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

NC DENR
Division of Waste Management - Solid Waste

Environmental Monitoring Reporting Form

Notice: This form and any information attached to it are "Public Records" as defined in NC General Statute 132-1. As such, these documents are available for inspection and examination by any person upon request (NC General Statute 132-6).

Instructions:

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

Solid Waste Monitoring Data Submittal Information

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

S&ME, Inc. (Consultant)

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

Name: William M. Miller, P.E. Phone: 828-687-9080

E-mail: wmiller@smeinc.com

Facility name:	Facility Address:	Facility Permit #	NC Landfill Rule: (.0500 or .1600)	Actual sampling dates (e.g., October 20-24, 2006)
Duke Energy Belews Creek Steam Station Pine Hall Road Ash Landfill	Duke Energy Belews Creek Steam Station 3195 Pine Hall Road Walnut Cove, NC 27052	85-03	.0500	October 19-20, 2009

Environmental Status: (Check all that apply)

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

Type of data submitted: (Check all that apply)

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

Notification attached?

☐ No. No groundwater or surface water standards were exceeded.
☒ Yes, a notification of values exceeding a groundwater or surface water standard is attached. It includes a list of groundwater and surface water monitoring points, dates, analytical values, NC 2L groundwater standard, NC 2B surface water standard or NC Solid Waste GWPS and preliminary analysis of the cause and significance of any concentration.
☐ Yes, a notification of values exceeding an explosive methane gas limit is attached. It includes the methane monitoring points, dates, sample values and explosive methane gas limits.

Certification

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

William M. Miller, P.E. | Senior Project Engineer | 828-687-9080

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

Signature | January 18, 2010 Date | Affix NC Licensed/ Professional Geologist Seal

NORTH CAROLINA PROFESSIONAL SEAL 17661 ENGINEER WILLIAM M. MILLER

44 Buck Shoals Rd, Suite C-3, Arden, NC 28704

Facility Representative Address

F-0176

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

Revised 6/2009

SEMI-ANNUAL
GROUNDWATER MONITORING REPORT
OCTOBER 2009 SAMPLING EVENT
DUKE ENERGY BELEWS CREEK STEAM STATION
PINE HALL ROAD ASH LANDFILL
PERMIT #85-03

S&ME Project No. 1411-09-047

Prepared For:

Prepared By:

S&ME, Inc.
44 Buck Shoals Road Suite C-3
Arden, North Carolina 28704

January 18, 2010

S&ME

January 18, 2010

Ms. Jackie Drummond
North Carolina Department of Environment and Natural Resources
Division of Waste Management
Solid Waste Section
1646 Mail Service Center
Raleigh, N.C. 27699-1646

Reference: **Semi-Annual Groundwater Monitoring Report**
October 2009 Sampling Event
Duke Energy Belews Creek Steam Station
Pine Hall Road Ash Landfill, Permit # 85-03
S&ME Project 1411-09-047

Dear Ms. Drummond:

This report presents the semi-annual groundwater monitoring for the Pine Hall Road Ash Landfill (Permit #85-03). The landfill is located at Duke Energy's Belews Creek Steam Station in Stokes County. Groundwater sampling for the landfill was performed on October 19 and 20, 2009. S&ME is submitting this report on the behalf of Duke Energy.

This report includes a brief discussion of the landfill and groundwater monitoring activities, a figure showing groundwater contours at the site, a summary of the analytical results, and preliminary evaluation of values in excess of the NCAC 2L groundwater standards. Also attached is the Environmental Monitoring Reporting Form. An EXCEL file containing the laboratory results in the Electronic Data Deliverable format will be sent to you by e-mail.

If you have questions or require additional information, please contact us at 828-687-9080.

Sincerely,

S&ME, Inc.

Scott Spinner
Staff Professional

William M. Miller, P.E.
Senior Project Engineer

NORTH CAROLINA PROFESSIONAL SEAL 17661 ENGINEER WILLIAM M. MILLER

Senior Review by: Larry Armstrong, P.E.

North Carolina Professional Engineering Firm License No. F-0176

S:\2009 PROJECTS\1411\ENVIRONMENTAL PROJECTS\11 09 047 Duke Energy Landfills - GW Reports\Pine Hall Road\Pine Hall Rd GW Report - Oct 2009\Final Report\Pine Hall Rd LF Oct 2009 Report -Final.doc

cc:

Duke Energy
PO Box 1006
Charlotte, NC 28201-1006
Attn: Mr. Ed Sullivan, P.E.
Mail Code EC13K

Duke Energy
Belews Creek Steam Station
3195 Pine Hall Road
Walnut Cove, NC 27052
Attn: Melanie Martin, Environmental Coordinator

TABLE OF CONTENTS

Page

1.0 BACKGROUND 1
2.0 SCOPE OF WORK 3
3.0 RESULTS 4
3.1 Site Groundwater Flow 4
3.2 Analytical Results 4

TABLES

Table 1: Field Data Parameters
Table 1: Summary of Field and Analytical Results
Table 2: Groundwater Analytical Results Appendix I – 40 CFR Part 258 Compounds

FIGURES

Figure 1: Groundwater Contours October 2009

APPENDIX I
Chain of Custody

1.0 BACKGROUND

The Pine Hall Road ash landfill is located at the Duke Energy Belews Creek Steam Station, in Stokes County, North Carolina. The ash landfill is permitted to accept (only) fly ash from Belews Creek Steam Station operations. Belews Creek Steam Station is owned and operated by Duke Energy Carolinas (Duke). The landfill is permitted under NCDENR Solid Waste Permit #85-03.

The landfill was originally permitted in 1983. The original landfill was unlined and was permitted with a soil cap one foot thick on the side slopes and two feet thick on flatter areas. A subsequent expansion (Phase I Expansion) was permitted in 2003. This phase was also unlined, but was permitted with a synthetic cap system to be applied at closure.

After groundwater exceedences were observed in wells installed near the landfill, the placement of additional ash in the Phase I Expansion was halted. The closure design was changed to utilize an engineered, synthetic cover system for the entire landfill, both the original landfill and the Phase 1 Expansion. The construction of the synthetic cover system was completed in December 2008.

The ash landfill and nearby surrounding area are portrayed on Figure 1. The ash landfill is located to the north of the surface water divide that runs along Pine Hall Road and to the east of a surface water divide that runs along Middleton Loop Road. These surface water divides appear to serve as the groundwater divides for the area near the landfill. Two surface water features are located in the area of the landfill. One is an ephemeral along a surface water drainage feature originating along the eastern side of the landfill. The second is a small stream located in a surface water drainage feature beginning north of Pine Hall Road that roughly parallels the western side of the landfill. Both these features drain to the north and into the Ash Basin. Groundwater flow beneath the landfill is from Pine Hall Road, generally northward, towards the Ash Basin. The Ash Basin is operated as a water treatment facility and is permitted by the NPDES program (NPDES Permit #NC0024406).

The groundwater monitoring system for the landfill consists of the following groundwater monitoring wells:

MW-1	MW2-7
MW-2	MW2-9
MW-3	OB-4
MW-4	OB-5
MW-5	OB-9
MW-6	MW-1D
MW-7	

Two surface water sample locations are also included in the monitoring system: location SW-1A from the ephemeral stream east of the landfill and location SW-2 from the stream west of the landfill.

Monitoring well MW-3 is considered to represent "background" groundwater quality. MW-1D is installed as a deep or rock well.

Thirteen (13) monitoring wells and two surface water locations were sampled at the Pine Hall Road Ash Landfill on October 19 and 20, 2009, as the semi-annual sampling for the landfill. Groundwater elevations were measured at the sampled monitoring wells on the day that the groundwater samples were collected. Field parameters from the sampling are presented in **Table 1**.

The sampling was conducted by Duke Energy according to North Carolina Solid Waste Management Guidelines. The parameters and compounds sampled and analyzed for were selected by Duke and NCDENR Division of Solid Waste. The samples were analyzed by a North Carolina certified laboratory.

The preliminary analysis of the cause and significance of these values is provided in Section 3.2. A summary of the laboratory analytical results is provided in **Table 2** for the compounds sampled on a semi-annual basis.

In addition to the semi-annual compounds, the groundwater samples were also analyzed for Appendix I compounds. Appendix I sampling and analysis was performed as part of the requirements contained in the Closure Plan Approval letter dated December 7, 2007, Document ID RC03425. Condition 11 of that document states:

> *Ground-water and surface water samples should be analyzed for Appendix I constituents in addition to currently analyzed constituents semi-annually. Appendix I analytical data will be evaluated, and based on results, the compliance Branch of the SWS may not require continued Appendix I analysis.*

Table 3 contains the summary of the laboratory results for the Appendix I compounds.

2.0 SCOPE OF WORK

To complete the scope of work, S&ME completed the following tasks:

- Received field sampling information provided by Duke (performed by Duke) for monitoring wells MW-1, MW-1D, MW-2, MW-3, MW-4, MW-5, MW-6, MW-7, MW2-7, MW2-9, OB-4, OB-5, OB-9 and surface water sample locations SW-1A and SW-2. This sampling was conducted on October 19 and 20, 2009.
- Reviewed the laboratory analytical results for samples. These results were provided in both in paper format and in an EXCEL file. The EXCEL file was manipulated to conform to the format requirements of the NCDENR Electronic Data Deliverable template.
- Developed a groundwater flow contour map using map data and groundwater elevation data supplied by Duke.
- Provided a preliminary evaluation of the cause and significance of values exceeding NC 2L groundwater standards.
- Prepared and submitted this Semi-Annual Groundwater Monitoring Report to Duke and to NCDENR.

3.0 RESULTS

3.1 Site Groundwater Flow

Groundwater flow contours for the site are shown on **Figure 1**. These contours were developed using the measured groundwater elevations in the wells from the October 19 and 20, 2009 sampling and from using the approximate surface water elevation for the Belews Creek Ash Basin.

Middleton Loop Road and Pine Hall Road are located along topographic highs and also appear to be groundwater divides. Groundwater flow at the site is from areas of higher topography along Middleton Loop Road and Pine Hall Road towards the Ash Basin. As shown by the groundwater elevations observed at MW-2 and MW-6, there also appears to be component of groundwater flow from along Pine Hall road towards the south.

3.2 Analytical Results

Monitoring Wells

A summary of the field data is presented in **Table 1.** As discussed in Section 1.0, groundwater samples were analyzed for the typical semi-annual compounds.
The results of the laboratory analyses for the groundwater monitoring well samples for the typical semi-annual samples are summarized in **Table 2.**

Semi-Annual Compounds – Monitoring Wells

Results from the monitoring wells were below the corresponding NCAC 2L groundwater quality standards[1] with the exceptions noted below:

- pH – pH values equal to and below 6.5 were measured in wells MW-1, MW-2, MW-3, MW-4, MW-5, MW-6, MW-7, MW2-7, MW2-9, OB-5, and OB-9. The detected pH values equal to and below 6.5 ranged from 5.0 in MW-1 to 6.5 in MW2-9.

  Monitoring well MW-3 is considered to be a background well and should not be impacted by the landfill. The pH values measured in MW-3 was 5.7. The pH values measured in the other wells are similar in magnitude to those measured in MW-3 and are consistent with historic readings at the site.

- Boron - Concentrations in excess of the NCAC 2L groundwater quality standard for boron of 315 µg/L were measured in wells MW2-7, MW2-9, OB-4, and OB-9. Wells MW-2-7, OB-4, and OB-9 are within the Review Boundary. Well MW2-9 is approximately 65 feet outside of the landfill Review Boundary, and approximately 10 feet outside of the Ash Basin Review Boundary. Groundwater flow in this region is towards the Ash Basin. It not anticipated that significant boron concentrations are flowing in any direction other than towards the Ash Basin.

[1] Groundwater sampling at this site occurred prior to the 15 A NCAC 02L .0202 Groundwater Quality Standards revision date of January 1, 2010. Therefore the analytical results were compared to the Groundwater Standards in effect at the time of sampling.

- Cadmium – A concentration in excess of the NCAC 2L groundwater quality standard for cadmium of 1.75 µg/L was measured in well OB-9. Well OB-9 is approximately 100 feet inside of the Review Boundary.

- Iron – Concentrations in excess of the NCAC 2L groundwater quality standard for iron of 300 µg/L were measured in wells MW-1, MW-2, MW-3, MW-5, MW-6, MW-7, MW2-9, and OB-5.

  Values for MW-1, MW-2, MW-5, and MW-6 are consistent with historic readings and compare reasonable well with the values for Fe measured at background well MW-3. Well OB-5 is located within the Review Boundary.

  US EPA recommends that when sampling for contaminants that may be biased by the presence of turbidity, the turbidity reading is desired to stabilize at a value below 10 Nephelometric Turbidity Units (NTUs).[2] Turbidity values measured in wells MW-6, MW-7, and MW2-9 were lower than 10 NTU (Table 1).

  The elevated iron concentration at MW2-9 may be caused by groundwater flowing from the landfill. As noted above, groundwater flow through MW2-9 is towards the Ash Basin.

- Manganese – Concentrations in excess of the NCAC 2L groundwater quality standard for manganese of 50 µg/L were measured in monitoring wells MW-1D, MW-2, MW-7, MW2-7, MW2-9, OB-4, and OB-9.

  Well MW-1D is located within the Review Boundary. This well was sampled in December 2008 and April 2009 with detected manganese concentrations of 15.7 µg/L and 483 µg/L, respectively. The recent sampling result was 215 µg/L. No other parameters were observed in this well that clearly indicates influence from the landfill. The elevated sample turbidity in the groundwater samples from wells MW-2 and MW-7 may be the reason for the elevated manganese concentrations detected. Additional sampling events are needed to determine if the elevated Mn values are from the landfill.

  The manganese values measures in Well MW2-7 are consistent with historic readings at the well. This well is located inside of the review boundary.

  The elevated manganese concentration detected in well MW2-9 may be caused by groundwater flowing from the landfill. As noted above, the groundwater flow through MW2-9 is towards the Ash Basin.

  Wells OB-4 and OB-9 are located within the Review Boundary.

- Nitrate (as Nitrogen) – A concentrations in excess of the NCAC 2L groundwater quality standard for nitrate (as nitrogen) 10,000 µg/L was measured in monitoring well MW2-7. The nitrate concentrations in this well have been increasing since the 2005-2006 period. This increase may be due to impacts from fertilizer applied as part of the erosion and sediment control for this portion of the landfill.

[2] Ground-Water Sampling Guidelines for Superfund and RCRA Project Managers, Ground Water Forum Issue Paper, EPA 542-S-02-001, May 2002, Yeskis and Zavala.

- Selenium – Concentrations in excess of the NCAC 2L groundwater quality standard for selenium of 50 µg/L were measured in monitoring wells MW2-7 and OB-9. The wells are located inside of the Review Boundary.
- Sulfate – Concentrations in excess of the NCAC 2L groundwater quality standard for sulfate of 250,000 µg/L were measured in monitoring wells MW2-7 and OB-9. The wells are located inside of the Review Boundary.
- Total Dissolved Solids – Concentrations in excess of the NCAC 2L groundwater quality standard for total dissolved solids of 500,000 µg/L were measured in monitoring wells MW2-7, OB-4, and OB-9. All three wells are located inside of the Review Boundary.

Appendix I Compounds – Monitoring Wells

In addition to sampling for the semi-annual compounds, the samples were analyzed for Appendix I compounds as a requirement of the Closure Plan Approval. Results from the monitoring wells were below the corresponding NCAC 2L groundwater quality standards for the Appendix I compounds with the exception of the previously discussed selenium concentrations detected in wells MW2-7 and OB-9, and cadmium concentration detected in OB-9. The laboratory analytical results for the Appendix I compounds are listed in **Table 3.**

Surface Water Analytical Results
As discussed in Section 1.0, surface water samples were analyzed for the typical semi-annual compounds. In addition these samples were analyzed for Appendix I compounds as a requirement of the Closure Plan Approval. Both of these sample locations discharge to the Ash Basin.

A summary of the field data is presented in Table 1. The results of the laboratory analyses for the surface water samples for the typical semi-annual samples are summarized in **Table 2**.

Semi-Annual Compounds – Surface Water Sample Locations
Results from the surface water samples were below the corresponding NCAC 2L groundwater quality standards with the exceptions noted below:

- pH – pH values below 6.5 were measured in both surface water samples SW-1A and SW-2, at values of 5.9 and 6.2, respectively.

  The pH values measured in the surface water samples are similar in magnitude to the historic groundwater pH readings at the site.

- Boron - Concentrations in excess of the NCAC 2L groundwater quality standard for boron of 315 µg/L were measured in surface water samples SW-1A and SW-2, at concentrations of 17,200 µg/L and 4,270 µg/L, respectively.

- Manganese – Concentrations in excess of the NCAC 2L groundwater quality standard for manganese of 50 µg/L were measured in surface water samples SW-1A and SW-2, at concentrations of 1,560 µg/L and 85.1 µg/L, respectively.

- Nitrate (as Nitrogen) – A concentration in excess of the NCAC 2L groundwater quality standard for nitrate (as nitrogen) 10,000 µg/L was measured in surface water sample SW-1A (29, 700 µg/L).

- Selenium – A concentration in excess of the NCAC 2L groundwater quality standard for selenium of 50 µg/L was measured in surface water sample SW-1A (94.8 µg/L).

- Sulfate – A concentration in excess of the NCAC 2L groundwater quality standard for sulfate of 250,000 µg/L was measured in surface water sample SW-1A (801,000 µg/L).

- Total Dissolved Solids – A concentration in excess of the NCAC 2L groundwater quality standard for total dissolved solids of 500,000 µg/L was measured in surface water sample location SW-1A (1,630,000µg/L).

Appendix I Compounds – Surface Water Sample Locations
The laboratory analytical results for the Appendix I compounds are listed in **Table 3**. The only compound measured at concentrations at or above the NCAC 2L groundwater quality standard was the previously discussed selenium concentration measured in the surface water sample from location SW-1A.

Semi-Annual Compounds - Values Equal to or Above the SWSL's

The groundwater analytical results for the compounds sampled on a semi-annual basis at the following wells and surface water sample locations were equal to or above the corresponding Solid Waste Section Limits (SWSL).[3]

- Arsenic – Concentration of arsenic in excess of the SWSL of 10 µg/l were measured in wells OB-4 and OB-9.
- Barium – A concentration of barium in excess of the SWSL of 100 µg/l was measured in well OB-5.
- Chromium – A concentration of chromium in excess of the SWSL of 10 µg/l was measured in well MW-4.
- Copper – A concentration in excess of the SWSL of 10 µg/l was measured in well MW-5.
- Lead – A concentration in excess of the SWSL of 10 µg/l was measured in well MW-5.
- Mercury – A concentration in excess of the SWSL of 5 µg/l was measured in well MW2-7 and OB-9.
- Nitrate (as Nitrogen) – A concentration in excess of the SWSL of 1000 µg/l was measured in wells MW-5, MW-6, MW2-9, and OB-9.
- Selenium – Concentrations of selenium in excess of the SWSL of 10 µg/L were measured in monitoring well OB-4 and at surface water location SW-2.
- Zinc – Concentrations of zinc in excess of the SWSL of 10 µg/l were measured in wells MW-5, MW-7, MW2-9, OB-5, and OB-9, and surface water sample SW-2.
- Toluene– A concentration in excess of the SWSL of 1 µg/l was measured in well MW-2.

[3] Note that the NCAC 2L standards are equal to or greater than the SWSL's; only locations that equal or exceed the SWSL's and that did not exceed the 2L standards are listed.

Appendix I Compounds - Values Equal to or Above the SWSL's

The groundwater analytical results for the Appendix I compounds at the following wells and surface water sample locations were equal to or above the corresponding Solid Waste Section Limits (SWSL).[4]

- Antimony – A concentration in excess of the SWSL of 6 µg/l was measured in well OB-4.
- Beryllium – Concentrations in excess of the SWSL of 1 µg/l were measured in well MW2-7, OB-9, SW-1A, and SW-2.
- Thallium – A concentration in excess of the SWSL of 5.5 µg/l was measured in well OB-4.
- Vanadium – A concentration in excess of the SWSL of 25 µg/l was measured in well OB-4.
- Toluene – Concentrations in excess of the SWSL of 1 µg/l were measured in wells MW-2 and SW-1A.

[4] Note that the NCAC 2L standards are equal to or greater than the SWSL's; only locations that equal or exceed the SWSL's and that did not exceed the 2L standards are listed.