



November 10, 2011

Ms. Jaclynne Drummond
NCDENR DWM Solid Waste Section
1646 Mail Service Center
Raleigh, North Carolina 27699-1646

**RE: Operations, Monitoring, and Maintenance Report – September 2011
Avery County Closed MSW Landfill
Spruce Pine, North Carolina**

Dear Ms. Drummond:

This report provides information concerning the operation and monitoring (O&M) of the Avery County Closed MSW Landfill (Permit No. 06-01) Landfill Gas Collection and Control System (LFGCCS). This report covers the September 2011 monitoring period. Mr. Don Misenheimer with RSG, performed the September site visit on September 15, 2011. Details of this inspection are provided below.

ACTION LIST

RSG has identified the following items to be addressed in order for the LFGCCS to operate as designed:

1. **W-1 and W-3:** These wells have been determined to be watered out/totally clogged. **RSG is currently evaluating options to address this condition.**
2. **W-2 and W-4:** These wells have been determined to be partially watered out/partially clogged and are only able have minimal system pressure applied for LFG extraction. **RSG is currently evaluating options to address this condition.**
3. **W-5, W-6, W-7 & W-8:** Orifice plate sizes should continue to be evaluated and adjusted as necessary.
4. **Flare:** An extended flare collar should be considered for possible high wind related issues onsite.
5. **Blower:** RSG is continuing to evaluate the blower size for optimal system performance.

LFG EXTRACTION WELL MONITORING REQUIREMENTS

As set forth in the *Off-site Landfill Gas Mitigation Plan*¹, approved, via letter, on February 10,

¹ *Off-Site Gas Mitigation Plan*. Richardson Smith Gardner and Assoc. January 18, 2011

2011 by NCDENR Division of Waste Management², monthly monitoring of the LFGCCS will include the following:

- CH₄, O₂, CO₂, and Pressure monitoring at each extraction well head;
- CH₄, O₂, CO₂, and Pressure monitoring at the flare station; and
- adjustment of LFGCCS to balance recovery and ensure safe operation of the system.

The County will maintain this LFGCCS for a period of at least 12 months to evaluate the effectiveness of increased LFG recovery from the waste mass in alleviating off-site migration of LFG. During this time, LFG monitoring at the landfill and for off-site properties will be continued on a monthly basis. Reporting of these results will be accordance with the approved LFG Monitoring Plan.

At this time RSG has not yet submitted the revised Landfill Gas Monitoring Plan. As this plan is submitted and approved, monitoring requirements may be updated.

LFG EXTRACTION WELL MONITORING ACTIVITIES

RSG performed the flare station and well field monitoring on September 15, 2011. When RSG arrived to the site, there was approximately 37-40 inches of available vacuum at each of the LFG wells across the well field. The results of this event are summarized below. Recommended actions are made in **bold**. Well field data and flare station data are provided in the **attached Table 1**.

The following actions were taken at the well field and flare station during this period:

Well Field

- **W-1 and W-3:** These wells have been determined to be watered out/totally clogged. **Outstanding Action Item: RSG is currently evaluating options to address this condition.**
- **W-2 and W-4:** These wells have been determined to be partially watered out/partially clogged and are only able have minimal system pressure applied for LFG extraction. **Outstanding Action Item: RSG is currently evaluating options to address this condition.**
- **W-7:** The 0.25" orifice plate at this location has been determined to be the proper size at this location. **Outstanding Action Item: Orifice plate sizes on wells W-5, W-6, W-7 & W-8, should continue to be evaluated and adjusted as necessary.**

Flare Station

- The flare was burning and the temperature data logger at the flare was checked and determined to be operational during this site visit. **An extended flare collar should be**

² *Off-Site Gas Mitigation Plan- Approval.* Letter from Jaclynne Drummond, NCDENR, February 10, 2011

considered for possible high wind related issues onsite.

- **Outstanding Action Item: RSG is continuing to evaluate the blower size for optimal system performance.**

LFG MONITORING WELL (PERIMETER) MONITORING

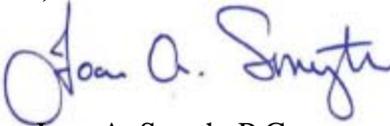
RSG personnel conducted the September 2011 monitoring of the perimeter LFG monitoring wells on September 15, 2011. Results of this monitoring event are included in **Attachment 1**. Monitoring wells P1, P3, and P7 each measured over the 100% LEL or 5% by volume of CH₄, while all other wells had no detectable concentrations of CH₄. These wells will continue to be monitored and data will be submitted in this reporting format.

If you have any questions, or require additional information, please contact us at your earliest convenience at 919-828-0577 or by e-mail (address below).

Sincerely,

Richardson Smith Gardner and Associates, Inc.


Don Misenheimer
Project Scientist, ext. 224
don@rsgengineers.com


Joan A. Smyth, P.G.
Senior Hydrogeologist ext. 221
joan@rsgengineers.com

Attachments

CC: Buddy Norris – Avery County
Bill Wagner – NCDENR
Stacey Smith, P.E. – RSG
File

Table



DATE: September 15, 2011

BY: DMM

**Table 1
Avery County Closed MSW Landfill
Landfill Gas Collection and Control System Monitoring
September 2011**

DataField CS - GEM Mode Data Output

Device ID	Date/Time mm/dd/yyyy	CH4 %	CO2 %	O2 %	Balance %	Adj. Temperature degF	Init. Static Pressure in H2O	Adj. Static Pressure in H2O	Adj. Diff. Pressure in H2O	Init. Flow Scfm	Adj. Flow Scfm	System Pressure in H2O
Avery-W1	9/15/2011 10:51	69.6	30.3	0	0.1	71	-39.6	-39.8	-0.004	<<>>	<<>>	-40.23
Avery-W2	9/15/2011 11:01	75.6	25.3	0	0	71	-2.4	-13.3	0.015	<<>>	<<>>	-38.11
Avery-W3	9/15/2011 11:04	66.7	30.1	0.1	3.1	72	-35.1	-35.1	0.018	4	5	-38.38
Avery-W4	9/15/2011 11:08	67.1	22.6	1.6	8.7	71	-2.9	-2.9	0.201	18	18	-38.32
Avery-W5	9/15/2011 10:17	36.9	28.4	0	34.7	70	-33.3	-33.4	4.531	6	6	-37.59
Avery-W6	9/15/2011 10:26	7	19.5	3.4	70.1	72	-15.8	-6.3	-0.02	9	<<>>	-40.45
Avery-W7	9/15/2011 10:33	15.7	25.8	0	58.5	71	-0.6	-0.6	6.602	1	1	-40.49
Avery-W8	9/15/2011 10:37	14.7	26.1	0	59.2	71	-6.9	-6.8	0.674	2	2	-40.49
Flare Station	9/15/2011 10:15	28.4	23.7	1.6	47.3	72	NA	NA	NA	NA	24*	-38.79

The differential pressure measurement should be positive. A negative differential pressure indicates no gas flow. Negative differential pressure may be the result of dirt or water obstructing the pitot tube perforations. Overpulling by adjacent extractions wells may also result in negative pressure being displayed.

<<>> = measurement out of range of GEM 2000 meter. The reading was likely too low for measurement by the instrument.

* The flow at the flare station was calculated with readings gathered on 9/15/11, using the orifice plate gas flow formula provided on the next page.

Air & Gas Flow – Oripac Flow Meter
 SCFM (Base Conditions 14.696 psi & 60 deg F.)

Conversion formula used to solve for flow rate based on plotting changes in inlet pressure and temperature. This formula is designed for use as a "quick check" reference only as the results may differ from the calculation values due to rounding, combining of variables, and making certain assumptions in an effort to keep the formula as abbreviated as possible. Equation source list available on request.

Input new h/w as well as new pressures and/or temperatures using the formula below:

$$SCFM = \frac{5.9816 \times (d^2) \times (K) \times (Y) \times \sqrt{h/w} \times \sqrt{\frac{2.703 \times P_L \times SG}{460 + T_L}}}{\frac{2.703 \times 14.7 \times SG}{460 + T_b}}$$

Where:

5.9816 = physical constant

d = bore in inches

K = flow coefficient

Y = expansion factor

h/w = differential pressure (inches w/c)

P_L = line pressure (psia)

T_L = line temperature (deg f)

T_b = base temperature (deg f)

β = beta ratio (d/D)

SG = specific gravity at line conditions (air = 1.00)

SH = specific heat ratio cp/cv (air = 1.4)

Rn = reynolds number at max flow

$$K = C \times \frac{1}{\sqrt{1 - \beta^4}}$$

$$Y = 1 - (.41 + .35 \beta^4) \left(\frac{h/w \times .0361}{P_L \times 1.4} \right)$$

$$C = 0.5959 + 0.0312 \beta^{2.1} - 0.1840 \beta^8 + 91.71 \beta^{2.5} \left(\frac{Rn}{1000} \right)^{-0.75}$$

*Rn value can be extrapolated from existing calc sheet values. Modification to include actual Rn at new conditions is typically not necessary. Input variables (Rn) from "Normal" operating conditions from calculation sheet.

Formulas for C, Y and K values are for justification purposes only. Refer to calculation sheet for Y and K values.

Lambda Square Inc.
71 Deer Park Ave., Babylon, NY 11702
www.lambdasquare.com

(800) 587-5423 / (631) 587-1000
FAX (631) 587-1011
info@lambdasquare.com

ORIFICE SIZING PROGRAM

"Streamlined" print versions of the basic sizing formula are available from Lambda Square. These are designed for use as a "quick check" reference only as the results may differ from the calculation values due to rounding, combining of variables, and making certain assumptions in an effort to keep the formulas as abbreviated as possible.

---- EQUATION SOURCES ----

Lambda Square calculations are preformed using the ORIFICE2 software sizing program developed and marketed by FlowSoft Inc. ORIFICE2 primarily utilizes the equations as found in the *Flow Measurement Engineering Handbook*, 2nd edition by R.W. Miller, available through McGraw Hill publishing (800) 262-4729. as well as other equations which are published in a number of widely used publications. The bibliography section lists those publications and the user is urged to obtain a copy for reference.

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Figure

G:\CAD\Avery County\Avery 11-3\sheets\AVERY-B0170.dwg - 7/1/2011 10:21 AM



REFERENCES

1. ADJACENT PROPERTIES ARE FROM AVERY COUNTY GIS MAPPING DEPARTMENT.
2. LANDFILL GAS EXTRACTION WELL LOCATIONS FROM FIELD SURVEY DATED APRIL 9, 2010, BY APPALACHIAN PROFESSIONAL LAND SURVEYORS AND CONSULTANTS. PIPING IS APPROXIMATE.
3. PROPERTY LINE FROM FIELD SURVEY DATED APRIL 9, 2010, BY APPALACHIAN PROFESSIONAL LAND SURVEYORS & CONSULTANTS.
4. SHOWN PIPE DIAMETERS ARE ASSUMED FROM "AVERY COUNTY LANDFILL - NATURAL GAS-TO-ENERGY PROJECT PROPOSAL", BY NATURAL POWER, INC., FEBRUARY 14, 2000, AND RSG SITE VISIT ON APRIL 6-7, 2011.



RICHARDSON SMITH GARDNER & ASSOCIATES
 INC. LIC. NO. C-282 (Engineering)
 www.rsgengineers.com
 14 N. Boylan Ave.
 Raleigh, N.C. 27603
 ph: 919-826-0577
 fax: 919-826-3899

FIGURE NO.	1	FILE NAME	AVERY-B0170
SCALE:	AS NOTED	PROJECT NO.	AVERY 11-3
CHECKED BY:	D.M.M.	DATE:	Jul. 2011
DRAWN BY:	J.A.L.		

TITLE:
**EXISTING LANDFILL GAS EXTRACTION SYSTEM
 AVERY COUNTY CLOSED MSWLF
 SPRUCE PINE, NC**

Attachment 1

NC Division of Waste Management - Solid Waste Section

Landfill Gas Monitoring Data Form

Notice: This form and any information attached to it are "Public Records" as defined in NC General Statute 132-1. As such, these documents are available for inspection and examination by any person upon request (NC General Statute 132-6).

Facility Name: Avery County Closed MSW LF Permit Number: 06-01

Date of Sampling: 9.15.11 NC Landfill Rule (.0500 or .1600): .0500

Name and Position of Sample Collector: DON MISENHEIMER (RSG)

Type and Serial Number of Gas Meter: GEM 2000 6M 88074107 Calibration Date of Gas Meter: 9.2.11

Date and Time of Field Calibration: 9.15.11 9:50a

Type of Field Calibration Gas (15/15 or 35/50): 15/15 Expiration Date of Field Calibration Gas Canister: 04/13

Pump Rate of Gas Meter: 0.5 L/min

Ambient Air Temperature: 70° Barometric Pressure: 30.0 General Weather Conditions: Scattered Clouds

Instructions: Under "Location or LFG Well" identify the monitoring wells or describe the location for other tests (e.g., inside buildings). A drawing showing the location of test must be attached. Report methane readings in both % LEL and % methane by volume. A reading in percent methane by volume can be converted to % LEL as follows: % methane by volume = % LEL/20

Location or LFG Well ID	Sample Tube Purge	Time	Time Pumped (s)	Initial %LEL	Stabilized %LEL	%CH4 by Volume	%O2	%CO2	Notes
P-1	760s	11:05a	760s	7100	7100	29.9	7.4	29.0	
P-2	760s	11:08a	760s	0	0	0	18.8	2.4	
P-3	760s	11:15a	760s	7100	7100	45.5	4.4	2.7	
P-4	760s	11:20a	760s	0	0	0	19.4	1.9	
P-5	760s	10:15a	760s	0	0	0	19.1	2.5	
P-6	760s	10:04a	760s	0	0	0	18.2	3.4	
P-7	760s	10:00a	760s	7100	7100	33.4	2.6	16.2	
P-8	760s	9:56a	760s	0	0	0	17.5	3.9	

If your facility has more gas monitoring locations than there is room on this form, please attach additional sheets listing the same information as contained on this form.

Certification

To the best of my knowledge, the information reported and statements made on this data submittal and attachments are true and correct. I am aware that there are significant penalties for making any false statement, representation, or certification including the possibility of a fine and imprisonment.

Don Misener (RSG) PROJECT SCIENTIST
SIGNATURE TITLE

NOTE:

* METER WAS FIELD CAL'D USING 15/15 GAS, THEREFORE HIGH READINGS MAY NOT HAVE A HIGH LEVEL OF ACCURACY. THE GEM 2000 WAS RE-CAL'D (FIELD)¹⁶ AFTER HIGH READINGS WERE FOUND. THE PROBES WERE RE-TESTED WITH NO SIGNIFICANT CHANGES