

ALTAMONT ENVIRONMENTAL, INC.

ENGINEERING & HYDROGEOLOGY

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February 9, 2012

Ms. Elizabeth Werner
North Carolina Department of Environment and Natural Resources
Division of Waste Management
Solid Waste Section
1646 Mail Service Center
Raleigh, NC 27699-1636

Subject: Duke Energy Carolinas, LLC
Marshall Steam Station
Catawba County, NC
FGD Landfill, Permit No. 1809
Monitoring Wells MS-8 and SW-1 Assessment

Dear Ms. Werner:

On behalf of Duke Energy Carolinas, LLC (Duke), Altamont Environmental Inc. submits the proposed *Groundwater Assessment Work Plan, Marshall Steam Station, FGD Landfill, Permit No. 1809, February 9, 2012*. This proposed assessment work plan is submitted in response to your letter of November 9, 2011 to Mr. Ed Sullivan, P.E. (Duke Energy), DOC ID 15490.

Altamont Environmental Inc. appreciates the opportunity to provide this information to the North Carolina Department of Environment and Natural Resources and to assist Duke Energy with these projects. Please call (828) 281-3350 if you have any questions or require additional information.

Sincerely,

ALTAMONT ENVIRONMENTAL, INC.



William M. Miller, P.E.
Project Manager

enclosure: *Groundwater Assessment Work Plan, Marshall Steam Station, FGD Landfill, Permit No. 1809, February 9, 2012.*

cc: Mark Poindexter, SWS, mark.poindexter@ncdenr.gov
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ALTAMONT ENVIRONMENTAL, INC.

ENGINEERING & HYDROGEOLOGY



Groundwater Assessment Work Plan

Marshall Steam Station

FGD Landfill, Permit No. 1809

February 9, 2012

Prepared for
Duke Energy Carolinas, LLC
8320 East NC Highway 150
Terrell, NC 28682
Project Number 2371.13

Prepared by
Altamont Environmental, Inc.
231 Haywood Street
Asheville, NC 28801
(828) 281-3350

Professional Certification

On behalf of Altamont Environmental, Inc., a firm licensed to practice engineering (certification number C-2185) in the State of North Carolina, I do hereby certify that the information contained in this report is correct and accurate to the best of my knowledge.



William M. Miller

2/9/12

William M. Miller, P.E.

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4. Method of Assessment for Wells at or Beyond the Compliance Boundary
5. Method of Assessment for Wells at or Beyond the Review Boundary
6. Method of Assessment for Surface Water Sampling Locations at or Beyond the Compliance Boundary

Appendices

- A. Letter from North Carolina Department of Environment and Natural Resources. November 9, 2011. To Ed Sullivan, P.E., Duke Energy. DOC ID 15490.

1.0 Introduction

The Marshall Steam Station flue gas desulfurization (FGD) Landfill, Permit No. 1809, is located at the Marshall Steam Station in Catawba County and is owned and operated by Duke Energy Carolinas, LLC (Duke).

In a letter, dated November 9, 2011,¹ to Mr. Ed Sullivan, P.E. of Duke Energy Carolinas, LLC (Duke), the North Carolina Department of Environment and Natural Resources (DENR) Division of Waste Management (DWM) stated that exceedances of groundwater standards, established in Title 15A North Carolina Administrative Code (NCAC) Subchapter 2L .0202 Groundwater Quality Standards (2L standards), were reported in groundwater samples collected from groundwater monitoring well MS-8 and surface water sampling location SW-1, during the March 22, 2011 sampling event. The letter is included as Appendix A.

The DENR letter stated that chromium and iron were reported at a concentration greater than the 2L standards in the groundwater sample collected from MS-8, and that iron and manganese were reported greater than the 2L standards in the sample collected at sample location SW-1 during this event. Monitoring well MS-8 is located at the compliance boundary and surface water sampling location SW-1 is a groundwater seep located beyond the compliance boundary. DENR also stated that industrial landfills are required to comply with the 2L standards at the compliance boundary in accordance with 15A NCAC 13B .0503 (2)(d)(iv).

In addition, the DENR letter stated that concentrations of chromium and iron were reported at concentrations above their respective 2L standards in groundwater monitoring wells MS-10, MS-15, and MS-16. These wells are located at the review boundary.

DENR stated that based on these exceedances, Duke shall submit a groundwater assessment work plan to the DSW Solid Waste Section. This document, prepared by Altamont Environmental Inc. (Altamont) on behalf of Duke, presents the proposed groundwater assessment work plan.

¹ North Carolina Department of Environment and Natural Resources. Division of Waste Management. November 9, 2011, Monitoring Well MS-8 and SW-1 Assessment. Duke Energy - Marshall Steam FGD Landfill. DOC ID 15490.
P:\Duke - Environmental Engineering - 2371\2371.13 Landfill Assessments\Assessment Work Plans\MSS\FGD Landfill\Final\1809 MSS FGD LF - Assessment Work Plan 020912.Docx

2.0 Background

2.1 Site Description

Marshall Steam Station (Marshall) is owned and operated by Duke. Marshall is a four-unit, coal-fired generating facility with a generating capacity of approximately 2070 megawatts. Marshall is the second largest coal facility owned by Duke Energy in the Carolinas and generates enough electricity to power approximately 2 million homes. Since it began commercial operation in 1965, Marshall has been among the most efficient power plants in the nation.

The plant is located in Catawba County, on Lake Norman (Figure 1). The flue gas desulfurization (FGD) landfill is located northwest of the power plant and west of the Marshall ash basin as shown on Figure 1. In general, the topography of the landfill site slopes from the west-northwest to the east towards the Marshall ash basin.

The landfill is permitted to receive FGD residue (gypsum), clarifier sludge, fly ash, bottom ash, asbestos waste, construction & demolition waste, and mill rejects (pyrites). The clarifier sludge is generated from the FGD wastewater treatment system. Only Cell 1 of the landfill is in operation and is approximately 18 acres in area. The landfill was constructed with an engineered liner system, consisting of a leachate collection and removal system, an HDPE geomembrane, and a geosynthetic clay liner. Contact stormwater and leachate are collected in the lined Cell 1, and then piped to the ash basin. The landfill began receiving waste in 2007.

2.2 Site Geology and Hydrogeology

The Marshall Steam Station is located in the Piedmont Physiographic Province of North Carolina, within the King's Mountain Belt. The rocks in the area were formed during the Precambrian era and metamorphosed during the Paleozoic era and consist of schist, gneiss, diorite, and granite. The soils that overlie the bedrock in the area have generally formed from the in-place weathering of the parent bedrock. These soils are termed residuum (residual soils) and saprolite. The residuum is typically finer-grained and has a higher clay content than the underlying saprolite. The highly weathered saprolite generally retains the overall structure and appearance of the underlying bedrock. The saprolite grades into partially weathered rock and finally into bedrock.

Groundwater generally occurs within the residuum and saprolite under unconfined conditions. Often, the heterogeneous nature of the soil results in variable porosities and permeabilities both laterally and vertically. However, low permeability units that would result in confining conditions between the overlying soils and bedrock are generally absent. In the underlying bedrock, groundwater occurs predominately in fractures and joints and flow may occur under either unconfined or confined conditions.

2.3 Description of Monitoring System

The monitoring system at the landfill consists of nine groundwater monitoring wells and one surface water sampling location listed below.

Monitoring Wells:	MS-8	MS-13
	MS-9	MS-14
	MS-10	MS-15
	MS-11	MS-16
	MS-12	
Surface Water		
Sampling Location:	SW-1	

The locations of the monitoring wells and surface water sampling location are shown on Figure 2. Well MS-8 is located north of the landfill and is described in the *Groundwater Sampling and Analysis Plan*² (SAP) as the background monitoring well for the site. Surface water sample location SW-1 is a groundwater seep; therefore the analytical results are compared to 2L standards.

2.4 Site Groundwater Flow

Generalized groundwater surface contours for the site are shown on Figure 3. These contours were developed using groundwater elevations measured at the wells on September 27, 2011.

Groundwater flow in the area of the landfill is generally from areas of higher topography, located to the north and west of the landfill, toward the Marshall Ash Basin, located to the east of the landfill. To a lesser extent, some component of groundwater flow is expected toward the surface water drainage feature containing surface water sample location SW-1.

² *Marshall Steam Station Flue Gas Desulfurization (FGD) Residue Landfill Phase 1, Cell 1 Permit No. 18-09 Groundwater Sampling and Analysis Plan*, August 19, 2011.

3.0 Groundwater Quality

In accordance with the SAP, the groundwater monitoring is performed semiannually in March and September. Sampling results are submitted to DENR within 90 days of sampling.

As noted in the DENR letter dated November 9, 2011, exceedances of the 2L standards were reported for a groundwater monitoring well and surface water sampling location during the March 22, 2011 monitoring event. After review of the DENR November 9, 2011 letter, a telephone conversation was conducted between representatives from DENR, Duke, and Altamont concerning these exceedances. Participating in that conversation were Ms. Elizabeth Werner, Hydrogeologist (DENR), Mr. Ed Sullivan, P.E. (Duke), and Mr. Bill Miller, P.E. (Altamont). During the conversation, Duke proposed that exceedances reported in groundwater sampling events, conducted more recently than the event noted in the DENR letter of November 9, 2011, would be addressed in the proposed assessment work plan. DENR agreed with this proposal.

Table 1 presents the 2L exceedances reported for groundwater monitoring well MS-8 located at the compliance boundary.

Table 2 presents the 2L exceedances reported for groundwater monitoring wells MS-10, MS-15, and MS-16 located at the review boundary.

Table 3 presents the 2L exceedances reported for surface water sampling location SW-1 located beyond the compliance boundary.

4.0 Proposed Groundwater Assessment Work Plan

4.1 Proposed Groundwater Assessment Work Plan for Well MS-8

The proposed groundwater assessment plan for evaluating the 2L standard exceedances at well MS-8 is provided in Table 4. In general, the proposed groundwater assessment plan for this well is to evaluate if the 2L exceedances at this well can be attributed to the site background water quality and/or if the exceedances can be attributed to sediment or particulate matter which is preserved in the groundwater samples as a result of well construction or groundwater sampling.

4.2 Proposed Groundwater Assessment Work Plan for Wells MS-10, MS-15, and MS-16

The proposed groundwater assessment plan for evaluating the 2L exceedances at wells MS-10, MS-15, and MS-16 is provided in Table 5. In general, the proposed groundwater assessment plan for these wells is to evaluate if the 2L exceedances at these wells can be attributed to the site background water quality and/or if the exceedances can be attributed to sediment or particulate matter which is preserved in the groundwater samples as a result of well construction or groundwater sampling.

4.3 Proposed Groundwater Assessment Work Plan for Surface Water Sample Location SW-1

The proposed groundwater assessment plan for evaluating the 2L exceedances at surface water sample location SW-1 is provided in Table 6. In general, the proposed groundwater assessment plan for this sample location is to evaluate if the 2L exceedances at this location can be attributed to the site background water quality and/or if the exceedances can be attributed to sediment or particulate matter which is preserved in the sample.

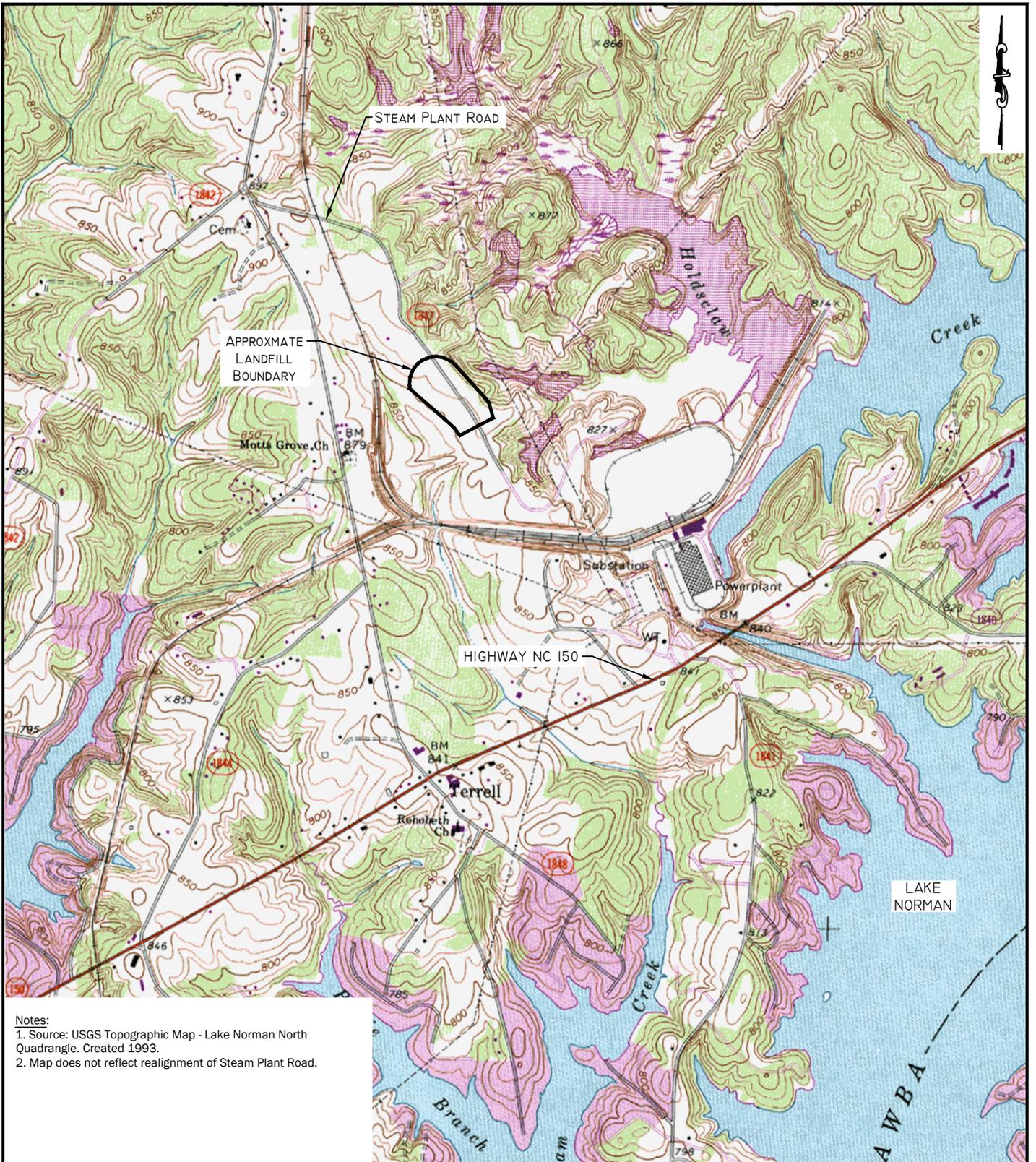
5.0 Assessment Report and Project Schedule

The groundwater assessment report will present results of the work proposed in Section 4.0 and will include interpretations of the results and recommendations for additional work, if deemed necessary. The next groundwater sampling event is scheduled in March 2012. The groundwater assessment report will include analytical results from the March 2012 groundwater sampling event.

The report will be prepared by a North Carolina Professional Engineer.

The project schedule is to submit the groundwater assessment report 120 days after the next scheduled groundwater sampling event unless redevelopment of one or more of the monitoring wells is required. The groundwater assessment report will be submitted 150 days after the next scheduled groundwater sampling event if redevelopment of one or more of the monitoring wells is required. The next groundwater sampling event is scheduled in March 2012. The proposed report submittal date is contingent upon DENR approval of the proposed groundwater assessment work plan by February 27, 2012.

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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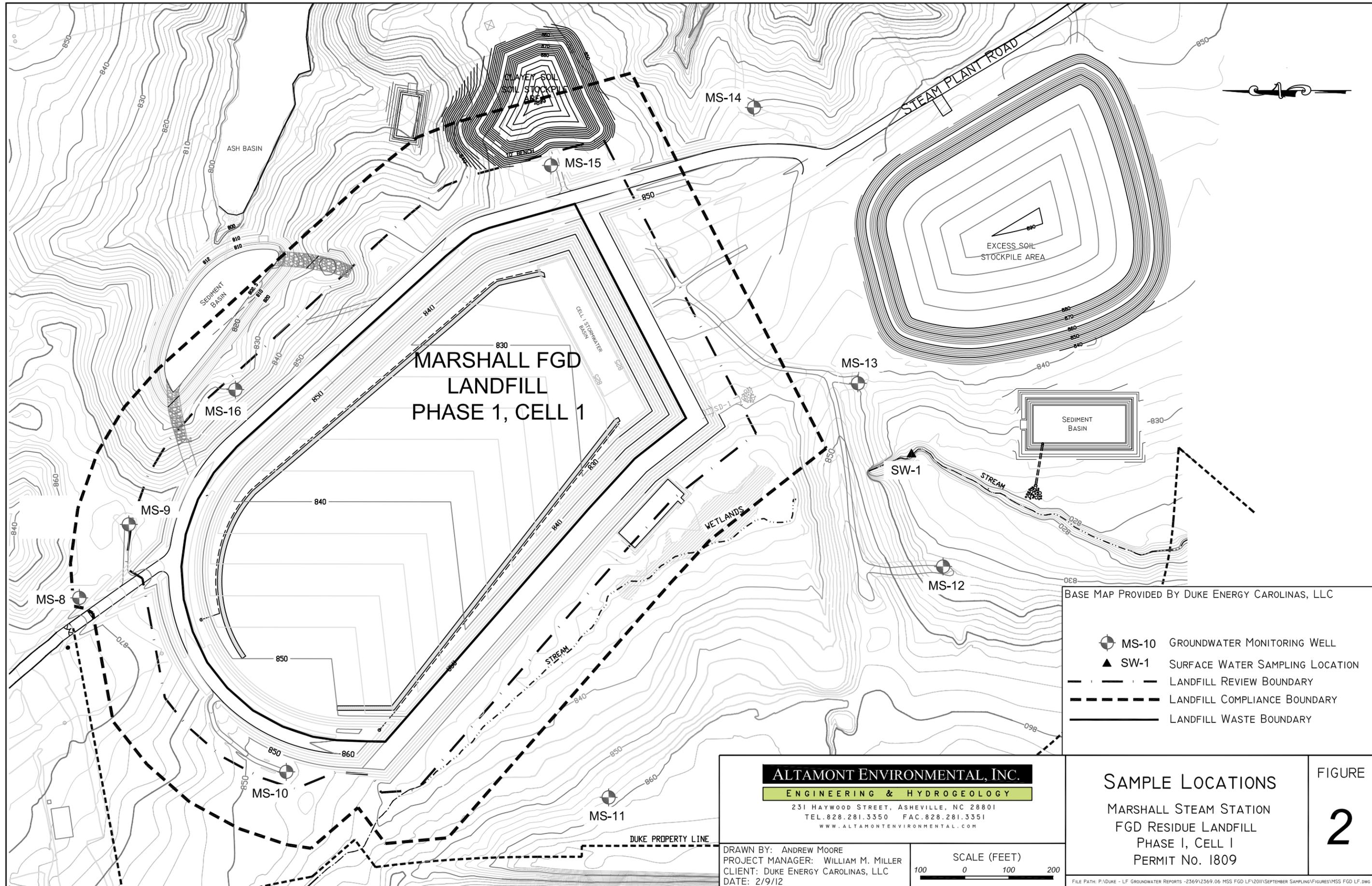
SITE LOCATION MAP
 MARSHALL STEAM STATION
 FGD RESIDUE LANDFILL
 PHASE I, CELL I
 PERMIT No. 1809

FIGURE
1

DRAWN BY: ANDREW MOORE
 PROJECT MANAGER: WILLIAM M. MILLER
 CLIENT: DUKE ENERGY CAROLINAS, LLC
 DATE: 2/9/12



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, LLC

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

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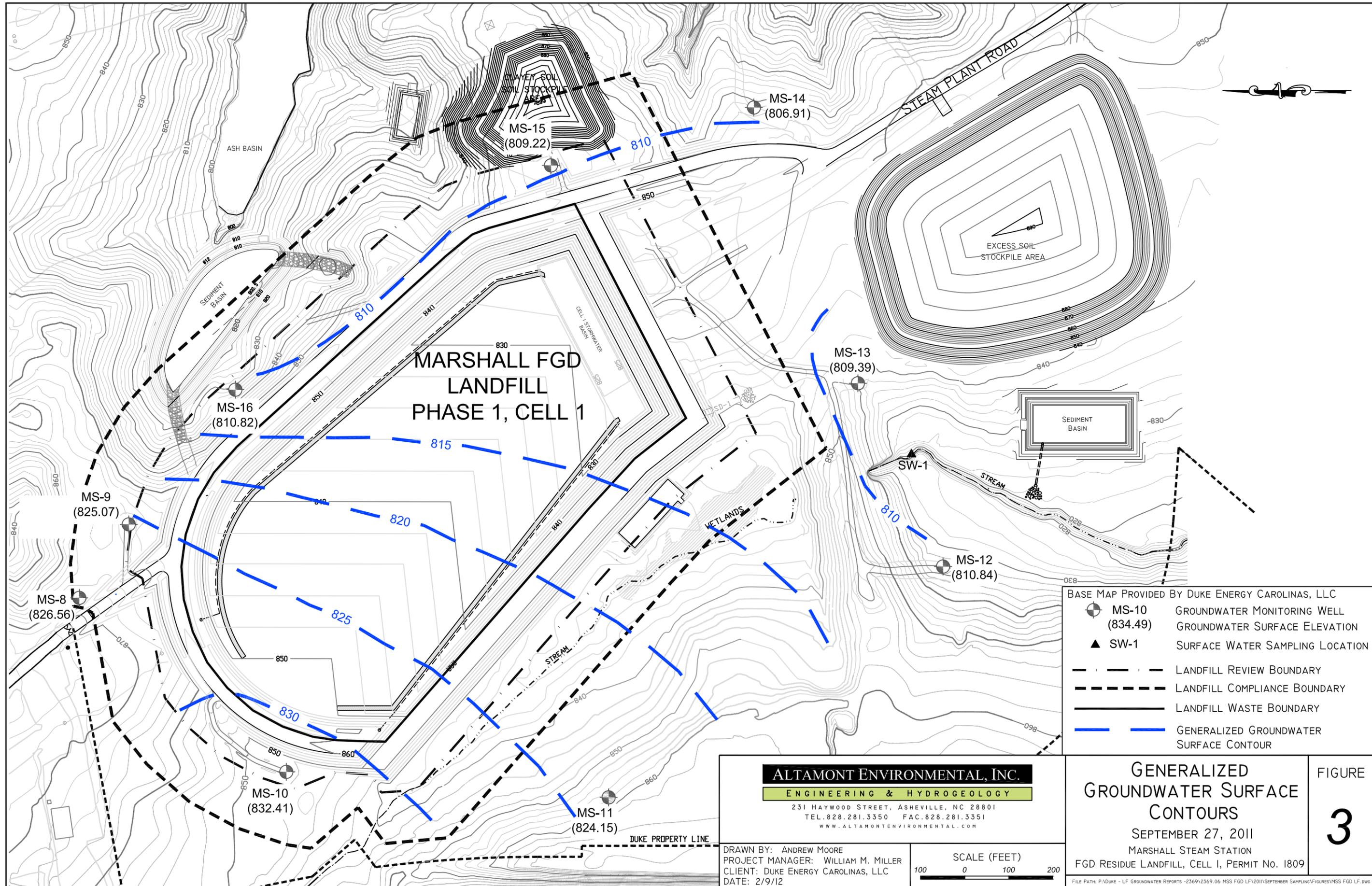
DRAWN BY: ANDREW MOORE
 PROJECT MANAGER: WILLIAM M. MILLER
 CLIENT: DUKE ENERGY CAROLINAS, LLC
 DATE: 2/9/12



SAMPLE LOCATIONS
 MARSHALL STEAM STATION
 FGD RESIDUE LANDFILL
 PHASE I, CELL I
 PERMIT No. 1809

FIGURE
2

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



BASE MAP PROVIDED BY DUKE ENERGY CAROLINAS, LLC	
	MS-10 GROUNDWATER MONITORING WELL
	(834.49) GROUNDWATER SURFACE ELEVATION
	SW-1 SURFACE WATER SAMPLING LOCATION
	LANDFILL REVIEW BOUNDARY
	LANDFILL COMPLIANCE BOUNDARY
	LANDFILL WASTE BOUNDARY
	GENERALIZED GROUNDWATER SURFACE CONTOUR

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GENERALIZED GROUNDWATER SURFACE CONTOURS
 SEPTEMBER 27, 2011
 MARSHALL STEAM STATION
 FGD RESIDUE LANDFILL, CELL I, PERMIT No. 1809

FIGURE
3

DRAWN BY: ANDREW MOORE
 PROJECT MANAGER: WILLIAM M. MILLER
 CLIENT: DUKE ENERGY CAROLINAS, LLC
 DATE: 2/9/12



TABLES

Table 1
2L Standard Groundwater Quality Exceedances for Wells
at or Beyond the Compliance Boundary
Marshall FGD Landfill, Catawba County, North Carolina

Well ID	Parameter	Sample Date for Exceedance	Date of Report	Analytical Result (µg/L)	15A NCAC 2L Standard (µg/L)
MS-8	Chromium	March 22, 2011	June 20, 2011	19.4	10
	Iron	September 27, 2011	December 22, 2011	474	300

Notes:

1. 15A NCAC 2L Standard is from "North Carolina Administrative Code, Title 15A: Department of Environment and Natural Resources, Subchapter 2L - Groundwater Classifications and Standards," DENR (last amended on January 1, 2010).
2. Analytical results provided by Duke Energy Carolinas, LLC.
3. Since the compliance boundary is located beyond the review boundary, these wells are located beyond the review boundary.

Table 2
2L Standard Groundwater Quality Exceedances for Wells
at or Beyond the Review Boundary
Marshall FGD Landfill, Catawba County, North Carolina

Well ID	Parameter	Sample Date for Exceedance	Date of Report	Analytical Result (µg/L)	15A NCAC 2L Standard (µg/L)
MS-10	Iron	March 22, 2011	June 20, 2011	631	300
MS-15	Chromium	September 27, 2011	December 22, 2011	19.7	10
MS-16	Iron	September 27, 2011	December 22, 2011	359	300

Notes:

1. 15A NCAC 2L Standard is from "North Carolina Administrative Code, Title 15A: Department of Environment and Natural Resources, Subchapter 2L - Groundwater Classifications and Standards," DENR (last amended on January 1, 2010).
2. Analytical results provided by Duke Energy Carolinas, LLC.
3. Since the compliance boundary is located beyond the review boundary, these wells are located inside of the compliance boundary.

Table 3
2L Standard Groundwater Quality Exceedances for Surface Water Sample Locations
at or Beyond the Compliance Boundary
Marshall FGD Landfill, Catawba County, North Carolina

Sample Location	Parameter	Sample Date for Exceedance	Date of Report	Analytical Result (µg/L)	15A NCAC 2L Standard (µg/L)
SW-1	Iron	September 27, 2011	December 22, 2011	624	300
	Manganese	September 27, 2011	December 22, 2011	75.2	50

Notes:

1. 15A NCAC 2L Standard is from "North Carolina Administrative Code, Title 15A: Department of Environment and Natural Resources, Subchapter 2L - Groundwater Classifications and Standards," DENR (last amended on January 1, 2010).
2. Analytical results provided by Duke Energy Carolinas, LLC.
3. The surface water sample location SW-1 is a groundwater seep and is considered to be groundwater. Therefore analytical results from this locations are compared to 2L standards.

Table 4
Method of Assessment for Monitoring Wells
at or Beyond the Compliance Boundary
Marshall FGD Landfill, Catawba County, North Carolina

Well ID	Parameter	Method of Assessment
MS-8	Chromium, Iron	<p>a. Review site groundwater flow and hydrogeologic reports to determine if groundwater flow from the landfill is towards MS-8:</p> <ol style="list-style-type: none"> 1. Evaluate groundwater flow from landfill with respect to MS-8 location. 2. Review site hydrogeologic reports. <p>b. Evaluate if the sources of exceedances are naturally occurring and are from sediment or other particulate matter by performing one or more of the following:</p> <ol style="list-style-type: none"> 1. Evaluate historic concentrations compared to date of initial waste placement. 2. Evaluate exceedances against background well results. 3. Evaluate exceedances against turbidity values. 4. Evaluate sampling flow rates. 5. Evaluate sample results for constituents attributed to FGD leachate. 6. Collect and analyze filtered and non-filtered samples. 8. Redevelop well and clean pump if steps above do not resolve issue.

Table 5
Method of Assessment for Wells
at or Beyond the Review Boundary
Marshall FGD Landfill, Catawba County, North Carolina

Well ID	Parameter	Method of Assessment
MS-10	Iron	a. Evaluate if the sources of exceedances are naturally occurring and are from sediment or other particulate matter by performing one or more of the following: <ol style="list-style-type: none"> 1. Evaluate historic concentrations compared to date of initial waste placement. 2. Evaluate exceedances against background well results. 3. Evaluate exceedances against turbidity values. 4. Evaluate sampling flow rates. 5. Evaluate sample results for constituents attributed to FGD leachate. 6. Collect and analyze filtered and non-filtered samples. 7. Redevelop well and clean pump if steps above do not resolve issue.
MS-15	Chromium	
MS-16	Iron	

Table 6
Method of Assessment for Surface Water Sample Locations
at or Beyond the Compliance Boundary
Marshall FGD Landfill, Catawba County, North Carolina

Sample Location	Parameter	Method of Assessment
SW-1	Iron, Manganese	<p>a. Review site groundwater flow and hydrogeologic reports to determine if groundwater flow from the landfill is toward SW-1:</p> <ol style="list-style-type: none"> 1. Evaluate groundwater flow from landfill with respect to SW-1 location. 2. Review site hydrogeologic reports. 3. Survey elevation of SW-1. <p>b. Evaluate if the sources of exceedances are naturally occurring and are from sediment or other particulate matter by performing one or more of the following:</p> <ol style="list-style-type: none"> 1. Evaluate historic concentrations compared to date of initial waste placement. 2. Evaluate exceedances against turbidity values. 3. Evaluate sample results for constituents attributed to FGD leachate. 4. Collect and analyze filtered and non-filtered samples. 5. Evaluate collection of surface water sample upstream of landfill from intermittent stream.

APPENDIX A
LETTER FROM NORTH CAROLINA DEPARTMENT OF ENVIRONMENT
AND NATURAL RESOURCES, NOVEMBER 9, 2011.
TO ED SULLIVAN, P.E., DUKE ENERGY DOC ID 15490.



North Carolina Department of Environment and Natural Resources

Division of Waste Management

Dexter R. Matthews

Director

Beverly Eaves Perdue
Governor

Dee Freeman
Secretary

November 9, 2011

Mr. Ed Sullivan, P.E.
Mail Code EC13K
PO Box 1006
Charlotte, NC 28201

RE: Monitoring Well MS-8 and SW-1 Assessment
Duke Energy – Marshall Steam FGD Landfill
Permit #18-09
Catawba County
DOC ID 15490

Dear Mr. Sullivan:

A review of groundwater analytical data from the FGD Landfill indicates exceedances of groundwater standards established in 15A NCAC 2L .0202 (2L Standards) during the March 22, 2011 monitoring event. Chromium and iron have been reported at concentrations greater than the 2L Standards in groundwater samples collected from MW-8, while iron and manganese have concentrations above 2L in SW-1, which has been determined to be a groundwater seep. Monitor well MW-8 appears to be located at the compliance boundary. Industrial landfills are required to comply with the 2L standards at the compliance boundary in accordance with 15A NCAC 13B .503 (2)(d)(iv).

Duke Energy shall acquire the services of a North Carolina licensed professional geologist and submit a groundwater assessment work plan to the Solid Waste Section (Section) outlining how the reported metals contamination in MW-8 will be delineated. The Section will review the submitted work plan, approve, or request additional information or amendments before implementation. Please submit this work plan within 90 days of receiving this letter. The work plan may include, but not limited to an alternate source demonstration for the metals contamination. In addition, monitoring wells MS-10, MS-15 and MS-6 have chromium and iron concentrations above their respective 2L Standards and appear to be located at the review boundary, which triggers the need for assessment.

The Section solicits your cooperation and would like to remind you that it is your responsibility to comply with the requirements of the rules and statues since the rules are self-implementing. Please contact me at (919) 707-8253 or via email Elizabeth.werner@ncdenr.gov if you have any questions or concerns regarding this letter. Thank you in advance for your anticipated cooperation in this matter.

Sincerely,

Elizabeth S Werner
Hydrogeologist

cc: William M. Miller, PE, Altamont Environmental Inc.
Mark Poindexter, SWS Ellen Lorscheider, SWS
Jason Watkins, SWS Deb Aja, SWS
Central File