Landfill Gas Monitoring Plan

WCA Material Recovery, LLC,
C&D Landfill (Phases 1 and 2)
Wake County, North Carolina
NCDENR Solid Waste Permit #92-31

Prepared for

WCA Material Recovery, LLC
421 Raleighview Road
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Revisions

Rev 0.0	December 2001	Addressed in original permit application documents
Rev 0.1	May 21, 2008	Phase 2 PTC application submittal (Section 11)
Rev 0.2	September 8, 2009	Updated per regulatory review – Note: this is the first standalone document addressing the issue
Rev 0.3	January 30, 2010	Updated per regulatory review – SWS review staff requested permanent sampling wells to be consistent with current regulations

1.0 Introduction

1.1 Background

Landfill gas (LFG) monitoring for the WCA Material Recovery, LLC, construction and demolition debris landfill (the "CDLF") commenced in 2002 with the opening of Phase 1. The facility is located at 2600 Brownfield Road, six (6) miles south of Knightdale, North Carolina, in rural Wake County, and was formerly known as the Material Reclamation and Recovery, LLC (MRR) Brownfield Road C&D Landfill. The facility is currently owned and operated by WCA Waste Corporation. The current monitoring network consists of ten (10) locations sampled via the bar-hole punch method (see **Section 2.3**), head-space sampling of five (5) active ground water monitoring wells, and ambient monitoring in the scale house, shown on **Drawing MP-1**.

Landfill gas is generated as a by-product during decomposition of organic waste in a sanitary landfill, including certain C&D wastes. Landfill gas typically includes methane, which can be explosive under certain conditions, and gas has been known to promote the migration of contaminants into ground water. The Solid Waste Rules typically focus on the explosive properties from a public safety standpoint. Normally, gas migrates above the ground water table and is restricted laterally by streams. No pipelines or trenches exist nearby to serve as potential conduits for off-site landfill gas migration at this facility, although the on-site soils (and dry rock) are porous and can potentially serve as gas migration pathways. No occupied structures appear to be at risk for gas migration.

LFG monitoring has been routinely performed in conjunction with the ground water monitoring and, presumably, at quarterly intervals (in between semi-annual ground water monitoring events). The monitoring has been performed using a GEM 2000 explosive gas meter, which records % methane, % carbon dioxide, % oxygen, and the balance of gases. Records for the December 2007 LFG sampling event were examined during preparation of the May 2008 PTC application for Phase 2, which indicated no methane detection at any of the monitored locations, with very low levels of carbon dioxide and soil-gas oxygen concentrations varying from 20.4% to 20.8%.

Explosive gas measurements are typically reported in terms of a percentage of the "lower explosive limit" of % LEL for the specific gas. The lower explosive limit for methane in standard atmospheric conditions is 5%, equivalent to 50,000 ppm; the upper limit is 15%. Action levels (discussed below) are based on threshold values tied to the LEL. Reported readings of 0% methane also indicate concentrations of 0% LEL. Landfill gas control at C&D Landfills is regulated under **Rule 15A NCAC 13B .0544 (d)**, which sets thresholds or "action limits" based on the LEL (see **Section 1.2**). Response activities to be taken in the event that a threshold is exceeded is defined in **NCAC 15A 13B .1646 (4) (c)**, the lined landfill rules, which is discussed in the Contingency Plan (see **Section 4.0**).

1.2 Regulatory Thresholds

NCDENR rules require monitoring to the following explosive gas limits:

- 25% of the Lower Explosive Limit (LEL, defined as 5% methane in standard atmosphere) within occupied structures – excluding collection/venting structures
- 100% LEL at the facility boundary
- No detectable concentration at off-site occupied structures.

1.3 Monitoring Location Criteria

Selection of tentative or initial monitoring locations is typically a judgment call on the part of the professional preparing the monitoring plan. Elements typically considered include the topography and presence of surface water bodies, depth of ground water, proximity to occupied structures and property lines, the presence of utility trenches, jointing in the subsurface, and the porosity of the soil. Gas tends to migrate from areas of higher pressure to lower pressure along a "path of least resistance," which in soil can be a non-saturated layer of sandy or gravelly material (such as the PWR zone in a typical piedmont soil profile) or some disturbed zone (such as pipeline bedding or backfill).

Soil permeability relative to gas migration is approximately an order of magnitude higher than that of ground water migration. However, the presence of water in the pore space is a hindrance to gas migration and saturated soils typically are not known to convey landfill gas, whereas other migration pathways are usually available at landfills. In soil, gas tends to disperse throughout the available pore space, seeking an outlet along the surface – where moisture, porosity, and pressure variations can hinder the discharge process – typically attaining a "steady state" condition during chronic gas migration due to the typically slow surface discharge. Soil-gas probes (whether temporary boreholes or permanent installations) sample the gas concentrations in the pore space, which can vary somewhat due to ambient climatic conditions (i.e., temperature and barometric pressure).

Often, a monitoring program using bar-hole punches – temporary shallow holes made at the time of the monitoring – is used until detection patterns warrant installing permanent probes. If detections are observed, the monitoring network can be expanded as needed to track a gas plume, similar to ground water monitoring, but typically only at-risk structures and the property line are of concern relative to the regulatory thresholds. At the subject facility, LFG monitoring locations BH-1 through BH-4 are situated along the north property line (between the landfill boundary and a small stream associated with steep topography), and BH-5 through BH-10 are situated along the east property line (bounded by a public road). The monitoring locations appear to be correct for conditions at the site. No new LFG monitoring locations are proposed, but several permanent monitoring wells are scheduled to be installed per regulatory requirements.

1.4 Monitoring Frequency

LFG is monitored quarterly at this facility, consistent with the Solid Waste rules, which provides sampling under variable ambient conditions.

2.0 LFG Monitoring Procedures

2.1 Detection Equipment

A portable combustible gas monitor, e.g., an Organic Vapor Analyzer (OVA) or Photo-Ion Detector (PID), shall be used to measure the concentration of combustible gases at sampling locations in units of percent of lower explosive limit. Lower explosive limit (LEL) means the lowest percent by volume of a mixture of combustible gas in air that will propagate a flame at 25 degrees Celsius and atmospheric pressure. The GEM 2000 meter used in the past or the GEM 5000 meter is appropriate – such meters are preferred to OVA or PID equipment due to the ability to calibrate the equipment specifically for methane and similar explosive gases.

The gas monitor shall be calibrated to methane using the manufacturer's calibration kit and procedure before the monitoring activities begin. If rented equipment is used, the calibration certificate should be current to within one month prior to the sampling event. All calibration data shall be kept with the specific sampling event records. It is preferable to monitor the facility with one specific meter, if possible, or sequential monitoring should be conducted using the same type of meter.

LFG monitoring technicians are required to become completely familiar with the equipment they are operating, in order to detect and correct conditions that could lead to false readings. The technician shall read the manufacturer’s user manual and copy of said document should be kept on-hand during the sampling activities. A copy of the meter in use at the site shall become part of this sampling plan and kept with this document for later reference.

2.2 Structures and Ambient Sampling

Gas monitoring within on-site structures shall be conducted during regular quarterly monitoring events. Sampling should occur at the earliest possible time after the structure has been unused (e.g., early morning). Monitoring locations include corners along floors and ceilings, at cracks in the floor, and at other areas likely to accumulate gas – including crawl spaces, toilets, and closets, if applicable. In the event that permanent gas detectors are warranted, the manufacturer’s instructions for set up and placement shall be observed.

Ambient monitoring (outdoors) shall be conducted to the extent possible at quiescent times and in locations that are sheltered from excess wind. At each location, an initial reading shall be taken, followed by another reading in approximately two minutes, with the meter allowed to reset or clear in between readings. Ambient monitoring shall be conducted around building foundations and surface intersections of buried utilities.

Gas monitoring will also be conducted in any confined space requiring the entry of personnel for maintenance or inspection. The monitoring of any confined spaces shall be conducted prior to entry by personnel in accordance with OSHA regulations. Procedures for this type of monitoring are beyond the scope of this document. If confined space gas monitoring is needed, either OSHA or air quality regulations should be consulted.

2.3 Temporary Sampling Locations

2.3.1 Bar-Hole Punch Tests

Gas monitoring in bar-hole punches will consist of punching a hole with a 3-foot probe. Tubing that is open-ended and perforated on the bottom should be placed in the bottom of the hole, taking care not to plug the bottom of the tubing with soil. An instantaneous reading shall be taken with the meter, then the boring shall be allowed to vent for 2 minutes and another reading shall be taken – both results shall be recorded for each bar-hole probe location. The boring should be flagged so that the site can be revisited. Subsequent testing should be conducted in close proximity to the original location.

2.3.2 Small Diameter Borings

An alternative to the bar-hole punch is to advance a 3-foot deep boring into the soil using an electric drill equipped with a 36-inch long, 1-inch diameter masonry bit. This method offers advantages over conventional drive-bar borings, e.g., the masonry bit is less prone to "refusing" on obstacles (rocks, roots, or debris), and the sidewalls of the boring do not become compacted. Once the boring is completed, instantaneous and two-minute gas readings are taken, similar to the procedure for the bar-hole punch test.

2.4 Permanent Sampling Locations

2.4.1 Monitoring Well Head-Space

Ground water monitoring well heads will not be sampled for landfill gas. Sampling of landfill gas at the ground water monitoring wells adds unessential exposure of the monitoring wells to potential inadvertent contamination.

2.4.2 Landfill Gas Monitoring wells

Permanent LFG monitoring wells (a.k.a. methane monitoring wells) are constructed similar to ground water monitoring wells, except the screen does not penetrate the water table. **Figure 1** shows a sampling port at the top of the monitoring well that must be installed to prevent the undetected escape of gas due to opening the well. Prior soil-gas sampling has detected no known gas migration, however more stringent regulatory requirements implemented since the subject facility was first permitted now mandates the use of permanent LFG monitoring wells. **Figure 2** shows the locations of six LFG monitoring wells, designated LFG-5 through LFG-10 to be consistent with the former bar-hole punch locations, which are located near the public road.

The landfill gas monitoring wells will be installed with a machine-turned hollow stem auger and constructed with 2-inch PVC pipe. Depths and screen intervals of the landfill gas monitoring wells will be determined in the field by qualified personnel during the installation. The screens will be installed to monitor the non-saturated "vadose zone" existing above water table – typically this zone coincides with the stratigraphic horizon termed "partially weathered rock" on this site. A tentative list of depths and screen intervals anticipated based on existing subsurface data is presented on **Table 1**. Records for the installations will be kept as part of the Operating Record for the facility.

3.0 Record Keeping and Reporting

3.1 Data Forms

The monitoring technician shall record the date, time, location, sampling personnel, equipment, atmospheric temperature, reported barometric pressure, and general weather conditions at the time of sampling, in addition to the concentration of combustible gases on the **Landfill Gas Monitoring Field Log**, (see example following this text).

3.2 Sampling Reports

A quarterly sampling report shall be prepared and submitted to the Solid Waste Section using a format acceptable to the Section – for now, a simple letter report with tabulated sampling results and a map showing the sampling locations will suffice. Copies of the data forms described above may be included. Future rule changes may place additional requirements on the quarterly reporting.

3.3 Permanent Record

A copy of each quarterly report shall be retained on-site as part of the permanent operating record for the facility.

4.0 Contingency Plan

4.1 Exceeded Thresholds

North Carolina Solid Waste Rules require specific action in response to the detection of methane exceeding a regulatory threshold (see **Section 1.2**), in the interest of protecting human health and safety. The following is borrowed from **NCAC 15A 13B .1646 (4) (c)**, which requires that upon detection of methane exceeding the threshold values (described above), the facility management must perform the following:

- Immediately take all steps required to protect human health and notify the Division.

- Within seven days place in the operating record a report of the methane gas levels (and the location of the detection), along with a description of the response to protect human health.

- Within 60 days implement a remediation plan for the methane gas release, place a copy of the plan in the Operating Record and notify the Division that the plan has been implemented – the plan shall describe the nature and extent of the problem and the proposed remedy.

4.2 Typical Remedies

The prescription of remedial activities is premature, due to the low likelihood of the facility exceeding a regulatory threshold. The Solid Waste Rules are not specific on what types of remedies are required to meet the regulatory thresholds. At other facilities, including MSW and LCID landfills, typical remedies have ranged from the installation of permanent monitoring devices within occupied structures, the installation of permanent LFG monitoring probes at critical locations (see **Section 1.3**), and in extreme cases, the installation of gas recovery devices. Such remedies are available and can be considered as warranted by future monitoring. Such remedies are mentioned here for completeness, but it is highly unlikely that such measures will be required at the subject facility.

5.0 Certification

The foregoing landfill gas monitoring plan has been prepared by a qualified geologist who is licensed to practice in the State of North Carolina. The plan has been prepared based on first-hand knowledge of site conditions and familiarity with North Carolina solid waste rules and industry standard protocol. In accordance with North Carolina Solid Waste Regulations, this plan should provide early detection of a landfill gas migration, in the interest of protecting public health and the environment. However, it should be noted that predicting or detecting landfill gas migration is, at best, an inexact science and the monitoring results may not be conclusive. No other warranties, expressed or implied, are made.

Signed _____

Printed G. David Garrett

Date January 30, 2010

Not valid unless this document bears the seal of the above-named licensed professional.

Table 1
Summary of Landfill Gas Monitoring Wells

See Drawing MP-1 (or Figure 1)

Proposed Landfill Gas Monitoring Wells

Well I.D.	Nearest Site Location	Boring Depth*	Screen Interval*	Depth Reference**
LFG-5	Facility entrance gate	35	5 – 35	P-5
LFG-6	Scale house-office	35	5 – 35	P-5
LFG-7	Facility access road	25	5 – 25	P-14
LFG-8	Facility access road	25	5 – 25	P-14
LFG-9	Facility access road	25	5 – 25	P-15
LFG-10	Concrete recycling pad	25	5 – 25	P-15

Note: the proposed landfill gas monitoring well locations are consistent with former bar-hole punch test locations. Exact locations for the well installation shall be determined in the field by qualified personnel.

The proposed landfill gas monitoring locations are considered up-gradient of the waste footprint with respect to ground water flow, thus the screen intervals are not expected to have a detrimental effect on the potential for movement of ground water contaminants or the ground water monitoring program.

*To be determined in the field by a qualified geologist or engineer. Initially, a test boring shall be advanced to determine the depth of the water table and/or auger refusal on rock; the well screen interval shall be determined to monitor the unsaturated zone above the water table and bedrock with sufficient screen length to accommodate seasonal fluctuation.

**Nearest test boring from original site suitability study or monitoring well data

DATE	NO.	REVISION
1-30-10	2	CHANGE BARHOLE PUNCH LOCATIONS TO LFG MONITORING WELLS
9-17-09	1	IDENTIFY DEEP MONITORING WELLS PER REGULATORY REVIEW

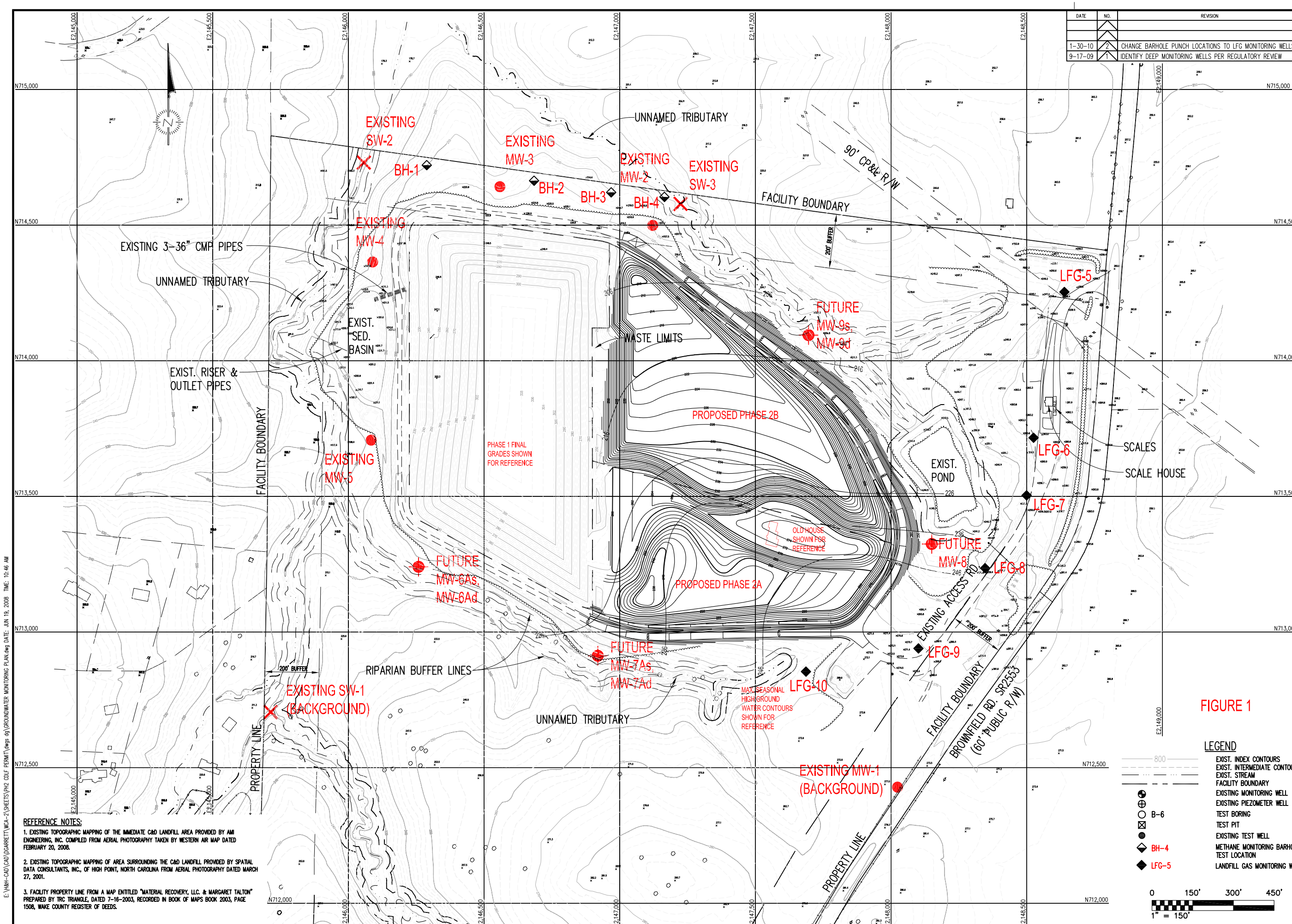

FIGURE 1

LEGEND

- EXIST. INDEX CONTOURS
- EXIST. INTERMEDIATE CONTOURS
- EXIST. STREAM
- FACILITY BOUNDARY
- EXISTING MONITORING WELL
- EXISTING PIEZOMETER WELL
- B-6 TEST BORING
- TEST PIT
- EXISTING TEST WELL
- BH-4 METHANE MONITORING BARHOLE TEST LOCATION
- LFG-5 LANDFILL GAS MONITORING WELL

REFERENCE NOTES:

1. EXISTING TOPOGRAPHIC MAPPING OF THE IMMEDIATE C&D LANDFILL AREA PROVIDED BY AMI ENGINEERING, INC. COMPILED FROM AERIAL PHOTOGRAPHY TAKEN BY WESTERN AIR MAP DATED FEBRUARY 20, 2008.

2. EXISTING TOPOGRAPHIC MAPPING OF AREA SURROUNDING THE C&D LANDFILL PROVIDED BY SPATIAL DATA CONSULTANTS, INC., OF HIGH POINT, NORTH CAROLINA FROM AERIAL PHOTOGRAPHY DATED MARCH 27, 2001.

3. FACILITY PROPERTY LINE FROM A MAP ENTITLED "MATERIAL RECOVERY, LLC. & MARGARET TALTON" PREPARED BY TRC TRIANGLE, DATED 7-16-2003, RECORDED IN BOOK OF MAPS BOOK 2003, PAGE 1508, WAKE COUNTY REGISTER OF DEEDS.

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SEAL

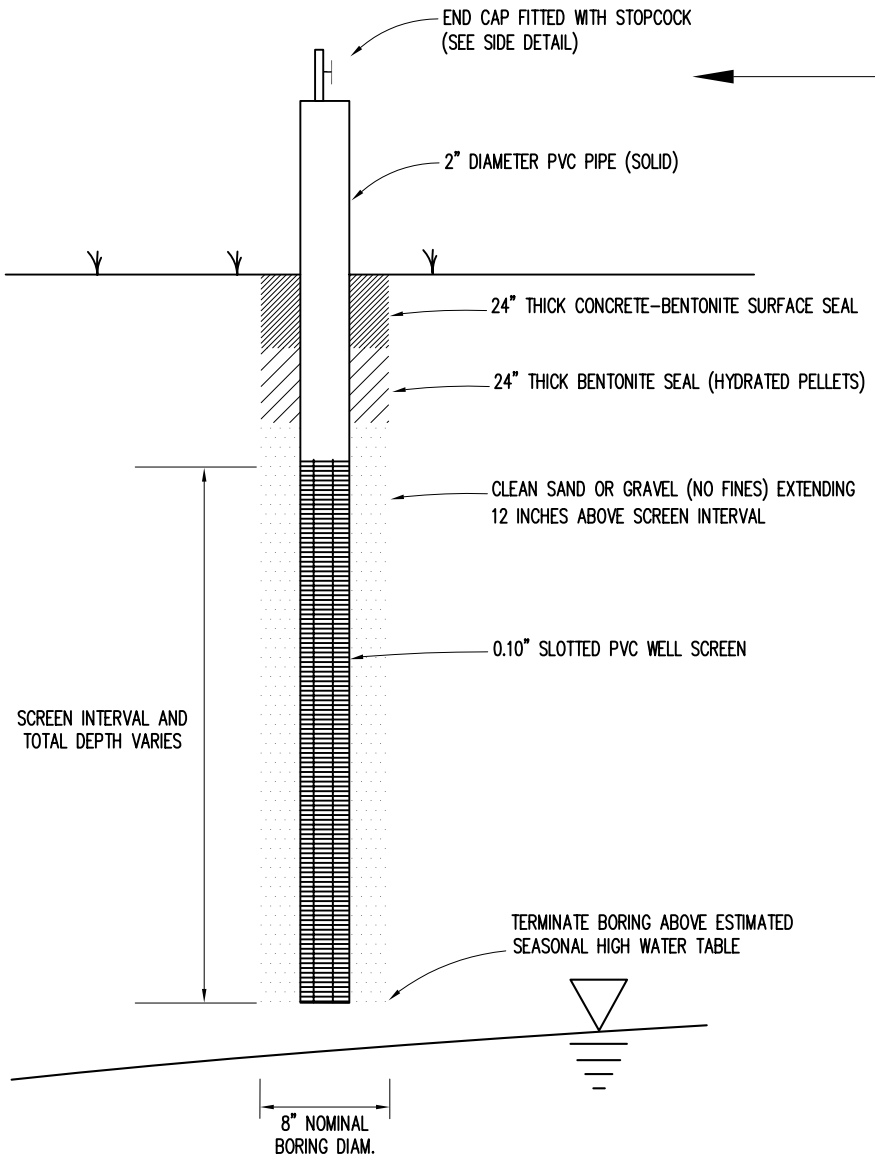
NORTH CAROLINA PROFESSIONAL SEAL GEOLOGIST DAVID G. GARRETT 1-30-10

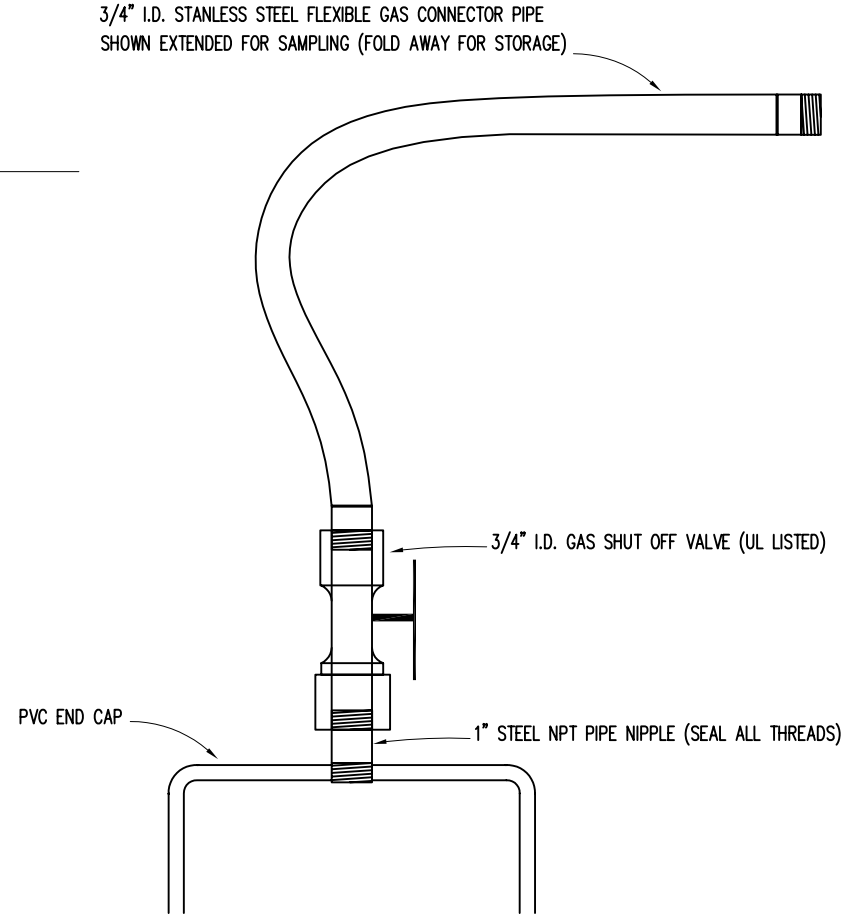
PROJECT TITLE:
WCA WASTE CORPORATION, INC.
BROWNFIELD RD. C&D LANDFILL
PH2 PERMIT MODIFICATIONS (#92-31)
WAKE COUNTY, NORTH CAROLINA

DRAWING TITLE:
GROUNDWATER AND METHANE MONITORING PLAN
PHASE 2 AMENDMENTS

DESIGNED BY: G.D.G.	DRAWN BY: A.W.H.
CHECKED BY: G.D.G.	PROJECT NO.: WCA-2
SCALE: AS SHOWN	DATE: JUNE 2008
FILE NAME: GROUNDWATER MONITORING PLAN	
SHEET NO. 21	DRAWING NO. MP1

E:\H&H-CAD\CAD\DGARRETT\WCA-2\SHEETS\PH2 CDLF PERMIT\dwgs dg\GROUNDWATER MONITORING PLAN.dwg DATE: JUN 19, 2008 TIME: 10:46 AM





NOTES:

1. THIS DESIGN IS INTENDED FOR PERMANENT METHANE MONITORING WELLS (A.K.A. LANDFILL GAS PROBES)
2. THIS DESIGN SHALL BE ADAPTED TO EXISTING OR FUTURE GROUND WATER MONITORING WELLS FOR HEAD SPACE SAMPLING
3. ALL PARTS SHALL BE NON-CORRODABLE MATERIALS AND UL-LISTED
4. IDEALLY, PERMANENT METHANE MONITORING WELLS SHOULD BE PROTECTED WITH HINGED-LID STEEL COVERS

LANDFILL GAS SAMPLING PORT
FOR PERMANENT MONITORING WELLS

DETAIL X/XXX
N.T.S.

FIGURE 2

DATE: _____

BOUNDARY PROBE MONITORING LOG

Project Name: _____ **Project Number:** _____

Site Contact: _____ **Technician(s):** _____

Starting Temperature: _____ **End Temperature:** _____

Starting Barometric Pressure: _____ **End Barometric Pressure:** _____

Monitoring Equipment: _____

Probe No.	% Methane (CH_4)	% Carbon Dioxide (CO_2)	% Oxygen (O_2)	% Balance Gas	Static Pressure (inches of water)	Comments

Completed by: _____