3

5103 2007

Johnston Co

51-03

RICHARDSON SMITH GARDNER & ASSOCIATES
Engineering and Geological Services

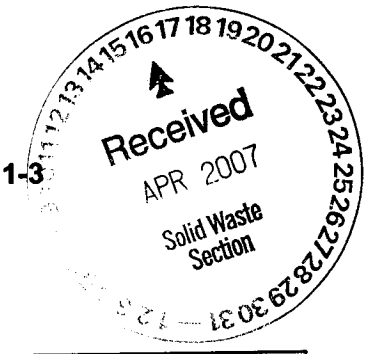
TRANSMITTAL FORM

If enclosures are not as noted or
if you require additional information,
please notify us immediately

April 16, 2007

By: US Mail [ ]
Overnight Mail [ ]
Hand [X]
Other [ ]

Ms. Toni Jones, E.I.
NCDENR Division of Waste Management
401 Oberlin Road, Suite 150
Raleigh, NC 27605
(919) 508-8400



SUBJECT: **Johnston County C&D Landfill - Area 2 - Cell 1 - Design Modifications 1-3**

RSG PROJECT NO: **JOHNSTON-31**

We are sending you the following items:

COPIES	ITEM	DESCRIPTION
1	Design Mod.	Leachate Force Main Alignment
1	Design Mod.	Construction Dewatering System
1	Design Mod	Leachate Collection System Layout

These are transmitted as checked below:

[X] **For Information**
[ ] As Requested
[ ] For Review and Comments
[ ] For Revision
[ ] For Approval
[ ] Approved
[ ] Approved as Noted
[ ] Approved as Noted-Revise and Resubmit
[ ] Not Approved-Revise and Resubmit
[ ] For Record and File
[ ] Submittal
[ ] For Recording

REMARKS: Toni: Design Mod. No. 1 is a modified force main alignment to take advantage of preferable site conditions to allow better hydraulic performance (i.e. less system head). Design Mod. No. 2 covers the dewatering system we discussed with you and Ed prior to the work. Design Mod. No. 3 covers adjustments to the leachate collection system layout as the result of our slope changes on the west side of the cell. Each of these will be included in the CQA report which should be submitted in about a month.

Note that we've consistently seen 3 to 6 gpm of flow in the dewatering manhole since construction was completed. Flow is clear and has no obvious odor but we're still pumping into the leachate force main. Currently, we are looking to add a dedicated sump pump in the dewatering manhole with a hard pipe to one of the sump side riser pipes to handle this flow long term. Just let me know if you have any questions or comments. Thanks!

cc:

Pieter K. Scheer, P.E.

14 N. BOYLAN AVENUE • RALEIGH, NC 27603 • TEL. 919-828-0577 • FAX 919-828-3899 • WWW.RSGENGINEERS.COM

RICHARDSON SMITH GARDNER & ASSOCIATES
Engineering and Geological Services
14 N. Boylan Avenue
Raleigh, NC 27603
Tel: 919-828-0577
Fax: 919-828-3899

Design Modification No. 1

Project:	Johnston County C&D Landfill Area 2 - Cell 1 Construction Smithfield, North Carolina
Owner:	Johnston County Dept. of Public Utilities 309 E. Market Street Smithfield, NC 27577
Contractor:	Shamrock Environmental Corp. ATTN: Henry Havener 6106 Corporate Park Drive Browns Summit, NC 27414

Regulatory Review Required (Y/N): Y
*If Yes, see below.

NOTE: Each modification described herein is a revision of a previously approved permit feature.

Reference(s):
Drawings S5 (Leachate Force Main Plan & Profile) and LM3 (Leachate Management System Details - Sheet 3 of 3)

Description of Modification(s):
Modify the location of the leachate force main, change originally designed air and vacuum valve assembly to just an air release valve assembly and relocate, and relocate the Phase 4A valve box. See also the attached memo from Stacey Smith, P.E.

Reason for Modification(s):
To allow for easier installation and long-term maintenance as well as to provide more favorable hydraulic conditions (less head) for the Area 2 leachate pumps.

Attachments:
1) Stacey Smith, P.E. memo. 2) Revised Drawings S5 and LM3.

Comments:

Regulatory Agency: NC DENR - Division of Waste Management
ATTN: Toni Jones, E.I.
401 Oberlin Road, Suite 150
Raleigh, NC 27605

By:	**Pieter K. Scheer, P.E.**
Title:	**Project Manager**
Date:	**April 16, 2007**

Distribution: [X] Owner [X] Contractor [X] Field [X] File [X] Regulatory Agency

RICHARDSON SMITH GARDNER & ASSOCIATES
Engineering and Geological Services

MEMORANDUM

To: Pieter Scheer, P.E., RSGA

From: Stacey Smith, P.E., RSGA

Date: February 26, 2007

Subject: Johnston County C&D Landfill
Area 2 - Cell 1
Leachate Forcemain Plan and Profile Modifications

A requested modification by the contractor (Shamrock) on the above mentioned project was reviewed regarding re-alignment of the proposed forcemain (reference Drawing No. S5). The requested alignment change begins at approximately station 6+50 and ends at approximately station 26+50. Apparently, during the design phase, an existing bench was not reflected in the topography and was not considered. After review, it appears that this bench will provide a more direct path through this area. However, based on as-built survey information (~Stations 6+50 to 20+50), a few high points (which will trap air) were identified that is anticipated to impact initial filling of the system and pressure testing of the system. An air release (temporary or permanent) should be installed at Stations ~6+99, ~8+98, and at ~11+05. Additionally, the air-vacuum valve proposed at ~Station 9+25 may be deleted and replaced with an air-release valve at ~Station 22+50 as the lines cross by/over the existing sediment basins. This re-alignment does not appear to further impact the system and slightly reduces the overall head required on the system. It is recommended that Drawing No. S5 be re-issued with these modifications.

* * *

H:\Projects\Johnston County\JOHNSTON-31 (Area 2 Cell 1 Construct) - PKS\memo2-26-07.wpd

51-03

RICHARDSON SMITH GARDNER & ASSOCIATES
Engineering and Geological Services
14 N. Boylan Avenue
Raleigh, NC 27603
Tel: 919-828-0577
Fax: 919-828-3899

Design Modification No. 2

Project:	Johnston County C&D Landfill Area 2 - Cell 1 Construction Smithfield, North Carolina
Owner:	Johnston County Dept. of Public Utilities 309 E. Market Street Smithfield, NC 27577
Contractor:	Shamrock Environmental Corp. ATTN: Henry Havener 6106 Corporate Park Drive Browns Summit, NC 27414

Regulatory Review Required (Y/N): Y
*If Yes, see below.

NOTE: Each modification described herein is a revision of a previously approved permit feature.

Reference(s):
Drawing S2 (Subgrade Grading and Drainage Plan)

Description of Modification(s):
Modify the subgrade plans to reduce excavation along the western slope due to the presence of seepage along and near the toe of this slope. A construction dewatering trench and manhole were also added (reference new Drawings CD1 and CD2). The water collected in the trench is routed to a manhole in the north berm where a temporary pump pumps the water into the leachate force main. Depending on flow observed over time a permanent pump may be installed in the manhole or the manhole may be grouted should flow curtail sufficiently. A flow of approximately 3 to 6 gpm has been observed in the manhole in the weeks after completion of the dewatering system.

Reason for Modification(s):
To address seepage observed during construction that was leading to soft subgrade conditions along and near the western toe of slope.

Attachments:
1) New Drawing CD1 (Cell 1 Construction Dewatering Plan), and 2) New Drawing CD2 (Construction Dewatering Details)

Comments:
Refer to Design Modification No. 3 for the changes to the leachate collection system piping as the result of slope changes.

Regulatory Agency: NC DENR - Division of Waste Management
ATTN: Toni Jones, E.I.
401 Oberlin Road, Suite 150
Raleigh, NC 27605

By:	**Pieter K. Scheer, P.E.**
Title:	**Project Manager**
Date:	**April 16, 2007**

Distribution: [X] Owner [X] Contractor [X] Field [X] File [X] Regulatory Agency

51-03

RICHARDSON SMITH GARDNER & ASSOCIATES
Engineering and Geological Services
14 N. Boylan Avenue
Raleigh, NC 27603
Tel: 919-828-0577
Fax: 919-828-3899

Design Modification No. 3

Project:	Johnston County C&D Landfill Area 2 - Cell 1 Construction Smithfield, North Carolina
Owner:	Johnston County Dept. of Public Utilities 309 E. Market Street Smithfield, NC 27577
Contractor:	Shamrock Environmental Corp. ATTN: Henry Havener 6106 Corporate Park Drive Browns Summit, NC 27414

Regulatory Review Required (Y/N): Y
*If Yes, see below.

NOTE: Each modification described herein is a revision of a previously approved permit feature.

Reference(s):
Drawing S3 (Cell 1 Composite Liner and Leachate Collection System Plan)

Description of Modification(s):
Modify the layout of Cell 1 leachate collection piping (see Drawing C1). See the attached calculations which also account for actual transmissivity values of the drainage geocomposite to be used in construction.

Reason for Modification(s):
Changes were required as a result of slope changes made as part of Design Modification No. 2.

Attachments:
1) Revised Leachate Collection System Drainage Layer Analysis and 2) New Drawing C1.

Comments:
Refer to Design Modification No. 2 for a description of slope changes.

Regulatory Agency: NC DENR - Division of Waste Management
ATTN: Toni Jones, E.I.
401 Oberlin Road, Suite 150
Raleigh, NC 27605

By:	**Pieter K. Scheer, P.E.**
Title:	**Project Manager**
Date:	**April 16, 2007**

Distribution: [X] Owner [X] Contractor [X] Field [X] File [X] Regulatory Agency

PROJECT Johnston County C&D Landfill - Area 2 - Cell 1

SUBJECT Leachate Collection Drainage Layer Analysis

SHEET 1 OF 6
JOB NO. JOHNSTON-31
DATE 3/22/07
COMPUTED BY PKS
CHECKED BY

Objective

To evaluate the ability of the leachate collection system (LCS) to maintain at most 1 foot of head on the geomembrane under Normal Operating Conditions (for drainage geocomposites head should be maintained within the thickness of the geonet drainage core). The analysis determines the maximum head using input values for permeability (natural drainage media - stone/sand) or transmissivity (drainage geocomposite) and selected slope and collection pipe spacing combinations.

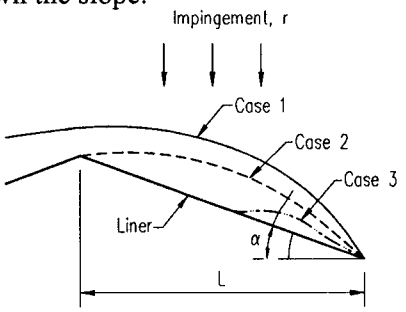
References

McEnroe, Bruce (1993), "Maximum Saturated Depth Over Landfill Liners," Journal of Environmental Engineering, Vol. 119, No. 2, pp. 262-270.

Richardson, G.N., Giroud, J-P. and Zhao, A. (2000), Design of Lateral Drainage Systems for Landfills, Tenax Corp., Baltimore.

Analysis

The McEnroe equations require the input of an impingement rate, a drainage media permeability, pipe spacing, and a liner slope. This information is used to find the maximum head on the liner. The McEnroe solution is for three cases (see figure below). Case 1 is for a saw-tooth bottom, with the liquid mound overtopping the peak. Case 2 has the liquid mound starting at the peak of the saw-tooth. Case three has the mound starting below the peak of the tooth. Cases two and three are appropriate for modeling a liner on an infinite slope with collector pipes uniformly spaced down the slope.



Step 1: Input the necessary physical factors: slope, permeability and impingement rate.

Step 2: The controlling value R is calculated

$$R = \frac{r}{k \sin^2 \alpha}$$

where:
- r = impingement rate
- k = design permeability of the drainage media (for Drainage Geocomposite, k = transmissivity/thickness) (See Note 1)
- α = slope angle of the liner

RICHARDSON SMITH GARDNER & ASSOCIATES
Engineering and Geological Services
14 N. Boylan Avenue, Raleigh, NC 27603
Telephone: (919) 828-0577

Note:

1. For stone/sand: The design permeability (k) = (specified minimum permeability)/(overall reduction factor (RF))
   For drainage geocomposites: k = (specified minimum transmissivity/thickness of geonet drainage core)/(RF)

$$RF = RF_{IN} \times RF_{CR} \times RF_{CC} \times RF_{BC} \times FS$$

where:
- RF_{IN} = reduction factor for intrusion
- RF_{CR} = reduction factor for creep
- RF_{CC} = reduction factor for chemical clogging
- RF_{BC} = reduction factor for biological clogging
- FS = overall factor of safety

Based on the recommendations of Richardson, Giroud, & Zhao, use the following values for a leachate collection system (LCS). An overall factor of safety of 2.0 for long-term conditions is also recommended. For shorter term (lower load) conditions, lower values may be used.

	RF_{IN}	RF_{CR}	RF_{CC}	RF_{BC}
Stone/Sand:	1.0	1.0	1.5-2.0	1.5-2.0
Dr. Geocomposite:	1.0-1.2	1.4-2.0	1.5-2.0	1.5-2.0

Step 3: The maximum head is calculated, using a formula dependent on the value of R:

For R > 1/4 (Case 1):

$$h_{max} = SL\left(R - RS + R^2S^2\right)^{\frac{1}{2}} \exp\left[\frac{1}{B}\arctan\left(\frac{2RS-1}{B}\right) - \frac{1}{B}\arctan\left(\frac{2R-1}{B}\right)\right]$$

For R = 1/4 (Case 2):

$$h_{max} = SL\frac{R(1-2RS)}{1-2R}\exp\left[\frac{2R(S-1)}{(1-2RS)(1-2R)}\right]$$

For R < 1/4 (Case 3):

$$h_{max} = SL\left(R - RS + R^2S^2\right)^{\frac{1}{2}}\left[\frac{(1-A-2R)(1+A-2RS)}{(1+A-2R)(1-A-2RS)}\right]^{\frac{1}{2A}}$$

where:
- h_{max} = maximum head (m - convert to desired units)
- L = horizontal length of pipe spacing or distance to peak (m) (see figure above)
- S = liner slope (m/m)
- A = $(1 - 4R)^{0.5}$
- B = $(4R - 1)^{0.5}$

RICHARDSON SMITH GARDNER & ASSOCIATES
Engineering and Geological Services
14 N. Boylan Avenue, Raleigh, NC 27603
Telephone: (919) 828-0577

RICHARDSON SMITH GARDNER & ASSOCIATES
Engineering and Geological Services
14 N. Boylan Avenue Tel: 919-828-0577
Raleigh, NC 27603 Fax: 919-828-3899

SHEET: 4/6
JOB #: JOHNSTON-31
DATE: 3/22/07
BY: PKS
CHKD BY:

Johnston County C&D Landfill - Area 2 - Cell 1
Leachate Collection Drainage Layer Analysis - Active Condition

Drainage Geocomposite:

Maximum Allowable Head (h_{max}):	0.30 inches	(= Thickness of Geonet Drainage Core)
Impingement (r):	1.5E-05 cm/sec	(Peak Daily Flow from HELP Model - Active Case)
Drainage Geocomposite Transmissivity (θ):	1.2E-03 m^3/m/sec	(Tested Minimum)
Thickness of Geonet Drainage Core:	0.30 inches	(Tested Minimum)
Reduction Factors for Drainage Geocomposite:		(Per Richardson, Zhao, & Giroud)
$RF_{intrusion}$:	1.0	
RF_{creep}:	1.0	
$RF_{chemical\ clogging}$:	1.0	
$RF_{biological\ clogging}$:	1.0	
Overall Factor of Safety:	1.0	
Reduction Factor for Drainage Geocomposite in LCS:	1.0	
Design Drainage Geocomposite Transmissivity (θ):	1.2E-03 m^3/m/sec	
Design Drainage Geocomposite Permeability (k):	16.01 cm/sec	(Design Transmissivity/Thickness of Geonet Drainage Core)

Slope (%)	Slope (Deg.)	S	R	Pipe Spacing (ft)	Pipe Spacing (m)	A	B	h_{max} (in) R < 0.25	h_{max} (in) R = 0.25	h_{max} (in) R > 0.25	Comment
2	1.15	0.020	0.00237	250	76.2	0.995	NA	0.14	N/A	N/A	O.K.
2.5	1.43	0.025	0.00151	300	91.4	0.997	NA	0.14	N/A	N/A	O.K.
3	1.72	0.030	0.00105	300	91.4	0.998	NA	0.11	N/A	N/A	O.K.
4	2.29	0.040	0.00059	300	91.4	0.999	NA	0.08	N/A	N/A	O.K.

Note: Spreadsheet Converts Units as Required.

RICHARDSON SMITH GARDNER & ASSOCIATES
Engineering and Geological Services
14 N. Boylan Avenue Tel: 919-828-0577
Raleigh, NC 27603 Fax: 919-828-3899

SHEET: 5.16
JOB #: JOHNSTON-31
DATE: 3/22/07
BY: PKS
CHKD BY:

Johnston County C&D Landfill - Area 2 - Cell 1
Leachate Collection Drainage Layer Analysis - Intermediate Condition

Drainage Geocomposite:

Maximum Allowable Head (h_{max}):	0.30 inches	(= Thickness of Geonet Drainage Core)
Impingement (r):	5.6E-06 cm/sec	(Peak Daily Flow from HELP Model - Intermediate Case)
Drainage Geocomposite Transmissivity (θ):	1.2E-03 m^3/m/sec	(Tested Minimum)
Thickness of Geonet Drainage Core:	0.30 inches	(Tested Minimum)
Reduction Factors for Drainage Geocomposite:		(Per Richardson, Zhao, & Giroud)
$RF_{intrusion}$:	1.1	
RF_{creep}:	1.5	
$RF_{chemical\ clogging}$:	1.5	
$RF_{biological\ clogging}$:	1.5	
Overall Factor of Safety:	1.5	
Reduction Factor for Drainage Geocomposite in LCS:	5.6	
Design Drainage Geocomposite Transmissivity (θ):	2.2E-04 m^3/m/sec	
Design Drainage Geocomposite Permeability (k):	2.88 cm/sec	(Design Transmissivity/Thickness of Geonet Drainage Core)

Slope (%)	Slope (Deg.)	S	R	Pipe Spacing (ft)	Pipe Spacing (m)	A	B	h_{max} (in) R < 0.25	h_{max} (in) R = 0.25	h_{max} (in) R > 0.25	Comment
2	1.15	0.020	0.00484	250	76.2	0.990	NA	0.28	N/A	N/A	O.K.
2.5	1.43	0.025	0.00310	300	91.4	0.994	NA	0.27	N/A	N/A	O.K.
3	1.72	0.030	0.00215	300	91.4	0.996	NA	0.23	N/A	N/A	O.K.
4	2.29	0.040	0.00121	300	91.4	0.998	NA	0.17	N/A	N/A	O.K.

Note: Spreadsheet Converts Units as Required.

RICHARDSON SMITH GARDNER & ASSOCIATES
Engineering and Geological Services
14 N. Boylan Avenue Tel: 919-828-0577
Raleigh, NC 27603 Fax: 919-828-3899

SHEET: 6 / 6
JOB #: JOHNSTON-31
DATE: 3/22/07
BY: PKS
CHKD BY:

Johnston County C&D Landfill - Area 2 - Cell 1
Leachate Collection Drainage Layer Analysis - Final Condition

Drainage Geocomposite:

Maximum Allowable Head (h_{max}):	0.30 inches	(= Thickness of Geonet Drainage Core)
Impingement (r):	1.1E-07 cm/sec	(= 100 gpad >>> HELP Model Prediction)
Drainage Geocomposite Transmissivity (θ):	1.2E-03 m^3/m/sec	(Tested Minimum)
Thickness of Geonet Drainage Core:	0.30 inches	(Tested Minimum)
Reduction Factors for Drainage Geocomposite:		(Per Richardson, Zhao, & Giroud)
$RF_{intrusion}$:	1.2	
RF_{creep}:	2.0	
$RF_{chemical\ clogging}$:	2.0	
$RF_{biological\ clogging}$:	2.0	
Overall Factor of Safety:	2.0	
Reduction Factor for Drainage Geocomposite in LCS:	19.2	
Design Drainage Geocomposite Transmissivity (θ):	6.4E-05 m^3/m/sec	
Design Drainage Geocomposite Permeability (k):	0.83 cm/sec	(Design Transmissivity/Thickness of Geonet Drainage Core)

Slope (%)	Slope (Deg.)	S	R	Pipe Spacing (ft)	Pipe Spacing (m)	A	B	h_{max} (in) R < 0.25	h_{max} (in) R = 0.25	h_{max} (in) R > 0.25	Comment
2	1.15	0.020	0.00033	250	76.2	0.999	NA	0.02	N/A	N/A	O.K.
2.5	1.43	0.025	0.00021	300	91.4	1.000	NA	0.02	N/A	N/A	O.K.
3	1.72	0.030	0.00015	300	91.4	1.000	NA	0.02	N/A	N/A	O.K.
4	2.29	0.040	0.00008	300	91.4	1.000	NA	0.01	N/A	N/A	O.K.

Note: Spreadsheet Converts Units as Required.