



December 5, 2011

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

**RE: Operations, Monitoring, and Maintenance Report – November 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 October 2011 monitoring period. Mr. Don Misenheimer with RSG, performed the November site visit on November 22, 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 for well rehabilitation 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*<sup>1</sup>, approved, via letter, on February 10,

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

2011 by NCDENR Division of Waste Management<sup>2</sup>, monthly monitoring of the LFGCCS will include the following:

- CH<sub>4</sub>, O<sub>2</sub>, CO<sub>2</sub>, and Pressure monitoring at each extraction well head;
- CH<sub>4</sub>, O<sub>2</sub>, CO<sub>2</sub>, 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 November 22, 2011. When RSG arrived to the site, there was approximately 41 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.**
- **Outstanding Action Item: Orifice plate sizes on wells W-5, W-6 &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 considered for possible high wind related issues onsite.**

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

- **Outstanding Action Item: RSG is continuing to evaluate the blower size for optimal system performance.**
- The gas quality at the flare is improving and options to increase gas flow are being evaluated.
- The condensate tank on-site was again observed to have a high liquid level. RSG notified Avery County to have this pumped out. **RSG will continue to monitor this liquid level.**

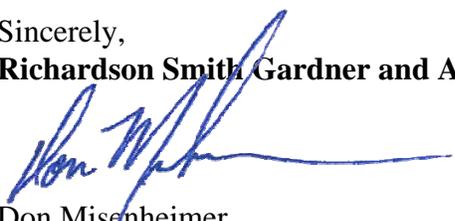
### **LFG MONITORING WELL (PERIMETER) MONITORING**

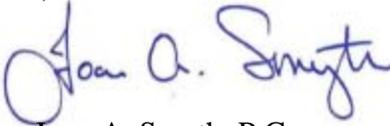
Five (5) additional LFG monitoring wells, P9 through P13, were installed on November 21, 2011. These well locations are shown on **Figure 1** and were installed to a maximum depth of 20 feet below grade. An installation summary of these wells, along with an updated Landfill Gas Monitoring Plan will be submitted under separate cover.

RSG personnel conducted the November 2011 monitoring of the perimeter LFG monitoring wells on November 22, 2011. Results of this monitoring event are included in **Attachment 1**. Monitoring wells P1, P3, P7, and P11 each measured over the 100% LEL or 5% by volume of CH<sub>4</sub>, while all other wells had no detectable concentrations of CH<sub>4</sub>. These wells will continue to be monitored and data will be submitted in this reporting format.

The next routine monitoring event is tentatively scheduled for the third week of November 2011. 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](mailto:don@rsgengineers.com)

  
Joan A. Smyth, P.G.  
Senior Hydrogeologist ext. 221  
[joan@rsgengineers.com](mailto:joan@rsgengineers.com)

#### Attachments

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

## **Table**



DATE: November 29, 2011

BY: DMM

**Table 1  
Avery County Closed MSW Landfill  
Landfill Gas Collection and Control System Monitoring  
November 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	11/22/2011 10:43	67.6	27.8	1.2	3.4	63	-40.8	-40.9	0.013	6	4	-41.06
Avery-W2	11/22/2011 10:46	48.6	27.5	0.2	23.7	65	-31.8	-31.8	0.021	3	5	-41.13
Avery-W3	11/22/2011 10:49	63.6	31.7	0.5	4.2	65	-38.4	-38.3	0.007	1	3	-41.01
Avery-W4	11/22/2011 10:51	66.1	23.6	2.2	8.1	67	-4	-4	-0.005	2	<<>>	-41.04
Avery-W5	11/22/2011 10:56	31.9	25.4	0	42.7	69	-10.6	-10.6	0.685	2	2	-41.49
Avery-W6	11/22/2011 11:00	68.9	30.8	0	0.3	70	-0.1	-1.5	0.254	<<>>	1	-41.71
Avery-W7	11/22/2011 11:03	64.2	35.1	0.5	0.2	65	0.1	0.1	0.899	<<>>	0	-41.66
Avery-W8	11/22/2011 11:05	62.6	36.7	0.3	0.4	63	0.1	-0.4	0.05	0	0	-41.63
Flare Station	11/22/2011 11:08	32	26.6	1.5	39.9	70	NA	NA	NA	NA	21*	-41

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 extraction 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 11/22/11, 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:

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

Where:

5.9816 = physical constant

d = bore in inches

K = flow coefficient

Y = expansion factor

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

P<sub>L</sub> = line pressure (psia)

T<sub>L</sub> = line temperature (deg f)

T<sub>b</sub> = 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](http://www.lambdasquare.com)

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

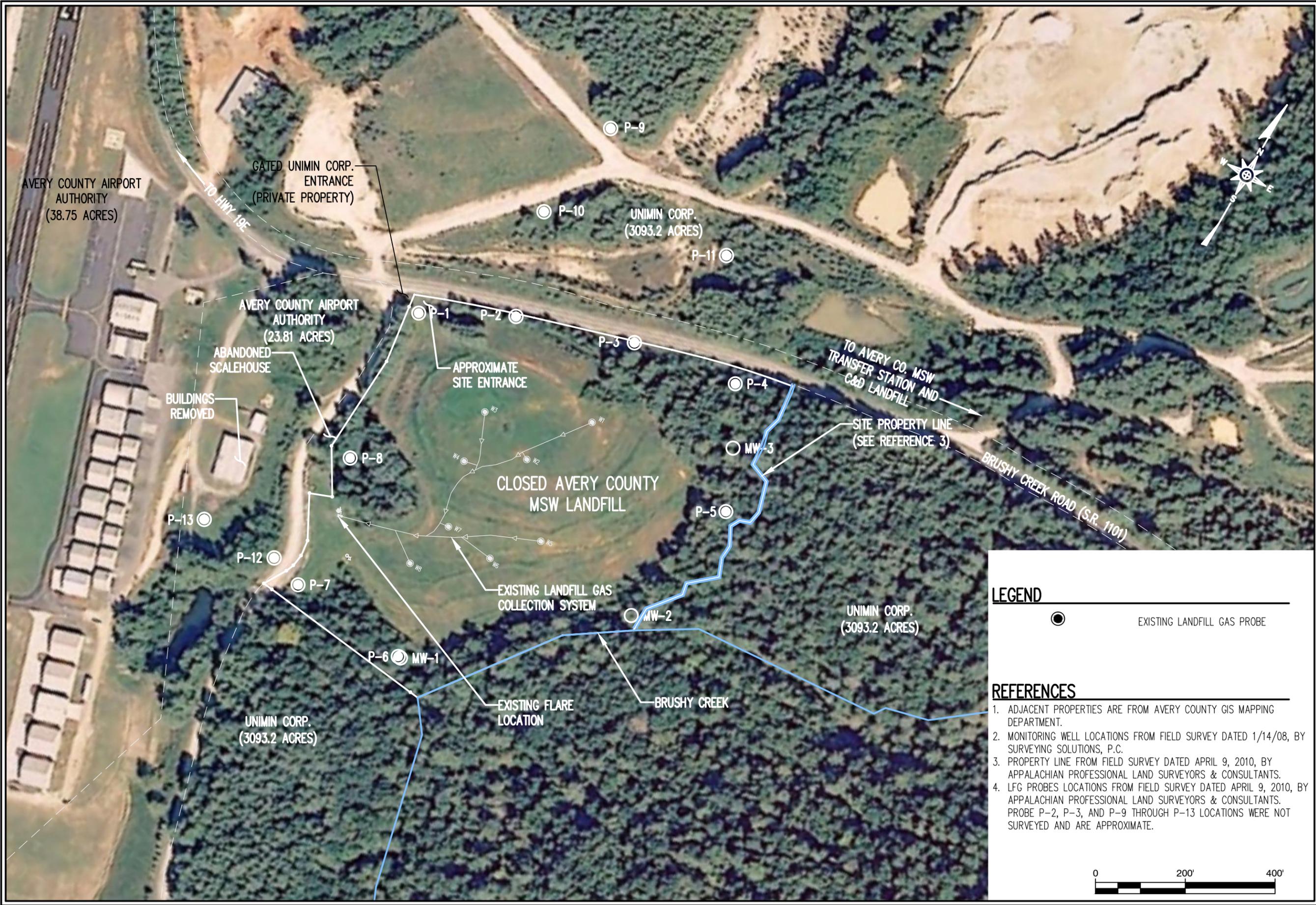
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**Figure**

G:\CAD\Avery County\Avery 10-2\sheets\AVERY-B0172.dwg - 12/2/2011 2:56 PM



**RICHARDSON SMITH GARDNER & ASSOCIATES**  
 NC LIC. NO. C-4828 (Engineering)  
 www.rsgengineers.com  
 14 N. Boylan Ave.  
 Raleigh, N.C. 27603  
 ph: 919-526-0577  
 fax: 919-526-3899

FIGURE NO.	1	FILE NAME	AVERY-B0172
SCALE:	AS NOTED	PROJECT NO.	AVERY 11-6
CHECKED BY:	J.A.S.	DATE:	Dec. 2011
DRAWN BY:	C.T.J.		

**LEGEND**

● EXISTING LANDFILL GAS PROBE

**REFERENCES**

1. ADJACENT PROPERTIES ARE FROM AVERY COUNTY GIS MAPPING DEPARTMENT.
2. MONITORING WELL LOCATIONS FROM FIELD SURVEY DATED 1/14/08, BY SURVEYING SOLUTIONS, P.C.
3. PROPERTY LINE FROM FIELD SURVEY DATED APRIL 9, 2010, BY APPALACHIAN PROFESSIONAL LAND SURVEYORS & CONSULTANTS.
4. LFG PROBES LOCATIONS FROM FIELD SURVEY DATED APRIL 9, 2010, BY APPALACHIAN PROFESSIONAL LAND SURVEYORS & CONSULTANTS. PROBE P-2, P-3, AND P-9 THROUGH P-13 LOCATIONS WERE NOT SURVEYED AND ARE APPROXIMATE.



TITLE:  
**LANDFILL GAS MONITORING 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 CO. CLOSED MSW LP Permit Number: 06-01

Date of Sampling: 11-22-11 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 6-M-070024P Calibration Date of Gas Meter: 9-20-11

Date and Time of Field Calibration: 11-22-11 10:30a

Type of Field Calibration Gas (15/15 or 35/50): 15/15 Expiration Date of Field Calibration Gas Canister: 4-2013

Pump Rate of Gas Meter: 0.5 L/min

Ambient Air Temperature: 62° Barometric Pressure: 27.30 General Weather Conditions: OVERCAST

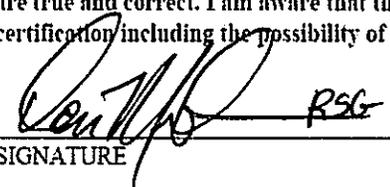
Instructions: Under "Location or LFG Well" identify the monitoring wells or describe the location for other tests (e.g., inside buildings). A drawing showing the location of test must be attached. Report methane readings in both % LEL and % methane by volume. A reading in percent methane by volume can 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
P1	7605	10:40a	7605	7100	7100	43.8	4.6	23.8	
P2	7605	10:42a	7605	0	0	0	14.8	0.7	
P3	7605	10:45a	7605	7100	7100	54.2	0.8	28.9	
P4	7605	10:47a	7605	0	0	0	17.7	4.0	
P5	7605	10:50a	7605	0	0	0	19.7	1.1	
P6	7605	10:55a	7605	0	0	0	15.9	4.8	
P7	7605	11:05a	7605	7100	7100	42.3	0	15.1	
P8	7605	11:09a	7605	0	0	0	19.2	2.5	
P9	7605	11:13a	7605	0	0	0	19.3	1.0	
P10	7605	11:20a	7605	0	0	0	18.6	1.7	
P11	7605	11:31a	7605	7100	7100	36.2	3.4	19.4	
P12	7605	11:33a	7605	0	0	0	19.5	1.1	
P13	7605	11:45a	7605	0	0	0	18.9	1.5	

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.

  
SIGNATURE

PROJECT SCIENTIST  
TITLE