

# Carlson Environmental Consultants, PC

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Monroe, NC 28112  
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August 4, 2005

*Carmen Johnson (CP)*  
Scanned by *[Signature]* Date *6/5/12* Doc # *RCO*  
*95-02*

Mr. Rocky Nelson  
Public Works Director  
Watauga County  
842 West King Street  
Boone, NC 28607

Subject: Methane Migration Sampling and Observation Report  
Watauga County Landfill – Boone, North Carolina



Dear Mr. Nelson:

On behalf of McGee Environmental, Inc. (MEI), Carlson Environmental Consultants, PC (CEC) is submitting this Methane Migration Sampling and Observation Report (Report) to Watauga County, North Carolina (County) in accordance with MEI's approved proposal to the County dated December 28, 2004. The purpose of this work was to assess the capability of an active landfill gas collection and control system to reduce the existing methane gas migration from the Watauga County Landfill (Landfill) located in Boone, North Carolina in order to meet applicable regulatory limits.

## BACKGROUND

The Watauga County Landfill is a closed municipal solid waste (MSW) landfill located in Watauga County adjacent to Highway 421 east of the Town of Boone (see the site location map in Attachment A). The Landfill operated as a sanitary landfill under Permit 95-01 from 1972 to 1984 and under Permit 95-02 from 1984 to 1994. A final cap was constructed on the Landfill in 1996, which included the installation of 22 landfill gas (LFG) passive vents (see vent drawing in Attachment B).

According to NCDENR-approved gas management plans submitted by Draper Aden Associates dated October 23, 1995 and July 19, 2002, the Landfill installed two (2) perimeter gas monitoring probes on the southern boundary of the Landfill in March 1996 (see the probe drawing in Attachment C and a site map in Attachment D). Each of the two sample probe locations has four (4) sampling tubes in each probe at varying depths. The location of these probes was due to several homes located within 300 feet of the Landfill boundary in this area. The remainder of the Landfill facility is bounded by undeveloped land and/or is over 1,000 feet from businesses or other homes.

In accordance with Section .1626 (4)(a) – (d) of 15A NCAC 13B, the County began quarterly monitoring on the two gas probes and in all on-site facility structures in 1996. The County also monitors the five homes (as available) along the southern Landfill boundary on a semi-annual basis. The County also installed several temporary geoprobes

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near the new maintenance shop and transfer station buildings in July 2003. According to historical data provided by the County, gas monitoring in Probe 1 and in on-site structures has not recorded methane concentrations above regulatory thresholds. Monitoring in the off-site homes (as available) has not shown methane gas concentrations. However, gas monitoring in Probe 2 has shown consistent methane concentrations in excess of the lower explosive limit (LEL) (or 5% by volume). Historical perimeter methane monitoring data is shown in Attachment E.

## **PROJECT OBJECTIVES AND SCOPE**

Due to the sustained elevated methane levels in Probe 2, the County received a notice from the North Carolina Department of Environment and Natural Resources (NCDENR) dated July 21, 2004 that requested the County proceed with additional measures to reduce perimeter methane migration and to protect adjacent residences from potential methane gas hazards (see Attachment F). As a response to the NOV, the County prepared an updated methane monitoring plan in which the County requested approval from the NCDENR to allow time to assess the impact of active gas collection on the methane migration. Arguably, applying active gas extraction to a landfill is often the most effective remediative measure to reduce methane migration.

Therefore, in conjunction with the Blue Ridge Resource Conservation and Development Council, Inc. (Blue Ridge), the County connected three passive gas vents along the southern boundary of the Landfill (closest to Probes 1 and 2) in December 2004. The initial installation connected existing passive gas vents EW-15, EW-14, and EW-13 by buried piping to a blower and open flare, which were installed in January 2005. The remainder of the 22 vertical gas wells were connected to the blower and flare system in April, May, and June 2005. The LFG collection and control system design was submitted to the NCDENR by Carlson Environmental Consultants, PC (CEC) in October 2004 and approved by Mr. Ed Mussler and Mr. Jalal Adouli of the NCDENR in November 2004. A drawing of the LFG collection and control system is shown in Attachment G.

The intent of the active LFG collection and control system is twofold: 1) the LFG collection and control system will be used to control methane migration; and, 2) the collected LFG will be used in a future beneficial use project, such as power generation or heating for on-site buildings. The County and Blue Ridge are working together to determine the best use for the Landfill's LFG. Construction on the beneficial use project is expected to begin in the fall of 2005.

The County contracted with MEI to perform weekly monitoring of the perimeter gas probes (Probe 1 and Probe 2) for three months after the startup of the LFG collection and control system. MEI also performed operations and maintenance (O&M) on the wellfield and control system during this time, and performed methane gas monitoring in on-site buildings and neighboring homes (as available).

## **MONITORING OBSERVATIONS**

### Perimeter Probe Monitoring

Based upon the approved protocol, MEI performed weekly perimeter gas monitoring beginning on February 11, 2005 and extending to May 11, 2005. MEI monitored LFG composition (methane, oxygen, carbon dioxide, and balance gas percent by-volume) and static pressure in inches of water column (in-wc). MEI used a field-calibrated CES-LandTEC GEM 500 to perform the LFG monitoring. The full monitoring data, including equipment calibrations, is shown in Attachment H. The County has continued to perform routine quarterly perimeter gas monitoring during this time.

Overall, the data indicates that the active LFG collection and control system was effective in reducing the observed methane in Probe 2. The methane concentrations reduced from a high of 48.8 percent methane on February 11, 2005 to zero percent on April 19, 2005. Based upon the data, the methane reductions showed a rapid decline once active gas collection began. The April 11, 2005 data indicated that both Probe 1 and Probe 2 had methane concentrations less than 5 percent, which is the regulatory lower explosive limit threshold and thus in compliance with Section .1626 (4)(a) – (d) of 15A NCAC 13B.

### Structure Monitoring

Per the approved protocol, MEI performed structure monitoring in adjacent homes (as available) and on-site buildings. The County assisted MEI with contacting neighboring homeowners. The County requested that one (1) round of structure monitoring be performed during this assessment period.

MEI used the MSA Orion G Combustible Gas Monitor to monitor the following residences adjacent to the Watauga County Landfill and the US Forest Service trailer for the presence of methane on April 5, 2005. This data is shown in Attachment I.

According to MEI's data, no methane gas was detected in the monitored areas noted above on the date and time of sampling. Access to the interior of only one adjacent private residence was granted to MEI and the County for the sampling. Access to the remaining four homes was not granted by the homeowners. In these four homes, only the exterior crawl spaces or the foundation was monitored by MEI.

## **CONCLUSIONS AND RECOMMENDATIONS**

Based upon the collected data and MEI's observations, it appears that the active LFG collection and control system has been an effective means to reduce offsite methane migration. The Landfill's two perimeter gas probes are currently indicating zero percent methane. The Landfill is currently in compliance with Section .1626 (4)(a) – (d) of 15A NCAC 13B, which requires methane concentrations in perimeter gas probes to be below

the lower explosive limit for methane (i.e., 5 percent). Onsite and offsite methane gas structure monitoring did not indicate the presence of methane gases on the time and date of sampling.

It should be noted that the majority of the methane reductions in the perimeter gas probes occurred while the LFG collection system only had three vertical wells connected to the blower system. The County completed the connection of all 22 wells in June 2005, which should further enable the active LFG system to control offsite methane migration. In addition, the County is currently investigating options to install a larger blower and open flare system at the Landfill, which should provide more available vacuum to all wells, thus allowing more migration control.

CEC recommends that the County provide this Report to the NCDENR and continue its perimeter probe monitoring on a quarterly basis. CEC believes that continuous operation of the active LFG collection and control system will be the most effective means to prevent future off-site methane migration. Due to the reduction in methane concentrations in the probes, additional monitoring of the perimeter probes or the installation of new probes are probably not required at this time. The County should continue to closely monitor the active LFG collection and control system and ensure that active LFG extraction continues along the southern boundary. Should methane gases be observed in the perimeter probes at concentrations above the lower explosive limit in the future, the County should alter its operations of the LFG collection system to aggressively collect gas from the southern boundary.

Please note that due to the potential hazards with combustible gases, CEC recommends that the County continue to take precautions for potential combustible gases in and around all on-site and off-site structures and continue to perform routine combustible gas monitoring. CEC recommends that onsite and offsite structure monitoring for combustible gases be performed on a quarterly basis. If combustible gases are detected in any structures, CEC recommends that additional measures be taken, such as the installation of permanent combustible gas detectors. CEC also recommends that the County make further attempts to gain access to the interiors, crawl spaces, and basements of all adjacent private homes at least once per year for monitoring.

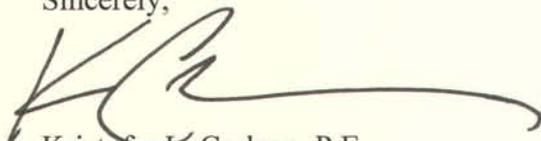
Mr. Rocky Nelson  
August 4, 2005  
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## CLOSING

CEC has relied upon and prepared this Methane Migration Sampling and Observation Report based upon monitoring data and observations provided by MEI and information provided by the County. CEC's conclusions and recommendations are based on our experience at this and similar MSW landfills. Please provide this report and data to the NCDENR for review and assessment.

On behalf of MEI, CEC appreciates the opportunity to provide this report to Watauga County. If you have any questions, please do not hesitate to call the undersigned at (704) 506-7312.

Sincerely,



Kristofer L. Carlson, P.E.  
President  
Carlson Environmental Consultants, PC

cc: J.V. Potter, Watauga County Landfill  
Eric S. McGee, MEI

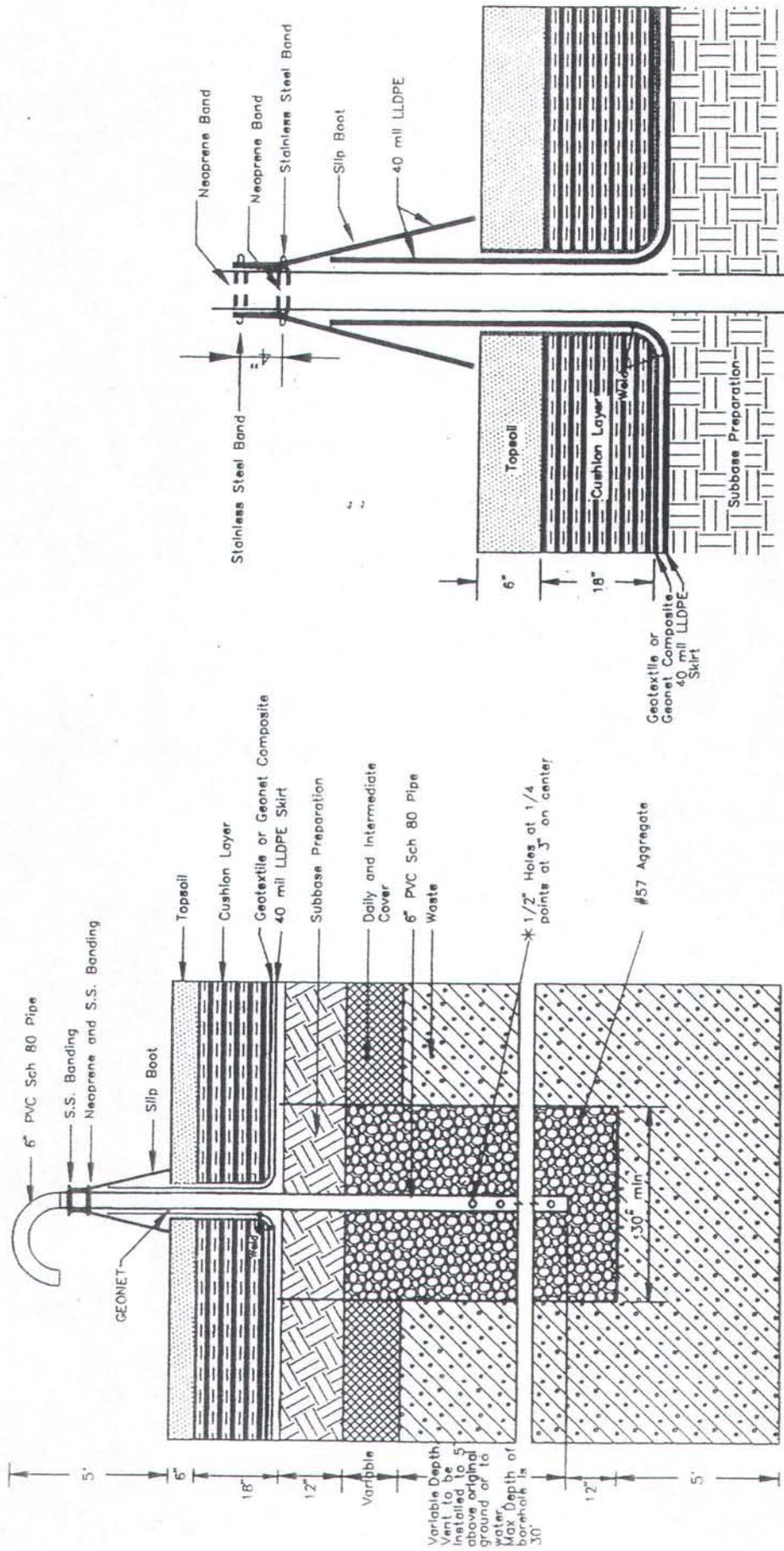
Attachments

**ATTACHMENT A**  
**SITE LOCATION MAP**



**ATTACHMENT B**

**LANDFILL GAS VENT DIAGRAM**



\* PVC Pipe to be perforated from 5' below grade to the bottom.

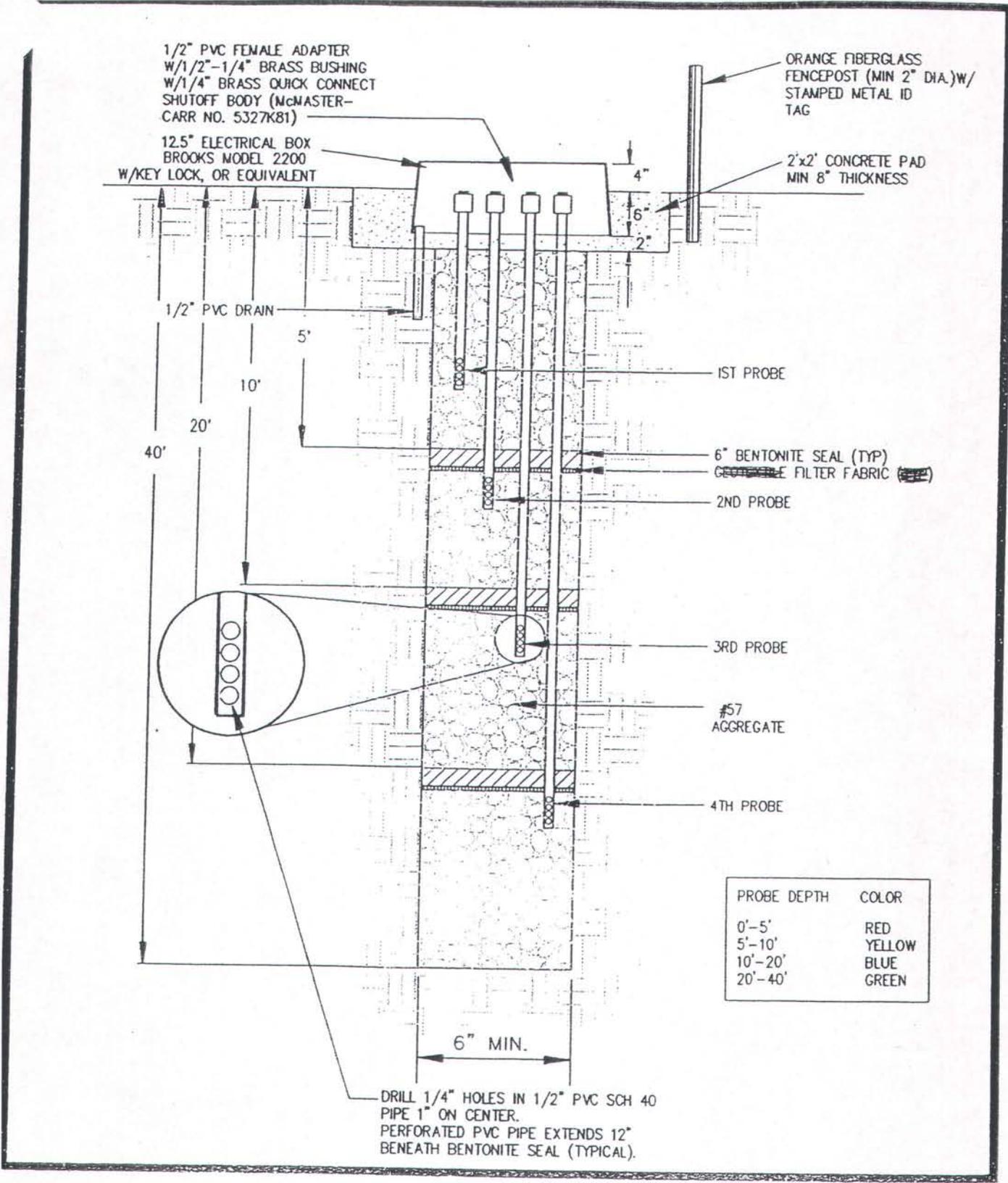
9.5

GAS VENT

NO SCALE

SLIP BOOT DETAIL

**ATTACHMENT C**  
**PERIMETER PROBE DRAWING**



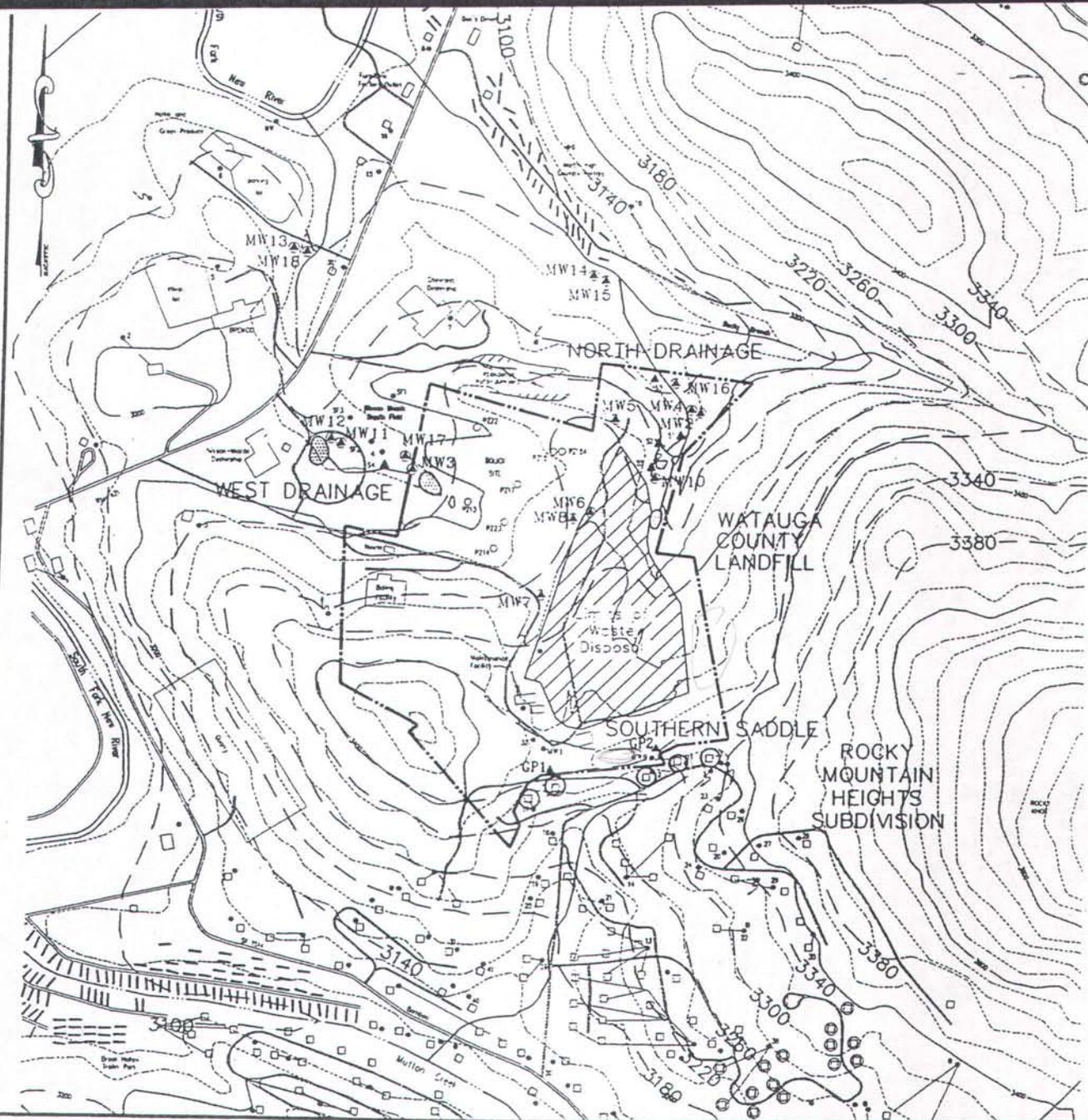
# TYPICAL GAS DETECTION PROBE—WATAUGA COUNTY

GPROBE7

JOB No.	DATE:	SCALE:	FIGURE
		NONE	2

**ATTACHMENT D**

**SITE MAP**



### LEGEND

- |   |   |
|---|---|
| — Existing Ground                             | *s1 Septic Field Monitoring Wells                 |
| — Overhead Power Line                         | s Spring  |
| — Stream                                      | s Spring Used as Potable Water Source             |
| ○ Pond  | * Existing Potable Well/<br>Sampled Well Ref. No. |
| □ / e Existing Residence/Multi-unit Residence | ▲ GP1 Gas Monitoring Well                         |
| — Existing Mobile Home                        |   |
| ● Assessment Monitoring Wells                 |   |
| ▲ Surface Water Sampling Locations            |   |
| ○ Piezometer                                  |   |
| — Groundwater Potentiometric Elevation        |   |

SCALE = 1" = 300'

LANDFILL GAS MONITORING  
 PROBE LOCATIONS  
 WATAUGA COUNTY LANDFILL  
 WATAUGA COUNTY, NORTH CAROLINA

FIGURE 1

(Inferred from static water level data obtained on April 11-13, 1995)

**ATTACHMENT E**

**HISTORICAL PERIMETER GAS PROBE DATA**



**ATTACHMENT F**

**NC DENR LETTER**



## North Carolina Department of Environment and Natural Resources

Dexter R. Matthews, Director

Division of Waste Management

Michael F. Easley, Governor  
William G. Ross Jr., Secretary

July 21, 2004

Mr. J. V. Potter  
Watauga County Operations Services Director  
336 Landfill Road  
Boone, N.C. 28607

RE: Methane Gas Compliance – Watauga County Closed Landfill (Permit # 95-02)

Dear Mr. Potter:

Methane gas concentrations in monitoring wells located at the property boundary at the Watauga County landfill continue to exceed the regulatory limit. Rule .0503 (2) (a) of Solid Waste Management Rules and Law 15A NCAC 13B, requires that explosive gases may not exceed the lower explosive limit at the property boundary. Sampling results from the two monitoring wells at the landfill have shown that methane is routinely being detected at concentrations greater than 5%.

As indicated in the June 23, 2004 correspondence from Draper Aden Associates to Ms. Wendy Simmons of the Solid Waste Section, Watauga County has taken a number of steps to address the situation and has additional plans for future activities that may help control gas migration at the facility. Unfortunately efforts so far have not been effective in preventing concentrations from exceeding the regulatory limit at the property boundary. As a result, additional efforts must be taken to insure the protection of public health and to correct the problem and bring the facility back in compliance with the requirements.

Given the right conditions, methane has the potential to be a significant public health hazard. There are several residences adjacent to the area of the landfill where the gas problem exists. Although the county is sampling these houses semi-annually, when accessible, semi-annual screening for methane may not provide sufficient safety coverage. The dynamics that influence gas movement and migration vary. Methane concentrations can fluctuate widely depending on the conditions at the time they were measured. Results from periodic screening can be misleading.

Therefore, within sixty days of receipt of this correspondence, Watauga County should proceed with the design and implementation of additional remedial measures necessary to bring the landfill in compliance with respect to explosive gas requirements. Previous actions have failed to correct the problem by preventing the migration of methane to the property boundary at concentrations greater than the regulatory limit.

The county should also take immediate steps to insure the protection of public health from potential hazards associated with methane gas. Residences on adjacent properties and any enclosed structures on the landfill property must be adequately monitored and protected at all times.

Thank you for your cooperation with this important matter. If you have any questions, please call me at (919) 733-0692, extension 257.

Sincerely,

Larry Rose  
Solid Waste Section

cc: Mark Poindexter – Head, Field Operations Branch  
Brent Rockett – Western District Supervisor  
Lynn Croy – Draper Aden Associates

1646 Mail Service Center, Raleigh, North Carolina 27699-1646  
Phone 919-733-4996 \ FAX 919-715-3605 \ Internet <http://wastenotnc.org>

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**ATTACHMENT G**

**LFG COLLECTION SYSTEM DRAWING**

Drawing Under Seperate Cover

Drawing Under Seperate Cover



**ATTACHMENT H**

**GAS MONITORING DATA AND REPORTS**

**METHANE GAS PROBE MONITORING SUMMARY  
EFFECTS OF ACTIVE LANDFILL GAS COLLECTION SYSTEM  
WATAUGA COUNTY LANDFILL - BOONE, NC**

PROBE	METHANE CONCENTRATION (% by vol)												
	2/11/2005	2/18/2005	2/25/2005	3/4/2005	3/12/2005	3/18/2005	3/26/2005	4/5/2005	4/11/2005	4/19/2005	4/27/2005	5/11/2005	
WCLFGP1Y	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
WCLFGP1G	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
WCLFGP1R	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
WCLFGP1B	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
WCLFGP2Y	19.7	4.1	1.8	0.9	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
WCLFGP2G	1.2	2.2	27.4	7.1	6.0	8.8	9.6	5.7	0.6	0.0	0.0	0.0	
WCLFGP2R	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
WCLFGP2B	48.8	23.0	10.7	6.5	4.3	3.0	2.1	1.0	0.4	0.0	0.0	0.0	

B = BLUE  
G = GREEN  
R = RED  
Y = YELLOW

## **McGee Environmental, Inc.**

6734 Knollgate Drive  
Charlotte, NC 28212

March 14, 2005  
Job No. J2-20501-00

Mr. Rocky Nelson  
County Manager  
Watauga County  
842 West King Street  
Boone, NC 28607

Subject: Watauga County Landfill Gas (LFG) System Operations and Monitoring  
Report: February 2005

Dear Rocky:

McGee Environmental, Inc. (MEI) performed monitoring services in accordance with the proposal dated December 28, 2004, at the Watauga County Landfill (Landfill) each week during February of 2005 (beginning one week after startup). The data is presented in Tables 1 through 3. Table 4 is a record of calibration. MEI has not received any response to the letters sent out to the property owners identified for structure monitoring on February 14, 2005.

### **Observations and Work Performed**

The active LFG collection system was started on February 2, 2005. The blower/flare station (BFS) has operated continuously with only brief shutdowns for maintenance activities. The converted solar flare has experienced some problems with combustion of the LFG. Very high wind conditions during the month of February have blown the flare out on numerous occasions. MEI re-lit the flare during each visit to the site and has worked with Landfill staff to keep the flare burning. BFS inlet vacuum ranged from 14.3 to 27.4 inches of Water Column (in-W.C.) during February. LFG flow rates peaked at 22 Standard Cubic Feet per Minute (SCFM) just after startup and have stabilized at 13 SCFM. Methane content declined from an initial concentration of 57.6 percent by-volume to around 30 percent during the last two monitoring events.

The extraction wells (EW) have been adjusted in an effort to minimize LFG migration along the southern boundary of the Landfill. Both EW-13 and EW-15 experienced rapid increases of balance gas and/or oxygen indicating air intrusion. Vacuum and flow were reduced to prevent excessive air infiltration. The monitored flow rate at EW-14 ranged from 12 to 28 SCFM with a respective vacuum of 14.4 to 25.6 in-W.C. This well provides the majority of LFG at the flare. Balance gas and oxygen levels have increased at EW-14 as well.

The perimeter monitoring wells provide a monitoring point to evaluate subsurface soil gas conditions and are the regulatory compliance point for potential LFG migration. The

Mr. Rocky Nelson

March 14, 2005

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compliance limit and lower explosive limit (LEL) of methane is 5.0 percent by-volume. Methane was not detected at any of the four levels of Probe #1. Methane was monitored in excess of 5% at the following locations at Probe #2: Blue, Green, and Yellow. During the monitoring procedure peak methane concentration and final methane concentration are recorded (Please see Table 3). In most cases, the sustained or final value (110 second sampling time) is used as the compliance reading. The sustained reading at the Blue level of Probe #2 declined from 34.2 percent by-volume to 8.1 percent methane during February. Probe #2 Yellow declined from 16.2 percent to 1.5 percent methane. The methane concentration at the Green level of Probe #2 actually increased from 1.2 percent to 25.8 percent methane by-volume.

### **Conclusions**

High wind conditions at the Landfill are making it difficult to keep the flare lit. The blower system continues to provide vacuum for the extraction wells at times when the flare is not burning however uncombusted LFG is being vented to atmosphere. MEI has made plans to improve the flare's ability to remain lit and to improve the solar ignition system. Oxygen concentration of the LFG at the BFS exceeded 5.0 percent by-volume during the last two monitoring events in February. MEI has made adjustments to the extraction wells and blower inlet flow control valve to reduce this valve below 5.0 percent.

The extraction wells are showing signs of air intrusion. Balance gas (assumed to be primarily atmospheric nitrogen) ranged from 38.8 percent at EW-14 to 49.4 percent at EW-15. Oxygen concentration has exceeded 5.0 percent at EW-14 and EW-15. MEI has reduced vacuum levels to bare minimum at EW-13 and EW-15 while maintaining a flow rate of 12 SCFM at EW-14. We are using an aggressive approach in balancing the wellfield to help reduce methane levels in the perimeter monitoring probes. Temperature at the wellheads ranged from 41° to 54 °F and does not indicate a problem at this time.

Monitoring data at the perimeter monitoring probes suggest that the active LFG collection system is helping reduce LFG migration along the southern boundary of the Landfill. Methane concentration has declined at two of three monitoring locations where it has previously been detected. The Green level at Probe #2 has seen an increase in methane concentration.

### **Recommendations**

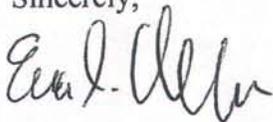
The LFG system is being operated in an aggressive mode to minimize LFG migration. MEI recommends continued monitoring and adjusting on a weekly basis to keep atmospheric air intrusion into the system as low as possible. We are currently using one of the smallest LFG blowers available and have made an effort to keep vacuum levels as low as possible on the system. Air intrusion continues to be a problem and will need to be reduced in the very near future. MEI recommends that EW-12, EW-16, EW-17, and EW-18 be connected to the active LFG system as soon as feasibly possible. With an

Mr. Rocky Nelson  
March 14, 2005  
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additional 4 extraction wells and associated pressure losses over long runs of pipe, we should be able to spread the system vacuum out over a larger system, and reduce air intrusion, while maximizing all of the control devices along the southern boundary of the Landfill.

Thank you for the opportunity to provide LFG operations and monitoring activities to Watauga County. If you have any questions, please do not hesitate to call me at (828) 337-5065.

Sincerely,



Eric S. McGee  
President  
McGee Environmental, Inc.

Enclosure

CC: J.V. Potter, Watauga County

Watauga County Landfill  
 February 2005 Monitoring Data  
 Table 1. Blower Flare Station Data

LOCATION	TIME	DATE	CH4	CO2	O2	BAL	SP	DP	TEMP	FLOW	COMMENT
BLOWER INLET	17:13	2/2/2005	57.6	33.7	2.6	6.1	-16.8				
BLOWER INLET	17:29	2/2/2005	56.4	33.2	1.7	8.7	-18.3				
BLOWER INLET	21:00	2/2/2005	53.4	31.1	3.0	12.5	-19.6				
BLOWER INLET	21:03	2/2/2005	53.3	31.6	2.6	12.5	-16.0				ADJUST DOWN
BLOWER INLET	9:53	2/3/2005	48.1	31.0	2.5	18.4	-14.3		36		
BLOWER INLET	11:03	2/3/2005	49.7	30.3	2.6	17.4	-19.7		39		
BLOWER INLET	11:04	2/3/2005	49.7	30.3	2.6	17.4	-16.5		39		ADJUST DOWN
BLOWER INLET	12:16	2/11/2005	33.1	24.5	4.4	38.0	-18.5		38		
BLOWER INLET	13:55	2/11/2005	32.2	23.5	4.5	39.8	-17.2		38		
BLOWER INLET	11:28	2/18/2005	29.9	24.1	5.3	40.7	-27.4		38		
BLOWER INLET	13:21	2/18/2005	29.0	22.7	5.6	42.7	-17.9		39		
BLOWER INLET	8:32	2/25/2005	30.3	23.3	5.8	40.6	-17.5		37		
BLOWER INLET	10:31	2/25/2005	30.1	23.7	5.5	40.7	-16.5		43		
FLARE INLET	9:51	2/3/2005	48.3	31.4	2.9	17.4	0.8	9.08	72	22	
FLARE INLET	11:06	2/3/2005	50.2	30.4	2.6	16.8	0.4	4.32	80	15	
FLARE INLET	12:22	2/11/2005	33.0	24.5	4.5	38.0	0.4	4.30	71	15	ADJUST DOWN
FLARE INLET	13:53	2/11/2005	32.3	23.9	4.5	39.3	0.4	4.34	72	15	
FLARE INLET	11:30	2/18/2005	30.2	24.0	5.3	40.5	0.6	8.24	69	21	
FLARE INLET	13:23	2/18/2005	29.2	23.0	5.7	42.1	1.9	3.29	70	13	ADJUST DOWN
FLARE INLET	8:35	2/25/2005	30.7	23.2	5.7	40.4	1.4	3.85	73	14	
FLARE INLET	10:34	2/25/2005	29.7	23.3	5.5	41.5	1.8	3.16	87	13	

BAL = BALANCE GAS  
 SP = STATIC PRESSURE; INCHES OF WATER COLUMN (IN-W.C.)  
 DP = DIFFERENTIAL PRESSURE (IN-W.C.)  
 FLOW = FLOWRATE; STANDARD CUBIC FEET PER MIN. (SCFM)

Watauga County Landfill  
February 2005 Monitoring Data  
Table 2. Extraction Wells

LOCATION	TIME	DATE	CH4	CO2	O2	BAL	SP	DP	TEMP	RFLOW	AFLOW	COMMENT
WCLFEW13	17:42	2/2/2005	58.4	35.3	0.9	5.4	-18.7	0.01	50	3	3	WIDE OPEN
WCLFEW13	10:57	2/3/2005	38.2	30.2	1.1	30.5	-16.8	0.01	51	3	3	WIDE OPEN
WCLFEW13	11:01	2/3/2005	31.8	29.5	0.9	37.8	-9.0	0.00	49	0	0	ADJUST DOWN
WCLFEW13	12:11	2/11/2005	26.4	24.9	2.5	46.2	-6.0	-0.21	46	0	0	ADJUST DOWN
WCLFEW13	11:52	2/18/2005	28.0	24.5	3.7	43.8	-4.6	0.00	43	0	0	
WCLFEW13	8:49	2/25/2005	29.8	25.2	2.6	42.4	-3.2	0.00	41	0	0	
WCLFEW14	17:46	2/2/2005	57.5	31.5	1.9	9.1	-18.5	0.10	53	19	20	WIDE OPEN
WCLFEW14	10:54	2/3/2005	55.6	31.5	2.4	10.5	-16.4	0.08	54	18	18	WIDE OPEN
WCLFEW14	12:04	2/11/2005	36.2	26.0	3.8	34.0	-25.6	0.19	54	28	26	ADJUST DOWN
WCLFEW14	11:48	2/18/2005	31.7	25.2	4.8	38.3	-25.3	0.15	53	24	22	
WCLFEW14	11:48	2/18/2005	31.7	25.2	4.8	38.3	-24.6	0.13	53	22	21	ADJUST DOWN
WCLFEW14	8:45	2/25/2005	31.7	23.9	5.6	38.8	-14.4	0.05	52	12	12	
WCLFEW15	17:49	2/2/2005	54.5	32.5	2.5	10.5	-18.7	0.07	52	15	15	WIDE OPEN
WCLFEW15	10:48	2/3/2005	45.3	28.8	4.1	21.8	-14.0	0.02	52	4	4	WIDE OPEN
WCLFEW15	10:51	2/3/2005	45.3	28.8	4.1	21.8	-8.4	0.00	50	1	1	ADJUST DOWN
WCLFEW15	11:59	2/11/2005	27.3	19.7	6.9	46.1	-7.3	0.01	49	3	2	ADJUST DOWN
WCLFEW15	11:43	2/18/2005	24.1	18.3	7.7	49.9	-5.9	0.00	48	1	1	
WCLFEW15	11:45	2/18/2005	24.1	18.3	7.7	49.9	-5.0	0.02	44	4	5	ADJUST DOWN
WCLFEW15	8:42	2/25/2005	25.1	18.6	6.9	49.4	-2.9	0.00	44	0	0	ADJUST DOWN

BAL = BALANCE GAS  
 SP = STATIC PRESSURE (IN-W.C.)  
 DP = DIFFERENTIAL PRESSURE (IN-W.C.)  
 RFLOW = REFERENCE FLOW (SCFM)  
 AFLOW = ADJUSTED FLOW (SCFM)

Watauga County Landfill  
February 2005 Monitoring Data  
Table 3. Monitoring Probes

LOCATION	TIME	DATE	PEAK CH4	CH4	CO2	O2	BAL	SP
WCLFGP1B	13:08	2/11/2005	0.0	0.0	3.2	18.2	78.6	0.0
WCLFGP1B	12:39	2/18/2005	0.0	0.0	3.2	18.4	78.4	0.0
WCLFGP1B	10:02	2/25/2005	0.0	0.0	3.2	18.0	78.8	0.0
WCLFGP1G	12:55	2/11/2005	0.0	0.0	3.6	16.7	79.7	0.0
WCLFGP1G	12:31	2/18/2005	0.0	0.0	3.8	17.6	78.6	0.0
WCLFGP1G	9:55	2/25/2005	0.0	0.0	3.1	17.3	79.6	0.0
WCLFGP1R	13:00	2/11/2005	0.0	0.0	2.4	18.7	78.9	0.1
WCLFGP1R	12:35	2/18/2005	0.0	0.0	2.5	19.1	78.4	0.0
WCLFGP1R	9:59	2/25/2005	0.0	0.0	2.6	18.5	78.9	0.0
WCLFGP1Y	12:51	2/11/2005	0.0	0.0	2.7	18.6	78.7	0.0
WCLFGP1Y	12:28	2/18/2005	0.0	0.0	2.7	19.0	78.3	0.0
WCLFGP1Y	9:51	2/25/2005	0.0	0.0	2.6	18.5	78.9	0.0
WCLFGP2B	13:27	2/11/2005	48.8	34.2	29.5	0.0	36.3	-0.2
WCLFGP2B	12:59	2/18/2005	23.0	14.7	27.0	0.0	58.3	0.0
WCLFGP2B	10:22	2/25/2005	10.7	8.1	25.0	0.0	66.9	0.0
WCLFGP2G	13:19	2/11/2005	1.2	1.2	0.8	20.1	77.9	-0.1
WCLFGP2G	12:52	2/18/2005	2.2	2.2	1.1	19.6	77.1	0.0
WCLFGP2G	10:16	2/25/2005	25.8	27.4	21.1	7.4	44.1	-0.1
WCLFGP2R	13:23	2/11/2005	0.0	0.0	14.6	11.1	74.3	0.0
WCLFGP2R	12:56	2/18/2005	0.0	0.0	14.5	8.6	76.9	0.0
WCLFGP2R	10:19	2/25/2005	0.0	0.0	10.0	12.2	77.8	0.0
WCLFGP2Y	13:15	2/11/2005	19.7	16.2	25.1	0.0	58.7	0.2
WCLFGP2Y	12:49	2/18/2005	4.1	3.6	22.7	0.0	73.7	0.0
WCLFGP2Y	10:12	2/25/2005	1.8	1.5	20.7	0.0	77.8	0.0

BAL = BALANCE GAS  
 SP = STATIC PRESSURE (IN-W.C.)  
 B = BLUE  
 G = GREEN  
 R = RED  
 Y = YELLOW

Watauga County Landfill  
February 2005 Monitoring Data  
Table 4. Calibration Log

LOCATION	TIME	DATE	CH4	CO2	O2	BAL	SP	COMMENT
CAL GAS	11:37	2/11/2005	0.0	0.0	3.7	96.3	224.0	4% O2
CAL GAS	11:38	2/11/2005	49.6	33.7	0.1	16.6	96.2	50% CH4
CAL GAS	11:20	2/18/2005	0.0	0.0	3.9	96.1	206.4	4% O2
CAL GAS	11:21	2/18/2005	50.1	35.0	0.0	14.9	142.4	50% CH4
CAL GAS	8:24	2/25/2005	0.0	0.1	4.1	95.8	182.6	4% O2
CAL GAS	8:26	2/25/2005	49.9	34.4	0.4	15.3	195.9	50% CH4

SP = STATIC PRESSURE

## **McGee Environmental, Inc.**

6734 Knollgate Drive  
Charlotte, NC 28212

April 12, 2005  
Job No. J2-20501-00

Mr. Rocky Nelson  
County Manager  
Watauga County  
842 West King Street  
Boone, NC 28607

Subject: Watauga County Landfill Gas (LFG) System Operations and Monitoring  
Report: March 2005

Dear Rocky:

McGee Environmental, Inc. (MEI) performed monitoring services in accordance with the proposal dated December 28, 2004, at the Watauga County Landfill (Landfill) each week during March of 2005. The data is presented in Tables 1 through 3. Table 4 is a record of calibration. MEI performed structure monitoring at the adjacent homes on April 5, 2005, and will present a record of the monitoring results in the April report.

### **Observations and Work Performed**

The blower/flare station (BFS) has operated continuously with only brief shutdowns for maintenance activities during March 2005. The converted solar flare has experienced some problems with combustion of the LFG. Very high wind conditions during the month of March have blown the flare out on numerous occasions. MEI re-lit the flare during each visit to the site and installed a flame deflector on the flare on March 18, 2005. Landfill staff reported that the flame was present more frequently after installation of the flame deflector. LFG flow rates have stabilized at 9-13 Standard Cubic Feet per Minute (SCFM). Methane content has stabilized at approximately 30 percent by-volume.

The extraction wells (EW) have been adjusted in an effort to minimize LFG migration along the southern boundary of the Landfill. The gas composition monitoring data at all three extraction wells indicates the presence of atmospheric air. Adjustments have been made to lower the concentration of balance gas (assumed to be primarily atmospheric nitrogen) and oxygen.

The perimeter monitoring wells provide a monitoring point to evaluate subsurface soil gas conditions and are the regulatory compliance point for potential LFG migration. The compliance limit and lower explosive limit (LEL) of methane is 5.0 percent by-volume. Methane was not detected at any of the four levels of Probe #1. Methane was monitored in excess of 5% at the Blue and Green levels of Probe #2. During the monitoring procedure peak methane concentration and final methane concentration are recorded (Please see Table 3). In most cases, the sustained or final value (110 second sampling time) is used as the compliance reading. The sustained reading at the Blue level of Probe

Mr. Rocky Nelson

April 12, 2005

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#2 declined from 5.3 percent by-volume to 1.7 percent methane during March. Methane concentration at the Green level of Probe #2 ranged from 6.0 percent to 9.6 percent. Methane was not detected at the Yellow and Red levels of Probe #2 during the last two monitoring events in March of 2005.

### **Conclusions**

The temporary flame deflector has improved the flare's ability to remain burning during high wind conditions at the Landfill. MEI has developed a design for a more permanent solution to the problem and we hope to have it installed by the end of April. Oxygen concentration of the LFG at the BFS exceeded 5.0 percent by-volume during the entire month of March. Our efforts to reduce vacuum by throttling the 6-inch valve at Condensate Sump 1 (CS-1) were not successful in lowering the oxygen concentration below 5.0 percent.

The extraction wells are showing signs of air intrusion. Balance gas (assumed to be primarily atmospheric nitrogen) ranged from 33.3 percent at EW-13 to 48.9 percent at EW-15. Oxygen concentration has exceeded 5.0 percent at EW-14 and EW-15. We are using an aggressive approach in balancing the wellfield to help reduce methane levels in the perimeter monitoring probes. Temperature at the wellheads ranged from 42° to 54 °F and does not indicate a problem at this time.

Monitoring data at the perimeter monitoring probes suggest that the active LFG collection system is helping reduce LFG migration along the southern boundary of the Landfill. Methane concentration has declined at two of three monitoring locations where it has previously been detected. Methane concentration at the Green level of Probe #2 increases to its peak at the end of the sampling time. This could be an indication that LFG is being drawn to the probe by the sampling process.

### **Recommendations**

The LFG system is being operated in an aggressive mode to minimize LFG migration. MEI recommends continued monitoring and adjusting on a weekly basis to keep atmospheric air intrusion into the system as low as possible. We are currently using one of the smallest LFG blowers available and have made an effort to keep vacuum levels as low as possible on the system. Air intrusion continues to be a problem and will need to be reduced in the very near future. MEI recommends that EW-12, EW-16, EW-17, and EW-18 be connected to the active LFG system as soon as feasibly possible. With an additional 4 extraction wells and associated pressure losses over long runs of pipe, we should be able to spread the system vacuum out over a larger system, and reduce air intrusion, while maximizing all of the control devices along the southern boundary of the Landfill.

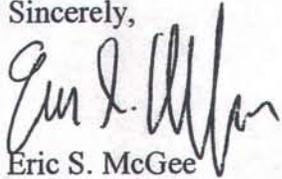
Mr. Rocky Nelson

April 12, 2005

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Thank you for the opportunity to provide LFG operations and monitoring activities to Watauga County. If you have any questions, please do not hesitate to call me at (828) 337-5065.

Sincerely,



Eric S. McGee

President

McGee Environmental, Inc.

Enclosure

CC: J.V. Potter, Watauga County

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Watauga County Landfill  
 March 2005 Monitoring Data  
 Table 1. Blower Flare Station Data

LOCATION	TIME	DATE	CH4	CO2	O2	BAL	SP	DP	TEMP	FLOW	COMMENT
BLOWER INLET	7:32	3/4/2005	29.5	22.9	5.6	42.0	-16.0		46		
BLOWER INLET	8:04	3/4/2005	29.2	22.7	5.5	42.6	-16.0		46		
BLOWER INLET	7:17	3/12/2005	32.5	24.5	5.3	37.7	-16.1		38		
BLOWER INLET	8:10	3/12/2005	31.7	23.8	5.8	38.7	-10.6		39		ADJUST DOWN
BLOWER INLET	8:56	3/18/2005	32.0	22.0	5.3	40.7	-43.1		43		RESTRICTED @CT-01
CT-01	9:09	3/18/2005	32.0	22.4	5.3	40.3	-11.4				WELLFIELD VALVE
BLOWER INLET	6:32	3/26/2005	31.5	23.3	5.8	39.4	-12.8		50		
FLARE INLET	7:47	3/4/2005	29.5	22.9	5.5	42.1	2.2	3.02	90	12	
FLARE INLET	8:06	3/4/2005	29.3	22.8	5.4	42.5	1.9	3.05	90	12	
FLARE INLET	7:20	3/12/2005	33.1	24.5	5.4	37.0	1.7	3.07	70	13	
FLARE INLET	8:18	3/12/2005	31.2	23.4	5.9	39.5	1.2	1.70	82	9	ADJUST DOWN
FLARE INLET	8:54	3/18/2005	32.2	22.7	5.4	39.7	1.4	1.02	90	7	
FLARE INLET	6:28	3/26/2005	31.6	23.3	5.8	39.3	1.1	1.81	91	9	

BAL = BALANCE GAS  
 SP = STATIC PRESSURE; INCHES OF WATER COLUMN (IN-W.C.)  
 DP = DIFFERENTIAL PRESSURE (IN-W.C.)  
 FLOW = FLOWRATE; STANDARD CUBIC FEET PER MIN. (SCFM)

Watauga County Landfill  
 March 2005 Monitoring Data  
 Table 2. Extraction Wells

LOCATION	TIME	DATE	CH4	CO2	O2	BAL	SP	DP	TEMP	RFLOW	AFLOW	COMMENT
WCLFEW13	8:01	3/4/2005	30.1	24.8	3.1	42.0	-3.0	0.00	48	0	0	
WCLFEW13	7:33	3/12/2005	36.6	28.2	1.9	33.3	-3.1	0.22	42	30	30	QUESTIONABLE FLOW DATA
WCLFEW13	9:23	3/18/2005	37.7	25.8	1.3	35.2	-2.6	0.00	48	0	0	
WCLFEW13	6:43	3/26/2005	34.8	27.0	1.8	36.4	-2.8	0.00	47	1	1	ADJUST DOWN
WCLFEW14	7:57	3/4/2005	29.7	23.1	5.5	41.7	-13.8	0.04	52	9	9	
WCLFEW14	7:30	3/12/2005	32.0	24.3	5.8	37.9	-14.0	0.05	52	11	11	
WCLFEW14	9:20	3/18/2005	31.4	22.8	5.5	40.3	-9.8	0.02	54	4	5	ADJUST DOWN
WCLFEW14	6:40	3/26/2005	31.2	23.4	5.9	39.5	-9.6	0.02	54	4	4	
WCLFEW15	7:54	3/4/2005	25.0	18.5	7.6	48.9	-2.3	0.00	52	0	0	
WCLFEW15	7:27	3/12/2005	32.5	21.7	7.0	38.8	-2.0	0.02	44	7	6	
WCLFEW15	9:15	3/18/2005	29.6	18.8	7.3	44.3	-1.8	0.00	46	0	0	
WCLFEW15	6:37	3/26/2005	29.5	19.5	7.1	43.9	-1.9	0.00	49	0	0	

BAL = BALANCE GAS  
 SP = STATIC PRESSURE (IN-W.C.)  
 DP = DIFFERENTIAL PRESSURE (IN-W.C.)  
 RFLOW = REFERENCE FLOW (SCFM)  
 AFLOW = ADJUSTED FLOW (SCFM)

Watauga County Landfill  
 March 2005 Monitoring Data  
 Table 3. Monitoring Probes

LOCATION	TIME	DATE	PEAK CH4	CH4	CO2	O2	BAL	SP
WCLFGP1B	8:40	3/4/2005	0.0	0.0	2.6	17.3	80.1	0.0
WCLFGP1B	8:43	3/12/2005	0.0	0.0	2.8	16.8	80.4	0.0
WCLFGP1B	9:49	3/18/2005	0.0	0.0	2.7	18.5	78.8	0.0
WCLFGP1B	7:17	3/26/2005	0.0	0.0	2.6	17.0	80.4	0.0
WCLFGP1G	8:33	3/4/2005	0.0	0.0	3.4	16.0	80.6	0.0
WCLFGP1G	8:37	3/12/2005	0.0	0.0	3.8	17.6	78.6	0.0
WCLFGP1G	9:42	3/18/2005	0.0	0.0	3.2	16.7	80.1	0.0
WCLFGP1G	7:10	3/26/2005	0.0	0.0	3.3	15.5	81.2	0.0
WCLFGP1R	8:37	3/4/2005	0.0	0.0	2	17.9	80.1	0.0
WCLFGP1R	8:40	3/12/2005	0.0	0.0	2.3	16.8	80.9	0.0
WCLFGP1R	9:46	3/18/2005	0.0	0.0	2.2	18.7	79.1	0.0
WCLFGP1R	7:14	3/26/2005	0.0	0.0	2.2	17.3	80.5	0.2
WCLFGP1Y	8:29	3/4/2005	0.0	0.0	2.2	17.7	80.1	0.0
WCLFGP1Y	8:33	3/12/2005	0.0	0.0	2.2	17.0	80.8	0.0
WCLFGP1Y	9:39	3/18/2005	0.0	0.0	2.3	18.6	79.1	0.0
WCLFGP1Y	7:06	3/26/2005	0.0	0.0	1.4	17.6	81.0	0.0
WCLFGP2B	9:06	3/4/2005	6.5	5.3	23.1	0.0	71.6	0.1
WCLFGP2B	9:05	3/12/2005	4.3	4.0	22.1	0.0	73.9	0.0
WCLFGP2B	10:08	3/18/2005	3.0	2.6	19.9	0.0	77.5	0.0
WCLFGP2B	7:36	3/26/2005	2.1	1.7	19.8	0.0	78.5	0.0
WCLFGP2G	8:58	3/4/2005	7.1	7.1	4.1	15.2	73.6	0.2
WCLFGP2G	8:58	3/12/2005	6.0	6.0	5.3	15.3	73.4	0.2
WCLFGP2G	10:01	3/18/2005	8.8	8.8	12.2	10.9	68.1	-0.1
WCLFGP2G	7:29	3/26/2005	9.6	9.6	20.0	7.4	63.0	0.0
WCLFGP2R	9:02	3/4/2005	0.0	0.0	10.8	11.0	78.2	0.0
WCLFGP2R	9:02	3/12/2005	0.0	0.0	7.5	13.5	79.0	0.1
WCLFGP2R	10:04	3/18/2005	0.0	0.0	0.0	19.8	80.2	0.0
WCLFGP2R	7:33	3/26/2005	0.0	0.0	6.6	14.3	79.1	0.0
WCLFGP2Y	8:54	3/4/2005	0.9	0.8	19.1	0.0	80.1	0.0
WCLFGP2Y	8:54	3/12/2005	0.6	0.6	18.1	0.0	81.3	0.0
WCLFGP2Y	9:58	3/18/2005	0.0	0.0	16.4	0.1	83.5	0.0
WCLFGP2Y	7:25	3/26/2005	0.0	0.0	16.4	0.8	82.8	0.0

BAL = BALANCE GAS  
 SP = STATIC PRESSURE (IN-W.C.)  
 B = BLUE  
 G = GREEN  
 R = RED  
 Y = YELLOW

Watauga County Landfill  
March 2005 Monitoring Data  
Table 4. Calibration Log

LOCATION	TIME	DATE	CH4	CO2	O2	BAL	SP	COMMENT
CAL GAS	7:11	3/12/2005	49.8	34.6	0.0	15.6	184.4	50% CH4
CAL GAS	8:48	3/18/2005	0.0	0.0	3.9	96.1	153.5	4% O2
CAL GAS	8:50	3/18/2005	49.4	34.2	0.0	16.4	184.6	50% CH4
CAL GAS	6:22	3/26/2005	0.0	0.0	4.0	96.0	178.0	4% O2
CAL GAS	6:24	3/26/2005	50.0	35	0.1	14.9	219.0	50% CH4

SP = STATIC PRESSURE

## **McGee Environmental, Inc.**

6734 Knollgate Drive  
Charlotte, NC 28212

May 11, 2005  
Job No. J2-20501-00

Mr. Rocky Nelson  
County Manager  
Watauga County  
842 West King Street  
Boone, NC 28607

Subject: Watauga County Landfill Gas (LFG) System Operations and Monitoring  
Report: April 2005

Dear Rocky:

McGee Environmental, Inc. (MEI) performed monitoring services in accordance with the proposal dated December 28, 2004, at the Watauga County Landfill (Landfill) each week during April of 2005. The data is presented in Tables 1 through 3. Table 4 is a record of calibration. MEI performed structure monitoring at the adjacent homes on April 5, 2005, details of the monitoring are presented below.

### **Observations and Work Performed**

#### Blower-Flare Station

The blower/flare station (BFS) has operated continuously with only brief shutdowns for maintenance activities during April 2005. The converted solar flare was burning on almost all observed occasions with one or two flame-outs during extremely high wind speed conditions. LFG flow rates ranged from 14 to 21 Standard Cubic Feet per Minute (SCFM).

#### Extraction Wells

The extraction wells (EW) have been adjusted in an effort to minimize LFG migration along the southern boundary of the Landfill. The gas composition monitoring data at all three extraction wells indicates the presence of atmospheric air. Adjustments have been made to lower the concentration of balance gas (assumed to be primarily atmospheric nitrogen) and oxygen.

#### Perimeter Monitoring Wells

The perimeter monitoring wells provide a monitoring point to evaluate subsurface soil gas conditions and are the regulatory compliance point for potential LFG migration. The compliance limit and lower explosive limit (LEL) of methane is 5.0 percent by-volume. Methane was not detected at any of the four levels of Probe #1. Methane was monitored in excess of 5% at the Green level of Probe #2 on April 4, 2005.

(704)506-8601 · (704) 296-2197 Fax · mcgeenvironmental@carolina.rr.com

Mr. Rocky Nelson  
May 11, 2005  
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During the monitoring procedure peak methane concentration and final methane concentration are recorded (Please see Table 3). In most cases, the sustained or final value (110 second sampling time) is used as the compliance reading. The sustained reading at the Green level of Probe #2 was 5.7 percent by-volume on April 5<sup>th</sup>. Methane was not detected above 1.0-percent during any of the subsequent monitoring events in April of 2005.

### Structure Monitoring

MEI used the MSA Orion G Combustible Gas Monitor to monitor the following residences adjacent to the Watauga County Landfill and the US Forest Service trailer for the presence of methane on April 5, 2005:

**425 Green Briar Rd.**

**Begin: 11:12**

**End: 11:27**

#### Living Room

- Upper and lower corners
- Around fireplace

#### Kitchen

- Upper and lower corners
- Behind refrigerator

#### Left Bedroom

- Upper and lower corners
- Under desk

#### Right Bedroom

- Upper and lower corners
- Between shelving/cabinets

#### Laundry Room

- Upper and lower corners
- Behind appliances

#### Rear Bedroom

- Upper and lower corners
- Upper and lower corners of closet

#### Bathroom

- Upper and lower corners
- Behind toilet
- Under sink

Mr. Rocky Nelson

May 11, 2005

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Crawl Space

- Near HVAC equipment
- Under air handler

No methane was detected during the time indicated on April 5, 2005.

**149 Wild Rose Lane**

**Begin: 11:30**

**End: 11:37**

Access to the residence was not granted.

The following locations on the exterior of the home were monitored:

Foundation

- Spot checks at soil masonry interface
- Vent wells
- Lower porch
- Basement door

No methane was detected during the time indicated on April 5, 2005.

**491 Green Briar Rd.**

**Begin: 11:40**

**End: 11:53**

Access to the residence was not granted.

The following locations on the exterior of the home were monitored:

Foundation

- Spot checks at soil masonry interface
- Vents
- Antenna pole
- Under outbuildings
- Cracks in foundation
- Under back porch
- Around sewer cleanout

Crawl Space

- Spot checks around entire perimeter of foundation
- Spot checks between floor joists
- Foundation piers
- Corners

No methane was detected during the time indicated on April 5, 2005

**513 Green Briar Rd.**

**Begin: 11:58**

**End: 12:03**

Access to the residence was not granted.

The following locations on the exterior of the home were monitored:

Mr. Rocky Nelson

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Foundation

- Spot checks at soil masonry interface
- Garage doors
- Gutter drains
- Foundation corners
- Around chimney
- Around sewer cleanout
- Basement windows
- Dryer vents
- Under deck
- Window well
- Electric service inlet

No methane was detected during the time indicated on April 5, 2005.

**535 Green Briar Rd.**

**Begin: 12:07**

**End: 12:19**

Access to the residence was not granted.

The following locations on the exterior of the home were monitored:

Foundation

- Spot checks at soil masonry interface
- Beside steps
- Around chimney
- Under back deck
- Around crawl space door
- Under front deck
- Foundation step ups

No methane was detected during the time indicated on April 5, 2005.

**NC Forest Service Trailer**

**Begin: 13:09**

**End: 13:27**

Crawl Space

- Spot checks around interior base
- Corners
- Under moisture barrier
- Electrical conduit

Main Room

- Upper and lower corners
- Under sink
- Beside stove
- Closet
- Around furnace
- Spot checks between floor joists

Mr. Rocky Nelson

May 11, 2005

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Bathroom

- Under sink
- Behind toilet
- Upper and lower corners

Left Office

- Upper and lower corners
- Under desks
- Between cabinet
- Closet upper and lower corners

Right Office

- Upper and lower corners
- Between book cases
- Under desk
- Closet upper and lower corners

No methane was detected during the time indicated on April 5, 2005.

**Conclusions**

The Blower/flare station continues to operate well with the flame deflector installed. Additional extraction wells connected to the LFG collection system in early May 2005 have improved the LFG composition and flow rates.

The extraction wells are showing signs of air intrusion. Balance gas (assumed to be primarily atmospheric nitrogen) ranged from 42.0 percent at EW-14 to 60.8 percent at EW-13. Oxygen concentration has exceeded 5.0 percent at all three wells. We are using an aggressive approach in balancing the wellfield to help reduce methane levels in the perimeter monitoring probes. Temperature at the wellheads ranged from 51° to 71 °F and does not indicate a problem at this time. Additional extraction wells connected to the LFG system in early May 2005 have allowed MEI to reduce vacuum on EW-13, EW-14, and EW-15. This should reduce atmospheric air intrusion.

Monitoring data at the perimeter monitoring probes suggest that the active LFG collection system is helping reduce LFG migration along the southern boundary of the Landfill. Methane concentrations were 0.0 percent by-volume at all perimeter monitoring probes during the last two monitoring events in April.

Structure monitoring at residences adjacent to the Landfill and the US Forest Service trailer on April 5, 2005, did not detect any methane.

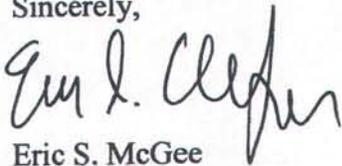
Mr. Rocky Nelson  
May 11, 2005  
Page 6 of 6

**Recommendations**

The LFG system is being operated in an aggressive mode to minimize LFG migration. MEI recommends that construction of the active LFG collection system proceed as planned until all 22 wells are under active extraction. MEI also recommends wellfield and BFS monitoring and adjusting at 2 week intervals until the system is complete and balanced.

Thank you for the opportunity to provide LFG operations and monitoring activities to Watauga County. If you have any questions, please do not hesitate to call me at (828) 337-5065.

Sincerely,



Eric S. McGee  
President  
McGee Environmental, Inc.

Enclosure

CC: J.V. Potter, Watauga County

C:\Project Files\Watauga\Report\watauga.2005.04.doc

Watauga County Landfill  
 April 2005 Monitoring Data  
 Table 1. Blower Flare Station Data

LOCATION	TIME	DATE	CH4	CO2	O2	BAL	SP	DP	TEMP	FLOW	COMMENT
BLOWER INLET	8:44	4/5/2005	26.5	20.1	6.5	46.9	-29.4		57		
BLOWER INLET	13:24	4/5/2005	27.6	20.5	6.3	45.6	-30.4		63		
WCLFCTO1	8:40	4/5/2005	29.0	20.4	6.1	44.5	-9.8				WELLFIELD VALVE
WCLFCTO1	8:41	4/5/2005	29.0	20.4	6.1	44.5	-22.7				ADJUST UP
WCLFCTO1	13:29	4/5/2005	28.0	21.0	5.8	45.2	-27.0				WELLFIELD VALVE
WCLFCTO1	13:29	4/5/2005	27.9	20.9	5.7	45.5	-28.6				WELLFIELD VALVE
BLOWER INLET	9:02	4/11/2005	25.1	20.1	6.8	48.0	-33.2				
BLOWER INLET	9:15	4/11/2005	26.1	21.1	6.1	46.7	-31.9				
BLOWER INLET	14:22	4/15/2005	23.9	20.6	6.7	48.8	-33.0				
BLOWER INLET	14:53	4/19/2005	24.6	19.6	6.9	48.9	-31.0		69		
BLOWER INLET	10:35	4/27/2005	21.3	17.8	7.6	53.3	-31.4		55		
BLOWER INLET	15:12	4/27/2005	21.7	19.6	6.9	51.8	-29.7		53		
BLOWER INLET	6:47	4/29/2005	16.7	14.6	10.0	58.7	-30.3		49		
BLOWER INLET	7:14	4/29/2005	21.7	19.2	7.6	51.5	-32.0		49		
FLARE INLET	8:47	4/5/2005	27.2	20.5	6.4	45.9	3.5	6.17	117	16	
FLARE INLET	13:27	4/5/2005	27.7	21.3	6.0	45.0	3.6	5.49	136	14	
FLARE INLET	9:18	4/11/2005	25.7	21.0	6.4	46.9	0.6	6.35	124	16	
FLARE INLET	14:19	4/15/2005	23.6	20.0	7.1	49.3	0.5	6.37	120	16	
FLARE INLET	14:51	4/19/2005	25.0	20.0	6.6	48.4	0.6	6.28	144	14	
FLARE INLET	10:38	4/27/2005	23.5	19.8	7.6	49.1	0.6	7.20	105	18	
FLARE INLET	15:15	4/27/2005	22.1	19.9	6.6	51.4	0.8	8.37	96	20	
FLARE INLET	6:50	4/29/2005	22.5	19.6	7.6	50.3	0.8	8.38	85	21	

BAL = BALANCE GAS  
 SP = STATIC PRESSURE; INCHES OF WATER COLUMN (IN-W.C.)  
 DP = DIFFERENTIAL PRESSURE (IN-W.C.)  
 FLOW = FLOWRATE; STANDARD CUBIC FEET PER MIN. (SCFM)

Watauga County Landfill  
 April 2005 Monitoring Data  
 Table 2. Extraction Wells

LOCATION	TIME	DATE	CH4	CO2	O2	BAL	SP	DP	TEMP	RFLOW	AFLOW	COMMENT
WCLFEW13	9:05	4/5/2005	29.7	24.2	2.2	43.9	-5.2	0.00	56	0	0	ADJUST UP
WCLFEW13	9:13	4/11/2005	23.2	22.8	3.4	50.6	-6.8	0.00	56	0	0	
WCLFEW13	14:31	4/15/2005	20.2	22.2	3.9	53.7	-6.9	0.00	57	0	0	
WCLFEW13	15:05	4/19/2005	24.4	22.3	3.7	49.6	-11.0	-0.01	63	0	0	
WCLFEW13	10:50	4/27/2005	15.7	17.8	6.6	59.9	-15.9	0.01	54	1	2	
WCLFEW13	7:09	4/29/2005	15.2	17.3	6.7	60.8	-16.5	0.00	53	0	0	
WCLFEW14	9:01	4/5/2005	30.7	22.4	4.9	42.0	-16.4	0.07	57	18	14	ADJUST DOWN
WCLFEW14	9:10	4/11/2005	25.4	20.0	7.2	47.4	-19.3	0.05	57	12	11	ADJUST DOWN
WCLFEW14	14:29	4/15/2005	25.0	21.4	6.5	47.1	-19.8	0.10	58	18	18	
WCLFEW14	15:00	4/19/2005	25.1	19.9	7.0	48.0	-18.5	0.05	62	9	10	
WCLFEW14	10:47	4/27/2005	26.3	21.4	7.2	45.1	-19.0	0.06	56	12	12	
WCLFEW14	7:04	4/29/2005	25.3	21.4	6.7	46.6	-19.2	0.05	56	10	10	
WCLFEW15	8:58	4/5/2005	24.6	18.2	7.6	49.6	-2.8	0.00	57	0	0	
WCLFEW15	9:07	4/11/2005	25.6	18.7	7.6	48.1	-3.4	0.00	55	0	0	
WCLFEW15	14:26	4/15/2005	22.8	17.7	8.0	51.5	-3.3	-0.01	62	0	0	
WCLFEW15	14:58	4/19/2005	24.2	17.2	8.1	50.5	-2.8	0.00	71	0	0	
WCLFEW15	10:42	4/27/2005	23.5	17.6	8.0	50.9	-3.5	0.00	53	0	0	
WCLFEW15	10:44	4/27/2005	23.5	17.6	8.0	50.9	-5.4	0.00	53	1	0	
WCLFEW15	7:01	4/29/2005	22.1	18.1	7.4	52.4	-5.2	0.00	51	0	0	

BAL = BALANCE GAS  
 SP = STATIC PRESSURE (IN-W.C.)  
 DP = DIFFERENTIAL PRESSURE (IN-W.C.)  
 RFLOW = REFERENCE FLOW (SCFM)  
 AFLOW = ADJUSTED FLOW (SCFM)

Watauga County Landfill  
 April 2005 Monitoring Data  
 Table 3. Monitoring Probes

LOCATION	TIME	DATE	PEAK CH4	CH4	CO2	O2	BAL	SP
WCLFGP1B	10:24	4/5/2005	0.0	0.0	2.6	17.2	80.2	0.0
WCLFGP1B	9:46	4/11/2005	0.0	0.0	2.5	17.3	80.2	0.0
WCLFGP1B	15:26	4/19/2005	0.0	0.0	2.4	17.2	80.4	0.0
WCLFGP1B	11:21	4/27/2005	0.0	0.0	2.7	16.6	80.7	0.0
WCLFGP1G	10:17	4/5/2005	0.0	0.0	0.1	19.7	80.2	0.0
WCLFGP1G	9:39	4/11/2005	0.0	0.0	1.2	17.5	81.3	0.0
WCLFGP1G	15:19	4/19/2005	0.0	0.0	3.1	16.3	80.6	0.0
WCLFGP1G	11:14	4/27/2005	0.0	0.0	1.8	17.2	81	0.0
WCLFGP1R	10:21	4/5/2005	0.0	0.0	2.3	17.4	80.3	0.0
WCLFGP1R	9:43	4/11/2005	0.0	0.0	2.3	17.8	79.9	0.0
WCLFGP1R	15:23	4/19/2005	0.0	0.0	2.2	18.2	79.6	0.0
WCLFGP1R	11:18	4/27/2005	0.0	0.0	2.4	17.0	80.6	0.0
WCLFGP1Y	10:14	4/5/2005	0.0	0.0	2.3	17.2	80.5	0.0
WCLFGP1Y	9:36	4/11/2005	0.0	0.0	1.7	17.9	80.4	0.0
WCLFGP1Y	15:16	4/19/2005	0.0	0.0	2.2	17.5	80.3	0.0
WCLFGP1Y	11:11	4/27/2005	0.0	0.0	2.7	16.6	80.7	0.0
WCLFGP2B	10:42	4/5/2005	1.0	0.6	18.2	0.0	81.2	-0.3
WCLFGP2B	10:07	4/11/2005	0.4	0.1	17.8	1.7	80.4	0.0
WCLFGP2B	15:45	4/19/2005	0.0	0.0	16.1	5.9	78.0	0.0
WCLFGP2B	11:40	4/27/2005	0.0	0.0	14.7	6.9	78.4	0.0
WCLFGP2G	10:36	4/5/2005	5.7	5.7	13.4	7.6	73.3	-0.1
WCLFGP2G	9:59	4/11/2005	0.5	0.6	0.6	18.4	80.4	0.0
WCLFGP2G	15:38	4/19/2005	0.0	0.0	12.6	8.5	78.9	0.0
WCLFGP2G	11:33	4/27/2005	0.0	0.0	0.4	19.4	80.2	0.2
WCLFGP2R	10:39	4/5/2005	0.0	0.0	0.3	19.8	79.9	0.0
WCLFGP2R	10:03	4/11/2005	0.0	0.0	5.3	15.3	79.4	0.0
WCLFGP2R	15:41	4/19/2005	0.0	0.0	6.3	15.6	78.1	0.0
WCLFGP2R	11:36	4/27/2005	0.0	0.0	6.2	15.0	78.8	0.0
WCLFGP2Y	10:32	4/5/2005	0.0	0.0	14.8	0.9	84.3	-0.5
WCLFGP2Y	9:55	4/11/2005	0.0	0.6	18.1	0.0	81.3	0.0
WCLFGP2Y	15:35	4/19/2005	0.0	0.0	12.5	8.5	79.0	0.3
WCLFGP2Y	11:29	4/27/2005	0.0	0.0	11.9	8.7	79.4	0.0

BAL = BALANCE GAS  
 SP = STATIC PRESSURE (IN-W.C.)  
 B = BLUE  
 G = GREEN  
 R = RED  
 Y = YELLOW

Watauga County Landfill  
April 2005 Monitoring Data  
Table 4. Calibration Log

LOCATION	TIME	DATE	CH4	CO2	O2	BAL	SP	COMMENT
CAL GAS	9:23	4/5/2005	50.0	35.0	0.1	14.9	229.0	50% CH4
CAL GAS	9:21	4/5/2005	0.0	0.0	3.8	96.2	193.2	4% O2
CAL GAS	8:56	4/11/2005	50.0	35.7	0.0	14.3	228.5	50% CH4
CAL GAS	8:54	4/11/2005	0.0	0.0	4.0	96.0	228.4	4% O2
CAL GAS	14:45	4/19/2005	49.4	35.8	0.0	14.8	228.8	50% CH4
CAL GAS	14:43	4/19/2005	0.0	0.0	3.9	96.1	225.9	4% O2
CAL GAS	10:30	4/27/2005	50.2	36.0	0.0	13.8	229.2	50% CH4
CAL GAS	10:29	4/27/2005	0.0	0.1	4.0	95.9	229.4	4% O2

SP = STATIC PRESSURE

## **McGee Environmental, Inc.**

6734 Knollgate Drive  
Charlotte, NC 28212

June 3, 2005  
Job No. J2-20501-00

Mr. Rocky Nelson  
County Manager  
Watauga County  
842 West King Street  
Boone, NC 28607

Subject: Watauga County Landfill Gas (LFG) System Operations and Monitoring  
Report: May 2005

Dear Rocky:

McGee Environmental, Inc. (MEI) performed monitoring services in accordance with the proposal dated December 28, 2004, at the Watauga County Landfill (Landfill) on May 11, 2005. MEI performed an additional round of LFG system monitoring on May 19, 2005. The data is presented in Tables 1 through 3. Table 4 is a record of calibration.

### **Observations and Work Performed**

#### Blower-Flare Station

The blower/flare station (BFS) has operated continuously with only brief shutdowns for maintenance activities during May 2005. Improved LFG composition and an increase in flow rate are due to the connection of additional extraction wells to the active LFG collection system. The flow rate has stabilized at 21 Standard Cubic Feet per Minute (SCFM). Methane concentration has increased to approximately 41 percent by-volume while oxygen concentration decline to 2.1 percent.

#### Extraction Wells

Five new extraction wells (EW) were added to the active LFG collection system in May of 2005. The new wells are EW-11, EW-12, EW-16, EW-17, and EW-18. Methane concentration at these wells ranged from 32 percent to 55 percent by-volume. MEI adjusted and balanced the system in an effort to increase methane concentration and decrease oxygen concentration at the BFS.

#### Perimeter Monitoring Wells

The perimeter monitoring wells provide a monitoring point to evaluate subsurface soil gas conditions and are the regulatory compliance point for potential LFG migration. The compliance limit and lower explosive limit (LEL) of methane is 5.0 percent by-volume. Methane was not detected at any of the perimeter monitoring wells on May 11, 2005.

Mr. Rocky Nelson  
June 3, 2005  
Page 2 of 2

### **Conclusions**

The Blower/flare station continues to operate well with the flame deflector installed. Additional extraction wells connected to the LFG collection system have improved LFG composition and overall system performance.

The three original extraction wells (EW-13, EW-14, and EW-15) have been subject to atmospheric air intrusion. The addition of five new wells has facilitated better distribution of system vacuum and should help to reduce oxygen and balance gas concentration at the BFS. As the LFG collection system construction progresses, gas composition and LFG collection efficiency should improve.

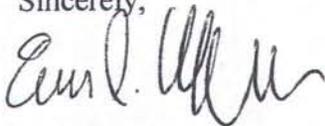
Monitoring data at the perimeter monitoring probes suggest that the active LFG collection system is helping reduce LFG migration along the southern boundary of the Landfill. Methane concentrations were 0.0 percent by-volume at all perimeter monitoring probes during the last three monitoring events conducted in April and May of 2005.

### **Recommendations**

The LFG system is being operated in an aggressive mode to minimize LFG migration. MEI recommends that construction of the active LFG collection system proceed as planned until all 22 wells are under active extraction. MEI also recommends wellfield and BFS monitoring and adjusting at 2 week intervals until the system is complete and balanced.

Thank you for the opportunity to provide LFG operations and monitoring activities to Watauga County. If you have any questions, please do not hesitate to call me at (828) 337-5065.

Sincerely,



Eric S. McGee  
President  
McGee Environmental, Inc.

Enclosure

CC: J.V. Potter, Watauga County

Watauga County Landfill  
 May 2005 Monitoring Data  
 Table 1. Blower Flare Station Data

LOCATION	TIME	DATE	CH4	CO2	O2	BAL	SP	DP	TEMP	FLOW	COMMENT
BLOWER INLET	5:47	5/11/2005	31.8	23.6	6.3	38.3	-22.0		65		
BLOWER INLET	6:12	5/11/2005	40.8	28.0	3.3	27.9	-23.2		65		
BLOWER INLET	11:40	5/19/2005	35.7	26.2	4.5	33.6	-18.4		69		
BLOWER INLET	12:13	5/19/2005	29.8	21.8	7.0	41.4	-18.5		69		
BLOWER INLET	10:39	5/23/2005	41.3	30.1	2.3	26.3	-24.7		67		
FLARE INLET	5:44	5/11/2005	26.5	20.0	7.7	45.8	9.3	-0.50	110	21	
FLARE INLET	6:14	5/11/2005	41.0	28.2	3.3	27.5	8.2	0.45	110	21	
FLARE INLET	11:43	5/19/2005	40.9	29.8	2.6	26.7	10.2	0.54	117	21	
FLARE INLET	12:15	5/19/2005	41.6	30.4	2.4	25.6	10.0	0.54	118	21	
FLARE INLET	10:41	5/23/2005	41.6	29.9	2.1	26.4	7.0	0.49	110	21	

BAL = BALANCE GAS

SP = STATIC PRESSURE; INCHES OF WATER COLUMN (IN-W.C.)

DP = DIFFERENTIAL PRESSURE (IN-W.C.)

FLOW = FLOWRATE; STANDARD CUBIC FEET PER MIN. (SCFM)

Watauga County Landfill  
 May 2005 Monitoring Data  
 Table 2. Extraction Wells

LOCATION	TIME	DATE	CH4	CO2	O2	BAL	SP	DP	TEMP	RFLOW	AFLOW	COMMENT
WCLFEW11	12:09	5/19/2005	45.1	32.2	2.6	20.1	-4.9	0.02	72	4	4	
WCLFEW12	6:09	5/11/2005	45.4	31.1	2.8	20.7	-14.6	0.05	67	11	11	
WCLFEW12	12:06	5/19/2005	32.7	25.4	5.5	36.4	-11.4	0.00	75	0	1	
WCLFEW13	6:06	5/11/2005	15.9	18.1	5.7	60.3	-3.2	0.00	64	0	0	
WCLFEW13	12:03	5/19/2005	19.4	20.0	4.1	56.5	-2.3	0.00	71	0	0	
WCLFEW14	6:02	5/11/2005	17.2	17.9	7.0	57.9	-11.2	0.03	60	6	6	
WCLFEW14	6:04	5/11/2005	17.2	17.9	7.0	57.9	-9.9	0.04	60	8	8	ADJUST DOWN
WCLFEW14	11:59	5/19/2005	17.6	17.1	7.9	57.4	-7.2	0.00	64	0	1	
WCLFEW14	12:29	5/19/2005	18.4	18.0	7.4	56.2	-6.6	0.00	72	1	1	ADJUST DOWN
WCLFEW14	12:33	5/19/2005	19.4	18.8	7.0	54.8	-3.9	0.00	74	0	0	2ND READ
WCLFEW15	5:52	5/11/2005	2.8	5.8	14.3	77.1	-3.2	0.00	61	0	0	
WCLFEW15	11:47	5/19/2005	2.1	6.2	12.9	78.8	-2.4	0.00	75	0	0	
WCLFEW16	5:57	5/11/2005	45.9	29.9	1.7	22.5	-17.4	0.02	67	6	5	
WCLFEW16	11:50	5/19/2005	37.7	26.1	3.3	32.9	-15.4	0.02	74	5	5	
WCLFEW17	6:00	5/11/2005	55.2	35.0	1.3	8.5	-15.3	0.02	67	4	4	
WCLFEW17	11:56	5/19/2005	51.3	34.5	1.5	12.7	-12.6	0.01	77	1	2	
WCLFEW18	11:54	5/19/2005	55.1	32.9	1.7	10.3	-5.6	0.00	81	0	0	

BAL = BALANCE GAS  
 SP = STATIC PRESSURE (IN-W.C.)  
 DP = DIFFERENTIAL PRESSURE (IN-W.C.)  
 RFLOW = REFERENCE FLOW (SCFM)  
 AFLOW = ADJUSTED FLOW (SCFM)

Watauga County Landfill  
 May 2005 Monitoring Data  
 Table 3. Monitoring Probes

LOCATION	TIME	DATE	PEAK CH4	CH4	CO2	O2	BAL	SP
WCLFGP1B	9:48	5/11/2005	0.0	0.0	2.6	16.1	81.3	0.0
WCLFGP1G	9:41	5/11/2005	0.0	0.0	2.3	16.2	81.5	0.0
WCLFGP1R	9:45	5/11/2005	0.0	0.0	2.0	17.5	80.5	0.0
WCLFGP1Y	9:37	5/11/2005	0.0	0.0	2.4	16.6	81	0.0
WCLFGP2B	10:07	5/11/2005	0.0	0.0	13.4	7.5	79.1	0.0
WCLFGP2G	10:00	5/11/2005	0.0	0.0	0	18.9	81.1	0.0
WCLFGP2R	10:03	5/11/2005	0.0	0.0	6.7	12.1	81.2	0.0
WCLFGP2Y	9:56	5/11/2005	0.0	0.0	10.2	8.5	81.3	0.0

BAL = BALANCE GAS  
 SP = STATIC PRESSURE (IN-W.C.)  
 B = BLUE  
 G = GREEN  
 R = RED  
 Y = YELLOW

Watauga County Landfill  
May 2005 Monitoring Data  
Table 4. Calibration Log

LOCATION	TIME	DATE	CH4	CO2	O2	BAL	SP	COMMENT
CAL GAS	5:12	5/11/2005	50.1	34.9	0.0	15.0	217.8	50% CH4
CAL GAS	5:10	5/11/2005	0.0	0.0	4.1	95.9	219.4	4% O2
CAL GAS	11:36	5/19/2005	50.3	35.2	0.0	14.5	221.2	50% CH4
CAL GAS	11:34	5/19/2005	0.0	0.0	4.0	96.0	220.7	4% O2

SP = STATIC PRESSURE

**ATTACHMENT I**  
**COMBUSTIBLE GAS MONITORING**

# ATTACHMENT I

## STRUCTURE MONITORING

### WATUAGA COUNTY LANDFILL – BOONE, NC

All monitoring occurred on April 5, 2005 and was performed by McGee Environmental, Inc. using a MSA Orion G Combustible Gas Monitor.

**425 Green Briar Rd.**

**Begin: 11:12**

**End: 11:27**

#### Living Room

- Upper and lower corners
- Around fireplace

#### Kitchen

- Upper and lower corners
- Behind refrigerator

#### Left Bedroom

- Upper and lower corners
- Under desk

#### Right Bedroom

- Upper and lower corners
- Between shelving/cabinets

#### Laundry Room

- Upper and lower corners
- Behind appliances

#### Rear Bedroom

- Upper and lower corners
- Upper and lower corners of closet

#### Bathroom

- Upper and lower corners
- Behind toilet
- Under sink

#### Crawl Space

- Near HVAC equipment
- Under air handler

No methane was detected during the time indicated on April 5, 2005.

**149 Wild Rose Lane            Begin: 11:30            End: 11:37**

Access to the residence was not granted.

The following locations on the exterior of the home were monitored:

Foundation

- Spot checks at soil masonry interface
- Vent wells
- Lower porch
- Basement door

No methane was detected during the time indicated on April 5, 2005.

**491 Green Briar Rd.            Begin: 11:40            End: 11:53**

Access to the residence was not granted.

The following locations on the exterior of the home were monitored:

Foundation

- Spot checks at soil masonry interface
- Vents
- Antenna pole
- Under outbuildings
- Cracks in foundation
- Under back porch
- Around sewer cleanout

Crawl Space

- Spot checks around entire perimeter of foundation
- Spot checks between floor joists
- Foundation piers
- Corners

No methane was detected during the time indicated on April 5, 2005

**513 Green Briar Rd.            Begin: 11:58            End: 12:03**

Access to the residence was not granted.

The following locations on the exterior of the home were monitored:

Foundation

- Spot checks at soil masonry interface
- Garage doors

- Gutter drains
- Foundation corners
- Around chimney
- Around sewer cleanout
- Basement windows
- Dryer vents
- Under deck
- Window well
- Electric service inlet

No methane was detected during the time indicated on April 5, 2005.

**535 Green Briar Rd.            Begin: 12:07            End: 12:19**

Access to the residence was not granted.  
The following locations on the exterior of the home were monitored:

Foundation

- Spot checks at soil masonry interface
- Beside steps
- Around chimney
- Under back deck
- Around crawl space door
- Under front deck
- Foundation step ups

No methane was detected during the time indicated on April 5, 2005.

**NC Forest Service Trailer            Begin: 13:09            End: 13:27**

Crawl Space

- Spot checks around interior base
- Corners
- Under moisture barrier
- Electrical conduit

Main Room

- Upper and lower corners
- Under sink
- Beside stove
- Closet
- Around furnace
- Spot checks between floor joists

Bathroom

- Under sink
- Behind toilet
- Upper and lower corners

Left Office

- Upper and lower corners
- Under desks
- Between cabinet
- Closet upper and lower corners

Right Office

- Upper and lower corners
- Between book cases
- Under desk
- Closet upper and lower corners

No methane was detected during the time indicated on April 5, 2005.