Water Quality Monitoring Plan

Johnston County Landfill
Solid Waste Permit No. 51-03

Prepared for:

Johnston County Department of Public Utilities
309 East Market Street
Smithfield, North Carolina

September 2013

Prepared by:

SMITH+GARDNER

14 N. Boylan Avenue, Raleigh NC 27603 | 919.828.0577

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S+G Project No. Johnston 12-4

NORTH CAROLINA LICENSED GEOLOGIST SEAL 2275 MADELINE GERMAN 9/27/13

Madeline German, P.G.
Project Geologist

NORTH CAROLINA LICENSED GEOLOGIST SEAL 1369 JOAN A. SMYTH 9/27/13

Joan A. Smyth, P.G.
Senior Hydrogeologist

September 2013

SMITH+GARDNER

14 N. Boylan Avenue, Raleigh NC 27603 | 919.828.0577

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JOHNSTON COUNTY LANDFILL
WATER QUALITY MONITORING PLAN

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1.0 INTRODUCTION

1.1 OVERVIEW

This Water Quality Monitoring Plan (WQMP) specifies the procedures and requirements to satisfy North Carolina Solid Waste Management Rule 15A NCAC 13B.1632. The WQMP addresses two major elements: groundwater system monitoring/sampling and surface water monitoring/sampling.

The WQMP will meet the following requirements:

- *Represent the quality of the background groundwater that has not been affected by leakage from the unit (.1631(1)).*

- *Represent the quality of the groundwater passing the relevant point of compliance as approved by the Division (.1631(2)).*

- *The groundwater monitoring programs must include consistent sampling and analysis procedures that are designed to ensure monitoring results that provide an accurate representation of groundwater quality at the background and down-gradient wells (..1632(a)).*

- *Detection Groundwater monitoring program (.1633).*

- *The sampling procedures and frequency must be protective of human health and the environment (.1632(c) and .1633(b)).*

- *Responsibility of sample collection and analysis must be defined as a part of the monitoring plan (.1632).*

This WQMP also addresses the following procedures that will be implemented to ensure the integrity of each sampling event:

- Sample preservation and shipment;

- Laboratory analytical procedures;

- Sample Chain-of-custody control; and

- Quality assurance/quality control programs.

The methods and procedures described in the WQMP are intended to facilitate the collection of true and representative samples and test data. Field procedures are presented in Section 2.0 in their general order of implementation. Equipment requirements for each field task are presented within the applicable section. Laboratory procedures, quality assurance methods, and record keeping requirements are presented in Sections 3.0 through 6.0.

Strict adherence to the procedures stipulated in this plan is required. Any variations from these procedures should be thoroughly documented.

1.2 CONTACT INFORMATION

In case of emergencies, or if questions arise during the implementation of this program, please contact the following:

1.2.1 Johnston County Landfill

680 County Home Road
Smithfield, North Carolina 27577
Phone: (919) 638-4750
Fax: (919) 934-7174
Mr. Rick Proctor – Solid Waste Division Manager
rick.proctor@johnstonnc.com

1.2.2 Engineer

Smith Gardner, Inc.
14 N. Boylan Avenue
Raleigh, North Carolina 27603
Phone: (919) 828-0577
Fax: (919) 828-3899

Ms. Joan A. Smyth, P.G. – Senior Hydrogeologist
joan@smithgarnderinc.com

Mr. Pieter K. Scheer, P.E. – Senior Engineer
pieter@smithgardnerinc.com

1.2.3 NCDENR

North Carolina Department of Environment and Natural Resources
Division of Waste Management:

Raleigh Central Office (RCO)
217 W Jones Street
Raleigh, North Carolina 27603
Phone: (919) 707-8200

Fayetteville Regional Office (FRO)
225 Green Street, Suite 714
Fayetteville, North Carolina 28301
Phone: (910) 486-1541
Fax: (910) 486-0707

Division of Waste Management (DWM) – Solid Waste Section

Field Operations Branch Head:	Mark Poindexter (RCO)
Eastern District Supervisor:	Dennis Shackelford (FRO)
Waste Management Specialist:	Mary Whaley ((919) 693-5023)

1.3 SITE BACKGROUND

The Johnston County Landfill Facility (Permit 51-03), located at 680 Country Home Road, Smithfield, NC, has been in operation since 1973, and contains multiple lined and unlined municipal solid waste (MSW) and construction and demolition debris (C&D) units. The facility is located approximately 5 miles west of Smithfield. Local development is mixed residential and agricultural use. The site and monitoring locations are shown on Figure 1.

1.3.1 Site History

The Johnston County Landfill Facility originally was developed with three separate unlined MSW landfill units. These units were named Phases 1&2, Phase 3 and Phase 4. The various units were in operation from the 1970's through 1997. Phase 5 was designed and constructed as the first lined MSW landfill at the facility.

In 1995, assessment monitoring was initiated at the original unlined landfill for a monitoring well network that expanded across most of the facility. Assessment monitoring historically indicated detectable concentrations of both inorganic and organic constituents as well as pesticides.

In 2005[1], additional site assessment work was performed to evaluate groundwater quality in what is now the C&D landfill footprint. This assessment was conducted to evaluate the extent of impact in the future C&D landfill footprint as a baseline for future monitoring. Results from this assessment indicated detectable concentrations of organic and pesticide constituents across this area. Detectable concentrations of inorganic constituents were determined to be due to high sample turbidity as proven by low to non-detectable concentrations of these same constituents in filtered samples. Assessment results also indicated the presence of a diabase dike within the proposed C&D landfill unit footprint. The diabase dike is shown on Figure 1.

To control rainwater infiltration into the unlined Phase 3 and 4 landfill units and minimize leachate creation within these unlined waste units, Johnston County permitted and constructed a double-lined MSW landfill in the valley between Phase 3 and 4 as a piggy-back landfill. The Phase 4A landfill unit fills the valley and partially overlaps the top of Phases 3 and 4. Additionally, the County permitted and constructed a lined C&D landfill which piggy-backs over the other sideslope of Phase 3. It should be noted that the liner system for the C&D landfill includes a leachate collection system that meets 15A NCAC 13B.1600 (et seq.) rule requirements and a liner system that consists of 12" of 10^{-5} cm/sec material and a 40-mil LLDPE liner. Once the piggy-backs are filled and closed, these landfills should cover approximately 70% of the Phase 3 landfill. The liner and leachate collection systems for these landfills will minimize future rainfall infiltration which will minimize the leachate generation from the bottom of the unlined landfills. This "presumptive remedy" strategy is sanctioned by the U.S. EPA.

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[1] Johnston County Proposed C&D Landfill Ground Water Assessment Report, G. N. Richardson & Associates, Inc., Revised through February, 2005.

1.3.2 Geology

The site is located in the western portion of the Coastal Plain Province in the fall zone. The formations found in this area consist of sediments of Cretaceous and Tertiary age, unconformably overlying metamorphic rocks of Pre-Cambrian to Cambrian age. The site is underlain by sediments of the Middendorf Formation which were deposited largely in a deltaic system. According to Geology of the Carolinas (Horton/Zullo, 1991) the formation consists of unfossiliferous, interbedded, thin clay and sand. The stratigraphy tends to be very discontinuous, indicating that the sediment deposits are lenticular. Most of the sediments range from silty clay to a coarse clayey sand and gravel with thin lenses of dense clay. There are occasional concretions of iron oxide minerals which form very hard thin layers within the sand layers. The Middendorf Formation dips very gently to the east, and is underlain by highly weathered metamorphic rocks of the Carolina Slate Belt.

Borings advanced at the site encountered sandy silts consistent with the Middendorf Formation, and partially weathered rock above bedrock. The bedrock encountered was a metamorphosed mudstone. The depths of these borings ranged between 15 feet and 75 feet deep. The unconsolidated sediments consisted of mostly silty sands and sandy silts with some clayey sand as well. The metamudstone bedrock was encountered at a depth of approximately 15 feet in the floodplain around the site, and at a depth of approximately 50 feet elsewhere on-site. Diabase dikes have also been located at the site beneath the Area 2 C&D landfill unit, the floodplain of Middle Creek, and the Phase 5 MSW landfill unit.

1.3.3 Hydrogeology

The hydrogeology at this site has been investigated through numerous piezometers, groundwater monitoring wells, aquifer slug tests and aquifer pumping tests. Groundwater flow is generally north across the site, except for the Phase 5 unit where the flow is generally northwest; in both instances groundwater flows toward Middle Creek, the local discharge feature. The uppermost aquifer consists of sands and silts and is unconfined in nature. Depth to groundwater ranges from approximately 5 to 40 feet below grade across the site.

The uppermost aquifer at the site primarily consists of silty and clayey sands. Hydraulic conductivity values measured in the soil aquifer varies on the order of 0.0083 ft/day to 0.289 ft/day based upon prior investigations.

2.0 MONITORING PROGRAM

2.1 OVERVIEW

This section of the Water Quality Monitoring Plan addresses each aspect of the monitoring program. At a minimum, Johnston County Landfill will monitor the groundwater quality on a semi-annual basis.

2.2 MONITORING NETWORK AND ANALYTICAL PARAMETERS

The Johnston County Landfill Facility (Permit#51-03) is composed of multiple adjacent and "piggy-back" landfill units that have previously been monitored as three separate units: Johnston County C&D, Johnston County MSW Phases 1-4 and 4A and Johnston County MSW Phase 5. The various units were installed at different times creating multiple well sets with each expansion.

Due to the fragmented nature of well monitoring network installation during these permitting events, the current monitoring network has significant redundancy, and also includes wells that are located inordinately close to individual waste units. To improve cohesiveness, avoid redundancy, and remove potential false positive detections, the monitoring network has been revised as outlined below and the facility will have one network which will be sampled and reported together. Modifications to the monitoring network are discussed in Section 2.2.1. Figure 1 shows the current and proposed monitoring network and potentiometric contours from the most recent sampling event (April 2013). Table 1 presents well construction details for the current monitoring network. Additionally, Table 1 summarizes which wells are proposed for inclusion in the future Detection Monitoring and Assessment Monitoring programs (discussed below).

2.2.1 Modifications from Previous Monitoring Network

Groundwater Monitoring

This monitoring plan combines the previously separate plans for the C&D landfill the Phase 1-4A landfill and the Phase 5 landfill.

Table 1 provides sampling location, construction details, sampling group (Detection or Assessment Monitoring) and relevant information regarding their status in the updated monitoring network.

Detection Monitoring Network

Monitoring well MW-3 has historically been used as the background (upgradient) well for the entire facility; however, it has been dry over the past 4 semi-annual sampling events. Monitoring well MW-5-1 will replace MW-3 as the background well for the facility.

Wells identified as detection monitoring wells (CDMW-3, CDMW-4, CDMW-6, CDMW-7, CDMW-8, MW-9D, MW-8D, MW-9C, MW-15D, MW-16D, MW-5-1, MW5-2, MW-5-5 and MW-5-6) will be sampled semi-annually for Appendix I parameters. Their positioning is designed for early detection of a release from the landfill units. Background locations and those wells furthest from the landfill were selected for this group. If detection monitoring well sampling results indicate constituent concentrations show landfill impact, those wells may be considered for assessment monitoring status (pending NCDENR approval)

One new well (PM-1) is proposed as a replacement well for cross-gradient wells CDMW-2, MW-4B and PZ-3 due to acquired property added to the facility footprint. The currently existing monitoring wells (CDMW-2, MW-4B and PZ-3) are located immediately adjacent to waste and are not representative of aquifer conditions near the compliance boundary. PM-1 will be included with the detection monitoring group.

Additionally, the leachate storage pond located on-site will be monitored by surrounding wells (leachate lagoon #1, leachate lagoon #2, leachate lagoon #3 and leachate lagoon #4). These wells will be sampled semi-annually.

Assessment Monitoring Network
Wells identified as assessment monitoring wells (MW-6, MW-7B, MW-11, MW-12B, MW-14D,) will be sampled semi-annually. These locations have historically been part of assessment monitoring associated with the Phase 1 – 4A landfill. If assessment monitoring results indicate constituent concentrations below the standard for two consecutive sampling events, those wells may be considered for detection monitoring (pending NCDENR approval). Wells can move between the detection monitoring and assessment monitoring group in accordance with rules .1633 and 1634.

As shown on Figure 1, twenty-three wells were removed from the monitoring network because they were interior locations, yielded redundant data, were located cross-gradient, or were historically dry. These wells will not be abandoned but will remain in place for additional water level data or potential additional sampling in the event further delineation data is necessary in the future. Table 1 summaries existing well locations, their monitoring program and reasons for network removal if necessary.

Surface Water Monitoring
Surface water sampling locations (SWPT-1, SWPT-2, SW5-1 and SW5-2) will be utilized to monitor Middle Creek and its tributaries for potential impact from the landfill. Sampling point CDSW-1 has been moved from its previous location of an unnamed tributary of Buzzard Branch, to a point where Buzzard Branch meets Middle Creek. The surface water monitoring locations are shown on Figure 1.

Leachate Monitoring
Four leachate locations will be included in the monitoring network. Leachate sampling locations for the Phase 4A MSW Landfill, the Phase 4A leak detection zone, the Phase 5 – north end manhole and lined C&D landfill will be sampled semi-annually.

The leachate junction box for multiple landfill units was removed from the monitoring network because it is a composite leachate sample that yields redundant data.

Leachate will be monitored in accordance with the guidance detailed in Section 2.3.1.1.

2.2.2 Analytical Parameters

As the landfill facility contains both lined and unlined landfill units, samples from certain wells in the monitoring network will be analyzed for Detection Monitoring parameters, while samples from other wells will be analyzed for Assessment Monitoring parameters. In general, the entire facility is operating under .1600 rules; therefore C&D parameters including tetrahydrofuran will not be monitored. The following sections summarize the wells and parameters related by monitoring type. Analytical parameters are presented in Table 2.

2.2.2.1 Detection Monitoring

Wells in the monitoring network selected for detection monitoring will be sampled for Appendix I parameters semi-annually in accordance with SWS approved methods. Detection monitoring locations are listed in Table 1.

2.2.2.2 Assessment Monitoring

Wells in the monitoring network selected for assessment monitoring will be sampled semi-annually. During one event, these samples will be analyzed for Appendix II parameters (typically during the spring event) and during the second event these samples will be analyzed for Appendix I parameters (typically during the fall event) in accordance with SWS approved methods. Assessment monitoring locations are listed in Table 1.

2.2.2.3 Leachate Monitoring

Leachate sampling locations will be sampled for Appendix I metals and VOCs plus nitrate, sulfate, phosphorous, total suspended solids, biochemical oxygen demand, chemical oxygen demand and ammonia. These locations are summarized in Table 1.

2.3 GROUNDWATER SAMPLE COLLECTION

2.3.1 Introduction

This section presents details of the procedures and equipment required to perform groundwater field measurements and sampling from monitoring wells during each monitoring event. Where possible, sampling will proceed from least to (potentially) most contaminated, or from the upgradient (background) wells to downgradient (compliance) wells.

2.3.1.1 Guidance Documents

Sampling, analysis, and submittals will be performed in accordance with this plan and the following guidance documents:

1. Groundwater, Surface Water and Soil Sampling for Landfills – NCDENR Guidance updated April 2008.
2. October 27, 2006 Memo from NCDENR entitled "New Guidelines for Electronic Submittal of Environmental Monitoring Data."
3. February 23, 2007 Memo from NCDENR entitled Addendum to October 27, 2006, North Carolina Solid Waste Section Memorandum Regarding New Guidelines for Electronic Submittal of Environmental Data.
4. October 16, 2007 Memo from NCDENR entitled Environmental Monitoring Data for North Carolina Solid Waste Management Facilities.

2.3.1.2 Fuel-Powered Equipment

Fuel-powered equipment, such as generators for pumps, must be situated away and downwind from sampling activities (i.e. purging and sampling). If field conditions prevent such placement, then the fuel source must be placed as far away as possible from the sampling activities. Sampling conditions must be described in detail in the field notes.

If fuel must be handled, it should be done the day before sampling. Effort should be made to avoid handling fuels on the day of sampling. If fuels must be dispensed during sampling activities, dispense fuel downwind and well away from any sampling locations. Wear gloves while working with fuel and dispose of the gloves away from sampling activities. Wash hands thoroughly after handling any fuels.

2.3.1.3 Equipment Decontamination

Non-dedicated equipment that may come in contact with the well casing and water will be decontaminated between wells. The procedure for decontaminating non-dedicated equipment is as follows:

1. Don new powder-free gloves.

2. Clean item with tap water and phosphate-free laboratory detergent Liqui-Nox or equivalent using a brush if necessary to remove particulate matter and surface films.

3. Rinse thoroughly with pesticide grade isopropanol and allow to air dry.

4. Rinse with organic-free water (Milli-Q water or other ultra-pure water) and allow to air dry.

5. Wrap with commercial-grade aluminum foil, if necessary, to prevent contamination of equipment during storage or transport.

Please note that Liqui-Nox detergent solutions will be stored in a clearly marked HDPE or PP container. Containers for pesticide-grade isopropanol will be made of inert materials such as Teflon, stainless steel, or glass.

Sampling will be planned and conducted to minimize the need for decontamination in the field through the use of dedicated sampling equipment, or a new, disposable, Teflon bailer at each well. Unclean equipment will be segregated from clean equipment during field activities. Clean equipment will remain in the manufacturer's packaging until use, or will be wrapped in commercial-grade aluminum foil or untreated butcher paper.

2.3.2 Water Level Measurements

2.3.2.1 Static Water Levels

Static water level and depth to the well bottom will be measured in each well prior to any purging or sampling activities. Static water level and well depth measurements are necessary to calculate the volume of stagnant water in the well prior to purging. Additionally, these measurements provide a field check on well integrity, degree of siltation, and are used to prepare potentiometric maps, calculate aquifer flow velocities and monitor changes in site hydrogeologic conditions.

Groundwater depths will be measured to a vertical accuracy of 0.01 feet relative to established wellhead elevations. Each well will have a permanent, easily identified reference point on the lip of the well riser from which water level measurements will be taken. The elevation of the reference point will be established by a Registered Land Surveyor.

2.3.2.2 Contamination Prevention

Upon opening each well, new powder-free nitrile surgical gloves will be donned. Appropriate measures will be implemented during measurement activities to prevent soils, decontamination supplies, precipitation, and other potential contaminants from entering the well or contacting clean equipment.

2.3.2.3 Equipment

An electronic water level indicator will be used to accurately measure depth to groundwater in each well and/or piezometer. The electronic water level indicator will be constructed of inert materials such as stainless steel and Teflon. Between each well, the device will be thoroughly decontaminated by washing with non-phosphate (Liqui-Nox) soap and rinsing with organic-free water to prevent cross contamination from one well to another.

The following measurements will be recorded in a dedicated field book prior to sample collection (see Section 6.0 for a detailed description of collected field notes):

- Depth to static water level and well bottom (to the nearest 0.01 foot);
- Height of water column in the riser (based upon measured depth of well);
- Condition of wellhead protective casing, base pad and riser; and
- Changes in condition of well and surroundings.

2.3.3 Monitoring Well Evacuation

2.3.3.1 Description

Water accumulated in each well may be stagnant and unrepresentative of surrounding aquifer conditions and therefore must be removed to insure that fresh formation water is sampled. Each well will be purged of standing water in the well casing following the static water level measurement. Ideally, monitoring well evacuation should be performed in upgradient wells first then systematically move to downgradient well locations.

2.3.3.2 Contamination Prevention

New, non-powdered, nitrile surgical gloves will be donned for well purging and sampling activities and whenever handling decontaminated field equipment.

Appropriate measures will be applied during measurement, purging and sampling activities to prevent surface soils, decontaminated supplies, precipitation, and other potential contaminants from entering the well or contacting cleaned equipment.

2.3.3.3 Calculations

The volume of standing water in the well riser and screen will be calculated immediately before well evacuation during each monitoring event. A standing water volume will be calculated for each well using measured static water level, well depth and well casing diameter according to the following equation:

$$V = (TD - SWL) \times C$$

Where:
- V = One well volume (gallons)
- TD = Total depth of the well (in feet)
- SWL = Static water level (in feet)
- C = Volume constant for given well diameter (gallons/foot)
  - C = 0.163 gal/ft for two-inch wells.
  - C = 0.653 gal/ft for four-inch wells.

2.3.3.4 Well Purging

Several options for well purging are used at this site including:

- Bailers;
- Low Flow Pumps; and
- Grundfos Redi-Flo Pumps.

Bailers – Where bailers are used, new, disposable bailers with either double or bottom check-valves will be used to purge each well. Disposable purge bailers will be constructed of fluorocarbon resin (Teflon) or inert plastic suitable for the well and ground conditions. Each bailer will be factory-clean and remain sealed in a plastic sleeve until use. A new Teflon-coated stainless steel, inert mono-filament line or nylon cord will be used for each well to retrieve the bailers. Where bailers are used, a minimum of three well volumes will be purged unless the well runs dry.

Low Flow Pumps – Monitoring wells may be purged and sampled using the low-flow sampling method in accordance with the *Solid Waste Section Guidelines for Groundwater, Soil, and Surface Water Sampling* (NCDENR, 2008).

Obtain depth-to-water measurements using an electronic water level indicator capable of recording the depth to an accuracy of 0.01 foot. Determine if the water table is located within the screened interval of the well. If the water table is not within the screened interval, the achievable drawdown before intersection with the screen will be calculated. If the water table is within the screened interval, total drawdown should not exceed 1 foot to minimize the aeration and turbidity. If the water table is above the top of the screened interval, drawdown should be minimal to prevent screen exposure.

If the purging equipment is non-dedicated, the equipment will be lowered into the well, taking care to minimize water column disturbance. If conditions (i.e., water column height and well yield) allow, the pump will be situated in the upper portion of the water column (minimum of 18 inches of pump submergence is recommended).

The minimum volume/time period for obtaining independent Water Quality Parameter Measurements (WQPM) will be determined. The minimum volume/time period is determined based on the stabilized flow rate and the amount of volume in the pump and the discharge tubing (alternatively, the volume of the flow cell can be used, provided it is greater than the volume of the pump and discharge tubing). Bladder pump volume should be obtained from the manufacturer. Discharge tubing volumes are as follows:

3/8-inch inside diameter tubing:	20 milliliters per foot
1/4-inch inside diameter tubing:	10 milliliters per foot
3/16-inch inside diameter tubing:	5 milliliters per foot

Begin purging the well after calculating the volume of the flow-cell or the pump and the discharge tubing. The flow rate should be based on historical data for that well (if available) and should not exceed 500 milliliters per minute. The initial round of WQPM should be recorded and the flow rate adjusted until drawdown in the well stabilizes. Water levels should be measured periodically to maintain a stabilized water level. The water level should not fall within 1 foot of the top of the well screen. If the purge rate has been reduced to 100 milliliters or less and the head level in the well continues to decline, the required water samples should be collected following stabilization of the WQPM, based on the criteria presented below.

If neither the head level nor the WQPM stabilize, a passive sample should be collected. Passive sampling is defined as sampling before WQMP have stabilized if the well yield is low enough that the well will purge dry at the lowest possible purge rate (generally 100 milliliters per minute or less).

WQPM stabilization is defined as follows: pH (+/- 0.2 S.U.), conductance (+/- 5% of reading), temperature (+/- 10% of reading or 0.2°C) and dissolved oxygen [+/- 20% of reading or 0.2 mg/L (whichever is greater)]. Oxidation reduction potential (ORP) will be measured and ideally should also fall within +/- 10mV of reading; however, this is not a required parameter. At a minimum, turbidity measurements should also be recorded at the beginning of purging, following the stabilization of the WQPM, and following the collection of the samples. The optimal turbidity range for micropurging is 25 Nephelometric Turbidity Units (NTU) or less. Turbidity measurements above 25 NTU are generally indicative of an excessive purge rate or natural conditions related to excessive fines in the aquifer matrix.

Stabilization of the WQPM should occur in most wells within five to six rounds of measurements. If stabilization does not occur following the removal of a purge volume equal to three well volumes, a passive sample will be collected.

The direct-reading equipment used at each well will be calibrated in the field according to the manufacturer's specifications prior to each day's use and checked at a minimum at the end of each sampling day. Calibration information should be documented in the instrument's calibration logbook and the field book.

Each well is to be sampled immediately following stabilization of the WQPM. The sampling flow rate must be maintained at a rate that is less than or equal to the purging rate. For volatile organic compounds, lower sampling rates (100 - 200 milliliters/minute) should be used. Final field parameter readings should be recorded prior to and after sampling.

Grundfos Redi-Flo Pumps – Where Redi-Flo pumps are used, the same low flow techniques for sampling will be used as described in the above Low Flow Pump section.

2.3.3.5 Purge Rate

Wells will be purged at a rate that will not cause recharge water to be excessively agitated or cascade through the screen. Methods will minimize disturbance to well sidewalls and bottoms which could result in silt and fine particulate matter suspension. The water volume purged from each well and the relative recharge rate will be documented in sampling field notes. Wells with very low recharge rates will be purged until dry. Damaged, dry or low yielding and high turbidity wells will be documented for reconsideration before the next sampling event.

2.3.3.6 Purge Water Disposal

Purge water will be managed to prevent possible soil and surface water contamination. Well site management options may include temporary containment and disposal as leachate or portable activated carbon filtration if warranted by field characteristics.

2.3.3.7 Non-Dedicated Equipment

Durable, non-dedicated equipment that is lowered into the well or which may come in contact with the water samples will be thoroughly decontaminated before each use. Equipment will be disassembled to the degree practical, washed with (non-phosphate) soapy potable tap water, and triple rinsed using de-ionized water. Detailed equipment decontamination procedures are detailed in Section 2.3.1.3.

2.3.4 Sample Collection

After purging activities are complete, groundwater samples will be collected for laboratory analysis. Samples should be collected from least contaminated location(s) first, followed by locations of increasing contamination across the site. Prior to sample collection, sample labels should be properly filled-out with permanent ink, such as Sharpie Pen. At a minimum, the label should identify the sample with the following information:

- Sample Location or Well Number;
- Sample Identification Number;
- Date and Time of Collection;
- Analysis Required;

- Sampler's Initials;
- Preservative Used (if any); and
- Other Pertinent Information As Necessary.

Affix completed sample labels to the sample bottle prior to sampling.

Sampling will occur within 24-hours of the well purging and as soon after well recovery as possible. Wells that fail to recharge or produce an adequate sample volume within 24-hours of purging will not be sampled.

2.3.4.1 Field Parameters

Field measurements for temperature, pH and specific conductance will be recorded immediately prior to sampling each monitoring point. For low-flow sampling, dissolved oxygen (DO) and oxidation reduction potential (ORP) will also be collected. Additionally, turbidity measurements should be collected for metals evaluation. The field test specimens will be collected with the sampling bailer and placed in a clean, non-conductive glass or plastic container for observation. PH, temperature, conductivity and turbidity meter calibration will be completed according to the manufacturers' specifications and consistent with Test Methods for Evaluating Solid Waste -Physical/Chemical Methods (SW-846). A pocket thermometer and litmus paper will be available in case of meter malfunction.

2.3.4.2 Sample Equipment

Several options for sample collection are used at this site including:

- Teflon Bailers;
- Low Flow Pumps and
- Grundfos Redi-Flo Pumps.

Of these, Low Flow purging/sampling systems are the most prevalent as the Grundfos pumps are utilized for low flow purging/sampling. Low flow purging/sampling is recommended for this site wherever possible.

Teflon Bailers – Where bailers are used, each well will be sampled using a new, factory-cleaned, disposable Teflon bailer with bottom check-valve and sample discharge mechanism. A new segment of Teflon-coated stainless steel wire, inert mono-filament line or nylon cord will be used to lower and retrieve each bailer. The bailer will be lowered into each well to the point of groundwater contact and allowed to fill as it sinks below the water table. Bottom contact will be avoided in order to avoid suspending sediment in the samples. The bailer will be retrieved and emptied in a manner which minimizes sample agitation.

Low Flow Pumps – After purging with the low flow pump systems samples may be collected immediately from the pumping system following the order outlined in Section 2.3.4.4.

Redi-Flo Pumps - After purging three well volumes samples may be collected from the Redi-Flo pumps in the order outlined in Section 2.3.4.4.

2.3.4.3 Sample Transfer

Samples will be transferred directly from the Teflon bailer into a sample container that has been specifically prepared for the preservation and storage of compatible parameters. A bottom emptying device provided will be used to transfer samples from bailer to sample container. The generation of air bubbles and sample agitation will be minimized during bailer discharge. Groundwater samples will be collected and contained in the order of volatilization sensitivity.

2.3.4.4 Order of Sample Collection

The following sampling order will be observed:

- Volatile Organics and Volatile Inorganics;
- Extractable Organics, Petroleum Hydrocarbons, Aggregate Organics and Oil and Grease;
- Total Metals;
- Inorganic Nonmetallics, Physical and Aggregate Properties and Biologicals;
- Microbiologicals; and
- Measurements of pH, Temperature, DO, ORP, Conductivity and Turbidity.

Note: If the pump used to collect groundwater samples is not suitable to collect volatile or extractable organics then collect the other parameters and withdraw the pump and tubing. Then collect the volatile and extractable organics.

Samples will be collected and analyzed in an unfiltered state during sampling events. Samples for dissolved metal analysis, if subsequently required, will be prepared by field filtration using a decontaminated peristaltic pump and a disposable 0.45 micron filter cartridge specifically manufactured for this purpose.

2.3.4.5 Decontamination

Reusable sampling equipment including water level probes, water quality meters, interface probes and filtering pumps which might contact aquifer water or samples will be thoroughly decontaminated between wells by washing with non-phosphate soapy, de-ionized water and rinsing with isopropanol and organic-free water. Detailed equipment decontamination procedures are discussed in Section 2.3.1.3.

2.3.4.6 Sample Preservation

Following sampling at each location, the sample bottles will be placed in a cooler with ice for preservation and transport.

2.3.4.7 Field Quality Assurance

Equipment and trip blanks will be prepared, handled and analyzed as groundwater samples to ensure cross-contamination has not occurred. Trip blanks will be prepared before leaving the laboratory to ensure the sample containers or handling processes have not affected the sample quality. Equipment blanks will be poured through the bailer into laboratory prepared sampling containers at the time of sampling to ensure the field conditions, equipment and handling during sampling collection have not affected the sample quality. This sample will be collected using the same equipment utilized for well sampling. A duplicate groundwater sample may be collected from a single well as a laboratory accuracy check. Blanks and duplicate containers, preservatives, handling and transport procedures for surface water samples are identical to those noted for groundwater samples. Additional information on Field Quality Assurance can be found in Section 3.0.

2.3.4.8 Sample Containers

Sample containers will be provided by the laboratory for each sampling event. Containers must be either new, factory-certified analytically clean by the manufacturer, or cleaned by the laboratory prior to shipment for sampling. Laboratory cleaning methods will be based on the bottle type and analyte of interest. Metal containers are thoroughly washed with non-phosphate detergent and tap water and rinsed with (1:1) nitric acid, tap water, (1:1) hydrochloric acid, tap water and non-organic water, in that order. Organic sample containers are thoroughly washed with non-phosphate detergent in hot water and rinsed with tap water, distilled water, acetone, and pesticide quality hexane, in that order. Other sample containers are thoroughly washed with non-phosphate detergent and tap water, rinsed with tap water, and rinsed with non-organic water. The laboratory will provide proper preservatives in the sample containers prior to shipment.

2.4 SURFACE WATER SAMPLE COLLECTION

This section presents procedure and equipment details required to perform surface water field measurements and sampling from springs, streams and ponds during each monitoring event.

2.4.1 Surface Water Level Observations

Surface water quality analyses are sensitive to site hydrologic conditions and recent precipitation events. Water levels may fluctuate significantly in comparison the groundwater table and may result in either diluting or increasing contaminant loading. Sampling event scheduling and the interpreted surface water data must account for recent weather and sampling station conditions.

2.4.1.1 Monitoring Conditions

Surface water level and sampling station conditions may be observed one day prior to and during each sampling event, if warranted by site conditions. Surface water observations will include the flood stage in streams, seasonal base flow conditions, and confirmation of location and timing for meaningful surface water quality sampling. The following objective observations will be recorded in a dedicated field book prior to sample collection:

- Relative stream water level;
- Surface water clarity; and
- Changes in surface monitoring station conditions and surroundings.

2.4.1.2 Monitoring Condition Modification

Modifications to surface sampling station conditions may be required prior to each sampling event. These modifications may include surface and submerged debris removal, slightly deepening the location to allow sample container immersion, or channeling/piping to consolidate local discharge. When modifications are required, sufficient time will be allowed for suspended solid settlement between the disturbance and sample collection. A four-hour minimum settling period prior to sampling will be observed.

2.4.2 Sample Collection

2.4.2.1 Collection Procedure

Surface water samples will be obtained from areas of minimal turbulence and aeration. Samples will be collected if flowing water is observed during the sampling event. New powder-free, surgical gloves will be donned prior to sample collection. The following procedure will be implemented regarding surface water sampling:

1. Put-on new powder-free surgical gloves.

2. Hold the bottle by the bottom with one hand and remove the cap with the other.

3. Push the sample container slowly into the water and tilt up toward the current to fill. A water depth of six inches is generally satisfactory. The sampler will avoid breaching the surface or losing sample preservatives while filling the container.

4. If there is little current movement, the container should be moved slowly, in a lateral, side to side direction, with the mouth of the container pointing upstream.

2.4.2.2 Field Parameters

Temperature, pH, specific conductivity, and turbidity will be logged at the start of sampling as a measure of field conditions and check for groundwater stability over time. Temperature, pH, specific conductivity, and turbidity measurements will be recorded for surface water samples. Temperature, pH, conductivity, and turbidity meter calibration will be completed at the beginning of each sampling event, according to the manufacturers' specifications and consistent with Test Methods for Evaluating Solid Waste - Physical/Chemical Methods (SW-846).

2.4.2.3 Observation

Surface water samples will be collected and contained in the order of parameter volatilization sensitivity as follows:

- Volatile Organics and Volatile Inorganics;

- Extractable Organics, Petroleum Hydrocarbons, Aggregate Organics and Oil and Grease;
- Total Metals;
- Inorganic Nonmetallics, Physical /Aggregate Properties, Biologicals;
- Microbiologicals; and
- Measurements of pH, Temperature, DO, ORP, Conductivity, and Turbidity.

Surface water samples will be collected unfiltered. If future dissolved metal analysis is required, samples will be prepared by field filtration using a decontaminated peristaltic filtering pump (or equivalent) and a disposable 0.45 micron filter cartridge manufactured for this purpose.

Surface water samples will be collected from surface water monitoring points shown on the attached Figure 1. Samples will be collected directly from the station in the container that has been prepared for the preservation and storage of compatible parameters. Samples will be collected in a manner that assures minimum agitation. Additional blanks and duplicate samples will not be collected with the surface water samples.

2.4.2.4 Decontamination

Field meters which might contact surface water samples will be thoroughly decontaminated between stations by washing with non-phosphate soapy, de-ionized water and rinsed with isopropanol and organic-free water. Detailed equipment decontamination procedures are detailed in Section 2.3.1.3.

2.4.2.5 Sample Containers

Sample containers will be prepared and provided by the laboratory for each surface water sampling event. Each container's preparation and preservatives will be the same as those utilized for groundwater sampling and addressed previously in Section 2.3.4.8.

3.0 FIELD QA/QC PROGRAM

3.1 OVERVIEW

Field Quality Assurance/Quality Control (QA/QC) requires the routine collection and analysis of trip blanks to verify that the handling process has not affected the quality of the samples. Contaminants found in the trip blanks could be attributed to:

1. Interaction between the sample and the container;
2. Contaminated source water; or
3. A handling procedure that alters the sample.

3.2 BLANK SAMPLES

3.2.1 Trip Blanks

The laboratory will prepare a trip blank by filling sample bottles with laboratory grade distilled or deionized water. Trip blanks will be placed in bottles of the specific type required for the analyzed parameters from a bottle pack specifically assembled by the laboratory for each groundwater sampling event. Trip blanks will be transported with the empty bottle packs and remain in the coolers throughout the sampling event. The blanks will be analyzed for volatile and purgeable organics.

3.2.2 Equipment Blanks

For wells sampled with non-dedicated equipment, equipment blank samples will be collected at a rate of one sample per day. To collect a "field" or "equipment" blank, a bailer will be filled with non-organic (milli-Q) water. Handling the bailer in a manner identical to well sampling, the water is transferred into equipment blank sample collection jars for the specified analysis. These samples are packed and sent to the laboratory with the other samples.

3.3 BLANK CONCENTRATIONS

The concentration levels of contaminants found in the trip or equipment blanks will be reported but will not be used to immediately correct the groundwater data. In the event that elevated parameter concentrations are found in a blank, the analysis will be flagged for further evaluation and possible re-sampling.

3.4 FIELD INSTRUMENTS

Field instruments utilized to measure groundwater characteristics will be calibrated prior to entering the field and recalibrated in the field as required to insure accurate measurement for each sample. The specific conductivity and pH meter shall be recalibrated utilizing two prepared solutions of known concentration in the range of anticipated values (between 4 and 10). A permanent thermometer, calibrated against a National Bureau of Standards Certified thermometer, will be used for temperature meter calibration. Other field equipment should be calibrated at least daily using the manufacturer's recommended specifications.

4.0 SAMPLE PRESERVATION AND SHIPMENT

4.1 OVERVIEW

Sample preservation, shipment, and chain-of-custody procedures to be observed between sampling and laboratory analysis are presented in the following sections.

4.2 SAMPLE PRESERVATION

Pre-measured chemical preservatives will be provided by the analytical laboratory. Hydrochloric acid will be used as a chemical stabilizer and preservative for volatile and purgeable organic specimens. Nitric acid will be used as the preservative for samples for metals analysis.

4.3 STORAGE/TRANSPORT CONDITIONS

Proper storage and transport conditions must be maintained to preserve sample integrity between collection and analysis. Ice and chemical cold packs will be used to cool and preserve samples, as directed by the analytical laboratory. Samples will be maintained at a temperature of 4° C. Dry ice is not to be used. Samples will be packed and/or wrapped in plastic bubble wrap to inhibit breakage or accidental spills.

Chain-of-Custody control documents will be placed in a waterproof pouch and sealed inside the cooler with the samples for shipping. Tape and/or custody seals will be placed on the outside of the shipping coolers, in a manner to prevent and detect tampering with the samples.

4.4 SAMPLE DELIVERY

Samples will be delivered to the analytical laboratory within a reasonable period of time in person or using an overnight delivery service to insure hold times are not exceeded. If samples are not shipped the same day, the ice used to keep the samples cool will be replenished to maintain the required 4° C temperature. Shipment and sample receipt will be coordinated with the laboratory. Do NOT store or ship highly contaminated samples (concentrated wastes, free product, etc.) or samples suspected of containing high concentrations of contaminants in the same cooler or shipping container with other environmental samples.

4.5 CHAIN OF CUSTODY

Chain-of-Custody control will be maintained from sampling through analysis to prevent tampering with analytical specimens. Chain-of-Custody control procedures for samples consist of the following:

1. Chain-of-Custody will originate at the laboratory with the shipment of prepared sample bottles and a sealed trip blank. Identical container kits will be shipped by express carrier to the sampler or site or picked up at the laboratory in sealed coolers.

2. Upon receipt of the sample kit, the sampler will inventory the container kit and check its consistency with number and types of containers indicated in the Chain-of-Custody forms and required for the sampling event.

3. Labels for individual sample containers will be completed, indicating the site, sampling time, sampling date, sample location/well number and preservation methods used for the sample (if any).

4. Collected specimens will be placed in ice filled coolers and will remain in the continuous possession of the field technician until shipment or transferal as documented by the Chain-of-Custody form has occurred. If continuous possession can not be maintained by the field technician, the coolers will be temporarily sealed and placed in a secure area.

5. Upon delivery to the laboratory, samples will be given laboratory sample numbers and recorded into a logbook indicating client, well number and delivery date and time. The laboratory director or his designee will sign the Chain-of-Custody control forms to formally receive the samples. The field technician, project manager and the laboratory director will work together to ensure that proper refrigeration of the samples is maintained.

6. Complete Chain-of-Custody form copies will be placed in the laboratory's analytical project file and attached to the laboratory analysis report upon completion.

Chain-of-Custody forms will be used to transfer direct deliveries from the sampler to the laboratory. A coded, express delivery shipping bill shall constitute the Chain-of Custody between the sampler and laboratory for overnight courier deliveries.

5.0 LABORATORY ANALYSIS

5.1 OVERVIEW

The ground and surface water parameters will be analyzed for field indicators of water quality (pH, conductivity, temperature, and turbidity) and those constituents listed in Table 1. Analytical methods from Test Methods For Evaluating Solid Waste - Physical/Chemical Methods (SW-846) or Methods For the Chemical Analysis of Water and Wastes will be used and be consistent with the Division of Waste Management's policies regarding analytical methods and reporting limits. Analysis will be performed by a laboratory certified by the North Carolina DENR for the analyzed parameters.

5.2 LABORATORY QUALITY ASSURANCE/QUALITY CONTROL

Formal environmental laboratory Quality Assurance/Quality Control (QA/QC) procedures are to be utilized throughout the event. The landfill owner/operator is responsible for selecting a laboratory contractor and ensuring that laboratory is utilizing proper QA/QC procedures. The laboratory must have a QA/QC program based on specific routine procedures outlined in a written laboratory Quality Assurance/Quality Control Manual. The QA/QC procedures listed in the manual shall provide the lab with the necessary assurances and documentation that accuracy and precision goals are achieved in analytical determinations. Internal quality control checks will be undertaken regularly by the lab to assess the precision and accuracy of analytical procedures.

5.3 LABORATORY QUALITY CONTROL CHECKS

The internal quality control checks include the use of calibration standards, standard references, duplicate samples and spiked or fortified samples. Calibration standards will be verified against a standard reference obtained from a second (alternate) source. For most analytical methods calibration curves shall be developed using at least one blank and three standards. Samples will be diluted, if necessary, to ensure that analytical measurements fall within the linear portion of the calibration curve. Where required, duplicate samples shall be processed at an average frequency of 10 percent to assess the precision of testing methods, and standard references shall be processed not less than monthly to assess the accuracy of analytical procedures. Method or procedural blanks and spiked or fortified samples shall be carried through all stages of sample preparation and measurement to validate the efficiency and accuracy of the analysis.

5.4 DATA REVIEW

During the analyses, quality control and sample data shall be reviewed by the laboratory manager to identify questionable data and determine if the necessary QA/QC requirements are being followed. If a portion of the lab work is subcontracted, it is the responsibility of the contracted laboratory to verify that the subcontracted work is performed by certified laboratories, using identical QA/QC procedures.

6.0 RECORD KEEPING AND REPORTING

6.1 OVERVIEW

This section addresses documentation and reporting requirements associated with the WQMP implementation.

6.1 FIELD LOGBOOK

The field technician will keep an up-to-date logbook documenting important information pertaining to the technician's field activities. The field logbook will document the following:

- Site Name and Location;
- Date and Time of Sampling;
- Climatic Conditions During Sampling Event;
- Sampling Point/Well Identification Number;
- Well Static Water Level;
- Height of Water Column in Well;
- Purged Water Volume and Well Yield (High or Low);
- Presence of Immiscible Layers and Detection Method;
- Observations on Purging and Sampling Event;
- Sample Collection Time;
- Temperature, pH, Temperature, DO, ORP, Turbidity and Conductivity Readings;
- Field Technician Signature;
- Relative stream water level ;
- Surface water clarity; and
- Changes in surface monitoring station conditions and surroundings.

6.2 GROUNDWATER SYSTEM EVALUATIONS

After each monitoring event, the potentiometric surface will be evaluated to determine whether the monitoring system remains adequate and to determine the rate and direction of groundwater flow at the site. The direction of groundwater flow will be determined by a comparison of groundwater surface elevations across the site through the construction of a potentiometric surface map. Groundwater flow rate will be determined using the following equation:

$$V=KI/n$$

Where: V = Velocity (feet/day)
K = Hydraulic Conductivity (feet/day)
I = Hydraulic Gradient (foot/foot)
n = Effective Porosity of aquifer soils (unit less)

If evaluation indicates the groundwater monitoring network is insufficient in meeting the rule requirements, the monitoring network will be modified accordingly and a work plan will be submitted to NCDENR for review prior to modifications to enhance the monitoring system.

6.3 RESULT REPORTING

Laboratory analytical data will be forwarded to the DWM within 60 calendar days of the receipt. The analytical data submitted will specify the sample collection date, the sampling point identification and include a sampling location map. Should a significant concentration of contaminants be detected in ground and surface water, as defined in North Carolina Solid Waste Rules, Groundwater Quality Standards, or Surface Water Quality Standards, the County will notify the DWM and will place a notice in the landfill records as to which constituents were detected.

Monitoring reports will be submitted with the following:

1. A potentiometric surface evaluation
2. Analytical laboratory reports and summary tables
3. A Solid Waste Environmental Monitoring Data Form (included in Appendix A)
4. Laboratory Data submitted in accordance with the Electronic Data Deliverable Template.

Monitoring reports may be submitted electronically by e-mail or in paper copy form. Copies of laboratory results and water quality reports for the Johnston County Landfill will be kept at the landfill office. Reports summarizing groundwater quality results and data evaluation will be submitted to the Division of Waste Management for each sampling event. Depending on the analytical results received, graphical analyses may be performed to evaluate plume movement and contaminant trends over time.

7.0 MONITORING PROGRAM MODIFICATIONS

7.1 OVERVIEW

This section addresses the procedures that should be followed with respect to water quality program modifications.

7.2 WELL ABANDONMENT/REHABILITATION

After each groundwater monitoring event, the potentiometric surface will be evaluated to determine whether the monitoring system remains adequate and to determine the rate and direction of groundwater flow at the site.

Should wells become irreversibly damaged or require rehabilitation, the DWM) will be notified. If monitoring wells and/or piezometers are damaged irreversibly they will be abandoned under the direction of the DWM. The abandonment procedure in unconsolidated materials will consist of over-drilling and/or pulling the well casing and plugging the well with an impermeable, chemically-inert sealant such as neat cement grout and/or bentonite clay. For bedrock well completions the abandonment will consist of plugging the interior well riser and screen with an impermeable neat cement grout and/or bentonite clay sealant.

7.3 ADDITIONAL WELL INSTALLATIONS

Additional well installations will be carried out in accordance with DWM directives. If the potentiometric maps reveal that the depth, location, or number of wells is insufficient to monitor potential releases of solid waste constituents from the landfill units, new well locations and depths will be submitted to the DWM for approval.

Monitoring wells will be installed under the supervision of a geologist or engineer who is registered in North Carolina and who will certify to the DWM that the installation complies with the North Carolina Regulations. Following installation, the documentation for the well construction will be submitted by the registered geologist or engineer within 30 days.

7.4 IMPLEMENTATION SCHEDULE

This Monitoring Program will be implemented with the approval of this Water Quality Monitoring Plan.

Figure

Johnston County Landfill
Water Quality Monitoring Plan
Solid Waste Permit No. 51-03

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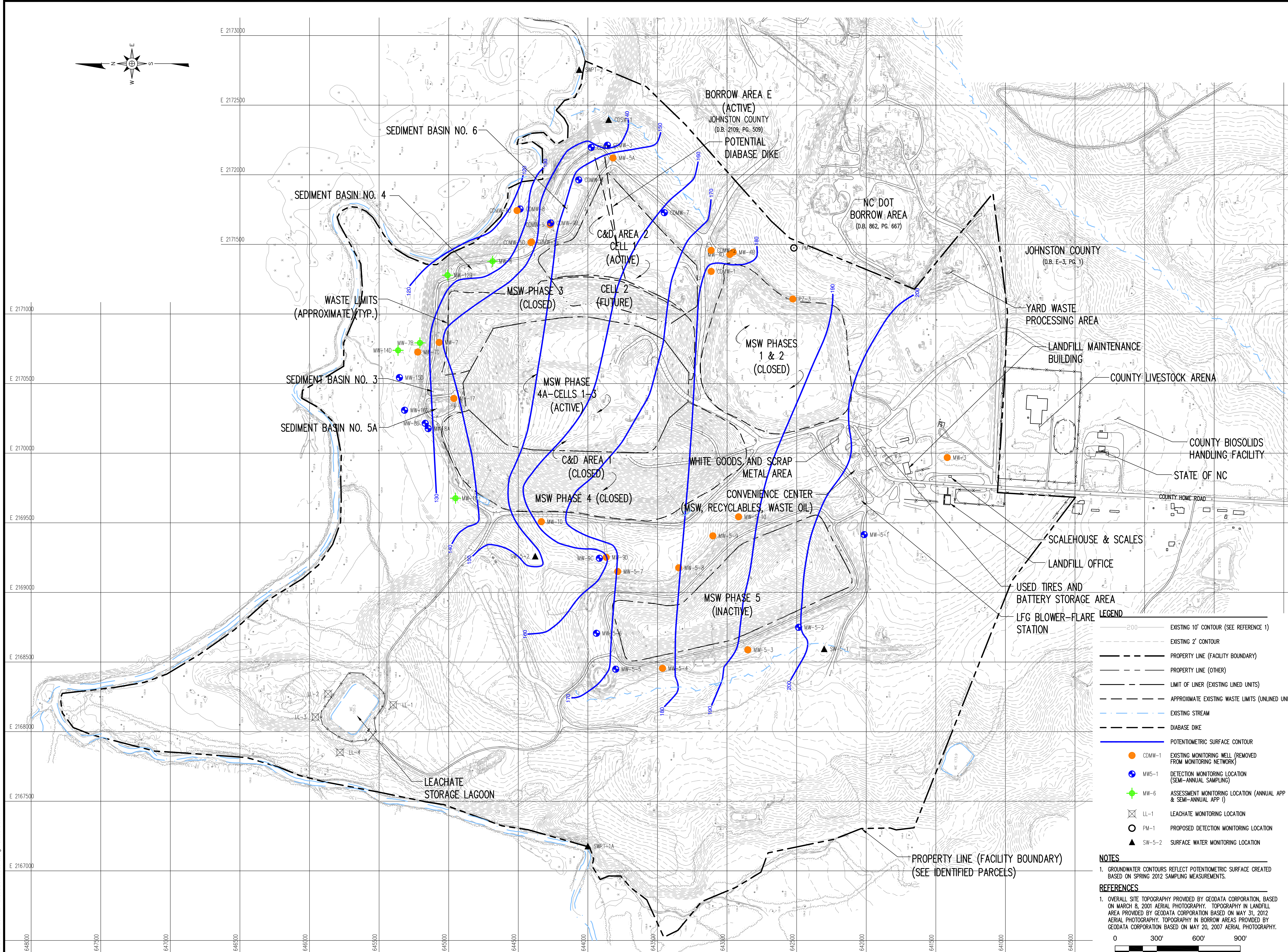

NOTES

1. GROUNDWATER CONTOURS REFLECT POTENTIOMETRIC SURFACE CREATED BASED ON SPRING 2012 SAMPLING MEASUREMENTS.

REFERENCES

1. OVERALL SITE TOPOGRAPHY PROVIDED BY GEODATA CORPORATION, BASED ON MARCH 8, 2001 AERIAL PHOTOGRAPHY. TOPOGRAPHY IN LANDFILL AREA PROVIDED BY GEODATA CORPORATION BASED ON MAY 31, 2012 AERIAL PHOTOGRAPHY. TOPOGRAPHY IN BORROW AREAS PROVIDED BY GEODATA CORPORATION BASED ON MAY 20, 2007 AERIAL PHOTOGRAPHY.

PREPARED FOR:

JOHNSTON COUNTY NORTH CAROLINA DEPARTMENT OF PUBLIC UTILITIES

PREPARED BY:

NC LIC. NO. C-0828 (ENGINEERING)

SMITH+GARDNER ENGINEERS

14 N. Boylan Avenue, Raleigh NC 27603 | 919.828.0577

SEAL

SEAL

REV.	DATE	DESCRIPTION

PROJECT TITLE:

JOHNSTON COUNTY LANDFILL

DRAWING TITLE:

WATER QUALITY MONITORING NETWORK

DESIGNED: J.A.S.	PROJECT NO.: JOHN 12-4
DRAWN: K.C.B.	SCALE: AS SHOWN
APPROVED:	DATE: JULY 2013
FILENAME: JOHN-D0679	
SHEET NUMBER:	DRAWING NUMBER: FIG.1

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Tables

Johnston County Landfill
Water Quality Monitoring Plan
Solid Waste Permit No. 51-03

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Well	Date Installed	Northing	Easting	Ground Surface Elevation	Top of Casing Elevation	Well Depth	Bottom Elevation	Screen Interval	Screen Lithology	Notes
Proposed Groundwater Detection Monitoring Network										
CDMW-3	8/28/2006	643860.05	2172212.35	167.70	170.65	36	131.70	26-36	NA	monitors diabase dike
CDMW-4	8/28/2006	643975.97	2172197.24	169.90	172.84	45	124.90	35-45	NA	monitors diabase dike
CDMW-6*	6/16/2004	644066.12	2171963.60	160.00	162.12	31.5	128.50	21.5-31.5	bedrock	
CDMW-7*	6/16/2004	643451.38	2171727.87	172.00	175.27	45	127.00	35-45	mudstone	
CDMW-8*	6/17/2004	644487.10	2171754.20	126.00	127.41	10	116.00	5-10	silty sand	
CDMW-9D	7/8/2003	644268.20	2171653.67	157.60	160.71	45	112.60	40-45	metamudstone	
MW-8D	12/7/1999	645168.55	2170214.84	152.26	153.44	33	119.26	28-33	metamudstone	
MW-9C	NA	643917.72	2169245.90	165.30	167.89	NA	NA	NA	NA	
MW-15D	6/26/2003	645354.15	2170543.68	125.60	128.70	24	101.60	19-24	metamudstone	
MW-16D	6/26/2003	645317.05	2170309.20	130.60	133.96	24	106.60	18-23	metamudstone	
MW5-1	4/16/1997	642015.58	2169415.40	229.62	232.17	30	199.62	14-29	silty sand with gravel	Site background well
MW5-2	4/22/1997	642487.14	2168749.63	211.23	206.77	22	189.23	5-20	silty clay	
MW5-5	4/22/1997	643800.44	2168449.11	197.73	185.42	22	175.73	5-20	silty clay	
MW5-6	4/22/1997	643938.92	2168706.91	195.12	199.11	39	156.12	21-36	silty clay	
PM-1	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	proposed replacement for PZ-3, MW-4B & CDMW-2
LL-1	NA	645398.84	2168192.54	151.50	153.82	NA	NA	NA	NA	Leachate Lagoon Monitoring Location
LL-2	NA	645867.44	2168271.33	148.10	150.33	NA	NA	NA	NA	Leachate Lagoon Monitoring Location
LL-3	NA	645957.48	2168106.00	149.03	151.57	NA	NA	NA	NA	Leachate Lagoon Monitoring Location
LL-4	NA	1/31/3668	5/16/7835	136.44	138.81	NA	NA	NA	NA	Leachate Lagoon Monitoring Location
Proposed Groundwater Assessment Monitoring Network										
MW-6	6/14/1991	644684.58	2171378.66	161.78	166.60	50	111.78	30-50	slate	
MW-7B	9/10/1993	645206.96	2170792.55	127.84	129.84	18	109.84	6-16	saprolite	
MW-11	9/15/1994	644950.77	2169676.92	134.00	144.32	25	109.00	14-24	clayey silt	
MW-12B	4/24/1997	645008.00	2171279.00	153.82	156.12	38	115.82	21.5-36.5	PWR - slate	
MW-14D	6/26/2003	645363.72	2170739.06	125.50	128.66	31	94.50	26-31	metamudstone	
Existing Wells - Proposed for Removal from Monitoring Network										
CDMW-1	8/29/2006	643114.61	2171305.99	186.70	189.46	20	166.70	5-20	NA	interior location - RFN
CDMW-2	8/29/2006	643114.86	2171456.69	183.20	186.13	20	163.20	5-20	NA	redundant, replaced - RFN
CDMW-5	8/29/2006	644405.08	2171517.29	164.20	167.39	34	130.20	19-34	NA	interior location - RFN
CDMW-5D	8/29/2006	644409.22	2171513.79	164.40	167.43	47	117.40	36-47	NA	interior location - RFN
CDMW-8D*	6/21/2004	644509.00	2171743.00	125.00	127.63	30	95.00	35-30	mudstone	historically dry - RFN
CDMW-9	3/10/2008	644270.74	2171641.69	157.70	160.50	30	127.70	20-30	siltstone	interior location - RFN
PZ-3	12/8/1998	642528.15	2171107.90	194.17	194.91	15	179.17	5-15	silty sand	replaced - RFN
MW-3	4/16/1991	641418.01	2169969.56	233.60	234.16	28	205.60	17.8-27.8	sand	interior location (between landfills) - RFN
MW-4B	9/10/1993	642957.03	2171444.05	179.57	182.97	20	159.57	8-18	sandy silty clay	replaced - RFN
MW-4D	12/15/1998	642980.96	2171427.56	182.74	182.98	68	114.74	63-68	metamudstone	interior location - RFN
MW-5A	12/8/1998	643820.20	2172120.74	171.90	173.70	24	147.90	14-24	sandy silt	interior location - RFN
MW-7	6/14/1991	645068.98	2170795.87	164.55	163.24	35	129.55	20-35	clay	interior location - RFN
MW-7D	12/8/1998	645222.32	2170726.50	126.89	127.91	30	96.89	25-30	metamudstone	interior location - RFN
MW-8A	NA	645147.30	2170177.01	NA	NA	NA	NA	NA	NA	redundant - RFN
MW-9D	12/7/1998	643868.45	2169252.80	166.08	170.25	40	126.08	35-40	metamudstone	redundant - RFN
MW-10	9/15/1994	644334.57	2169508.35	167.79	175.65	35	132.79	19-34	clayey silt	redundant & cross-gradinet - RFN
MW-17	NA	644963.10	2170393.58	NA	NA	NA	NA	NA	NA	interior location - RFN
MW5-3	4/22/2997	642851.56	2168588.27	205.58	203.80	22	183.58	5-20	silty clay	redundant & cross-gradinet - RFN
MW5-4	4/22/1997	643464.18	2168455.67	191.84	186.58	22	169.84	5-20	sandy clayey silt	cross gradient - RFN
MW5-7	4/18/1997	643786.20	2169150.69	167.96	182.73	23	144.96	6-21	silt	interior location (between landfills) - RFN
MW5-8	4/21/1997	643347.86	2169177.25	183.10	189.31	22	161.10	5-20	silt	interior location (between landfills) - RFN
MW5-9	3/18/1995	643102.64	2169406.82	194.51	198.31	30	164.51	NA	clayey silt	interior location (between landfills) - RFN
MW5-10	4/21/1997	642917.77	2169543.59	198.56	202.88	25	173.56	8-28	sand	interior location (between landfills) - RFN

Well	Date Installed	Northing	Easting	Ground Surface Elevation	Top of Casing Elevation	Well Depth	Bottom Elevation	Screen Interval	Screen Lithology	Notes
Surface Water Monitoring Locations										
CDSW-1	NA	644527.55	2171717.4	NA	NA	NA	NA	NA	NA	
SWPT-1	NA	643982.528	2166379.022	NA	NA	NA	NA	NA	NA	
SWPT-2	NA	644062.774	2172755.306	NA	NA	NA	NA	NA	NA	
SW5-1	NA	642303.119	2168595.202	NA	NA	NA	NA	NA	NA	
SW5-2	NA	644378.433	2169260.65	NA	NA	NA	NA	NA	NA	
Leachate Monitoring Locations										
Phase 5	NA	NA	NA	NA	NA	NA	NA	NA	NA	Monitors Phase 5 Leachate
Phase 4A	NA	NA	NA	NA	NA	NA	NA	NA	NA	Monitors Phase 4A Leachate
Phase 4A Witness	NA	NA	NA	NA	NA	NA	NA	NA	NA	Monitors Phase 4A Leak Detection Zone (double liner)
C&D	NA	NA	NA	NA	NA	NA	NA	NA	NA	Monitors C&D Landfill Leachate

NA = Not Available
RFN - Removed from Groundwater Monitoring Network
* Groundsurface estimated from topography shown on Figure 1

Table 2
Analytical Parameters
Johnston County Landfill Facility

Appendix I Constituents	**Synonyms**
Antimony	
Arsenic	
Barium	
Beryllium	
Cadmium	
Chromium	
Cobalt	
Copper	
Lead	
Nickel	
Selenium	
Silver	
Thallium	
Vanadium	
Zinc	
Temperature	
pH	
Turbidity	
Specific Conductance	
Acetone	2-Propanone
Acrylonitrile	2-Propenenitrile
Benzene	
Bromochloromethane	Chlorobromomethane
Bromodichloromethane	Dibromochloromethane
Bromoform	Tribromomethane
Carbon Disulfide	
Carbon Tetrachloride	Tetrachloromethane
Chlorobenzene	
Chloroethane	Ethyl chloride
Chloroform	Trichloromethane
Dibromochloromethane	Chlorodibromomethane
1,2-Dibromo-3-chloropropane	DBCP
1,2-Dibromoethane	Ethylene dibromide, EDB
1,2-Dichlorobenzene	o-Dichlorobenzene
1,4-Dichlorobenzene	p-Dichlorobenzene
trans-1,4-Dichloro-2-butene	
1,1-Dichloroethane	Ethyldidene chloride
1,2-Dichloroethane	Ethylene dichloride
1,1-Dichloroethylene	Vinylidene chloride
cis-1,2-Dichloroethylene	
trans-1,2-Dichloroethylene	
1,2-Dichloropropane	Propylene dichloride
cis-1,3-Dichloropropene	
trans-1,3-Dichloropropene	
Ethylbenzene	
2-Hexanone	Methyl butyl ketone
Methyl bromide	Bromomethane
Methyl chloride	Chloromethane
Methyl ethyl ketone	2-Butanone
Methyl iodide	Iodomethane
4-Methyl-2-pentanone	Methyl isobutyl ketone
Methylene bromide	Dibromomethane
Methylene chloride	Dichloromethane
Styrene	Ethenylbenzene
1,1,1,2-Tetrachloroethane	
1,1,2,2-Tetrachloroethane	
Tetrachloroethylene	Perchloroethylene
Toluene	Methyl benzene
1,1,1-Trichloroethane	Methyl chloroform
1,1,2-Trichloroethane	
Trichloroethylene	
Trichloroflouromethane	CFC-11
1,2,3-Trichloropropane	
Vinyl acetate	Acetic acid, ethenyl ester
Vinyl chloride	Choroethene
Xylenes	Dimethyl benzene
C&D Landfill Additional Parameters:	
Mercury	
Chloride	
Manganese	
Sulfate	
Iron	
Alkalinity	
Total Dissolved Solids	
Tetrahydrofuran	
Leachate Additional Parameters:	
BOD	
COD	
phosphate	
nitrate	
sulfate	

Appendix A

Johnston County Landfill
Water Quality Monitoring Plan
Solid Waste Permit No 51-03

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DENR USE ONLY: ☐Paper Report ☐Electronic Data - Email CD (data loaded: Yes / No) Doc/Event #:

NC DENR

Division of Waste Management - Solid Waste

Environmental Monitoring Reporting 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).

Instructions:

- **Prepare one form for each individually monitored unit.**
- **Please type or print legibly.**
- Attach a notification table with values that attain or exceed NC 2L groundwater standards or NC 2B surface water standards. The notification must include a preliminary analysis of the cause and significance of each value. (e.g. naturally occurring, off-site source, pre-existing condition, etc.).
- Attach a notification table of any groundwater or surface water values that equal or exceed the reporting limits.
- Attach a notification table of any methane gas values that attain or exceed explosive gas levels. This includes any structures on or nearby the facility (NCAC 13B .1629 (4)(a)(i).
- Send the original signed and sealed form, any tables, and Electronic Data Deliverable to: Compliance Unit, NCDENR-DWM, Solid Waste Section, 1646 Mail Service Center, Raleigh, NC 27699-1646.

Solid Waste Monitoring Data Submittal Information

Name of entity submitting data (laboratory, consultant, facility owner):

Contact for questions about data formatting. Include data preparer's name, telephone number and E-mail address:

Name: ______________________ Phone: ______________________

E-mail: ______________________

Facility name:	Facility Address:	Facility Permit #	NC Landfill Rule: (.0500 or .1600)	Actual sampling dates (e.g., October 20-24, 2006)

Environmental Status: (Check all that apply)

☐ Initial/Background Monitoring ☐ Detection Monitoring ☐ Assessment Monitoring ☐ Corrective Action

Type of data submitted: (Check all that apply)

☐ Groundwater monitoring data from monitoring wells
☐ Groundwater monitoring data from private water supply wells
☐ Leachate monitoring data
☐ Surface water monitoring data
☐ Methane gas monitoring data
☐ Corrective action data (specify) ______________________
☐ Other(specify) ______________________

Notification attached?

☐ No. No groundwater or surface water standards were exceeded.

☐ Yes, a notification of values exceeding a groundwater or surface water standard is attached. It includes a list of groundwater and surface water monitoring points, dates, analytical values, NC 2L groundwater standard, NC 2B surface water standard or NC Solid Waste GWPS and preliminary analysis of the cause and significance of any concentration.

☐ Yes, a notification of values exceeding an explosive methane gas limit is attached. It includes the methane monitoring points, dates, sample values and explosive methane gas limits.

Certification

To the best of my knowledge, the information reported and statements made on this data submittal and attachments are true and correct. Furthermore, I have attached complete notification of any sampling values meeting or exceeding groundwater standards or explosive gas levels, and a preliminary analysis of the cause and significance of concentrations exceeding groundwater standards. I am aware that there are significant penalties for making any false statement, representation, or certification including the possibility of a fine and imprisonment.

Facility Representative Name (Print) Title (Area Code) Telephone Number

Affix NC Licensed/ Professional Geologist Seal

Signature Date

Facility Representative Address

NC PE Firm License Number (if applicable effective May 1, 2009)

Revised 6/2009