Water Quality Monitoring Plan

Revised July 28, 2016

Marshall Flue Gas Desulfurization Residue Landfill, Phase 1, Cell 1, Permit No. 18-09

Duke Energy – Marshall Steam Station

Terrell, North Carolina

Amec Foster Wheeler Project No. 7810160654

To:	Duke Energy Carolinas, LLC
Date	7/28/2016
From:	Amec Foster Wheeler

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Executive Summary

The following Water Quality Monitoring Plan (WQMP) – Revised July 28, 2016, represents the second 5-year update to the WQMP for the Duke Energy (Duke) Flue Gas Desulfurization (FGD) Residue Landfill at Marshall Steam Station.

The original WQMP was approved in November 2006. The current WQMP (the first 5-year update) was prepared by Altamont Environmental, Inc. (Altamont) and titled *Groundwater Sampling and Analysis Plan*, dated August 19, 2011.

The current Permit to Operate is scheduled to expire on November 21, 2016. As part of the permit amendment (renewal), Amec Foster Wheeler was requested to review and update the current WQMP as needed per the requirements stated in 15A NCAC 13B .0504 (1)(g)(iv).

The water quality monitoring network remains unchanged for the Marshall FGD Landfill facility since the last update; therefore, the overall content of the current WQMP remains relevant and applicable. In general, Amec Foster Wheeler retained Altamont's 2011 plan content and organization for this WQMP update with the exception of the following revisions:

- Minor text edits, primarily changing absolute terms to qualifier terms
- Updated Department of Environment and Natural Resources (DENR) references to Department of Environmental Quality (DEQ)
- Table 1 total depths for MS-8 and MS-16 were revised to reflect the bottom of the well and not the bottom of the borehole.
- Table 2 detection limits column was removed since it is lab-specific. Detection limits are generally specified by the analytical methods which are still listed.
- Table 2 dissolved oxygen (DO) and oxidation reduction potential (ORP) rows were added under in situ parameters.
- Table 2 analytical method for in situ parameters was changed to "Multi-Parameter Water Quality Meter" and "Turbidimeter" as appropriate instead of listing a specific brand of equipment.
- Table 2 units were changed for chloride, fluoride, nitrate, sulfate, and total dissolved solids from micrograms per liter to milligrams per liter, which is the more common laboratory reporting format for those parameters.
- Table 2 and 3 parameters Antimony, Beryllium, Thallium, and Vanadium were added as requested in a Permit to Operate Renewal Application letter from the North Carolina Department of Environmental Quality (DEQ), Division of Waste Management (DWM), Solid Waste Section (SWS) dated June 17, 2016.
- Table 2 and 3 parameter Cobalt was added as requested in an email to Mr. Mark Shumpert of Amec Foster Wheeler from Ms. Tyler Hardin of Duke Energy dated July 19, 2016.
- Table 3 ORP row added under in situ parameters.
- Table 3 holding times corrected from 6 months to 28 days for mercury and fluoride.

- Replaced Duke Energy Field Sampling Forms, as provided by Duke (Figures 4 through 7)
- Revised report submittal timeframe from within 90 days post-sampling to within 120 days post-sampling to be consistent with requirement stated in the facility's Permit to Operate.

Amec Foster Wheeler included Figures 1 through 3 and Appendix A as unrevised from Altamont's 2011 WQMP.

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1 Program Description

1.1 Scope of Work

This Water Quality Monitoring Plan (WQMP) is designed to guide the monitoring efforts that are used to evaluate the effects of the Marshall Steam Station (Marshall) Flue Gas Desulfurization (FGD) Residue Landfill, Phase 1, Cell 1, on the groundwater in the area. This plan has been prepared according to the guidelines set forth by the North Carolina Department of Environmental Quality (DEQ) Water Quality Guidance Document for Solid Waste Facilities (SW-1001-87), and by the Environmental Protection Agency (EPA) in "Interim Guidelines and Specifications for Preparing Quality Assurance Plans" (QAMS-500/80), and documents the methodologies of field sampling, record-keeping protocols, data quality objectives, and data validation procedures that will be used in this program.

1.2 Background and Site Hydrogeological Description

Marshall Steam Station (Marshall) is located in Catawba County, on Highway NC 150, just west of Lake Norman. The station is owned and operated by Duke Energy Carolinas, LLC (Duke). Marshall is located in the Piedmont physiographic region. Figure 1 shows the location of the plant and the location of the FGD landfill, Phase 1, Cell 1.

The Marshall Steam Station has a generating capacity of 2,090 megawatts (MW) of electric power by the combustion of coal. Therefore, the Marshall station generates enough electricity to power over one-and-a- half million homes.

The FGD Residue Landfill will consist of two cells. When completed, the landfill footprint will contain approximately 31.9 acres. Construction of Cell 1 was completed in 2006, and a Permit to Operate was issued on November 21, 2006. Duke has not requested a Permit to Construct for Cell 2.

Cell 1 has a footprint of approximately 14.8 acres. In general the landfill is permitted to receive industrial wastes generated by Duke at Marshall and at other Duke facilities. The waste received at the FGD residue landfill consists primarily of gypsum. The FGD residue is conveyed to the landfill site by truck, where the material is spread and compacted.

The landfill was constructed with a leachate collection and removal system and an engineered liner system to prevent impacts to groundwater. When closed, the completed landfill will receive an engineered cover system to reduce infiltration.

The FGD landfill is located entirely on Duke property, northwest of the Marshall Station and to the west of the Marshall Ash Basin. The landfill is located to the east of a north-south trending railroad line. . Located to the west of this railroad line is Sherrill's Ford Road, which also runs north-south along a surface water divide. Located between the landfill footprint and the railroad line is a surface water drainage feature. This feature drains to the south, to an intermittent stream that drains to Lake Norman. There is a topographic divide running north-northwest through the landfill footprint, along Steam Plant Road. Surface drainage to the west of Steam Plant Road drains to the surface drainage feature and surface drainage to the east of Steam Plant Road drains to the Marshall Ash Basin.

As described in the site hydrogeological study (Hydrogeological Study FGD Scrubber Landfill, Duke Power-- Marshall Steam Station, Terrell, North Carolina, S&ME Project No: 1264-02-578, May 30, 2003), the subsurface conditions in the landfill area consist of residual soils and partially to fully weathered rock (saprolite) , which have formed by the in-place weathering of the parent rock. As is typical in the groundwater systems located in the Piedmont region, groundwater at the landfill site occurs within the residuum and saprolite under unconfined aquifer conditions. The predominant discharge areas for groundwater in the landfill area are expected to be the drainage feature and the ash basins located to the east of the landfill.

The subsurface conditions at the landfill were described by S&ME as follows:

- Residuum: Beneath the ground surface, residual material consisting of silts, silty clays, clayey silts, and silty sands. Sandy silts were found at depths ranging from 2.5 to 14 feet below ground surface.
- Saprolite: Saprolite material was found at depths ranging from 13.5 feet to 68.5 feet below ground surface. This material is a product of weathered bedrock, consisting of silts to clayey silts and sandy silts to silty sands, having a Standard Penetration Test (SPT) resistance of 50 blows per foot or more.
- Partially Weathered Rock: This material is defined as material exhibiting SPT resistances in excess of 100 blows per foot. This material was found at depths ranging from 25.5 feet to 90 feet below ground surface.
- Bedrock: Bedrock was found at depths ranging from 25.5 feet to 79.5 feet. When sampled, this material was classified as granite, schist, and gneiss. Horizontal to high-angle fractures were found in the upper ten feet of the bedrock areas. Many fractures were found to be iron stained, indicating flow of water into the fractures.

1.3 Well Locations and Installation

Groundwater and surface water conditions at the landfill are monitored using nine groundwater monitoring wells and one surface water sampling location. Monitoring well locations and construction information are provided in Table 1. The locations of these wells are shown on Figure 2. Monitoring well MS-8 will be used as the background well for this sampling program.

The wells were constructed of two-inch diameter polyvinyl chloride (PVC) well screen and casing. The well screens were placed where they would intercept the aquifer and have slot sizes of 0.010 inch. The screen lengths are shown in Table 1.

The wells were installed by a well driller registered in North Carolina in accordance with applicable DEQ regulations. The locations of the wells and the elevations of the tops of the casings were surveyed under the direction of a Professional Surveyor, licensed in North Carolina. Figure 3 shows a typical construction diagram for the wells. Each well is equipped with dedicated bladder- type pump systems. Well construction records for the existing wells are included in Appendix A. A brief description of the monitoring locations and their monitoring function is provided below.

Monitoring Well MS-8—Background Well

Monitoring well MS-8 will be used as a background monitoring well. This well is located approximately 250 feet north of the landfill, on the west side of Steam Plant Road. This well is screened to monitor groundwater in the saprolite layer.

Monitoring Well MS-9

This existing well is located north of the landfill. This well is screened to monitor groundwater in the saprolite layer.

Monitoring Well MS-10

This well is located west of the landfill. This well is screened to monitor groundwater in the saprolite layer.

Monitoring Well MS-11

This well is located west of the landfill. This well is screened to monitor groundwater in the saprolite layer.

Monitoring Well MS-12 (Formerly Designated as Well OW-3)

This well is located south of the landfill. This well is screened to monitor groundwater in the saprolite layer.

Monitoring Well MS-13 (Formerly Designated as Well MS-6)

This well is located south of the landfill. The well is screened to monitor groundwater in the saprolite layer.

Monitoring Well MS-14 (Formerly Designated as Well B-5)

This well is located to the southeast of the landfill. This well is screened to monitor groundwater in the saprolite layer.

Monitoring Well MS-15 (Formerly Designated as Well B-4)

This well is located to the east of the landfill. This well is screened to monitor groundwater in the saprolite layer.

Monitoring Well MS-16

This well is located to the northeast of the landfill. This well is screened to monitor groundwater in the saprolite layer.

1.4 Surface Water Sample Location

A surface water sample will be collected from location SW-1. This surface water sampling location is located south of the landfill, between wells MS-12 and MS-13, as shown on Figure 2. The North Carolina State Plane coordinates and elevation for this sampling location are shown in Table 1.1.

1.5 Monitoring Frequency

The wells and surface water sample location will be sampled semiannually in March and September.

1.6 Parameters

The parameters to be sampled and analyzed, units of measure, and analytical methods are presented in Table 2.

1.7 Data Quality Objectives

The overall Quality Assurance (QA) objective is to provide reliable data of known and acceptable quality. Measurements will be documented to yield results that are representative of the groundwater and surface water quality. Data will be calculated and reported in units as required by DEQ.

The analytical QA objectives for precision, accuracy, and completeness have been established by the laboratories in accordance with EPA or other accepted agencies for each measurement variable, where possible. The objectives are outlined in the Duke Energy Analytical Laboratory Procedures Manual and are available upon request.

Detection limits for the water analyses are generally specified by the analytical method. As stated above, appropriate methods have been selected to meet applicable standards for groundwater quality. Instances may occur, however, in which the condition of the sample may not allow detection of the desired limits for various parameters either because of matrix interference or elevated analyte concentrations requiring sample dilution. The laboratory(s) will provide sufficient documentation with each data package to notify reviewers about any analytical issues with the data, if needed.

2 Sampling Procedures

2.1 Sampling Equipment

Development, purging, and sampling equipment are selected so that materials are compatible with the sample parameters and comply with state and federal regulatory requirements for sampling. Positive-gas- displacement fluorocarbon resin bladder pumps are installed in each monitoring well and are dedicated purging and sampling systems.

2.1.1 Equipment Cleaning Procedures

Dedicated sampling equipment has been installed in each monitoring well. In the event non-dedicated equipment is used between wells, equipment will be cleaned before and after use in each well in accordance with standard EPA-approved cleaning procedures for field equipment. This standard is outlined in the *Standard Operating Procedures and Quality Assurance Manual*, Engineering Support Branch, EPA Region IV, February 1, 1991.

2.2 Groundwater Sampling

2.2.1 Development of Wells

Each of the nine wells addressed in this WQMP have been developed. If new wells are installed they will be developed before they are sampled.

After installation of new wells, and prior to initial sampling, the monitoring wells will be developed. Development reduces silt that has settled into the bottom of the well following installation, and reduces fine silt and clay particles from the well screen and sandpack surrounding the screen. Well development is performed to reduce potential for clogging and promote well performance. Development involves removing an estimated ten or more well volumes from the well using a positive-gas-displacement fluorocarbon resin bladder pump with up-and-down agitation to loosen particles from the well screen. After development of a well, a true well depth is recorded, referenced to the top of well casing (TOC).

2.2.2 Groundwater Level and Total Depth Measurements

Water level measurements are collected and recorded to determine the groundwater elevations, determine groundwater flow direction, and to calculate the volume of standing water in the well. Each monitoring well has been surveyed to determine the elevation of the TOC. Total well depth and water level measurements are referenced to the TOC and recorded to the nearest one-hundredth of a foot.

Water level measurements are collected with an electronic measuring device consisting of a spool of dual conductor wire and sensor. When the sensor comes in contact with water, the circuit is closed and a meter light and/or buzzer is attached to the spool to signal the contact. The sensor is lowered further until it rests on the bottom of the well to determine the total depth of the well reference to the TOC. The depth and water level measurements are used to verify that the well has not filled with silt and to calculate the volume of water in the well. The volume of well water (in gallons) is calculated using the following equation:

$$V = h * \pi \mathbf{r}^2 * (7.48052 \text{ gal/ft}^3)$$

where V = volume of water in the well screen and casing (gallons)
h = height of standing water (feet) = total well depth – water level
r = radius of well casing (feet)

In dedicated sampling systems, an accurate well depth is determined, as indicated above, after development of the well and prior to installation of the dedicated bladder pump. The well depth, water level measurement, and calculated well volume are recorded on the Groundwater Monitoring Data Sheet (Figure 4).

2.2.3 Well Purging and Sampling

The selection of purging technique is dependent on the hydrogeologic properties of the aquifer and hydraulic characteristics of each well. Hydraulic conductivity, water column, well volume, screen length, and other information are evaluated to select the purging technique to acquire

groundwater representative of the aquifer conditions. The Groundwater Monitoring Data Sheet (Figure 4) is used to record purging methods and measurements.

A multi-parameter water quality monitoring instrument is used to measure field stabilization or indicator parameters for determining representative groundwater during purging. These instruments measure pH, specific conductance, temperature, dissolved oxygen (DO), and oxidation-reduction potential (ORP). Instrument calibration must be performed and documented before and after each sampling event. The pH subsystem will be calibrated with two pH standards (pH 7.0 and 4.0) bracketing the expected groundwater pH. The specific conductance subsystem will be calibrated using two standards bracketing the expected groundwater conductivity. Calibration results will be recorded on a Field Sampling Calibration Form (Figure 5).

Various well purging techniques are described below. Currently, each well is fitted with dedicated pumps. The purging method utilized at any particular well will be selected after considering the characteristics of the well and the purging method(s) used during previous sampling events.

Conventional Purging

This technique entails removing one equivalent well volume and measuring the indicator parameters (temperature, pH, and specific conductance). When the parameters have stabilized to within ±0.2 pH units and ±10% for temperature and conductivity over three to five well volumes, representative groundwater has been achieved for sampling. It is acceptable to begin sampling after five complete well volumes have been removed, even when indicator parameters have not stabilized. Groundwater is pumped into a graduated container to measure the volume of water purged. Under normal rates of recovery, samples should be collected immediately after purging, in accordance with EPA guidelines.

For low-yield wells, incapable of yielding three to five well volumes in a reasonable amount of time (e.g., 2 hours or less), groundwater is purged to the elevation of the pump intake while measuring indicator parameters. Typically, low-yield wells are evacuated to dryness one time and sampled when sufficient water level recovery occurs.

Low-Flow Purging

Low-flow purging and sampling are appropriate when the recharge rate of the well approximates or equals the discharge rate of the pump with minimal drawdown of the water column (≤ 1 foot).

During low-flow purging and sampling, groundwater is pumped into a flow-through chamber at flow rates that stabilize water level drawdown within the well. Indicator parameters are measured over time (usually at five-minute intervals). When parameters have stabilized within ±0.2 pH units and ±10% for temperature, conductivity, and DO, and ±10 milli-Volts (mV) for ORP over three consecutive readings, representative groundwater has been achieved for sampling. Turbidity is not included as a stabilization parameter, but turbidity levels of 10 nephelometric turbidity units (NTU) or less should be targeted.

Modified Low-Flow Purging

This technique is considered a viable option particularly in the Piedmont region due to clay soils where water level drawdown cannot be stabilized while pumping.

When the well recharge rate is less than the pump discharge rate, excessive drawdown (> 1 foot) of the water column occurs and mixes with stagnant water located above the screened interval. One equivalent well volume is removed initially before measuring indicator parameters. Frequently, removal of the initial well volume reduces the hydraulic head and allows for matching of the recharge rate with the pumping rate, providing stabilization of drawdown. Indicator parameters should be measured, at five-minute intervals, using a flow-through chamber attached to a multi-parameter water quality instrument. When parameters have stabilized to within ±0.2 pH units, ±10% for temperature, conductivity, and DO, and ±10 mV for ORP over three consecutive readings, representative groundwater has been achieved for sampling. Turbidity is not included as a stabilization parameter, but turbidity levels of 10 NTU or less should be targeted.

Very Low Yield Well Purging

This technique provides the best option for wells that historically purge to dryness and do not sufficiently recharge to provide adequate volume for sample collection. The volume of the pumping system (i.e., the pump bladder, tubing, and flow-through chamber) is calculated for removal. Two volumes will be removed by the pumping system if pumping occurs at the lowest possible rate (≤100 milliliters per minute [mL/min]). Indicator parameters will be measured and recorded initially, and then sample collection will begin.

2.2.4 Sample Collection

After representative groundwater has been obtained by purging and the indicator parameters have stabilized, sampling may begin. Sampling personnel must wear new, clean, disposable, non-powdered latex or nitrile gloves during sample collection for each well. Samples are collected in the following order:

- Metals
- Sulfate and chloride
- Nitrate
- Total dissolved solids

Pertinent notations, water-level measurements, removed well volumes, and indicator parameters are documented on the Groundwater Monitoring Data Sheet.

2.2.5 Sample Containers, Volume, Preservative, and Holding Time

Sample containers supplied by the laboratory for the collection of groundwater samples shall be new and precleaned, as approved by EPA procedures appropriate for the parameters of interest. Table 3 summarizes the sample containers, sample volume, preservation procedures, and holding times required for each type of sample and parameter. Sample containers are kept closed until used. Sample containers are provided by Duke or vendor laboratories.

2.3 Surface Water Sampling

Surface water samples are collected using techniques and equipment that provide representative characteristics of the water body being investigated and reduces the chance for sample contamination. Typically, samples are collected by grab or peristaltic pump.

When filling a sample container by grab, use new, clean, non-powdered latex or nitrile gloves. Grasp the sample container by the lower half and position the container opening to face upstream. When using a peristaltic pump to collect a surface water sample, position the intake opening above the stream bottom to reduce the potential for collecting sediment. Run the pump for several minutes so that representative water is being collected after positioning the intake opening.

2.4 Sample Tracking

The Chain-Of-Custody (COC) program allows for tracing the possession and handling of individual samples from the time of field collection through laboratory analysis and report preparation. Samples are pre-logged prior to sample collection. This process assigns a unique tracking number for each sample and generates corresponding labels. An example of the COC Record is provided as Figure 6.

2.5 Sample Labeling

Sample containers are pre-labeled and organized prior to field activities as part of the pre-sampling staging process. As samples are actually collected, the sampling personnel write the following information directly on the label: sampling date and time, and initials of sample collector. This information is also recorded on the Groundwater Monitoring Data Sheet (Figure 4) and the COC Record (Figure 6).

2.6 Field Documentation

Field documentation from each sampling event is recorded on the Groundwater Monitoring Data Sheets, the Field Sampling Calibration Form, and the Chain-of-Custody Record. These sheets are arranged in sequential order and filed by project and date. Additionally, a Groundwater Sampling Site Checklist (Figure 7) is completed indicating information of the monitoring well such as proper identification (ID) tag, condition of protective casing and pad. Field notations are made during the course of the field work to document the following information:

- Identification of well
- Well depth
- Static water level depth and measurement technique
- Presence of immiscible layers and detection method
- Well yield—high or low
- Purge volume or pumping rate
- Sample identification numbers

- Well evacuation procedure/equipment
- Sample withdrawal procedure/equipment
- Date and time of collection
- Types of sample containers used
- Identification of replicates or blind samples
- Preservative(s) used
- Parameters requested for analysis
- Field analysis data and methods
- Sample distribution and transporter
- Field observations during sampling event
- Name of sample collector(s)
- Climatic conditions including estimate of air temperature

Recorded entries are made in indelible ink. Errors should be corrected by drawing one line through the error, initialing and dating the correction, and starting a new entry on the next line (if necessary).

2.7 Chain-of-Custody Record

The chain-of-custody (COC) Record (Figure 6) accompanies the sample(s), traces sample possession from time of collection to delivery to the laboratory(s), and clearly identifies which sample containers have been designated for each requested parameter. The record includes the following types of information:

- Sample identification number
- Signature of collector
- Date and time of collection
- Sample type (e.g., groundwater, immiscible layer)
- Identification of well
- Number of containers
- Parameters requested for analysis
- Preservative(s) used
- Signature of persons involved in the chain of possession
- Inclusive dates of possession

2.8 Sample Custody, Shipment, and Laboratory Receipt

For the purpose of these procedures, a sample is considered in custody if it is:

- In actual possession of the responsible person
- In view, after being in physical possession
- Locked or sealed in a manner so that no one can tamper with it, after having been in physical custody; or in a secured area, restricted to authorized personnel

Samples are maintained in the custody of the sampling crew during the sampling event. At the end of each sampling day and prior to the transfer of the samples off-site, COC entries are completed on the COC for each sample. Upon transfer of custody, the COC form is signed by a sampling crew member, including the date and time. If outside vendor laboratories are utilized, samples are delivered to these facilities by Duke personnel or courier.

COC forms received by the laboratory(s) are signed and dated by the respective supervising scientist(s) or their designee (at the Duke Energy lab), or the laboratory sample custodian (at vendor labs) immediately following receipt by the laboratory.

The analysts at the laboratory(s) maintain a sample-tracking record that will follow each sample through each stage of laboratory processing. The sample tracking records show the date of sample extraction or preparation, and analysis. These records are used to determine compliance with holding time limits during lab audits and data validation.

Custody procedures followed by Duke laboratory personnel are described in detail in the Duke Energy Laboratory Services Procedures Manual.

3 Analytical Procedures

The main analytical laboratory used in this program is the Duke Energy Laboratory Services Laboratory, which has North Carolina Drinking Water (NC37804) and Wastewater (#248) Certifications. The organizational structure and staff qualifications of the laboratory are discussed in its generic Quality Assurance Program (QAP). The QAP and Laboratory Services Procedures Manual are available for review upon request.

Vendor laboratories that meet EPA and North Carolina certification requirements may be used for analyses which cannot be performed in-house.

The analytical procedures are listed in Table 2. Indicator parameters are measured in the field according to: *Duke Energy Scientific Services Section Quality Assurance Plan and Procedure 3210*.X.[1]

4 Internal Quality Control Checks

Internal laboratory quality control (QC) checks used by the laboratories are described in their generic QAP and procedures manual. The laboratories demonstrate the ability to produce acceptable results using the methods specified.

[1] "X" indicates the most current version of the procedure

Internal quality control checks for sampling procedures and laboratory analyses will be conducted with each sampling event. These checks will consist of the preparation and submittal of field blanks, trip (travel) blanks, and/or field replicates for analysis of each parameter at frequencies described in the laboratory(s) procedures manuals. Equipment rinsate blanks for laboratory-cleaned equipment will be collected quarterly.

The field QC blanks and replicates may be included as internal QC checks are described as below. The specific type and number of blanks used may vary depending on the sampling event and will be determined by the Duke field sampling personnel:

- Field Blanks: A field blank consists of a sample container filled in the field with organic-free, deionized, or distilled water prepared and preserved in the same manner as the samples. The field blank is transported to the laboratory with the samples and analyzed along with the field samples for the constituents of interest to check for contamination imparted to the samples by the sample container, preservative, or other exogenous sources.

- Trip Blanks: A trip (travel) blank is a sample container filled with organic-free water in the laboratory that travels unopened with the sample bottles. It is returned to the laboratory with the field samples, and analyzed along with the field samples for parameters of interest.

- Field Replicates: A field replicate is a duplicate sample prepared at the sampling locations from equal portions of each sample aliquots combined to make the sample. Both the field replicate and the sample are collected at the same time, in the same container type, preserved in the same way, and analyzed by the same laboratory as a measure of sampling and analytical precision.

- Equipment Blanks: If non-dedicated equipment is used between wells, it is recommended that equipment blanks be collected. The field equipment is cleaned following documented cleaning protocols. An aliquot of the final control rinse water is passed over the cleaned equipment directly into a sample container and submitted for analyses.

5 Validation of Field Data Package

The field data package includes complete field records and measurements developed by the sampling team personnel. The field data package validation procedure consists of the following:

- A review of field data contained on the Groundwater Monitoring Data Sheet for completeness

- Verification that equipment blanks, field blanks, and trip blanks were properly prepared, identified, and analyzed

- A check of the Field Sampling Calibration Form for equipment calibration and instrument conditions

- A review of the Chain-Of-Custody Record for proper completion, signatures of field personnel and the laboratory sample custodian, dates, and for verification that the correct analyses were specified.

6 Validation of Laboratory Data

The laboratory will perform a validation review of the submitted samples and analytical results to check that the laboratory QA/QC requirements are acceptable.

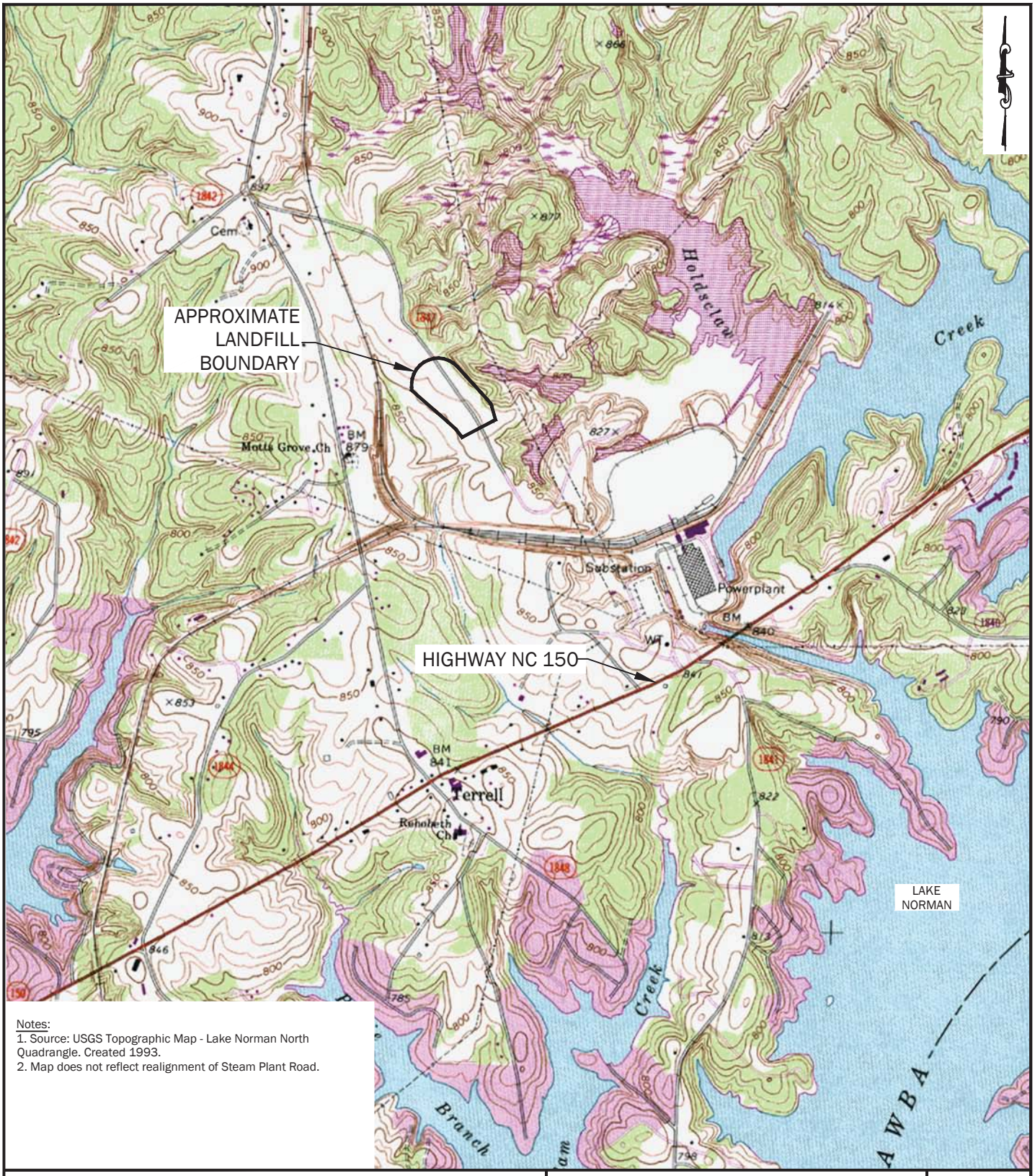
7 Report Submittal

A report of monitoring results will be submitted to the DEQ Division of Waste Management (DWM) within 120 days following the date of sampling. The report submittal will consist of the following:

- Environmental Monitoring Reporting Form (DEQ Form)
- Table of Detections and Discussion of 2L Exceedances
- Groundwater Elevation Contour Map
- Electronic Data Deliverable (EDD) in Excel Format

DEQ will be notified in the event that vendor lab analyses have not been completed within this time frame. The Groundwater Monitoring Data Sheet, Field Calibration Forms, Chain-of-Custody Records, Laboratory(s) QA data, and Data Validation Checklists are kept on file by Duke and are available upon request.

FIGURES



Notes:
1. Source: USGS Topographic Map - Lake Norman North Quadrangle. Created 1993.
2. Map does not reflect realignment of Steam Plant Road.

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SITE LOCATION MAP

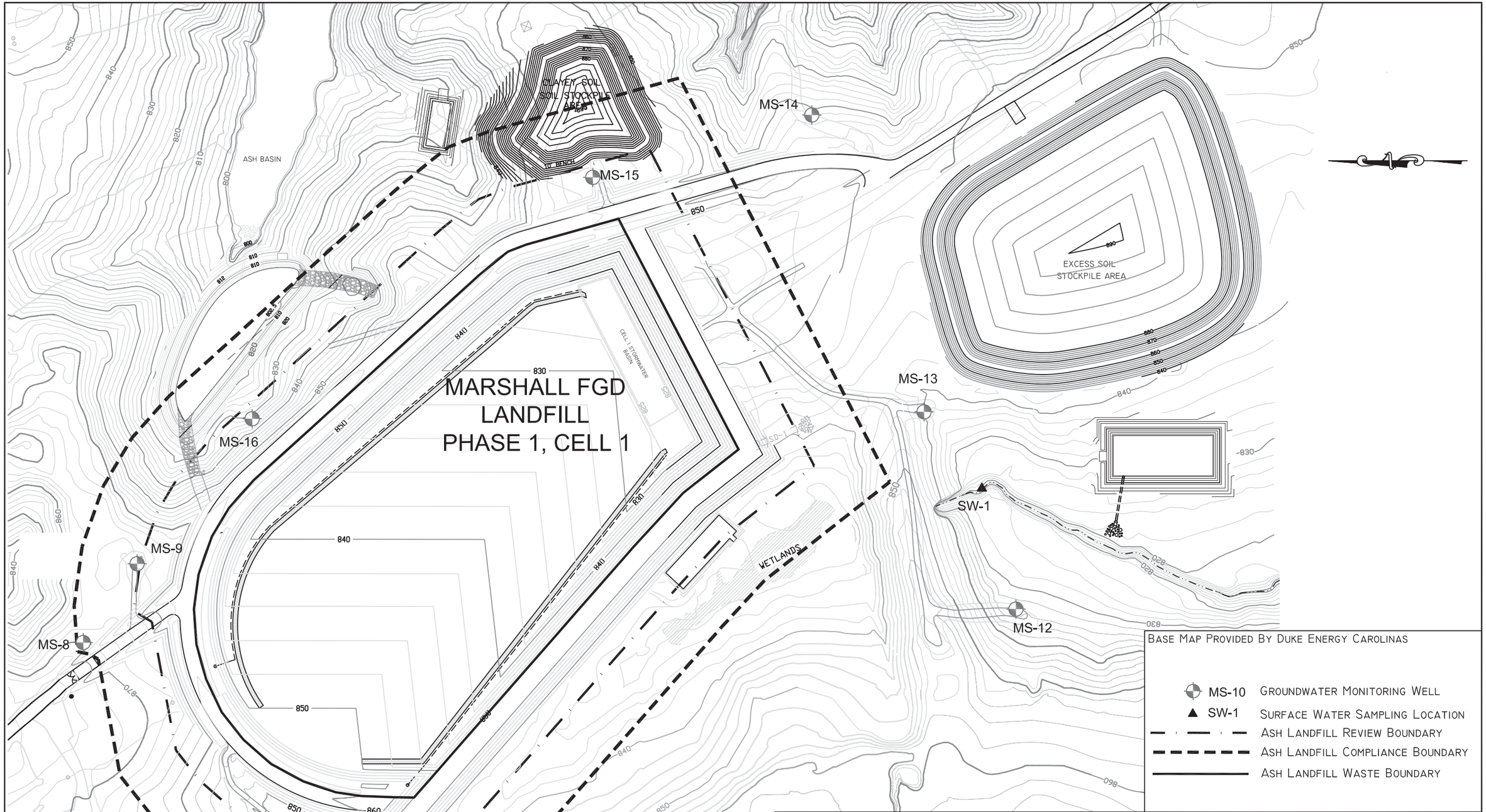
MARSHALL STEAM STATION
FGD RESIDUE LANDFILL
PHASE I, CELL I
PERMIT NO. 18-09

FIGURE
1

DRAWN BY: ANDREW MOORE
PROJECT MANAGER: WILLIAM M. MILLER
CLIENT: DUKE ENERGY CAROLINAS
DATE: 08/11/11

SCALE (FEET)
1000 0 1000 2000

FILE PATH: P:\DUKE - LF GROUNDWATER REPORTS -2369\2369.06 MSS FGD LF\FIGURES\SITE LOCATION MAP.DWG



BASE MAP PROVIDED BY DUKE ENERGY CAROLINAS

MS-10	GROUNDWATER MONITORING WELL
SW-1	SURFACE WATER SAMPLING LOCATION
	ASH LANDFILL REVIEW BOUNDARY
	ASH LANDFILL COMPLIANCE BOUNDARY
	ASH LANDFILL WASTE BOUNDARY

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PROJECT MANAGER: WILLIAM M. MILLER
CLIENT: DUKE ENERGY CAROLINAS
DATE: 08/19/11

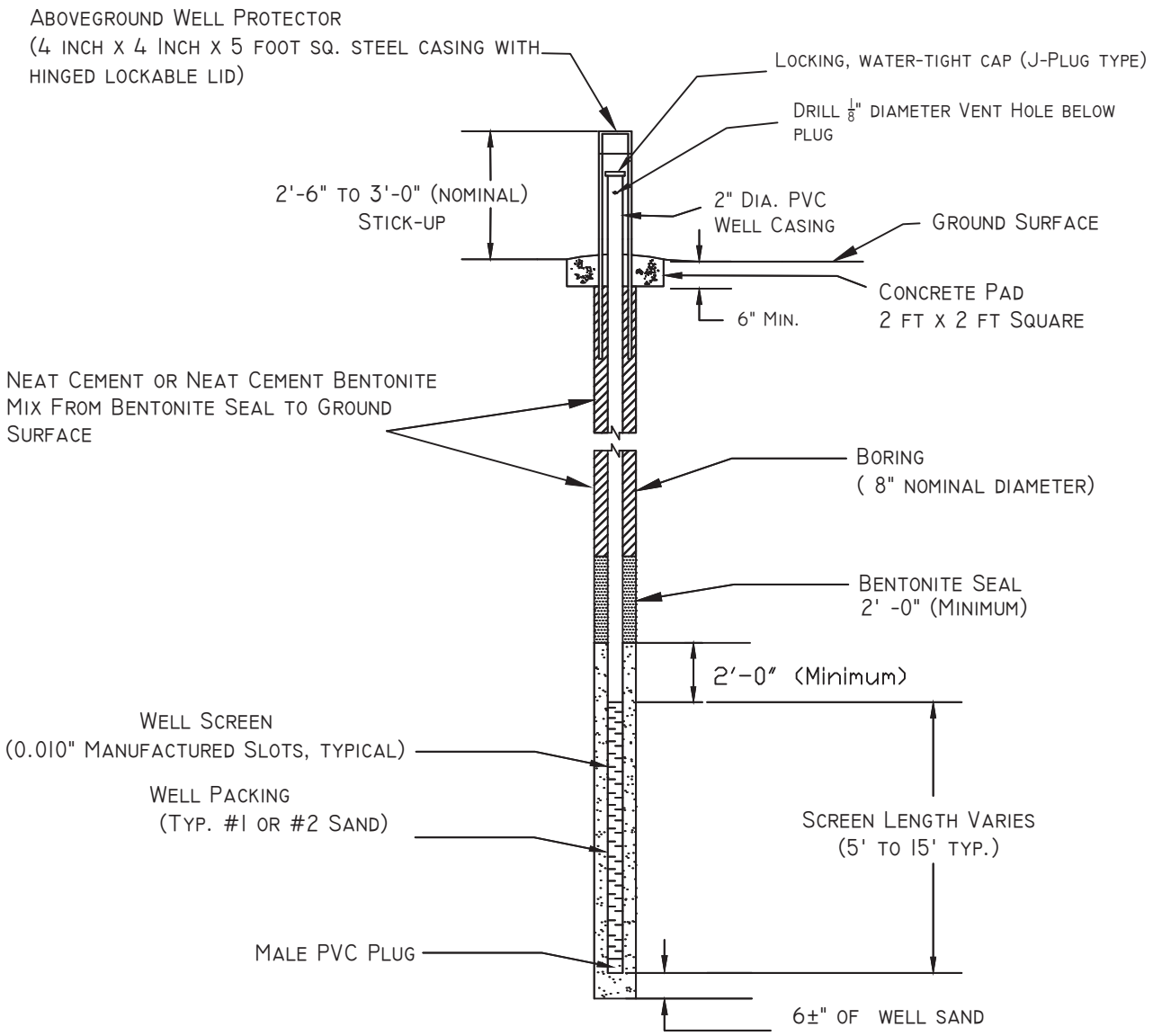
SCALE (FEET)
100 0 100 200

SAMPLE LOCATIONS

MARSHALL STEAM STATION
FGD RESIDUE LANDFILL
PHASE 1, CELL 1
PERMIT NO. 18-09

FIGURE
2

FILE PATH: P:\DUKE - LF GROUNDWATER REPORTS -2369\2369.06 MSS FGD LF\2011\MARCH SAMPLING\FIGURES\MSS FGD LF.DWG



Typical Well Construction Details
(no scale)

Information provided by Duke Energy Carolinas

ALTAMONT ENVIRONMENTAL, INC.
Engineering & Hydrogeology
231 Haywood Street, Asheville, NC 28801
tel.828.281.3350 fac.828.281.3351
www.altamontenvironmental.com

DRAWN BY: ANDREW MOORE
PROJECT MANAGER: WILLIAM M. MILLER
CLIENT: DUKE ENERGY CAROLINAS
DATE: 8/15/11

NO SCALE

TYPICAL MONITORING WELL CONSTRUCTION DETAILS

FIGURE 3

File Path: P:\Duke - Environmental Engineering - 2371\2371.11 Landfill SAPs\2371.1101 MSS FGD\Figure 3 Typical MW-2004.dwg

DUKE ENERGY

GROUNDWATER MONITORING DATA SHEET

FOR LOW FLOW SAMPLING

PROCEDURE NO	3175.3

SITE NAME		PERMIT #		SITE ID	
PROJECT NAME		FIELD CREW			
SAMPLING DATE(s)	☐ ☐ ☐ ☐	WELL/LOCATION NAME			

MONITORING WELL INFORMATION

WELL DIAMETER (in)		TOC ELEV (ft msl)		MIDDLE OF WETTED SCREEN (ft toc)	0.00
WELL DEPTH (ft TOC)		GS ELEV (ft msl)		PUMP INTAKE DEPTH (ft TOC)	
SCREEN LENGTH (ft)		ELEV REF		SCREEN INTERVAL (ft TOC)	0.00 TO 0.00

EQUIPMENT INFORMATION

LEVEL METER SERIAL#		SAMPLING EQUIPMENT	QED T1200	PURGE METHOD
		TUBING DIAMETER (in)	1/2 OD	Low Flow

PUMP CONTROLLER SETTINGS

PRESSURE	(psi)	RECHARGE	(sec)	DISCHARGE	(sec)

SAMPLING INFORMATION

INITIAL DEPTH TO WATER (ft TOC)		WATER COLUMN (ft)	
WATER ELEVATION (ft msl)		WELL VOLUME (gal)	
DETECTED ODOR	None	CONVERSION FACTOR	
APPEARANCE	Normal		

Well Volume = water column X conversion factor
(Conversion factor dependent on well diameter and selected well volume units)

TIME (hh:mm)	WATER LEVEL (ft)	FLOWRATE (ml/min)	☐ TEMP (deg C)	☐ SPECIFIC COND. (umho/cm)	☐ pH (SU)	☐ TURBIDITY (NTU)	☐ ORP (mV -NEH)	☐ DISSOLVED OXYGEN (mg/L)	☐ (gal) WELL VOL (recalculates on current water level)

DRAW-DOWN	0.00	(ft)				CHLORINE (mg/l)
INITIAL PURGE VOLUME		(gal)	SAMPLE COLLECTED BY	DATE	TIME	
TOTAL PURGE VOLUME	0.00	(gal)		@		NA

QC By:		Sample preservation verified to pH (units)	< 2.0

WELL CONDITION			ADDITIONAL WELL CONDITION NOTES
PROTECTIVE CASING	Good Condition		
WELL PAD	Good Condition		
WELL CASING	Good Condition		
WELL TAG	Good Tag		

SAMPLING NOTES

FIGURE 4

FIELD SAMPLING CALIBRATION FORM

STUDY:

DATE (s): | **SURFACE UNIT READER:**

COLLECTORS: | **SURFACE UNIT SERIAL #:**

ANALYZER MODEL#: | **ANALYZER SERIAL #:**

OTHER EQUIPMENT: TURBIDIMETER NO.2 - 3260-GW | **WEATHER CONDITIONS:**

PROCEDURE #: HYDROLAB 3210.6 **VALIDATED BY:**

Calibration Date / Time		DATE:		TIME:		DATE:		TIME:	
		CALIBRATION BP (mmHg)		0.00		CALIBRATION BP (mmHg)		0.00	
Parameter	Calibation Standard	Instrument Value		Standard Value	Calibration Results	Instrument Value		Standard Value	Calibration Results
SPEC. COND. (uS/cm)	SS	0.0	—/—►	0.0	INSTRUMENT ZEROED	0.0	—/—►	0.0	INSTRUMENT ZEROED
	SS		—►	227			—►	227	
	SS		—/—►	75			—/—►	75	
Specifc conductance checkpoint (used if sampled well is outside of initial calibration range).									
SPEC. COND. CHECK (uS/cm)	SS		—/—►	1410			—/—►	1410	
pH (units)	B (7.00)		—►	7.13			—►	7.13	
	B (4.00)		—►	4.01			—►	4.01	
	B (10.00)		—/—►	10.24			—/—►	10.24	
			Buffer Temp.	0.00			Buffer Temp.	0.00	
pH Check	B (7.00)		—►	7.13					
Time:			Buffer Temp.	0.00					
☑ ORP			—►	489			—/—►	489	
		N/A	—/—►	N/A		N/A	—/—►	N/A	
Zobell's			ORP Temp.	0.00			ORP Temp.	0.00	
☑ DO (mg/L)	TEMP (C^{O})								
	BP (mmHg)								
	COND								
	100 % mg/L		—►	-0.09			—►	-0.09	
	After Cal				After Cal % SAT				After Cal % SAT
	LCS								
	LCSD								
☑ TURB (ntu)	SS		—/—►				—/—►		
Temp Cert Device #									
TEMP (deg C)	NIST	N/A	—/—►	N/A	Adjustment Not Available	N/A	—/—►	N/A	Adjustment Not Available

INSTRUMENT MAINTENANCE	DATE / TIME

Conductance Subsystem

- ☐ Cleaned Electrodes
- ☐ Tested - OK
- ☐ See Notes

pH Subsystem

- ☐ Cleaned Electrodes
- ☐ Replaced ref Electrode KCL
- ☐ Replaced Ref. Electrode Tip
- ☐ Tested - OK
- ☐ See Notes

Oxidation Reduction Subsystem

- ☐ Cleaned Electrode
- ☐ Tested - OK
- ☐ See Notes

Temperature Subsystem

- ☐ Cleaned Electrode
- ☐ Tested - OK
- ☐ See Notes

Dissolved Oxygen Subsystem

- ☐ Replaced Teflon Membrane
- ☐ Replaced DO electrolyte
- ☐ Cleaned Electrode
- ☐ See Notes

Field Barometric Pressure

Beginning BP	(mmHg)	Ending BP	(mmHg)

KEY: B = Buffer; SS = Standard solution; W = Winkler; AW = Average Winkler; —► = Adjusted To; —/—► = Not Adjusted To; N/A = Not Applicable

NOTES:

FIGURE 5

CHAIN OF CUSTODY RECORD AND ANALYSIS REQUEST FORM

DUKE ENERGY.

Duke Energy Analytical Laboratories
Mail Code MG03A2 (Building 7405)
13339 Hagers Ferry Rd
Huntersville, N. C. 28078
(980) 875-5245
Fax: (980) 875-5038

Customer must Complete

1)Project Name:		2)Phone No:
3)Client		4)Fax No:
5)Business Unit:	6)Process:	7)Resp. To:
8)Task ID:	9)Activity ID:	10)Mail Code:

Analytical Laboratory Use Only

LIMS #		MATRIX: GW-WW	Samples Originating From NC__ SC___
Logged By	Date & Time		SAMPLE PROGRAM Ground Water __ NPDES ____ Drinking Water ____ UST ____ RCRA Waste ____
Vendor:		Cooler Temp (C)	
PO #		[15]Preserv.:1=HCL 2=H_2SO_4 3=HNO_3 4=Ice 5=None	
MR #		Volume	

[19]Page __1__ of __1__
DISTRIBUTION
ORIGINAL to LAB, COPY to CLIENT

Revised: 10/21/15

Customer to complete all appropriate NON-SHADED areas.

Customer to complete appropriate columns to right

LAB USE ONLY [11]Lab ID	[13]Sample Description or ID	[14]Collection Information Date	Time	Signature	[16]Analyses Required TESTS	[18]Grab						[20]Total # of Containers

Customer to sign & date below

21)Relinquished By	Date/Time	Accepted By:	Date/Time
21)Relinquished By	Date/Time	Accepted By:	Date/Time
21)Relinquished By	Date/Time	Accepted By:	Date/Time
23)Seal/Locked By	Date/Time	Sealed/Lock Opened By	Date/Time

24)Comments:

Customer, important please indicate desired turnaround

[22]Requested Turnaround

14 Days _____√_____

*7 Days _____

* 48 Hr _____

*Other _____ Cost Will Apply

* Add.

FIGURE 6

NORTH CAROLINA GROUNDWATER SAMPLING SITE CHECKLIST

LOCATION / SITE PERMIT # **SAMPLE DATE**
SITE CONTACT **FIELD CREW**
WEATHER
PAGE 1 OF 1

ACCESS TO WELLS																
Access cleared into well																
Access cleared around well																
Tall grass or weeds - needs mowing																
Road washing out / muddy / needs grading																
Fallen tree blocking access																
WELL SECURITY																
Well found locked																
Well found unlocked																
WELL LOCK CONDITION																
Lock in good condition																
Lock rusted, difficult to open / needs replacing																
Replaced damaged lock																
WELL CASINGS																
Casing in good condition																
Damaged casing / still functional																
Damaged casing / repair required																
CONCRETE PADS																
Pad in good condition																
Minor cracks																
Major cracks / broken / repair required																
Undermined / washing out																
Fire ants around concrete pad																
WELL PROTECTIVE CASINGS																
Casing in good condition																
Damaged casing / still functional																
Damaged casing / repair required																
Broken hinge on protective lid																
Wasp nest inside protective casing																
Ants inside protective casing																
WELL CAPS																
Well cap in good conditon																
Damaged / needs replacement																
Replaced damaged well cap																
FLUSH MOUNT WELLS																
Vault in good condition																
Water inside vault																
Vault bolt holes broken or stripped																
Bolts stripped																
Vault lid cracked or broken																
WELL ID TAGS																
Well tag in good condition																
Well tag missing																
Well tag damaged / illegible																
Lacks required information - Driller Reg #																
Lacks required information - Completion date																
Lacks required information - Total well depth																
Lacks required information - Depth to screen																
Lacks required information - Non potable tag																

NOTE:

FIGURE 7

TABLES

Table 1
Monitoring Well Information

	MS-8	MS-9	MS-10	MS-11	MS-12	MS-13	MS-14	MS-15	MS-16
Previous Well Name	N/A	N/A	N/A	N/A	OW-3	MS-6	B-5	B-4	N/A
Northing	680,717.89	681,384.45	681,027.65	680,297.49	679,540.04	679,732.80	679,968.41	680,428.02	681,143.02
Easting	1,412,027.98	1,412,181.74	1,411,622.46	1,411,564.82	1,412,086.50	1,412,500.68	1,413,123.89	1,412,993.27	1,412,486.19
Type of Casing	PVC	PVC	PVC	PVC	PVC	PVC	PVC	PVC	PVC
Top of Casing Elevation (ft)	872.34	868.04	851.29	859.78	835.66	841.90	844.07	861.47	836.98
Well Diameter (inches)	2	2	2	2	2	2	2	2	2
Well Stick-up (ft-ags)	3	2.68	3	2.91	2.96	2.71	2.80	3.05	3
Total Depth (ft-bgs)	48	50	20	39	27	38	41	59	34
Screen Length (ft)	10	10	10	10	10	10	10	10	10
Screen Interval (ft-bgs)	38 to 48	40 to 50	10 to 20	29 to 39	17 to 27	28 to 38	31 to 41	49 to 59	24 to 34

Table 1.1
Surface Water Sample Location

	SW-1
Northing	679,611.00
Easting	1,412,341.30
Elevation (ft-MSL)	822.30

Notes:

As-built well coordinates and top of PVC casing elevations provided by Duke Energy

Well depth and screen information was obtained from the Well Construction Records

Coordinates are NC State Plane Grid, NAD83

Elevations are NAVD88

N/A = Not Applicable

ft = feet

ft-ags = feet above ground surface

ft-bgs = feet below ground surface

Table 2
Sample Parameters and Analytical Methods

PARAMETER	UNITS	ANALYTICAL METHOD
In Situ Parameters		
Field pH	pH Units	Multi-Parameter Water Quality Meter
Field Specific Conductance	µmhos/cm	Multi-Parameter Water Quality Meter
Field Temperature	°Celsius	Multi-Parameter Water Quality Meter
Field Dissolved Oxygen	mg/L	Multi-Parameter Water Quality Meter
Field Oxidation Reduction Potential	mV	Multi-Parameter Water Quality Meter
Field Turbidity	NTU	Turbidimeter
Water Level	ft	Water Level Meter
Laboratory Analyses		
Antimony	µg/L	EPA 200.7/EPA 6010
Arsenic	µg/L	EPA 200.8/EPA 6020
Barium	µg/L	EPA 200.7/EPA 6010
Beryllium	µg/L	EPA 200.7/EPA 6010
Boron	µg/L	EPA 200.7/EPA 6010
Cadmium	µg/L	EPA 200.8/EPA 6020
Chloride	mg/L	EPA 300.0
Chromium	µg/L	EPA 200.7/EPA 6010
Cobalt	µg/L	EPA 200.7/EPA 6010
Copper	µg/L	EPA 200.7/EPA 6010
Fluoride	mg/L	EPA 300.0
Iron	µg/L	EPA 200.7/EPA 6010
Lead	µg/L	EPA 200.8/EPA 6020
Manganese	µg/L	EPA 200.7/EPA 6010
Mercury	µg/L	EPA 7470
Nickel	µg/L	EPA 200.7/EPA 6010
Nitrate	mg/L	EPA 300.0
Selenium	µg/L	EPA 200.8/EPA 6020
Silver	µg/L	EPA 200.7/EPA 6010
Sulfate	mg/L	EPA 300.0
Thallium	µg/L	EPA 200.8/EPA 6020
Total Dissolved Solids	mg/L	SM 2540C
Vanadum	µg/L	EPA 200.8/EPA 6020
Zinc	µg/L	EPA 200.7/EPA 6010

Notes:

µmhos/cm = micro-ohms per centimeter

mg/L = milligrams per liter

mV = millivolts

NTU = nephelometric turbidity units

ft = feet

µg/L = micrograms per liter

Table 3
Sample Containers, Preservatives, and Holding Times

PARAMETER	CONTAINERS	PRESERVATIVES	HOLDING TIMES
In Situ Parameters			
Field pH	In Situ	None	Analyze Immediately
Field Specific Conductance	In Situ	None	Analyze Immediately
Field Temperature	In Situ	None	Analyze Immediately
Field Dissolved Oxygen	In Situ	None	Analyze Immediately
Field Oxidation Reduction Potential	In Situ	None	Analyze Immediately
Field Turbidity	In Situ	None	Analyze Immediately
Laboratory Analyses			
Antimony	500 mL HDPE	pH<2 HNO_3	6 months
Arsenic	500 mL HDPE	pH<2 HNO_3	6 months
Barium	500 mL HDPE	pH<2 HNO_3	6 months
Beryllium	500 mL HDPE	pH<2 HNO_3	6 months
Boron	500 ml HDPE	pH<2 HNO_3	6 months
Cadmium	500 mL HDPE	pH<2 HNO_3	6 months
Chloride	500 mL HDPE	Cool to 4°Celsius	28 days
Chromium	500 mL HDPE	pH<2 HNO_3	6 months
Cobalt	500 mL HDPE	pH<2 HNO_3	6 months
Copper	500 mL HDPE	pH<2 HNO_3	6 months
Fluoride	500 mL HDPE	pH<2 HNO_3	28 days
Iron	500 mL HDPE	pH<2 HNO_3	6 months
Lead	500 mL HDPE	pH<2 HNO_3	6 months
Manganese	500 mL HDPE	pH<2 HNO_3	6 months
Mercury	500 mL HDPE	pH<2 HNO_3	28 days
Nickel	500 mL HDPE	pH<2 HNO_3	6 months
Nitrate	500 mL HDPE	Cool to 4°Celsius	48 hours
Selenium	500 mL HDPE	pH<2 HNO_3	6 months
Silver	500 mL HDPE	pH<2 HNO_3	6 months
Sulfate	500 mL HDPE	Cool to 4°Celsius	28 days
Thallium	500 mL HDPE	pH<2 HNO_3	6 months
Total Dissolved Solids	500 mL HDPE	Cool to 4°Celsius	7 days
Vanadium	500 mL HDPE	pH<2 HNO_3	6 months
Zinc	500 mL HDPE	pH<2 HNO_3	6 months

Notes:

mL = milliliter

HDPE = high density polyethylene

HNO_3 = nitric acid

APPENDIX A

Monitoring Well Construction Records

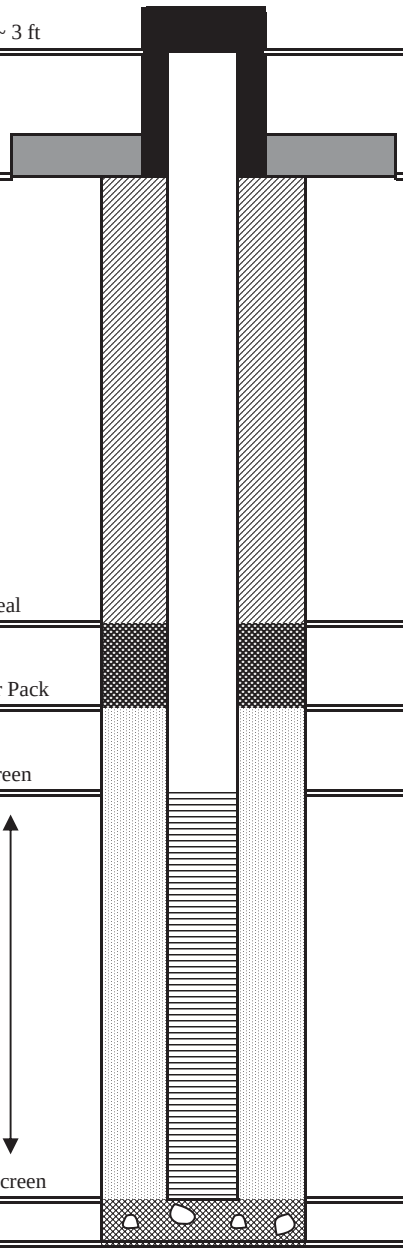
MONITORING WELL CONSTRUCTION

WELL ID: MS-8 **TOTAL DEPTH: 48.5 ft bls**

S&ME PROJECT AND NO:	WELL USE / TYPE:	INSTALLATION DATE:
Marshall Steam Station, 1356-06-728	Monitoring	9/12/2006

DRILLING CONTRACTOR:	DRILLER AND LICENCE NO.:	DRILLING METHOD:
S&ME, Inc.	Larry Shrader, 3349	4.25 H.S.A.

WATER LEVEL AT TOB:	NORTHING:	EASTING:	TOP OF CASING ELEV.:	GROUND SURFACE ELEV.:
42.45 ft bls	681496.7	1412015.4	872.34	869.35



Stickup (ft): ~ 3 ft	872.34
Depth BLS 0 ft - Top of Grout	869.35
34 ft - Top of Seal	835.35
36 ft - Top of Filter Pack	833.35
38 ft - Top of Screen	831.35
Screened Interval 10 feet	
48 ft - Bottom of Screen	821.35
Cave In	820.85
48.5 ft bls - Total Depth	

PAD TYPE:
2'x2' Concrete

PROTECTIVE CASING:
4"x4" Lockable Steel

CASING TYPE:
2-inch Sch. 40 PVC

CASING INTERVAL:
0 to 38 ft bls

SCREEN TYPE:
2-inch 0.010 Slot Sch. 40 PVC

SCREEN INTERVAL
38 to 48 ft bls

GROUT TYPE:
Neat Cement

GROUT INTERVAL
0 to 34 ft bls

SEAL TYPE:
Bentonite

SEAL INTERVAL:
36 to 38 ft bls

FILTER PACK:
#1 Filter Sand

FILTER PACK INTERVAL:
36 to 48 ft bls

DEVELOPMENT:
Purged ~15 Gallons

NOTES:

TBD - To Be Determined

For Lithologic Information See Attached Boring Log

WELL CONSTRUCTION RECORD

(MS-8)

North Carolina - Department of Environment and Natural Resources - Division of Water Quality - Groundwater Section

WELL CONTRACTOR (INDIVIDUAL) NAME (prin Larry Shrader **CERTIFICATION #** 3349

WELL CONTRACTOR COMPANY NAME S&ME, Inc. **PHONE #** 704-523-4726

STATE WELL CONSTRUCTION PERMIT# _____ **ASSOCIATED WQ PERMIT#** _____

(if applicable) (if applicable)

1. WELL USE (Check Applicable Box): Residential ☐ Municipal/Public ☐ Industrial ☐ Agricultral ☐ Monitoring ☒ Recovery ☐ Heat Pump Water Injection ☐ Other ☐ If Other, List Use _____

2. WELL LOCATION:
   Nearest Town: Terrell County Iredell
   Marshall Steam Station
   (Street Name, Numbers, Community, Sudivision, Lot No.,Zip Code)

   Topographic/Land setting
   ☐ Ridge ☐ Slope ☐ Valley ☒ Flat
   (check appropriate box)

   Latitude/longitude of well location
   35°-36'-23.134 N / 80°-58'-41.729W
   (degrees/minutes/seconds)

   Latitude/longitude scource: ☐GPS ☐Topographic Map
   ↳ Physical Survey (check box)

3. OWNER: Duke Power
   Address 526 South Church Street
   (Street or Route No.)
   Charlotte NC 28202
   City or Town State Zip Code
   (704) 373-7900
   Area code - Phone Number

4. DATE DRILLED 9/12/2006
5. TOTAL DEPTH 48 ft bls
6. DOES WELL REPLACE EXISTING WELL? YES ☐ NO ☐
7. STATIC WATER LEVEL Below Top of Casing: 42.77 ft.
   (Use "+" if Above Top of Casing)
8. TOP OF CASING IS ~ 3.0 FT. Above Land Surface*
   ***Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.**
9. YIELD (gpm) n/a METHOD OF TEST n/a
10. WATER ZONES (depth): n/a

DEPTH From	To	DRILLING LOG Formation Descrpition
0	3	M/F Sandy Clay
3	8.5	Silty M/F Sand
8.5	39	Silty C/V.Fine Sand
39	43.5	Silty F/V. Fine Sand
		w/ Co. Sand Lenses
43.5	48	Silty F/V. Fine Sand
48	48.5	PWR

11. DISINFECTION: Type n/a Amount n/a
12. CASING:

	Depth			Diameter	Wall Thickness or Weight/Ft.	Material
From	0	To 38	Ft.	2-inch	Sch. 40	PVC
From		To	Ft.			
From		To	Ft.			

13. GROUT:

	Depth			Material	Method
From	0	To 34	Ft.	Neat Cement	Pour
From	34	To 36	Ft.	Bentonite	Pour

14. SCREEN:

	Depth			Diameter	Slot Size	Material
From	38	To 48	Ft.	2-inch in.	0.01 in.	PVC
From		To	Ft.	in.	in.	

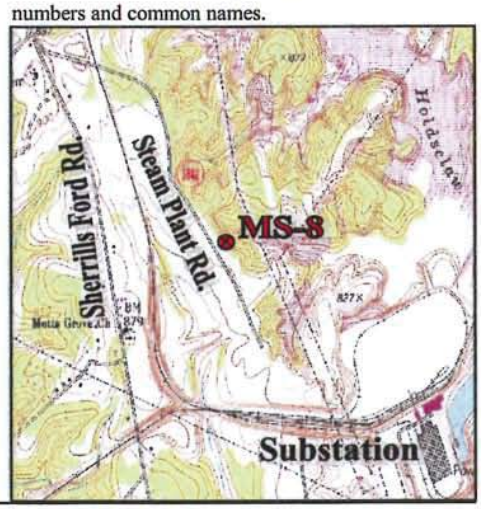
15. SAND/GRAVEL PACK:

	Depth			Size	Material
From	36	To 48	Ft.	#1	Silica Sand
From		To	Ft.		

16. REMARKS:

LOCATION SKETCH

Show direction and distance in miles from at least two State Roads or County Roads. Include the road numbers and common names.



I DO HERE BY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER

Larry W. Shrader 9-25-06

SIGNATURE OF PERSON CONSTRUCTING THE WELL DATE

Submit the original to the Division of Water Quality, Groundwater Section, 1636 Mail Service Center - Raleigh, NC 27699-1636 Phone No. (919) 733-3221, within 30 days.

GW-1 REV. 07/2001

MONITORING WELL CONSTRUCTION

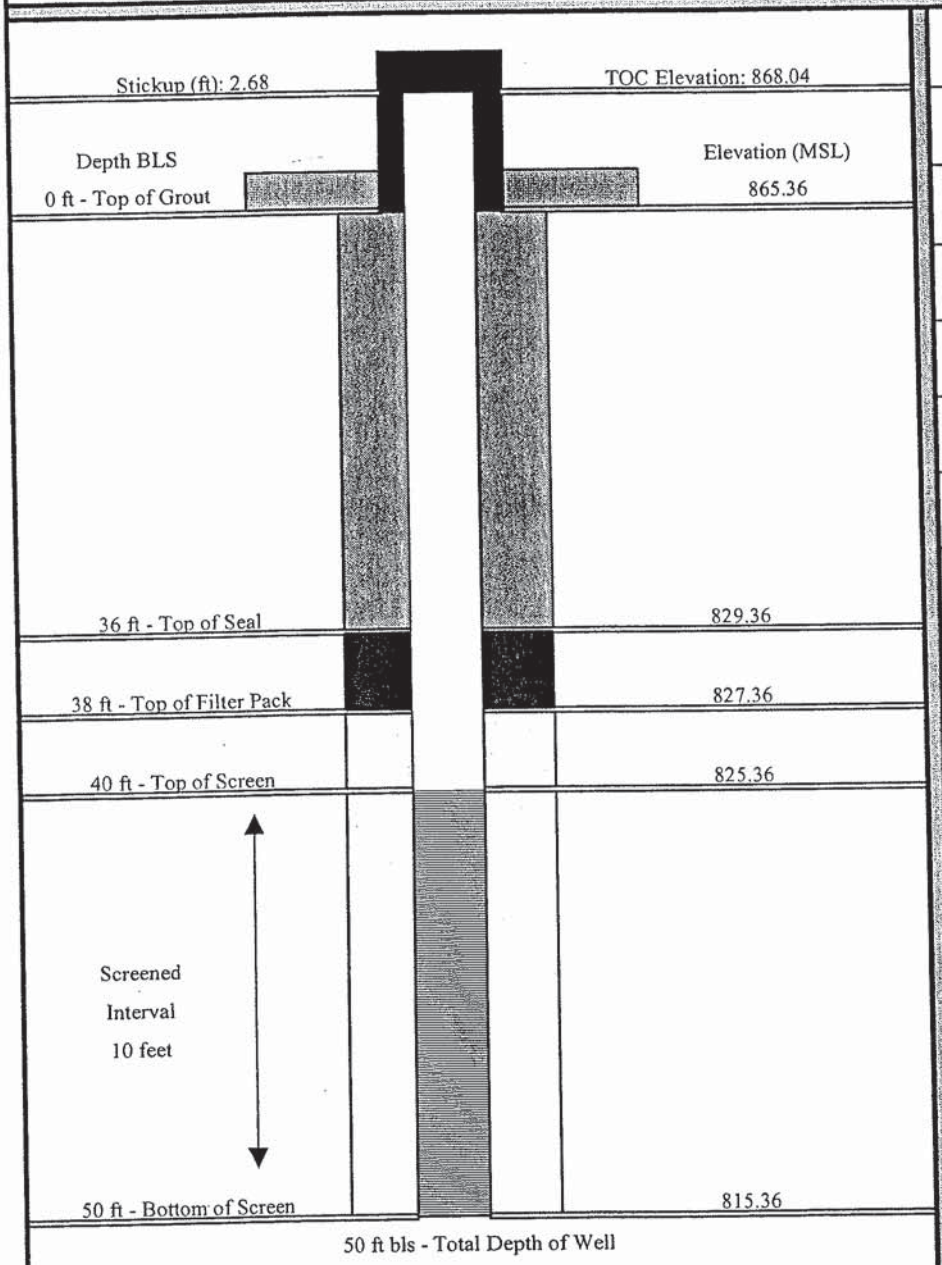
WELL ID: MS-9 **TOTAL DEPTH: 50 ft bls**

S&ME
ENVIRONMENTAL SERVICES · ENGINEERING · TESTING

S&ME PROJECT AND NO:	WELL USE / TYPE:	INSTALLATION DATE:
Marshall Steam Station - Beneficial Fill, 1264-03-072	Observation	01/16/2003

DRILLING CONTRACTOR:	DRILLER AND LICENCE NO.:	DRILLING METHOD:
S&ME, Inc.	Brian Wilson, 2718	4.25 HSA

STATIC WATER LEVEL:	NORTHING:	EASTING:	TOP OF CASING ELEV.:	GROUND SURFACE ELEV.:
44.5 ft bls at 24-hrs	681384.5	1412181.7	868.04	865.36



PAD TYPE:
2'x2' Concrete

PROTECTIVE CASING:
4"x4" Lockable Steel

CASING TYPE:
2-inch Sch. 40 PVC

CASING INTERVAL:
0 to 40 ft bls

SCREEN TYPE:
2-inch 0.010 Slot Sch. 40 PVC

SCREEN INTERVAL
40 to 50 ft bls

GROUT TYPE:
Neat Cement

GROUT INTERVAL
0 to 36 ft bls

SEAL TYPE:
Bentonite

SEAL INTERVAL:
36 to 38 ft bls

FILTER PACK:
#1 Filter Sand

FILTER PACK INTERVAL:
38 to 50 ft bls

DEVELOPMENT:
Purged minimum 5 well volumes

NOTES:
For Lithologic Information See Attached Boring Log

WELL CONSTRUCTION RECORD

(MS-9)

North Carolina - Department of Environment and Natural Resources - Division of Water Quality - Groundwater Section

WELL CONTRACTOR (INDIVIDUAL) NAME (prin Brian Wilson CERTIFICATION # 2718

WELL CONTRACTOR COMPANY NAME S&ME, Inc. PHONE # 704-523-4726

STATE WELL CONSTRUCTION PERMIT# _____ ASSOCIATED WQ PERMIT# _____

(if applicable) (if applicable)

1. WELL USE (Check Applicable Box): Residential ☐ Municipal/Public ☐ Industrial ☐ Agricultral ☐
   Monitoring ☐ Recovery ☐ Heat Pump Water Injection ☐ Other ☑ If Other, List Use observation well

2. WELL LOCATION:
   Nearest Town: Terrell County Catawba
   Marshall Steam Station
   (Street Name, Numbers, Community, Sudivision, Lot No.,Zip Code)

   Topographic/Land setting
   ☑ Ridge ☐ Slope ☐ Valley ☐ Flat
   (check appropriate box)
   Latitude/longitude of well location
   _____
   (degrees/minutes/seconds)
   Latitude/longitude scource: ☐GPS ☐Topographic Map
   (check box)

3. OWNER: Duke Power
   Address 526 South Church Street
   (Street or Route No.)
   Charlotte NC 28202
   City or Town State Zip Code
   (704) 373-7900
   Area code - Phone Number

4. DATE DRILLED 01/16/2003
5. TOTAL DEPTH 50 ft bls
6. DOES WELL REPLACE EXISTING WELL? YES ☐ NO ☑
7. STATIC WATER LEVEL Below Top of Casing: 48.5 ft.
   (Use "+" if Above Top of Casing)
8. TOP OF CASING IS ~3.0 FT. Above Land Surface*
   *Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.
9. YIELD (gpm) n/a METHOD OF TEST n/a
10. WATER ZONES (depth): n/a

DEPTH From	DEPTH To	DRILLING LOG Formation Descrpition
0	4	Silty Clay
4	9	Fine Sandy Silt
9	50	Silty Very Fine Sand

11. DISINFECTION: Type n/a Amount n/a
12. CASING:

	Depth From	Depth To	Diameter	Wall Thickness or Weight/Ft.	Material
	0	40	2-inch	Sch. 40	PVC

13. GROUT:

	Depth From	Depth To	Material	Method
	0	36	Neat Cement	Pour
	36	38	Bentonite	Pour

14. SCREEN:

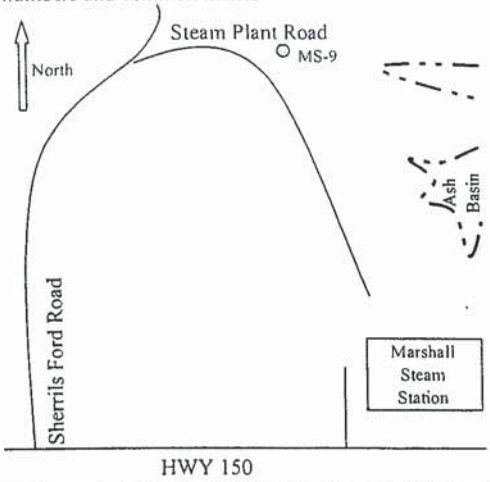
	Depth From	Depth To	Diameter	Slot Size	Material
	40	50	2-inch in.	0.01 in.	PVC
			in.	in.	

15. SAND/GRAVEL PACK:

	Depth From	Depth To	Size	Material
	38	50	#1	Silica Sand

LOCATION SKETCH

Show direction and distance in miles from at least two State Roads or County Roads. Include the road numbers and common names.



16. REMARKS:

I DO HERE BY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER

Brian E. Wilson 2-7-03

SIGNATURE OF PERSON CONSTRUCTING THE WELL DATE

Submit the original to the Division of Water Quality, Groundwater Section, 1636 Mail Service Center - Raleigh, NC 27699-1636 Phone No. (919) 733-3221, within 30 days.

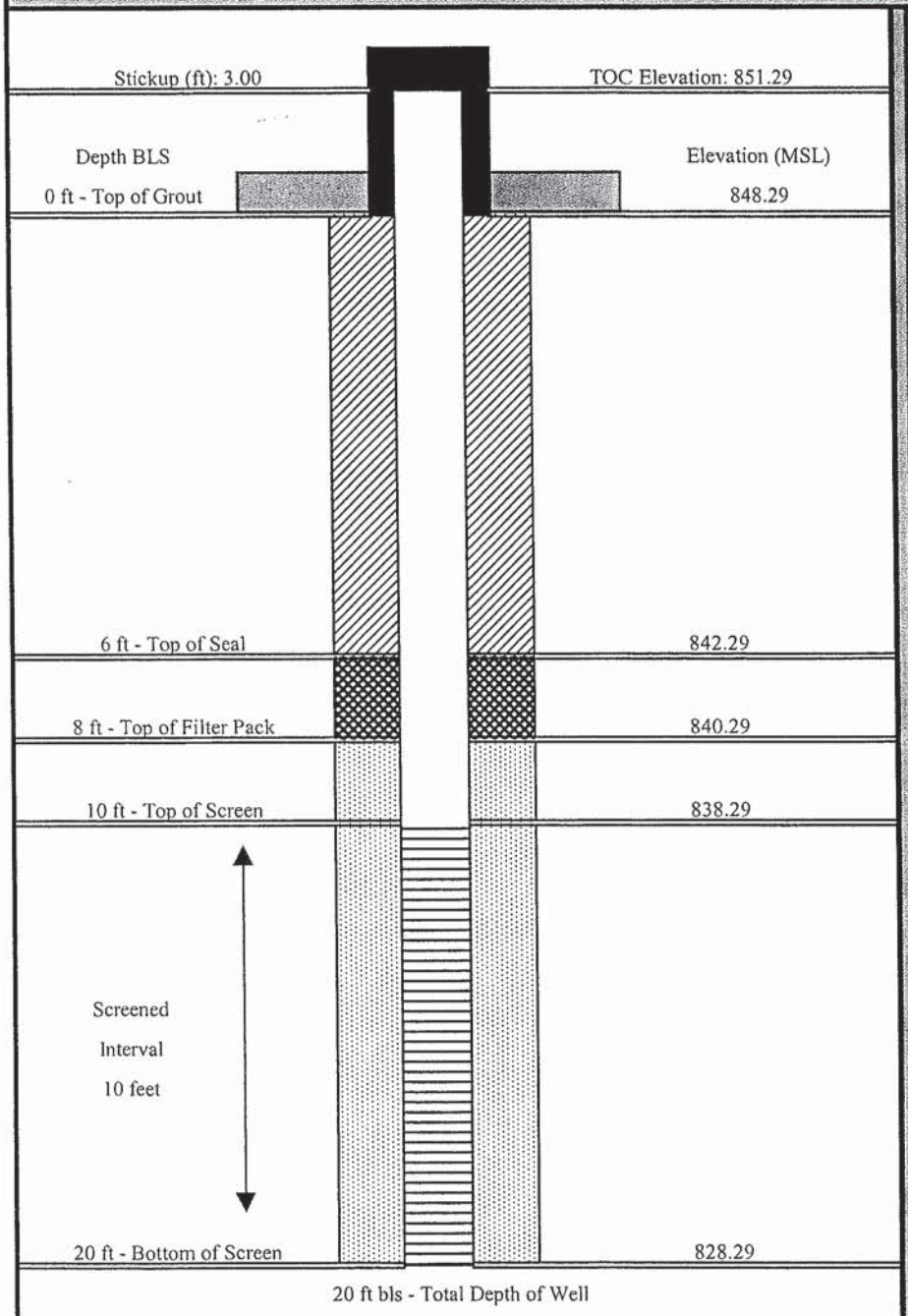
GW-1 REV. 07/2001

MONITORING WELL CONSTRUCTION

WELL ID: MS-10 **TOTAL DEPTH: 20 ft bls**

S&ME
ENVIRONMENTAL SERVICES • ENGINEERING • TESTING

S&ME PROJECT AND NO:			WELL USE / TYPE:	INSTALLATION DATE:
MSS-FGD Scrubber Landfill, 1264-02-578			Observation	07/08/2003
DRILLING CONTRACTOR:	DRILLER AND LICENCE NO.:			DRILLING METHOD:
S&ME, Inc.	Jay Little, 2717			4.25 HSA
STATIC WATER LEVEL:	NORTHING:	EASTING:	TOP OF CASING ELEV.:	GROUND SURFACE ELEV.:
12 ft bls at 24-hrs	681027.6	1411622.5	851.29	848.29



PAD TYPE:
2'x2' Concrete

PROTECTIVE CASING:
4"x4" Lockable Steel

CASING TYPE:
2-inch Sch. 40 PVC

CASING INTERVAL:
0 to 10 ft bls

SCREEN TYPE:
2-inch 0.010 Slot Sch. 40 PVC

SCREEN INTERVAL
10 to 20 ft bls

GROUT TYPE:
Neat Cement

GROUT INTERVAL
0 to 6 ft bls

SEAL TYPE:
Bentonite

SEAL INTERVAL:
6 to 8 ft bls

FILTER PACK:
#1 Filter Sand

FILTER PACK INTERVAL:
8 to 20 ft bls

DEVELOPMENT:
Purged minimum 5 well volumes

NOTES:
For Lithologic Information See Attached Boring Log

WELL CONSTRUCTION RECORD

(MS-10)

North Carolina - Department of Environment and Natural Resources - Division of Water Quality - Groundwater Section

WELL CONTRACTOR (INDIVIDUAL) NAME (prin Jay Little **CERTIFICATION #** 2717

WELL CONTRACTOR COMPANY NAME S&ME, Inc. **PHONE #** 704-523-4726

STATE WELL CONSTRUCTION PERMIT# _____ **ASSOCIATED WQ PERMIT#** _____

(if applicable) (if applicable)

1. WELL USE (Check Applicable Box): Residential ☐ Municipal/Public ☐ Industrial ☐ Agricultral ☐
   Monitoring ☐ Recovery ☐ Heat Pump Water Injection ☐ Other ☑ If Other, List Use observation well

2. WELL LOCATION:
   Nearest Town: Terrell County Catawba
   Marshall Steam Station
   (Street Name, Numbers, Community, Sudivision, Lot No.,Zip Code)

   Topographic/Land setting
   ☐ Ridge ☐ Slope ☑ Valley ☐ Flat
   (check appropriate box)

   Latitude/longitude of well location
   _____
   (degrees/minutes/seconds)
   Latitude/longitude scource: ☐GPS ☐Topographic Map
   (check box)

3. OWNER: Duke Power
   Address 526 South Church Street
   (Street or Route No.)
   Charlotte NC 28202
   City or Town State Zip Code
   (704) 373-7900
   Area code - Phone Number

4. DATE DRILLED 07/08/2003
5. TOTAL DEPTH 20 ft bls
6. DOES WELL REPLACE EXISTING WELL? YES ☐ NO ☑
7. STATIC WATER LEVEL Below Top of Casing: 12 ft.
   (Use "+" if Above Top of Casing)
8. TOP OF CASING IS ~3.0 FT. Above Land Surface*
   *Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.
9. YIELD (gpm) n/a METHOD OF TEST n/a
10. WATER ZONES (depth): n/a

DEPTH From To	DRILLING LOG Formation Descrpition
0 to 7	Fine Sandy Clay
7 to 12	Silty Clay
12 to 20	Fine Sandy Silt

11. DISINFECTION: Type n/a Amount n/a
12. CASING:

	Depth		Diameter	Wall Thickness or Weight/Ft.	Material
From 0	To 10	Ft.	2-inch	Sch. 40	PVC
From	To	Ft.			
From	To	Ft.			

13. GROUT:

	Depth		Material	Method
From 0	To 6	Ft.	Neat Cement	Pour
From 6	To 8	Ft.	Bentonite	Pour

14. SCREEN:

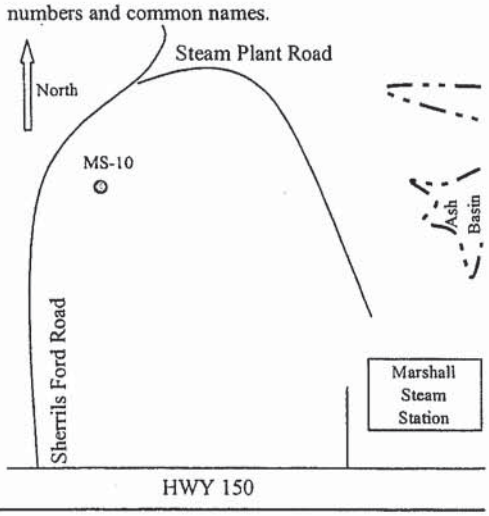
	Depth		Diameter	Slot Size	Material
From 10	To 20	Ft.	2-inch in.	0.01 in.	PVC
From	To	Ft.	in.	in.	

15. SAND/GRAVEL PACK:

	Depth		Size	Material
From 8	To 20	Ft.	#1	Silica Sand
From	To	Ft.		

LOCATION SKETCH

Show direction and distance in miles from at least two State Roads or County Roads. Include the road numbers and common names.



16. REMARKS:

I DO HERE BY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER

Jay A. Little 7-17-03

SIGNATURE OF PERSON CONSTRUCTING THE WELL DATE

Submit the original to the Division of Water Quality, Groundwater Section, 1636 Mail Service Center - Raleigh, NC 27699-1636 Phone No. (919) 733-3221, within 30 days.

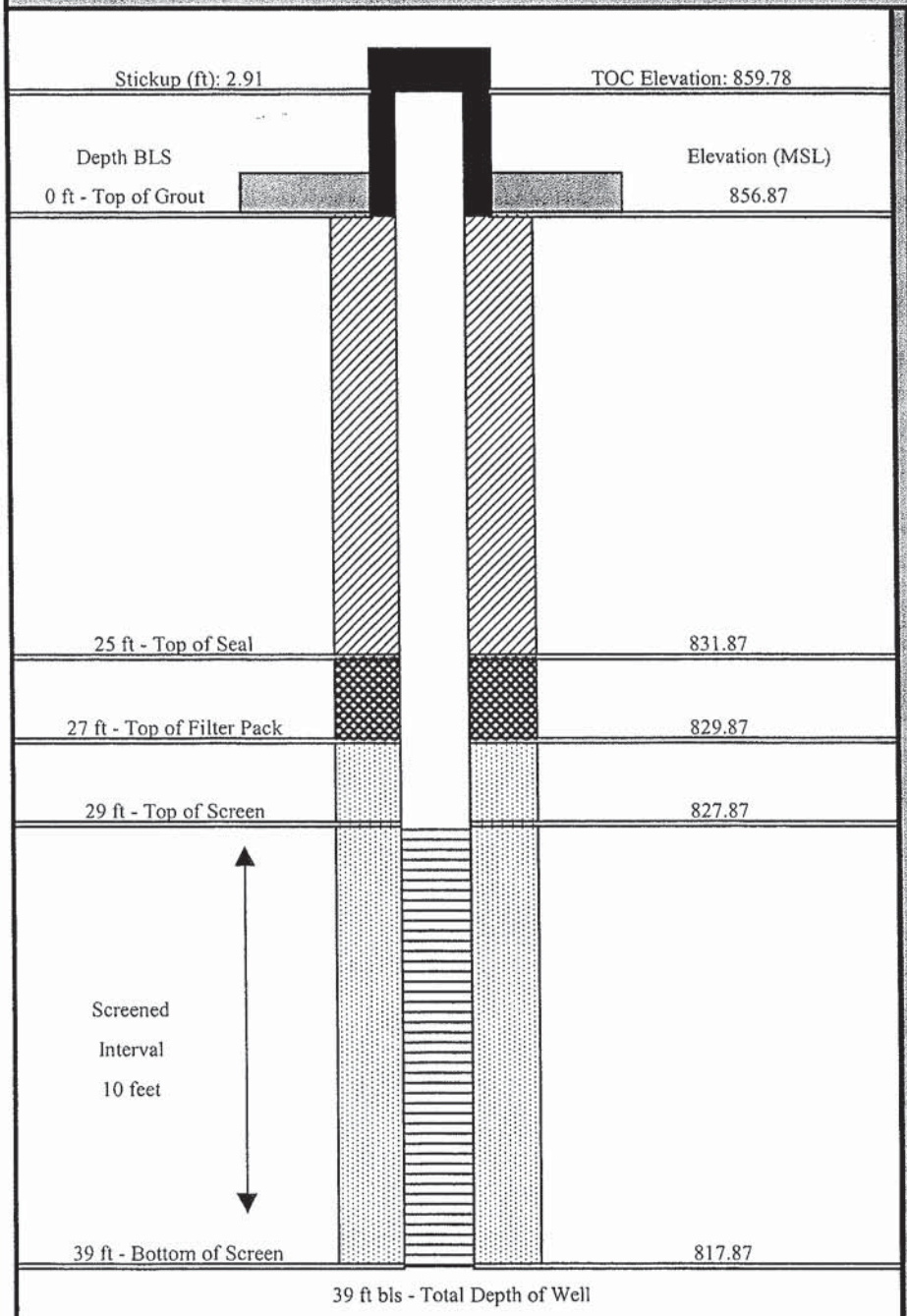
GW-1 REV. 07/2001

MONITORING WELL CONSTRUCTION

WELL ID: MS-11 **TOTAL DEPTH: 39 ft bls**

S&ME
ENVIRONMENTAL SERVICES · ENGINEERING · TESTING

S&ME PROJECT AND NO:			WELL USE / TYPE:	INSTALLATION DATE:
MSS-FGD Scrubber Landfill, 1264-02-578			Observation	07/09/2003
DRILLING CONTRACTOR:	DRILLER AND LICENCE NO.:			DRILLING METHOD:
S&ME, Inc.	Jay Little, 2717			4.25 HSA
STATIC WATER LEVEL:	NORTHING:	EASTING:	TOP OF CASING ELEV.:	GROUND SURFACE ELEV.:
33 ft bls at 24-hrs	680297.5	1411564.8	859.78	856.87



PAD TYPE:
2'x2' Concrete

PROTECTIVE CASING:
4"x4" Lockable Steel

CASING TYPE:
2-inch Sch. 40 PVC

CASING INTERVAL:
0 to 29 ft bls

SCREEN TYPE:
2-inch 0.010 Slot Sch. 40 PVC

SCREEN INTERVAL
29 to 39 ft bls

GROUT TYPE:
Neat Cement

GROUT INTERVAL
0 to 25 ft bls

SEAL TYPE:
Bentonite

SEAL INTERVAL:
25 to 27 ft bls

FILTER PACK:
#1 Filter Sand

FILTER PACK INTERVAL:
37 to 39 ft bls

DEVELOPMENT:
Purged minimum 5 well volumes

NOTES:
For Lithologic Information See Attached Boring Log

WELL CONSTRUCTION RECORD

(MS-11)

North Carolina - Department of Environment and Natural Resources - Division of Water Quality - Groundwater Section

WELL CONTRACTOR (INDIVIDUAL) NAME (prin Jay Little **CERTIFICATION #** 2717

WELL CONTRACTOR COMPANY NAME S&ME, Inc. **PHONE #** 704-523-4726

STATE WELL CONSTRUCTION PERMIT# _____ **ASSOCIATED WQ PERMIT#** _____

(if applicable) (if applicable)

1. WELL USE (Check Applicable Box): Residential ☐ Municipal/Public ☐ Industrial ☐ Agricultral ☐
   Monitoring ☐ Recovery ☐ Heat Pump Water Injection ☐ Other ☑ If Other, List Use observation well

2. WELL LOCATION:
   Nearest Town: Terrell County Catawba
   Marshall Steam Station
   (Street Name, Numbers, Community, Sudivision, Lot No.,Zip Code)

   Topographic/Land setting
   ☐ Ridge ☑ Slope ☐ Valley ☐ Flat
   (check appropriate box)
   Latitude/longitude of well location
   _____
   (degrees/minutes/seconds)
   Latitude/longitude scource: ☐GPS ☐Topographic Map
   (check box)

3. OWNER: Duke Power
   Address 526 South Church Street
   (Street or Route No.)
   Charlotte NC 28202
   City or Town State Zip Code
   (704) 373-7900
   Area code - Phone Number

4. DATE DRILLED 07/09/2003
5. TOTAL DEPTH 39 ft bls
6. DOES WELL REPLACE EXISTING WELL? YES ☐ NO ☑
7. STATIC WATER LEVEL Below Top of Casing: 33 ft.
   (Use "+" if Above Top of Casing)
8. TOP OF CASING IS ~3.0 FT. Above Land Surface*
   ***Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.**
9. YIELD (gpm) n/a METHOD OF TEST n/a
10. WATER ZONES (depth): n/a

DEPTH From To	DRILLING LOG Formation Descrpition
0 to 7	Silty Clay
7 to 12	Fine Sandy Silt
12 to 22	Silty Fine Sand
22 to 27	Silty Coarse/Fine Sand
27 to 32	Fine Sandy Silt
32 to 37	Silty Med/Fine Sand
37 to 39	Silty Coarse/Fine Sand

11. DISINFECTION: Type n/a Amount n/a
12. CASING:

	Depth	Diameter	Wall Thickness or Weight/Ft.	Material
From 0	To 29 Ft.	2-inch	Sch. 40	PVC
From	To Ft.			
From	To Ft.			

13. GROUT:

	Depth	Material	Method
From 0	To 25 Ft.	Neat Cement	Pour
From 25	To 27 Ft.	Bentonite	Pour

14. SCREEN:

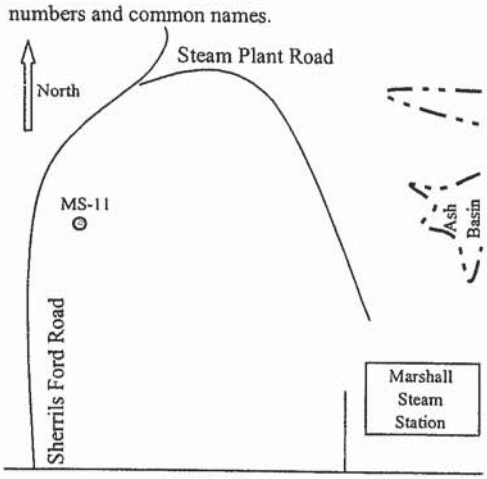
	Depth	Diameter	Slot Size	Material
From 29	To 39 Ft.	2-inch in.	0.01 in.	PVC
From	To Ft.	in.	in.	

15. SAND/GRAVEL PACK:

	Depth	Size	Material
From 27	To 39 Ft.	#1	Silica Sand
From	To Ft.		

LOCATION SKETCH

Show direction and distance in miles from at least two State Roads or County Roads. Include the road numbers and common names.



16. REMARKS:

I DO HERE BY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER

Jay A. Little 7-17-03

SIGNATURE OF PERSON CONSTRUCTING THE WELL DATE

Submit the original to the Division of Water Quality, Groundwater Section, 1636 Mail Service Center - Raleigh, NC 27699-1636 Phone No. (919) 733-3221, within 30 days.

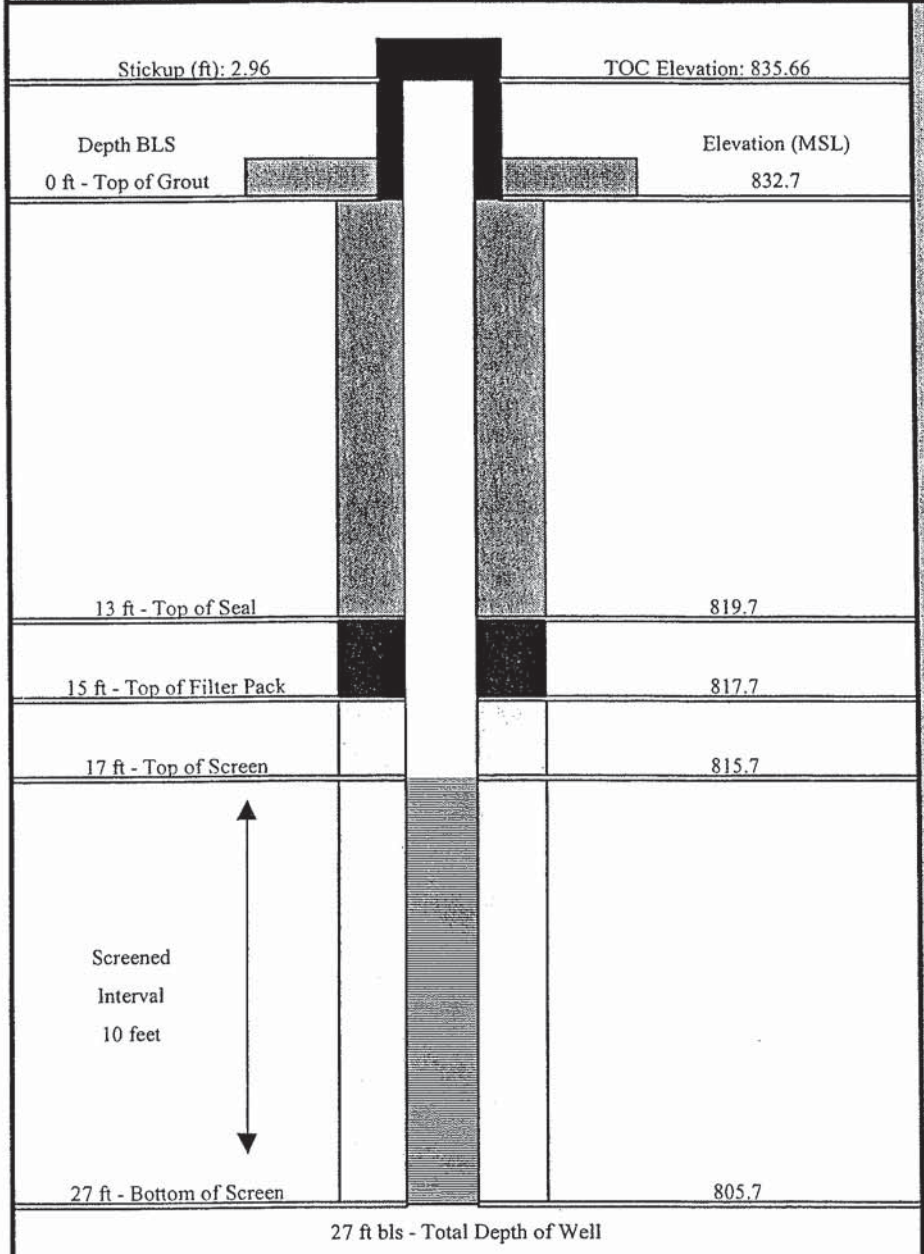
GW-1 REV. 07/2001

MONITORING WELL CONSTRUCTION

WELL ID: OW-3 (MS-12) TOTAL DEPTH: 27 ft bls

S&ME
ENVIRONMENTAL SERVICES · ENGINEERING · TESTING

S&ME PROJECT AND NO:			WELL USE / TYPE:	INSTALLATION DATE:
Marshall Steam Station - Beneficial Fill, 1264-03-072			Observation	02/11/2003
DRILLING CONTRACTOR:	DRILLER AND LICENCE NO.:			DRILLING METHOD:
S&ME, Inc.	Brian Wilson, 2718			4.25 HSA
STATIC WATER LEVEL:	NORTHING:	EASTING:	TOP OF CASING ELEV.:	GROUND SURFACE ELEV.:
17.89 ft bls at 24-hrs	679540.0	1412086.5	835.66	832.7



PAD TYPE:
2'x2' Concrete

PROTECTIVE CASING:
4"x4" Lockable Steel

CASING TYPE:
2-inch Sch. 40 PVC

CASING INTERVAL:
0 to 17 ft bls

SCREEN TYPE:
2-inch 0.010 Slot Sch. 40 PVC

SCREEN INTERVAL
17 to 27 ft bls

GROUT TYPE:
Neat Cement

GROUT INTERVAL
0 to 13 ft bls

SEAL TYPE:
Bentonite

SEAL INTERVAL:
13 to 15 ft bls

FILTER PACK:
#1 Filter Sand

FILTER PACK INTERVAL:
15 to 27 ft bls

DEVELOPMENT:
Purged minimum 5 well volumes

NOTES:
For Lithologic Information See Attached Boring Log

WELL CONSTRUCTION RECORD

OW-3 - MS-12

North Carolina - Department of Environment and Natural Resources - Division of Water Quality - Groundwater Section

WELL CONTRACTOR (INDIVIDUAL) NAME (prin Brian Wilson CERTIFICATION # 2718

WELL CONTRACTOR COMPANY NAME S&ME, Inc. PHONE # 704-523-4726

STATE WELL CONSTRUCTION PERMIT# _____ ASSOCIATED WQ PERMIT# _____

(if applicable) (if applicable)

1. WELL USE (Check Applicable Box): Residential ☐ Municipal/Public ☐ Industrial ☐ Agricultral ☐ Monitoring ☐ Recovery ☐ Heat Pump Water Injection ☐ Other ☑ If Other, List Use observation well

2. WELL LOCATION:
   Nearest Town: Terrell County Catawba
   Marshall Steam Station
   (Street Name, Numbers, Community, Sudivision, Lot No.,Zip Code)

   Topographic/Land setting
   ☐ Ridge ☐ Slope ☑ Valley ☐ Flat
   (check appropriate box)
   Latitude/longitude of well location
   _____
   (degrees/minutes/seconds)
   Latitude/longitude scource: ☐GPS ☐Topographic Map
   (check box)

3. OWNER: Duke Power
   Address 526 South Church Street
   (Street or Route No.)
   Charlotte NC 28202
   City or Town State Zip Code
   (704) 373-7900
   Area code - Phone Number

4. DATE DRILLED 02/11/2003
5. TOTAL DEPTH 27 ft bls
6. DOES WELL REPLACE EXISTING WELL? YES ☐ NO ☑
7. STATIC WATER LEVEL Below Top of Casing: 25 ft.
   (Use "+" if Above Top of Casing)
8. TOP OF CASING IS ~3.0 FT. Above Land Surface*
   *Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.
9. YIELD (gpm) n/a METHOD OF TEST n/a
10. WATER ZONES (depth): n/a

DEPTH From	DEPTH To	DRILLING LOG Formation Descrpition
0	9	Sandy Clay
9	14	Fine Sandy Silt
14	19	Silty Med/Fine Sand
19	22	Fine Sandy Silt
22	27	Silty Med/Fine Sand

11. DISINFECTION: Type n/a Amount n/a
12. CASING:

	Depth From	To	Ft.	Diameter	Wall Thickness or Weight/Ft.	Material
	0	17		2-inch	Sch. 40	PVC

13. GROUT:

	Depth From	To	Ft.	Material	Method
	0	13		Neat Cement	Pour
	13	15		Bentonite	Pour

14. SCREEN:

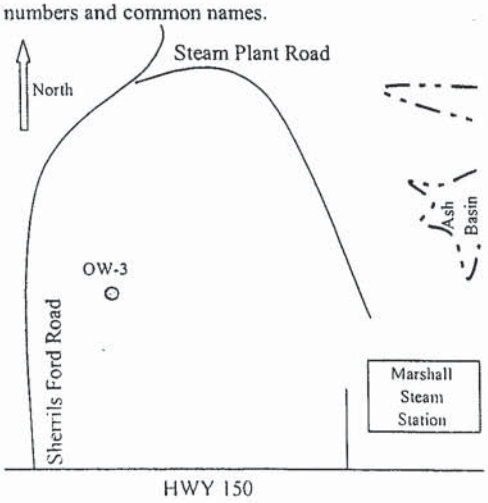
	Depth From	To	Ft.	Diameter	Slot Size	Material
	17	27		2-inch in.	0.01 in.	PVC
				in.	in.	

15. SAND/GRAVEL PACK:

	Depth From	To	Ft.	Size	Material
	15	27		#1	Silica Sand

LOCATION SKETCH

Show direction and distance in miles from at least two State Roads or County Roads. Include the road numbers and common names.



16. REMARKS:

I DO HERE BY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER

Brian E. Wilson 2/17/03

SIGNATURE OF PERSON CONSTRUCTING THE WELL DATE

Submit the original to the Division of Water Quality, Groundwater Section, 1636 Mail Service Center - Raleigh, NC 27699-1636 Phone No. (919) 733-3221, within 30 days.

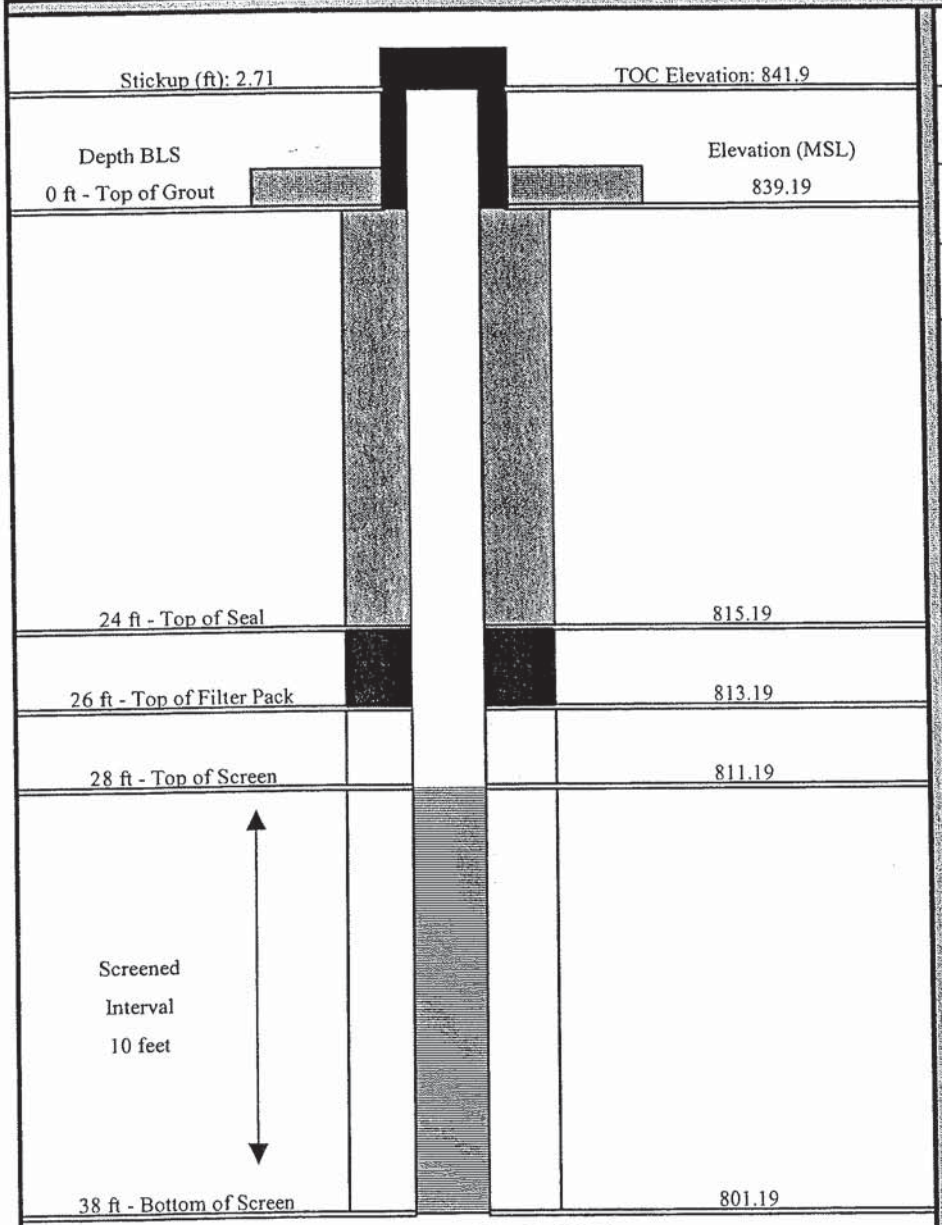
GW-1 REV. 07/2001

MONITORING WELL CONSTRUCTION

WELL ID: MS-6 (MS-13) TOTAL DEPTH: 38 ft bls

S&ME
ENVIRONMENTAL SERVICES · ENGINEERING · TESTING

S&ME PROJECT AND NO:			WELL USE / TYPE:	INSTALLATION DATE:
Marshall Steam Station - Beneficial Fill, 1264-03-072			Observation	12/17/2002
DRILLING CONTRACTOR:	DRILLER AND LICENCE NO.:			DRILLING METHOD:
S&ME, Inc.	Jay Little, 2717			4.25 HSA
STATIC WATER LEVEL:	NORTHING:	EASTING:	TOP OF CASING ELEV.:	GROUND SURFACE ELEV.:
26.89 ft bls at 24-hrs	679732.8	1412500.7	841.9	839.19



PAD TYPE:
2'x2' Concrete

PROTECTIVE CASING:
4"x4" Lockable Steel

CASING TYPE:
2-inch Sch. 40 PVC

CASING INTERVAL:
0 to 28 ft bls

SCREEN TYPE:
2-inch 0.010 Slot Sch. 40 PVC

SCREEN INTERVAL
28 to 38 ft bls

GROUT TYPE:
Neat Cement

GROUT INTERVAL
0 to 24 ft bls

SEAL TYPE:
Bentonite

SEAL INTERVAL:
24 to 26 ft bls

FILTER PACK:
#1 Filter Sand

FILTER PACK INTERVAL:
26 to 38 ft bls

DEVELOPMENT:
Purged minimum 5 well volumes

NOTES:
For Lithologic Information See Attached Boring Log

WELL CONSTRUCTION RECORD

(MS-6) - MS-13

North Carolina - Department of Environment and Natural Resources - Division of Water Quality - Groundwater Section

WELL CONTRACTOR (INDIVIDUAL) NAME (prin Jay Little CERTIFICATION # 2717

WELL CONTRACTOR COMPANY NAME S&ME, Inc. PHONE # 704-523-4726

STATE WELL CONSTRUCTION PERMIT# _____ ASSOCIATED WQ PERMIT# _____

(if applicable) (if applicable)

1. WELL USE (Check Applicable Box): Residential ☐ Municipal/Public ☐ Industrial ☐ Agricultral ☐ Monitoring ☐ Recovery ☐ Heat Pump Water Injection ☐ Other ☑ If Other, List Use observation well

2. WELL LOCATION:
   Nearest Town: Terrell County Catawba
   Marshall Steam Station
   (Street Name, Numbers, Community, Sudivision, Lot No.,Zip Code)

   Topographic/Land setting
   ☐ Ridge ☐ Slope ☑ Valley ☐ Flat
   (check appropriate box)

   Latitude/longitude of well location
   _____
   (degrees/minutes/seconds)
   Latitude/longitude scource: ☐GPS ☐Topographic Map
   (check box)

3. OWNER: Duke Power
   Address 526 South Church Street
   (Street or Route No.)
   Charlotte NC 28202
   City or Town State Zip Code
   (704) 373-7900
   Area code - Phone Number

4. DATE DRILLED 12/17/2002
5. TOTAL DEPTH 38 ft bls
6. DOES WELL REPLACE EXISTING WELL? YES ☐ NO ☑
7. STATIC WATER LEVEL Below Top of Casing: 31.36 ft.
   (Use "+" if Above Top of Casing)
8. TOP OF CASING IS ~ 3.0 FT. Above Land Surface*
   *Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.
9. YIELD (gpm) n/a METHOD OF TEST n/a
10. WATER ZONES (depth): n/a

DEPTH From	To	DRILLING LOG Formation Descrpition
0	0.5	Fine Sandy Silt
0.5	9	Silty Clay
9	17	Fine Sandy Silt
17	27	Silty Fine Sand
27	38	Silty Med/Fine Sand

11. DISINFECTION: Type n/a Amount n/a
12. CASING:

	Depth From	To	Diameter	Wall Thickness or Weight/Ft.	Material
	0	28 Ft.	2-inch	Sch. 40	PVC
		Ft.			
		Ft.			

13. GROUT:

	Depth From	To	Material	Method
	0	24 Ft.	Neat Cement	Pour
	24	26 Ft.	Bentonite	Pour

14. SCREEN:

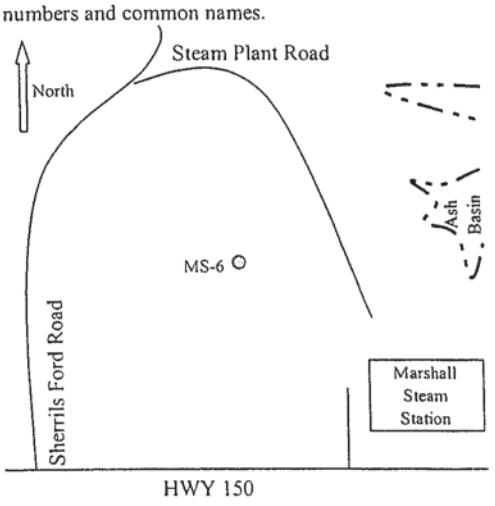
	Depth From	To	Diameter	Slot Size	Material
	28	38 Ft.	2-inch in.	0.01 in.	PVC
		Ft.	in.	in.	

15. SAND/GRAVEL PACK:

	Depth From	To	Size	Material
	26	38 Ft.	#1	Silica Sand
		Ft.		

LOCATION SKETCH

Show direction and distance in miles from at least two State Roads or County Roads. Include the road numbers and common names.



16. REMARKS:

I DO HERE BY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER

Jay A. Little 2-7-03

SIGNATURE OF PERSON CONSTRUCTING THE WELL DATE

Submit the original to the Division of Water Quality, Groundwater Section, 1636 Mail Service Center - Raleigh, NC 27699-1636 Phone No. (919) 733-3221, within 30 days.

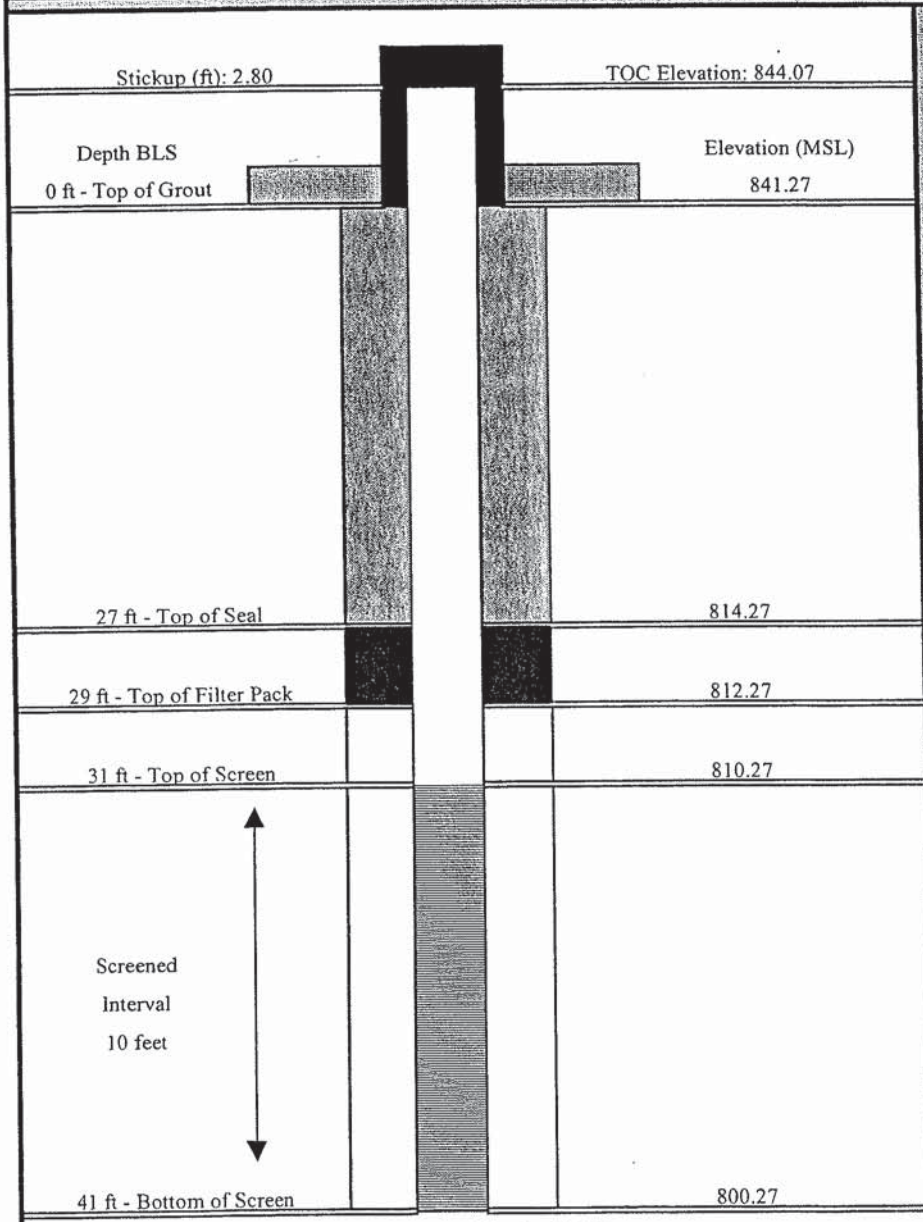
GW-1 REV. 07/2001

MONITORING WELL CONSTRUCTION

WELL ID: B-5 (MS-14) **TOTAL DEPTH: 41 ft bls**

S&ME
ENVIRONMENTAL SERVICES • ENGINEERING • TESTING

S&ME PROJECT AND NO:			WELL USE / TYPE:	INSTALLATION DATE:
Marshall Steam Station - Beneficial Fill, 1264-03-072			Observation	01/07/2003
DRILLING CONTRACTOR:	DRILLER AND LICENCE NO.:			DRILLING METHOD:
S&ME, Inc.	Brian Wilson, 2718			4.25 HSA
STATIC WATER LEVEL:	NORTHING:	EASTING:	TOP OF CASING ELEV.:	GROUND SURFACE ELEV.:
36.3 ft bls at 24-hrs	679968.4	1413123.9	844.07	841.27



PAD TYPE:	2'x2' Concrete
PROTECTIVE CASING:	4"x4" Lockable Steel
CASING TYPE:	2-inch Sch. 40 PVC
CASING INTERVAL:	0 to 31 ft bls
SCREEN TYPE:	2-inch 0.010 Slot Sch. 40 PVC
SCREEN INTERVAL	31 to 41 ft bls
GROUT TYPE:	Neat Cement
GROUT INTERVAL	0 to 27 ft bls
SEAL TYPE:	Bentonite
SEAL INTERVAL:	27 to 29 ft bls
FILTER PACK:	#1 Filter Sand
FILTER PACK INTERVAL:	29 to 41 ft bls
DEVELOPMENT:	Purged minimum 5 well volumes

NOTES:
For Lithologic Information See Attached Boring Log

WELL CONSTRUCTION RECORD

(B-5) - MS-14

North Carolina - Department of Environment and Natural Resources - Division of Water Quality - Groundwater Section

WELL CONTRACTOR (INDIVIDUAL) NAME (prin Brian Wilson CERTIFICATION # 2718

WELL CONTRACTOR COMPANY NAME S&ME, Inc. PHONE # 704-523-4726

STATE WELL CONSTRUCTION PERMIT# _____ (if applicable) ASSOCIATED WQ PERMIT# _____ (if applicable)

1. WELL USE (Check Applicable Box): Residential ☐ Municipal/Public ☐ Industrial ☐ Agricultral ☐ Monitoring ☐ Recovery ☐ Heat Pump Water Injection ☐ Other ☑ If Other, List Use observation well

2. WELL LOCATION:
Nearest Town: Terrell County Catawba
Marshall Steam Station
(Street Name, Numbers, Community, Sudivision, Lot No.,Zip Code)

Topographic/Land setting
☐ Ridge ☑ Slope ☐ Valley ☐ Flat
(check appropriate box)
Latitude/longitude of well location
(degrees/minutes/seconds)
Latitude/longitude scource: ☐GPS ☐Topographic Map
(check box)

3. OWNER: Duke Power
Address 526 South Church Street
(Street or Route No.)
Charlotte NC 28202
City or Town State Zip Code
(704) 373-7900
Area code - Phone Number

4. DATE DRILLED 01/07/2003
5. TOTAL DEPTH 41 ft bls
6. DOES WELL REPLACE EXISTING WELL? YES ☐ NO ☑
7. STATIC WATER LEVEL Below Top of Casing: 39.3 ft.
(Use "+" if Above Top of Casing)
8. TOP OF CASING IS ~3.0 FT. Above Land Surface*
*Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.
9. YIELD (gpm) n/a METHOD OF TEST n/a
10. WATER ZONES (depth): n/a

DEPTH From To	DRILLING LOG Formation Descrpition
0 to 3.5	Silty Clay
3.5 to 9.5	Clayey Silt
9.5 to 12	Silty Fine Sand
12 to 37	Fine Sandy Silt
37 to 41	Silty Fine Sand

11. DISINFECTION: Type n/a Amount n/a
12. CASING:

	Depth		Diameter	Wall Thickness or Weight/Ft.	Material
From 0	To 31	Ft.	2-inch	Sch. 40	PVC
From	To	Ft.			
From	To	Ft.			

13. GROUT:

	Depth		Material	Method
From 0	To 27	Ft.	Neat Cement	Pour
From 27	To 29	Ft.	Bentonite	Pour

14. SCREEN:

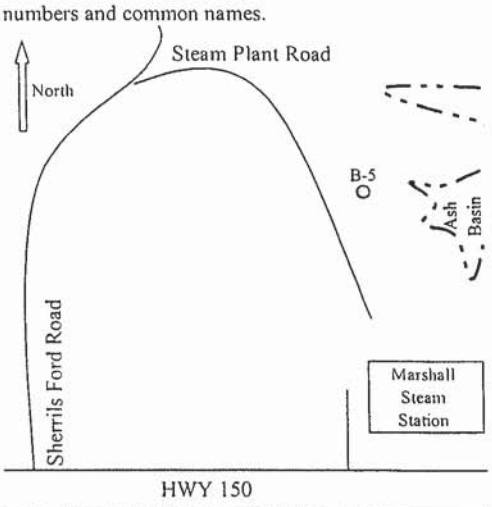
	Depth		Diameter	Slot Size	Material
From 31	To 41	Ft.	2-inch in.	0.01 in.	PVC
From	To	Ft.	in.	in.	

15. SAND/GRAVEL PACK:

	Depth		Size	Material
From 29	To 41	Ft.	#1	Silica Sand
From	To	Ft.		

LOCATION SKETCH

Show direction and distance in miles from at least two State Roads or County Roads. Include the road numbers and common names.



16. REMARKS:

I DO HERE BY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER

Brian E. Wilson 2/6/03

SIGNATURE OF PERSON CONSTRUCTING THE WELL DATE

Submit the original to the Division of Water Quality, Groundwater Section, 1636 Mail Service Center - Raleigh, NC 27699-1636 Phone No. (919) 733-3221, within 30 days.

GW-1 REV. 07/2001

MONITORING WELL CONSTRUCTION

WELL ID: B-4 (MS-15) **TOTAL DEPTH: 59 ft bls**

S&ME
ENVIRONMENTAL SERVICES · ENGINEERING · TESTING

S&ME PROJECT AND NO:			WELL USE / TYPE:	INSTALLATION DATE:
Marshall Steam Station - Beneficial Fill, 1264-03-072			Observation	12/03/2002
DRILLING CONTRACTOR:	DRILLER AND LICENCE NO.:			DRILLING METHOD:
S&ME, Inc.	Jay Little, 2717			4.25 HSA
STATIC WATER LEVEL:	NORTHING:	EASTING:	TOP OF CASING ELEV.:	GROUND SURFACE ELEV.:
52 ft bls at 24-hrs	680428.0	1412993.3	861.47	858.42

Stickup (ft): 3.05 — TOC Elevation: 861.47

Depth BLS	Elevation (MSL)
0 ft - Top of Grout	858.42
45 ft - Top of Seal	813.42
47 ft - Top of Filter Pack	811.42
49 ft - Top of Screen	809.42
59 ft - Bottom of Screen	799.42

Screened Interval 10 feet

59 ft bls - Total Depth of Well

PAD TYPE:
2'x2' Concrete

PROTECTIVE CASING:
4"x4" Lockable Steel

CASING TYPE:
2-inch Sch. 40 PVC

CASING INTERVAL:
0 to 49 ft bls

SCREEN TYPE:
2-inch 0.010 Slot Sch. 40 PVC

SCREEN INTERVAL
49 to 59 ft bls

GROUT TYPE:
Neat Cement

GROUT INTERVAL
0 to 45 ft bls

SEAL TYPE:
Bentonite

SEAL INTERVAL:
45 to 47 ft bls

FILTER PACK:
#1 Filter Sand

FILTER PACK INTERVAL:
47 to 59 ft bls

DEVELOPMENT:
Purged minimum 5 well volumes

NOTES:
For Lithologic Information See Attached Boring Log

WELL CONSTRUCTION RECORD

(B-4) - MS-15

North Carolina - Department of Environment and Natural Resources - Division of Water Quality - Groundwater Section

WELL CONTRACTOR (INDIVIDUAL) NAME (prin Jay Little CERTIFICATION # 2717

WELL CONTRACTOR COMPANY NAME S&ME, Inc. PHONE # 704-523-4726

STATE WELL CONSTRUCTION PERMIT# _____ ASSOCIATED WQ PERMIT# _____

(if applicable) (if applicable)

1. WELL USE (Check Applicable Box): Residential ☐ Municipal/Public ☐ Industrial ☐ Agricultral ☐ Monitoring ☐ Recovery ☐ Heat Pump Water Injection ☐ Other ☑ If Other, List Use observation well

2. WELL LOCATION:
   Nearest Town: Terrell County Catawba
   Marshall Steam Station
   (Street Name, Numbers, Community, Sudivision, Lot No.,Zip Code)

   Topographic/Land setting
   ☑ Ridge ☐ Slope ☐ Valley ☐ Flat
   (check appropriate box)
   Latitude/longitude of well location
   _____
   (degrees/minutes/seconds)
   Latitude/longitude scource: ☐GPS ☐Topographic Map
   (check box)

3. OWNER: Duke Power
   Address 526 South Church Street
   (Street or Route No.)
   Charlotte NC 28202
   City or Town State Zip Code
   (704) 373-7900
   Area code - Phone Number

4. DATE DRILLED 12/03/2002
5. TOTAL DEPTH 59 ft bls
6. DOES WELL REPLACE EXISTING WELL? YES ☐ NO ☑
7. STATIC WATER LEVEL Below Top of Casing: 55 ft.
   (Use "+" if Above Top of Casing)
8. TOP OF CASING IS ~3.0 FT. Above Land Surface*
   *Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.
9. YIELD (gpm) n/a METHOD OF TEST n/a
10. WATER ZONES (depth): n/a

DEPTH From	DEPTH To	DRILLING LOG Formation Descrpition
0	7	Clayey Silt
7	42	Fine Sandy Silt
42	47	Silty Fine Sand
47	52	Fine Sandy Silt
52	59	Silty Fine Sand

11. DISINFECTION: Type n/a Amount n/a
12. CASING:

	Depth From	Depth To	Diameter	Wall Thickness or Weight/Ft.	Material
	0	49	2-inch	Sch. 40	PVC

13. GROUT:

Depth From	Depth To	Material	Method
0	45	Neat Cement	Pour
45	47	Bentonite	Pour

14. SCREEN:

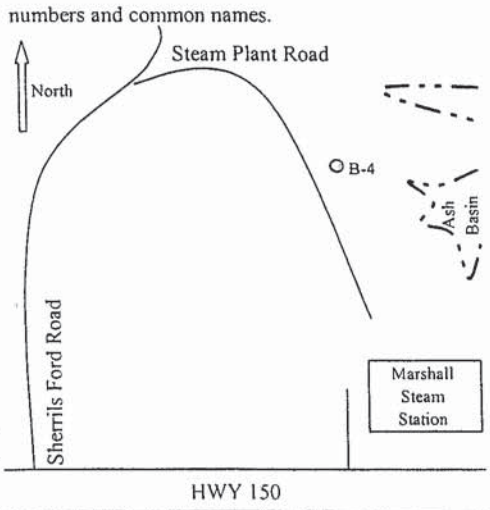
Depth From	Depth To	Diameter	Slot Size	Material
49	59	2-inch in.	0.01 in.	PVC
		in.	in.	

15. SAND/GRAVEL PACK:

Depth From	Depth To	Size	Material
47	59	#1	Silica Sand

LOCATION SKETCH

Show direction and distance in miles from at least two State Roads or County Roads. Include the road numbers and common names.



16. REMARKS:

I DO HERE BY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER

Jay A. Little 2-7-03

SIGNATURE OF PERSON CONSTRUCTING THE WELL DATE

Submit the original to the Division of Water Quality, Groundwater Section, 1636 Mail Service Center - Raleigh, NC 27699-1636 Phone No. (919) 733-3221, within 30 days.

GW-1 REV. 07/2001

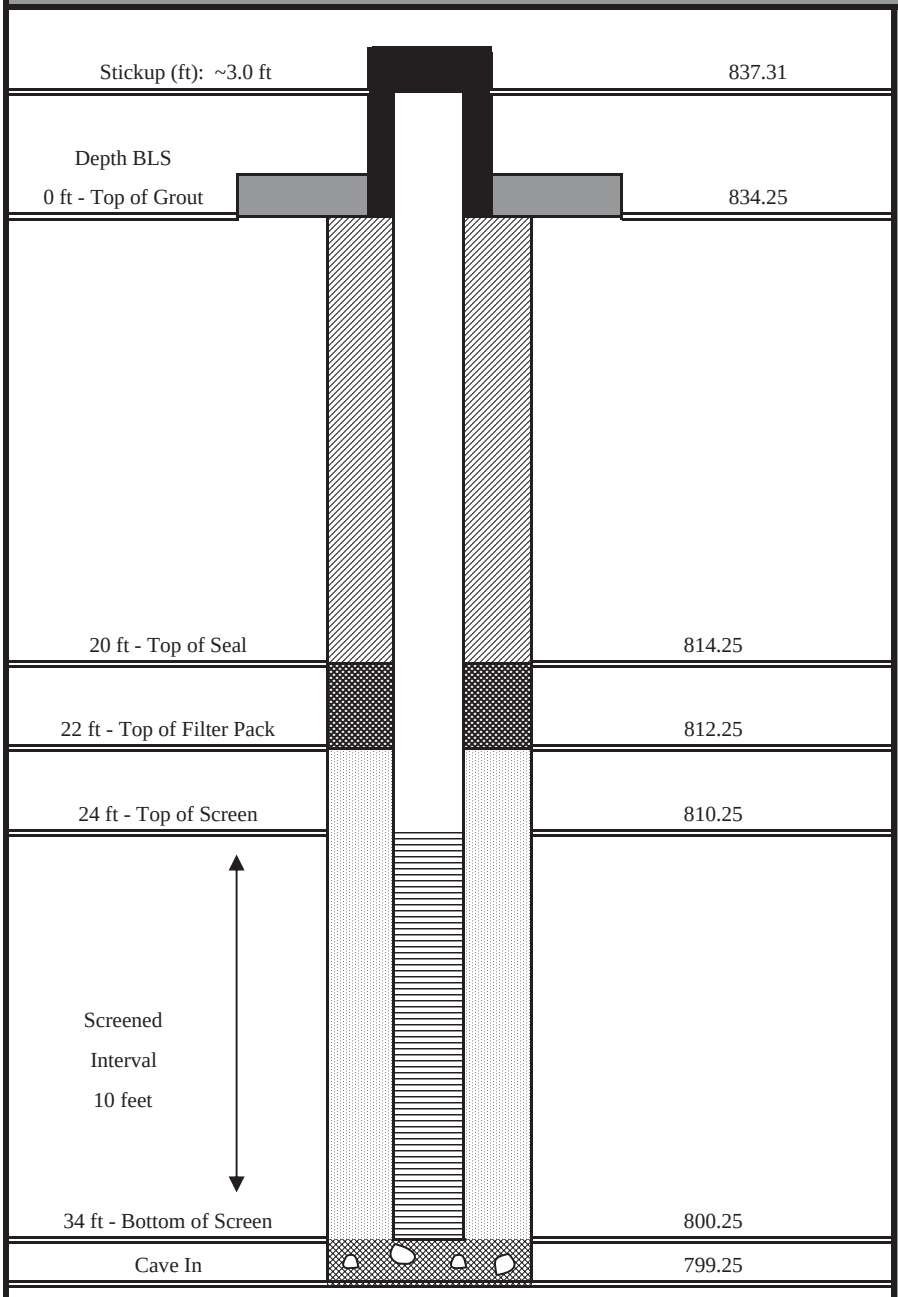
MONITORING WELL CONSTRUCTION

WELL ID: MS-16 **TOTAL DEPTH: 35 ft bls**

S&ME PROJECT AND NO:	WELL USE / TYPE:	INSTALLATION DATE:
Marshall Steam Station, 1356-06-728	Monitoring	9/11/2006

DRILLING CONTRACTOR:	DRILLER AND LICENCE NO.:	DRILLING METHOD:
S&ME, Inc.	Larry Shrader, 3349	4.25 H.S.A.

WATER LEVEL AT TOB:	NORTHING:	EASTING:	TOP OF CASING ELEV.:	GROUND SURFACE ELEV.:
26 ft bls	681142.3	1412485.1	837.31	834.25



PAD TYPE:
2'x2' Concrete

PROTECTIVE CASING:
4"x4" Lockable Steel

CASING TYPE:
2-inch Sch. 40 PVC

CASING INTERVAL:
0 to 24 ft bls

SCREEN TYPE:
2-inch 0.010 Slot Sch. 40 PVC

SCREEN INTERVAL
24 to 34 ft bls

GROUT TYPE:
Neat Cement

GROUT INTERVAL
0 to 20 ft bls

SEAL TYPE:
Bentonite

SEAL INTERVAL:
20 to 22 ft bls

FILTER PACK:
#1 Filter Sand

FILTER PACK INTERVAL:
22 to 34 ft bls

DEVELOPMENT:
Purged ~15 Gallons

NOTES:

TBD - To Be Determined

For Lithologic Information See Attached Boring Log

WELL CONSTRUCTION RECORD
(MS-16)

North Carolina - Department of Environment and Natural Resources - Division of Water Quality - Groundwater Section

WELL CONTRACTOR (INDIVIDUAL) NAME (prin Larry Shrader **CERTIFICATION #** 3349

WELL CONTRACTOR COMPANY NAME S&ME, Inc. **PHONE #** 704-523-4726

STATE WELL CONSTRUCTION PERMIT# _____ **ASSOCIATED WQ PERMIT#** _____
(if applicable) (if applicable)

1. WELL USE (Check Applicable Box): Residential ☐ Municipal/Public ☐ Industrial ☐ Agricultral ☐
Monitoring ☒ Recovery ☐ Heat Pump Water Injection ☐ Other ☐ If Other, List Use _____

2. WELL LOCATION:
Nearest Town: Terrell County Iredell
Marshall Steam Station
(Street Name, Numbers, Community, Sudivision, Lot No.,Zip Code)

Topographic/Land setting
☐ Ridge ☒ Slope ☐ Valley ☐ Flat
(check appropriate box)

Latitude/longitude of well location
35°-36'-19.714"N / 80°-58'-35.966"W
(degrees/minutes/seconds)

Latitude/longitude scource: ☐GPS ☐Topographic Map
↳ Physical Survey (check box)

3. OWNER: Duke Power
Address 526 South Church Street
(Street or Route No.)
Charlotte NC 28202
City or Town State Zip Code
(704) 373-7900
Area code - Phone Number

4. DATE DRILLED 9/11/2006
5. TOTAL DEPTH 34 ft bls
6. DOES WELL REPLACE EXISTING WELL? YES ☐ NO ☐
7. STATIC WATER LEVEL Below Top of Casing: 24.7 ft.
(Use "+" if Above Top of Casing)
8. TOP OF CASING IS ~3.0 FT. Above Land Surface*
***Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.**
9. YIELD (gpm) n/a METHOD OF TEST n/a
10. WATER ZONES (depth): n/a

DEPTH From	To	DRILLING LOG Formation Descrpition
0	3	Slightly Clayey, M/F Sand
3	9.5	Fine Sandy Silt
9.5	13.5	Silty, Fine/V. Fine Sand
13.5	18.5	Medium to Fine Sand
18.5	23.5	Very Fine Sandy Silt
23.5	29	PWR
29	35	PWR

11. DISINFECTION: Type n/a Amount n/a
12. CASING:

	Depth			Diameter	Wall Thickness or Weight/Ft.	Material
From	0	To 24	Ft.	2-inch	Sch. 40	PVC
From		To	Ft.			
From		To	Ft.			

13. GROUT:

	Depth			Material	Method
From	0	To 20	Ft.	Neat Cement	Pour
From	20	To 22	Ft.	Bentonite	Pour

14. SCREEN:

	Depth			Diameter		Slot Size		Material
From	24	To 34	Ft.	2-inch	in.	0.01	in.	PVC
From		To	Ft.		in.		in.	

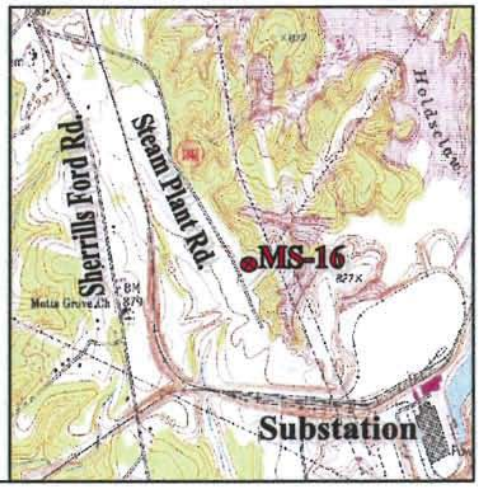
15. SAND/GRAVEL PACK:

	Depth			Size	Material
From	22	To 34	Ft.	#1	Silica Sand
From		To	Ft.		

16. REMARKS:

LOCATION SKETCH

Show direction and distance in miles from at least two State Roads or County Roads. Include the road numbers and common names.



I DO HERE BY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER

Larry W. Shrader 9-25-06
SIGNATURE OF PERSON CONSTRUCTING THE WELL DATE

Submit the original to the Division of Water Quality, Groundwater Section, 1636 Mail Service Center - Raleigh, NC 27699-1636 Phone No. (919) 733-3221, within 30 days.

GW-1 REV. 07/2001