Duke Energy
Belews Creek Steam Station
3195 Pine Hall Road
Belews Creek, NC 27009
(336) 445-0642 OFFICE
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DUKE ENERGY.

July 29, 2014

Dr. Sergei Chernikov
State of North Carolina
Department of Environment and Natural Resources
Division of Water Resources
Water Quality Permitting Section - NPDES
1617 Mail Service Center
Raleigh, North Carolina 27699-1617

Subject: Duke Energy Carolinas LLC – NPDES Permit Modification
Belews Creek Steam Station - #NC0024406

Dear Dr.Chernikov:

Duke Energy Carolinas, LLC requests the subject permit be modified to address ash dike seeps. Enclosed is information pertinent to the ash dike seeps. Please find attached a location map, flow measurements and analytical data. A check in the amount of $1030 is also enclosed for the major permit modification fee.

Also enclosed is a revised groundwater monitoring plan, which includes a receptor survey, sampling & analysis plan and a flow directional map.

Thank you in advance for your assistance on this matter. Should you have questions regarding this request, please contact Allen Stowe at (704) 382-4309 or Allen.Stowe@duke-energy.com.

Sincerely,

Jesse E Huntley II

Jesse E. Huntley II
General Manager III, Regulated Fossil Stations

Attachments

Check Date:	Jul/18/2014	Vendor Number:	0000129653	Name:	STATE OF NORTH CAROLINA		Check Number:	1000120727
Invoice Number		Invoice Date	Voucher ID	Gross Amount	Discounts Taken	Late Charge	Paid Amount	
NPDESPERMITNC0024406 NPDES PERMIT NC 0024406		Jul/14/2014	10659748	1,030.00	0.00	0.00	1,030.00	

Check Number:	Date	Total Gross Amount	Total Discounts	Total Late Charges	Total Paid Amount
1000120727	Jul/18/2014	$1,030.00	$0.00	$0.00	$1,030.00

DUKE ENERGY NAME AND LOGO ARE ON BACK. HOLD AT AN ANGLE TO VIEW. VOID IF ABSENT.

DUKE ENERGY.

Duke Energy Business Services
400 South Tryon Street
Charlotte, NC 28285

JPMORGAN CHASE BANK, N.A.
Syracuse, NY

1000120727
50-937/213

Corporate Accounts Payable
ST25B | 400 South Tryon Street
Charlotte, NC 28285

Date 7/18/14

Pay *One thousand thirty and xx / 100 Dollars*

$**1,030.00

To The Order Of

STATE OF NORTH CAROLINA
DENR/DWR
1617 MAIL SERVICE CENTER
Raleigh, NC 27699-1617

Authorized Signature

⑈1000120727⑈ ⑆021309379⑆ 601846561⑈

Belews Creek Steam Station
Ash Basin
Seep Monitoring – July 2014

Flow measurement devices were installed at seep sampling locations S-1 through S-9 to measure seepage flows and to provide sufficient depth to allow collection of water quality samples for laboratory analysis. The flow measurements at sampling locations S-10 and S-11 were performed using the area-velocity method. Water quality samples at these locations were collected directly from the streams into laboratory-prepared containers. See Figure 1 for the approximate seep sampling locations.

The flow measurement devices were constructed to impound the seepage in a channel and to direct the collected flow into a PVC pipe for flow measurement. The flow measurement devices were inspected after installation and prior to sampling to confirm sufficient flow and depth for sampling, and to verify that only minimal leakage, if any, was present. Sufficient time was allowed for the impounded seepage flows to reach equilibrium discharge flow before flow measurement and sampling.

Descriptions of the seep sampling locations are provided in Table 1.

Seep Flow Measurement Methods

Seepage flow is generally variable. Flow may increase or decrease depending on the amount of rainfall, groundwater levels, weather conditions, and other factors.

The seepage flows at S-1 through S-9 were measured using the timed-volumetric method. A volume of water was collected from the discharge of the PVC pipe directly into an appropriately sized container. Volumes (in mL) were measured in the field utilizing a graduated container. The amount of time (in seconds) needed to collect the volume of water was recorded and flows (in MGD) were calculated for the timed-volume. The calculated flows (in MGD) at each seep location are presented in Appendix A.

The seepage flows at sampling locations S-10 and S-11 were calculated using the area-velocity method. Point velocities and water depth were measured at a minimum of 20 stations along a transect setup perpendicular to the direction of flow using a Swoffer® 3000 flow meter mounted to a standard United States Geologic Survey (USGS) top-set wading rod. The average velocity and cross-sectional area of the wetted channel were used to calculate flows in MGD. The calculated flows (in MGD) at each seep location are presented in Appendix A.

Seep Sample Collection Method

Water quality samples were collected at locations S-1 through S-11. To minimize potential effects of stormwater runoff, seep samples were collected during a period with minimal preceding rainfall. Samples were collected from the discharge flow at the flow measurement devices or directly from the seep into sample bottles while minimizing disturbance and entrainment of soil/sediment.

Analytical parameters for analysis were: TSS, TDS, Oil & Grease, Cl, SO_4, F, COD, Al, As, B, Ba, Ca, Cd, Cu, Cr, Fe, Mn, Mo, Mg, Ni, Pb, Sb, Se, Tl, Zn, Hardness and Hg. Storage and preservation techniques of the samples, after collection and prior to analyses, were followed according to Appendix B. Analyses were conducted by Duke Energy's Huntersville analytical laboratory (NC Wastewater Certification #248) and Pace Analytical Laboratories (NC Wastewater Certification # 12). Laboratory analytical methods used for each parameter are provided in Table 2 and analytical results are presented

in Appendix A.

Seep In-situ measurements

In-situ field parameters (temperature, pH, and specific conductance) were measured utilizing calibrated field meters either at the discharge of the seep directly, at the discharge of the flow measurement devices, or in the water pool created behind the device, if sufficient water depth did not exist at the device discharge.

Dan River and Ash Basin (in-process) Water Quality Sample Collection Method

Water quality samples and in-situ measurements from the Dan River were collected at a location upstream (Dan River-Upstream) and downstream (Dan River-Downstream) of the ash basin (Figure 2). Additionally, water samples and in-situ measurements were collected from an in-process ash basin location (Figure 1). The grab samples were collected from the river and basin's surface (0.3 m) directly into appropriate sample bottles. Preservation and analyses methods for the river and ash basin samples are provided in Table 2 and Appendix B.

Recommendations

The low volume of flow at each seep location coupled with the relatively low constituent concentrations in the samples, suggest that there is little potential to influence water quality in the Dan River or Belews Lake. If reasonable potential analyses demonstrate that there is no potential to exceed water quality standards, then Duke Energy proposes to re-evaluate the BCSS seep locations listed in this document annually over the next 5-year permit cycle. These annual evaluations would be documented and would verify the condition of the existing seeps and determine the presence of new seeps. DWR will be promptly notified if any new seeps are identified or any significant changes are observed for the existing seeps. If any existing or newly identified seeps are determined to reach the Dan River or Belews Lake, and demonstrate reasonable potential to exceed a water quality standard, Duke Energy will do one of the following: 1) stop the seep, 2) capture and route the seep so that it is discharged through a NPDES permitted outfall or 3) address the seep using Best Management Plans approved by DWR.

Table 1 – Belews Creek Steam Station Ash Basin – Seep Locations and Descriptions

Seep ID	Location Coordinates[4]		Flow Description	Description
	Latitude	Longitude		
S-1	36.293	-80.085	Continuous	Located northwest of Active Ash Basin, west of Middleton Loop. Tributary to the Dan River. Well defined stream approximately 3-ft wide.
S-2	36.297	-80.085	Continuous	Located northwest of Active Ash Basin, west of Middleton Loop. Tributary to the Dan River. Well defined stream approximately 3.5-ft wide.
S-3	36.298	-80.083	Continuous	Located northwest of Active Ash Basin, west of Middleton Loop. Tributary to the Dan River. Well defined stream approximately 3-ft wide.
S-4	36.298	-80.082	Continuous	Located northwest Active Ash Basin, west of Middleton Loop. Tributary to the Dan River. Well defined stream approximately 3-ft wide.
S-5	36.300	-80.081	Continuous	Located northwest Active Ash Basin, west of Middleton Loop. Tributary to the Dan River. Well defined stream approximately 3.5-ft wide.
S-6	36.296	-80.061	Continuous	Located in former NPDES discharge ditch approximately 100' downstream of decommissioned NPDES discharge pipe on east side of Pine Hall Road.
S-7	36.287	-80.064	Continuous	Location is a relatively flat area of low diffuse flow on the south side of the plant entrance road. Tributary to the pond located on west side of plant access road.
S-8	36.280	-80.078	Continuous	Location is south of Pine Hall Road. Sample location is a well defined stream approximately 4-feet wide.
S-9	36.280	-80.072	Continuous	Located is south of Pine Hall Road west of the Structural Fill. Sample location is below confluence of two smaller springs. Well defined stream approximately 2.5-feet wide.
S-10	36.299	-80.076	Continuous	Located downstream from Active Ash Basin dike. Sampling location is the western stream in this area prior to the confluence with the larger stream (S-11) below the dike. Well defined stream channel approximately 6-feet wide.

Seep ID	Location Coordinates[4]		Flow Description	Description
	Latitude	Longitude		
S-11	36.299	-80.076	Continuous	Located downstream from Active Ash Basin dike. Sampling location is the eastern stream in this area prior to the confluence with the smaller stream (S-10) below the dike. Well defined stream channel approximately 6-feet wide.

Notes:

1. Flow description for each seep sample location is based on observation during site visits performed by HDR Engineering, Inc. (HDR) in June and July 2014.
2. Flow measurements and analytical samples were collected on July 8, 15, and 16, 2014.
3. Location coordinates for seep sampling locations are approximate.
4. Location coordinates (degrees) in NAD 83 datum.

Table 2 – Laboratory Analytical Methods

Parameter	Method	Reporting Limit	Units	Lab
COD	HACH 8000	20	mg/L	Duke Energy
Chloride	EPA 300.0	1	mg/L	Duke Energy
Fluoride	EPA 300.0	1	mg/L	Duke Energy
Sulfate	EPA 300.0	1	mg/L	Duke Energy
Oil and Grease	EPA 1664B	5	ug/L	Pace Analytical
Mercury (Hg)	EPA 245.1	0.05	ug/L	Duke Energy
Aluminum (Al)	EPA 200.7	0.005	mg/L	Duke Energy
Barium (Ba)	EPA 200.7	0.005	mg/L	Duke Energy
Boron (B)	EPA 200.7	0.05	mg/L	Duke Energy
Calcium (Ca)	EPA 200.7	0.01	mg/L	Duke Energy
Hardness	EPA 200.7	0.19	mg/L ($CaCO_3$)	Duke Energy
Iron (Fe)	EPA 200.7	0.01	mg/L	Duke Energy
Magnesium (Mg)	EPA 200.7	0.005	mg/L	Duke Energy
Manganese (Mn)	EPA 200.7	0.005	mg/L	Duke Energy
Zinc (Zn)	EPA 200.7	0.005	mg/L	Duke Energy
Antimony (Sb)	EPA 200.8	1	ug/L	Duke Energy
Arsenic (As)	EPA 200.8	1	ug/L	Duke Energy
Cadmium (Cd)	EPA 200.8	1	ug/L	Duke Energy
Chromium (Cr)	EPA 200.8	1	ug/L	Duke Energy
Copper (Cu)	EPA 200.8	1	mg/L	Duke Energy
Lead (Pb)	EPA 200.8	1	ug/L	Duke Energy
Molybdenum (Mo)	EPA 200.8	1	ug/L	Duke Energy
Nickel (Ni)	EPA 200.8	1	ug/L	Duke Energy
Selenium (Se)	EPA 200.8	1	ug/L	Duke Energy
Thallium (Tl) Low Level	EPA 200.8	0.2	ug/L	Duke Energy
TDS	SM2540C	25	mg/L	Duke Energy
TSS	SM2540D	5	mg/L	Duke Energy

Appendix A
Seep Flows and Analytical Results

Seep Flows and Analytical Results
Belews Creek Seep Monitoring
July 2014

Parameter	Units	S-1	S-2	S-3	S-4	S-5	S-6	S-7	S-8	S-9	S-10	S-11	Ash Pond	Dan River-Upstream	Dan River-Downstream
Oil & Grease	mg/l	< 5	< 5	< 5.0	< 5	< 5	< 5.0	< 5	< 5	< 5	< 5	< 5	NA	< 5	< 5
COD	mg/l	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	NA	< 20	< 20
Cl - Chloride (00940)	mg/l	2.4	34	2.9	29	3	160	4.2	11	8.2	380	430	500	3	23
Fluoride	mg/l	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	NA	< 1	< 1
SO4 - Sulfate (00945)	mg/l	1.4	< 1	< 1	< 1	1.3	36	1.5	8.7	440	11	81	140	2.5	8
Hg - Mercury (71900)	µg/l	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	0.09	< 0.05	< 0.05	< 0.05	< 0.05
Al - Aluminum (01105)	mg/l	0.35	0.202	0.169	0.032	0.244	0.057	0.103	0.026	0.138	0.128	0.065	0.151	0.48	0.392
Ba - Barium (01007)	mg/l	0.022	0.082	0.012	0.039	0.01	0.081	0.055	0.041	0.053	0.307	0.301	NA	0.018	0.023
B - Boron (01022)	mg/l	< 0.05	0.059	< 0.05	< 0.05	< 0.05	3.76	< 0.05	0.064	2.72	5.83	9.84	15.7	< 0.05	0.661
Ca-Calcium	mg/l	3.89	4.7	1.38	5.7	2.16	80.6	1.61	5.33	88	98.1	194	229	4.17	14.1
Hardness	mg/l ($CaCO_3$)	19.1	32.7	7.72	32.2	11.4	288	9.31	24.9	427	499	713	875	17.2	54.8
Fe - Iron (01045)	mg/l	0.947	0.366	0.567	0.216	0.46	0.188	13.3	0.06	0.148	4.01	1.22	78.5	0.71	0.629
Mg-Magnesium	mg/l	2.28	5.1	1.04	4.36	1.46	21	1.28	2.81	50.4	61.8	55.6	73.6	1.66	4.77
Mn - Manganese (01055)	mg/l	0.037	0.094	0.052	0.043	0.023	0.21	0.604	0.013	0.31	5.21	9.71	138	0.024	0.045
Zn - Zinc (01092)	mg/l	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	0.006	< 0.005	0.012	0.061	0.007	0.01	0.002	< 0.005	< 0.005
Sb - Antimony (01097)	µg/l	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	NA	< 1	< 1
As - Arsenic (01002)	µg/l	< 1	< 1	1.39	< 1	< 1	1.57	10.6	< 1	< 1	1.81	2.14	9.7	< 1	< 1
Cd - Cadmium (01027)	µg/l	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	1	< 1	< 1	< 1	< 1
Cr - Chromium (01034)	µg/l	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Cu - Copper (01042)	µg/l	2.63	< 1	1.42	< 1	< 1	< 1	13.9	2.62	3.58	< 1	< 1	1.55	< 1	< 1
Pb - Lead (01051)	µg/l	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Molybdenum (Mo)	µg/l	< 1	< 1	< 1	< 1	< 1	2.9	< 1	< 1	< 1	< 1	< 1	NA	< 1	< 1
Ni - Nickel (01067)	µg/l	< 1	1.03	< 1	1.04	< 1	1.17	< 1	< 1	9.79	11.4	11.1	NA	< 1	< 1
Se - Selenium (01147)	µg/l	< 1	< 1	< 1	< 1	< 1	< 1	< 1	3.58	7	< 1	< 1	6.02	< 1	< 1
Tl - Thallium (01059)	µg/l	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	0.419	0.487	NA	< 0.2	< 0.2
TDS - Total Diss. Solids (70300)	mg/l	61	100	36	95	44	630	34	91	750	1100	1500	1800	45	120
TSS-Total Suspended Solids	mg/l	16	17	< 5	< 5	7	< 5	37	< 5	6	38	< 5	2000	10	7
pH	s.u.	5.5	5.9	6.77	5.7	6.32	6.55	6.09	5.5	6.41	5.73	5.92	8.28	7.12	6.47
Temperature	°C	20.4	22.1	20.2	20.3	22.2	22.7	24.4	20.8	25.4	20.2	22.3	29.32	31.6	29.7
Specific conductance	µS/cm	50.5	119	30.45	105.7	38.2	730	54.7	94.6	869	1081	1448	1933	81.2	153.8
Flow	MGD	0.0053	0.0063	0.0015	0.0048	0.0059	0.0034	0.0011	0.0057	0.0017	0.0129	0.181	7.3	158.3	158.3

Notes:
1. Flow measurements and analytical samples were collected on July 8, 15, and 16, 2014. Some parameters were not analyzed (NA) for the ash pond sample
2. N/A indicates not applicable
3. S-7 sample temperature upon receipt in the analytical lab was slightly above 6 degrees Celsius (7.9 degrees C)
4. Flow at locations upstream and downstream of BCSS in the Dan River is from the USGS Dan River-Pine Hall daily average flows for the date of river sampling

Appendix B

Sample Preservation and Hold times

Parameter name	Container[1]	Preservation[2,3]	Maximum holding time[4]
Table IB—Inorganic Tests:			
1. Acidity	P, FP, G	Cool, ≤6 °C[18]	14 days.
2. Alkalinity	P, FP, G	Cool, ≤6 °C[18]	14 days.
4. Ammonia	P, FP, G	Cool, ≤6 °C[18], H_2SO_4 to pH <2	28 days.
9. Biochemical oxygen demand	P, FP, G	Cool, ≤6 °C[18]	48 hours.
10. Boron	P, FP, or Quartz	HNO_3 to pH <2	6 months.
11. Bromide	P, FP, G	None required	28 days.
14. Biochemical oxygen demand, carbonaceous	P, FP G	Cool, ≤6 °C[18]	48 hours.
15. Chemical oxygen demand	P, FP, G	Cool, ≤6 °C[18], H_2SO_4 to pH <2	28 days.
16. Chloride	P, FP, G	None required	28 days.
17. Chlorine, total residual	P, G	None required	Analyze within 15 minutes.
21. Color	P, FP, G	Cool, ≤6 °C[18]	48 hours.
23-24. Cyanide, total or available (or CATC) and free	P, FP, G	Cool, ≤6 °C[18], NaOH to pH >10[5][6], reducing agent if oxidizer present	14 days.
25. Fluoride	P	None required	28 days.
27. Hardness	P, FP, G	HNO_3 or H_2SO_4 to pH <2	6 months.
28. Hydrogen ion (pH)	P, FP, G	None required	Analyze within 15 minutes.
31, 43. Kjeldahl and organic N	P, FP, G	Cool, ≤6 °C[18], H_2SO_4 to pH <2	28 days.
Table IB—Metals:[7]			
18. Chromium VI	P, FP, G	Cool, ≤6 °C[18], pH = 9.3-9.7[20]	28 days.
35. Mercury (CVAA)	P, FP, G	HNO_3 to pH <2	28 days.
35. Mercury (CVAFS)	FP, G; and FP-lined cap[17]	5 mL/L 12N HCl or 5 mL/L BrCl[17]	90 days.[17]
3, 5-8, 12, 13, 19, 20, 22, 26, 29, 30, 32-34, 36, 37, 45, 47, 51, 52, 58-60, 62, 63, 70-72, 74, 75. Metals, except boron, chromium VI, and mercury	P, FP, G	HNO_3 to pH <2, or at least 24 hours prior to analysis[19]	6 months.
38. Nitrate	P, FP, G	Cool, ≤6 °C[18]	48 hours.
39. Nitrate-nitrite	P, FP, G	Cool, ≤6 °C[18], H_2SO_4 to pH <2	28 days.
40. Nitrite	P, FP, G	Cool, ≤6 °C[18]	48 hours.
41. Oil and grease	G	Cool to ≤6 °C[18], HCl or H_2SO_4 to pH <2	28 days.
42. Organic Carbon	P, FP, G	Cool to ≤6 °C[18], HCl, H_2SO_4, or H_3PO_4 to pH <2	28 days.
44. Orthophosphate	P, FP, G	Cool, to ≤6 °C[18][24]	Filter within 15 minutes; Analyze within 48 hours.
46. Oxygen, Dissolved Probe	G, Bottle and top	None required	Analyze within 15 minutes.
47. Winkler	G, Bottle and top	Fix on site and store in dark	8 hours.
48. Phenols	G	Cool, ≤6 °C[18], H_2SO_4 to pH <2	28 days.
49. Phosphorous (elemental)	G	Cool, ≤6 °C[18]	48 hours.
50. Phosphorous, total	P, FP, G	Cool, ≤6 °C[18], H_2SO_4 to pH <2	28 days.
53. Residue, total	P, FP, G	Cool, ≤6 °C[18]	7 days.
54. Residue, Filterable	P, FP, G	Cool, ≤6 °C[18]	7 days.
55. Residue, Nonfilterable (TSS)	P, FP, G	Cool, ≤6 °C[18]	7 days.
56. Residue, Settleable	P, FP, G	Cool, ≤6 °C[18]	48 hours.
57. Residue, Volatile	P, FP, G	Cool, ≤6 °C[18]	7 days.
61. Silica	P or Quartz	Cool, ≤6 °C[18]	28 days.
64. Specific conductance	P, FP, G	Cool, ≤6 °C[18]	28 days.
65. Sulfate	P, FP, G	Cool, ≤6 °C[18]	28 days.
66. Sulfide	P, FP, G	Cool, ≤6 °C[18], add zinc acetate plus sodium hydroxide to pH >9	7 days.
67. Sulfite	P, FP, G	None required	Analyze within 15 minutes.
68. Surfactants	P, FP, G	Cool, ≤6 °C[18]	48 hours.
69. Temperature	P, FP, G	None required	Analyze.
73. Turbidity	P, FP, G	Cool, ≤6 °C[18]	48 hours.

[1]"P" is for polyethylene; "FP" is fluoropolymer (polytetrafluoroethylene (PTFE); Teflon®), or other fluoropolymer, unless stated otherwise in this Table II; "G" is glass; "PA" is any plastic that is made of a sterilizable material (polypropylene or other autoclavable plastic), "LDPE" is low density polyethylene.

[2]Except where noted in this Table II and the method for the parameter, preserve each grab sample within 15 minutes of collection. For a composite sample collected with an automated sample (e.g., using a 24-hour composite sample; see 40 CFR 122.21(g)(7)(i) or 40 CFR Part 403, Appendix E), refrigerate the sample at ≤6 °C during collection unless specified otherwise in this Table II or in the method(s). For a composite sample to be split into separate aliquots for preservation and/or analysis, maintain the sample at ≤6 °C, unless specified otherwise in this Table II or in the method(s), until collection, splitting, and preservation is completed. Add the preservative to the sample container prior to sample collection when the preservative will not compromise the integrity of a grab sample, a composite sample, or aliquot split from a

composite sample within 15 minutes of collection. If a composite measurement is required but a composite sample would compromise sample integrity, individual grab samples must be collected at prescribed time intervals (e.g., 4 samples over the course of a day, at 6-hour intervals). Grab samples must be analyzed separately and the concentrations averaged. Alternatively, grab samples may be collected in the field and composited in the laboratory if the compositing procedure produces results equivalent to results produced by arithmetic averaging of results of analysis of individual grab samples. For examples of laboratory compositing procedures, see EPA Method 1664 Rev. A (oil and grease) and the procedures at 40 CFR 141.34(f)(14)(iv) and (v) (volatile organics).

[3]When any sample is to be shipped by common carrier or sent via the U.S. Postal Service, it must comply with the Department of Transportation Hazardous Materials Regulations (49 CFR part 172). The person offering such material for transportation is responsible for ensuring such compliance. For the preservation requirement of Table II, the Office of Hazardous Materials, Materials Transportation Bureau, Department of Transportation has determined that the Hazardous Materials Regulations do not apply to the following materials: Hydrochloric acid (HCl) in water solutions at concentrations of 0.04% by weight or less (pH about 1.96 or greater; Nitric acid (HNO_3) in water solutions at concentrations of 0.15% by weight or less (pH about 1.62 or greater); Sulfuric acid (H_2SO_4) in water solutions at concentrations of 0.35% by weight or less (pH about 1.15 or greater); and Sodium hydroxide (NaOH) in water solutions at concentrations of 0.080% by weight or less (pH about 12.30 or less).

[4]Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before the start of analysis and still be considered valid. Samples may be held for longer periods only if the permittee or monitoring laboratory has data on file to show that, for the specific types of samples under study, the analytes are stable for the longer time, and has received a variance from the Regional Administrator under Sec. 136.3(e). For a grab sample, the holding time begins at the time of collection. For a composite sample collected with an automated sampler (e.g., using a 24-hour composite sampler; see 40 CFR 122.21(g)(7)(i) or 40 CFR part 403, Appendix E), the holding time begins at the time of the end of collection of the composite sample. For a set of grab samples composited in the field or laboratory, the holding time begins at the time of collection of the last grab sample in the set. Some samples may not be stable for the maximum time period given in the table. A permittee or monitoring laboratory is obligated to hold the sample for a shorter time if it knows that a shorter time is necessary to maintain sample stability. See 136.3(e) for details. The date and time of collection of an individual grab sample is the date and time at which the sample is collected. For a set of grab samples to be composited, and that are all collected on the same calendar date, the date of collection is the date on which the samples are collected. For a set of grab samples to be composited, and that are collected across two calendar dates, the date of collection is the dates of the two days; e.g., November 14-15. For a composite sample collected automatically on a given date, the date of collection is the date on which the sample is collected. For a composite sample collected automatically, and that is collected across two calendar dates, the date of collection is the dates of the two days; e.g., November 14-15. For static-renewal toxicity tests, each grab or composite sample may also be used to prepare test solutions for renewal at 24 h, 48 h, and/or 72 h after first use, if stored at 0-6 °C, with minimum head space.

[5]ASTM D7365-09a specifies treatment options for samples containing oxidants (e.g., chlorine). Also, Section 9060A of Standard Methods for the Examination of Water and Wastewater (20th and 21st editions) addresses dechlorination procedures.

[6]Sampling, preservation and mitigating interferences in water samples for analysis of cyanide are described in ASTM D7365-09a. There may be interferences that are not mitigated by the analytical test methods or D7365-09a. Any technique for removal or suppression of interference may be employed, provided the laboratory demonstrates that it more accurately measures cyanide through quality control measures described in the analytical test method. Any removal or suppression technique not described in D7365-09a or the analytical test method must be documented along with supporting data.

[7]For dissolved metals, filter grab samples within 15 minutes of collection and before adding preservatives. For a composite sample collected with an automated sampler (e.g., using a 24-hour composite sampler; see 40 CFR 122.21(g)(7)(i) or 40 CFR Part 403, Appendix E), filter the sample within 15 minutes after completion of collection and before adding preservatives. If it is known or suspected that dissolved sample integrity will be compromised during collection of a composite sample collected automatically over time (e.g., by interchange of a metal between dissolved and suspended forms), collect and filter grab samples to be composited (footnote 2) in place of a composite sample collected automatically.

[8]Guidance applies to samples to be analyzed by GC, LC, or GC/MS for specific compounds.

[9]If the sample is not adjusted to pH 2, then the sample must be analyzed within seven days of sampling.

[10]The pH adjustment is not required if acrolein will not be measured. Samples for acrolein receiving no pH adjustment must be analyzed within 3 days of sampling.

[11]When the extractable analytes of concern fall within a single chemical category, the specified preservative and maximum holding times should be observed for optimum safeguard of sample integrity (*i.e.*, use all necessary preservatives and hold for the shortest time listed). When the analytes of concern fall within two or more chemical categories, the sample may be preserved by cooling to ≤6 °C, reducing residual chlorine with 0.008% sodium thiosulfate, storing in the dark, and adjusting the pH to 6-9; samples preserved in this manner may be held for seven days before extraction and for forty days after extraction. Exceptions to this optional preservation and holding time procedure are noted in footnote 5 (regarding the requirement for thiosulfate reduction), and footnotes 12, 13 (regarding the analysis of benzidine).

[12]If 1,2-diphenylhydrazine is likely to be present, adjust the pH of the sample to 4.0 ±0.2 to prevent rearrangement to benzidine.

[13]Extracts may be stored up to 30 days at <0 °C.

[14]For the analysis of diphenylnitrosamine, add 0.008% $Na_2S_2O_3$ and adjust pH to 7-10 with NaOH within 24 hours of sampling.

[15]The pH adjustment may be performed upon receipt at the laboratory and may be omitted if the samples are extracted within 72 hours of collection. For the analysis of aldrin, add 0.008% $Na_2S_2O_3$.

[16]Place sufficient ice with the samples in the shipping container to ensure that ice is still present when the samples arrive at the laboratory. However, even if ice is present when the samples arrive, immediately measure the temperature of the samples and confirm that the preservation temperature maximum has not been exceeded. In the isolated cases where it can be documented that this holding temperature cannot be met, the permittee can be given the option of on-site testing or can request a variance. The request for a variance should include supportive data which show that the toxicity of the effluent samples is not reduced because of the increased holding temperature. Aqueous samples must not be frozen. Hand-delivered samples used on the day of collection do not need to be cooled to 0 to 6 °C prior to test initiation.

[17]Samples collected for the determination of trace level mercury (<100 ng/L) using EPA Method 1631 must be collected in tightly-capped fluoropolymer or glass bottles and preserved with BrCl or HCl solution within 48 hours of sample collection. The time to preservation may be extended to 28 days if a sample is oxidized in the sample bottle. A sample collected for dissolved trace level mercury should be filtered in the laboratory within 24 hours of the time of collection. However, if circumstances preclude overnight shipment, the sample should be filtered in a designated clean area in the field in accordance with procedures given in Method 1669. If sample integrity will not be maintained by shipment to and filtration in the laboratory, the sample must be filtered in a designated clean area in the field within the time

period necessary to maintain sample integrity. A sample that has been collected for determination of total or dissolved trace level mercury must be analyzed within 90 days of sample collection.

[18]Aqueous samples must be preserved at ≤6 °C, and should not be frozen unless data demonstrating that sample freezing does not adversely impact sample integrity is maintained on file and accepted as valid by the regulatory authority. Also, for purposes of NPDES monitoring, the specification of "≤°C" is used in place of the "4 °C" and "<4 °C" sample temperature requirements listed in some methods. It is not necessary to measure the sample temperature to three significant figures (1/100th of 1 degree); rather, three significant figures are specified so that rounding down to 6 °C may not be used to meet the ≤6 °C requirement. The preservation temperature does not apply to samples that are analyzed immediately (less than 15 minutes).

[19]An aqueous sample may be collected and shipped without acid preservation. However, acid must be added at least 24 hours before analysis to dissolve any metals that adsorb to the container walls. If the sample must be analyzed within 24 hours of collection, add the acid immediately (see footnote 2). Soil and sediment samples do not need to be preserved with acid. The allowances in this footnote supersede the preservation and holding time requirements in the approved metals methods.

[20]To achieve the 28-day holding time, use the ammonium sulfate buffer solution specified in EPA Method 218.6. The allowance in this footnote supersedes preservation and holding time requirements in the approved hexavalent chromium methods, unless this supersession would compromise the measurement, in which case requirements in the method must be followed.

[21]Holding time is calculated from time of sample collection to elution for samples shipped to the laboratory in bulk and calculated from the time of sample filtration to elution for samples filtered in the field.

[22]Sample analysis should begin as soon as possible after receipt; sample incubation must be started no later than 8 hours from time of collection.

[23]For fecal coliform samples for sewage sludge (biosolids) only, the holding time is extended to 24 hours for the following sample types using either EPA Method 1680 (LTB-EC) or 1681 (A-1): Class A composted, Class B aerobically digested, and Class B anaerobically digested.

[24]The immediate filtration requirement in orthophosphate measurement is to assess the dissolved or bio-available form of orthophosphorus (*i.e.*, that which passes through a 0.45-micron filter), hence the requirement to filter the sample immediately upon collection (*i.e.*, within 15 minutes of collection).

[38 FR 28758, Oct. 16, 1973

NOTES:

1. PARCEL DATA FOR THE SITE WAS OBTAINED FROM DUKE ENERGY REAL ESTATE AND IS APPROXIMATE.
2. ASH BASIN, ASH LANDFILL, AND STRUCTURAL FILL WASTE BOUNDARIES ARE APPROXIMATE.
3. AS-BUILT MONITORING WELL LOCATIONS PROVIDED BY DUKE ENERGY.
4. SHALLOW MONITORING WELLS (S) - WELL SCREEN INSTALLED ACROSS THE SURFICIAL WATER TABLE.
5. DEEP MONITORING WELLS (D) - WELL SCREEN INSTALLED IN THE TRANSITION ZONE BETWEEN COMPETENT BEDROCK AND THE REGOLITH.
6. ORTHOPHOTOGRAPHY WAS OBTAINED FROM NC ONEMAP GIS WEB SITE (DATED 2010).
7. TOPOGRAPHIC CONTOURS WERE OBTAINED FROM NCDOT WEB SITE (DATED 2010) AND ARE APPROXIMATE.
8. THE ASH BASIN COMPLIANCE BOUNDARY IS ESTABLISHED ACCORDING TO THE DEFINITION FOUND IN 15A NCAC 02L .0107 (a).
9. HYDROGRAPHY WAS OBTAINED FROM THE USGS NATIONAL MAP VIEWER AND DOWNLOAD PLATFORM ON MARCH 28, 2014 (http://nationalmap.gov/viewer.html)
10. SEEP SAMPLING LOCATIONS ARE APPROXIMATE.
11. NPDES OUTFALL AND WATER QUALITY SAMPLE LOCATIONS PROVIDED BY DUKE ENERGY.

SCALE (FEET)

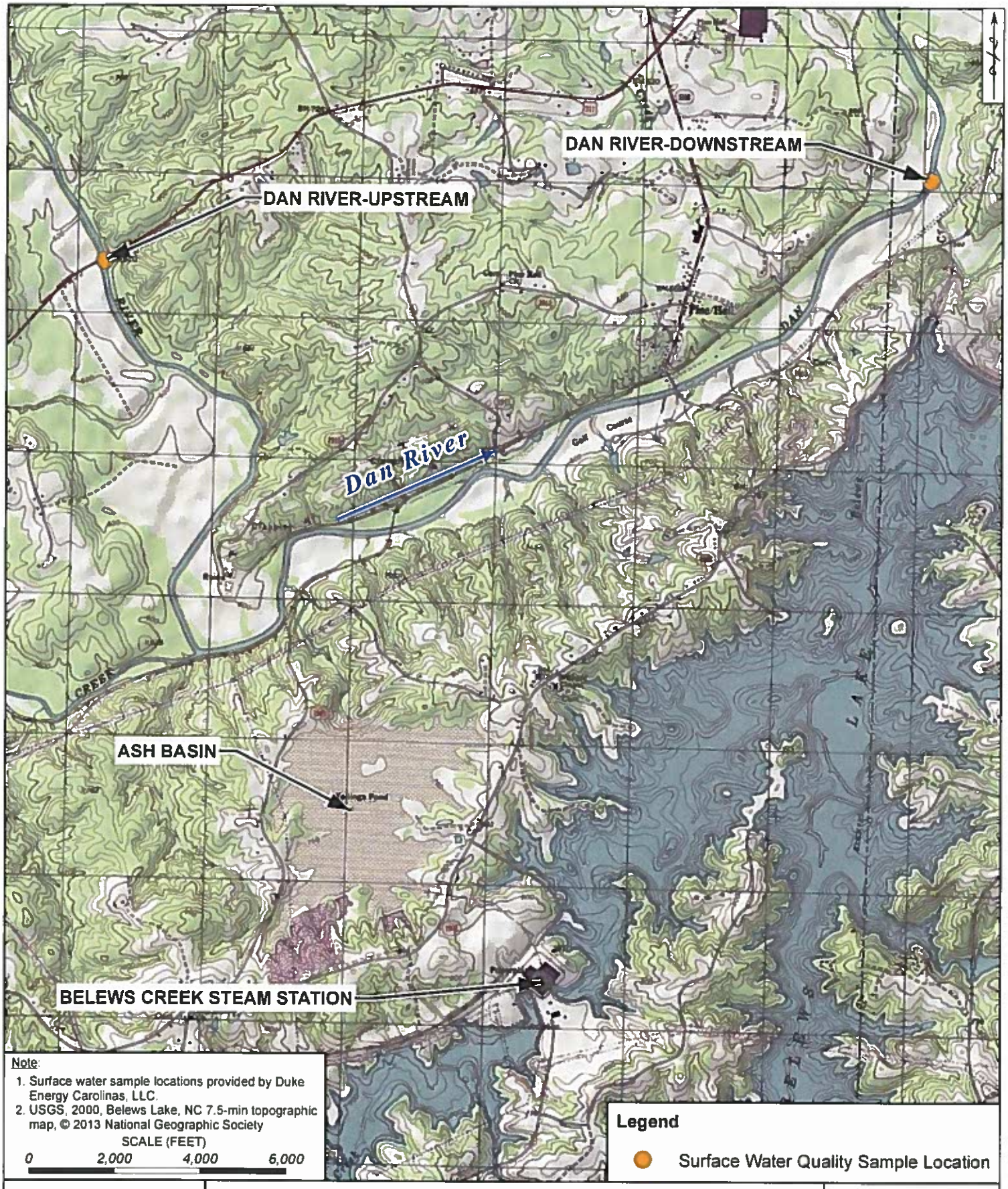
600' 0 600' 1,200'

1" = 1,200'

IDENTIFIED SEEPS AND WATER QUALITY SAMPLE LOCATION MAP
DUKE ENERGY CAROLINAS, LLC
BELEWS CREEK STEAM STATION ASH BASIN
NPDES PERMIT #NC0024406
STOKES COUNTY, NORTH CAROLINA

DATE
JULY 23, 2014

FIGURE
1



Note:

1. Surface water sample locations provided by Duke Energy Carolinas, LLC.
2. USGS, 2000, Belews Lake, NC 7.5-min topographic map, © 2013 National Geographic Society

SCALE (FEET)

0 2,000 4,000 6,000

Legend

Surface Water Quality Sample Location

HDR

License Number F-0116
440 South Church Street Charlotte NC 28202

SURFACE WATER QUALITY SAMPLE LOCATION MAP
BELEWS CREEK STEAM STATION
DUKE ENERGY CAROLINAS, LLC
STOKES COUNTY, NORTH CAROLINA

DATE

July 31, 2014

FIGURE

2

Belews Creek Ash Basin (NPDES Permit NC0024406)
Groundwater Monitoring Program
Reports and Recommendations

Groundwater monitoring is conducted around the ash basin system at the Belews Creek Steam Station under NPDES Permit NC0024406. The following items are presented to describe potential on-site and off-site receptors, the nature of the groundwater flow regime around the Belews Creek site, and the Belews Creek groundwater monitoring program.

- **Item 1** - Receptor Survey Belews Creek Steam Station Ash Basin
- **Item 2** - Generalized Groundwater Flow Direction Figure
- **Item 3** - Groundwater Monitoring Program Sampling, Analysis, and Reporting Plan

The referenced items and documents are included to describe the current state of the groundwater monitoring program and any changes to the existing monitoring plan. Changes to the current program (including installation of additional observation or monitoring wells) which are proposed by Duke Energy in the future may be allowed following consultation with NC DENR and should not require a re-opening of the Belews Creek NPDES permit.

Item 1 - Receptor Survey Belews Creek Steam Station Ash Basin

A receptor survey has been completed to identify private water supply wells, public water supplies, surface water bodies, and wellhead protection areas (if present) within a 0.5-mile radius of the Belews Creek ash basin compliance boundary. The report presents the methodology and findings of the survey. This report is included as Enclosure 1.

Item 2 - Generalized Groundwater Flow Direction Figure

The Belews Creek ash basin site and the generalized groundwater flow directions for the shallow water table are presented in a figure contained in Enclosure 2. The figure presents the generalized groundwater flow direction around the ash basin with arrows depicting probable generalized groundwater flow directions for the shallow water table. These generalized flow directions were developed based on the site hydrogeologic conceptual groundwater flow model, site topography, and historic site groundwater elevation data.

Item 3 - Groundwater Monitoring Program Sampling, Analysis, and Reporting Plan

The groundwater monitoring program sampling, analysis, and reporting plan (Plan) was developed to support the requirement for groundwater monitoring around the Belews Creek ash

basin. The Plan describes the groundwater monitoring network, methodologies of field sampling, record-keeping protocols, analytical procedures, data quality objectives, data validation, and reporting that will be used to support the Belews Creek ash basin groundwater monitoring program. This document is included as Enclosure 3.

As stated in the Plan, it is recommended that sample reporting requirements be changed to require reporting within 60 days of the date of sample collection. It is recommended that the compliance monitoring wells at the Belews Creek site continue to be sampled at a frequency of three times per year and analyzed for the same constituents that have been historically analyzed for the NPDES-required groundwater monitoring.

We also plan to develop a groundwater flow model of the site predicting expected groundwater flow paths from areas around the ash pond to the appropriate receiving water body. The groundwater flow model would be used to verify the current understanding of the groundwater flow directions at the site and could be used to evaluate exceedances if any are found to be related to impacts from the ash basin. We propose that model will be developed and the groundwater flow modeling report be submitted to NCDENR within 120 days of the NPDES permit being issued. As plans are made to develop the groundwater flow model, the installation of additional observation wells in or around the ash basin system may be beneficial to enhance the model. If Duke's evaluation deems additional observation wells to be beneficial, we will communicate our recommendations to NCDENR prior to well installation.

NCDENR Aquifer Protection Section (APS) developed a policy for compliance evaluation of groundwater results at ash basins with no prior groundwater monitoring and published a memorandum providing that policy on June 17, 2011. The memorandum titled *Policy for Compliance Evaluation of Long-Term Permitted Facilities with No Prior Groundwater Monitoring Requirements* outlined the process for evaluating compliance of groundwater monitoring results based on the requirements in 15A NCAC 2L .0106.

The memorandum acknowledges the factors that monitoring well placement and existing conditions at the ash basins have on determination of exceedances of 2L Standards in groundwater monitoring results at ash basins.

The memorandum included a flow chart showing the process for determining if a measured groundwater concentration greater than 15A NCAC 02L .0202 would cause the facility to be non-compliant and would result in implementation of corrective action.

Duke recommends continued utilization of the June 17, 2011, NCDENR memorandum to evaluate exceedances of 2L Standards at the Belews Creek ash basin. For exceedances that are

not the result of naturally occurring site conditions, the process prescribed in the memorandum requires the permittee to comply with corrective action requirements as specified in 15A NCAC 02L .0106.

Enclosures: Enclosure 1 – Receptor Survey Belews Creek Steam Station Ash Basin
Enclosure 2 – Generalized Groundwater Flow Direction Figure
Enclosure 3 – Groundwater Monitoring Program Sampling, Analysis, and Reporting Plan

Enclosure 1

Receptor Survey

Belews Creek Ash Basin System

(NPDES Permit NC0024406)

RECEPTOR SURVEY
BELEWS CREEK STEAM STATION ASH BASIN
NPDES PERMIT NC0024406

Belews Creek Steam Station
3195 Pine Hall Road
Belews Creek, North Carolina

Prepared for:
DUKE ENERGY CAROLINAS, LLC
Charlotte, North Carolina

Prepared by:
HDR ENGINEERING, INC. OF THE CAROLINAS
Charlotte, North Carolina

July 31, 2014

REPORT VERIFICATION

PROJECT: **RECEPTOR SURVEY**
BELEWS CREEK STEAM STATION ASH BASIN
NPDES PERMIT NC0024406

This document has been reviewed for accuracy and quality commensurate with the intended application.

Prepared by: _____ Date: 7/31/14

Checked by: _____ Date: 7/31/2014

Approved by: _____ Date: 7/31/2014

Project Manager: Brooke Ahrens, PE

RECEPTOR SURVEY
BELEWS CREEK STEAM STATION ASH BASIN
NPDES PERMIT NC0024406

TABLE OF CONTENTS

Section 1
Introduction

Duke Energy Carolinas, LLC's (Duke Energy) owns and operates Belews Creek Steam Station (BCSS) located on Belews Lake in Stokes County at 3195 Pine Hall Road, Belews Creek, North Carolina (Figure 1). The station generates electricity from combustion of coal. BCSS began operation in 1974.

Coal ash residue from BCSS's coal combustion process has historically been disposed in the BCSS ash basin located across Pine Hall Rd to the northwest of the station. The ash basin currently receives waste streams from the BCSS power house and yard holding sumps, ash sluice lines (mostly sluiced bottom ash), chemical holding pond, coal yard sumps, stormwater and remediated groundwater, and treated FGD wastewater. The discharge from the ash basin is permitted by the North Carolina Department of Environment and Natural Resources (NCDENR) Division of Water Resources (DWR) under the National Pollutant Discharge Elimination System (NPDES) Permit NC0024406.

HDR Engineering, Inc. of the Carolinas (HDR) has completed a receptor survey to identify water supply wells, public water supplies, surface water bodies, and wellhead protection areas (if present) within a 0.5 mile radius of the BCSS ash basin compliance boundary (Figure 1). The compliance boundary for groundwater quality in relation to the ash basin is defined in accordance with 15A NCAC 02L .0107(a) as being established at either 500 feet from the waste boundary or at the property boundary, whichever is closer to the source.

The receptor survey activities performed and the findings of those activities are presented in Sections 3 and 4, respectively.

Section 2
Background

2.1 Plant and Ash Basin Description

BCSS is a two-unit coal-fired electricity generating facility with a capacity of 2,240 megawatts located on Belews Lake in Stokes County at 3195 Pine Hall Road, Belews Creek, North Carolina. The ash basin is located along Pine Hall Road and is situated between mostly vacant and residential properties (located along Middleton Loop), the Dan River, and Belews Lake. Pine Hall Road generally runs from southwest to northeast in the vicinity of the site, to the south and east of the ash basin. Middleton Loop runs along the west and north boundaries of the ash basin, and is located along a topographic divide. The topography at the site generally slopes downward from Middleton Loop toward the Dan River.

The ash basin system consists of a single cell, impounded by an earthen dike, located on the north end of the ash basin. The ash basin was constructed in 1970-1972 and it is located approximately 3,200 feet northwest of the station.

The ash basin system is an integral part of the station's wastewater treatment system. The ash basin receives inflows from the station's ash removal system, station yard drain sump, stormwater flows, and station wastewater.

The discharge from the ash basin is through a concrete discharge tower located in the northwest portion of the ash basin. The concrete discharge tower drains through 24-inch diameter SDR 17 HDPE conduit into a concrete flume box and into a small stream which flows northward to the Dan River.

2.2 Description of Surrounding Properties

Properties located within 0.5 miles of the BCSS ash basin compliance boundary generally consist of residential properties located to the northeast, north, west and southwest. Duke Energy

property is located to the north, northwest, south and east with Belews Lake beyond to the south and east. Figure 1 shows the properties surrounding the ash basin.

Section 3
Receptor Survey Activities

3.1 NCDENR Records Review

HDR reviewed the NCDENR Department of Environmental Health (DEH) Public Water Supply Section's (PWSS) Public Water Supply Water Sources Geographic Information System (GIS) point data set (pwsws.shp) obtained from the NC OneMap GeoSpatial Portal (http://data.nconemap.com/geoportal/catalog/main/home.page) to identify public water supply sources within a 0.5 mile radius of the BCSS ash basin compliance boundary.

On April 17, 2014, HDR reviewed the NCDENR Division of Water Resources (DWR) Source Water Assessment Program (SWAP) online database for public water supply sources to identify wells located within a 0.5 mile radius of the ash basin compliance boundary, to confirm the location of wells included in the Public Water Supply Water Sources GIS point data set, and to identify wellhead protection areas located within a 0.5 mile radius of the compliance boundary. The NCDENR SWAP database provides detailed assessments of all public drinking water intakes and wellhead protection areas in North Carolina. The website address is: (http://swap.ncwater.org/website/swap/viewer.htm).

On May 27, 2014, Mr. Chad Hearn with HDR contacted Mr. Sean McGuire, GIS Specialist with the NCDENR PWSS, by telephone. Mr. McGuire stated that as of May 27, 2014, the data contained in the Public Water Supply Water Sources GIS point data set obtained from the NC OneMap GeoSpatial Portal was current through November 18, 2009, and that it is the most current GIS data set of public water supply locations available from North Carolina state agencies. The GIS point data for the public water supply wells includes but is not limited to information such as public water supply (PWS) system identification numbers, ownership information, PWS source type, well depth, and well yield.

Mr. McGuire indicated the Public Water Supply Water Sources GIS point data set and the SWAP online database are scheduled to be updated and released to the public by July 2014. As

of the date of this report, the Public Water Supply Water Sources GIS point data set and the SWAP online database were not updated. HDR recommends review of the data set and database once they are made available.

3.2 Stokes County Records Review

HDR contacted the Stokes County Environmental Health Department to inquire about the location and details (if available) for recorded private water supply wells located in Stokes County within a 0.5 mile radius of the ash basin compliance boundary. On May 28, 2014, Mr. Chad Hearn of HDR contacted Ms. Leslie Easter with the Stokes County Environmental Health Department. Ms. Easter indicated that Stokes County began collecting well record information for private water supply wells in September 2000. Ms. Easter provided well record information for eight wells located within a 0.5 radius of the compliance boundary.

In addition, Ms. Easter indicated that municipal water service is not available within a 0.5 mile radius of the ash basin compliance. Ms. Easter indicated that the Town of Walnut Cove is the closest municipal water service to properties located within a 0.5 mile radius of the ash basin compliance boundary.

3.3 Utility Department Records Review

HDR contacted the Town of Walnut Cove Water & Sewer Department to inquire about the availability of municipal water supply to properties located in Stokes County within a 0.5 mile radius of the ash basin compliance boundary. On April 22, 2014, Mr. Chad Hearn of HDR spoke with Ms. Brandy of the Town of Walnut Cove Water & Sewer Department, by telephone. Ms. Brandy indicated that the Town of Walnut Cove does not provide municipal water supply to properties located within a 0.5 mile radius of the ash basin compliance boundary.

3.4 HDR Field Survey

HDR personnel performed a field reconnaissance on April 18, 2014 to identify water supply wells and surface waters located within a 0.5 mile radius of the ash basin compliance boundary.

A windshield survey was conducted from public roadways to identify water meters, valves, and potential well heads/well houses. Prior to conducting the field reconnaissance, HDR personnel reviewed orthophotography obtained from NC OneMap GeoSpatial portal (dated 2010) to identify potential well heads/well houses and surface waters within a 0.5 mile radius of the ash basin compliance boundary.

In addition, HDR personnel contacted Duke Energy site personnel to identify the water supply source(s) for BCSS.

3.5 USGS Hydrography Review

HDR reviewed the United States Geological Survey (USGS) National Hydrography Dataset (NHD) obtained from the USGS National Map Viewer (http://viewer.nationalmap.gov/viewer/) to identify surface waters within 0.5 miles of the ash basin compliance boundary. Hydrography data obtained from the USGS NHD is included on Figure 1.

Section 4
Findings

Details of the findings from the local and state records review and field survey activities are provided in Sections 4.1 through 4.4. A general summary of the receptor survey findings is provided in Section 4.5.

4.1 NCDENR Records

One public water supply well was identified in the Public Water Supply Water Sources GIS point data set (obtained from NC OneMap GeoSpatial Portal) and on the NCDENR SWAP online database within a 0.5 mile radius of the ash basin compliance boundary. This well is identified with PWS preceding the Public Water Supply System ID Number (PWS: 0285432). The location of the well is identified on Figure 1. Available information for the well is provided in Table 1.

No wellhead protection areas were identified on the NCDENR SWAP online database within a 0.5 mile radius of the ash basin compliance boundary.

4.2 Stokes County Records

The Stokes County Environmental Health Department has record of eight private water supply wells located within a 0.5 mile radius of the ash basin compliance boundary. These wells are identified with PRW preceding the identification number as it is referenced to available well information provided in Table 1. The approximate locations of these wells are identified on Figure 1 as "recorded" private water supply wells.

4.3 Utility Department Records

Ms. Brandy with the Town of Walnut Cove indicated that the Town of Walnut Cove does not provide water service to the properties located within a 0.5 mile radius of the ash basin compliance boundary, and that the properties likely have private water supply wells.

4.4 HDR Field Survey Findings

During the field reconnaissance, HDR field personnel identified 28 private water supply wells at properties located within a 0.5 mile radius of the ash basin compliance boundary. The wells are included on Figure 1 as "field identified" private water supply wells.

Stokes County had records for 4 of the 28 wells identified during the field reconnaissance (PRW-2, PRW-4, PRW-7, and PRW-8). The other 4 wells (PRW-1, PRW-3, PRW-5, and PRW-6) Stokes County had records for were not able to be confirmed in the field. The 8 wells that Stokes County had records for are included on Figure 1 as "recorded" private water supply wells, and general well and property information is included in Table 1.

The location of the one public water supply well included in NCDENR's records and located within a 0.5 mile radius of the compliance boundary was confirmed in the field.

For properties where the structures and potential wells were not visible from a public right-of-way and Stokes County did not have records for water supply wells, HDR was not able to confirm the location or presence of a well. Based on the lack of municipal water supply in the area, it is assumed these properties contain private water supply wells. Approximate locations based on structures identified during the field reconnaissance and/or orthophotography review are included on Figure 1 as "assumed" private water supply wells. A total of 14 assumed private water supply wells are located within a 0.5 mile radius of the ash basin compliance boundary.

Duke Energy personnel indicated that no active water supply wells are present on Duke Energy's property. The City of Winston Salem provides municipal water supply to the station, which is piped from south of the plant along Craig Road to the main powerhouse building.

From the public roadway, HDR personnel did not observe indications of municipal water supply for the properties located within a 0.5 mile radius of the ash basin compliance boundary.

Several surface water bodies were identified and/or confirmed during HDR's field reconnaissance. The surface water bodies located within a 0.5 mile radius of the ash basin

compliance boundary generally flow toward Belews Lake to the east and the Dan River to the north, south, and west.

4.5 Summary of Receptor Survey Findings

A summary of the receptor survey findings is provided below. The approximate location of water supply wells and surface water bodies are shown on Figure 1. Available property and well information for the 8 private water supply wells recorded with Stokes County and the 1 identified public water supply well are provided in Table 1.

- A total of 32 private water supply wells were identified within a 0.5 mile radius of the ash basin compliance boundary. The Stokes County Environmental Health Department had records for 8 of the 32 private water supply wells.
- Fourteen additional private water supply wells are assumed at residences located within a 0.5 mile radius of the ash basin compliance boundary.
- One public water supply well was identified within a 0.5 mile radius of the ash basin compliance boundary.
- Several surface water bodies that flow from the topographic divide along Middleton Loop toward the Dan River were identified within a 0.5 mile radius of the ash basin.
- No wellhead protection areas were identified within a 0.5 mile radius of the ash basin compliance boundary.

FIGURES

NOTES:
1. PARCEL DATA FOR THE SITE WAS OBTAINED FROM DUKE ENERGY REAL ESTATE AND IS APPROXIMATE.
2. ASH BASIN WASTE BOUNDARY IS APPROXIMATE.
3. ORTHOPHOTOGRAPHY WAS OBTAINED FROM NC ONEMAP GIS WEB SITE (DATED 2010).
4. THE COMPLIANCE BOUNDARY IS ESTABLISHED ACCORDING TO THE DEFINITION FOUND IN 15A NCAC 02L .0107 (a).
5. FIELD IDENTIFIED WELLS WERE OBSERVED DURING HDR'S FIELD RECONNAISSANCE PERFORMED ON APRIL 18, 2014.
6. RECORDED WELLS ARE BASED ON INFORMATION PROVIDED BY STOKES COUNTY ENVIRONMENTAL HEALTH DEPARTMENT.
7. ASSUMED PRIVATE WELLS ARE APPROXIMATE AND BASED ON THE PRESENCE OF A RESIDENCE AND LACK OF MUNICIPAL WATER SUPPLY IN THE AREA.
8. PUBLIC WELLS ARE BASED ON INFORMATION OBTAINED FROM NCDENR'S PUBLIC WATER SUPPLY WELL DATABASE PROVIDED TO HDR ON JULY 11, 2014.
9. HYDROGRAPHY WAS OBTAINED FROM THE USGS NATIONAL MAP VIEWER AND DOWNLOAD PLATFORM ON MARCH 28, 2014 (http://nationalmap.gov/viewer.html)

SCALE (FEET)
700' 0 700' 1,400'
1" = 1,400'

License Number: F-0116
440 South Church Street Charlotte, NC 28202

RECEPTOR SURVEY MAP
DUKE ENERGY CAROLINAS, LLC
BELEWS CREEK STEAM STATION ASH BASIN
NPDES PERMIT #NC0024406
STOKES COUNTY, NORTH CAROLINA

DATE
JULY 31, 2014

FIGURE
1

TABLES

Table 1
Public and Private Water Supply Wells
Within 0.5-Mile Radius of Belews Creek Ash Basin Compliance Boundary
Duke Energy Carolinas, LLC/Belews Creek Steam Station

Well ID (shown on Figure 1)	Public Water System Name	Well Owner/ User	Property Address (well location)	Parcel ID Number	Reported Well Use	Approximate Distance from Ash Basin Compliance Boundary (ft)	Direction from Ash Basin	Well Depth (ft-bgs)	Well Casing Depth (ft-bgs)	Well Yield (gpm)
PWS: 0285432	Withers Chapel UMC	Withers Chapel UMC 285432 (owner and user)	2793 Pine Hall Rd Pine Hall, NC 27042	6982-00-79-8715	Transient, Non-Community	1,350	NE	N/A	N/A	40
PRW-1	N/A	Mark C. Durrett (owner)	Across street from Withers Chapel UMC Pine Hall Rd Walnut Cove, NC 27052	6982-00-79-4809	Domestic	1,180	NE	N/A	N/A	N/A
PRW-2	N/A	Dan T. and Karen A. Westmoreland (owner)	1413 Middleton Loop Rd Walnut Cove, NC 27052	6982-00-06-5073	Domestic	160	W	185	40	50
PRW-3	N/A	James Michael Byrd (owner)	1184 Old Plantation Rd Walnut Cove, NC 27052	6972-00-94-8482	Domestic	1,210	SW	N/A	N/A	N/A
PRW-4	N/A	Toney Gray Wilson (owner)	1140 Old Plantation Rd Walnut Cove, NC 27052	6972-00-93-3833	Domestic	1,580	SW	N/A	N/A	N/A
PRW-5	N/A	Frank O. Sechrest (owner)	1051 Old Plantation Rd Walnut Cove, NC 27052	6972-00-83-5098	Domestic	2,170	SW	825	82	2
PRW-6	N/A	LCW Associates LLC (owner)	3946 Pine Hall Rd Walnut Cove, NC 27052	6972-00-93-5203	Domestic	1,550	SW	305	115	15
PRW-7	N/A	Jessica C. Baker (owner)	3951 Pine Hall Rd Walnut Cove, NC 27052	6972-00-92-8374	Domestic	1,520	SW	205	75	2
PRW-8	N/A	James T. Hairston (owner)	3854 Pine Hall Rd Walnut Cove, NC 27052	6982-00-03-5785	Domestic	630	SW	205	85	15

Notes:

1. Public water supply well (PWS) information obtained from NCDENR's Public Water Supply Water Sources Geographic Information System (GIS) point data set (last updated on November 18, 2009) and NCDENR's SWAP online database (reviewed on April 18, 2014).
2. Private water supply well (PRW) information obtained from the Stokes County Health Department's available records on May 29, 2014. (Note: Stokes County began obtaining well records in 2000.)
3. Owner and property address information for private water supply wells obtained from Stokes County Interactive GIS Website.
4. Distances between well and the ash basin compliance boundary are approximate and based on location information provided by NCDENR's data set, Stokes County GIS website, and the Stokes County Environmental Health Department records.
5. Transient, Non-Community Well serves 25+ people at least 60 days per year (e.g., restaurants, churches, DOT rest areas).
6. N/A indicates not available
7. ft-bgs indicates feet below ground surface
8. gpm indicates gallons per minute
9. N = North, S = South, E = East, W = West, NE = Northeast, SW = Southwest

Enclosure 2

Generalized Groundwater Flow Direction Figure

Belews Creek Ash Basin System

(NPDES Permit NC0024406)

July 31, 2014

Ms. Kim Hutchinson, P.E.
Duke Energy Carolinas, LLC
Mail Code EC13Z
P.O. Box 1006
Charlotte, NC 28201-1006

Via Email: kim.hutchinson@duke-energy.com

Subject: Generalized Groundwater Flow Directions Figure
Duke Energy Carolinas, LLC
Belews Creek Steam Station Ash Basin

Dear Ms. Hutchinson:

HDR is pleased to provide the attached figure presenting generalized groundwater flow directions for the shallow water table aquifer adjacent to the ash basin at the Duke Energy Carolinas, LLC (Duke Energy) Belews Creek Steam Station (BCSS).

This letter provides the background on the development of this information.

1.0 Background

Duke Energy owns and operates BCSS, a coal-fired electric generating station, located in Stokes County. BCSS uses an ash basin for disposal of ash generated by the coal combustion process and other water treatment at the coal-fired plant.

In 2011, Duke Energy provided Altamont Environmental, Inc. (Altamont) information on the groundwater monitoring wells installed at the ash basin and information on the water levels in the ash basin. Altamont utilized this information along with consideration of adjacent bodies of water and site topography to develop generalized groundwater direction flow arrows for the areas adjacent to the ash basins. This information was presented in the report titled *Generalized Groundwater Flow Direction Maps for Ash Basins, Duke Energy Carolinas, LLC, Fossil Stations, December 12, 2011*. The report contained figures with similar generalized groundwater flow arrows for all seven of the Duke Energy Carolinas fossil station ash basins. The report was prepared by Altamont staff and was sealed by William M. Miller, PE. The information from that report is used with the permission of Duke Energy.

As stated in Section 3.0 of the report:

> *The purpose of the Generalized Ash Basin Groundwater Flow Direction Maps, Figures 1 through 7, is to provide Duke with an interpretation of the generalized*

> *groundwater flow directions in the areas surrounding the ash basins. The maps were developed utilizing existing data that were readily available and with data collected as part of on-going monitoring at the ash basins. No additional field investigation was conducted as part of the development of the maps.*
>
> *The maps are not intended to provide absolute groundwater flow direction data at a specific location. Rather, they are an interpretation of the generalized groundwater flow direction for the shallow water table based on readily available data.*
>
> *As described in the following sections (Section 4.0, Section 5.0, and Section 6.0), there may be hydrogeologic conditions present at the ash basins that cause groundwater flow conditions to differ from the generalized groundwater flow directions shown on Figures 1 through 7.*

The generalized groundwater flow directions were determined based on a consideration of the information described above, most notably that the sites are located in the Piedmont physiographic province (Piedmont). In addition, the generalizations of typical Piedmont hydrogeology found in *A Master Conceptual Model for Hydrogeological Site Characterization in the Piedmont and Mountain Region of North Carolina* (LeGrand 2004) apply to these sites.

As stated in Section 5.0 of the report, the possible effects of pumping from adjacent water supply wells were not considered in the development of the generalized groundwater flow direction arrows.

The groundwater elevations used in development of the generalized groundwater direction flow arrows were from the compliance groundwater monitoring wells (compliance wells) - wells monitored in association with the National Pollution Discharge Elimination System (NPDES) permits - and from groundwater monitoring wells voluntarily (voluntary wells) installed by Duke Energy. No groundwater elevation data readings were performed on the voluntary wells after January 2012. The compliance wells were installed in 2010.

Section 7.0 of the Altamont report discusses the development of the generalized groundwater flow direction arrows and the relative level of confidence in the interpretation of the generalized flow direction. The text below was copied from that report:

> *Groundwater flow direction arrows are used to depict the interpreted direction of generalized groundwater flow. Three different colors of arrows were used to indicate the relative level of confidence in the interpretation of the generalized groundwater flow direction.*
>
> *The relative level of confidence in the interpretation of flow direction was determined by:*

- *The distance from groundwater monitoring wells or surface water elevation data*
- *The number of groundwater data elevation points utilized*
- *Consideration of the surface topography*

Descriptions of the relative confidence levels indicated by groundwater flow direction arrow colors are as follows:

- *Black arrows represent high confidence in the groundwater flow direction interpretation. The black arrows were used in areas in which there were several known groundwater or surface water elevation data points and the surface topography supported the interpretation of groundwater flow characteristic of typical Piedmont groundwater flow.*
- *Gray arrows represent moderate confidence in the groundwater flow direction interpretation. The gray arrows were used in areas where at least one groundwater or surface water elevation point was known or in areas where there was strong surface topographic data to support the groundwater flow direction interpretation.*
- *White arrows represent estimated groundwater flow direction interpretation. The white arrows were used in areas where there was little or no groundwater or surface water elevation data and there was not conclusive surface topographic data to support a gray arrow.*

2.0 Scope of HDR Review and Results

Since limited groundwater elevation data readings were performed on the voluntary wells after January 2012, HDR reviewed the historic groundwater level data available from the compliance groundwater monitoring wells in conjunction with the current approximate ash basin pond elevation data.

HDR found the generalized groundwater flow direction arrows presented in the Altamont report to generally represent the probable direction of groundwater flow for the shallow water table aquifer. As stated in the Altamont report, the generalized groundwater flow direction arrows present an interpretation of flow direction based on data from the shallow water table aquifer and do not consider the possible effects of pumping from adjacent water supply wells.

The ash basin pond elevation at BCSS is essentially unchanged from the ash basin pond elevation utilized in the Altamont report. Based on the topography of the site, the ash basin pond elevation, and the water levels measured in the compliance wells, it is unlikely that there would be a significant change in the direction of the groundwater flow as represented by the generalized groundwater flow direction arrows developed by Altamont.

The generalized groundwater flow directions for the area adjacent to the BCSS ash basin are found on the attached figure *Belews Creek Steam Station Ash Basin Figure BCSS-1*.

HDR appreciates the opportunity to provide continued support to Duke Energy. Should you have any questions regarding this submittal or need further information, please do not hesitate to contact me.

Respectfully submitted,

HDR Engineering, Inc. of the Carolinas

William M. Miller, P.E.
Senior Engineer

cc: Ty Ziegler, HDR
Scott Spinner, HDR

Attachments:

Belews Creek Steam Station Ash Basin Figure BCSS-1

GENERAL NOTES:
1. PARCEL DATA FOR THE SITE WAS OBTAINED FROM DUKE ENERGY REAL ESTATE AND IS APPROXIMATE.
2. ASH BASIN WASTE BOUNDARY, ASH LANDFILL LIMIT OF WASTE, AND STRUCTURAL FILL BOUNDARY ARE APPROXIMATE.
3. AS-BUILT MONITORING WELL LOCATIONS PROVIDED BY DUKE ENERGY.
4. SHALLOW MONITORING WELLS (S) - WELL SCREEN INSTALLED ACROSS THE SURFICIAL WATER TABLE.
5. DEEP MONITORING WELLS (D) - WELL SCREEN INSTALLED IN THE TRANSITION ZONE BETWEEN COMPETENT BEDROCK AND THE REGOLITH.
6. TOPOGRAPHY DATA FOR THE SITE WAS OBTAINED FROM NC DOT GEOGRAPHIC INFORMATION SYSTEM (GIS) WEB SITE.
7. ORTHOPHOTOGRAPHY WAS OBTAINED FROM NC ONEMAP GIS WEB SITE (DATED 2009).
8. THE ASH BASIN COMPLIANCE BOUNDARY IS ESTABLISHED ACCORDING TO THE DEFINITION FOUND IN 15A NCAC 02L .0107 (a).

SCALE (FEET)
500' 0 500' 1000'
1" = 1000'

North Carolina Engineering Firm Number: F-0116
440 South Church Street Charlotte, NC 28202

GENERALIZED GROUNDWATER FLOW DIRECTIONS
DUKE ENERGY CAROLINAS, LLC
BELEWS CREEK STEAM STATION ASH BASIN
NPDES PERMIT #NC0024406
STOKES COUNTY, NORTH CAROLINA

DATE
JULY 31, 2014

FIGURE
BCSS-1

Enclosure 3

Groundwater Monitoring Program Sampling, Analysis, and Reporting Plan

Belews Creek Ash Basin System

(NPDES Permit NC0024406)

Belews Creek Steam Station Ash Basin

Groundwater Monitoring Program Sampling, Analysis, and Reporting Plan

NPDES Permit NC0024406

July 31, 2014

Report Verification

PROJECT: **GROUNDWATER MONITORING PROGRAM**
BELEWS CREEK STEAM STATION
ASH BASIN
NPDES PERMIT NC0024406

TITLE: **GROUNDWATER MONITORING**
SAMPLING, ANALYSIS, AND REPORTING PLAN

This document has been reviewed for accuracy and quality commensurate with the intended application.

Prepared by: _____ Date: 7/31/2014

Checked by: _____ Date: 7/31/2014

Approved by: _____ Date: 7/31/2004

Project Manager: Brooke Ahrens, PE

Professional Geologist Seal:

HDR Engineering, Inc. of the Carolinas
440 South Church St., Suite 1000
Charlotte, NC 28202
North Carolina Geology License Number C-503

Table of Contents

Page

APPENDICES

List of Figures

List of Tables

Section 1 - Introduction

This Groundwater Monitoring Program Sampling, Analysis, and Reporting Plan (Plan) is developed to support the Duke Energy Carolinas, LLC (Duke Energy) requirement for groundwater monitoring around the Belews Creek Steam Station (BCSS) ash basin operated under National Pollution Discharge Elimination System (NPDES) Permit NC0024406.

This Plan describes the groundwater monitoring network, methodologies of field sampling, record-keeping protocols, laboratory analytical methods, data quality objectives, data validation, and reporting that will be used for the BCSS ash basin groundwater monitoring program.

Section 2 - Site Description

2.1 Plant Description

BCSS is a coal-fired electricity-generating facility with a capacity of 2,240 megawatts located on Belews Lake in Stokes County, North Carolina. BCSS is a two-unit station which began commercial operation in 1974. Belews Creek, a tributary of the Dan River, was impounded by Duke Energy (formerly Duke Power at the time of initial impoundment) to form Belews Lake. Belews Lake is approximately 3,800 acres in area and provides cooling water for the station.

2.2 Ash Basin Description

The coal ash residue from the coal combustion process has historically been disposed of in the BCSS ash basin. The ash basin currently receives waste streams from the BCSS power house and yard holding sumps, ash sluice lines (mostly bottom ash), chemical holding pond, coal yard sumps, stormwater, and treated FGD wastewater. The discharge from the ash basin is permitted by the North Carolina Department of Environment and Natural Resources (NCDENR) Department of Water Resources (DWR) under NPDES Permit NC0024406.

The ash basin system consists of a single cell impounded by an earthen dike located on the north end of the ash basin. The ash basin system was constructed from 1970-1972 and it is located approximately 3,200 feet northwest of the power plant. The waste boundary for the ash basin encompasses approximately 342 acres.

The approximate full pond elevation for the BCSS ash basin is 750 feet. The normal pond elevation of Belews Lake is approximately 725 feet. Figure 2 is shown with an ash basin elevation at 748 feet.

Due to the nature of BCSS operations, inflows to the ash basin are highly variable. The inflows from the station to the ash basin are discharged to the southeast portion of the ash basin. The ash basin pond elevation is controlled by the use of concrete stop logs. The discharge from the ash basin is through a concrete discharge tower located in the northwest portion of the ash basin. The concrete discharge tower drains through a 24-inch-diameter SDR 17 HDPE conduit for approximately 1,600 feet and then discharges into a concrete flume box. The discharge is to an un-named tributary that flows northward to the Dan River.

Section 3 - Site Geology and Hydrogeology

3.1 Geologic/Soil Framework

BCSS and its associated ash basin system are located in the Milton Belt of the Piedmont physiographic province (Piedmont), one of several northeast-trending geologic belts of the southern crystalline Appalachians. The rocks of the Milton belt were formed during the Precambrian era and metamorphosed during the early to late Paleozoic era (Butler and Secor 1991). The Milton belt bedrock is characterized by strongly foliated gneiss and schist, commonly with distinct compositional layering and having felsic composition – quartzite, calc-silicate gneiss, and marble are minor units (Carpenter 1982).

The soils that overlie the bedrock in the area have generally formed from the in-place weathering of the parent bedrock. The fractured bedrock is overlain by a mantle of unconsolidated material known as regolith. The regolith, where present, includes the soil zone; a zone of weathered, decomposed bedrock known as saprolite; and alluvium. Saprolite, the product of chemical and mechanical weathering of the underlying bedrock, is typically composed of silt and coarser granular material up to boulder size and may reflect the texture of the rock from which it was formed. The weathering products of felsic rocks may be sandy-textured and rich in quartz content while mafic rocks form a more clayey saprolite (LeGrand 2004).

Based on a review of the monitoring well installation logs provided by Duke Energy, the soils comprising the saprolite layer on site were characterized as ranging from micaceous clayey silt to gneissic, textured, partially weathered rock. Bedrock encountered on site consists of biotite gneiss with some quartz inclusions.

3.2 Hydrogeologic Framework

The groundwater system in the Piedmont Province in most cases is comprised of two interconnected layers or mediums: 1) residuum/saprolite and weathered rock (regolith) overlying, and 2) fractured crystalline bedrock (Heath 1980; Harned and Daniel 1992). Within the regolith layer, a thoroughly weathered and structureless material termed residuum occurs near the ground surface with the degree of weathering decreasing with depth. The residuum grades into a coarser-grained material that retains the structure of the parent bedrock and is termed saprolite. Beneath the saprolite, partially weathered bedrock occurs with depth until sound bedrock is encountered. This mantle of residual soil, saprolite, and weathered rock is a hydrogeologic unit that covers and crosses various types of rock (LeGrand 1988). It provides an intergranular medium through which the recharge and discharge of water from the underlying fractured rock occurs. The bedrock layer consists of fractured, nonporous crystalline bedrock. The fractures control both the hydraulic conductivity and storage capacity of the rock mass.

A transition zone at the base of the regolith has been interpreted to be present in many areas of the Piedmont. The zone consists of partially weathered/fractured bedrock and lesser amounts of saprolite that grades into bedrock and has been described as “being the most permeable part

of the system, even slightly more permeable than the soil zone" (Harned and Daniel 1992). The zone thins and thickens within short distances and its boundaries may be difficult to distinguish. It has been suggested that the zone may serve as a conduit of rapid flow and transmission of contaminated water (Harned and Daniel 1992).

Piedmont topography is characterized by gently rounded sloped hills and valleys. Recharge typically occurs on upland areas and slopes while groundwater discharge is concentrated in surface water bodies and lowland areas. LeGrand's (1988, 2004) conceptual model of the groundwater setting in the Piedmont incorporates the above two medium systems into an entity that is useful for the description of groundwater conditions. That entity is the surface drainage basin that contains a perennial stream or river (LeGrand 1988). Each basin is similar to adjacent basins and the conditions are generally repetitive from basin to basin. Within a basin, movement of groundwater is generally restricted to the area extending from the drainage divides to a perennial stream or river (Slope-Aquifer System; LeGrand 1988, 2004). Rarely does groundwater move beneath a perennial stream or river to another more distant stream (LeGrand 2004).

Therefore, in most cases in the Piedmont, the groundwater system is a two-medium system (LeGrand 1988) restricted to the local drainage basin. The groundwater occurs in a system composed of two interconnected layers: residuum/saprolite and weathered rock overlying fractured crystalline rock separated by the transition zone. Typically, the residuum/saprolite is partly saturated and the water table fluctuates within it. Water movement is generally through the fractured bedrock. The near-surface fractured crystalline rocks can form extensive aquifers. The character of such aquifers results from the combined effects of the rock type, fracture system, topography, and weathering. Topography exerts an influence on both weathering and the opening of fractures while the weathering of the crystalline rock modifies both transmissive and storage characteristics.

The aquifer system in the Piedmont typically exists in an unconfined or semi-confined condition in the bedrock zone. Under natural conditions, the general direction of groundwater flow can be approximated from the surface topography. Groundwater moves both vertically down through the regolith and parallel to the bedrock surface to areas where groundwater discharges as seepage into streams, lakes, or other surface water bodies.

The BCSS ash basin is generally bounded to the north by the earthen dike and a natural ridge (Figure 2). Pine Hall Road runs along the east and south sides of the ash basin and appears to generally be located along a surface water divide. Belews Lake is located to the east and south of Pine Hall Road. Middleton Loop road is located on the west side of the ash basin and appears to generally be located along a surface water divide. The geology/groundwater conditions at the site are expected to be generally consistent with the characteristics of the conceptual groundwater model developed by LeGrand for the Piedmont region.

Section 4 - Monitoring Program

4.1 Regulatory Requirements for Groundwater Monitoring

The NPDES program regulates wastewater discharges to surface waters to ensure that surface water quality standards are maintained. BCSS operates under NPDES Permit NC0024406 which authorizes discharge of cooling water (Outfall 001) into West Belews Creek/Belews Lake, and discharge of the ash basin (Outfall 003) to the Dan River in accordance with effluent limitations, monitoring requirements, and other conditions set forth in the permit. The NPDES permitting program requires that permits be renewed every 5 years.

The BCSS NPDES permit requires groundwater monitoring. Permit Condition A (11) Attachment XX, Version 1.1, dated June 15, 2011, lists the groundwater monitoring wells to be sampled, the parameters and constituents to be measured and analyzed, and the requirements for sampling frequency and results reporting. These requirements are provided in Table 2. Attachment XX also provides requirements for well location and well construction. A copy of Attachment XX is included as Appendix B.

The compliance boundary for groundwater quality at the BCSS ash basin site is defined in accordance with 15A NCAC 02L .0107(a) as being established at either 500 feet from the waste boundary or at the property boundary, whichever is closer to the source.

Sampling at the compliance groundwater wells commenced in January 2011. Analytical results have been submitted to the Department of Water Resources (DWR) before the last day of the month following the date of sampling for all monitoring wells. In the future, analytical results will be submitted to the DWR within 60 days of the date of sampling for all monitoring wells.

4.2 Description of Groundwater Monitoring System

The groundwater monitoring system for the BCSS ash basin system consists of the following monitoring wells: MW-200S, MW-200D, MW-201D, MW-202S, MW-202D, MW-203S, MW-203D, MW-204S, and MW-204D. The compliance monitoring wells were installed in December 2010. Well construction data is provided in Table 1.

The locations for the monitoring wells were selected in consultation with the DWR Aquifer Protection Section. The locations of the monitoring wells, the waste boundary, and the compliance boundary are shown on Figure 2. A summary of the monitoring well location data is included in Appendix C. Based on the slope-aquifer system conceptual model, groundwater at the site is expected to flow downward from the topographic divides along Pine Hall Road on the east and south sides of the ash basin and Middleton Loop on the west side of the ash basin. As described below, the wells provide monitoring data on the groundwater adjacent to the ash basin.

Monitoring wells MW-202S and MW-202D are located to the south of the Pine Hall Road Ash Landfill at the west end of Duke Power Steam Plant Road approximately 2,000 feet south of the

BCSS ash basin compliance boundary and are considered by Duke Energy to represent background water quality. Monitoring wells MW-200S and MW-200D are located to the north of the ash basin dike. Monitoring well MW-201D is located west of Pine Hall Road near the former ash basin discharge canal. Monitoring wells MW-203S, MW-203D, MW-204S, and MW-204D are located west of the ash basin along Middleton Loop.

Monitoring wells MW-200S, MW-202S, MW-203S, and MW-204S were installed by rotary drilling methods using hollow stem augers with the well screen installed above auger refusal to monitor the shallow aquifer within the saprolite layer. The screen lengths for these wells range from 7.6 feet to 20 feet. The screens were installed with screen intervals from 2.4 feet to 10 feet below ground surface (bgs) at MW-200S, from 37 feet to 57 feet bgs at MW-202S, from 24.6 feet to 39.6 feet bgs at MW-203S, and from 16 feet to 31 feet bgs at MW-204S. Total depths of these wells are 12.76 feet, 60.01 feet, 42.51 feet, and 33.94 feet below well top of casing (TOC) for MW-200S, MW-202S, MW-203S, and MW-204S, respectively.

Monitoring wells MW-200D, MW-201D, MW-202D, MW-203D, and MW-204D were installed by rotary drilling methods using hollow stem augers and by rock coring techniques (HQ diameter barrel) with the well screen installed in the uppermost region of the fractured rock transition zone. These wells were constructed with screen lengths of either 5 or 10 feet. The screens were installed with screen intervals from 11.5 feet to 16.5 feet bgs at MW-200D, from 30.8 feet to 40.8 feet bgs at MW-201D, from 84 feet to 89 feet bgs at MW-202D, from to 84.4 feet to 89.4 feet bgs at MW-203S, and 33 feet to 38 feet bgs at MW-204D.[1] Total well depths are 19.50 feet, 44.14 feet, 91.40 feet, 91.86 feet, and 41.07 feet below TOC for MW-200D, MW-201D, MW-202D, MW-203D, and MW-204D, respectively.

With the exception of monitoring wells MW-202S and MW-202D, the ash basin monitoring wells were installed at or near the compliance boundary. Background monitoring wells MW-202S and MW-202D are located approximately 2,000 feet south of the ash basin compliance boundary.

The monitoring wells at BCSS are equipped with dedicated bladder-type pumps.

Groundwater monitoring wells MW-101S, MW-101D, MW-102S, MW-102D, MW-103S, MW-03D, MW-104S, and MW-104D were installed by Duke Energy in 2006 as part of a voluntary monitoring system. No groundwater samples are currently collected from these wells under the compliance monitoring program.

4.3 Monitoring Frequency

The monitoring wells will be sampled three times per year in January, May, and September.

4.4 Sample Parameters and Methods

The monitoring program consists of sampling and analysis for parameters and constituents identified in Attachment XX of the NPDES permit (Appendix B).

[1] Ash Basin Monitoring Well Installation Report, Belews Creek Steam Station, MACTEC Project No. 6228-10-5284, January 21, 2011.

The parameters and constituents and the analytical methods are presented in Table 2.

The analytical results for the detection monitoring program will be compared to the 2L Standards or the site-specific background concentrations for the parameter or constituent.

4.5 Data Quality Objectives

The overall Quality Assurance (QA) objective is to ensure that reliable data of known and acceptable quality are provided. All measurements will be documented to yield results that are representative of the groundwater quality. Data will be calculated and reported in units as required by the NCDENR.

The analytical QA objectives for precision, accuracy, and completeness have been established by the laboratory(s) in accordance with the Environmental Protection Agency (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.

Appropriate methods have been selected to meet applicable standards for groundwater quality. Instances may occur, however, in which the condition of the sample will not allow detection of the desired limits for various parameters either because of matrix interference or high analyte concentrations requiring sample dilution. The laboratory(s) will provide sufficient documentation with each data package to notify reviewers about any analytical problems with the data, if needed.

Section 5 - Sampling Procedures

5.1 Sampling Equipment

Development, purging, and sampling equipment shall be selected to ensure 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 as dedicated purging and sampling systems.

5.1.1 Equipment Cleaning Procedures

Dedicated sampling equipment has been installed in each monitoring well. In the event non-dedicated equipment is used between monitoring wells, equipment will be cleaned before use and between wells 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.

5.2 Groundwater Sampling

5.2.1 Development of Monitoring Wells

All nine monitoring wells addressed in this sampling plan have been developed.

If new monitoring wells are installed, they will be developed prior to initial sampling. Development removes silt that has settled into the bottom of the well following installation and removes fine silt and clay particles from the well screen and sand-pack surrounding the screen. Well development is necessary to eliminate potential clogging and enhance 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 referencing the top of well casing (TOC).

5.2.2 Groundwater Level and Total Depth Measurements

Water level measurements shall be collected and recorded to determine the groundwater elevations and groundwater flow direction and to calculate the volume of standing water in the well. All monitoring wells have been surveyed to determine the elevation of the TOC. All depth and water level measurements shall be referencing the TOC and recorded to the nearest one-hundredth of a foot.

Water level measurements shall be made 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 are 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 referencing the TOC. The depth and water level measurements shall be 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:

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

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)

For example, a 2-inch-diameter casing will have a volume of 0.1631 gallons per foot.

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 will be re-measured any time the dedicated sampling system is removed for repair or replacement. The well depth, water level measurement, and calculated well volume are recorded on the Groundwater Monitoring Data Sheet (Figure 4).

5.2.3 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. 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 percent 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. Turbidity is not a required stabilization parameter, but turbidity levels of 10 nephelometric turbidity units (NTU) or less should be targeted.

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 minimize or stabilize water level drawdown within the well. Indicator parameters are measured over time (usually at 5-minute intervals). When parameters have stabilized within ±0.2 pH units; ±10 percent for temperature, conductivity, and DO; and ±10 millivolts (mV) for ORP over three consecutive readings; representative groundwater has been achieved for sampling. Turbidity is not a required stabilization parameter, but turbidity levels of 10 NTU or less should be targeted.

MODIFIED LOW-FLOW PURGING

This technique is considered a viable option particularly in the Piedmont region due to the likely presence of fine-grained 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 5-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 percent for temperature, conductivity, and DO; and ±10 mV for ORP over three consecutive readings; representative groundwater has been achieved for sampling. Turbidity is not a required 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 monitoring wells that historically purge to dryness and do not sufficiently recharge to provide adequate volume for sample collection. Wells that yield less than 100 milliliters per minute (mL/min) frequently incur significant drawdown during well purging. Therefore, if the well yield is less than 100 mL/min, the volume of the pumping system (i.e., the pump bladder, tubing, and flow-through chamber) shall be calculated and two pumping system volumes shall be removed. Indicator parameters will be measured and recorded initially, and then sample collection will begin.

5.3 Sample Collection

Groundwater samples are collected after representative groundwater has been determined by purging and stabilizing the indicator parameters.

Sampling personnel wear clean, disposable, non-powdered nitrile gloves at each location. Samples are collected in the order of the volatilization sensitivity of the parameters:

- Metals, metalloids, and selenium
- Sulfate and chloride
- Total dissolved solids

After collection, samples will be preserved and stored according to parameter-specific methods and delivered to the laboratory under proper Chain-of-Custody (COC) procedures. All pertinent notations, water-level measurements, removed well volumes, and indicator parameters shall be documented on the Groundwater Monitoring Data Sheet (Figure 4).

5.4 Sample Containers, Volume, Preservation, and Holding Time

All sample containers supplied by the laboratory for the collection of groundwater samples shall be new and pre-cleaned 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 will be kept closed until used. All sample containers will be provided by Duke Energy or vendor laboratories.

5.5 Sample Tracking

The COC procedures allow for tracing the possession and handling of individual samples from the time of field collection through laboratory analysis and report preparation. Samples shall be 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.

5.6 Sample Labeling

Sample containers shall be pre-labeled and organized prior to field activities as part of the pre-sampling staging process. As samples are collected, the sampling personnel shall 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).

5.7 Field Documentation

Field documentation from each sampling event is recorded on the Groundwater Monitoring Data Sheets (Figure 4), the Field Sampling Calibration Form (Figure 5), and the Chain-of-Custody Record (Figure 6). Additionally, a Groundwater Sampling Site Checklist (Figure 7) is completed indicating information about the monitoring well such as proper identification (ID) tag and

condition of protective casing and pad. Field notations shall be 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

This field notation information will be entered on the Groundwater Monitoring Data Sheets (Figure 4), the Field Sampling Calibration Form (Figure 5), or the Chain-of-Custody Record and Analysis Request Form (Figure 6) which are filled out for each sampling event. These documents will be arranged and filed by project and date. Recorded entries will be made on electronic forms or on paper forms in indelible ink. Errors on paper documents will be corrected by drawing a line through the error, initialing and dating the correction, and starting a new entry on the next line (if necessary).

5.8 Chain-of-Custody Record

The 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 analysis. 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

5.9 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

All samples shall be 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, entries shall be completed on the COC form for all samples. 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 shall be delivered to these facilities by Duke Energy personnel or courier.

All COC forms received by the laboratory(s) shall be 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 all stages 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 Energy laboratory personnel are described in detail in the Duke Energy Laboratory Services Procedures Manual.

Section 6 - Analytical Methods

The main analytical laboratory used in this program is the Duke Energy Laboratory Services Laboratory: N.C. 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 the Analytical Laboratory Procedures Manual are available for review upon request.

Vendor laboratories that meet EPA and North Carolina certification requirements may be used for analyses with approval by Duke Energy.

The analytical methods used for the samples analyzed for this Groundwater Monitoring Program are listed in Table 2. Specific conductance, field pH, and temperature are measured in the field according to the Duke Energy Groundwater Monitoring and Sample Collection Procedure or the instrument manufacturer instructions.

Section 7 - Internal Quality Control Checks

Internal laboratory QC checks used by the laboratories are described in each laboratory's generic QAP and procedures manual. Using the internal laboratory QC checks, the laboratories demonstrate the ability to produce acceptable results using the methods specified.

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 all parameters at frequencies described in the laboratory(s) procedures manuals.

The field QC blanks and replicates that may be included as internal QC checks are described below. The specific type and number of blanks used may vary depending on the sampling event and will be determined by the Duke Energy 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. Field blanks are typically utilized for each sampling event. The field blanks are typically analyzed for major anions, cations, and metals.

- 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. Trip blanks are typically utilized when sampling for volatile organic compounds. The trip blank is returned to the laboratory with the field samples and analyzed along with the field samples for parameters of interest.

- 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.

- Field Replicates: A field replicate is a duplicate sample prepared at the sampling locations from equal portions of all 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.

Section 8 - Validation of Field Data Package

The field data package includes all of the field records and measurements developed by the sampling team personnel. The field data package validation will be performed by Duke Energy personnel. The procedure for validation consists of the following:

- A review of field data contained on the Groundwater Monitoring Data Sheets 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 COC Record for proper completion, signatures of field personnel and the laboratory sample custodian, dates and times, and for verification that the correct analyses were specified.

Section 9 - Validation of Laboratory Data

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

Section 10 - Report Submittal

A report of the monitoring results for all wells will be submitted to the DWR within 60 days of the date of sampling. The monitoring results will be submitted on DENR Form GW-59CCR.

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

Section 11 - References

Butler, J. R. and Secor, D. T. 1991. The Central Piedmont, p. 59-78, in Horton, J. W., Jr., and Zullo, V. A., eds., The Geology of the Carolinas: The University of Tennessee Press, Knoxville, Tennessee, 406p.

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Heath, R.C. 1980. Basic elements of ground-water hydrology with references to conditions in North Carolina: U. S. Geological Survey Water-Resources Open-File Report 80-44, 86p.

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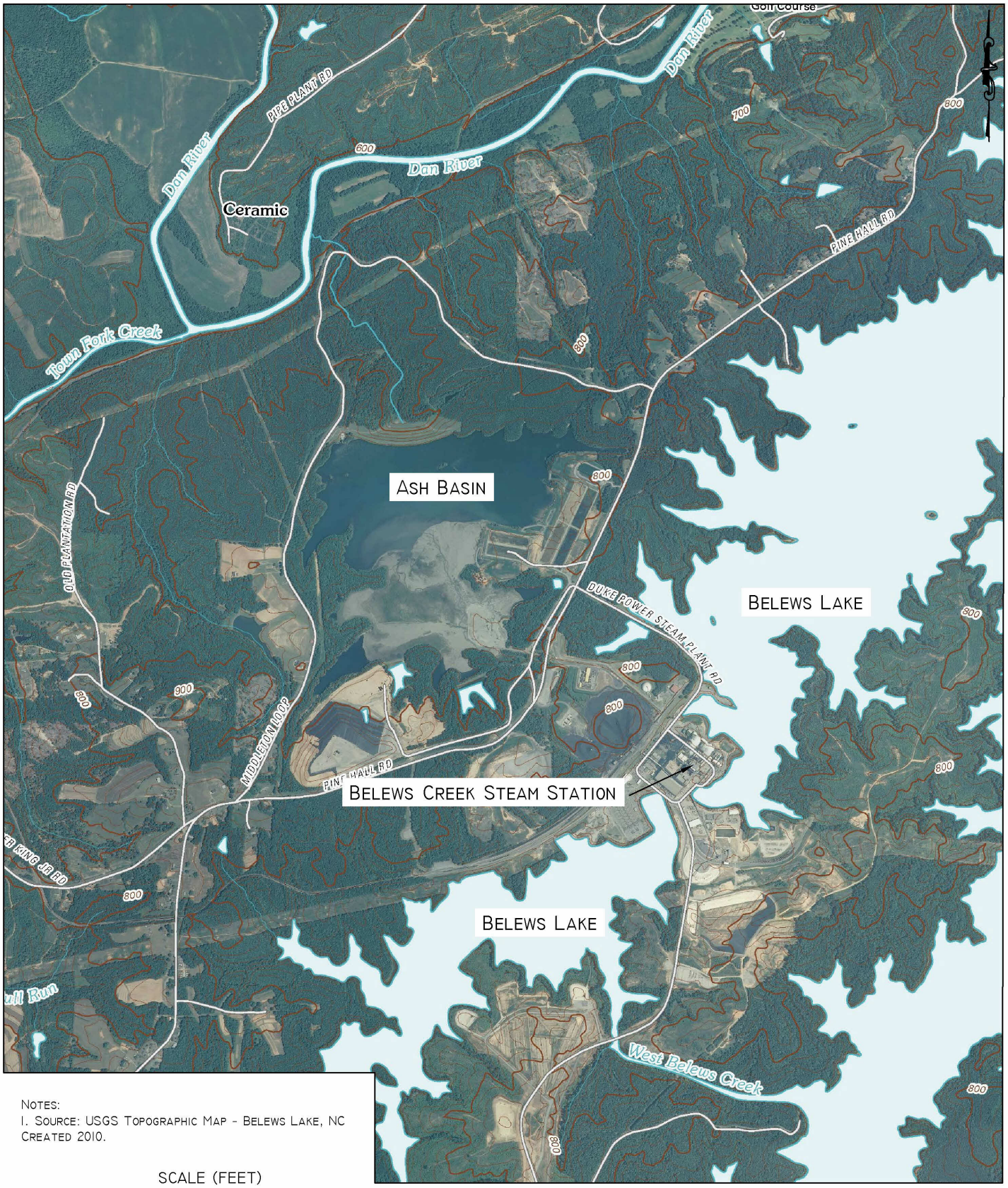
LeGrand, Harry, Sr. 2004. A Master Conceptual Model for Hydrogeological Site Characterization in the Piedmont and Mountain Region of North Carolina, North Carolina Department of Environment and Natural Resources.

MACTEC. 2011. Ash Basin Monitoring Well Installation Report, Belews Creek Steam Station, MACTEC Project No. 6228-10-5284, January 21, 2011.

Figures



NOTES:
1. SOURCE: USGS TOPOGRAPHIC MAP - BELEWS LAKE, NC CREATED 2010.

SCALE (FEET)

3,000 0 3,000 6,000

HDR

License Number: F-0116
440 South Church Street Charlotte, NC 28202

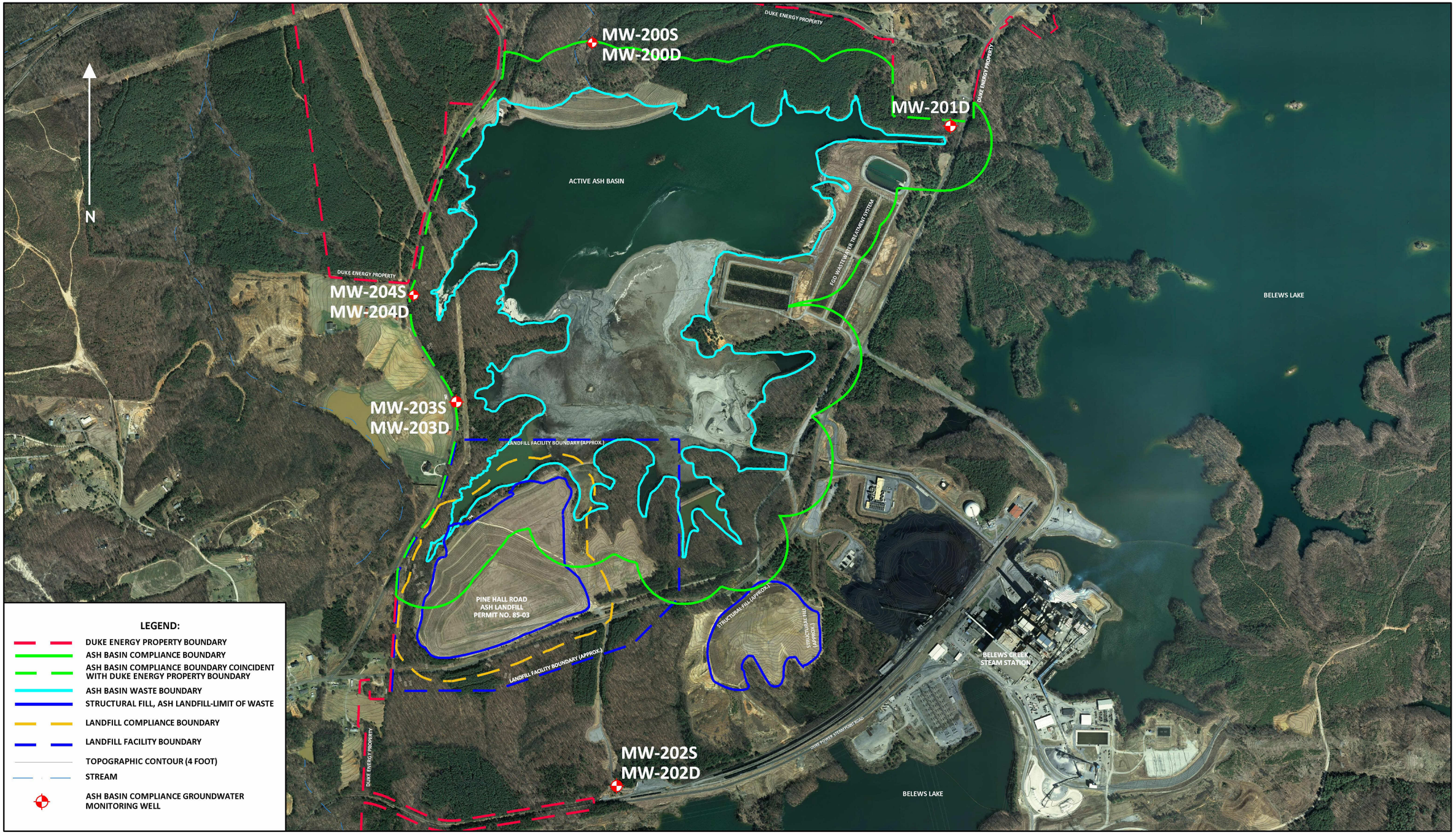
SITE LOCATION MAP
BELEWS CREEK STEAM STATION
DUKE ENERGY CAROLINAS, LLC
STOKES COUNTY, NORTH CAROLINA

DATE

JULY 31, 2014

FIGURE

1



GENERAL NOTES:

1. PARCEL DATA FOR THE SITE WAS OBTAINED FROM DUKE ENERGY REAL ESTATE AND IS APPROXIMATE.
2. ASH BASIN WASTE BOUNDARY, ASH LANDFILL LIMIT OF WASTE, AND STRUCTURAL FILL BOUNDARY ARE APPROXIMATE.
3. AS-BUILT MONITORING WELL LOCATIONS PROVIDED BY DUKE ENERGY.
4. SHALLOW MONITORING WELLS (S) - WELL SCREEN INSTALLED ACROSS THE SURFICIAL WATER TABLE.
5. DEEP MONITORING WELLS (D) - WELL SCREEN INSTALLED IN THE TRANSITION ZONE BETWEEN COMPETENT BEDROCK AND THE REGOLITH.
6. TOPOGRAPHY DATA FOR THE SITE WAS OBTAINED FROM NC DOT GEOGRAPHIC INFORMATION SYSTEM (GIS) WEB SITE.
7. ORTHOPHOTOGRAPHY WAS OBTAINED FROM NC ONEMAP GIS WEB SITE (DATED 2009).
8. THE ASH BASIN COMPLIANCE BOUNDARY IS ESTABLISHED ACCORDING TO THE DEFINITION FOUND IN 15A NCAC 02L .0107 (a).

SCALE (FEET)

500' 0 500' 1000'

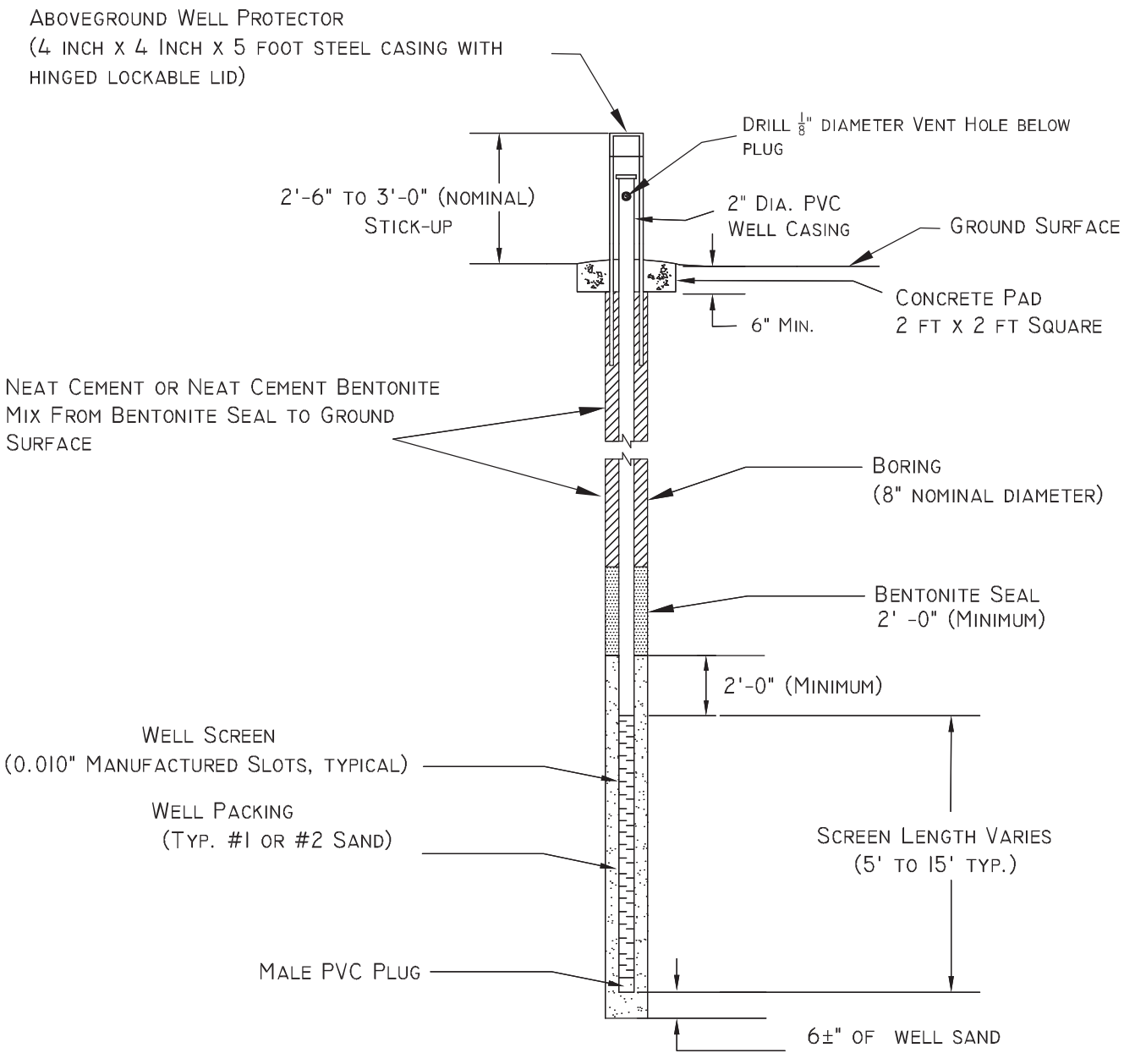
1" = 1000'

North Carolina Engineering Firm Number: F-0116
440 South Church Street Charlotte, NC 28202

COMPLIANCE MONITORING WELLS
DUKE ENERGY CAROLINAS, LLC
BELEWS CREEK STEAM STATION ASH BASIN
NPDES PERMIT #NC0024406
STOKES COUNTY, NORTH CAROLINA

DATE
JULY 31, 2014

FIGURE
2



Typical Well Construction Details
(no scale)

INFORMATION PROVIDED BY DUKE ENERGY CAROLINAS, LLC

License Number: F-0116
440 South Church Street Charlotte, NC 28202

TYPICAL MONITORING WELL CONSTRUCTION DETAILS

DATE
JULY 31, 2014

FIGURE
3

DUKE ENERGY

GROUNDWATER MONITORING DATA SHEET FOR CONVENTIONAL SAMPLING

PROCEDURE NO	3175.1

SITE NAME	Belews Creek Steam Station	PERMIT #	NC0024406	SITE ID	N/A
PROJECT NAME	Ash Basin Groundwater Monitoring	FIELD CREW			
SAMPLING DATE(s)	☐ ☐ ☐ ☐	WELL/LOCATION NAME			

MONITORING WELL INFORMATION

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

EQUIPMENT INFORMATION

LEVEL METER SERIAL#		SAMPLING EQUIPMENT		PURGE METHOD	
		TUBING DIAMETER (in)			

PUMP CONTROLLER SETTINGS							
PRESSURE		(psi)	RECHARGE		(sec)	DISCHARGE	(sec)

SAMPLING INFORMATION

INITIAL DEPTH TO WATER (ft TOC)		WATER COLUMN (ft)		*Well Volume = water column X conversion factor*	
WATER ELEVATION (ft msl)		WELL VOLUME (gal)		(Conversion factor dependent on well diameter and selected well volume units)	
DETECTED ODOR	None	CONVERSION FACTOR	0.1631		
APPEARANCE	Normal				

PURGE VOLUME (gal)	WATER LEVEL AFTER PURGE * (ft)	COMPLETE EVACUATION (YES/NO)	☑ 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)

TOTAL PURGE VOLUME	* Optional measurement to recalculate well volume when purging results in substantial drawdown of water column	SAMPLE COLLECTED BY	DATE	@ TIME	CHLORINE (mg/l)
0.00					NA

QC By:	

WELL CONDITION

PROTECTIVE CASING		
WELL PAD		
WELL CASING		
WELL TAG		

ADDITIONAL WELL CONDITION NOTES

SAMPLING NOTES

FIGURE 4: EXAMPLE GROUNDWATER MONITORING DATA SHEET

FIELD SAMPLING CALIBRATION FORM

STUDY: Belews Creek Steam Station Ash Basin Groundwater Monitoring

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

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

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

OTHER EQUIPMENT: | **WEATHER CONDITIONS:**

PROCEDURE #: HYDROLAB 3210.3 **VALIDATED BY:**

Calibration Date / Time		DATE:		TIME:		DATE:		TIME:	
		BP (mmHg)				BP (mmHg)			
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	Zero Pass
	SS		—►	350			—/—►	350	
	SS		—/—►	150			—/—►	150	
pH (units)	B (7.00)		—►	7.00			—/—►		
	B (4.00)		—►	4.00			—/—►		
	B (10.00)		—/—►	10.00			—/—►		
			Buffer Temp.	25.00			Buffer Temp.		
Mid-Day Ck	B (7.00)		—►						
Time:			Buffer Temp.						
☑ ORP (mV)	SS (7.00)		—►	285			—/—►	285	
	SS (4.00)	N/A	—/—►	462		N/A	—/—►	462	
			ORP Temp.	25.00			ORP Temp.	25.00	
☐ DO (mg/L)	W								
	W								
	AW		—►				—/—►		
☐ TURB (ntu)	SS		—/—►				—/—►		
Temp Cert Device #									
TEMP (deg C)	NIST	N/A	—/—►	N/A	Adjustment Not Available	N/A	—/—►	N/A	Adjustment Not Available
AMMONIUM (mg/L)	SS	N/A	—/—►	N/A		N/A	—/—►	N/A	
	SS	N/A	—/—►	N/A		N/A	—/—►	N/A	

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

Dissolved Oxygen Subsystem

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

Ammonium Subsystem

- ☐ Cleaned Electrode Tip
- ☐ Installed New Electrode
- ☐ Removed Electrode / Installed Plug
- ☐ Tested - OK ☐ See Notes

Oxidation Reduction Subsystem

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

Turbidity Subsystem

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

Temperature Subsystem

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

Depth Subsystem

- ☐ Reset / Calibrated
- ☐ Tested - OK ☐ See Notes

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

NOTES:

FIGURE 5: EXAMPLE FIELD SAMPLING CALIBRATION FORM

CHAIN OF CUSTODY RECORD AND ANALYSIS REQUEST FORM

Duke Energy SM

For Detailed Instructions, see:
http://dewww/essenv/coc/

Duke Energy Analytical Lab Services
Mail Code MGO3A2 (Building 7405)
13339 Hagers Ferry Rd
Huntersville, N. C. 28078
(704) 875-5245
Fax: (704) 875-5038

Analytical Laboratory Use Only

LIMS #

Samples Originating From NC √ SC

Logged By

Date & Time

SAMPLE PROGRAM
Groundwater √
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 #

Customer to complete all appropriate NON-SHADED areas.

[19]Page 1 of 1
DISTRIBUTION
ORIGINAL to LAB,
COPY to CLIENT

Customer must Complete

1)Project Name		2)Phone No:
3)Client		4)Fax No:
5)Business Unit: 20036	6)Process:	7)Resp. To:
8)Project ID:	9)Activity ID:	10)Mail Code:

LAB USE ONLY [11]Lab ID	[12]Chem Desktop No.	[13]Sample Description or ID	[14]Collection Information Date	Time	Signature	[17]Comp.	[18]Grab	[16]Analyses Required	[20]Total # of Containers
									6

Customer to complete appropriate columns to right

Customer to sign & date below

21)Relinquished By	Date/Time	Accepted By	Date/Time
Relinquished By	Date/Time	Accepted By	Date/Time
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
* Add. Cost Will Apply

FIGURE 6 - CHAIN OF CUSTODY RECORD AND ANALYSIS REQUEST FORM

NORTH CAROLINA GROUNDWATER SAMPLING SITE CHECKLIST

LOCATION / SITE Belews Creek Steam Station / Ash Basin Groundwater Monitoring PERMIT # NC0022406 **SAMPLE DATE**
SITE CONTACT **FIELD CREW**
WEATHER
PAGE 1 OF 1

		MW-200S	MW-200D	MW-201D	MW-202S	MW-202D	MW-203S	MW-203D	MW-204S	MW-204D						
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: GROUNDWATER SAMPLING SITE CHECKLIST

Tables

Table 1
Monitoring Well Information
Belews Creek Steam Station Ash Basin

	MW-200S	MW-200D	MW-201D	MW-202S	MW-202D	MW-203S	MW-203D	MW-204S	MW-204D
North (ft)	929,458.70	929,457.98	928,562.86	921,472.88	921,477.01	925,599.25	925,588.28	926,748.45	926,744.91
East (ft)	1,683,065.88	1,683,060.81	1,686,914.24	1,683,331.79	1,683,327.04	1,681,605.68	1,681,611.54	1,681,146.05	1,681,144.75
Top of PVC Casing Elevation (ft)	635.89	636.05	783.98	789.97	790.78	786.14	785.57	776.29	776.78
Well Diameter	2"	2"	2"	2"	2"	2"	2"	2"	2"
Well Stick-up (ft)	2.71	2.75	2.72	2.36	2.91	2.68	2.20	2.80	2.86
Type of Casing	PVC	PVC	PVC	PVC	PVC	PVC	PVC	PVC	PVC
Total Depth below TOC (ft)	12.76	19.50	44.14	60.01	91.40	42.51	91.86	33.94	41.07
Screen Length (ft)	7.6	5	10	20	5	15	5	15	5
Screen Interval (ft below TOC)	5.16 - 12.76	14.50 - 19.50	34.14 - 44.14	40.01 - 60.01	86.40 - 91.40	27.51 - 42.51	86.86 - 91.86	18.94 - 33.94	36.07 - 41.07

Notes:

1. ft indicates feet.
2. TOC indicates top of casing.
3. As-built well coordinates (NAD 83) and top of PVC casing elevations (NAVD 88) provided by Duke Energy.
4. Top of PVC casing elevations for S and D well pairs are inverted on Table 1 included with Well Construction Records (Appendix A).
5. Well diameter, type of casing, and screen lengths were obtained from Well Construction Records provided by Duke Energy.
6. Well total depth below TOC and well stick-up measurements provided by Duke Energy.

Table 2
Sample Parameters and Analytical Methods
Belews Creek Steam Station Ash Basin

PARAMETER	UNITS	ANALYTICAL METHOD
In Situ Parameters		
Field pH	pH Units	Hydrolab
Conductivity	µmhos/cm	Hydrolab
Temperature	°C	Hydrolab
Water Level	ft	Water Level Meter
Laboratory Analyses		
Antimony	µg/L	TRM / EPA 200.8
Arsenic	µg/L	TRM / EPA 200.8
Barium	µg/L	TRM / EPA 200.7
Boron	µg/L	TRM / EPA 200.7
Cadmium	µg/L	TRM / EPA 200.8
Chloride	µg/L	EPA 300.0
Chromium (total)	µg/L	TRM / EPA 200.7
Copper	µg/L	TRM / EPA 200.7
Iron	µg/L	TRM / EPA 200.7
Lead	µg/L	TRM / EPA 200.8
Manganese	µg/L	TRM / EPA 200.7
Mercury	µg/L	EPA 245.1
Nickel	µg/L	TRM / EPA 200.7
Nitrate (as Nitrogen)	µg/L	EPA 300.0
Selenium	µg/L	TRM / EPA 200.8
Sulfate	µg/L	EPA 300.0
Thallium	µg/L	TRM / EPA 200.8
Total Dissolved Solids	µg/L	SM 2450C
Zinc	µg/L	TRM / EPA 200.7

Notes:

1. µmhos/cm indicates micro-mhos per centimeter.
2. ft indicates feet.
3. µg/L indicates micrograms per liter.
4. TRM indicates total recoverable metals.
5. EPA indicates Environmental Protection Agency.
6. SM indicates Standard Method.

Table 3
Sample Containers, Preservatives, and Holding Times
Belews Creek Steam Station Ash Basin

PARAMETER	CONTAINERS	PRESERVATIVES	HOLDING TIMES
In Situ Parameters			
Field pH	In Situ	None	Analyze Immediately
Conductivity	In Situ	None	Analyze Immediately
Temperature	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
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 4^{o} C	28 days
Chromium (total)	500 ml HDPE	pH<2 HNO_3	6 months
Copper	500 ml HDPE	pH<2 HNO_3	6 months
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	6 months
Nickel	500 ml HDPE	pH<2 HNO_3	6 months
Nitrate (as Nitrogen)	500 ml HDPE	Cool 4^{o} C	28 days
Selenium	500 ml HDPE	pH<2 HNO_3	6 months
Sulfate	500 ml HDPE	Cool 4^{o} C	28 days
Thallium	500 ml HDPE	pH<2 HNO_3	6 months
Total Dissolved Solids	500 ml HDPE	Cool 4^{o} C	28 days
Zinc	500 ml HDPE	pH<2 HNO_3	6 months

Notes:

1. ml indicates milliliter.
2. HNO_3 indicates nitric acid.
3. HDPE indicates high density polyethylene.

A

Appendix A - Boring Logs and Monitoring Well Construction Records

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January 21, 2011

Mr. Thomas Wiest, Project Manager
Duke Energy Corporation
3195 Pine Hall Road
Belews Creek, North Carolina 27009

Subject: **Ash Basin Monitoring Well Installation Report**
Belews Creek Steam Station
3195 Pine Hall Road
Belews Creek, Stokes County, North Carolina
MACTEC Project No.: 6288-10-5284

Dear Mr. Wiest:

MACTEC is pleased to provide this report on behalf of our client, AE Drilling, LLC. The purpose of this report is to present the results of monitoring well installation and evaluation activities conducted in November and December 2010 at the above-referenced site (Figure 1). The well installation and testing was conducted in general accordance with the requirements outlined in the Ash Basin Groundwater Monitoring Well Installation Project Work Summary (Work Summary) provided by Duke Energy (Duke). The following Figure, Tables and Appendices have been included:

Figure 1:	Monitoring Well Locations
Table 1:	Summary of Well Construction Details
Table 2:	Summary of Slug Test Results
Appendix A:	Rock Core Photographs
Appendix B:	Soil and Rock Boring Logs
Appendix C:	NCDENR Monitoring Well Construction Records
Appendix D:	Monitoring Well Development Records
Appendix E:	Photographs of Completed Well Pairs
Appendix F:	Slug Test Data

Four Type II groundwater monitoring well pairs and one Type II single groundwater monitoring well (a total of 9 wells) were installed between November 9, 2010 and December 17, 2010 at the locations shown on Figure 1. The well locations were pre-determined by Duke and marked in the field with wooden stakes and survey flagging. Each well pair consisted of one shallow well (using the identifier "S") set into overburden soils and one deep well (using the identifier "D) set into

MACTEC Engineering and Consulting, Inc.
2801 Yorkmont Road, Suite 100 • Charlotte, NC 28208 • Phone: 704.357.8600 • Fax: 704.357.8638

bedrock. Please note that a shallow well was not installed at location MW-201 because bedrock was encountered prior to groundwater, indicating a local absence of a surficial aquifer in these locations. Furthermore, the original MW-202D was installed to a depth at 66 feet and was abandoned due to a lack of a surficial aquifer in that location. Standard Penetration Testing (SPT) and split-spoon sampling was performed at five-foot intervals from the surface to bedrock during installation of the deep well at each well pair. Soils observed in the split-spoon samples were logged in the field in accordance with the Unified Soil Classification System (ASTM D2487/D2488). Upon auger refusal, each deep boring was extended a minimum of 10 feet into competent bedrock using HQ-sized rock core techniques.

Rock core samples were logged in the field in accordance with the Field Guide for Rock Core Logging and Fracture Analysis established by Midwest Geosciences. As specified in the Work Summary, split-spoon sampling and rock coring were not performed during installation of the shallow wells. Photographs of rock cores obtained during installation of the five deep wells are included as Appendix A.

Shallow wells were installed using 4.25-inch ID hollow stem augers; deep wells were installed using 4.25-inch ID hollow stem augers to refusal, then HQ-sized rock core approximately 10 feet into competent bedrock. Total depths for shallow wells ranged from 10 feet below ground surface (bgs) in MW-200S to 57 feet bgs in MW-202S. Total depths for bedrock wells ranged from 16.7 feet bgs in MW-200 to 89.6 feet bgs in MW-202D. Shallow wells were constructed with 15 feet of 0.010-slot 2-inch diameter PVC well screen (except wells MW-200S and MW-202S in which a 7.6 and 20 foot screens, respectively were installed) and riser with well screens set so that most of screen is below the static water table at the time of installation. Deep wells were constructed with 5-foot well screens (except well MW-201D, in which a 10-foot screen was installed) set across low-RQD bedrock core intervals to facilitate maximum water flow through each well. Filter sand was placed in the annular space between the augers and the casing from the total depth of the boring to at least one foot above the screen. A bentonite seal was placed on top of the filter pack and the well was grouted to the surface. Please note that shallow well depths were typically adjusted after installation, but prior to placement of bentonite, to account for rise in hydraulic head observed at each location. In these instances, additional filter sand was placed between the bottom of the borehole and the bottom of the well. Each well was completed with a stand-up well cover

that extends approximately 30 inches above-grade and set into a 2-foot by 2-foot concrete pad. Monitoring well ID tags were secured to the outside of the stand-up covers and well numbers were etched into the wet concrete pad. Soil boring logs and well construction records for the ten monitoring wells installed in during this work have been included as Appendix B and C, respectively.

Subsequent to installation, each well was developed using a submersible or bladder pump to remove fine-grained material. In general, each well was purged until the development water appeared visually clear, at which time, water quality parameters (temperature, pH, conductivity and turbidity) were recorded in 5-gallon increments until turbidity readings were less than or equal to 50 NTUs. Purge water generated during well development ranged from 8 gallons to 130 gallons and was discharged to the ground surface adjacent to each well. Monitoring well development records are included as Appendix D. Photographs of the completed monitoring well pairs are included as Appendix E.

Rising head slug tests were performed on each well on December 20, 21 and 28, 2010. Prior to the tests an In-situ Level Troll pressure transducer and 4-foot long stainless steel slug were placed into the well. The water level in the well was recorded as a "Background" test until the well recharged to within 90% of the original measurement. Subsequent to normalization, the rising head test was started, the slug was removed and the change in head versus time was measured using a Rugged-reader data logger. Slug test data was analyzed using Aqtesolv software to estimate hydraulic conductivity in each well. A summary of slug test data is presented in Table 2. Copies of raw data generated during completion of the rising head slug tests are included in Appendix F. Electronic slug test data is included on the attached compact disc.

Please contact the undersigned at (704) 357-8600, if you have questions or comments concerning this project.

Sincerely,

MACTEC ENGINEERING AND CONSULTING, INC.

Mark P. Filardi, P.G.
Senior Geologist

Robert C. Foster, L.G.
Principal

Enclosures

cc: William M. Miller, PE, PLS, Altamont Environmental
Mark Lassiter, PG, AE Drilling, LLC

FIGURE

Source: USDA-FSA-APFO NAIP MrSID Mosaic for Stokes County, North Carolina, dated 2008.

Monitoring Well Location

N

0 500 1,000 2,000 3,000 4,000 Feet

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MONITORING WELL LOCATIONS
DUKE ENERGY
BELEWS CREEK STEAM STATION
GASTON COUNTY, NORTH CAROLINA

PREPARED BY	DATE	CHECKED BY	DATE	JOB NUMBER	FIGURE
SJM	1/26/2011			6228-10-5284	1

TABLES

Table 1
Summary of Well Construction Details
Belews Creek Steam Station, Belews Creek, North Carolina

Well Number	Coordinates		Drilling Method	Construction Details				Measured Details			
	Latitude	Longitude		Well Diameter (I.D. in.)	Borehole Depth (ft bgs)	Well Depth (ft bgs)	Screen Interval (ft bgs)	Top of Casing Elevation (NAVD 88)	Well Depth (ft below TOC)	Depth to Water (ft below TOC)	Height of Water Column (ft)
MW-200S	36 17 56.33949	80 04 31.64295	HSA	2	10.2	10.2	2.4 - 10.0	636.05	12.96	5.07	7.89
MW-200D	36 17 56.33182	80 04 31.70478	HSA/Rock Core	2	20.8	16.7	11.5 - 16.5	635.89	19.70	6.18	13.52
MW-201D	36 17 47.89150	80 03 44.51818	HSA/Rock Core	2	45.1	41.0	30.8 - 40.8	783.98	43.80	33.41	10.39
MW-202S	36 16 37.40685	80 04 27.33922	HSA	2	57.5	57.2	37 -57	790.78	60.23	46.67	13.56
MW-202D	36 16 37.44718	80 04 27.39777	HSA/Rock Core	2	89.2	89.2	84 - 89	789.97	91.10	47.52	43.58
MW-203S	36 17 18.02189	80 04 48.96620	HSA	2	39.8	39.8	24.6 - 39.6	785.57	42.74	33.37	9.37
MW-203D	36 17 17.91405	80 04 48.89317	HSA/Rock Core	2	89.6	89.6	84.4 - 89.4	786.14	92.11	32.93	59.18
MW-204S	36 17 29.33528	80 04 54.73279	HSA	2	31.3	31.2	16 - 31	776.78	34.15	26.16	7.99
MW-204D	36 17 29.30013	80 04 54.74819	HSA/Rock Core	2	45.2	38.2	33 - 38	776.29	41.27	26.86	14.41

ft bgs = feet below ground surface
HSA = Hollow-stem Auger

Prepared by Date: CDF 1-20-11
Checked by Date: RCF 1-21-11

Table 2
Summary of Slug Test Data
Belews Creek Steam Station, Belews Creek, North Carolina

WELL ID	Test Date	Aquifer Model	Rising Head Test		Borehole Depth (ft bgs)	Well Depth (ft bgs)	Screen Interval (ft bgs)	Well Diameter (I.D. in.)
			Solution Method	K-value (cm/sec)				
MW-200S	12/20/2010	unconfined	Bouwer-Rice	2.26 E-03	10.2	10.2	2.4 - 10.0	2
MW-200D	12/20/2010	confined	Bouwer-Rice	4.78 E-02	20.8	16.7	11.5 - 16.5	2
MW-201D	12/20/2010	confined	Bouwer-Rice	1.19 E-03	45.1	41	30.8 - 40.8	2
MW-202S	12/28/2010	unconfined	Bouwer-Rice	2.25 E-04	57.5	57.2	37 - 57	2
MW-202D	12/28/2010	confined	Bouwer-Rice	2.55 E-05	89.2	89.2	84 - 89	2
MW-203S	12/21/2010	unconfined	Bouwer-Rice	3.87 E-02	39.8	39.8	24.6 - 39.6	2
MW-203D	12/21/2010	confined	Bouwer-Rice	1.43 E-02	89.6	89.6	84.4 -89.4	2
MW-204S	12/21/2010	unconfined	Bouwer-Rice	5.54 E-02	31.3	31.2	16 - 31	2
MW-204D	12/21/2010	confined	Bouwer-Rice	7.62 E-03	45.2	38.2	33 - 38	2

Prepared By Date: chb 1-21-11
Checked By Date: RCF 1/21/11

APPENDICES

APPENDIX A
ROCK CORE PHOTOGRAPHS

Photograph 1: MW-200D (Core Run 1).

Photograph 2: MW-200D (Core Run 2).

Photograph 3: MW-204D (Core Run 1).

Photograph 4: MW-204D (Core Runs 1 and 2).

Photograph 5: MW-201D (Core Run 1).

Photograph 6: MW-201D (Core Run 2).

Photograph 7: MW-201D (Core Run 3).

Photograph 8: MW-201D (Core Run 4).

Photograph 9: MW-203D (Core Run 1).

Photograph 10: MW-203 (Core Runs 1 and 2).

Photograph 11: MW-202D (Core Run 3).

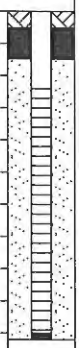
Photograph 12: MW-202D (Core Run 1).

Photograph 13: MW-202D (Core Run 2).

APPENDIX B

SOIL AND ROCK BORING LOGS

DEPTH (ft)	SOIL CLASSIFICATION SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	LEGEND	ELEV (ft)	SAMPLES: IDENT	SAMPLES: TYPE	SAMPLES: N-COUNT (1st 6" / 2nd 6" / 3rd 6")	REMARKS
0	Yellowish brown (10 YR 5/6) clayey sand (SC), wet to very moist, some organics, gravel						
10	Auger refusal at 10.8 feet below ground surface						



SOIL_BELEWS CREEK.GPJ 1/26/11

DRILLER: Dan Bergman/AE Drilling
EQUIPMENT: CME 750 ATV
METHOD: 4.25" (ID) HSA
HOLE DIA.: 8"
REMARKS:

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

PROJECT: Belews Creek Steam Station
WELL ID: MW-200S

November 12, 2010
PROJ. NO.: 6228105284.04 **PAGE 1 OF 1**

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DEPTH (ft)	SOIL CLASSIFICATION SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	LEGEND	ELEV (ft)	SAMPLES IDENT	SAMPLES TYPE	SAMPLES N-COUNT 1st 6" 2nd 6" 3rd 6"	REMARKS
0	Yellowish brown (10 YR 5/6) clayey sand (SC) (probable fill/disturbed alluvium), firm, some organics, little gravel, wet to very moist ▽						manmade berm 20 feet from location indicative of disturbed area/earthwork
5	Light olive brown (2.5 Y 5/3) silty sand (SM), little gravel (angular rock fragments), micaceous, very dense, trace garnets, some relict rock structure, moist			SS-1		9-28-46	Hard drilling drill chatter
10				SS-2		50/0.4	
15	Biotite quartz gneiss (Bedrock), Dark gray (2.5 YR 4/6) with some white (7.5 YR 8/6), very strong, indurated, gneissic, thinly to medium foliated fresh, competent, moderately fractured			RC-1			RC 1 (Rec= 96%, RQD= 30%) trace auger fractures at 11.2, at 11.6 inch horizontal iron stained, 65 degree iron stained joint (open) at 11.9, four horizontal joints cross cut at 65 degrees with iron staing at 12.8 to 13.5, mechanical break at 13.8, two iron stained joints at 14.1, two 80 degree joints with moderately healed mineralization at 15.5 feet.
20				RC-2			RC 2 (Rec= 100%, RQD= 100%) horizontal iron stained joint at 15.9, horizontal iron stained joint at 16.5, 20 degree iron stained joint at 17.1, iron stained joint at 16.8, horizontal iron stained joints at 16.8 - 17.1 and 17.3, vertical moderately healed iron stained mineralized joint from 19.5 to 20.5 feet.
25							
30							
35							
40							
45							

SOIL BELEWS CREEK.GPJ 1/26/11

DRILLER: Dan Bergman/AE Drilling
EQUIPMENT: CME 750 ATV
METHOD: 4.25" (ID) HSA, HQ Core
HOLE DIA.: 8" HSA, HQ Core
REMARKS:

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

PROJECT: Belews Creek Steam Station
WELL ID: MW-200D

November 12, 2010
PROJ. NO.: 6228105284.04 **PAGE 1 OF 1**

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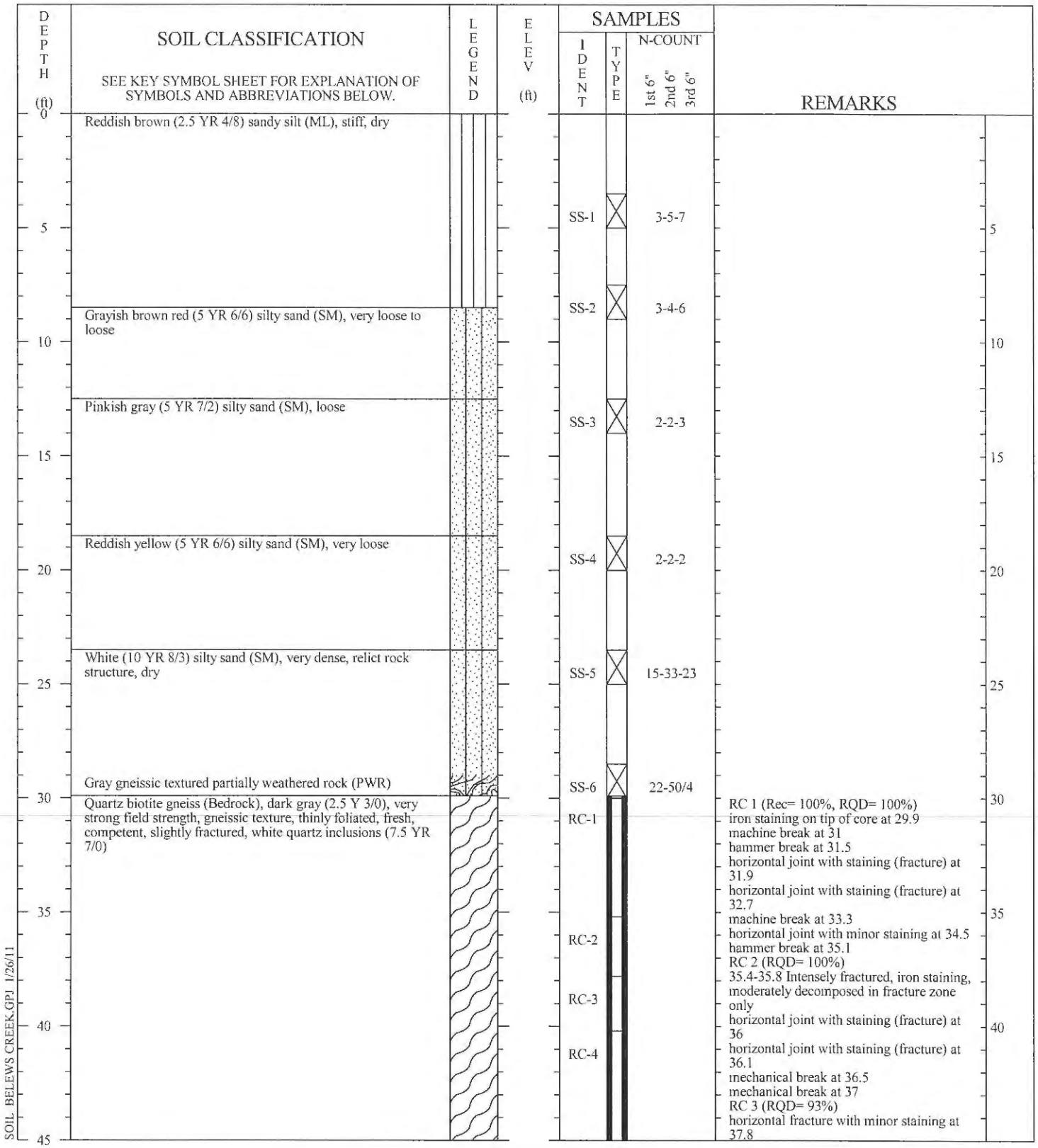

SOIL_BELEWS CREEK.GPJ 1/26/11

DRILLER: Dan Bergman/AE Drilling
EQUIPMENT: CME 750 ATV
METHOD: 4.25" (ID) HSA, HQ Core
HOLE DIA.: 8" HSA, HQ Core
REMARKS:

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

PROJECT: Belews Creek Steam Station
WELL ID: MW-201D

November 16, 2010
PROJ. NO.: 6228105284.04 **PAGE** 1 **OF** 2

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DEPTH (ft)	SOIL CLASSIFICATION SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	LEGEND	ELEV (ft)	SAMPLES IDENT	SAMPLES TYPE	SAMPLES N-COUNT 1st 6" 2nd 6" 3rd 6"	REMARKS
45							mechanical break at 37.9 horizontal joint fracture at healed quart infilling at 39.5 RC 4 (RQD= 86%) mechanical break at 40.3 mechanical break at 40.6 mechanical break at 40.8 near horizontal join with minor staining at 41.2 mechanical break at 42 mechanical break along quartz infilling at 43.3 mechanical break at 44.2
50							
55							
60							
65							
70							
75							
80							
85							
90							

SOIL_BELEWS CREEK.GPJ 1/26/11

DRILLER: Dan Bergman/AE Drilling
EQUIPMENT: CME 750 ATV
METHOD: 4.25" (ID) HSA, HQ Core
HOLE DIA.: 8" HSA, HQ Core
REMARKS:

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

PROJECT: Belews Creek Steam Station
WELL ID: MW-201D

November 16, 2010
PROJ. NO.: 6228105284.04 **PAGE 2 OF 2**

MACTEC

DEPTH (ft)	SOIL CLASSIFICATION SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	LEGEND	ELEV (ft)	SAMPLES: IDENT	SAMPLES: TYPE	SAMPLES: N-COUNT (1st 6" / 2nd 6" / 3rd 6")	REMARKS
0	Reddish brown (5 YR 4/6) clayey silt (ML), micaceous						
15	Light brown (7.5 YR 7/6) clayey silt (ML), micaceous						

SOIL_BELEWS CREEK.GPJ 1/27/11

DRILLER: John Gorman/AE Drilling
EQUIPMENT: CME 750 ATV
METHOD: 4.25" (ID) HSA
HOLE DIA.: 8"
REMARKS:

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

PROJECT: Belews Creek Steam Station
WELL ID: MW-202S

December 17, 2010
PROJ. NO.: 6228105284.04 **PAGE 1 OF 2**

MACTEC

DEPTH (ft)	SOIL CLASSIFICATION SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	LEGEND	ELEV (ft)	SAMPLES: IDENT	SAMPLES: TYPE	SAMPLES: N-COUNT (1st 6" 2nd 6" 3rd 6")	REMARKS
45	Light brown (7.5 YR 7/6) clayey silt (ML), micaceous						
50	Pale yellowish orange (10 YR 8/6) silty fine sand (SM)						
55							
60							
65							
70							
75							
80							
85							
90							

SOIL_BELEWS CREEK.GPJ 1/27/11

DRILLER: John Gorman/AE Drilling
EQUIPMENT: CME 750 ATV
METHOD: 4.25" (ID) HSA
HOLE DIA.: 8"
REMARKS:

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

PROJECT: Belews Creek Steam Station
WELL ID: MW-202S

December 17, 2010
PROJ. NO.: 6228105284.04

MACTEC

DEPTH (ft)	SOIL CLASSIFICATION SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	LEGEND	ELEV (ft)	SAMPLES IDENT	SAMPLES TYPE	SAMPLES N-COUNT 1st 6" 2nd 6" 3rd 6"	REMARKS
0	Reddish brown (5 YR 4/6) clayey silt (ML), stiff, micaceous						
				SS-1	X	4-4-6	
5							
	Light brown (7.5 YR 7/6) clayey silt (ML), stiff, micaceous, some reddish brown mottling			SS-2	X	4-5-6	
10							
	Light brown (7.5 YR 7/6) clayey silt (ML), stiff, micaceous, some reddish brown mottling, some CaCO3 secondary mineralization			SS-3	X	3-4-6	
15							
				SS-4	X	2-4-5	
20							
	Reddish brown (2.5 YR 5/6) clayey silt (ML) with light brown and black mottling, stiff			SS-5	X	4-5-8	
25							
	Light brown (10 YR 6/8) clayey silt (ML) with white and black mottles, stiff to very stiff, micaceous			SS-6	X	5-5-7	
30							
				SS-7	X	12-12-15	
35							
				SS-8	X	2-7-6	
40							
	Light brown (10 YR 6/8) clayey silt (ML) with white and black mottling, very stiff, saprolitic (feldspar) ▼			SS-9	X	7-9-11	
45							

SOIL BELEWS CREEK.GPJ 1/27/11

DRILLER: William Burnette/AE Drilling
EQUIPMENT: CME 750 ATV
METHOD: 4.25" (ID) HSA, HQ Core
HOLE DIA.: 8" HSA, HQ Core
REMARKS:

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

PROJECT: Belews Creek Steam Station
WELL ID: MW-202D

December 15, 2010
PROJ. NO.: 6228105284.04 **PAGE 1 OF 2**

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DEPTH (ft)	SOIL CLASSIFICATION SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	LEGEND	ELEV (ft)	SAMPLES IDENT	SAMPLES TYPE	SAMPLES N-COUNT 1st 6" 2nd 6" 3rd 6"	REMARKS
45	Light brown (10 YR 6/8) clayey silt (ML) with white and black mottling, very stiff, saprolitic (feldspar)						
50				SS-10	X	5-8-10	
55	Pale yellowish orange (10 YR 8/6) silty fine sand (SM), firm			SS-11	X	10-10-14	moist
	Tan (10 YR 6/8) silt (ML), moist, hard			SS-12	X	8-13-30	saprolitic layer
60							
65	Light brown (10 YR 7/6) silty fine sand (SM), moist, dense to very dense			SS-13	X	12-23-34	water entering borehole, spoon is saturated
70				SS-14	X	50/6	
75				SS-15	X	30-50/3	
	Auger Refusal at 79 feet below land surface						
80	Gneiss (Bedrock), very weak yellowish brown (10 YR 5/6), oxidation, gneissic, thinly foliated, highly decomposed, moderately disintigrated, intensely fractured	+ + +					RC 1 (Rec= 35%, RQD= 0%) Runs 1, 2 and 3 are intensely fractured (difficult to determine proximity and whether fracturing is mechanical or jointed) RC 2 (Rec= 24%, RQD= 0%)
85							RC 3 (Rec= 67%, RQD= 13%) Four 45 degree joints parallel to foliation with oxidation/iron staining in bottom foot of Run 3
90							

SOIL_BELEWS CREEK.GPJ 1/27/11

DRILLER: William Burnette/AE Drilling
EQUIPMENT: CME 750 ATV
METHOD: 4.25" (ID) HSA, HQ Core
HOLE DIA.: 8" HSA, HQ Core
REMARKS:

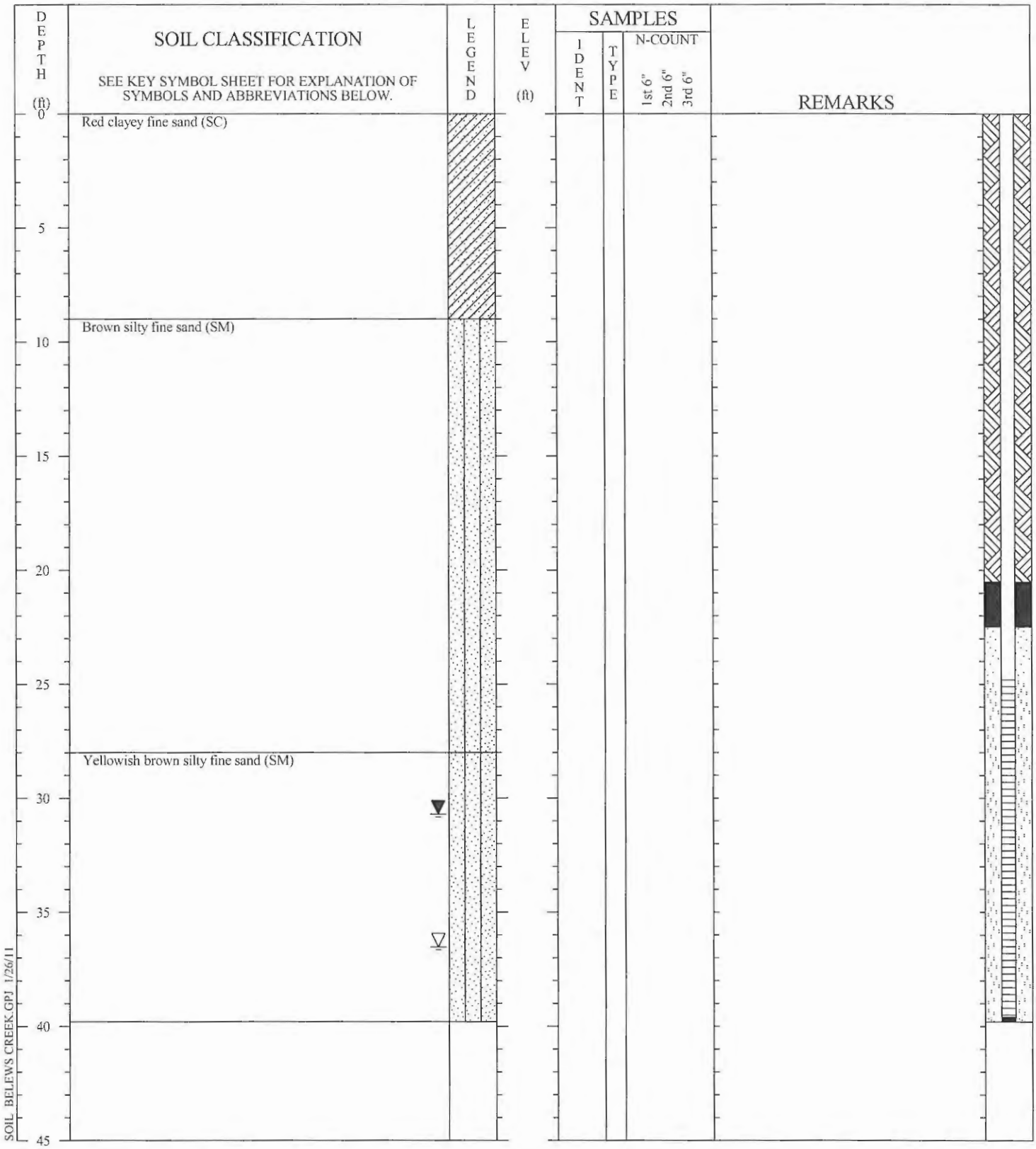
THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

PROJECT: Belews Creek Steam Station
WELL ID: MW-202D

December 15, 2010
PROJ. NO.: 6228105284.04 **PAGE 2 OF 2**

MACTEC



SOIL_BELEWS CREEK.GPJ 1/26/11

DRILLER: John Gorman/AE Drilling
EQUIPMENT: CME 750 ATV
METHOD: 4.25" (ID) HSA
HOLE DIA.: 8"
REMARKS:

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

PROJECT: Belews Creek Steam Station
WELL ID: MW-203S

November 9, 2010
PROJ. NO.: 6228105284.04 **PAGE 1 OF 1**

MACTEC

DEPTH (ft)	SOIL CLASSIFICATION SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	LEGEND	ELEV (ft)	SAMPLES IDENT	SAMPLES TYPE	SAMPLES N-COUNT 1st 6" 2nd 6" 3rd 6"	REMARKS
0	Red (2.5 YR 5/8) clayey sand (SC), some roots, moist						
5	Red (2.5 YR 5/8) clayey very fine sand (SC), very firm, trace roots, moist			SS-1	X	6-9-14	
10	Strong brown (7.5 YR 5/6) silty very fine sand (SM), loose, trace relict rock structure, moist			SS-2	X	3-4-5	
15	Strong brown (7.5 YR 5/6) silty very fine sand (SM), loose, little relict rock structure, moist			SS-3	X	3-3-3	
20	Yellowish brown (10 YR 5/6), silty very fine sand (SM), loose, little relict rock structure, moist			SS-4	X	3-3-4	
25	Strong brown (7.5 YR 5/6), silty very fine sand (SM), loose, some relict rock structure, moist			SS-5	X	3-3-4	
30	Yellowish brown (10 YR 5/6), silty very fine sand (SM), loose, some relict rock structure, moist			SS-6	X	2-2-4	increased moisture
35				SS-7	X	2-3-4	soil cuttings becoming wet
40	Light yellowish brown (2.5 YR 6/3) silty fine sand (SM), some relict rock structure, wet			SS-8	X	3-4-7	
45				SS-9	X	4-5-7	wet and firm

SOIL_BELEWS CREEK.GPJ 1/27/11

DRILLER: Dan Bergman/AE Drilling
EQUIPMENT: CME 750 ATV
METHOD: 4.25" (ID) HSA, HQ Core
HOLE DIA.: 8" HSA, HQ Core
REMARKS:

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

PROJECT: Belews Creek Steam Station
WELL ID: MW-203D

November 9, 2010
PROJ. NO.: 6228105284.04 **PAGE 1 OF 3**

MACTEC

DEPTH (ft)	SOIL CLASSIFICATION SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	LEGEND	ELEV (ft)	SAMPLES IDENT	SAMPLES TYPE	SAMPLES N-COUNT 1st 6" 2nd 6" 3rd 6"	REMARKS
45	Light yellowish brown (2.5 YR 6/3) silty fine sand (SM), some relict rock structure, wet						
	Pale brown (10 YR 6/3) silty sand (SM), very firm, wet			SS-10		6-10-14	trace quartz vein 0.1" in residuum
50							
	Light yellowish brown (2.5 YR 6/8) silty sand (SM), trace to little gravel/quartz, some relict rock structure, very dense, wet			SS-11		2-33-44	
55							
				SS-12		7-17-30	dense and trace quartz
60							slight drill chatter
	Light yellowish brown (2.5 YR 6/3) silty sand (SM), very dense, some strong relict rock structure, moist			SS-13		27-42-53	subhorizontal foliation and trace quartz vein 0.1"
65							67-79.6 Hard drilling
	Light yellowish brown (2.5 YR 6/3) silty sand (SM), very dense, strong relict rock structure with subhorizontal foliation, moist			SS-14		50/0.5	
70							
	Yellowish brown (10 R 5/6) silty sand (SM), very dense, some relict rock structure, moist			SS-15		50/0.2	
75							
				SS-16		50/0.2	RC 1 (Rec= 40%, RQD= 6%)
80	Biotite quartz gneiss (Bedrock), very dark gray (2.5 Y 3/N3) to white (10 YR 8/1) with some secondary oxidation of brownish yellow (10 YR 6/6), friable to moderately indurated, very weak to moderate strength, thinly foliated, moderately decomposed and fractured			RC-1			joints and mechanical breaks, vertical to sub-horizontal, 2-moderately healed 45 degree joints, oxidation and stained joints. Recovery began at 82.6, Fracture zone at 82.8-83.1, vertical joint at 83.1-83.5, 10 degree joint with iron staining at 83.5, 20 degree iron stained joint at 83.6, fracture zone at 83.7 to 84.6 with iron staining.
85	Quartz biotite gneiss (Bedrock), very dark gray (2.5 Y 3/N3) to white (10 YR 8/1), moderately indurated, moderate to strong strength, gniessic texture, thinly foliated, slightly to moderately decomposed, slightly disintegrated			RC-2			RC 2 (Rec= 78%, RQD= 18%) moderately fractured, jointing and mechanical breaks, two 45 degree moderately healed joints, infiltrated noncohesive and mineralization. One horizontal and one 20 degree joint with iron staining at 85.8, one 10 degree iron
90							

SOIL_BELEWS CREEK.GPJ 1/27/11

DRILLER: Dan Bergman/AE Drilling
EQUIPMENT: CME 750 ATV
METHOD: 4.25" (ID) HSA, HQ Core
HOLE DIA.: 8" HSA, HQ Core
REMARKS:

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

PROJECT: Belews Creek Steam Station
WELL ID: MW-203D

November 9, 2010
PROJ. NO.: 6228105284.04 **PAGE 2 OF 3**

MACTEC

DEPTH (ft)	SOIL CLASSIFICATION SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	LEGEND	ELEV (ft)	SAMPLES IDENT	SAMPLES TYPE	SAMPLES N-COUNT 1st 6" 2nd 6" 3rd 6"	REMARKS
90							stained joint at 86.0, 45 degree quartz vein (0.1") at 86.3, one moderately narrow 10 degree iron stained with some disintegrated rock at 86.4, three mineralized horizontal and one mineralized vertical joint at 87.0, two 10 degree iron stained joints at 87.3, one 65 degree partly healed narrow joint from 87.4-87.9, one horizontal joint with iron staining fracture zone, iron stained with disintegration and discolored at 88.2-89.2.
95							
100							
105							
110							
115							
120							
125							
130							
135							

SOIL_BELEWS CREEK.GPJ 1/27/11

DRILLER: Dan Bergman/AE Drilling
EQUIPMENT: CME 750 ATV
METHOD: 4.25" (ID) HSA, HQ Core
HOLE DIA.: 8" HSA, HQ Core
REMARKS:

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

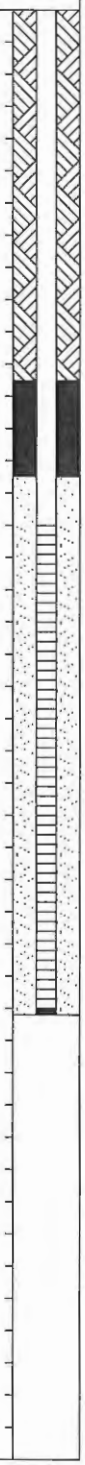
SOIL TEST BORING RECORD

PROJECT: Belews Creek Steam Station
WELL ID: MW-203D

November 9, 2010
PROJ. NO.: 6228105284.04 **PAGE 3 OF 3**

MACTEC

DEPTH (ft)	SOIL CLASSIFICATION SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	LEGEND	ELEV (ft)	SAMPLES IDENT	SAMPLES TYPE	SAMPLES N-COUNT 1st 6" 2nd 6" 3rd 6"	REMARKS
0	Red silty fine sand (SM)						
5							
10							
15							
20	Yellow brown silty fine sand (SM)						
25							
30							
35							
40							
45							



SOIL BELEWS CREEK.GPJ 1/26/11

DRILLER: Dan Bergman/AE Drilling
EQUIPMENT: CME 750 ATV
METHOD: 4.25" (ID) HSA
HOLE DIA.: 8"
REMARKS:

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

PROJECT: Belews Creek Steam Station
WELL ID: MW-204S

November 16, 2010
PROJ. NO.: 6228105284.04 **PAGE 1 OF 1**

MACTEC

DEPTH (ft)	SOIL CLASSIFICATION SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	LEGEND	ELEV (ft)	SAMPLES IDENT	SAMPLES TYPE	SAMPLES N-COUNT 1st 6" 2nd 6" 3rd 6"	REMARKS
0	Red (2.5 YR 5/8) silty sand (SM), loose						
5				SS-1		4-4-3	
10	Reddish pink (10 R 5/6) silty sand (SM), firm			SS-2		3-4-7	
15	(10 YR) silty sand (SM), firm, few relict rock structure			SS-3		5-5-6	
20	Yellow brown (10 YR 6/8) silty sand (SM), firm, few relict rock structure			SS-4		5-5-7	
25	Reddish brown (2.5 YR 4/8) silty sand (SM), firm, with relict rock structure and small rock fragments			SS-5		5-6-13	
30	Yellow (pale) brown (10 YR 5/6) sandy silt (SM), very dense, few gray rock fragments, wet			SS-6		15-42-50/3	
35	Biotite gneiss (Bedrock), dark gray (2.5 YR 3/0), very strong field strength, gneissic texture, thinly foliated, fresh, competent, intensely fractured			RC-1			RC 1 (Rec= 100%, RQD= 68%) horizontal joint at 33.1 shallow angle fracture with oxidation and staining at 34.1 shallow angle fracture with oxidation and staining at 34.2 mechanical break at 34.3 shallow angle joint fracture with staining at 34.4 shallow angle joint fracture with staining at 34.5 horizontal fracture joint at 34.7 horizontal fracture joint with staining at 34.9 horizontal fracture joint with staining at 35.4 horizontal fracture joint with staining at 36.1 RC 2 (Rec= 100%, RQD= 95%)
40	Biotite gneiss (Bedrock), dark gray (2.5 YR 3/0), very strong, gneissic texture, thinly foliated, fresh, competent, slightly fractured			RC-2			
45							

SOIL_BELEWS CREEK.GPJ 1/27/11

DRILLER: Dan Bergman/AE Drilling
EQUIPMENT: CME 750 ATV
METHOD: 4.25" (ID) HSA, HQ Core
HOLE DIA.: 8" HSA, HQ Core
REMARKS:

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

PROJECT: Belews Creek Steam Station
WELL ID: MW-204D

November 15, 2010
PROJ. NO.: 6228105284.04 **PAGE 1 OF 2**

MACTEC

DEPTH (ft)	SOIL CLASSIFICATION SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	LEGEND	ELEV (ft)	SAMPLES: IDENT	SAMPLES: TYPE	SAMPLES: N-COUNT 1st 6" / 2nd 6" / 3rd 6"	REMARKS
45							horizontal fracture with minor staining at 37.5 horizontal fracture with minor staining at 37.9 horizontal fracture with minor staining at 38.2 mechanical breaks at 38.5, 39.0, 39.2, 41.5, 42.5, 42.9 and 43.1
50							
55							
60							
65							
70							
75							
80							
85							
90							

SOIL_BELEWS CREEK.GPJ 1/27/11

DRILLER: Dan Bergman/AE Drilling
EQUIPMENT: CME 750 ATV
METHOD: 4.25" (ID) HSA, HQ Core
HOLE DIA.: 8" HSA, HQ Core
REMARKS:

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

PROJECT: Belews Creek Steam Station
WELL ID: MW-204D

November 15, 2010
PROJ. NO.: 6228105284.04 **PAGE 2 OF 2**

MACTEC

APPENDIX C

NCDENR MONITORING WELL CONSTRUCTION RECORDS

NON RESIDENTIAL WELL CONSTRUCTION RECORD

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

WELL CONTRACTOR CERTIFICATION # 3485-A

1. WELL CONTRACTOR: John Gorman
Well Contractor (Individual) Name
A.E. Drilling Services, Inc.
Well Contractor Company Name
Two United Way
Street Address
Greenville SC 29607
City or Town State Zip Code
(864) 288-1986
Area code Phone number

2. WELL INFORMATION:
WELL CONSTRUCTION PERMIT#
OTHER ASSOCIATED PERMIT#(if applicable)
SITE WELL ID #(if applicable) MW-204S

3. WELL USE (Check One Box) Monitoring ■ Municipal/Public ☐
Industrial/Commercial ☐ Agricultural ☐ Recovery ☐ Injection ☐
Irrigation ☐ Other ☐ (list use)
DATE DRILLED 11-16-10

4. WELL LOCATION:
3195 Pine Hall Road. Belews Creek. NC 2700^
(Street Name, Numbers, Community, Subdivision, Lot No., Parcel, Zip Code)
CITY: Belews Creek COUNTY Stokes
TOPOGRAPHIC / LAND SETTING: (check appropriate box)
☐Slope ☐Valley ■Flat ☐Ridge ☐Other
LATITUDE 36 ° 17 ' 29.335 " DMS OR DD
LONGITUDE 80 ° 04 ' 54.732 " DMS OR DD
Latitude/longitude source: ■GPS ☐Topographic map
(location of well must be shown on a USGS topo map andattached to this form if not using GPS)

5. FACILITY (Name of the business where the well is located.)
Duke Energy Belews Creek
Facility Name Facility ID# (if applicable)
3195 Pine Hall Road
Street Address
Belews Creek NC 27009
City or Town State Zip Code
Ed Sullivan
Contact Name
P.O. Box 37929
Mailing Address
Charlotte NC 28237
City or Town State Zip Code
(980) 373-3719
Area code Phone number

6. WELL DETAILS:
a. **TOTAL DEPTH:** 31.2'
b. **DOES WELL REPLACE EXISTING WELL?** YES ☐ NO ■
c. **WATER LEVEL** Below Top of Casing: 26.16 FT. +
(Use "+" if Above Top of Casing)

d. **TOP OF CASING IS** 2.8 FT. Above Land Surface*
*Top of casing terminated at/or below land surface may require a variance in accordance with 15A NCAC 2C .0118.
e. **YIELD (gpm):** N/M **METHOD OF TEST**
f. **DISINFECTION: Type** N/A **Amount**
g. **WATER ZONES** (depth):
Top Bottom Top Bottom
Top Bottom Top Bottom
Top Bottom Top Bottom

7. CASING:	Depth		Diameter	Thickness/ Weight	Material
Top 0	Bottom 16	Ft. 2		Sch 40	PVC
Top	Bottom	Ft.			
Top	Bottom	Ft.			

8. GROUT:	Depth		Material	Method
Top 0	Bottom 11.5	Ft.	Cement	
Top 11.4	Bottom 14.5	Ft.	Bentonite	
Top	Bottom	Ft.		

9. SCREEN:	Depth		Diameter	Slot Size	Material
Top 16	Bottom 31	Ft. 2 in.		0.010 in.	PVC
Top	Bottom	Ft. in.		in.	
Top	Bottom	Ft. in.		in.	

10. SAND/GRAVEL PACK:

	Depth		Size	Material
Top 0	Bottom 31.2	Ft.	#1	Sand
Top	Bottom	Ft.		
Top	Bottom	Ft.		

11. DRILLING LOG

Top	Bottom	Formation Description
0	31	silty sand / sandy silt

12. REMARKS:

I DO HEREBY 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.

SIGNATURE OF CERTIFIED WELL CONTRACTOR DATE 1/11

John Gorman
PRINTED NAME OF PERSON CONSTRUCTING THE WELL

Submit within 30 days of completion to: Division of Water Quality - Information Processing,
1617 Mail Service Center, Raleigh, NC 27699-161, Phone : (919) 807-6300

Form GW-1b
Rev. 2/09

NON RESIDENTIAL WELL CONSTRUCTION RECORD

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

WELL CONTRACTOR CERTIFICATION # 3485-A

1. WELL CONTRACTOR: John Gorman
Well Contractor (Individual) Name
A.E. Drilling Services, Inc.
Well Contractor Company Name
Two United Way
Street Address
Greenville SC 29607
City or Town State Zip Code
(864) 288-1986
Area code Phone number

2. WELL INFORMATION:
WELL CONSTRUCTION PERMIT#
OTHER ASSOCIATED PERMIT#(if applicable)
SITE WELL ID #(if applicable) MW-204D

3. WELL USE (Check One Box) Monitoring ● Municipal/Public ☐
Industrial/Commercial ☐ Agricultural ☐ Recovery ☐ Injection ☐
Irrigation ☐ Other ☐ (list use)
DATE DRILLED 11-15-10

4. WELL LOCATION:
3195 Pine Hall Road. Belews Creek. NC 2700^
(Street Name, Numbers, Community, Subdivision, Lot No., Parcel, Zip Code)
CITY: Belews Creek COUNTY Stokes
TOPOGRAPHIC / LAND SETTING: (check appropriate box)
☐ Slope ☐ Valley ● Flat ☐ Ridge ☐ Other
LATITUDE 36 ° 17 ' 29.300 " DMS OR DD
LONGITUDE 80 ° 04 ' 54.748 " DMS OR DD
Latitude/longitude source: ● GPS ☐ Topographic map
(location of well must be shown on a USGS topo map andattached to this form if not using GPS)

5. FACILITY (Name of the business where the well is located.)
Duke Energy Belews Creek
Facility Name Facility ID# (if applicable)
3195 Pine Hall Road
Street Address
Belews Creek NC 27009
City or Town State Zip Code
Ed Sullivan
Contact Name
P.O. Box 37929
Mailing Address
Charlotte NC 28237
City or Town State Zip Code
(980) 373-3719
Area code Phone number

6. WELL DETAILS:
a. **TOTAL DEPTH:** 38.2
b. **DOES WELL REPLACE EXISTING WELL?** YES ☐ NO ●
c. **WATER LEVEL** Below Top of Casing: 26.86 FT. +
(Use "+" if Above Top of Casing)

d. **TOP OF CASING IS** 2.9 FT. Above Land Surface*
*Top of casing terminated at/or below land surface may require a variance in accordance with 15A NCAC 2C .0118.
e. **YIELD (gpm):** N/M **METHOD OF TEST**
f. **DISINFECTION: Type** N/A **Amount**
g. **WATER ZONES** (depth):
Top Bottom Top Bottom
Top Bottom Top Bottom
Top Bottom Top Bottom

7. CASING:

	Depth		Diameter	Thickness/ Weight	Material
Top 0.0	Bottom 33	Ft.	2 in	sch40	PVC
Top	Bottom	Ft.			
Top	Bottom	Ft.			

8. GROUT:

	Depth		Material	Method
Top	Bottom	Ft.	cement	
Top	Bottom	Ft.	Bentonite	
Top	Bottom	Ft.		

9. SCREEN:

	Depth		Diameter	Slot Size	Material
Top 33	Bottom 38	Ft. 2	in. 0.010	in.	PVC
Top	Bottom	Ft.	in.	in.	
Top	Bottom	Ft.	in.	in.	

10. SAND/GRAVEL PACK:

	Depth		Size	Material
Top 31.2	Bottom 45.2	Ft.	#2	sand
Top	Bottom	Ft.		
Top	Bottom	Ft.		

11. DRILLING LOG

Top	Bottom	Formation Description
0	32	silty sand / sandy silt
32	45	biotite gneiss

12. REMARKS:

I DO HEREBY 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.

SIGNATURE OF CERTIFIED WELL CONTRACTOR — DATE 1/11

John Gorman
PRINTED NAME OF PERSON CONSTRUCTING THE WELL

Submit within 30 days of completion to: Division of Water Quality - Information Processing,
1617 Mail Service Center, Raleigh, NC 27699-161, Phone : (919) 807-6300

Form GW-1b
Rev. 2/09

NON RESIDENTIAL WELL CONSTRUCTION RECORD

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

WELL CONTRACTOR CERTIFICATION # 3485-A

1. WELL CONTRACTOR: John Gorman
Well Contractor (Individual) Name
A.E. Drilling Services, Inc.
Well Contractor Company Name
Two United Way
Street Address
Greenville SC 29607
City or Town State Zip Code
(864) 288-1986
Area code Phone number

2. WELL INFORMATION:
WELL CONSTRUCTION PERMIT#
OTHER ASSOCIATED PERMIT#(if applicable)
SITE WELL ID #(if applicable) MW-202D

3. WELL USE (Check One Box) Monitoring ● Municipal/Public ☐
Industrial/Commercial ☐ Agricultural ☐ Recovery ☐ Injection ☐
Irrigation ☐ Other ☐ (list use)
DATE DRILLED 12-17-10

4. WELL LOCATION:
3195 Pine Hall Road. Belews Creek. NC 2700^
(Street Name, Numbers, Community, Subdivision, Lot No., Parcel, Zip Code)
CITY: Belews Creek COUNTY Stokes
TOPOGRAPHIC / LAND SETTING: (check appropriate box)
●Slope ☐Valley ☐Flat ☐Ridge ☐Other
LATITUDE 36 ° 16 ' 37.447 " DMS OR DD
LONGITUDE 80 ° 04 ' 27.397 " DMS OR DD
Latitude/longitude source: ●GPS ☐Topographic map
(location of well must be shown on a USGS topo map andattached to this form if not using GPS)

5. FACILITY (Name of the business where the well is located.)
Duke Energy Belews Creek
Facility Name Facility ID# (if applicable)
3195 Pine Hall Road
Street Address
Belews Creek NC 27009
City or Town State Zip Code
Ed Sullivan
Contact Name
P.O. Box 37929
Mailing Address
Charlotte NC 28237
City or Town State Zip Code
(980) 373-3719
Area code Phone number

6. WELL DETAILS:
a. **TOTAL DEPTH:** 89.2'
b. **DOES WELL REPLACE EXISTING WELL?** YES ☐ NO ●
c. **WATER LEVEL** Below Top of Casing: 47.52 FT +
(Use "+" if Above Top of Casing)

d. **TOP OF CASING IS** 2.9 FT. Above Land Surface*
*Top of casing terminated at/or below land surface may require a variance in accordance with 15A NCAC 2C .0118.
e. **YIELD (gpm):** N/M **METHOD OF TEST**
f. **DISINFECTION: Type** N/A **Amount**
g. **WATER ZONES** (depth):
Top Bottom Top Bottom
Top Bottom Top Bottom
Top Bottom Top Bottom

7. CASING:	Depth	Diameter	Thickness/ Weight	Material
Top 0.0	Bottom 84.0 Ft.	2in	Sch 40	PVC
Top	Bottom Ft.			
Top	Bottom Ft.			

8. GROUT:	Depth	Material	Method
Top 0.0	Bottom 80.0 Ft.	cement	
Top 80.0	Bottom 82.0 Ft.	Bentonite	
Top	Bottom Ft.		

9. SCREEN:	Depth	Diameter	Slot Size	Material
Top 84.0	Bottom 89.0 Ft.	2 in.	0.010 in.	PVC
Top	Bottom Ft.	in.	in.	
Top	Bottom Ft.	in.	in.	

10. SAND/GRAVEL PACK:	Depth	Size	Material
Top 82.0	Bottom 89.2 Ft.	#2	Sand
Top	Bottom Ft.		
Top	Bottom Ft.		

11. DRILLING LOG

Top	Bottom	Formation Description
0	79	clayey silt and silty sand
79	89	Biotite Gneiss

12. REMARKS:

I DO HEREBY 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.

SIGNATURE OF CERTIFIED WELL CONTRACTOR DATE 1/11

John Gorman
PRINTED NAME OF PERSON CONSTRUCTING THE WELL

Submit within 30 days of completion to: Division of Water Quality - Information Processing, 1617 Mail Service Center, Raleigh, NC 27699-161, Phone : (919) 807-6300

Form GW-1b
Rev. 2/09

NON RESIDENTIAL WELL CONSTRUCTION RECORD

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

WELL CONTRACTOR CERTIFICATION # 3485-A

1. WELL CONTRACTOR: John Gorman
Well Contractor (Individual) Name
A.E. Drilling Services, Inc.
Well Contractor Company Name
Two United Way
Street Address
Greenville SC 29607
City or Town State Zip Code
(864) 288-1986
Area code Phone number

2. WELL INFORMATION:
WELL CONSTRUCTION PERMIT#
OTHER ASSOCIATED PERMIT#(if applicable)
SITE WELL ID #(if applicable) MW-202S

3. WELL USE (Check One Box) Monitoring ☒ Municipal/Public ☐
Industrial/Commercial ☐ Agricultural ☐ Recovery ☐ Injection ☐
Irrigation ☐ Other ☐ (list use)
DATE DRILLED 12-17-10

4. WELL LOCATION:
3195 Pine Hall Road. Belews Creek. NC 2700^
(Street Name, Numbers, Community, Subdivision, Lot No., Parcel, Zip Code)
CITY: Belews Creek COUNTY Stokes
TOPOGRAPHIC / LAND SETTING: (check appropriate box)
☒ Slope ☐ Valley ☐ Flat ☐ Ridge ☐ Other
LATITUDE 36 ° 16 ' 37.408 " DMS OR DD
LONGITUDE 80 ° 04 ' 27.339 " DMS OR DD
Latitude/longitude source: ☒ GPS ☐ Topographic map
(location of well must be shown on a USGS topo map andattached to this form if not using GPS)

5. FACILITY (Name of the business where the well is located.)
Duke Energy Belews Creek
Facility Name Facility ID# (if applicable)
3195 Pine Hall Road
Street Address
Belews Creek NC 27009
City or Town State Zip Code
Ed Sullivan
Contact Name
P.O. Box 37929
Mailing Address
Charlotte NC 28237
City or Town State Zip Code
(980) 373-3719
Area code Phone number

6. WELL DETAILS:
a. **TOTAL DEPTH:** 57.2
b. **DOES WELL REPLACE EXISTING WELL?** YES ☐ NO ☒
c. **WATER LEVEL** Below Top of Casing: 46.67 FT. +
(Use "+" if Above Top of Casing)

d. **TOP OF CASING IS** 2.4 FT. Above Land Surface*
*Top of casing terminated at/or below land surface may require a variance in accordance with 15A NCAC 2C .0118.
e. **YIELD (gpm):** N/M **METHOD OF TEST**
f. **DISINFECTION:** Type N/A **Amount**
g. **WATER ZONES** (depth):
Top Bottom Top Bottom
Top Bottom Top Bottom
Top Bottom Top Bottom

7. CASING:	Depth	Diameter	Thickness/ Weight	Material
Top 0.0	Bottom 37.0 Ft.	2in	sch 40	PVC
Top	Bottom Ft.			
Top	Bottom Ft.			

8. GROUT:	Depth	Material	Method
Top 33.0	Bottom 35.0 Ft.	Bentonite	
Top 0.0	Bottom 33.0 Ft.	Cement	
Top	Bottom Ft.		

9. SCREEN:	Depth	Diameter	Slot Size	Material
Top 37.0	Bottom 57.0 Ft.	2 in.	0.010 in.	PVC
Top	Bottom Ft.	in.	in.	
Top	Bottom Ft.	in.	in.	

10. SAND/GRAVEL PACK:	Depth	Size	Material
Top 35.0	Bottom 57.5 Ft.	#1	sand
Top	Bottom Ft.		
Top	Bottom Ft.		

11. DRILLING LOG

Top	Bottom	Formation Description
0	57.5	clayey silt & silty sand

12. REMARKS:

I DO HEREBY 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.

SIGNATURE OF CERTIFIED WELL CONTRACTOR 1/11 DATE

John Gorman
PRINTED NAME OF PERSON CONSTRUCTING THE WELL

Submit within 30 days of completion to: Division of Water Quality - Information Processing, 1617 Mail Service Center, Raleigh, NC 27699-161, Phone : (919) 807-6300

Form GW-1b
Rev. 2/09

NON RESIDENTIAL WELL CONSTRUCTION RECORD

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

WELL CONTRACTOR CERTIFICATION # 3485-A

1. WELL CONTRACTOR: John Gorman
Well Contractor (Individual) Name

A.E. Drilling Services, Inc.
Well Contractor Company Name

Two United Way
Street Address

Greenville SC 29607
City or Town State Zip Code

(864) 288-1986
Area code Phone number

2. WELL INFORMATION:

WELL CONSTRUCTION PERMIT#

OTHER ASSOCIATED PERMIT#(if applicable)

SITE WELL ID #(if applicable) MW-2005

3. WELL USE (Check One Box) Monitoring ☒ Municipal/Public ☐
Industrial/Commercial ☐ Agricultural ☐ Recovery ☐ Injection ☐
Irrigation ☐ Other ☐ (list use)

DATE DRILLED 11/12/10

4. WELL LOCATION:

3195 Pine Hall Road. Belews Creek. NC 2700^
(Street Name, Numbers, Community, Subdivision, Lot No., Parcel, Zip Code)

CITY: Belews Creek COUNTY Stokes

TOPOGRAPHIC / LAND SETTING: (check appropriate box)
☐ Slope ☒ Valley ☐ Flat ☐ Ridge ☐ Other

LATITUDE 36 ° 17 ' 56.339" DMS OR _____ DD

LONGITUDE 80 ° 4 ' 31.642" DMS OR _____ DD

Latitude/longitude source: ☒ GPS ☐ Topographic map
(location of well must be shown on a USGS topo map andattached to this form if not using GPS)

5. FACILITY (Name of the business where the well is located.)

Duke Energy Belews Creek
Facility Name Facility ID# (if applicable)

3195 Pine Hall Road
Street Address

Belews Creek NC 27009
City or Town State Zip Code

Ed Sullivan
Contact Name

P.O. Box 37929
Mailing Address

Charlotte NC 28237
City or Town State Zip Code

(980) 373-3719
Area code Phone number

6. WELL DETAILS:

a. **TOTAL DEPTH:** 10.2

b. **DOES WELL REPLACE EXISTING WELL?** YES ☐ NO ☒

c. **WATER LEVEL** Below Top of Casing: 5.07 FT. +
(Use "+" if Above Top of Casing)

d. **TOP OF CASING IS** 2.7 FT. Above Land Surface*
*Top of casing terminated at/or below land surface may require a variance in accordance with 15A NCAC 2C .0118.

e. **YIELD (gpm):** N/m **METHOD OF TEST**

f. **DISINFECTION:** Type N/A **Amount**

g. **WATER ZONES** (depth):
Top Bottom Top Bottom
Top Bottom Top Bottom
Top Bottom Top Bottom

7. CASING:

	Depth		Diameter	Thickness/ Weight	Material
Top 0.0	Bottom 2.4	Ft.	2 inch	sch 40	PVC
Top	Bottom	Ft.			
Top	Bottom	Ft.			

8. GROUT:

	Depth		Material	Method
Top 0.0	Bottom 0.5	Ft.	Cement	
Top 0.5	Bottom 1.5	Ft.	Bentonite	
Top	Bottom	Ft.		

9. SCREEN:

	Depth		Diameter		Slot Size		Material
Top 2.4	Bottom 10.0	Ft.	2	in.	0.010	in.	PVC
Top	Bottom	Ft.		in.		in.	
Top	Bottom	Ft.		in.		in.	

10. SAND/GRAVEL PACK:

	Depth		Size	Material
Top 1.5	Bottom 10.2	Ft.	GP-1	Sand
Top	Bottom	Ft.		
Top	Bottom	Ft.		

11. DRILLING LOG

Top	Bottom	Formation Description
0	10	clayey sand

12. REMARKS:

I DO HEREBY 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.

SIGNATURE OF CERTIFIED WELL CONTRACTOR 1/11 DATE

John Gorman
PRINTED NAME OF PERSON CONSTRUCTING THE WELL

Submit within 30 days of completion to: Division of Water Quality - Information Processing, 1617 Mail Service Center, Raleigh, NC 27699-161, Phone : (919) 807-6300

Form GW-1b
Rev. 2/09

NON RESIDENTIAL WELL CONSTRUCTION RECORD

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

WELL CONTRACTOR CERTIFICATION # 3485-A

1. WELL CONTRACTOR: John Gorman
Well Contractor (Individual) Name
A.E. Drilling Services, Inc.
Well Contractor Company Name
Two United Way
Street Address
Greenville SC 29607
City or Town State Zip Code
(864) 288-1986
Area code Phone number

2. WELL INFORMATION:
WELL CONSTRUCTION PERMIT#
OTHER ASSOCIATED PERMIT#(if applicable)
SITE WELL ID #(if applicable) MW-200D

3. WELL USE (Check One Box) Monitoring ● Municipal/Public ☐
Industrial/Commercial ☐ Agricultural ☐ Recovery ☐ Injection ☐
Irrigation ☐ Other ☐ (list use)
DATE DRILLED 11-12-10

4. WELL LOCATION:
3195 Pine Hall Road. Belews Creek. NC 2700^
(Street Name, Numbers, Community, Subdivision, Lot No., Parcel, Zip Code)
CITY: Belews Creek COUNTY Stokes
TOPOGRAPHIC / LAND SETTING: (check appropriate box)
☐ Slope ● Valley ☐ Flat ☐ Ridge ☐ Other
LATITUDE 36 ° 17 ' 56.331 " DMS OR DD
LONGITUDE 80 ° 04 ' 31.704 " DMS OR DD
Latitude/longitude source: ● GPS ☐ Topographic map
(location of well must be shown on a USGS topo map andattached to this form if not using GPS)

5. FACILITY (Name of the business where the well is located.)
Duke Energy Belews Creek
Facility Name Facility ID# (if applicable)
3195 Pine Hall Road
Street Address
Belews Creek NC 27009
City or Town State Zip Code
Ed Sullivan
Contact Name
P.O. Box 37929
Mailing Address
Charlotte NC 28237
City or Town State Zip Code
(980) 373-3719
Area code Phone number

6. WELL DETAILS:
a. **TOTAL DEPTH:** 16.7
b. **DOES WELL REPLACE EXISTING WELL?** YES ☐ NO ●
c. **WATER LEVEL** Below Top of Casing: 6.18 FT. +
(Use "+" if Above Top of Casing)

d. **TOP OF CASING IS** 2.7 FT. Above Land Surface*
*Top of casing terminated at/or below land surface may require a variance in accordance with 15A NCAC 2C .0118.
e. **YIELD (gpm):** N/M **METHOD OF TEST**
f. **DISINFECTION: Type** N/A **Amount**
g. **WATER ZONES** (depth):
Top Bottom Top Bottom
Top Bottom Top Bottom
Top Bottom Top Bottom

7. CASING:	Depth		Diameter	Thickness/ Weight	Material
Top 0	Bottom 11.7	Ft.	2in	sch 40	PVC
Top	Bottom	Ft.			
Top	Bottom	Ft.			

8. GROUT:	Depth		Material	Method
Top 0.0	Bottom 8.0	Ft.	cement	
Top 8.0	Bottom 10.5	Ft.	Bentonite	
Top	Bottom	Ft.		

9. SCREEN:	Depth		Diameter		Slot Size		Material
Top 11.7	Bottom 16.5	Ft.	2	in.	0.010	in.	PVC
Top	Bottom	Ft.		in.		in.	
Top	Bottom	Ft.		in.		in.	

10. SAND/GRAVEL PACK:

	Depth		Size	Material
Top 10.5	Bottom 20.8	Ft.	GP-2	sand
Top	Bottom	Ft.		
Top	Bottom	Ft.		

11. DRILLING LOG

Top	Bottom	Formation Description
0	10	clayey and silty sand
10	20	Biotite gneiss

12. REMARKS:

I DO HEREBY 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.

SIGNATURE OF CERTIFIED WELL CONTRACTOR DATE 1/11

John Gorman
PRINTED NAME OF PERSON CONSTRUCTING THE WELL

Submit within 30 days of completion to: Division of Water Quality - Information Processing, 1617 Mail Service Center, Raleigh, NC 27699-161, Phone : (919) 807-6300

Form GW-1b
Rev. 2/09

NON RESIDENTIAL WELL CONSTRUCTION RECORD

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

WELL CONTRACTOR CERTIFICATION # 3485-A

1. WELL CONTRACTOR: JOHN GORMAN
Well Contractor (Individual) Name

A E DRILLING SERVICES, LLC
Well Contractor Company Name

Two United Way
Street Address

Greenville SC 29607
City or Town State Zip Code

(864) 288-1986
Area code Phone number

2. WELL INFORMATION:

WELL CONSTRUCTION PERMIT#

OTHER ASSOCIATED PERMIT#(if applicable)

SITE WELL ID #(if applicable) ~~MW-203~~ MW-203D

3. WELL USE (Check One Box) Monitoring ☒ Municipal/Public ☐
Industrial/Commercial ☐ Agricultural ☐ Recovery ☐ Injection ☐
Irrigation ☐ Other ☐ (list use)

DATE DRILLED 11-10-10

4. WELL LOCATION:
3195 Pine Hall Rd. Belews Creek, NC
(Street Name, Numbers, Community, Subdivision, Lot No., Parcel, Zip Code)

CITY: Belews Creek COUNTY Stokes

TOPOGRAPHIC / LAND SETTING: (check appropriate box)
~~Slope~~ ☐Valley ☐Flat ~~Ridge~~ ☐Other

LATITUDE 36 ° 17 ' 17.914 " DMS OR 3x.xxxxxxxx DD

LONGITUDE ~~80~~ 080 ° 04 ' 48.893 " DMS OR 7x.xxxxxxxx DD

Latitude/longitude source: ☒GPS ☐Topographic map
(location of well must be shown on a USGS topo map andattached to this form if not using GPS)

5. FACILITY (Name of the business where the well is located.)

Facility Name Facility ID# (if applicable)

Street Address

City or Town State Zip Code

Contact Name

Mailing Address

City or Town State Zip Code

( ) Area code Phone number

6. WELL DETAILS:

a. TOTAL DEPTH: 89.6

b. DOES WELL REPLACE EXISTING WELL? YES ☐ NO ☒

c. WATER LEVEL Below Top of Casing: 32.93 FT. +
(Use "+" if Above Top of Casing)

d. TOP OF CASING IS ~~3.0~~ 2.2 FT. Above Land Surface*
*Top of casing terminated at/or below land surface may require a variance in accordance with 15A NCAC 2C .0118.

e. YIELD (gpm): N/M METHOD OF TEST

f. DISINFECTION: Type N/A Amount

g. WATER ZONES (depth):
Top Bottom Top Bottom
Top Bottom Top Bottom
Top Bottom Top Bottom

7. CASING:

	Depth		Diameter	Thickness/ Weight	Material
Top +3.0	Bottom 84.4	Ft.	2"	SCH040	PVC
Top	Bottom	Ft.			
Top	Bottom	Ft.			

8. GROUT:

	Depth		Material	Method
Top 0.0	Bottom 80.2	Ft.	PORTLAND	TREMIE
Top	Bottom	Ft.		
Top	Bottom	Ft.		

9. SCREEN:

	Depth		Diameter		Slot Size		Material
Top 84.4	Bottom 89.4	Ft.	2	In.	.01	in.	PVC
Top	Bottom	Ft.		In.		in.	
Top	Bottom	Ft.		In.		in.	

10. SAND/GRAVEL PACK:

	Depth		Size	Material
Top 82.5	Bottom 89.6	Ft.	#1	SAND
Top	Bottom	Ft.		
Top	Bottom	Ft.		

11. DRILLING LOG

Top	Bottom	Formation Description
0	79	clayey & silty Sand
79	89	Biotite gneiss

12. REMARKS:

I DO HEREBY 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.

John Gorman 11-12-10
SIGNATURE OF CERTIFIED WELL CONTRACTOR DATE

JOHN GORMAN
PRINTED NAME OF PERSON CONSTRUCTING THE WELL

Sameas other

Submit the original to the Division of Water Quality within 30 days. Attn: Information Mgt., 1617 Mail Service Center – Raleigh, NC 27699-1617 Phone No. (919) 807-6300

Form GW-1b
Rev. 11/08

NON RESIDENTIAL WELL CONSTRUCTION RECORD

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

WELL CONTRACTOR CERTIFICATION # 3485-A

1. WELL CONTRACTOR: JOHN GORMAN
Well Contractor (Individual) Name

A E DRILLING SERVICES, LLC
Well Contractor Company Name

Two United Way
Street Address

Greenville SC 29607
City or Town State Zip Code

(864) 288-1986
Area code Phone number

2. WELL INFORMATION:

WELL CONSTRUCTION PERMIT#

OTHER ASSOCIATED PERMIT#(if applicable)

SITE WELL ID #(if applicable) ~~MW-2035~~ MW-2035

3. WELL USE (Check One Box) Monitoring ☒ Municipal/Public ☐
Industrial/Commercial ☐ Agricultural ☐ Recovery ☐ Injection ☐
Irrigation ☐ Other ☐ (list use)

DATE DRILLED 11-9-10

4. WELL LOCATION:
3195 Pine Hall Road, Belews Creek, NC
(Street Name, Numbers, Community, Subdivision, Lot No., Parcel, Zip Code)

CITY: Belews Creek COUNTY Stokes

TOPOGRAPHIC / LAND SETTING: (check appropriate box)
☒ Slope ☐ Valley ☐ Flat ☒ Ridge ☐ Other

LATITUDE 36 ° 17 ' 18.021 " DMS OR 3x.xxxxxxxx DD

LONGITUDE ~~79~~ 80 ° 04 ' 48.966 " DMS OR 7x.xxxxxxxx DD

Latitude/longitude source: ☒ GPS ☐ Topographic map
(location of well must be shown on a USGS topo map andattached to this form if not using GPS)

5. FACILITY (Name of the business where the well is located.)

Same as others for Belews

Facility Name Facility ID# (if applicable)

Street Address

City or Town State Zip Code

Contact Name

Mailing Address

City or Town State Zip Code

( ) Area code Phone number

6. WELL DETAILS:

a. **TOTAL DEPTH:** 39.8

b. **DOES WELL REPLACE EXISTING WELL?** YES ☐ NO ☒

c. **WATER LEVEL** Below Top of Casing: 33.37 FT. +
(Use "+" if Above Top of Casing)

d. **TOP OF CASING IS** 2.7 FT. Above Land Surface*
*Top of casing terminated at/or below land surface may require a variance in accordance with 15A NCAC 2C .0118.

e. **YIELD (gpm):** N/M **METHOD OF TEST**

f. **DISINFECTION: Type** N/A **Amount**

g. **WATER ZONES** (depth):
Top Bottom Top Bottom
Top Bottom Top Bottom
Top Bottom Top Bottom

7. CASING:	Depth		Diameter	Thickness/ Weight	Material
Top	2.9	Bottom 24.6 Ft.	2"	SCH 40	PVC
Top		Bottom Ft.			
Top		Bottom Ft.			

8. GROUT:	Depth		Material	Method
Top	0.0	Bottom 20.5 Ft.	PORTLAND	TREMIE
Top		Bottom Ft.		
Top		Bottom Ft.		

9. SCREEN:	Depth		Diameter	Slot Size	Material
Top	24.6	Bottom 39.6 Ft.	2 in.	.01 in.	PVC
Top		Bottom Ft.	in.	in.	
Top		Bottom Ft.	in.	in.	

10. SAND/GRAVEL PACK:

	Depth		Size	Material
Top	22.5	Bottom 39.8 Ft.	#1	SAND
Top		Bottom Ft.		
Top		Bottom Ft.		

11. DRILLING LOG

Top	Bottom	Formation Description
0	39.8	silty and clayey sand

12. REMARKS:

I DO HEREBY 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.

SIGNATURE OF CERTIFIED WELL CONTRACTOR 11-11-10 DATE

JOHN GORMAN
PRINTED NAME OF PERSON CONSTRUCTING THE WELL

Submit the original to the Division of Water Quality within 30 days. Attn: Information Mgt., 1617 Mail Service Center – Raleigh, NC 27699-1617 Phone No. (919) 807-6300

Form GW-1b
Rev. 11/08

NON RESIDENTIAL WELL CONSTRUCTION RECORD

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

WELL CONTRACTOR CERTIFICATION # 3485-A

1. WELL CONTRACTOR: John Gorman
Well Contractor (Individual) Name
A.E. Drilling Services, Inc.
Well Contractor Company Name
Two United Way
Street Address
Greenville SC 29607
City or Town State Zip Code
(864) 288-1986
Area code Phone number

2. WELL INFORMATION:
WELL CONSTRUCTION PERMIT#
OTHER ASSOCIATED PERMIT#(if applicable)
SITE WELL ID #(if applicable) MW-20D

3. WELL USE (Check One Box) Monitoring ☒ Municipal/Public ☐
Industrial/Commercial ☐ Agricultural ☐ Recovery ☐ Injection ☐
Irrigation ☐ Other ☐ (list use)
DATE DRILLED 11-16-10

4. WELL LOCATION:
3195 Pine Hall Road. Belews Creek. NC 2700^
(Street Name, Numbers, Community, Subdivision, Lot No., Parcel, Zip Code)
CITY: Belews Creek COUNTY Stokes
TOPOGRAPHIC / LAND SETTING: (check appropriate box)
☐ Slope ☐ Valley ☒ Flat ☐ Ridge ☐ Other
LATITUDE 36 ° 17 ' 47.891 " DMS **OR** DD
LONGITUDE 80 ° 03 ' 44.518 " DMS **OR** DD
Latitude/longitude source: ☒ GPS ☐ Topographic map
(location of well must be shown on a USGS topo map andattached to this form if not using GPS)

5. FACILITY (Name of the business where the well is located.)
Duke Energy Belews Creek
Facility Name Facility ID# (if applicable)
3195 Pine Hall Road
Street Address
Belews Creek NC 27009
City or Town State Zip Code
Ed Sullivan
Contact Name
P.O. Box 37929
Mailing Address
Charlotte NC 28237
City or Town State Zip Code
(980) 373-3719
Area code Phone number

6. WELL DETAILS:
a. **TOTAL DEPTH:** 41.0
b. **DOES WELL REPLACE EXISTING WELL?** YES ☐ NO ☒
c. **WATER LEVEL** Below Top of Casing: 33.41 FT. +
(Use "+" if Above Top of Casing)

d. **TOP OF CASING IS** 2.7 FT. Above Land Surface*
*Top of casing terminated at/or below land surface may require a variance in accordance with 15A NCAC 2C .0118.
e. **YIELD (gpm):** N/M **METHOD OF TEST**
f. **DISINFECTION: Type** N/A **Amount**
g. **WATER ZONES** (depth):
Top Bottom Top Bottom
Top Bottom Top Bottom
Top Bottom Top Bottom

7. CASING:

Depth	Diameter	Thickness/ Weight	Material
Top 0 Bottom 30.8 Ft.			
Top Bottom Ft.			
Top Bottom Ft.			

8. GROUT:

Depth	Material	Method
Top 0 Bottom 20.5 Ft.	Cement	
Top 20.5 Bottom 22.5 Ft.	Bentonite	
Top Bottom Ft.		

9. SCREEN:

Depth	Diameter	Slot Size	Material
Top 30.8 Bottom 40.8 Ft.	2 in.	0.010 in.	PVC
Top Bottom Ft.	in.	in.	
Top Bottom Ft.	in.	in.	

10. SAND/GRAVEL PACK:

Depth	Size	Material
Top 30 Bottom 41 Ft.	GP-2	Sand
Top Bottom Ft.		
Top Bottom Ft.		

11. DRILLING LOG

Top	Bottom	Formation Description
0	30	sandy silt and silty sand
30	45	Biotite gneiss

12. REMARKS:

I DO HEREBY 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.

SIGNATURE OF CERTIFIED WELL CONTRACTOR DATE 1/11

John Gorman
PRINTED NAME OF PERSON CONSTRUCTING THE WELL

Submit within 30 days of completion to: Division of Water Quality - Information Processing, 1617 Mail Service Center, Raleigh, NC 27699-161, Phone : (919) 807-6300

Form GW-1b
Rev. 2/09

APPENDIX D

MONITORING WELL DEVELOPMENT RECORDS

Belews Creek AE #3718 12-20-10

MW-202S

Gallons Pumped	10	20	30	40
Turb	78	58	40	29
COND	.267	.121	.115	.124
PH	8.18	7.44	6.63	6.27
Temp	12.1	12.6	13.1	13.0

MW-202D

Gallons Pumped	20	30	40	50
Turb.	621	316	147	46
COND.	.242	.137	.108	.115
PH	7.14	6.85	6.62	6.48
Temp.	12.4	12.8	13.3	13.2

864-288-2272

MACTEC

MONITORING WELL DEVELOPMENT DATA

Project Name: Belews Creek Date: 11-16-2010

Project Number: _____ Personnel: JCG

Well Number: MW-2005

Date of Installation: 11-12-10

Installation Method: HSA ~~4.25~~ 4.25"

Well Depth: 9.3 feet bgs

Screen Length: _____ feet

Static Water Level: 2.7 feet bgs

1 Well Volume: 0.42 gallons

5 Well Volumes: 2.1 gallons

Depth to Sediment Before Development: 9.3 feet bgs

Depth to Sediment After Development: 9.3 feet bgs

Development Technique: Submersible Pump

Development Equipment: WHALE AND HARIBO

PARAMETER	BEFORE 3	DURING 6	DURING 9	AFTER
pH	5.84	5.84	5.76	5.88
Temperature (°C)	14.2	14.7	14.7	14.1
Specific Conductance (mS/cm)	0.16	.098	.083	.082
Turb.	103	110	53	30

Quantity of Water Removed: 8 gallons

Character of Water After Development: clear

Additional Comments: _____

MACTEC

MONITORING WELL DEVELOPMENT DATA

Project Name: BeLews Creek Date: 11-16-2010

Project Number: _____ Personnel: JCG

Well Number: MW-200D

Date of Installation: 11-12-10

Installation Method: HSA + HQ

Well Depth: 16.4 feet bgs

Screen Length: _____ feet

Static Water Level: 3.0 feet bgs

1 Well Volume: .85 gallons

5 Well Volumes: 4.26 gallons

Depth to Sediment Before Development: 16.4 feet bgs

Depth to Sediment After Development: 16.4 feet bgs

Development Technique: Submersible Pump

Development Equipment: WHALE AND HARIBA

PARAMETER	BEFORE	10	DURING 20	AFTER 30
pH	6.42	6.7	6.57	6.64
Temperature (°C)	15.4	15.3	16.4	15.4
Specific Conductance (mS/cm)	.196	.185	.186	.177
Turb.	760	175	179	40

Quantity of Water Removed: 25.5 gallons

Character of Water After Development: _____

Additional Comments: _____

MACTEC

MONITORING WELL DEVELOPMENT DATA

Project Name: Belews Creek Date: 11-17-10

Project Number: _____ Personnel: JCG

Well Number: MW-201D

Date of Installation: 11-17-2010

Installation Method: 4.25" HSA & HQ

Well Depth: 41.0 feet bgs

Screen Length: ~~3.0~~ 10.0' feet

Static Water Level: 33.1 feet bgs

1 Well Volume: 0.5 gallons

5 Well Volumes: 2.51 gallons

Depth to Sediment Before Development: 41.0 feet bgs

Depth to Sediment After Development: 41.0 feet bgs

Development Technique: Submersible Pump

Development Equipment: whale and HORIBA

PARAMETER	BEFORE	DURING		AFTER
pH	6.67	7.90	7.9	7.96
Temperature (°C)	14.9	14.8	15.6	15.0
Specific Conductance (mS/cm)	.407	.357	.367	.349
Turb.	300	180	81	46

Quantity of Water Removed: 20 gallons

Character of Water After Development: clear

Additional Comments: well Pumps Dry and RecHARges slowly

MACTEC

MONITORING WELL DEVELOPMENT DATA

Project Name: Belews Creek Date: 11/10/10

Project Number: 6228-10-5284 Personnel: RWL

Well Number: MW-203S

Date of Installation: 11/9/10

Installation Method: 4 1/4" HSA

Well Depth: 39.8 feet bgs

Screen Length: 15' feet

Static Water Level: 30.70 feet bgs

1 Well Volume: 1.5 gallons

5 Well Volumes: 7.0' gallons

Depth to Sediment Before Development: 39.8 feet bgs

Depth to Sediment After Development: 39.8 feet bgs

Development Technique: Purge w/ submersible pump

Development Equipment: Waterra

PARAMETER	BEFORE	DURING (3)	DURING (6)	AFTER
pH	6.0	5.9	5.86	4.81
Temperature (°C)	16.0	13.8	14.5	14.1
Specific Conductance (mS/cm)	.046	.035	.029	.069
TURB	770	106	3	1

Quantity of Water Removed: 20 gallons

Character of Water After Development: clear

Additional Comments: water drawn to screen, but did not dry during purging

MACTEC

MONITORING WELL DEVELOPMENT DATA

Project Name: Belews Creek
Date: 11/10/10
Project Number: 6228-10-52841
Personnel: Rodney Clark

Well Number: MW-203D
Date of Installation: 11/9/10
Installation Method: 4¼ HSA's & HQ Core
Well Depth: 89.6' feet bgs
Screen Length: 5 feet

Static Water Level: 30.91 feet bgs
1 Well Volume: 9.4 gallons
5 Well Volumes: 47.0 gallons
Depth to Sediment Before Development: 89.6 feet bgs
Depth to Sediment After Development: 89.6 feet bgs

Development Technique: Purge w/ submersible pump
Development Equipment: Waterra

PARAMETER	BEFORE	1	DURING 3	During ~~After~~ 8
pH	5.45	7.14	7.04	6.85 (9)
Temperature (°C)	15.7	15.7	16.8	15.9
Specific Conductance (mS/cm)	.210	.146	.128	.112
TB	548	999	999	436

Quantity of Water Removed: 130 ~~40~~ gallons
Character of Water After Development: cloudy light tan color

Additional Comments: Turbidity dropped to 260 at 7 well volumes then started to increase to 436 at 9 well volumes. Removed surge block at 9 well volumes, then turb. began to drop. Turb. at 13 well volumes is 41, Temp 15.4 pH 6.86, cond. .108

MACTEC

MONITORING WELL DEVELOPMENT DATA

Project Name: Belews Creek Date: 11-16-2010

Project Number: _____ Personnel: JCG

Well Number: MW-2045

Date of Installation: 11-15-10

Installation Method: HSA 4.25"

Well Depth: 31.2 feet bgs

Screen Length: 15.0' feet

Static Water Level: 22.7 feet bgs

1 Well Volume: 0.54 gallons

5 Well Volumes: 2.7 gallons

Depth to Sediment Before Development: 30.4 feet bgs

Depth to Sediment After Development: 31.2 feet bgs

Development Technique: Submersible Pump

Development Equipment: WHALE & HORIBA

PARAMETER	BEFORE	DURING 5	DURING 10	AFTER 15
pH	6.05	6.05	6.01	5.92
Temperature (°C)	15.9	15.8	15.8	15.6
Specific Conductance (mS/cm)	.075	.066	.065	.062
TURB	242	40	36	29

Quantity of Water Removed: 20 gallons

Character of Water After Development: clear

Additional Comments: _____

MACTEC

MONITORING WELL DEVELOPMENT DATA

Project Name: Below's Creek Date: 11-16-2010

Project Number: _____ Personnel: JCG

Well Number: MW-204D

Date of Installation: 11-15-2010

Installation Method: HSA + HQ

Well Depth: 38.2 feet bgs

Screen Length: 5.0 feet

Static Water Level: 23.3 feet bgs

1 Well Volume: 0.94 gallons

5 Well Volumes: 4.74 gallons

Depth to Sediment Before Development: 27.8 feet bgs

Depth to Sediment After Development: 38.2 feet bgs

Development Technique: Submersible Pump

Development Equipment: Whale & Horiba

PARAMETER	BEFORE	DURING		AFTER
pH	6.37	6.75	5.89	5.85
Temperature (°C)	15.6	14.3	14.4	14.6
Specific Conductance (mS/cm)	.084	.056	.048	.045
TURB.	628	79	60	37

Quantity of Water Removed: 20 gallons

Character of Water After Development: clear

Additional Comments: well Pumps Dry Quickly, but Recharges Quickly

APPENDIX E

PHOTOGRAPHS OF COMPLETED WELL PAIRS

Photograph 1: Well pair MW-200S and MW-200D.

Photograph 2: Well MW201-D.

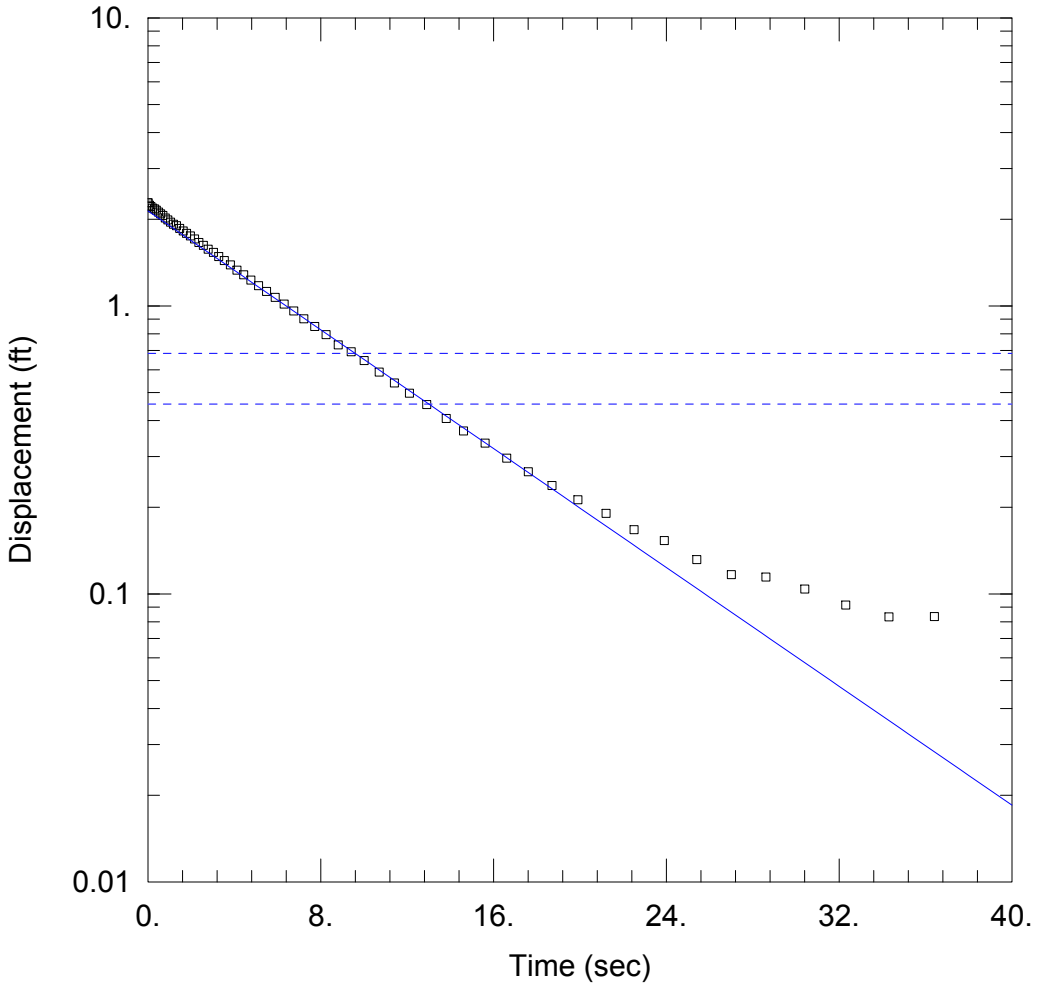
Photograph 3: Well pair MW202S and MW-202D.

Photograph 4: Well pair MW-203S and MW203D.

Photograph 5: Well pair MW-204S and MW-204D.

APPENDIX F

SLUG TEST DATA



MW-204D RISING HEAD TEST

PROJECT INFORMATION

Company: MACTEC
Client: Duke Energy
Project: 6228-10-5284
Location: Belews Steam Station
Test Well: MW-204D
Test Date: 12-19-10

AQUIFER DATA

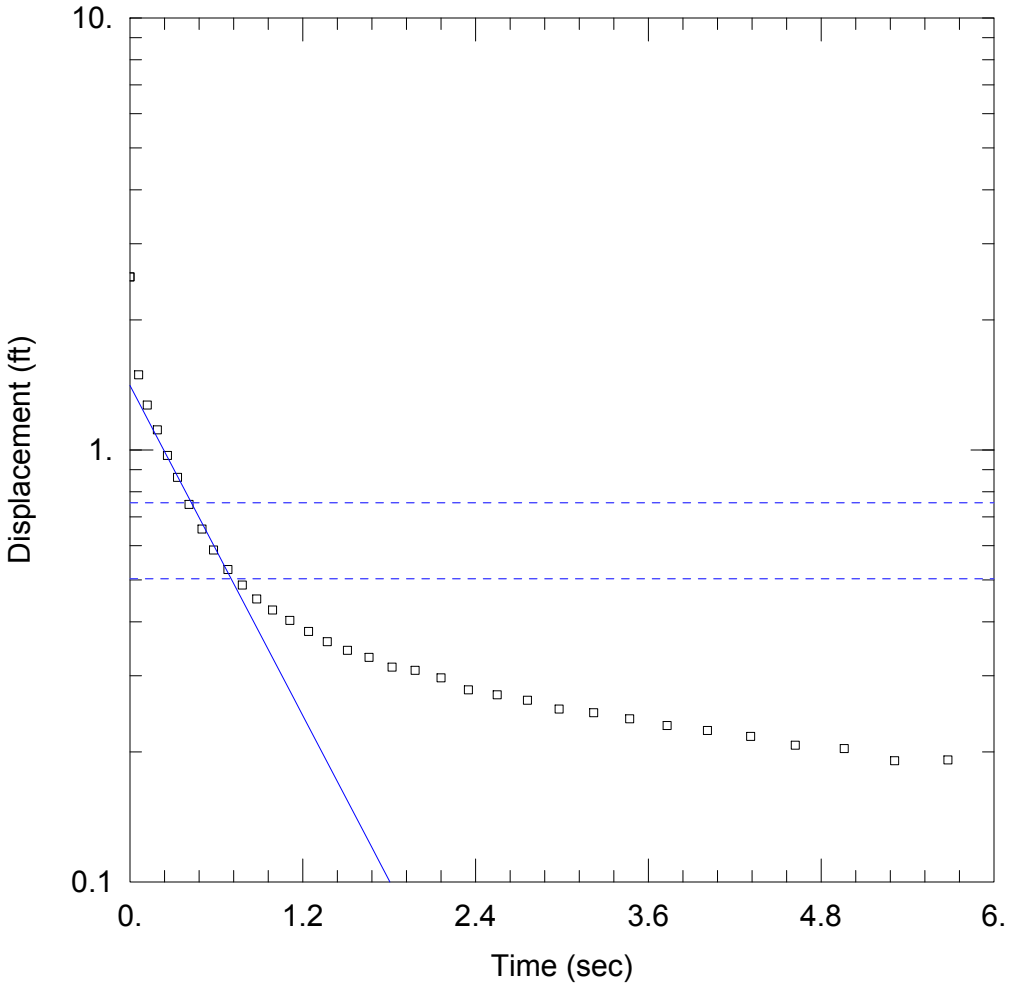
Saturated Thickness: 14.41 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-204D)

Initial Displacement: 2.281 ft
Total Well Penetration Depth: 14.41 ft
Casing Radius: 0.086 ft
Static Water Column Height: 14.41 ft
Screen Length: 5. ft
Well Radius: 0.16 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 0.007617 cm/sec
y0 = 2.136 ft



MW-203S RISING HEAD TEST

PROJECT INFORMATION

Company: MACTEC
Client: Duke Energy
Project: 6228-10-5284
Location: Belews Steam Station
Test Well: MW-203S
Test Date: 12-21-10

AQUIFER DATA

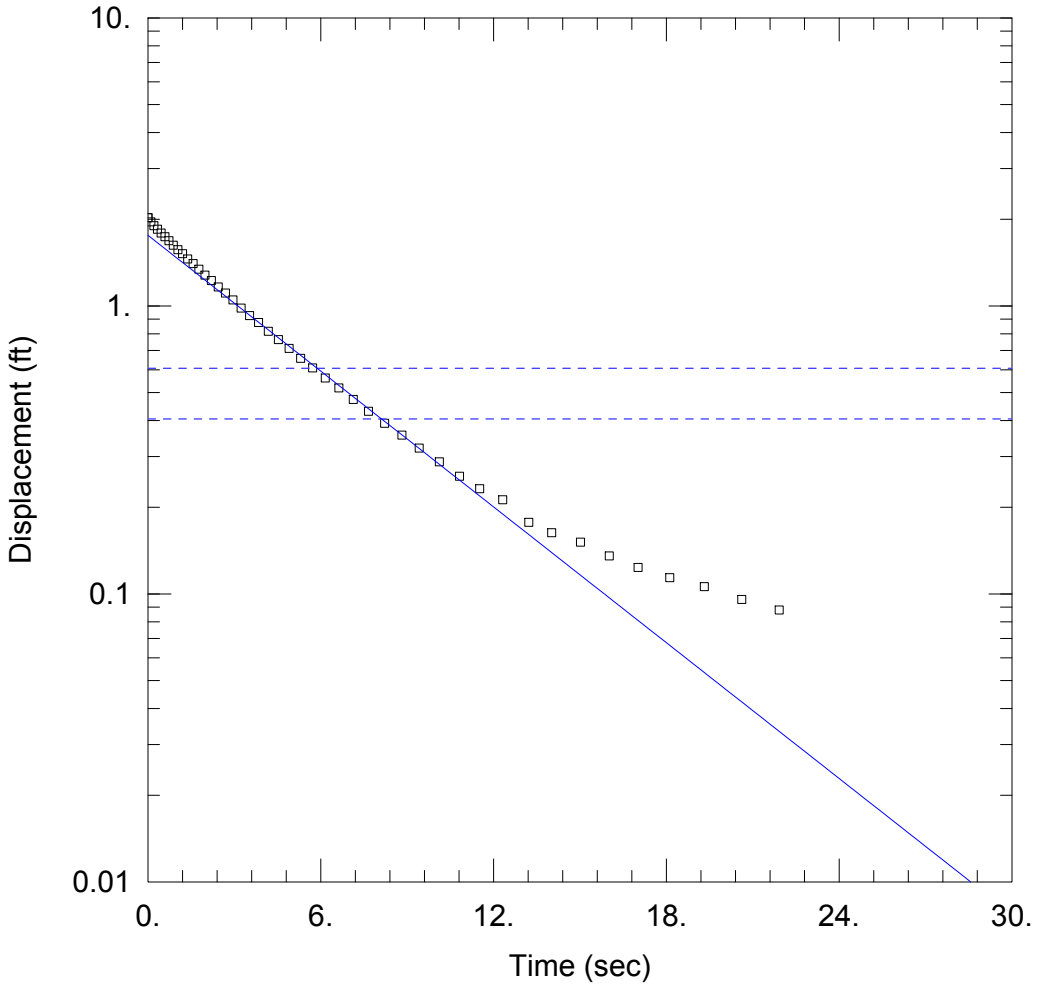
Saturated Thickness: 9.37 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-203S)

Initial Displacement: 2.516 ft
Total Well Penetration Depth: 9.37 ft
Casing Radius: 0.086 ft
Static Water Column Height: 9.37 ft
Screen Length: 9.37 ft
Well Radius: 0.34 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.03868 cm/sec
y0 = 1.409 ft



MW-203D RISING HEAD TEST

PROJECT INFORMATION

Company: MACTEC
Client: Duke Energy
Project: 6228-10-5284
Location: Belews Steam Station
Test Well: MW-203D
Test Date: 12-21-10

AQUIFER DATA

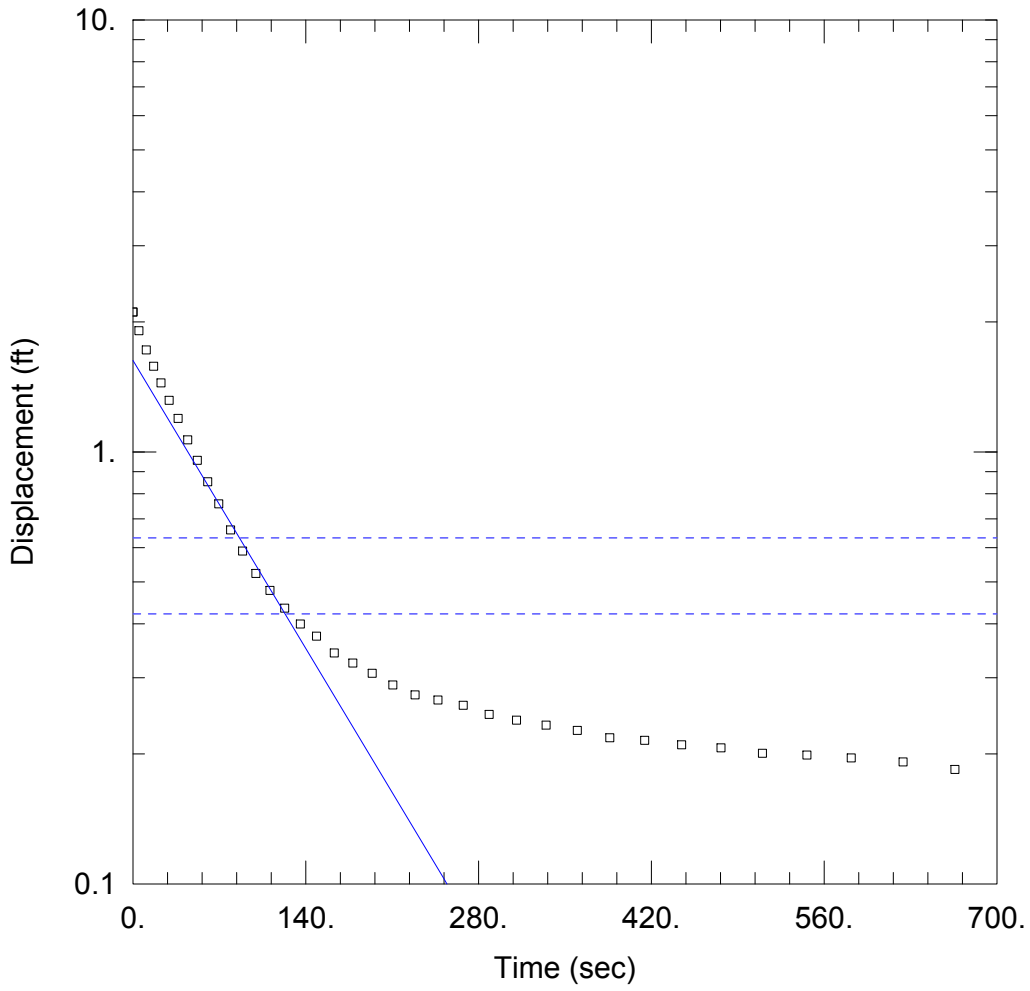
Saturated Thickness: 59.18 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-203D)

Initial Displacement: 2.024 ft
Total Well Penetration Depth: 59.18 ft
Casing Radius: 0.086 ft
Static Water Column Height: 59.18 ft
Screen Length: 5. ft
Well Radius: 0.16 ft

SOLUTION

Aquifer Model: Confined
K = 0.01431 cm/sec
Solution Method: Bouwer-Rice
y0 = 1.758 ft



MW-202S RISING HEAD TEST

PROJECT INFORMATION

Company: MACTEC
Client: Duke Energy
Project: 6228-10-5284
Location: Belews Steam Station
Test Well: MW-202S
Test Date: 12-28-10

AQUIFER DATA

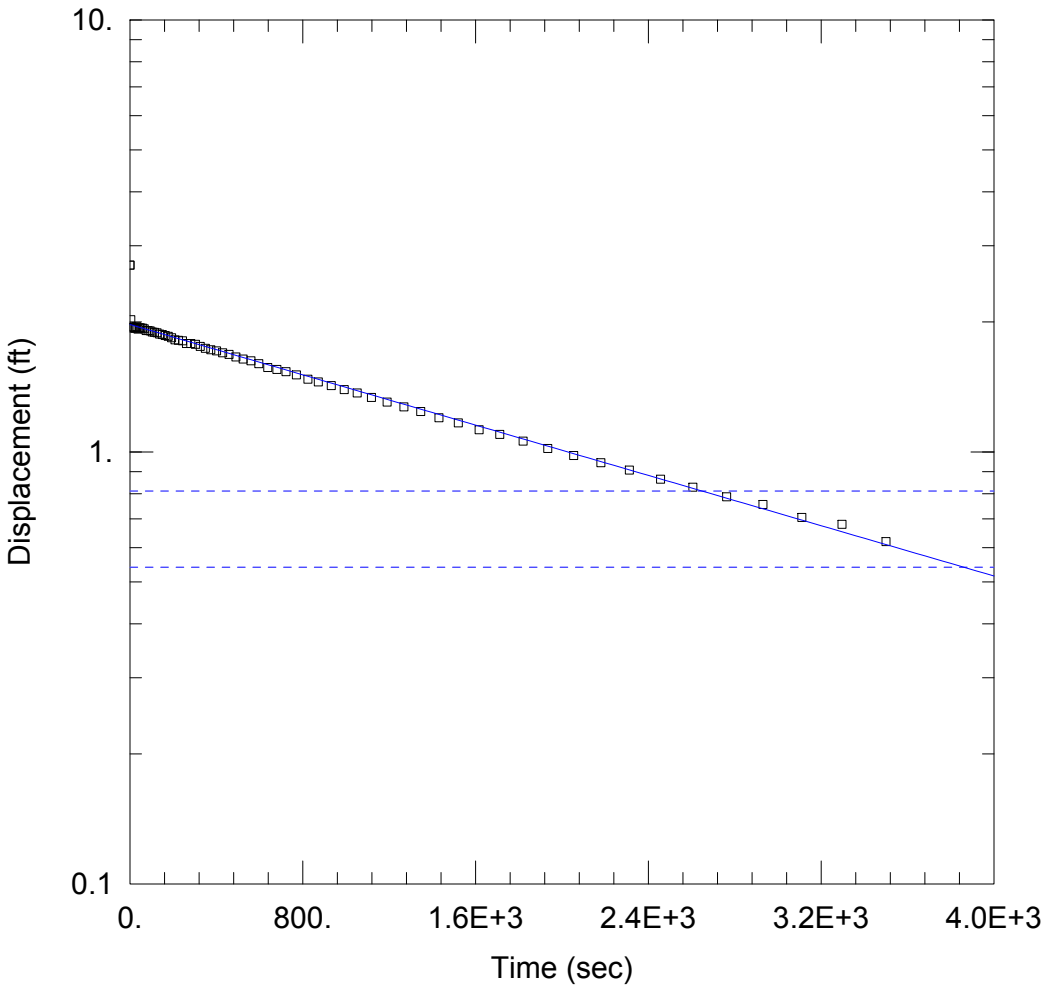
Saturated Thickness: 13.56 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-202S)

Initial Displacement: 2.108 ft
Total Well Penetration Depth: 13.56 ft
Casing Radius: 0.086 ft
Static Water Column Height: 13.56 ft
Screen Length: 13.56 ft
Well Radius: 0.34 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.000225 cm/sec
y0 = 1.628 ft



MW-202D RISING HEAD TEST

PROJECT INFORMATION

Company: MACTEC
Client: Duke Energy
Project: 6228-10-5284
Location: Belews Steam Station
Test Well: MW-202D
Test Date: 12-28-10

AQUIFER DATA

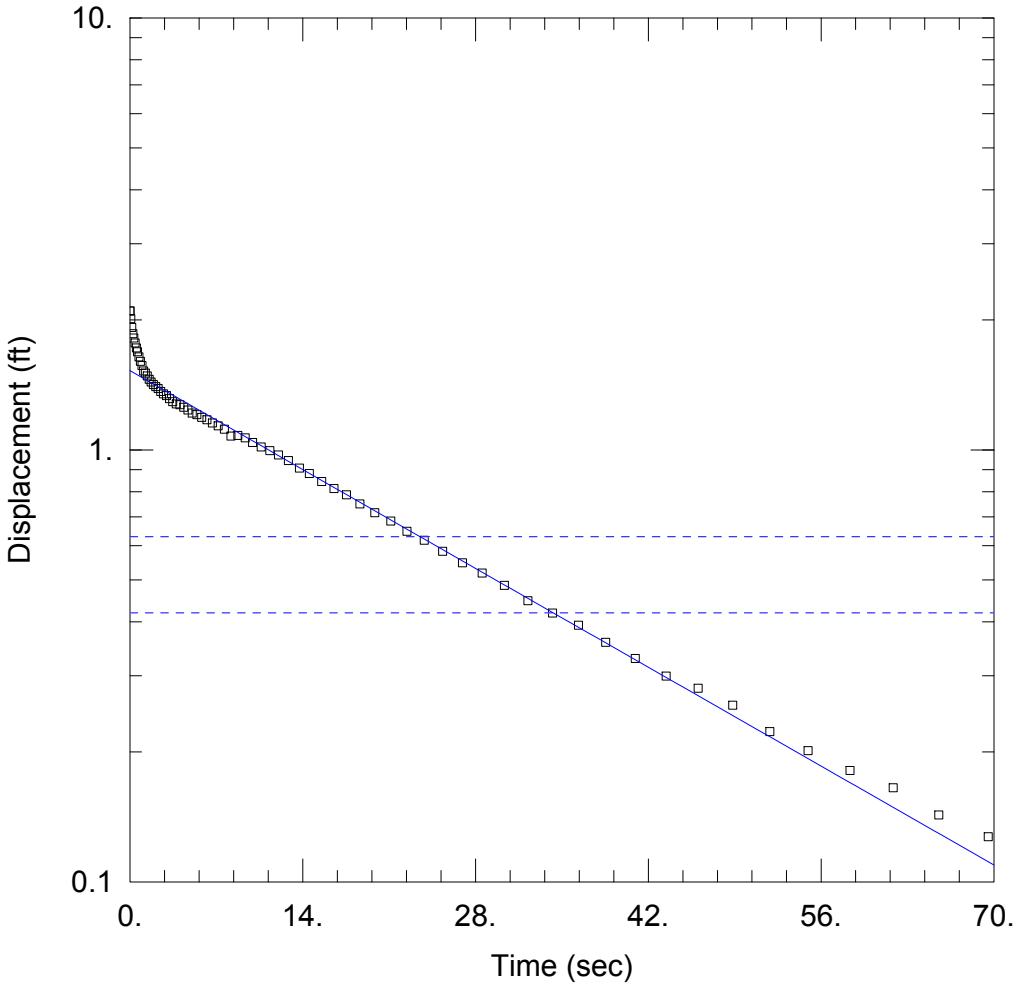
Saturated Thickness: 43.58 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-202D)

Initial Displacement: 2.706 ft
Total Well Penetration Depth: 43.58 ft
Casing Radius: 0.086 ft
Static Water Column Height: 43.58 ft
Screen Length: 5. ft
Well Radius: 0.16 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 2.548E-5 cm/sec
y0 = 1.972 ft



MW-201D RISING HEAD TEST

PROJECT INFORMATION

Company: MACTEC
Client: Duke Energy
Project: 6228-10-5284
Location: Belews Steam Station
Test Well: MW-201D
Test Date: 12-20-10

AQUIFER DATA

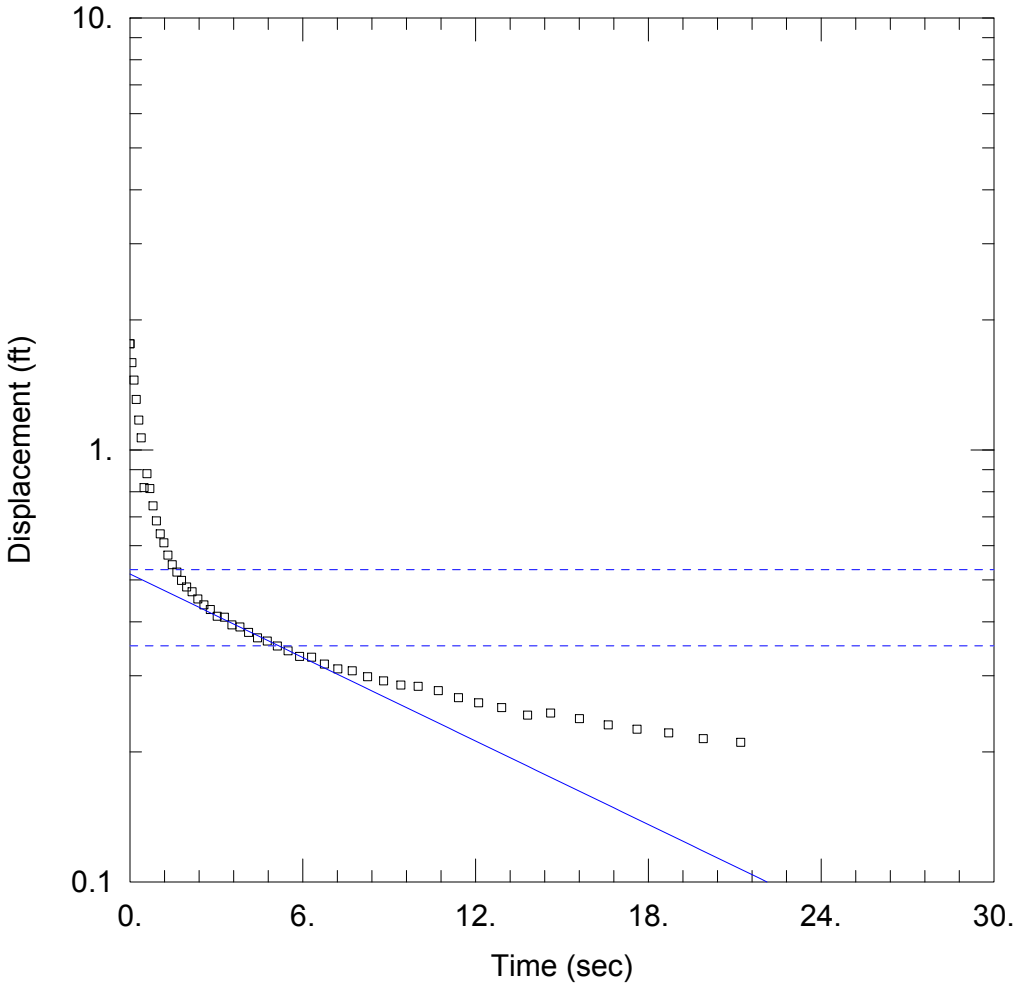
Saturated Thickness: 10.39 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-201D)

Initial Displacement: 2.098 ft
Total Well Penetration Depth: 10.39 ft
Casing Radius: 0.086 ft
Static Water Column Height: 10.39 ft
Screen Length: 10. ft
Well Radius: 0.16 ft

SOLUTION

Aquifer Model: Confined
K = 0.001191 cm/sec
Solution Method: Bouwer-Rice
y0 = 1.526 ft



MW-200S RISING HEAD TEST

PROJECT INFORMATION

Company: MACTEC
Client: Duke Energy
Project: 6228-10-5284
Location: Belews Steam Station
Test Well: MW-200S
Test Date: 12-20-10

AQUIFER DATA

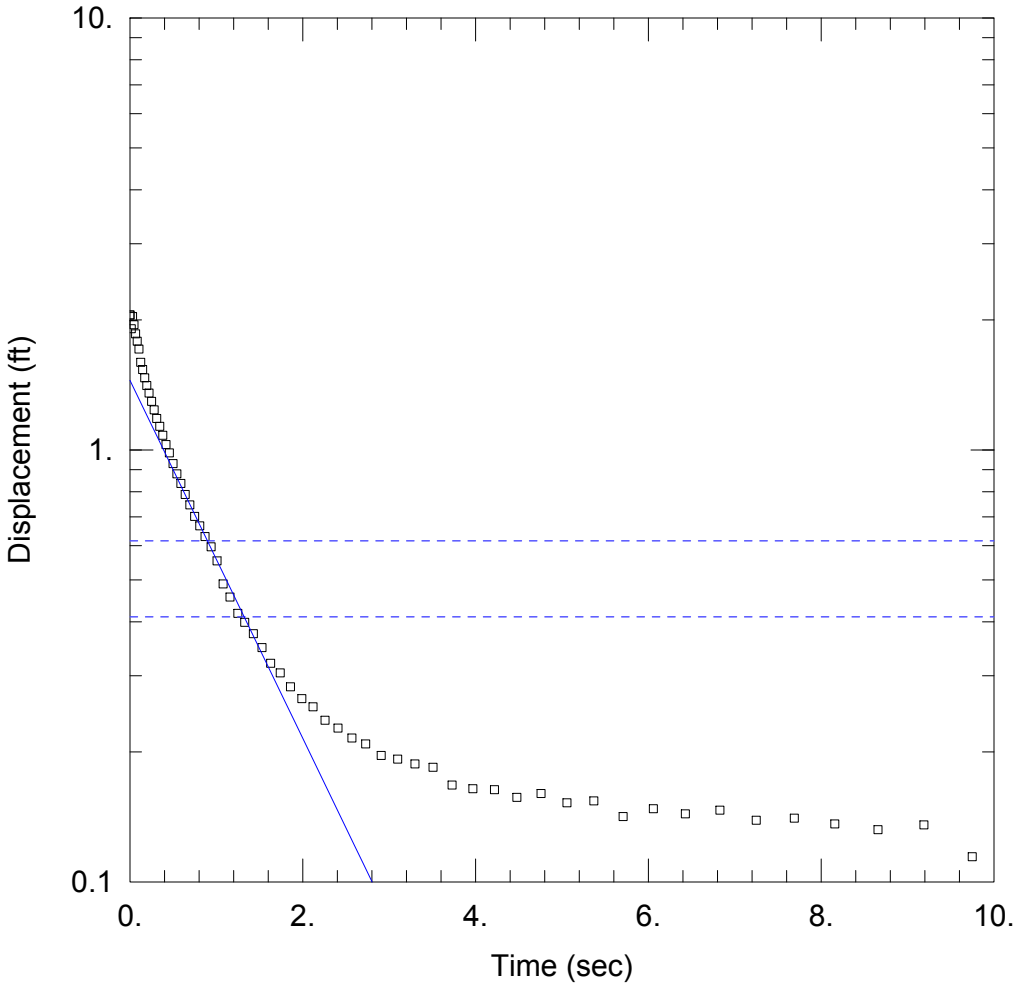
Saturated Thickness: 7.89 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-200S)

Initial Displacement: 1.76 ft
Total Well Penetration Depth: 7.89 ft
Casing Radius: 0.086 ft
Static Water Column Height: 7.89 ft
Screen Length: 7.6 ft
Well Radius: 0.34 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.002262 cm/sec
y0 = 0.5163 ft



MW-200D RISING HEAD TEST

PROJECT INFORMATION

Company: MACTEC
Client: Duke Energy
Project: 6228-10-5284
Location: Belews Steam Station
Test Well: MW-200D
Test Date: 12-20-10

AQUIFER DATA

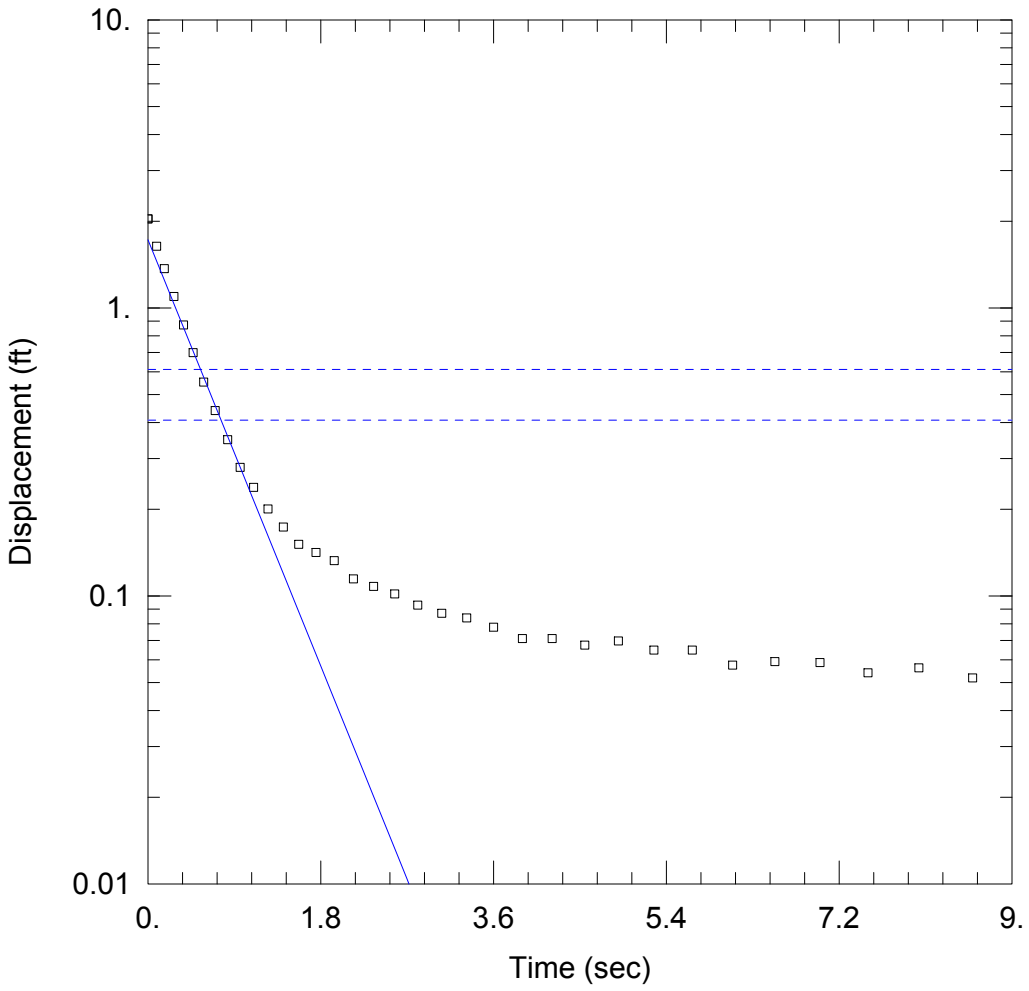
Saturated Thickness: 13.52 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-200D)

Initial Displacement: 2.053 ft
Total Well Penetration Depth: 7.82 ft
Casing Radius: 0.086 ft
Static Water Column Height: 13.52 ft
Screen Length: 4.8 ft
Well Radius: 0.16 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 0.04781 cm/sec
y0 = 1.449 ft



MW-204S RISING HEAD TEST

PROJECT INFORMATION

Company: MACTEC
Client: Duke Energy
Project: 6228-10-5284
Location: Belews Steam Station
Test Well: MW-204S
Test Date: 12-20-10

AQUIFER DATA

Saturated Thickness: 7.99 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-204S)

Initial Displacement: 2.038 ft
Total Well Penetration Depth: 7.99 ft
Casing Radius: 0.086 ft
Static Water Column Height: 7.99 ft
Screen Length: 7.99 ft
Well Radius: 0.34 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.05538 cm/sec
y0 = 1.724 ft

B

Appendix B - Permit Condition A(11) Attachment XX, Version 1.1, June 15, 2011

A. (6) GROUNDWATER MONITORING WELL CONSTRUCTION AND SAMPLING

1. The permittee shall conduct groundwater monitoring as may be required to determine the compliance of this NPDES permitted facility with the current groundwater Standards found under 15A NCAC 2L .0200

2. WELL CONSTRUCTION. Within 120 days of permit issuance, monitoring wells, as proposed on Attachment XX, shall be installed to monitor groundwater quality.

   a. Monitoring wells shall be constructed in accordance with 15A NCAC 02C .0108 (Standards of Construction for Wells Other than Water Supply) and any other jurisdictional laws and regulations pertaining to well construction. The general locations for all monitoring wells are indicated on Attachment XX.

   b. Within 30 days of completion of well construction, a completed Well Construction Record (Form GW-1) must be submitted for each monitoring well to Division of Water Quality, Aquifer Protection Section, 1636 Mail Service Center, Raleigh, NC 27699-1636.

   c. The Winston-Salem Regional Office, telephone number (336) 771-5000, shall approve the location of new monitoring wells prior to installation. The regional office shall be notified at least 48 hours prior to the construction of any monitoring well and such notification to the Aquifer Protection Section's regional supervisor shall be made from 8:00 a.m. until 5:00 p.m. on Monday through Friday, excluding State Holidays.

   d. Within 60 days of completion of the monitoring wells, the Permittee shall submit two original copies of a site map with a scale no greater than 1-inch equals 500 feet. At a minimum, the map shall include the following information:

      i. The location and identity of each monitoring well.
      ii. The location of major components of the waste disposal system.
      iii. The location of property boundaries within 500 feet of the disposal areas.
      iv. The latitude and longitude of the established horizontal control monument.
      v. The elevation of the top of the well casing (i.e., measuring point) relative to a common datum.
      vi. The depth of water below the measuring point at the time the measuring point is established.
      vii. The location of compliance and review boundaries.
      viii. The date the map is prepared and/or revised.
      ix. Topographic contours in no more than ten (10) foot intervals

   e. The above information should be overlaid on the most recent aerial photograph taken of the site. Control monuments shall be installed in such a manner and made of such materials that the monument will not be destroyed due to activities taking place on the property. The map and any supporting documentation shall be sent to the Division of Water Quality, Aquifer Protection Section, 1636 Mail Service Center, Raleigh, NC 27699-1636.

   f. The well(s) must be constructed by a North Carolina Certified Well Contractor, the property owner, or the property lessee according to General Statutes 87-98.4. If the construction is not performed by a certified well contractor, the property owner or lessee, provided they are a natural person, must physically perform the actual well construction activities.

g. The monitoring wells shall be regularly maintained. Such maintenance shall include ensuring that the well caps are rust-free and locked at all times, the outer casing is upright and undamaged, and the well does not serve as a conduit for contamination.

3. GROUNDWATER SAMPLING AND COMPLIANCE. Monitoring wells shall be sampled after construction and thereafter at the frequencies and for the parameters as specified in Attachment XX. All maps, well construction forms, well abandonment forms and monitoring data shall refer to the permit number and the well nomenclature as provided on Attachment XX.

a. Per 15A NCAC 02H .0800, a Division certified laboratory shall conduct all laboratory analyses for the required effluent, groundwater or surface water parameters.

b. The measurement of water levels shall be made prior to purging the wells. The depth to water in each well shall be measured from the surveyed point on the top of the casing. The measurement of pH shall be made after purging and prior to sampling for the remaining parameters.

c. The measuring points (top of well casing) of all monitoring wells shall be surveyed to provide the relative elevation of the measuring point for each monitoring well. The measuring points (top of casing) of all monitoring wells shall be surveyed relative to a common datum.

d. For monitoring wells that are not located at the Compliance Boundary, the Compliance Monitoring Form (GW-59CCR) is not required. However, predictive calculations or modeling shall be submitted to the Regional Office annually (i.e. 12 months after permit issuance) demonstrating groundwater quality standards at the Compliance Boundary.

e. Two copies of the monitoring well sampling shall be submitted on a Compliance Monitoring Form (GW-59CCR), and received no later than the last working day of the month following the sampling month. Copies of the laboratory analyses shall be kept on site, and made available upon request. The Compliance Monitoring Form (GW-59CCR) shall include this permit number and the appropriate well identification number. All information shall be submitted to the following address:

Division of Water Quality
Information Processing Unit
1617 Mail Service Center
Raleigh, North Carolina 27699-1617

f. For groundwater samples that exceed the ground water quality standards in 15A NCAC 02L .0202, the Regional Office shall be contacted within 30 days after submission of the groundwater monitoring report; an evaluation may be required to determine the impact of the waste disposal activities. Failure to do so may subject the permittee to a Notice of Violation, fines, and/or penalties.

4. COMPLIANCE BOUNDARY. The compliance boundary for the disposal system shall be specified in accordance with 15A NCAC 02L .0107(a). This disposal system was individually permitted prior to December 30, 1983; therefore, the compliance boundary is established at either 500 feet from the effluent disposal area, or at the property boundary, whichever is closest to the effluent disposal area. An exceedance of groundwater standards at or beyond the compliance boundary is subject to remediation action according to 15A NCAC 02L .0106(c) as well as enforcement actions in accordance with North Carolina General Statute 143-215.6A through 143-215.6C.

ATTACHMENT XX – GROUNDWATER MONITORING PLAN

Permit Number: NC0024406 **Version 1.1**

WELL NOMENCLATURE	PARAMETER DESCRIPTION				FREQUENCY
Monitoring Wells: MW-200S, MW-200D, MW-201D, MW-202S, MW-202D, MW-203S, MW-203D, MW-204S, MW-204D	**Antimony**	**Chromium**	**Nickel**	**Thallium**	January, May, September
	Arsenic	**Copper**	**Nitrate**	**Water Level**	
	Barium	**Iron**	**pH**	**Zinc**	
	Boron	**Lead**	**Selenium**		
	Cadmium	**Manganese**	**Sulfate**		
	Chloride	**Mercury**	**TDS**		

Note 1: For locations of monitoring wells, see attached map.

Note 2: Monitoring revisions may be considered, as applicable, if there are no significant detections prior to permit renewal.

Belews Creek Steam Station
Ash Basin Compliance Groundwater Monitoring Well Construction Data
As-Built Data

Well ID	Northing (feet)	Easting (feet)	TOC Elevation (feet)	Screen Interval (feet bgs)	Top of Rock (feet bgs)
MW-200S	925,426.70	1,683,065.85	633.89	1.4 - 10	—
MW-200D	925,417.59	1,683,060.81	636.06	11.5 - 16.5	11
MW-201D	928,542.84	1,685,554.24	763.98	35.8 - 40.8	30
MW-202S	921,471.80	1,683,151.75	789.97	47 - 57	—
MW-202D	921,477.03	1,683,327.24	790.76	84 - 89	79
MW-203S	921,199.25	1,681,655.88	786.14	24.6 - 39.6	—
MW-203D	921,189.25	1,681,611.54	785.57	84.4 - 89.4	80
MW-204S	924,748.45	1,681,146.05	776.29	26 - 31	—
MW-204D	925,744.70	1,681,144.75	776.78	33 - 38	33

NOTES:
1. COORDINATES SHOWN ARE BASED ON THE NORTH CAROLINA STATE PLANE COORDINATE SYSTEM.
3. ELEVATIONS SHOWN ARE REFERENCED TO THE NAVD 88 VERTICAL DATUM.
4. COORDINATES AND ELEVATIONS SHOWN ARE IN U.S. SURVEY FEET.

SHEET NO.	OF	
1	2	ASH BASIN COMPLIANCE GROUNDWATER MONITORING WELLS DUKE ENERGY BELEWS CREEK STEAM STATION STOKES COUNTY, NORTH CAROLINA

Duke Energy

REV	DATE	DESCRIPTION	BY	CHK	APV
0	04-10-2015	SUBMITTED TO NCDENR	PD	MWP	JC

ALTAMONT ENVIRONMENTAL, INC
ENGINEERING & HYDROGEOLOGY
231 HAYWOOD STREET, ASHEVILLE, NC 28801
TEL. 828 281 3350 FAC. 828 281 3351
www.altamontenvironmental.com
NC ENGINEERING FIRM #C-2185

SCALE (FEET) 1" = 500'

C

Appendix C - Monitoring Well Locations

007310-378567 Belews Creek Steam Station Monitoring Well Locations					
Description	**Northing**	**Easting**	**Elevation**	**Description**	**Elevation**
TOP OF PVC MW-200D	929457.98	1683060.81	636.05	MAG NAIL SET MW-200D	633.30
TOP OF PVC MW-200S	929458.70	1683065.88	635.89	MAG NAIL SET MW-200S	633.18
TOP OF PVC MW-201D	928562.86	1686914.24	783.98	MAG NAIL SET MW-201D	781.26
TOP OF PVC MW-202D	921477.01	1683327.04	790.78	MAG NAIL SET MW-202D	787.87
TOP OF PVC MW-202S	921472.88	1683331.79	789.97	MAG NAIL SET MW-202S	787.61
TOP OF PVC MW-203D	925588.28	1681611.54	785.57	MAG NAIL SET MW-203D	783.37
TOP OF PVC MW-203S	925599.25	1681605.68	786.14	MAG NAIL SET MW-203S	783.46
TOP OF PVC MW-204D	926744.91	1681144.75	776.78	MAG NAIL SET MW-204D	773.92
TOP OF PVC MW-204S	926748.45	1681146.05	776.29	MAG NAIL SET MW-204S	773.49
Note1: Coordinates shown are based on the North Carolina State Plane Coordinate System					
Note2: Horizontal Datum of NC Grid 1983 (NSRS 2007)					
Note3: Elevations shown are referenced to the NAVD 88 vertical datum					
Note4: Coordinates and elevations shown are in U.S. Survey Foot					
Note5: Coordinates and elevations shown only for as-built wells as requested by NCDENR					
Note6: Mag nails set in concrete base of each well for future elevation check					