Boring No.	GW-11
Client Project	DURHAM CO. LANDFILL	Depth (ft.)	LIFT 2
Project No.	2015-798-001	Sample No.	UPPER
Lab ID No.	2015-798-001-011		

Test Pressures		Final Sample Dimensions	
Cell Pressure(psi)	60.0	Sample Length (cm), L	7.91
Back Pressure(psi)	50.0	Sample Area (cm^2), A	40.37
Eff. Cons. Pressure(psi)	10.0	Pipette Area (cm^2), a_p	0.03142
Response (%)	96	Annulus Area (cm^2), a_a	0.76712
		Equilibrium Level (cm), R_{eq}	1

AVERAGE PERMEABILITY = 4.0E-07 cm/sec @ 20°C
AVERAGE PERMEABILITY = 4.0E-09 m/sec @ 20°C

DATE		TIME			ELAPSED TIME t	PIPETTE READI NG R_p	INCREMENT GRADIENT i	TEMP.	INCREMENTAL PERMEABILITY @ 20°C
(mm/dd/yy)	(hr)	(min)	(sec)	(min)	(min)	(cm)	(cm/cm)	(°C)	(cm/sec)
11/20/15	9	59	27	59.45	0.000	9.2	13.5	21.7	NA
11/20/15	9	59	53	59.88	0.433	9.0	13.2	21.7	4.3E-07
11/20/15	10	0	7	0.12	0.667	8.9	13.0	21.7	4.1E-07
11/20/15	10	0	22	0.37	0.917	8.8	12.9	21.7	3.8E-07
11/20/15	10	0	36	0.60	1.150	8.7	12.7	21.7	4.2E-07
11/20/15	10	0	51	0.85	1.400	8.6	12.6	21.7	3.9E-07
11/20/15	10	1	21	1.35	1.900	8.4	12.2	21.7	4.0E-07

Tested By: AF Date: 11/19/15 Checked By: GEM Date: 11/23/15

DCN: CT-22A DATE: 2/16/2015 REVISION: 3 SMITH + GARDNER - DURHAM CO LANDFILL\[2015-798-001-011 Permometer.xlsm]Sheet1

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FLEXIBLE WALL PERMEABILITY TEST

PERMOMETER METHOD

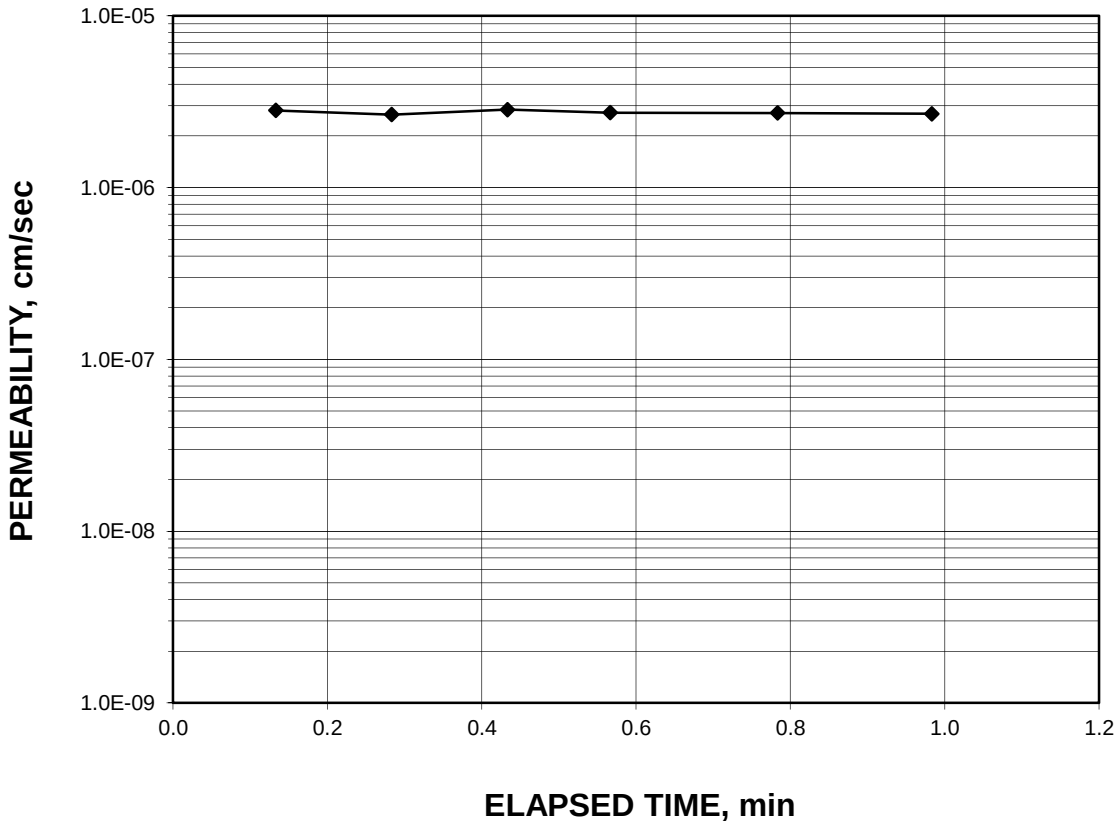
ASTM D 5084-10

Client	SMITH + GARDNER, INC.	Boring No.	GW-11
Client Project	DURHAM CO. LANDFILL	Depth (ft.)	LIFT 1
Project No.	2015-798-001	Sample No.	LOWER
Lab ID No.	2015-798-001-012		

Visual Description: BROWN CLAYEY SAND

AVERAGE PERMEABILITY = 2.7E-06 cm/sec @ 20°C
AVERAGE PERMEABILITY = 2.7E-08 m/sec @ 20°C

PERMEABILITY vs. TIME



Tested By: AF Date: 11/19/15 Checked By: GEM Date: 11/23/15

DCN: CT-22A DATE: 12/15/2015 PROJECT: 2015-798-001 SMITH + GARDNER - DURHAM CO LANDFILL\[2015-798-001-012 Permometer.xlsm]Sheet1

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FLEXIBLE WALL PERMEABILITY TEST

PERMOMETER METHOD

ASTM D 5084-10

Client	SMITH + GARDNER, INC.	Boring No.	GW-11
Client Project	DURHAM CO. LANDFILL	Depth (ft.)	LIFT 1
Project No.	2015-798-001	Sample No.	LOWER
Lab ID No.	2015-798-001-012		

Specific Gravity	2.70	Assumed
Sample Condition		Undisturbed

Visual Description: BROWN CLAYEY SAND

MOISTURE CONTENT:	BEFORE TEST	AFTER TEST
Tare Number	801	800
Wt. of Tare & WS (gm.)	355.52	356.39
Wt. of Tare & DS (gm.)	315.04	307.77
Wt. of Tare (gm.)	97.79	103.12
Wt. of Water (gm.)	40.48	48.62
Wt. of DS (gm.)	217.25	204.65
Moisture Content (%)	**18.6**	**23.8**

SPECIMEN:	BEFORE TEST	AFTER TEST
Wt. of Tube & WS (gm.)	470.27	NA
Wt. of Tube (gm.)	0.00	NA
Wt. of WS (calc.) (gm.)	470.27	490.58
Length 1 (in.)	2.519	2.506
Length 2 (in.)	2.536	2.489
Length 3 (in.)	2.517	2.468
Top Diameter (in.)	2.826	2.774
Middle Diameter (in.)	2.801	2.775
Bottom Diameter (in.)	2.807	2.747
Average Length (in.)	2.52	2.49
Average Area (in.^{2})	6.21	6.01
Sample Volume (cm^3)	256.75	244.84
Unit Wet Wt. (gm./ cm^3)	1.832	2.004
Unit Wet Wt. (pcf)	114.3	125.1
Unit Dry Wt. (pcf)	96.4	101.1
Unit Dry Wt. (gm./ cm^3)	1.544	1.619
Void Ratio, e	0.749	0.668
Porosity, n	0.428	0.400
Pore Volume (cm^3)	109.9	98.0
Total Wt. Of Sample After Test		486.17

Tested By: AF Date: 11/19/15 Checked By: GEM Date: 11/23/15

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FLEXIBLE WALL PERMEABILITY TEST
PERMOMETER METHOD

ASTM D 5084-10

Client	SMITH + GARDNER, INC.	Boring No.	GW-11
Client Project	DURHAM CO. LANDFILL	Depth (ft.)	LIFT 1
Project No.	2015-798-001	Sample No.	LOWER
Lab ID No.	2015-798-001-012		

Test Pressures		Final Sample Dimensions	
Cell Pressure(psi)	60.0	Sample Length (cm), L	6.32
Back Pressure(psi)	50.0	Sample Area (cm^2), A	38.75
Eff. Cons. Pressure(psi)	10.0	Pipette Area (cm^2), a_p	0.03142
Response (%)	97	Annulus Area (cm^2), a_a	0.76712
		Equilibrium Level (cm), R_{eq}	1

AVERAGE PERMEABILITY = 2.7E-06 cm/sec @ 20°C
AVERAGE PERMEABILITY = 2.7E-08 m/sec @ 20°C

DATE		TIME			ELAPSED TIME t	PIPETTE READI NG R_p	INCREMENT GRADIENT i	TEMP.	INCREMENTAL PERMEABILITY @ 20°C
(mm/dd/yy)	(hr)	(min)	(sec)	(min)	(min)	(cm)	(cm/cm)	(°C)	(cm/sec)
11/20/15	12	59	1	59.02	0.000	9.5	17.6	22.3	NA
11/20/15	12	59	9	59.15	0.133	9.0	16.5	22.3	2.8E-06
11/20/15	12	59	18	59.30	0.283	8.5	15.5	22.3	2.7E-06
11/20/15	12	59	27	59.45	0.433	8.0	14.5	22.3	2.8E-06
11/20/15	12	59	35	59.58	0.567	7.6	13.6	22.3	2.7E-06
11/20/15	12	59	48	59.80	0.783	7.0	12.4	22.3	2.7E-06
11/20/15	13	0	0	0.00	0.983	6.5	11.4	22.3	2.7E-06

Tested By: AF Date: 11/19/15 Checked By: GEM Date: 11/23/15

DCN: CT-22A DATE: 2/16/2015 REVISION: 3 SMITH + GARDNER - DURHAM CO LANDFILL\[2015-798-001-012 Permometer.xlsm]Sheet1

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ATTACHMENT E – PRESSURE TESTS

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SMITH+GARDNER

DATE: 3/6/2015
RECORDED BY: Don Misenheimer
JOB NO: BES 14-1
PAGE: 1 of 14

Pressure Test Report

Test Time Calculator: *NOTE - This formula should be used for pipes with nominal diameters from 4" to 30". Consult with pipe/fitting manufacturer if pipe size is outside of this range.*

Time test (*T*) is determined using the following formula from **Section 9.2** of **ASTM standard F 1417 - 92,** and modified for **0.5 psig**, as directed in **Section 9.5** of the standard. Input 1) pipe diameter and 2) length for the section tested in the shaded cells below. For multiple diameters, perform this calculation for each pipe diameter being tested, and take the sum total T.

$$T = (0.085\ DK/Q)/2$$

where:

D =	4	nominal pipe size, inches
L =	140	length of test section, feet
K =	1	0.000419 DL (not less than 1.0)
Q =	0.0015	leak rate in cfm/square feet of internal surface = 0.0015 CFM/SF
T =	113.33	seconds
	1.89	minutes
	0.03	hours

Pressure Test Field Log

Contractor or Company: Biogas Energy

Pipe Line Description: HDPE, 4"
(*material, thickness rating, etc.*)

Section Tested: From: Existing EW-39

To: GW-5

Test Section: Diameter: 4 Length: 140

Test Start Time/Date: 5:30 PM Maximum Start Pressure (psig): 5

Test End Time/Date: 5:35 PM Maximum End Pressure (psig): 5

Total Test Time: 0:05 Total Pressure Drop (psig): 0

Test Result (circle one): Pass (pressure drop less than 0.5 psig)
Fail (pressure drop greater than 0.5 psig)

Leak Location (if Fail):

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SMITH+GARDNER

DATE: 3/9/2015
RECORDED BY: Don Misenheimer
JOB NO: BES 14-1
PAGE: 2 of 14

Pressure Test Report

Test Time Calculator: *NOTE - This formula should be used for pipes with nominal diameters from 4" to 30". Consult with pipe/fitting manufacturer if pipe size is outside of this range.*

Time test (*T*) is determined using the following formula from **Section 9.2** of **ASTM standard F 1417 - 92,** and modified for **0.5 psig**, as directed in **Section 9.5** of the standard. Input 1) pipe diameter and 2) length for the section tested in the shaded cells below. For multiple diameters, perform this calculation for each pipe diameter being tested, and take the sum total T.

$$T = (0.085\ DK/Q)/2$$

where:

D =	4	nominal pipe size, inches
L =	30	length of test section, feet
K =	1	0.000419 DL (not less than 1.0)
Q =	0.0015	leak rate in cfm/square feet of internal surface = 0.0015 CFM/SF
T =	113.33	seconds
	1.89	minutes
	0.03	hours

Pressure Test Field Log

Contractor or Company: Biogas Energy

Pipe Line Description: HDPE, 4"
(*material, thickness rating, etc.*)

Section Tested: From: Existing lateral

To: GW-7

Test Section: Diameter: 4 Length: 30

Test Start Time/Date: 11:46 AM Maximum Start Pressure (psig): 5

Test End Time/Date: 11:50 AM Maximum End Pressure (psig): 5

Total Test Time: 0:04 Total Pressure Drop (psig): 0

Test Result (circle one): Pass (pressure drop less than 0.5 psig)
Fail (pressure drop greater than 0.5 psig)

Leak Location (if Fail):

DocuSign Envelope ID: B6FD1063-E888-4562-9D78-B619BA49FEE3

SMITH+GARDNER

DATE: 3/9/2015
RECORDED BY: Don Misenheimer
JOB NO: BES 14-1
PAGE: 3 of 14

Pressure Test Report

Test Time Calculator: *NOTE - This formula should be used for pipes with nominal diameters from 4" to 30". Consult with pipe/fitting manufacturer if pipe size is outside of this range.*

Time test (*T*) is determined using the following formula from **Section 9.2** of **ASTM standard F 1417 - 92,** and modified for **0.5 psig**, as directed in **Section 9.5** of the standard. Input 1) pipe diameter and 2) length for the section tested in the shaded cells below. For multiple diameters, perform this calculation for each pipe diameter being tested, and take the sum total T.

$$T = (0.085\ DK/Q)/2$$

where:

D =	4	nominal pipe size, inches
L =	150	length of test section, feet
K =	1	0.000419 DL (not less than 1.0)
Q =	0.0015	leak rate in cfm/square feet of internal surface = 0.0015 CFM/SF
T =	**113.33**	**seconds**
	1.89	**minutes**
	0.03	**hours**

Pressure Test Field Log

Contractor or Company: Biogas Energy

Pipe Line Description: HDPE, 4"
(*material, thickness rating, etc.*)

Section Tested: From: Existing lateral

To: GW-2

Test Section: Diameter: 4 Length: 150

Test Start Time/Date: 12:21 AM Maximum Start Pressure (psig): 5

Test End Time/Date: 12:24 AM Maximum End Pressure (psig): 5

Total Test Time: 0:03 Total Pressure Drop (psig): 0

Test Result (circle one): Pass (pressure drop less than 0.5 psig)
Fail (pressure drop greater than 0.5 psig)

Leak Location (if Fail):

DocuSign Envelope ID: B6FD1063-E888-4562-9D78-B619BA49FEE3

SMITH+GARDNER

DATE: 3/10/2015
RECORDED BY: Don Misenheimer
JOB NO: BES 14-1
PAGE: 4 of 14

Pressure Test Report

Test Time Calculator: *NOTE - This formula should be used for pipes with nominal diameters from 4" to 30". Consult with pipe/fitting manufacturer if pipe size is outside of this range.*

Time test (*T*) is determined using the following formula from **Section 9.2** of **ASTM standard F 1417 - 92,** and modified for **0.5 psig**, as directed in **Section 9.5** of the standard. Input 1) pipe diameter and 2) length for the section tested in the shaded cells below. For multiple diameters, perform this calculation for each pipe diameter being tested, and take the sum total T.

$$T = (0.085\ DK/Q)/2$$

where:

D =	4	nominal pipe size, inches
L =	400	length of test section, feet
K =	1	0.000419 DL (not less than 1.0)
Q =	0.0015	leak rate in cfm/square feet of internal surface = 0.0015 CFM/SF
T =	113.33	seconds
	1.89	minutes
	0.03	hours

Pressure Test Field Log

Contractor or Company: Biogas Energy

Pipe Line Description: HDPE, 4"
(*material, thickness rating, etc.*)

Section Tested: From: Existing lateral

To: GW-8 to GW-9

Test Section: Diameter: 4 Length: 400

Test Start Time/Date: 10:25 AM Maximum Start Pressure (psig): 5

Test End Time/Date: 10:28 AM Maximum End Pressure (psig): 5

Total Test Time: 0:03 Total Pressure Drop (psig): 0

Test Result (circle one): Pass (pressure drop less than 0.5 psig)
Fail (pressure drop greater than 0.5 psig)

Leak Location (if Fail):

DocuSign Envelope ID: B6FD1063-E888-4562-9D78-B619BA49FEE3

SMITH+GARDNER

DATE: 3/10/2015
RECORDED BY: Don Misenheimer
JOB NO: BES 14-1
PAGE: 5 of 14

Pressure Test Report

Test Time Calculator: *NOTE - This formula should be used for pipes with nominal diameters from 4" to 30". Consult with pipe/fitting manufacturer if pipe size is outside of this range.*

Time test (*T*) is determined using the following formula from **Section 9.2** of **ASTM standard F 1417 - 92,** and modified for **0.5 psig**, as directed in **Section 9.5** of the standard. Input 1) pipe diameter and 2) length for the section tested in the shaded cells below. For multiple diameters, perform this calculation for each pipe diameter being tested, and take the sum total T.

$$T = (0.085\ DK/Q)/2$$

where:

D =	4	nominal pipe size, inches
L =	120	length of test section, feet
K =	1	0.000419 DL (not less than 1.0)
Q =	0.0015	leak rate in cfm/square feet of internal surface = 0.0015 CFM/SF
T =	113.33	seconds
	1.89	minutes
	0.03	hours

Pressure Test Field Log

Contractor or Company: Biogas Energy

Pipe Line Description: HDPE, 4"
(*material, thickness rating, etc.*)

Section Tested: From: GW-8 lateral

To: GW-10

Test Section: Diameter: 4 Length: 120

Test Start Time/Date: 10:53 AM Maximum Start Pressure (psig): 5

Test End Time/Date: 10:56 AM Maximum End Pressure (psig): 5

Total Test Time: 0:03 Total Pressure Drop (psig): 0

Test Result (circle one): Pass (pressure drop less than 0.5 psig)
Fail (pressure drop greater than 0.5 psig)

Leak Location (if Fail):

DocuSign Envelope ID: B6FD1063-E888-4562-9D78-B619BA49FEE3

SMITH+GARDNER

DATE: 3/10/2015
RECORDED BY: Don Misenheimer
JOB NO: BES 14-1
PAGE: 6 of 14

Pressure Test Report

Test Time Calculator: *NOTE - This formula should be used for pipes with nominal diameters from 4" to 30". Consult with pipe/fitting manufacturer if pipe size is outside of this range.*

Time test (*T*) is determined using the following formula from **Section 9.2** of **ASTM standard F 1417 - 92,** and modified for **0.5 psig**, as directed in **Section 9.5** of the standard. Input 1) pipe diameter and 2) length for the section tested in the shaded cells below. For multiple diameters, perform this calculation for each pipe diameter being tested, and take the sum total T.

$$T = (0.085\ DK/Q)/2$$

where:

D =	4	nominal pipe size, inches
L =	265	length of test section, feet
K =	1	0.000419 DL (not less than 1.0)
Q =	0.0015	leak rate in cfm/square feet of internal surface = 0.0015 CFM/SF
T =	113.33	seconds
	1.89	minutes
	0.03	hours

Pressure Test Field Log

Contractor or Company: Biogas Energy

Pipe Line Description: HDPE, 4"
(*material, thickness rating, etc.*)

Section Tested: From: Existing lateral

To: GW-4 to GW-6

Test Section: Diameter: 4 Length: 265

Test Start Time/Date: 11:56 AM Maximum Start Pressure (psig): 5

Test End Time/Date: 11:59 AM Maximum End Pressure (psig): 5

Total Test Time: 0:03 Total Pressure Drop (psig): 0

Test Result (circle one): Pass (pressure drop less than 0.5 psig)
Fail (pressure drop greater than 0.5 psig)

Leak Location (if Fail):

DocuSign Envelope ID: B6FD1063-E888-4562-9D78-B619BA49FEE3

SMITH+GARDNER

DATE: 3/12/2015
RECORDED BY: Don Misenheimer
JOB NO: BES 14-1
PAGE: 7 of 14

Pressure Test Report

Test Time Calculator: *NOTE - This formula should be used for pipes with nominal diameters from 4" to 30". Consult with pipe/fitting manufacturer if pipe size is outside of this range.*

Time test (*T*) is determined using the following formula from **Section 9.2** of **ASTM standard F 1417 - 92,** and modified for **0.5 psig**, as directed in **Section 9.5** of the standard. Input 1) pipe diameter and 2) length for the section tested in the shaded cells below. For multiple diameters, perform this calculation for each pipe diameter being tested, and take the sum total T.

$$T = (0.085\ DK/Q)/2$$

where:

D =	4	nominal pipe size, inches
L =	140	length of test section, feet
K =	1	0.000419 DL (not less than 1.0)
Q =	0.0015	leak rate in cfm/square feet of internal surface = 0.0015 CFM/SF
T =	113.33	seconds
	1.89	minutes
	0.03	hours

Pressure Test Field Log

Contractor or Company: Biogas Energy

Pipe Line Description: HDPE, 4"
(*material, thickness rating, etc.*)

Section Tested: From: Existing lateral

To: GW-11

Test Section: Diameter: 4 Length: 140

Test Start Time/Date: 9:11 AM Maximum Start Pressure (psig): 5

Test End Time/Date: 9:14 AM Maximum End Pressure (psig): 5

Total Test Time: 0:03 Total Pressure Drop (psig): 0

Test Result (circle one): Pass (pressure drop less than 0.5 psig)
Fail (pressure drop greater than 0.5 psig)

Leak Location (if Fail):

DocuSign Envelope ID: B6FD1063-E888-4562-9D78-B619BA49FEE3

SMITH+GARDNER

DATE: 3/12/2015
RECORDED BY: Don Misenheimer
JOB NO: BES 14-1
PAGE: 8 of 14

Pressure Test Report

Test Time Calculator: *NOTE - This formula should be used for pipes with nominal diameters from 4" to 30". Consult with pipe/fitting manufacturer if pipe size is outside of this range.*

Time test (*T*) is determined using the following formula from **Section 9.2** of **ASTM standard F 1417 - 92,** and modified for **0.5 psig**, as directed in **Section 9.5** of the standard. Input 1) pipe diameter and 2) length for the section tested in the shaded cells below. For multiple diameters, perform this calculation for each pipe diameter being tested, and take the sum total T.

$$T = (0.085\ DK/Q)/2$$

where:

D =	4	nominal pipe size, inches
L =	110	length of test section, feet
K =	1	0.000419 DL (not less than 1.0)
Q =	0.0015	leak rate in cfm/square feet of internal surface = 0.0015 CFM/SF
T =	113.33	seconds
	1.89	minutes
	0.03	hours

Pressure Test Field Log

Contractor or Company: Biogas Energy

Pipe Line Description: HDPE, 4"
(*material, thickness rating, etc.*)

Section Tested: From: Existing lateral

To: EW-22R

Test Section: Diameter: 4 Length: 110

Test Start Time/Date: 2:20 PM Maximum Start Pressure (psig): 5

Test End Time/Date: 2:23 PM Maximum End Pressure (psig): 5

Total Test Time: 0:03 Total Pressure Drop (psig): 0

Test Result (circle one): Pass (pressure drop less than 0.5 psig)
Fail (pressure drop greater than 0.5 psig)

Leak Location (if Fail):

DocuSign Envelope ID: B6FD1063-E888-4562-9D78-B619BA49FEE3

SMITH+GARDNER

DATE: 3/12/2015
RECORDED BY: Don Misenheimer
JOB NO: BES 14-1
PAGE: 9 of 14

Pressure Test Report

Test Time Calculator: *NOTE - This formula should be used for pipes with nominal diameters from 4" to 30". Consult with pipe/fitting manufacturer if pipe size is outside of this range.*

Time test (*T*) is determined using the following formula from **Section 9.2** of **ASTM standard F 1417 - 92,** and modified for **0.5 psig**, as directed in **Section 9.5** of the standard. Input 1) pipe diameter and 2) length for the section tested in the shaded cells below. For multiple diameters, perform this calculation for each pipe diameter being tested, and take the sum total T.

$$T = (0.085\ DK/Q)/2$$

where:

D =	4	nominal pipe size, inches
L =	30	length of test section, feet
K =	1	0.000419 DL (not less than 1.0)
Q =	0.0015	leak rate in cfm/square feet of internal surface = 0.0015 CFM/SF
T =	**113.33**	**seconds**
	1.89	**minutes**
	0.03	**hours**

Pressure Test Field Log

Contractor or Company: Biogas Energy

Pipe Line Description: HDPE, 4"
(*material, thickness rating, etc.*)

Section Tested: From: Existing lateral

To: GW-12

Test Section: Diameter: 4 Length: 30

Test Start Time/Date: 2:01 PM Maximum Start Pressure (psig): 5

Test End Time/Date: 2:04 PM Maximum End Pressure (psig): 5

Total Test Time: 0:03 Total Pressure Drop (psig): 0

Test Result (circle one): Pass (pressure drop less than 0.5 psig)
Fail (pressure drop greater than 0.5 psig)

Leak Location (if Fail):

DocuSign Envelope ID: B6FD1063-E888-4562-9D78-B619BA49FEE3

SMITH+GARDNER

DATE: 3/12/2015
RECORDED BY: Don Misenheimer
JOB NO: BES 14-1
PAGE: 10 of 14

Pressure Test Report

Test Time Calculator: *NOTE - This formula should be used for pipes with nominal diameters from 4" to 30". Consult with pipe/fitting manufacturer if pipe size is outside of this range.*

Time test (*T*) is determined using the following formula from **Section 9.2** of **ASTM standard F 1417 - 92,** and modified for **0.5 psig**, as directed in **Section 9.5** of the standard. Input 1) pipe diameter and 2) length for the section tested in the shaded cells below. For multiple diameters, perform this calculation for each pipe diameter being tested, and take the sum total T.

$$T = (0.085\ DK/Q)/2$$

where:

D =	4	nominal pipe size, inches
L =	20	length of test section, feet
K =	1	0.000419 DL (not less than 1.0)
Q =	0.0015	leak rate in cfm/square feet of internal surface = 0.0015 CFM/SF
T =	113.33	seconds
	1.89	minutes
	0.03	hours

Pressure Test Field Log

Contractor or Company: Biogas Energy

Pipe Line Description: HDPE, 4"
(*material, thickness rating, etc.*)

Section Tested: From: Existing lateral

To: GW-13

Test Section: Diameter: 4 Length: 20

Test Start Time/Date: 2:47 PM Maximum Start Pressure (psig): 5

Test End Time/Date: 2:50 PM Maximum End Pressure (psig): 5

Total Test Time: 0:03 Total Pressure Drop (psig): 0

Test Result (circle one): Pass (pressure drop less than 0.5 psig)
Fail (pressure drop greater than 0.5 psig)

Leak Location (if Fail):

DocuSign Envelope ID: B6FD1063-E888-4562-9D78-B619BA49FEE3

SMITH+GARDNER

DATE: 3/12/2015
RECORDED BY: Don Misenheimer
JOB NO: BES 14-1
PAGE: 11 of 14

Pressure Test Report

Test Time Calculator: *NOTE - This formula should be used for pipes with nominal diameters from 4" to 30". Consult with pipe/fitting manufacturer if pipe size is outside of this range.*

Time test (*T*) is determined using the following formula from **Section 9.2** of **ASTM standard F 1417 - 92,** and modified for **0.5 psig**, as directed in **Section 9.5** of the standard. Input 1) pipe diameter and 2) length for the section tested in the shaded cells below. For multiple diameters, perform this calculation for each pipe diameter being tested, and take the sum total T.

$$T = (0.085\ DK/Q)/2$$

where:

D =	4	nominal pipe size, inches
L =	55	length of test section, feet
K =	1	0.000419 DL (not less than 1.0)
Q =	0.0015	leak rate in cfm/square feet of internal surface = 0.0015 CFM/SF
T =	**113.33**	**seconds**
	1.89	**minutes**
	0.03	**hours**

Pressure Test Field Log

Contractor or Company: Biogas Energy

Pipe Line Description: HDPE, 4"
(*material, thickness rating, etc.*)

Section Tested: From: Existing lateral

To: GW-14

Test Section: Diameter: 4 Length: 55

Test Start Time/Date: 4:54 PM Maximum Start Pressure (psig): 5

Test End Time/Date: 5:00 PM Maximum End Pressure (psig): 5

Total Test Time: 0:06 Total Pressure Drop (psig): 0

Test Result (circle one): Pass (pressure drop less than 0.5 psig)
Fail (pressure drop greater than 0.5 psig)

Leak Location (if Fail):

DocuSign Envelope ID: B6FD1063-E888-4562-9D78-B619BA49FEE3

SMITH+GARDNER

DATE: 3/12/2015
RECORDED BY: Don Misenheimer
JOB NO: BES 14-1
PAGE: 12 of 14

Pressure Test Report

Test Time Calculator: *NOTE - This formula should be used for pipes with nominal diameters from 4" to 30". Consult with pipe/fitting manufacturer if pipe size is outside of this range.*

Time test (*T*) is determined using the following formula from **Section 9.2** of **ASTM standard F 1417 - 92,** and modified for **0.5 psig**, as directed in **Section 9.5** of the standard. Input 1) pipe diameter and 2) length for the section tested in the shaded cells below. For multiple diameters, perform this calculation for each pipe diameter being tested, and take the sum total T.

$$T = (0.085\ DK/Q)/2$$

where:

D =	4	nominal pipe size, inches
L =	20	length of test section, feet
K =	1	0.000419 DL (not less than 1.0)
Q =	0.0015	leak rate in cfm/square feet of internal surface = 0.0015 CFM/SF
T =	**113.33**	**seconds**
	1.89	**minutes**
	0.03	**hours**

Pressure Test Field Log

Contractor or Company: Biogas Energy

Pipe Line Description: HDPE, 4"
(*material, thickness rating, etc.*)

Section Tested: From: Existing lateral

To: GW-15

Test Section: Diameter: 4 Length: 20

Test Start Time/Date: 5:39 PM Maximum Start Pressure (psig): 5

Test End Time/Date: 5:43 PM Maximum End Pressure (psig): 5

Total Test Time: 0:04 Total Pressure Drop (psig): 0

Test Result (circle one): Pass (pressure drop less than 0.5 psig)
Fail (pressure drop greater than 0.5 psig)

Leak Location (if Fail):

DocuSign Envelope ID: B6FD1063-E888-4562-9D78-B619BA49FEE3

SMITH+GARDNER

DATE: 3/18/2015
RECORDED BY: Don Misenheimer
JOB NO: BES 14-1
PAGE: 13 of 14

Pressure Test Report

Test Time Calculator: *NOTE - This formula should be used for pipes with nominal diameters from 4" to 30". Consult with pipe/fitting manufacturer if pipe size is outside of this range.*

Time test (*T*) is determined using the following formula from **Section 9.2** of **ASTM standard F 1417 - 92,** and modified for **0.5 psig**, as directed in **Section 9.5** of the standard. Input 1) pipe diameter and 2) length for the section tested in the shaded cells below. For multiple diameters, perform this calculation for each pipe diameter being tested, and take the sum total T.

$$T = (0.085\ DK/Q)/2$$

where:

D =	4	nominal pipe size, inches
L =	286	length of test section, feet
K =	1	0.000419 DL (not less than 1.0)
Q =	0.0015	leak rate in cfm/square feet of internal surface = 0.0015 CFM/SF
T =	**113.33**	**seconds**
	1.89	**minutes**
	0.03	**hours**

Pressure Test Field Log

Contractor or Company: Biogas Energy

Pipe Line Description: HDPE, 4"
(*material, thickness rating, etc.*)

Section Tested: From: Existing Well EW-30

To: GW-1 to GW-3

Test Section: Diameter: 4 Length: 286

Test Start Time/Date: 10:23 AM Maximum Start Pressure (psig): 5

Test End Time/Date: 10:26 AM Maximum End Pressure (psig): 5

Total Test Time: 0:03 Total Pressure Drop (psig): 0

Test Result (circle one): Pass (pressure drop less than 0.5 psig)
Fail (pressure drop greater than 0.5 psig)

Leak Location (if Fail):

DocuSign Envelope ID: B6FD1063-E888-4562-9D78-B619BA49FEE3

SMITH+GARDNER

DATE: 3/18/2015
RECORDED BY: Don Misenheimer
JOB NO: BES 14-1
PAGE: 14 of 14

Pressure Test Report

Test Time Calculator: *NOTE - This formula should be used for pipes with nominal diameters from 4" to 30". Consult with pipe/fitting manufacturer if pipe size is outside of this range.*

Time test (*T*) is determined using the following formula from **Section 9.2** of **ASTM standard F 1417 - 92,** and modified for **0.5 psig**, as directed in **Section 9.5** of the standard. Input 1) pipe diameter and 2) length for the section tested in the shaded cells below. For multiple diameters, perform this calculation for each pipe diameter being tested, and take the sum total T.

$$T = (0.085\ DK/Q)/2$$

where:

D =	4	nominal pipe size, inches
L =	155	length of test section, feet
K =	1	0.000419 DL (not less than 1.0)
Q =	0.0015	leak rate in cfm/square feet of internal surface = 0.0015 CFM/SF
T =	**113.33**	**seconds**
	1.89	**minutes**
	0.03	**hours**

Pressure Test Field Log

Contractor or Company: Biogas Energy

Pipe Line Description: HDPE, 4"
(*material, thickness rating, etc.*)

Section Tested: From: Existing lateral

To: GW-16

Test Section: Diameter: 4 Length: 155

Test Start Time/Date: 4:20 PM Maximum Start Pressure (psig): 5

Test End Time/Date: 4:24 PM Maximum End Pressure (psig): 5

Total Test Time: 0:04 Total Pressure Drop (psig): 0

Test Result (circle one): Pass (pressure drop less than 0.5 psig)
Fail (pressure drop greater than 0.5 psig)

Leak Location (if Fail):

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ATTACHMENT F – APPROVED ASBESTOS WORKPLAN

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SMITH+GARDNER
ENGINEERS

ADDRESS 14 N. Boylan Avenue, Raleigh NC 27603
TEL 919.828.0577
WEB www.smithgardnerinc.com

November 7, 2014

Mr. Jeff Dellinger
Industrial Hygiene Consultant
Health Hazards Control Unit
NC DHHS/Division of Public Health
2nd Floor, Room D-1
5505 Six Forks Road
Raleigh, North Carolina 27609

RE: Potential Contact with Asbestos-Contaminated Waste
Landfill Gas Collection System Expansion 2014 – City of Durham Landfill
Durham, North Carolina

Dear Mr. Dellinger:

On behalf of MP Durham, LLC, Smith Gardner, Inc. (S+G), has prepared the **attached** Asbestos Work Plan for above mentioned project. This letter serves as notification of potential uncovering of asbestos-contaminated waste during the proposed expansion of the existing Landfill Gas Collection System. This work will be performed with S+G as the project Engineer. The project will take place at the City of Durham Landfill in Durham, North Carolina located on at 2115 E. Club Boulevard. The project is tentatively scheduled to begin November 2014, for completion by the end of the year.

A Site Plan, including areas of the system expansion, is included in the Asbestos Work Plan.

lease contact us at (919) 828-0577 or by e-mail (below) if you have any questions or require any additional information.

Sincerely,
SMITH GARDNER, INC.

Carter T. Shore, E.I.
Staff Engineer
carter@smithgardnerinc.com

Stacey A. Smith, P.E.
Senior Engineer
stacey@smithgardnerinc.com

Attachments

cc: Don M. Misenheimer, AAI, S+G
Bob Gettys, MP Durham, LLC
Steve Laliberty, BES CH4
file

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DocuSign Envelope ID: B6FD1063-E888-4562-9D78-B619BA49FEE3

SMITH+GARDNER

Matt Lamb <matt@smithgardnerinc.com>

Fwd: MP Wayne, LLC/MP Durham, LLC Asbestos Work Plans review

1 message

Matt Lamb <matt@smithgardnerinc.com> Fri, Mar 11, 2016 at 8:23 AM
To: Don Misenheimer <don@smithgardnerinc.com>, Stacey Smith <stacey@smithgardnerinc.com>

Email approval dated December 10, 2014 at 5:15pm

Matt S. Lamb

Senior Scientist

SMITH + GARDNER

14 N. Boylan Avenue

Raleigh, NC 27603

P (919) **828.0577 x121**

F (919) **828.3899**

C (919) **801.3548**

---------- Forwarded message ----------
From: **Matt Lamb** <matt@smithgardnerinc.com>
Date: Wed, Dec 10, 2014 at 5:43 PM
Subject: Fwd: MP Wayne, LLC/MP Durham, LLC Asbestos Work Plans review
To: Don Misenheimer <don@smithgardnerinc.com>, Stacey Smith <stacey@smithgardnerinc.com>, Bob Gettys <bgettys@besch4.com>, Ryan Hennessy <RHennessy@besch4.com>, Ryan Hennessy <hennessygenerator@gmail.com>, Steve Laliberty <SLaliberty@besch4.com>

Gentlemen, based on Jeff Dellinger's email reply in this thread, there are only minor questions regarding the asbestos work plans at Wayne and Durham. He has given approval via this email to commence work.

Please let me know if you have questions.

Thanks

Matt S. Lamb

Senior Scientist

SMITH + GARDNER

14 N. Boylan Avenue

Raleigh, NC 27603

P (919) **828.0577 x121**

F (919) **828.3899**

C (919) **801.3548**

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---------- Forwarded message ----------
From: **Dellinger, Jeff** <jeff.dellinger@dhhs.nc.gov>
Date: Wed, Dec 10, 2014 at 5:15 PM
Subject: RE: MP Wayne, LLC/MP Durham, LLC Asbestos Work Plans review
To: Matt Lamb <matt@smithgardnerinc.com>

Hey Wayne,

Sorry for the delay. I got behind.

Regarding the Wayne County and Durham County projects.

I do have a couple of questions but consider them minor and we can clarify them by phone later.

Use this email as a reference that I have read both of the plans and have no major concerns.

So, start your projects.

Thanks for your patience.

jeff

From: Matt Lamb [matt@smithgardnerinc.com]
Sent: Wednesday, December 10, 2014 10:02 AM
To: Dellinger, Jeff; Don Misenheimer
Subject: Re: MP Wayne, LLC/MP Durham, LLC Asbestos Work Plans review

Jeff:

I hoe your training went well. I didn't see any comments back from you last Friday as you had indicated. I just wanted to make sure I didn't miss those. We are very anxious to begin work.

Thank you.

On Tue, Dec 2, 2014 at 4:28 PM, Dellinger, Jeff <jeff.dellinger@dhhs.nc.gov> wrote:

> Hey Matt,
>
> I'll finish my review and will get with you this week.
>
> Thanks,

jeff

Jeffery W. Dellinger

Industrial Hygiene Consultant Supervisor

N.C. Department of Health and Human Services

Industrial Hygiene Consultant, OEEB-Division of Public Health

5505 Six Forks Road

Raleigh, NC 27609

(Office) 919 - 707-5972

(Fax) 919 - 870-4808

jeff.dellinger@dhhs.nc.gov

http://epi.publichealth.nc.gov/asbestos/ahmp.html

-

http://epi.publichealth.nc.gov/lead/lhmp.html

-

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From: Matt Lamb [mailto:matt@smithgardnerinc.com]
Sent: Tuesday, December 02, 2014 2:26 PM
To: Dellinger, Jeff
Cc: stacey@smithgardnerinc.com; Don Misenheimer
Subject: MP Wayne, LLC/MP Durham, LLC Asbestos Work Plans review

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Jeff:

I understand you're in training this week, but I wanted to check and see how the review for the asbestos work plans are coming. These are for the Methane Power sites at the Wayne Co. Landfill and the City of Durham Landfill. Please let me know when you think you want to go over any comments or questions you may have.

Thanks

Matt Lamb

Sr. Scientist

SMITH + GARDNER

14 N. Boylan Avenue

Raleigh, NC 27603

P (919) **828.0577**
F (919) **828.3899**
C (919) **801.3548**

--

Matt
S. Lamb
Senior Scientist

SMITH
+
GARDNER

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Asbestos Work Plan

Landfill Gas Collection System Expansion 2014
City of Durham Landfill
(Solid Waste Permit No. 3201-MSWLF-1979)

Prepared for:

MP Durham, LLC
2115 E. Club Boulevard
Durham, North Carolina

November 2014

Prepared by:

NC LIC. NO. C-0828 (ENGINEERING)

SMITH+GARDNER

14 N. Boylan Avenue, Raleigh NC 27603 | 919.828.0577

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Asbestos Work Plan

City of Durham Landfill
(Solid Waste Permit No. 3201-MSWLF-1979)

Prepared For:
MP Durham, LLC
Durham, North Carolina

BES biogas energy solutions CH4POWER smart energy

S+G Project No. BES-14-1

Carter T. Shore, E.I.
Staff Engineer

Stacey A. Smith, P.E.
Senior Engineer

NORTH CAROLINA PROFESSIONAL SEAL 023002 ENGINEER STACEY A. SMITH

10.7.14

November 2014

NC LIC. NO. C-0828 (ENGINEERING)

SMITH+GARDNER

14 N. Boylan Avenue, Raleigh NC 27603 | 919.828.0577

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Landfill Gas Collection System Expansion 2014
City of Durham Landfill
(Solid Waste Permit No. 3201-MSWLF-1979)

Asbestos Work Plan

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1.0 OVERVIEW

This asbestos work plan (Plan) is written for work proposed within the City of Durham Landfill located in Durham, NC. This document is intended to provide direction for the Contractor involved in waste disturbing activities in areas with known or suspected asbestos-contaminated waste, or where asbestos contaminated waste is discovered. This document is meant to assist in compliance with Federal NESHAP regulations as administered by the State of North Carolina. This document is not intended to take the place of any regulations or the Contractor's responsibility of his employees, subcontractors, or agents. It is critical that the Contractor realize the context of the subject matter by being familiar with the current regulations.

Landfill sites permitted to accept asbestos waste or other sites where it is unknown if indiscriminate dumping of asbestos waste has taken place should be approached with caution when planning any subsurface investigations within the waste units. Encountering asbestos during drilling and digging/trenching should be anticipated.

In the absence of adequate records to demonstrate that no asbestos is present in the project areas, this plan should be followed and a copy of this plan kept in the active work area.

> *SAFETY NOTE:*
> *The Contractor shall be solely responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the Work. The Contractor shall comply with all applicable Laws and Regulations relating to the safety of persons or property, or to the protection of persons or property from damage, injury, or loss; and shall erect and maintain all necessary safeguards for such safety and protection.*

This project shall consist of the installation of new landfill gas (LFG) extraction wells. The installation will consist of 19 new LFG extraction wells and the re-drilling of one (1) extraction well. All bore holes will be approximately 36 inches in diameter. Associated trenching (approximately 2850 feet total) is also planned through the course of this project. The project description and activities are discussed further in **Section 5.0**.

2.0 DEFINITIONS

As used herein, the following terms are defined:

2.1 Adequately Wet (40 CFR §61.141)

To sufficiently mix or penetrate with water to prevent the release of particulates. If visible emissions are observed coming from asbestos-containing material, then that material has not been adequately wetted and represents an EPA NESHAP Violation.

2.2 Asbestos (40 CFR §61.141)

The asbestiform varieties of serpentinite (chrysotile), riebeckite (crocidolite), cummingtonite-grunerite, anthophyllite, amosite, and actinolite-tremolite.

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2.3 Asbestos Waste Disposal Area

Approved area for the disposal of asbestos waste at a solid waste facility.

2.4 Friable Asbestos-Containing Material (ACM)

Any material containing more than one percent (1%) asbestos as determined using the method specified in Appendix A, Subpart F, 40 CFR Part 763, Section 1, Polarized Light Microscopy (PLM), that, when dry, can be crumbled, pulverized, or reduced to powder by hand pressure. (Sec. 61.141). Friable ACM readily releases asbestos fibers into the air when damaged or disturbed.

2.5 Non-Friable (US EPA, Region 4 - Asbestos Enforcement Bulletin, June 2003)

ACM which cannot be crumbled, pulverized, or reduced to powder by hand pressure. Non-friable ACM would NOT readily release fibers into the air unless the material was severely damaged.

2.6 Regulated Asbestos-Containing Material (RACM)

Per 40 CFR 61 Subpart M § 61.141 - Definitions, the following are regulated asbestos containing materials (RACM) categories: (a) friable asbestos material, (b) Category I non-friable ACM that has become friable, (c) Category I non-friable ACM that will be or has been subjected to sanding, grinding, cutting, or abrading, or (d) Category II non-friable ACM that has a high probability of becoming or has become crumbled, pulverized, or reduced to powder by the forces expected to act on the material in the course of demolition or renovation operations.

2.7 Accredited Asbestos Supervisor (AAS)

A person who, **at a minimum**, has completed a five (5) day asbestos abatement contractor/supervisor training course as outlined in the EPA's Asbestos Model Accreditation Plan (40 CFR §763, Subpart E, App. C (B)(2)). Full accreditation **is required** for this position.

2.8 Trained Asbestos Supervisor (TAS)

A person who, **at a minimum**, has completed a five (5) day asbestos abatement contractor/supervisor training course as outlined in the EPA's Asbestos Model Accreditation Plan (40 CFR §763, Subpart E, App. C (B)(2)). Full accreditation is not required for this position.

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2.9 Accredited Asbestos Inspector (AAI)

A person who, **at a minimum**, is a NC Accredited Asbestos Inspector as outlined in the EPA's Asbestos Model Accreditation Plan (40 CFR §763, Subpart E, App. C (B)(3)). Full accreditation **is required** for this position.

3.0 REGULATIONS

3.1 Abbreviations

NESHAP	National Emissions Standards for Hazardous Air Pollutants
OSHA	Occupational Safety and Health Administration

3.2 Potential Asbestos-Contaminated Waste

The following regulation shall be followed before digging/drilling begins on a project with **potential** for asbestos-contaminated waste:

Regulation	Citation
NESHAP	40 CFR §61.151 (d)

Notification requirements are described in **Section 4.0**.

3.3 Identified Asbestos-Contaminated Waste

The following regulations, **at a minimum**, should be followed **if** asbestos-contaminated waste is identified. Any asbestos-contaminated waste identified should be treated as if it were new asbestos waste entering the landfill and existing procedures for handling, transporting, and disposal in an asbestos waste disposal area should be followed, as required by the following rules:

Regulation	Citation
NESHAP	40 CFR §61
NC General Statutes	NC GS §130A, Article 19
NC Solid Waste Rules	15A NCAC 13B .0505 11(d)
NC Solid Waste Rules	15A NCAC 13B .1626 1(d)
OSHA	29 CFR 1926.1101
OSHA	29 CFR 1910.120

4.0 NOTIFICATION

In accordance with 40 CFR §61.151 (d) and 40 CFR §61.154 (j), the following State agency (NESHAP Administrator) will be notified with a formal notification form (permit) before digging begins on a project with the **potential** for encountering asbestos-contaminated waste:

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Health Hazards Control Unit
NC DHHS/Division of Public Health
2nd Floor, Room D-1
5505 Six Forks Road
Raleigh, NC 27609-3806
Attn: Mr. Jeffery W. Dellinger, Industrial Hygiene Consultant
Telephone: 919-707-5950
Fax: 919-870-4808

At a minimum, this notification shall include the following:

1. Scheduled starting and completion date.
2. Reason for disturbing the waste.
3. Procedures to be used to control emissions during the excavation, storage, transport, and ultimate disposal of the excavated potential asbestos-containing material. If deemed necessary, the Administrator may require changes in the emission control procedures to be used.
4. Location of any temporary storage site and the final disposal site.
5. Site Plan.

The NESHAP Administrator shall be notified in writing at least 45 days prior to the start of work on this project.

5.0 PROJECT ACTIVITIES

This project is proposed to take place at the City of Durham Landfill, as shown on **Figure 1** and shall consist of the installation of new landfill gas (LFG) extraction wells and the re-drilling of a LFG extraction well and associated trenching. The installation will connsisti of 19 new LFG extraction wells and the re-drilling of one (1) LFG extraction well. All bore holes will be approximately 36 inches in diameter.

Associated trenching (approximately 2850 feet total) is also planned through the course of this project. Trenching in these areas will be will be approximately three (3) feet wide and up to four (4) feet deep in most locations. The approximate locations of the proposed LFG extraction wells, leachate collection system, and associated trenching are shown on **Figure 2.** Select details for LFG extraction wells and trenching are shown on **Figure 3.**

This project is tentatively scheduled to begin November 2014, for completion by the end of the year.

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5.1 Involved Parties

The parties involved are as follows:

Owner:
City of Durham Landfill
c/o Department of Water Management
1600 Mist Lake Drive, Durham, NC 27704
Contact: Mr. Simon Lobdell, P.E., C.E. III, City of Durham
Phone: (919) 560-4381 x 35201
Email: simon.lobdell@durhamnc.gov

Developer/Contractor:
Biogas Energy Solutions, LLC
40 Tower Ln #46, Avon, CT 06001
Contact: Mr.Steve Laliberty
Phone: (860) 678-7537
Email: slaliberty@besch4.com

Engineers/Construction Quality Assurance:
Smith Gardner, Inc.
14 N. Boylan Avenue, Raleigh, NC 27603
Contact: Mr. Don Misenheimer, AAI
Phone: 919-828-0577 x 224
Email: don@smithgardnerinc.com

5.2 Work Area Setup and Maintenance

It is required to have at least one (1) TAS in the immediate vicinity of the waste excavation to oversee the work area setup and maintenance. The TAS shall setup the work area such that the operator, his/her employees, and the public are protected while disturbing potential asbestos containing waste throughout the process until disposal of all asbestos waste has been completed, as follows:

- The work area shall be restricted from the public at a minimum of 50 feet and shall include adequate fencing and signage to delineate the disturbance area. This fencing shall be orange safety fencing. Signage shall be in accordance the OSHA Asbestos in Construction Standard 1926.1101 and the contractor shall adhere to the signage requirements for asbestos (presumed or otherwise) as referenced in the OSHA regulation. The fencing shall enclose enough area to adequately allow for project activities.

- The TAS is responsible for determining the locations of any covered containers, inside the fencing, that may be used to hold potential asbestos containing waste materials. These containers should also have signage stating "Potential Asbestos Containing Material--Authorized Personnel Only."

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5.3 Inspection of Excavated Waste

As waste is excavated from the well or trench, it will be placed adjacent to the excavation location. An AAI shall observe the waste for signs of ACM. If the excavated waste does not appear to be contaminated by asbestos, the waste will be properly contained and transported to an approved landfill for disposal. If asbestos contaminated waste is identified or suspected by the AAI, the ACM Contingency Plan (Section 5.4) shall be followed.

5.4 ACM Contingency Plan

If asbestos contaminated waste is identified or suspected by the AAI, the following steps shall be followed:

- If the AAI determines that suspect asbestos containing waste is present, the suspect waste must be maintained adequately wet by the contractor and immediately be properly contained and transported to an approved landfill for disposal as discussed in Section 5.5.

- If the AAI determines an amount of ACM is greater than an incidental amount or is in a condition such that an immediate risk of exposure is likely, he shall notify the TAS. If the TAS agrees with this determination, all work MUST IMMEDIATELY STOP and the area cleared of all personnel. The TAS shall notify an AAS to provide oversight to any abatement activities, in accordance with all Federal, State and Local laws, to be performed by the contractor or sub-contractors. Work may commence at another location determined by the AAS to be a safe distance away from significant suspect waste area. Work may continue at this location after the AAS determines that abatement has occurred and the suspect waste has been properly contained and disposed of in either a designated cell or another location determined by the landfill operator/manager as discussed in Section 5.5.

5.5 Disposal

All friable and all regulated asbestos containing material must be maintained adequately wet, properly contained and disposed of at an approved ACM waste disposal landfill. For this project, asbestos waste will be disposed at one (1) or both of the approved facilities below:

- Republic Landfill located in Person County, North Carolina; or
- Sampson County Disposal, LLC Landfill located in Sampson County, North Carolina; or
- Another facility approved to accept asbestos containing wastes.

All asbestos waste disposal will be coordinated by the Contractor/Asbestos Contractor and properly manifested for disposal. Additionally, the asbestos contractor will

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complete the NC Asbestos Waste Shipment Record, included in **Attachment A**, and their own sample description form if samples are collected. The chain of custody shall be maintained by the Contractor.

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Figures

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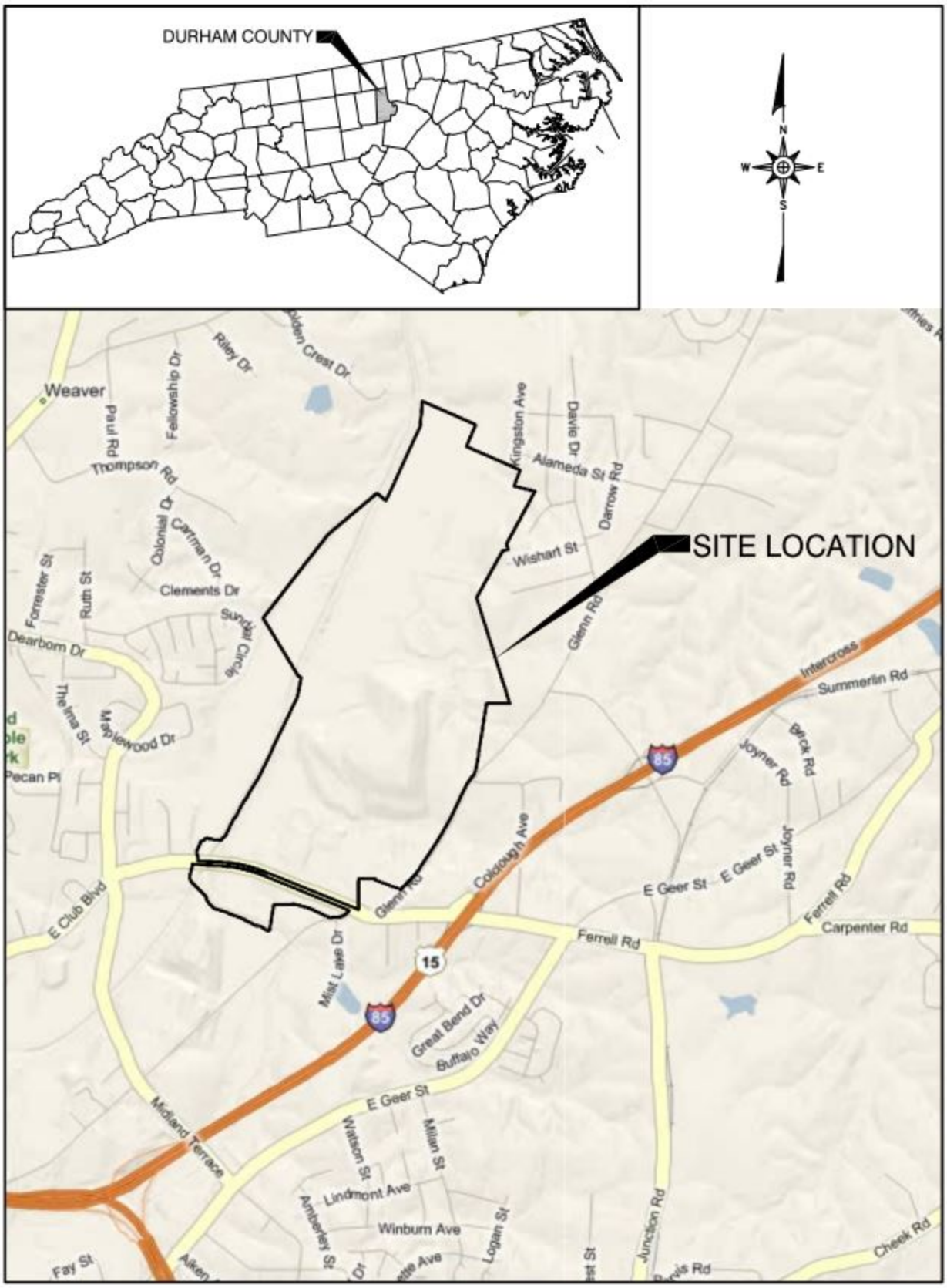

FIG 1
Durham GCCS Expansion
Site Location Map

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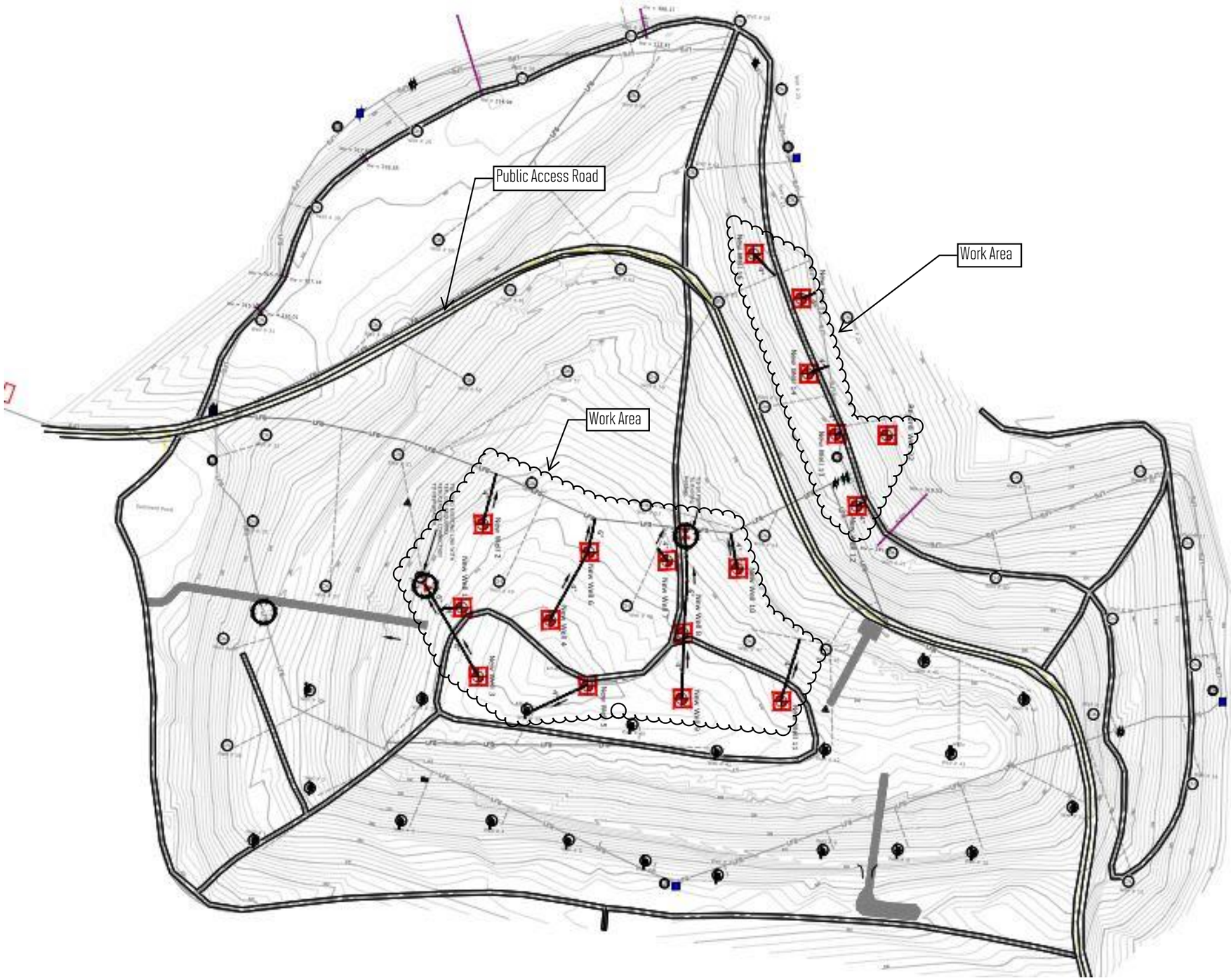

New wells proposed are place with a 75 foot radius of influence. Exact location will be determined in the field based on ground conditions.

Header Routing:
The final routing of the new header will be determined by the final location of the new wells and the elimination of down slope wells if possible.

FIG 2
Durham GCCS Expansion
Site Plan

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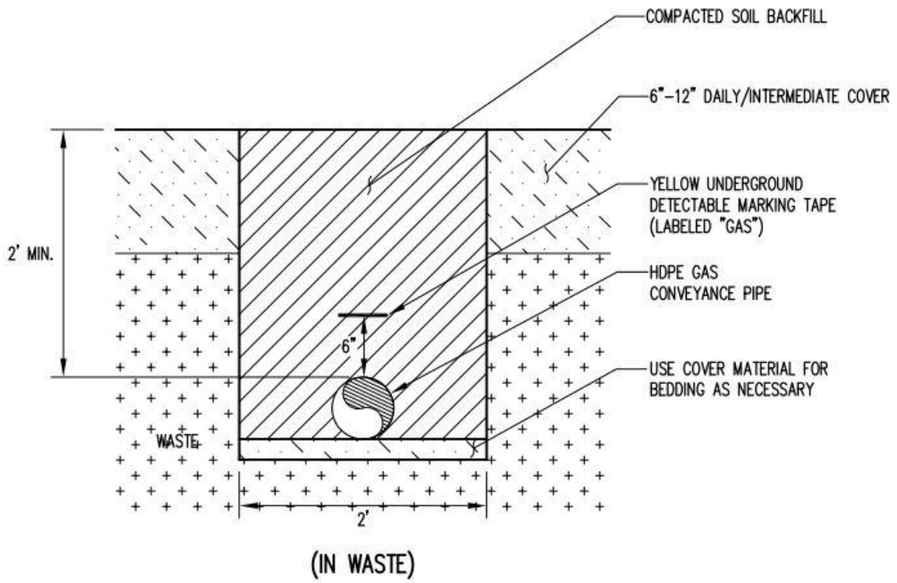
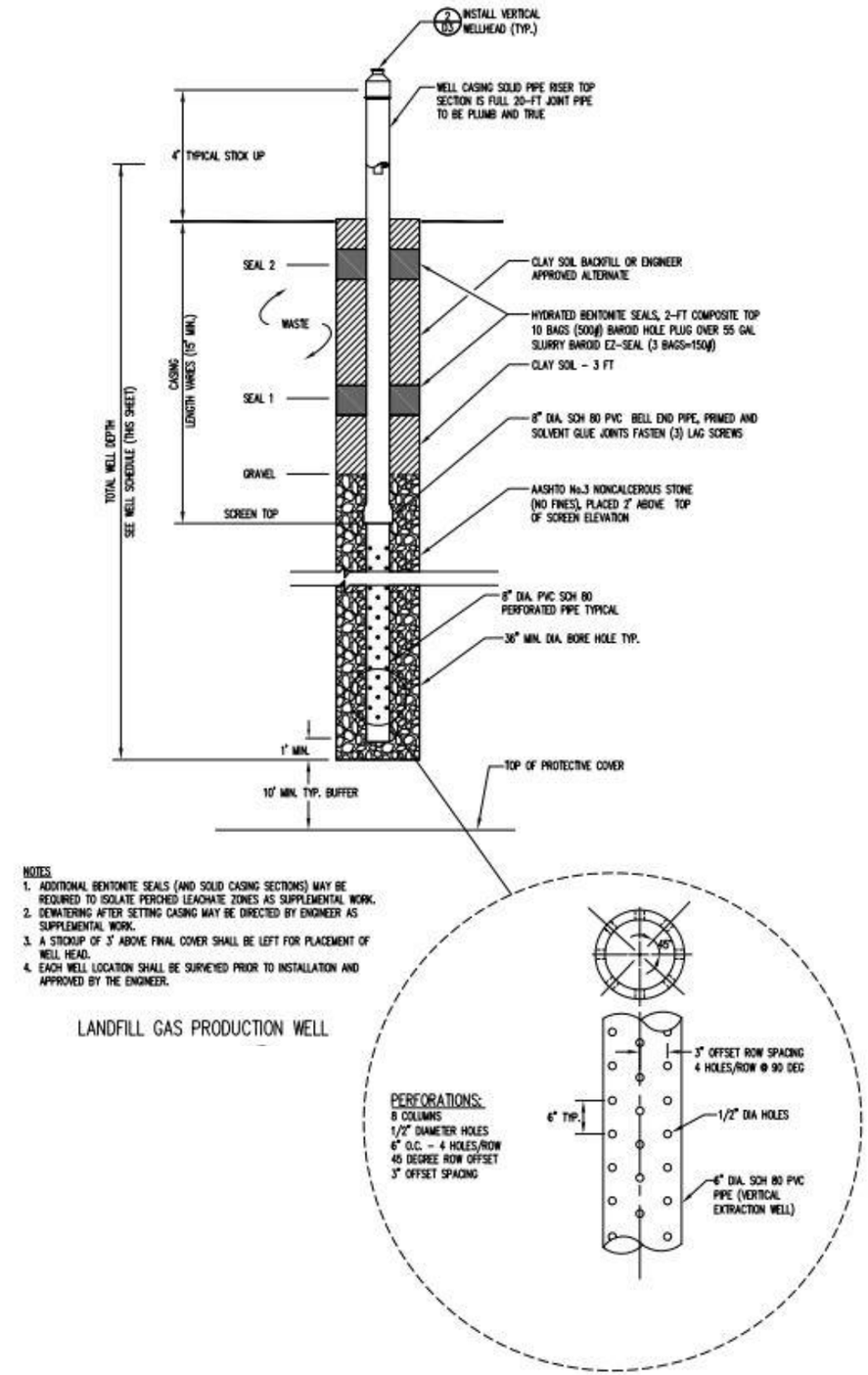


GAS CONVEYANCE PIPE TRENCH



NOTES
1. ADDITIONAL BENTONITE SEALS (AND SOLID CASING SECTIONS) MAY BE REQUIRED TO ISOLATE PERCHED LEACHATE ZONES AS SUPPLEMENTAL WORK.
2. DEWATERING AFTER SETTING CASING MAY BE DIRECTED BY ENGINEER AS SUPPLEMENTAL WORK.
3. A STICKUP OF 3' ABOVE FINAL COVER SHALL BE LEFT FOR PLACEMENT OF WELL HEAD.
4. EACH WELL LOCATION SHALL BE SURVEYED PRIOR TO INSTALLATION AND APPROVED BY THE ENGINEER.

LANDFILL GAS PRODUCTION WELL

FIG 3
Durham GCCS Expansion Details

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Attachment A

NC Asbestos Waste Shipment Record

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NC DEPARTMENT OF HEALTH AND HUMAN SERVICES
DIVISION OF PUBLIC HEALTH
HEALTH HAZARDS CONTROL UNIT

TYPE OR USE BALLPOINT PEN
PRESS FIRMLY - ALL COPIES
MUST BE LEGIBLE

NORTH CAROLINA ASBESTOS WASTE SHIPMENT RECORD

1. Waste Generator/Owner Name and Address:	Work Site Name and Physical Address:	Waste Generator/Owner Phone Number: (_____)_____
2. Contractor Name and Address:		Contractor Phone Number: (_____)_____
3. Waste Disposal Site (WDS) Name, Mailing Address:	WDS Physical Site Location: NC Landfill Permit #:	WDS Phone Number: (_____)_____

4. Name of Responsible Agency:

[ ] Forsyth Co. Environmental Affairs Dept.
[ ] Mecklenburg Co. Dept. of Environmental Protection
[ ] NC DHHS - Health Hazards Control Unit
[ ] WNC Regional Air Pollution Control Agency

Permit #:_____ NESHAP (ACTS) ID #:_____
Start Date:_____ Complete Date:_____

5. Description of materials:

6. Containers Number:_____ Vehicle: _____
Type:_____ _____

RQ, ASBESTOS, CLASS 9
NA 2212, III

7. Total Quantity (yd^3)m^3:

8. Special Handling Instructions and Additional information:

EMERGENCY CONTACT: DIVISION OF EMERGENCY MANAGEMENT AT 1-800-858-0368

9. CONTRACTOR=S CERTIFICATION: I hereby declare that the contents of this consignment are fully and accurately described above by proper shipping name and are classified, packed, marked, and labeled, and are in all respects in proper condition for transport by highway according to applicable international and government regulations.

Printed/Typed Name & Title:_____

Signature:_____ Date (MM/DD/YY):_____

10. Transporter 1 (Acknowledgment of Receipt of Materials):

Printed/Typed Name & Title:_____

Address:_____ Phone Number:_____

Signature:_____ Date (MM/DD/YY):_____

11. Transporter 2 (Acknowledgment of Receipt of Materials):

Printed/Typed Name & Title:_____

Address:_____ Phone Number:_____

Signature:_____ Date (MM/DD/YY):_____

12. Discrepancy Indication Space:

13. Waste Disposal Site: Owner or Operator Certification of Receipt of Asbestos Materials Covered by this Manifest, Except as Noted in Item #12.

Printed/Typed Name & Title:_____ Total Weight (Tons):_____

Signature:_____ Date (MM/DD/YY):_____

DHHS 3787 (Revised8/99)
Health Hazards Control Unit

(1 copy- Waste Generator/Owner; 1 copy- Contractor; 1 copy - Transporter; 1 copy -Disposal Site; 1 copy - Health Hazards Control Unit)

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INSTRUCTIONS
DHHS 3787 - Revised 8/99

PURPOSE: This form serves as an Asbestos Waste Shipment Record (WSR) to be completed whenever disposing of permitable asbestos containing materials in an approved disposal site. This form is required to be completed by the Waste Generator/Owner and Contractor under 15 NCAC 2D .0525 (40 CFR, Part 61, Subpart M). A copy of this form shall be retained by the Waste Generator/Owner, the Contractor, the Transporter, and the Waste Disposal Site for permanent records of disposal of permitable asbestos containing materials as required by 40 CFR part 61, Subpart M, Section 61.150(d)(1). One copy of this form shall be provided to the Health Hazards Control Unit at the address below pursuant to 10A NCAC 41C .0605(j).

PREPARATION: All pertinent information regarding the Waste Generator/Owner, the Contractor, the Transporter and the Waste Disposal Site (WDS) should be completed and retained as indicated above.

WASTE GENERATOR/OWNER SECTION (ITEMS 1-9)

1. Enter the name of the facility at which the asbestos waste is generated and the physical address of the facility. In the appropriate spaces, enter the name of the facility owner, mailing address and the owner=s phone number.

2. If a demolition or renovation, enter the name and address of the company and authorized agent responsible for performing the asbestos removal. In the appropriate spaces, also enter the phone number of the contractor.

3. Enter the name, mailing address, and physical site location of the waste disposal site (WDS) that will be receiving the asbestos materials. In the appropriate spaces, enter the NC Landfill Permit # of the WDS and phone number of the WDS. Enter Aon-site≅ if the waste will be disposed of on the generator=s property.

   All regulated asbestos materials must go to an approved landfill as per the Solid Waste Management Division regulations and amendments.

4. Indicate the name of responsible agency by placing an Ax≅ in the corresponding [ ]. Based upon the responsible agency=s requirements, complete the start date and the complete date for the asbestos removal project. Also enter the permit number and/or NESHAP (ACTS) ID number as applicable.

5. Indicate the types of asbestos waste materials generated by entering: AF≅ for friable asbestos material and/or ANF≅ for nonfriable asbestos material, followed by a detailed description of the type of asbestos waste materials, i.e. sprayed-on/troweled-on material, ceiling tile, floor tile, pipe insulation, boiler insulation, etc.

6. Enter the number of containers used to transport the asbestos materials listed in item 5. Enter one of the following codes for the containers used in transporting each type of asbestos material (specify any other type of container used if not listed below). Enter one of the following codes for the type of vehicle used to transport the asbestos materials (specify any other type of vehicle if not listed below).

Containers	Vehicles
DM - Metal drums, barrels	OD - Open Dumpster
DP - Plastic drums, barrels	CD - Closed Dumpster
BA - 6 mil Plastic bags or wrapping	DT - Dump Truck
	TT - Tractor Trailer

7. Enter the quantities of each type (F and/or NF) of asbestos material removed in units of cubic yards (cubic meters).

8. Use this space to indicate special transportation, treatment, storage or disposal or Bill of Lading information. If an alternative waste disposal site is designated, note it here. Emergency response telephone numbers or similar information may be included here.

9. The authorized agent of the contractor must read and then sign and date this certification. The date should be the date of receipt by the transporter.

TRANSPORTER SECTION (ITEMS 10 & 11)

10 & 11. Enter name, address, and telephone number of each transporter used, if applicable. Print or type the full name and title of person accepting responsibility and acknowledging receipt of materials as listed on this Waste Shipment Record for transport. Enter Signature and date of receipt. Add additional pages if necessary.

DISPOSAL SITE SECTION (ITEMS 12 & 13)

12. The authorized representative of the WDS must note in this space any discrepancy between waste described on the manifest and waste actually received, as well as any improperly enclosed or contained waste. Any rejected materials should be listed and destination of those materials provided. A site that converts asbestos-containing waste material to nonasbestos material is considered a WDS.

13. The signature (by hand) of the authorized WDS agent indicates acceptance and agreement with statements on this manifest except as noted in Item 12. The WDS agency should complete the Total Weight (in tons) of the amount of asbestos-containing waste received. The date should be the date of signature and receipts of shipment.

NOTE: The WDS must send a completed copy of the WSR to the contractor and waste generator/owner listed in Item 2 within 30 days after receipt of the waste per 40 CFR Part 61, Subpart M, Section 61.154(e)(2).

REORDER: Additional forms may be ordered from:

NC Department of Health and Human Services
Health Hazards Control Unit
Occupational & Environmental Epidemiology Branch
1912 Mail Service Center
Raleigh, NC 27699-1912 Phone: 919/733-0820 FAX: 919/733-8493

Certificate Of Completion

Envelope Id: B6FD1063E88845629D78B619BA49FEE3
Status: Completed
Subject: Please DocuSign: Seal 2015 FINAL Record Report-Durham-031816.pdf
Source Envelope:
Document Pages: 136
Signatures: 2
Certificate Pages: 4
Initials: 0
AutoNav: Enabled
EnvelopeId Stamping: Enabled
Time Zone: (UTC-05:00) Eastern Time (US & Canada)

Envelope Originator:
Smith Gardner, Inc.
14 N. Boylan Ave
Raleigh, NC 27603
docusign@smithgardnerinc.com
IP Address: 24.106.183.110

Record Tracking

Status: Original
March 18, 2016 | 10:51

Holder: Smith Gardner, Inc.
docusign@smithgardnerinc.com

Location: DocuSign

Signer Events	Signature	Timestamp
Matt Lamb matt@smithgardnerinc.com Security Level: Email, Account Authentication (None)	DocuSigned by: Matt Lamb 8EFF4BC4580845F... Using IP Address: 24.106.183.110	Sent: March 18, 2016 | 10:52 Viewed: March 18, 2016 | 10:53 Signed: March 18, 2016 | 10:53
Electronic Record and Signature Disclosure: Accepted: March 18, 2016 | 10:53 ID: 0c94bc7d-2a61-4742-80fc-cc60abf87849		
Stacey A. Smith stacey@smithgardnerinc.com President Security Level: Email, Account Authentication (None)	DocuSigned by: Stacey A. Smith 27B482DF1A09438... Using IP Address: 24.106.183.110	Sent: March 18, 2016 | 10:53 Viewed: March 18, 2016 | 11:19 Signed: March 18, 2016 | 11:19
Electronic Record and Signature Disclosure: Accepted: March 18, 2016 | 11:19 ID: 7d02d52b-e55f-4d22-949b-d7ee5a0304ee		

In Person Signer Events	Signature	Timestamp

Editor Delivery Events	Status	Timestamp

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Intermediary Delivery Events	Status	Timestamp

Certified Delivery Events	Status	Timestamp

Carbon Copy Events	Status	Timestamp

Notary Events		Timestamp

Envelope Summary Events	Status	Timestamps
Envelope Sent	Hashed/Encrypted	March 18, 2016 | 10:53
Certified Delivered	Security Checked	March 18, 2016 | 11:19
Signing Complete	Security Checked	March 18, 2016 | 11:19
Completed	Security Checked	March 18, 2016 | 11:19

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