GROUNDWATER ASSESSMENT WORK PLAN

For
CAPE FEAR STEAM ELECTRIC PLANT
500 CP&L ROAD
MONCURE, NORTH CAROLINA 27559
NPDES PERMIT #NC0003433
N 35.593970/W -79.048827

PREPARED FOR

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SUBMITTED: SEPTEMBER 2014

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EXECUTIVE SUMMARY

Duke Energy Progress, Inc. (Duke Energy) owns and operates the Cape Fear Steam Electric Plant (Cape Fear Plant) located on approximately 900 acres in central North Carolina near Moncure, North Carolina. Ash generated from coal combustion was stored on-site in ash basins. Operations were terminated at the Cape Fear Plant in October 2012 and demolition activities are currently underway.

Wastewater discharges from the ash basins are permitted by the North Carolina Department of Environment and Natural Resources (NCDENR) Division of Water Resources (DWR) under the National Pollution Discharge Elimination System (NPDES) Permit #NC0003433.

In a Notice of Regulatory Requirement (NORR) letter dated August 13, 2014, the Division of Water Resources (DWR) of the North Carolina Department of Environment and Natural Resources (NCDENR) requested that Duke Energy prepare a Groundwater Assessment Plan to identify the source and cause of contamination, any imminent hazards to public health and safety and actions taken to mitigate them, and all receptors and significant exposure pathways. In addition, the Plan directed Duke Energy to determine the horizontal and vertical extent of soil and groundwater contamination and factors affecting contaminant transport and the geological and hydrogeological features influencing the movement, chemical, and physical character of the contaminants.

The following plan includes:

- Implementation of a receptor survey to identify public and private water supply wells (including irrigation well and unused or abandoned wells), surface water features, and wellhead protection areas (if present) within a 0.5 mile radius of the Cape Fear Plant ash basins compliance boundary;

- Installation of borings within the ash basins for chemical and geotechnical analysis of residuals in and in-place soils;

- Installation of background soil borings;

- Installation of monitoring wells and piezometers;

- Collection and analysis of groundwater samples from existing site wells and newly installed monitoring wells;

- Statistical evaluation of the groundwater analytical data; and
- Development of a groundwater computer model to evaluate the long term fate and transport of constituents of concern in groundwater beneath the ash basins.

The information obtained through this Work Plan will be utilized to prepare a Comprehensive Site Assessment (CSA) report in accordance with the requirements of the NORR. In addition to the components listed above, a human health and ecological risk assessment will be conducted. This assessment will include the preparation of a conceptual site model illustrating potential pathways from the source to possible receptors.

During the CSA process if additional investigations are required, NCDENR will be notified.
1.0 INTRODUCTION

Duke Energy Progress, Inc. (Duke Energy) owns and operates the Cape Fear Steam Electric Plant (Cape Fear Plant) located on approximately 900 acres in central North Carolina near Moncure, North Carolina. The Cape Fear Plant is located in Chatham County along the east bank of the Cape Fear River southeast of Moncure and west of Corinth Road. The site location is shown on Figure 1.

The Cape Fear Plant began operations in 1923 and additional units were added in the following years. In the most current configuration, the Cape Fear Plant employed two coal-fired units along with four oil-fueled combustion turbine units. Ash generated from coal combustion was stored on-site in ash basins. Operations were terminated at the Cape Fear Plant in October 2012 and demolition activities are currently underway.

Wastewater discharges from the ash basins are permitted by the North Carolina Department of Environment and Natural Resources (NCDENR) Division of Water Resources (DWR) under the National Pollution Discharge Elimination System (NPDES) Permit #NC0003433.

Groundwater monitoring has been performed in accordance with the conditions stated in NPDES Permit beginning in December 2010. Elevated values greater than the North Carolina Administrative Code (NCAC) Title 15A Chapter 02L.0202 groundwater quality standards (2L Standards) have been measured in groundwater samples from some Plant monitoring wells.

The compliance boundary for groundwater quality for the Cape Fear ash basins are defined in accordance with NCAC Title 15A Chapter 02L.0107(a) (T15 A NCAC 02L .0107(a)) as being established at either 500 feet from the waste boundary or at the property boundary, whichever is closest. The compliance monitoring network includes two background monitoring wells, BGMW-4 and BGTMW-4, plus 11 monitoring wells located along the compliance boundary. The locations of the monitoring wells are shown on Figure 2. Analytical results from sampling these wells are submitted to NCDENR by the end of the month following sampling.

In a Notice of Regulatory Requirement (NORR) letter dated August 13, 2014, the Division of Water Resources (DWR) of the North Carolina Department of Environment and Natural Resources (NCDENR) requested that Duke Energy prepare a Comprehensive Site Assessment (CSA) in accordance with 15A NCAC 02L .0106(g) to address those groundwater constituents that have elevated values greater than the 2L groundwater quality Standards at the compliance boundary. A summary of the
elevated constituent values is provided in Table 1 and a copy of the DWR letter is provided in Appendix A.

SynTerra has prepared this Groundwater Assessment Work Plan on behalf of Duke Energy. This document has been prepared to meet the requirements of 15A NCAC 02L.0106(g) and to:

- Identify the source and cause of contamination;
- Identify imminent hazards to public health and safety and actions taken to mitigate them in accordance to 15A NCAC 02L .0106(f);
- Identify receptors and significant exposure pathways;
- Determine the horizontal and vertical extent of soil and groundwater contamination and significant factors affecting contaminant transport; and
- Determine geological and hydrogeological features influencing the movement, chemical, and physical character of the contaminants.

The information obtained through this Work Plan will be utilized to prepare a CSA report in accordance with the requirements of the NORR. In addition to the components listed above, a human health and ecological risk assessment will be conducted. This assessment will include the preparation of a conceptual site model illustrating potential pathways from the source to possible receptors.

During the CSA process if additional investigations are required, NCDENR will be notified.
2.0 SITE HISTORY AND SOURCE CHARACTERIZATION

2.1 Plant Description
Duke Energy Progress, Inc. owns and operates the Cape Fear Steam Electric Plant (Cape Fear Plant) located on approximately 900 acres in central North Carolina near Moncure, North Carolina. The Cape Fear Plant is located in Chatham County along the east bank of the Cape Fear River southeast of Moncure and west of Corinth Road. The site location is shown on Figure 1.

The Cape Fear Plant began operations in 1923. Additional units were added from 1924 to 1969. In the most current configuration, the Cape Fear Plant employed two coal-fired units along with four oil-fueled combustion turbine units. Ash generated from coal combustion was stored on-site in ash basins. Operations were terminated at the Cape Fear Plant in October 2012 and demolition activities are currently underway.

2.2 Ash Basins
Ash generated from coal combustion was stored in on-site ash basins. The ash basins are referred to as “ash ponds” in the Plant’s NPDES permit. Five ash basins have historically been used at the Cape Fear Plant and are referenced using the date of construction: 1956, 1963, 1970, 1978, and 1985. The 1956 ash basin is located north of the former Plant, and the remaining ash basins are located south of the Plant area. The 1963 and 1970 ash basins were constructed on the west side of the Plant property adjacent to the Cape Fear River. The 1978 ash basin was constructed east of and abutting the 1963 and 1970 ash basins. The 1985 ash basin was constructed east of the existing ash basins between the discharge canal and Corinth Road. The ash basins are impounded by earthen dams. A 500-foot compliance boundary encircles the ash basins. The ash basin locations are indicated on Figure 2.

Currently, the 1956, 1963, and 1970 ash basins are dry and entirely covered with vegetation (both hardwood and pine trees). A small area near the southern end of the 1970 ash basin is seasonally wet. The 1978 ash basin is partially vegetation-covered (both trees and scrub), and a portion of the southern end of the ash basin retains water. The 1985 ash basin has some grass cover and ponded water in the southwest corner of the ash basin.
Wastewater discharges from the ash basins are permitted by the NCDENR DWR under NPDES Permit NC0003433.

2.3 Groundwater Monitoring System
The compliance monitoring network includes two background monitoring wells, BGMW-4 and BGTMW-4, plus 11 monitoring wells located along the compliance boundary. The locations of the monitoring wells, waste boundary, and compliance boundary are shown on Figure 2.

Monitoring wells BGMW-4 and BGTMW-4 represent background groundwater quality northeast of the ash basins. CMW-5 is the compliance boundary well for the northeast side of the compliance boundary. Monitoring well CMW-3 is the compliance boundary well for the north side of the ash basins. Monitoring wells CMW-2, CTMW-2, CMW-8, CTMW-8, CMW-1, CTMW-1, CMW-7, and CTMW-7 are compliance boundary wells to the west and southwest of the ash basins. Monitoring well CMW-6 is the compliance boundary well for the southeast side of the ash basins.

Wells BGTMW-4, CTMW-1, CTMW-2, CTMW-7, and CTMW-8 were installed in the upper bedrock and were paired with shallow wells BGMW-4, CMW-1, CMW-2, CMW-7, and CMW-8, which were installed above the bedrock in residuum to monitor the vertical hydraulic gradient in the area and aquifer conditions within the shallow bedrock. The remainder of the compliance boundary wells, CMW-3, CMW-5, and CMW-6, were installed in the residuum, above bedrock.

In accordance with the current NPDES permit, the monitoring wells are sampled three times per year in March, June, and October for the parameters listed below. The analytical results for the compliance monitoring program are compared to the 2L Standards.

It is proposed that monitoring for aluminum be discontinued. Aluminum is a very common, naturally-occurring element in soil and rocks of the area. A preliminary statistical evaluation indicates that aluminum concentrations in downgradient compliance monitoring wells are not statistically significant increases (SSIs) over the background well data set for the most recent sampling event. Further, aluminum is not consistently monitored across the entirety of Duke Energy facilities, and there is no 2L Standard for aluminum.
### NPDES Groundwater Monitoring Requirements

<table>
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3.0 RECEPTOR INFORMATION

The August 13, 2014 NORR states:

No later than October 14th, 2014 as authorized pursuant to 15A NCAC 02L .0106(g), the DWR is requesting that Duke perform a receptor survey at each of the subject facilities and submitted to the DWR. The receptor survey is required by 15A NCAC 02L .0106(g) and shall include identification of all receptors within a radius of 2,640 feet (one-half mile) from the established compliance boundary identified in the respective National Pollutant Discharge Elimination System (NPDES) permits. Receptors shall include, but not be limited to, public and private water supply wells (including irrigation wells and unused or abandoned wells) and surface water features within one-half mile of the facility compliance boundary. For those facilities for which Duke has already submitted a receptor survey, please update your submittals to ensure they meet the requirements stated in this letter and referenced attachments and submit them with the others. If they do not meet these requirements, you must modify and resubmit the plans.

The results of the receptor survey shall be presented on a sufficiently scaled map. The map shall show the coal ash facility location, the facility property boundary, the waste and compliance boundaries, and all monitoring wells listed in the respective NPDES permits. Any identified water supply wells shall be located on the map and shall have the well owner’s name and location address listed on a separate table that can be matched to its location on the map.

In accordance with the requirements of the NORR, SynTerra is in the process of conducting 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 Cape Fear Plant ash basin compliance boundary. The compliance boundary for groundwater quality, in relation to the ash basins, 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. Potential receptors include public and private water supply wells (including irrigation wells and unused or abandoned wells) and surface water features within a 0.5-mile radius of the Cape Fear Plant compliance boundary.

The survey consists of a review of publicly available data from NCDENR Department of Environmental Health (DEH), NC OneMap GeoSpatial Portal, DWR Source Water Assessment Program (SWAP) online database, county GIS, Environmental Data...
Resources, Inc. (EDR) Records Review, the USGS National Hydrography Dataset (NHD), as well as a vehicular survey along public roads located within 0.5 mile radius of the compliance boundary.

Additional receptor information will be collected as part of the anticipated assessment to comply with the CSA guidelines (NCDENR, August 2014).
4.0 REGIONAL GEOLOGY AND HYDROGEOLOGY

Topographically, the Cape Fear Plant is situated in the Piedmont plateau region of central North Carolina, a few miles north and west of the contact between the Piedmont and the North Carolina Coastal Plain. The Piedmont is characterized by well-rounded hills and rolling ridges. Elevations in the area of the Cape Fear Plant are between 150 and 200 feet above mean sea level.

Geologically, the Plant is located within the Deep River Basin (specifically the northern portion of the Sanford Sub-basin), an irregular, half graben structural feature of Triassic age. In the area of the Plant, the basin is surrounded by and presumably underlain by igneous and metamorphic rocks of the Carolina Terrane (formerly Carolina Slate Belt) rocks. Over time, continental sediments filled the basin to great thicknesses and have subsequently been cut by numerous diabase dikes. The stratigraphy of the basin, consistent with other basins in North Carolina and Virginia, is represented by a lower sequence of coarse-grained arkosic sandstone and conglomerate; a middle sequence of siltstone, shale, and thin coal deposits; and an upper sequence of sandstone, mudstone, siltstone, and conglomerate. In general, the strata of the Deep River Basin dip gently to the east (Horton and Zullo, 1991).

According to the Geologic Map of North Carolina (1985), the Cape Fear Plant is situated within the rocks of the Pekin Formation of the Chatham Group; although, the Plant appears to be situated near the gradational contact of the Pekin Formation with the Cumnock Formation (Figure 3). The Geologic Map of North Carolina describes each of these units as being comprised of fluvial sedimentary rocks such as conglomerate, sandstone, and mudstone.

Rocks of the region, except where exposed in road cuts, stream channels, and steep hillsides, are covered with unconsolidated material formed from the in-situ chemical and physical breakdown of the bedrock. This unconsolidated material is referred to as residuum.

Groundwater within the area exists under unconfined, also known as water table, conditions within the residuum and in the fractures and joints of the underlying bedrock. The water table and bedrock aquifers are interconnected. The residuum acts as a reservoir for water supply to the fractures and joints in the underlying bedrock. Shallow groundwater generally flows from local recharge zones in topographically high areas, such as ridges, toward groundwater discharge zones, such as stream valleys. Ridge and topographic high areas serve as groundwater recharge zones. Groundwater flow patterns in recharge areas tend to develop a somewhat radial pattern from the

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center of the recharge area outward toward the discharge areas and are expected to mimic surface topography. The closest surface water discharge for the subject property occurs to the west as small, perennial and intermittent streams and creeks that flow toward the Cape Fear River, a large regional river. The predominant flow direction for groundwater is to the west and west-southwest.
5.0 SITE GEOLOGY AND HYDROGEOLOGY

Direct observations at the Cape Fear Plant confirm the presence of residuum, developed above the sedimentary rocks of the Plant area that is generally 15 to 30 feet thick and extends from the ground surface to the contact with rock. Boring logs from previous drilling activities at the site generally describe the sedimentary rocks underlying the Plant as brown to gray mudstones and siltstones.

Groundwater beneath the Plant area occurs within the residuum at depths ranging from about 10 feet to about 20 feet below the ground surface. Depths to groundwater in wells completed in the shallow bedrock are similar. Groundwater elevations from paired wells typically show slight downward vertical gradients in upland areas and an upward gradient near the Cape Fear River. Analysis of potentiometric data for Plant wells confirms that groundwater flows from upland areas located east of the Plant towards the west-southwest toward the Cape Fear River. The approximate groundwater gradient for June 2014 data was 10.55 feet (vertical change) over 4,200 feet (horizontal distance) or 2.5 feet/1,000 feet as measured from well CMW-5 to well CMW-1.
6.0 GROUNDWATER MONITORING RESULTS

6.1 Groundwater Analytical Results
June 2014 was the twelfth compliance monitoring event conducted in accordance with the NPDES Permit. The routine analytical data indicates that boron, iron, manganese, sulfate, selenium, total dissolved solids (TDS) and pH have been elevated relative to 2L Standards. Boron tends to be detected near or greater than the 2L Standard in compliance boundary wells CMW-1, CMW-3, CMW-6, and CMW-8. Iron tends to be detected greater than the 2L Standard in compliance boundary wells CMW-1, CTMW-1, CMW-2, CMW-5, CMW-7, CMW-8, and CTMW-8. Infrequent detections of iron at concentrations above the 2L Standard have occurred in background wells BGMW-4 and BGTMW-4 and compliance boundary wells CTMW-2, CMW-3, CMW-6, and CTMW-7. Manganese tends to be detected greater than the 2L Standard in background well BGTMW-4 and in compliance boundary wells CMW-1, CTMW-1, CMW-2, CMW-3, CMW-7, CTMW-7, CMW-8, and CTMW-8. Infrequent detections of manganese at concentrations above the 2L Standard have occurred at background well BGMW-4 and compliance boundary wells CMW-5 and CMW-6. Sulfate tends to be infrequently detected above the 2L Standard at CMW-3. Selenium tends to be detected above the 2L Standard at compliance boundary well CMW-3. TDS tends to be similar to or greater than the 2L Standard in compliance boundary wells CMW-2, CMW-3, CMW-6, and CTMW-8. In general, the groundwater pH tends to be slightly less than or within the 2L Standard range. The concentration ranges for the constituents which have elevated values greater than 2L Standards are provided in Table 1.

Arsenic and cadmium have each been detected in at least one background or compliance boundary well at concentrations greater than the 2L Standard. However, these constituents have not been detected at elevated concentrations with regularity and are believed to be related to sample turbidity or represent data outliers.

6.2 Preliminary Statistical Evaluation Results
As a preliminary evaluation tool, statistical analysis was conducted on the groundwater analytical data collected between December 2010 and June 2014 at the Cape Fear Plant. The statistical analysis was conducted in accordance with US EPA, Statistical Training Course for Ground Water Monitoring Data Analysis, EPA530-R-93-003, 1992 and US EPA’s Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities; Unified Guidance EPA 530/R-09-007, March 2009.

An inter-well prediction interval statistical analysis was utilized to evaluate the groundwater data. The inter-well prediction interval statistical evaluation involves comparing background well data to the results for the most recent sample date from
compliance boundary wells. Monitoring wells BGMW-4 and BGTMW-4 are the background wells. Monitoring wells CMW-1, CTMW-1, CMW-2, CTMW-2, CMW-3, CMW-5, CMW-6, CMW-7, CTMW-7, CMW-8, and CTMW-8 are considered compliance boundary wells. Statistical analysis was performed on the inorganic constituents with detectable concentrations for the most recent routine sampling event (June 2014).

The statistical analysis indicated statistically significant increases (SSIs) over background concentrations for the following:

- CMW-1 barium, boron, iron, manganese, and TDS (however, barium and TDS are consistently less than the 2L Standard);
- CTMW-1 boron, chloride, manganese, sulfate, and TDS (boron, chloride, sulfate, and TDS concentrations are consistently less than the 2L Standard);
- CMW-2 boron, chloride, iron, manganese, nickel, sulfate, and TDS (boron, chloride, and nickel are consistently less than the 2L Standard);
- CTMW-2 arsenic and barium (concentrations for both constituents are consistently less than the 2L Standard);
- CMW-3 boron, chloride, manganese, selenium, sulfate, and TDS (chloride, sulfate, and TDS are consistently less than the 2L Standard);
- CMW-5 aluminum, boron, and iron (no 2L Standard exists for aluminum and boron is consistently less than the 2L Standard);
- CMW-6 boron, chloride, sulfate, and TDS (chloride, sulfate, and TDS are consistently less than the 2L Standard);
- CMW-7 manganese and zinc (zinc is consistently less than the 2L Standard);
- CTMW-7 chloride, manganese, and TDS (chloride and TDS are consistently less than the 2L Standard);
- CMW-8 barium, boron, iron, manganese, nickel, sulfate, and TDS (barium, nickel, sulfate, and TDS are consistently less than the 2L Standard); and
- CTMW-8 barium, boron, manganese, sulfate, and TDS (barium, boron, and sulfate are consistently less than the 2L Standard).

A more robust statistical analysis will be completed as part of the CSA using data from additional background wells.
7.0 ASSESSMENT WORK PLAN

The scope of work discussed in this plan is designed to meet the requirements of 15A NCAC 02L .0106(g) and to:

- Identify the source and cause of contamination;
- Identify any imminent hazards to public health and safety and actions taken to mitigate them in accordance to 15A NCAC 02L .0106(f);
- Identify all receptors and significant exposure pathways;
- Determine the horizontal and vertical extent of soil and groundwater contamination and all significant factors affecting contaminant transport; and
- Determine geological and hydrogeological features influencing the movement, chemical, and physical character of the contaminants.

The following sections generally describe anticipated assessment activities to fill data gaps associated with the source, vertical and horizontal extent for those constituents in soil and groundwater as discussed in Section 1.0 that have elevated values greater than the 2L Standards. The assessment may be iterative with additional assessment activities possibly identified and added prior to the preparation of the CSA. The following are the activities anticipated at this time.

7.1 Anticipated Ash Basin Boring Locations

Borings are anticipated within the ash basin to determine the thickness of ash present in the basin as well as to determine the current residual saturation of the ash. Four borings are anticipated in the ash basin at the locations shown on Figure 4.

The borings may be conducted using Roto-Sonic drilling (or other drilling methods) to provide continuous soil cores through ash and into the underlying native soil. Drilling will be extended approximately 20 feet below the bottom of the ash to allow for characterization of the underlying native soil.

Ash samples will be collected at each boring location for laboratory analysis of total metals and SPLP metals. To characterize possible variation in ash composition, two samples, a shallow and a deep, are anticipated at each location if the ash thickness is less than 20 feet. If the thickness is greater than 20 feet, three samples (shallow, intermediate, and deep) may be collected. A summary of the boring details is provided in Table 3. The depths at which the samples are collected will be noted on sample IDs.
7.2 Anticipated Soil Boring Locations

7.2.1 Inside Ash Basins
As discussed above, Roto-Sonic drilling (or similar technology) may be used to conduct borings within the ash basins. These borings are anticipated to extend to a depth of approximately 20 feet below the bottom of the ash to characterize the native soil below the ash basins.

Soil samples are anticipated at each of the three boring locations immediately below the ash and at the bottom of the borings to provide information on the vertical distribution of metals beneath the ash. The collected soil samples will be analyzed for total metals, SPLP metals, and geotechnical parameters. A summary of the anticipated boring details is provided in Table 3.

Following collection of the soil samples, the borings will be abandoned by filling with a bentonite-grout mixture, or they may be converted to a piezometer to measure groundwater elevations beneath the ash basin(s).

7.2.2 Outside Ash Basins
Soil samples are anticipated to be collected during installation of monitoring wells for metals analysis at all wells to further assess concentrations across the Plant. Geotechnical parameters pertinent to developing the computer model will be collected from BW-1S, BW-9D, AW-12D, AW-1S, AW-2S, and AW-3S. Soil samples are anticipated at each of the boring locations immediately above the water table and within the transition zone. The soil samples will be analyzed for total metals, SPLP metals, and geotechnical parameters. A summary of the anticipated boring details is provided in Table 3.

7.3 Anticipated Sediment and Surface Water Locations
Surface water and sediment samples are not anticipated at this time. Data associated with recent seep sampling will be used to infer preferential pathways and migration from groundwater to surface water in various areas of the Plant. Seep data analysis may be used to guide the collection of additional sediment or surface water data in the future.

7.4 Anticipated Groundwater Monitoring Wells
A number of monitoring wells, piezometers, and observation wells are present at the site to monitor conditions within the aquifer horizontally and vertically. These existing wells will be supplemented with additional wells to complete the CSA.
7.4.1 General Construction, Development, Aquifer Testing

Monitoring wells and piezometers will be constructed by North Carolina-licensed well drillers. Drilling equipment will be decontaminated prior to use at each location using a high pressure steam cleaner. Monitoring wells will be constructed of 2-inch ID, National Sanitation Foundation (NSF) grade polyvinyl chloride (PVC) (ASTM 2012a,b) schedule 40 flush-joint threaded casing and 0.010-inch machine-slotted pre-packed screens. Piezometers will be constructed of one-inch ID, NSF Schedule 40 PVC flush-joint threaded casing and pre-packed screens.

Monitoring wells will be installed as nested Type II wells or as single wells. A shallow well will be installed with the top of the well screen approximately five feet below the water table. The deeper well will be installed into shallow bedrock to an approximate depth, based on specific conditions, of generally 10 feet below the residuum/bedrock transition zone. This will provide information on the vertical distribution of aquifer characteristics between the shallow water-bearing residuum and the shallow bedrock (chemistry and aquifer parameters) as well as determining the magnitude of vertical hydraulic gradients.

For nested Type II wells, the shallow well screen intervals will typically be a 10 foot length. The deeper of the nested wells will be installed first using a five foot well screen length. The wells will be constructed in accordance with 15A NCAC 02C (Well Construction Standards). The monitoring wells will be completed with either steel above ground protective casings with locking caps or steel flush-mount manholes with locking expansion caps, and well tags. The protective covers will be secured and completed in a concrete collar and a minimum two-foot square concrete pad.

Piezometers will be installed in a similar manner, but with one-inch ID, NSF Schedule 40- PVC flush-joint threaded casing and pre-packed screens. A pelletized bentonite seal will be placed above the filter pack and the remainder of the annular space will be filled with neat cement grout from the top of the bentonite seal to near ground surface. The piezometers will be completed with either steel above ground protective casings with locking caps or steel flush-mount manholes with locking expansion caps, and well tags. The protective covers will be secured and completed in a concrete collar and a minimum one-foot square concrete pad.

Following installation, the monitoring wells will be developed in order to remove drill fluids, clay, silt, sand, and other fines which may have been
introduced into the formation or sand pack during drilling and well installation, and to establish communication of the well with the aquifer. Well development will be performed using a portable submersible pump, which will be repeatedly moved up and down the well screen interval until the water obtained is relatively clear. Development will be continued by sustained pumping until monitoring parameters (e.g., conductivity, pH, temperature) are generally stabilized; estimated quantities of drilling fluids, if used, are removed; and, turbidity decreases to acceptable levels.

After the wells have been developed, hydraulic conductivity tests (rising head slug tests) will be conducted on each of the wells. The slug tests will be performed in accordance with ASTM D4044-96 Standard Test Method (Field Procedure) for Instantaneous Change in Head (Slug) Tests for Determining Hydraulic Properties of Aquifers and NCDENR Performance and Analysis of Aquifer Slug Test and Pumping Test Policy, dated May 31, 2007.

The data obtained during the slug tests will be reduced and analyzed using AQTESOLV™ for Windows, version 4.5, software to determine the hydraulic conductivity of the soils in the vicinity of wells.

**7.4.2 Background Wells**

An existing background well pair BGMW-4 and BGTMW-4 are located to the north of Shaddox Creek and adjacent to and downgradient from a wood panel manufacturing facility. Three new background wells, a new well pair east of Corinth Road and a deeper (shallow bedrock) well paired with voluntary well MW-9, will be installed beyond the compliance boundary at the locations shown on Figure 4 to further evaluate background water quality in different hydrogeologic settings around the Plant area. A summary of proposed boring details is provided in Table 3.

**7.4.3 Ash Basins**

During previous assessment activities conducted at the Cape Fear Plant, monitoring wells and piezometers have been installed within the ash basins (Figure 4). Therefore, limited additional monitoring wells or piezometers are anticipated to be installed within the ash basins as part of the CSA (Figure 4).

**7.4.4 Downgradient Assessment Areas**

A preliminary review of site data and existing monitoring well/piezometer locations indicate that there is sufficient horizontal and vertical coverage of the ash basin and compliance boundary to complete a CSA of the Cape Fear Plant, with the exception of the area south of the 1985 ash basin. Therefore, it is
anticipated that a monitoring well nest will be installed southeast of CMW-6 and within the Plant property boundary. Additionally, a deeper well, completed in the shallow bedrock and paired with MW-12 will be installed in the area as shown on Figure 4 for the purpose of providing additional hydrogeologic and geochemical information in this area. A summary of the boring details is provided in Table 3.

7.4.5 Groundwater Sampling
It is anticipated that groundwater samples will be collected using a low-flow sampling technique consistent with compliance monitoring well sampling protocol. The groundwater samples will be analyzed for the parameters listed in Table 2. Total and dissolved metals analysis will be conducted. In addition to the groundwater samples collected from the new monitoring wells, it is anticipated that groundwater samples will be collected from one or more of the existing site monitoring wells. A summary of the anticipated groundwater samples is included in Table 3. During groundwater sampling activities, water level measurements will be made at the existing site monitoring wells, observation wells, and piezometers, along with the new monitoring installations. The data will be used to generate potentiometric maps as well as to determine the degree of residual saturation beneath the ash basin.

7.5 Influence of Pumping Wells on Groundwater System
There are no private water supply wells located within a 0.5-mile radius of the compliance boundary for the ash basins. Twenty potential water supply wells may be located greater than 0.5 miles and upgradient of the compliance boundary and/or beyond a regional groundwater divide. Based on the established distances and possible limited withdrawal rates, the area of influence of the off-site wells is not expected to be large enough to substantially affect the groundwater system near the ash basins.

7.6 Site Conceptual Model
Using existing hydrogeological site data along with data that will be generated during the CSA activities, a Site Conceptual Model (SCM) will be prepared. The SCM will be prepared in accordance with Evaluating Metals in Groundwater at DWR Permitted Facilities (July 2012) and the NCDENR memorandum, Hydrogeologic Investigation and Reporting Policy (May 31, 2007). The SCM will define the groundwater flow systems at the site, horizontally and vertically, and provide a better understanding of the fate and transport of constituents of concern in groundwater. This information will be used to develop a groundwater computer model for Cape Fear Plant. Figure 4 shows the proposed locations for geologic cross sections anticipated for the SCM.
7.7 Development of Groundwater Computer Model
Data from existing and new monitoring wells will be used to develop a groundwater computer model of the system. The groundwater modeling will be conducted in accordance with the requirements of the May 31, 2007 NCDENR memorandum, *Groundwater Modeling Policy*.

At this time, it is anticipated that a numerical groundwater flow model will be developed using the MODFLOW finite difference model that was developed by the USGS and is one of the most widely accepted and widely used groundwater flow models. The MODFLOW model will be created as a multi-layer flow model to better determine the vertical flow component of the aquifer system which will allow for more accurate fate and transport modeling. Once the model is created, it will be calibrated to site conditions by modifying model inputs, such as hydraulic conductivity, within established limits based on actual site data, until a reasonable match between the model and actual site conditions is accomplished.

After the MODFLOW model is calibrated, the modeled flow data will be imported into MT3D or RT3D and a fate and transport model will be created. MT3D and RT3D are three-dimensional numerical solute fate and transport model, which will be used to predict the short and long-term movement of the constituents of interest in groundwater at the site and under the various predictive scenarios discussed above.

Due to the data requirements of the computer modeling, the computer model will be completed after the majority of the groundwater assessment activities. The results of the groundwater modeling are anticipated as an appendix to the CSA Report.
8.0 IMPLEMENTATION SCHEDULE AND REPORT SUBMITTAL

Implementation will take place immediately following approval of this Groundwater Assessment Work Plan by DWR. The anticipated schedule of activities and project completion once the plan is approved is provided below.

- 10 days to begin field activities upon approval of plan.
  (Including, but not limited to, notification of public utility locate services, road access clearing, bottle/container requests from laboratories for the required soil and groundwater samples)

- 60 days to complete field activities.
  - Complete drilling activities
  - Conduct slug tests
  - Survey soil boring, well, sediment, and surface water locations
  - Collect groundwater and surface water samples
  - Collect site-wide water levels
  - Begin setup of groundwater computer model

- 30 days after completion of field activities, receive analytical data.

- 60 days after receipt of analytical data, evaluate results, conduct statistical evaluation, prepare summary tables, develop CSM, and calibrate computer model.

- 20 days to complete assessment report, per legislation.

- 90 days (up to 180 days) to complete computer modeling and Corrective Action Plan.

- Conduct additional work as may be required to complete the CSA.

- 90 days to complete CSA preparation, review, and submittal, in accordance with NCDENR guidance.

It is assumed that:

- No more than one iterative assessment step will be required;
- No off-site assessment or access agreements are anticipated;
• Duke Energy will make a diligent effort to collect all receptor information in accordance with NCDENR guidance (August 2014); however, it is anticipated that all such information may not be available;

• If off-site water supply wells sampling is deemed necessary, NCDENR staff may be requested to assist with access;

• No special permitting is anticipated; and

• Data may not reflect all seasonal or extreme hydrologic conditions.

• During the CSA process if additional investigations are required NCDENR, will be notified.

• In addition to the components listed above, a human health and ecological risk assessment will be conducted.
9.0 REFERENCES

ASTM, D4044-96 Standard Test Method (Field Procedure) for Instantaneous Change in Head (Slug) Tests for Determining Hydraulic Properties of Aquifers.


North Carolina Department of Natural Resources and Community Development, 1985, Geologic Map of North Carolina, 1:500,000.
FIGURES
LEGEND

- BACKGROUND MONITORING WELL (SURVEYED)
- COMPLIANCE MONITORING WELL (SURVEYED)
- DUKE ENERGY PROPOSED CAPE FEAR PLANT
- RIZE SITE LIMITS
- ASH BASIN BOUNDARY (APPROXIMATE)
- ASH BASIN BOUNDARY
- DUKE ENERGY PROGRESS CAPE FEAR PLANT
- FLOW DIRECTION

FIGURE 2
SITE LAYOUT

SOURCES:
2. 2014 AERIAL PHOTOGRAPH WAS OBTAINED FROM WSP FLOWN ON APRIL 17, 2014.
3. DRAWING HAS BEEN SET WITH A PROJECTION OF NORTH CAROLINIA STATE PLANE COORDINATE SYSTEM FIPS 3200 (NAD 83).

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Greenville, South Carolina 29601
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LEGEND

BACKGROUND MONITORING WELL (SURVEYED)
COMPLIANCE MONITORING WELL (SURVEYED)
DUKE ENERGY PROGRESS CAPE FEAR PLANT
500FT COMPLIANCE BOUNDARY
WATER BOUNDARY
2017 LiDAR CONTOUR MAJOR
2017 LiDAR CONTOUR MINOR
PARCEL LINE (Chatham and Lee Co GIS)
FLOW DIRECTION
GENERALIZED GROUNDWATER FLOW DIRECTION
SUPPORTED BY GROUNDWATER ELEVATION DATA
OR TOPOGRAPHIC DATA
2007 LiDAR CONTOUR MAJOR
2007 LiDAR CONTOUR MINOR
PARCEL LINE (Chatham and Lee Co GIS)
FLOW DIRECTION
GENERALIZED GROUNDWATER FLOW DIRECTION
SUPPORTED BY GROUNDWATER ELEVATION DATA
OR TOPOGRAPHIC DATA

SOURCES:
1. 2017 HIGH RESOLUTION AERIAL PHOTOGRAPH
   OBTAINED FROM CHATHAM COUNTY GIS WEBSITE AT
   http://www.chathamgis.com/
2. 2014 AERIAL PHOTOGRAPH WAS OBTAINED FROM
   WSP FLOWN ON APRIL 17, 2014.
3. DRAWING HAS BEEN SET WITH A PROJECTION OF
   NORTH CAROLINA STATE PLANE COORDINATE
   SYSTEM FIPS 3200 (NAD 83).
4. 2FT CONTOUR INTERVALS FROM NCDOT LIDAR DATED
   2007

NOTE:
1. CONTOUR LINES ARE USED FOR REPRESENTATIVE
   PURPOSES ONLY AND ARE NOT TO BE USED FOR
   DESIGN OR CONSTRUCTION PURPOSES.
TABLES
# TABLE 1
## SUMMARY OF CONCENTRATION RANGES FOR CONSTITUENTS DETECTED GREATER THAN 2L STANDARDS

CAPE FEAR STEAM ELECTRIC PLANT  
DUKE ENERGY PROGRESS, INC., MONCURE, NORTH CAROLINA

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>ANTIMONY</th>
<th>ARSENIC</th>
<th>BORON</th>
<th>CADMIUM</th>
<th>IRON</th>
<th>MANGANESE</th>
<th>SELENIUM</th>
<th>SULFATE</th>
<th>TDS</th>
<th>pH</th>
</tr>
</thead>
<tbody>
<tr>
<td>2L STANDARD eff. 4/1/2013</td>
<td>1</td>
<td>10</td>
<td>700</td>
<td>2</td>
<td>300</td>
<td>50</td>
<td>20</td>
<td>250</td>
<td>500</td>
<td>6.5 - 8.5</td>
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<table>
<thead>
<tr>
<th>Units</th>
<th>(ug/l)</th>
<th>(ug/l)</th>
<th>(ug/l)</th>
<th>(ug/l)</th>
<th>(ug/l)</th>
<th>(mg/l)</th>
<th>(mg/l)</th>
<th>SU</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Well ID</th>
<th>Well Location Relative to Compliance Boundary</th>
<th>Concentration Range</th>
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</thead>
<tbody>
<tr>
<td>BG M W - 4</td>
<td>Background</td>
<td>&lt; 2L</td>
</tr>
<tr>
<td>BG T M W - 4</td>
<td>Background</td>
<td>0.6 - 1.1</td>
</tr>
<tr>
<td>CM W - 1</td>
<td>CB</td>
<td>&lt; 2L</td>
</tr>
<tr>
<td>CT M W - 1</td>
<td>CB</td>
<td>&lt; 2L</td>
</tr>
<tr>
<td>CM W - 2</td>
<td>CB</td>
<td>&lt; 2L</td>
</tr>
<tr>
<td>CT M W - 2</td>
<td>CB</td>
<td>&lt; 2L</td>
</tr>
<tr>
<td>CM W - 3</td>
<td>CB</td>
<td>&lt; 2L</td>
</tr>
<tr>
<td>CM W - 5</td>
<td>CB</td>
<td>&lt; 2L</td>
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<tr>
<td>CM W - 6</td>
<td>CB</td>
<td>&lt; 2L</td>
</tr>
<tr>
<td>CM W - 7</td>
<td>CB</td>
<td>&lt; 2L</td>
</tr>
<tr>
<td>CT M W - 7</td>
<td>CB</td>
<td>&lt; 2L</td>
</tr>
<tr>
<td>CM W - 8</td>
<td>CB</td>
<td>&lt; 2L</td>
</tr>
<tr>
<td>CT M W - 8</td>
<td>CB</td>
<td>&lt;0.5 - 1.7</td>
</tr>
</tbody>
</table>

Notes:  
B - Data flagged due to detection in field blank  
CB - Compliance Boundary  
< 2L - Constituent has not been detected above the 2L Standard or beyond range for pH  
Shown concentration ranges only include concentrations detected above the laboratory’s reporting limit.

Prepared by: RBI  
Checked by: BER
**TABLE 2**
GROUNDWATER ASSESSMENT PARAMETER LIST
CAPE FEAR STEAM ELECTRIC PLANT
DUKE ENERGY PROGRESS, INC., MONCURE, NORTH CAROLINA

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>UNITS</th>
<th>FIELD EQUIPMENT/ LAB METHOD</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>SU</td>
<td>YSI Professional Plus or YSI 556 MPS</td>
</tr>
<tr>
<td>Specific Conductivity</td>
<td>µS/cm</td>
<td>YSI Professional Plus or YSI 556 MPS</td>
</tr>
<tr>
<td>Temperature</td>
<td>ºC</td>
<td>YSI Professional Plus or YSI 556 MPS</td>
</tr>
<tr>
<td>ORP</td>
<td>mV</td>
<td>YSI Professional Plus or YSI 556 MPS</td>
</tr>
<tr>
<td>Dissolved Oxygen</td>
<td>mg/L</td>
<td>YSI Professional Plus or YSI 556 MPS</td>
</tr>
<tr>
<td>Turbidity</td>
<td>NTU</td>
<td>Hach 2100Q</td>
</tr>
</tbody>
</table>

**Field Parameters - Inorganics (Total & Dissolved)**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Units</th>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antimony</td>
<td>µg/L</td>
<td>EPA 200.8</td>
</tr>
<tr>
<td>Arsenic</td>
<td>µg/L</td>
<td>EPA 200.8</td>
</tr>
<tr>
<td>Barium</td>
<td>mg/L</td>
<td>EPA 200.7</td>
</tr>
<tr>
<td>Boron</td>
<td>mg/L</td>
<td>EPA 200.7</td>
</tr>
<tr>
<td>Cadmium</td>
<td>µg/L</td>
<td>EPA 200.8</td>
</tr>
<tr>
<td>Chromium</td>
<td>µg/L</td>
<td>EPA 200.8</td>
</tr>
<tr>
<td>Copper</td>
<td>mg/L</td>
<td>EPA 200.7</td>
</tr>
<tr>
<td>Iron</td>
<td>mg/L</td>
<td>EPA 200.7</td>
</tr>
<tr>
<td>Lead</td>
<td>µg/L</td>
<td>EPA 200.8</td>
</tr>
<tr>
<td>Manganese</td>
<td>mg/L</td>
<td>EPA 200.7</td>
</tr>
<tr>
<td>Mercury</td>
<td>µg/L</td>
<td>EPA 245.1</td>
</tr>
<tr>
<td>Molybdenum</td>
<td>µg/L</td>
<td>EPA 200.8</td>
</tr>
<tr>
<td>Nickel</td>
<td>µg/L</td>
<td>EPA 200.8</td>
</tr>
<tr>
<td>Selenium</td>
<td>µg/L</td>
<td>EPA 200.8</td>
</tr>
<tr>
<td>Thallium (low level)</td>
<td>µg/L</td>
<td>EPA 200.8</td>
</tr>
<tr>
<td>Zinc</td>
<td>mg/L</td>
<td>EPA 200.7</td>
</tr>
</tbody>
</table>

**Lab Parameters - Anions/Cations**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Units</th>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrate as Nitrogen</td>
<td>mg-N/L</td>
<td>EPA 300.0</td>
</tr>
<tr>
<td>Ferrous Iron</td>
<td>mg/L</td>
<td>(Field Test Kit)</td>
</tr>
<tr>
<td>Sulfate</td>
<td>mg/L</td>
<td>EPA 300.0</td>
</tr>
<tr>
<td>Sulfide</td>
<td>mg/L</td>
<td>SM 4500 Sd</td>
</tr>
<tr>
<td>Methane</td>
<td>mg/L</td>
<td>RSK 175</td>
</tr>
<tr>
<td>Chloride</td>
<td>mg/L</td>
<td>EPA 300.0</td>
</tr>
<tr>
<td>Calcium</td>
<td>mg/L</td>
<td>EPA 200.7</td>
</tr>
<tr>
<td>Magnesium</td>
<td>mg/L</td>
<td>EPA 200.7</td>
</tr>
<tr>
<td>Sodium</td>
<td>mg/L</td>
<td>EPA 200.7</td>
</tr>
<tr>
<td>Potassium</td>
<td>mg/L</td>
<td>EPA 200.7</td>
</tr>
<tr>
<td>Bromide</td>
<td>mg/L</td>
<td>EPA 300.1</td>
</tr>
<tr>
<td>Total Organic Carbon</td>
<td>mg/L</td>
<td>EPA 5310</td>
</tr>
<tr>
<td>Alkalinity (as CaCO3)</td>
<td>mg/L</td>
<td>SM 2320B</td>
</tr>
<tr>
<td>Total Dissolved Solids</td>
<td>mg/L</td>
<td>SM 2540C</td>
</tr>
</tbody>
</table>

**Notes:**
- SU - Standard Units
- µS/cm - microsiemens per centimeter
- ºC - degrees Celsius
- mV - millivolts
- NTU - Nephelometric Turbidity Units
- µg/L - micrograms per liter
- mg-N/L - milligrams nitrate (as nitrogen) per liter

Prepared by: RBI  Checked by: JAW
### TABLE 3
**ASSESSMENT SAMPLING PLAN**
**CAPE FEAR STEAM ELECTRIC PLANT**
**DUKE ENERGY PROGRESS, INC., MONCURE, NORTH CAROLINA**

<table>
<thead>
<tr>
<th>ASH MANAGEMENT AREA</th>
<th>BORING / WELL ID</th>
<th>ESTIMATED BORING DEPTH (ft bgs)</th>
<th>ESTIMATED NO. OF SAMPLES</th>
<th>SAMPLE MEDIA</th>
<th>SAMPLE DEPTHS/INTERVALS/TARGET ZONES</th>
<th>LAB ANALYSIS</th>
<th>PURPOSE/NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ash Basin</strong></td>
<td>AB-1</td>
<td>40</td>
<td>4-5</td>
<td>Ash</td>
<td>1-2' Intermediate (if &gt;20' thick) Above ash/sediment contact</td>
<td>Total metals = SLP Total metals = SLP Total metals = SLP Total metals + Geotech Total metals + Geotech</td>
<td>Iwan ash thickness, determine residual saturation of ash, characterize ash chemistry and leachability, characterize soil chemistry beneath ash, geologic cross section, groundwater modeling</td>
</tr>
<tr>
<td></td>
<td>AB-2</td>
<td>40</td>
<td>4-5</td>
<td>Ash</td>
<td>1-2' Intermediate (if &gt;20' thick) Above ash/sediment contact</td>
<td>Total metals = SLP Total metals = SLP Total metals = SLP Total metals + Geotech Total metals + Geotech</td>
<td>Iwan ash thickness, determine residual saturation of ash, characterize ash chemistry and leachability, characterize soil chemistry beneath ash, geologic cross section, groundwater modeling</td>
</tr>
<tr>
<td></td>
<td>AB-3</td>
<td>40</td>
<td>4-5</td>
<td>Ash</td>
<td>1-2' Intermediate (if &gt;20' thick) Above ash/sediment contact</td>
<td>Total metals = SLP Total metals = SLP Total metals = SLP Total metals + Geotech Total metals + Geotech</td>
<td>Iwan ash thickness, determine residual saturation of ash, characterize ash chemistry and leachability, characterize soil chemistry beneath ash, geologic cross section, groundwater modeling</td>
</tr>
<tr>
<td></td>
<td>AB-4</td>
<td>40</td>
<td>4-5</td>
<td>Ash</td>
<td>1-2' Intermediate (if &gt;20' thick) Above ash/sediment contact</td>
<td>Total metals = SLP Total metals = SLP Total metals = SLP Total metals + Geotech Total metals + Geotech</td>
<td>Iwan ash thickness, determine residual saturation of ash, characterize ash chemistry and leachability, characterize soil chemistry beneath ash, geologic cross section, groundwater modeling</td>
</tr>
<tr>
<td><strong>New Monitoring Wells</strong></td>
<td>BW-15/1D</td>
<td>20/50</td>
<td>4</td>
<td>Soil</td>
<td>Just above the water table Within transition zone</td>
<td>Screened interval Screened interval</td>
<td>Total metals + Geotech Total metals + Geotech Table 2 List Table 2 List</td>
</tr>
<tr>
<td></td>
<td>BW-9D</td>
<td>50</td>
<td>3</td>
<td>Soil</td>
<td>Just above the water table Within transition zone</td>
<td>Screened interval</td>
<td>Total metals + Geotech Total metals + Geotech Table 2 List</td>
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<tr>
<td></td>
<td>AW-12D</td>
<td>50</td>
<td>3</td>
<td>Soil</td>
<td>Just above the water table Within transition zone</td>
<td>Screened interval</td>
<td>Total metals + Geotech Total metals + Geotech Table 2 List</td>
</tr>
<tr>
<td></td>
<td>AW-15/D</td>
<td>20</td>
<td>50</td>
<td>Soil</td>
<td>Just above the water table Within transition zone</td>
<td>Screened interval Screened interval</td>
<td>Total metals + Geotech Total metals + Geotech Table 2 List Table 2 List</td>
</tr>
<tr>
<td></td>
<td>AW-25/D</td>
<td>20</td>
<td>50</td>
<td>Soil</td>
<td>Just above the water table Within transition zone</td>
<td>Screened interval Screened interval</td>
<td>Total metals + Geotech Total metals + Geotech Table 2 List Table 2 List</td>
</tr>
<tr>
<td></td>
<td>AW-35/D</td>
<td>20</td>
<td>50</td>
<td>Soil</td>
<td>Just above the water table Within transition zone</td>
<td>Screened interval Screened interval</td>
<td>Total metals + Geotech Total metals + Geotech Table 2 List Table 2 List</td>
</tr>
</tbody>
</table>
| **Existing Monitoring Wells** | Existing Monitoring Wells | TBD | Variable | TBD | Water | Well Screen Interval (variable) | Table 2 List | **Notes:**

- Total Metals - As, B, Ba, Cd, Cr, Cu, Fe, Hg, Mn/Mo, Ni, Pb, Sr, Se, Ti, and Zn.
- SLP (Synthetic Precipitation Leaching Procedure) Metals - As, B, Ba, Cd, Cr, Cu, Fe, Hg, Mn/Mo, Ni, Pb, Sr, Se, Ti, and Zn.
- Geotech = Geotechnical parameters include moisture content, particle size distribution, Atterberg limits, specific gravity, and permeability.
- Table 2 List - Parameter list presented in Table 2 of this document.
- TBD = To be determined.

Prepared by: TDP  Checked by: JAW
APPENDIX A

NCDENR LETTER OF AUGUST 13, 2014
August 13, 2014

CERTIFIED MAIL 7004 2510 0000 3651 1168
RETURN RECEIPT REQUESTED

Paul Newton
Duke Energy
526 South Church Street
Charlotte, NC 28202

Subject: Notice of Regulatory Requirements
Title 15A North Carolina Administrative Code (NCAC) 02L.0106
14 Coal Ash Facilities in North Carolina

Dear Mr. Newton:

Chapter 143, North Carolina General Statutes, authorizes and directs the Environmental Management Commission of the Department of Environment and Natural Resources to protect and preserve the water and air resources of the State. The Division of Water Resources (DWR) has the delegated authority to enforce adopted pollution control rules.

Rule 15A NCAC 02L.0103(d) states that no person shall conduct or cause to be conducted any activity which causes the concentration of any substance to exceed that specified in 15A NCAC 02L.0202. As of the date of this letter, exceedances of the groundwater quality standards at 15A NCAC 02L.0200 Classifications and Water Quality Standards Applicable to the Groundwaters of North Carolina have been reported at each of the subject coal ash facilities owned and operated by Duke Energy (herein referred to as Duke).

Groundwater Assessment Plans

No later than September, 26 2014 Duke Energy shall submit to the Division of Water Resources plans establishing proposed site assessment activities and schedules for the implementation, completion, and submission of a comprehensive site assessment (CSA) report for each of the following facilities in accordance with 15A NCAC 02L.0106(g):

- Asheville Steam Electric Generating Plant
- Belews Creek Steam Station
- Buck Steam Station
- Cape Fear Steam Electric Generating Plant
- Cliffside Steam Station
Dan River Combined Cycle Station
H.F. Lee Steam Electric Plant
Marshall Steam Station
Mayo Steam Electric Generating Plant
Plant Allen Steam Station
Riverbend Steam Station
Roxboro Steam Electric Generating Plant
L.V. Sutton Electric Plant
Weatherspoon Steam Electric Plant

The site assessment plans shall include a description of the activities proposed to be completed by Duke that are necessary to meet the requirements of 15A NCAC 02L .0106(g) and to provide information concerning the following:

(1) the source and cause of contamination;
(2) any imminent hazards to public health and safety and actions taken to mitigate them in accordance to 15A NCAC 02L .0106(f);
(3) all receptors and significant exposure pathways;
(4) the horizontal and vertical extent of soil and groundwater contamination and all significant factors affecting contaminant transport; and
(5) geological and hydrogeological features influencing the movement, chemical, and physical character of the contaminants.

For your convenience, we have attached guidelines detailing the information necessary for the preparation of a CSA report. The DWR will review the plans and provide Duke with review comments, either approving the plans or noting any deficiencies to be corrected, and a date by which a corrected plan is to be submitted for further review and comment or approval. For those facilities for which Duke has already submitted groundwater assessment plans, please update your submittals to ensure they meet the requirements stated in this letter and referenced attachments and submit them with the others.

Receptor Survey

No later than October 14th, 2104 as authorized pursuant to 15A NCAC 02L .0106(g), the DWR is requesting that Duke perform a receptor survey at each of the subject facilities and submitted to the DWR. The receptor survey is required by 15A NCAC 02L .0106(g) and shall include identification of all receptors within a radius of 2,640 feet (one-half mile) from the established compliance boundary identified in the respective National Pollutant Discharge Elimination System (NPDES) permits. Receptors shall include, but shall not be limited to, public and private water supply wells (including irrigation wells and unused or abandoned wells) and surface water features within one-half mile of the facility compliance boundary. For those facilities for which Duke has already submitted a receptor survey, please update your submittals to ensure they meet the requirements stated in this letter and referenced attachments and submit them with the others. If they do not meet these requirements, you must modify and resubmit the plans.
The results of the receptor survey shall be presented on a sufficiently scaled map. The map shall show the coal ash facility location, the facility property boundary, the waste and compliance boundaries, and all monitoring wells listed in the respective NPDES permits. Any identified water supply wells shall be located on the map and shall have the well owner’s name and location address listed on a separate table that can be matched to its location on the map.

Failure to comply with the State's rules in the manner and time specified may result in the assessment of civil penalties and/or the use of other enforcement mechanisms available to the State.

We appreciate your attention and prompt response in this matter. If you have any questions, please feel free to contact S. Jay Zimmerman, Water Quality Regional Operations Section Chief, at (919) 807-6351.

Sincerely,

[Signature]

John E. Skvarla, III

Attachment enclosed

cc: Thomas A. Reeder, Director, Division of Water Resources
    Regional Offices – WQROS
    File Copy
GUIDELINES FOR COMPREHENSIVE SITE ASSESSMENT

This document provides guidelines for those involved in the investigation of contaminated soil and/or groundwater, where the source of contamination is from:

- Incidents caused by activities subject to permitting under G.S. 143-215.1
- Incidents caused by activities subject to permitting under G.S. 87-88
- Incidents arising from agricultural operations, including application of agricultural chemicals, but not including unlawful discharges, spills or disposal of such chemicals

Comprehensive Site Assessment (CSA)

NOTE: Regional Offices may request additional information in support of the CSA to aid in their review and will not approve the CSA if any of the elements specified below have not been included or have not been sufficiently addressed

Minimum Elements of the Comprehensive Site Assessment Report:
A. Title Page
   - Site name, location and Groundwater Incident number (if assigned) and Permit Number;
   - Date of report;
   - Responsible Party and/or permittee, including address and phone number;
   - Current property owner including address and phone number;
   - Consultant/contractor information including address and phone number;
   - Latitude and longitude of the facility; and
   - Seal and signature of certifying P.E. or P.G., as appropriate.

B. Executive Summary
   The Executive Summary should provide a brief overview of the pertinent site information (i.e., provide sufficient information to acquaint the reader with the who, what, when, where, why and how for site activities to date).

1. Source information:
   - Type of contaminants

2. Initial abatement/emergency response information.
3. Receptor information:
   - Water supply wells;
   - Public water supplies (wells, surface water intakes);
   - Surface water bodies;
   - Wellhead protection areas;
   - Deep aquifers in the Coastal Plain physiographic region;
   - Subsurface structures; and
   - Land use.

4. Sampling/investigation results:
   - Nature and extent of contamination;
   - Maximum contaminant concentrations;
   - Site hydrogeology.

5. Conclusions and recommendations.

C. Table of Contents
   - First page number for each section listed.
   - List of figures (all referenced by number and placed in a single section following contents text).
   - List of tables (all referenced by number and placed in a single section following contents text).
   - List of appendices.

D. Site History and Source Characterization
   - Provide a history of property ownership and use. Indicate dates of ownership, uses of the site, and potential sources of contaminants.
   - Discuss the source(s) of contamination, including primary and secondary sources.
   - For permitted activities, describe nature of activity, permitted waste, application of all instances of over-application/irrigation of wastes or water
   - Summarize assessment activities and corrective actions performed to date including emergency response, initial abatement, primary and secondary source removal.
   - Discuss geographical setting and present/future surrounding land uses.

E. Receptor Information
   - Provide a site map showing labeled well locations within a
minimum of 1500 feet of the known extent of contamination. Key to the table and maps described.

NOTE: As the known extent of contamination changes, the receptor survey must be updated to reflect the change. This applies throughout the Receptor Information section.

- In table format, list all water supply wells, public or private, including irrigation wells and unused wells, (omit those that have been properly abandoned in accordance with 15A NCAC 2C .0100) within a minimum of 1500 feet of the known extent of contamination. Note whether well users are also served by a municipal water supply.

- For each well, include well number, well owner and user names, addresses and telephone numbers, use of the well, well depth, well casing depth, well screen interval, and distance from source of contamination;

NOTE: It will often be necessary to conduct any or all of the following in order to ensure reliability in a water supply well survey:

  o Call the city/county water department to inquire about city water connections;
  o Visit door-to-door (make sure that you introduce yourself and state your purpose to residents prior to examining their property) to obtain accurate description of water usage, and if some residents are not at home, ask surrounding neighbors who are home about the water usage at those residences. Even if a public water line is available, some residents still use their well water and are not connected to the public water system; and
  o Search for water meters and well houses.

- Site map showing location of subsurface structures (e.g., sewers, utility lines, conduits, basements, septic tanks, drain fields, etc.) within a minimum of 1,500 feet of the known extent of contamination;

- Table of surrounding property owner addresses;

- Discuss the availability of public water supplies within a minimum of 1,500 feet of the source area, including the distance and location to the nearest public water lines and the source(s) of the public water supply;
- Identify all surface water bodies (e.g., ditch, pond, stream, lake, river) within a minimum of 1,500 feet of the source of contamination;
- Determine the location of any designated wellhead protection areas as defined in 42 USC 300h-7(e) within a minimum of 1,500 feet of the source of contamination. Identify and discuss the location of the water supply well(s) for which the area was designated a wellhead protection area, and the extent of the protected area. Include information about the well owner, well-construction specifications (especially at screened intervals), pumping rate and pumping schedule. Information regarding designated wellhead protection areas may be obtained by contacting the Public Water Supply Section at (919) 707-9083;
- Discuss the uses and activities (involving possible human exposure to contamination) that could occur at the site and adjacent properties. Examples of such activities and uses include but are not limited to use of a property for an office, manufacturing operation, residence, store, school, gardening or farming activities, recreational activities, or undeveloped land;
- Determine whether the contaminated area is located in an area where there is recharge to an unconfined or semi-confined deeper aquifer that is being used or may be used as a source of drinking water. Based on a review of scientific literature on the regional hydrogeology and well construction records and lithological logs for deeper wells in the area, identify and describe the deep aquifers underlying the source of contamination. Include information on the depth of the deep aquifer in relation to the surficial saturated zone, the lithology and hydraulic conductivity of the strata between the surficial aquifer and the deeper aquifer, and the difference in groundwater head between the surficial aquifer and the deeper aquifer. Discuss the local and regional usage of the deep aquifer and the draw down from major pumping influences. Also, specify the distance from the source of contamination to major discharge areas such as streams and rivers. Cite all sources and references used for this discussion.

**NOTE:** *This requirement (last bullet) only pertains to*
contamination sources in the Coastal Plain physiographic region as designated on a map entitled “Geology of North Carolina” published by the Department in 1985. However, recharge/discharge, hydraulic conductivity, lithology, head difference, etc. is also important information at mountains and piedmont sites.

F. Regional Geology and Hydrogeology

Provide a brief description of the regional geology and hydrogeology. Cite all references.

G. Site Geology and Hydrogeology

- Describe the soil and geology encountered at the site. Use the information obtained during assessment activities (e.g., lithological descriptions made during drilling, probe surveys, etc.). This information should correspond to the geologic cross sections required in N. below; and
- Based on the results of the groundwater investigation, describe the site hydrogeology, including a discussion of groundwater flow direction, hydraulic gradient, hydraulic conductivity and groundwater velocity. Discuss the effects of the geologic and hydrogeological characteristics on the migration, retardation, and attenuation of contaminants.

H. Soil Sampling Results

Using figures and tables to the extent possible, describe all soil sampling performed to date and provide the rationale for sample locations, number of samples collected, etc. Include the following information:

- Location of soil samples;
- Date of sampling;
- Type of soil samples (from excavation, borehole, Geoprobe, etc.);
- Soil sample collection procedures (split spoon, grab, hand auger, etc.)
- Depth of soil samples below land surface;
- Soil sample identification
- Soil sample analyses;
- Soil sample analytical results (list any contaminant detected above the method detection limit); and
• Identify any sample analytical results that exceed the applicable cleanup levels.

NOTE: Information related to H. above should correspond to the sampling location and sampling results maps required in N. below.

I. Groundwater Sampling Results

Using figures and tables to the extent possible describe the groundwater sampling performed to date and provide the rationale for sample locations (based on source and contaminant type), number of samples collected, etc. Include the following information:

• Location of groundwater samples and monitoring wells;
• Date of sampling;
• Groundwater sample collection procedures (bailer, pump, etc.);
• Groundwater sample identification and whether samples were collected during initial abatement, CSA, etc.;
• Groundwater sample analyses;
• Groundwater sample analytical results (list any contaminant detected above the method detection limit; and
• Identify all sample analytical results that exceed 15A NCAC 2L or interim standards.

NOTE: Information related to I. above should correspond to the sampling location and sampling results maps required in N. below.

J. Hydrogeological Investigation

Describe the hydrogeological investigation performed including all methods, procedures and calculations used to characterize site hydrogeological conditions. The following information should be discussed and should correspond to the maps and figures required below:

• Groundwater flow direction;
• Hydraulic gradient (horizontal and vertical);
• Hydraulic conductivity;
• Groundwater velocity;
• Contaminant velocity;
• Slug test results; *
• Aquifer test results; *
• Plume’s physical and chemical characterization; and
• Fracture trace study if groundwater in bedrock is impacted. *
* Check with the Regional Office prior to performing these tests and study to see if necessary for the site.

K. Groundwater Modeling Results

Groundwater modeling or predictive calculations may be necessary at some sites (source area proximate to surface water, source area located within wellhead protection area or source area overlying semi-confined or unconfined deeper Coastal Plain aquifer) to verify, based on site specific hydrogeological conditions, whether groundwater contamination poses a risk to receptors. For contamination shown to pose a risk to receptors, groundwater modeling may be necessary to determine an appropriate cleanup level for contaminated groundwater. Modeling should illustrate the input data used to complete the model and will generally be required for natural attenuation proposals (see Groundwater Modeling Policy at http://portal.ncdenr.org/web/wq/aps/gwpro/policy).

NOTE: Input data for models should be derived from site specific information with limited assumptions or estimates. All assumptions and estimated values including biodegradation rates must be conservative (predict reasonable worst-case scenarios) and must be well documented.

L. Discussion

- Nature and extent of contamination, including primary and secondary source areas, and impacted groundwater and surface water resources;
- Maximum contaminant concentrations;
- Contaminant migration and potentially affected receptors

M. Conclusions and Recommendations

If corrective action will be necessary, provide a preliminary evaluation of remediation alternatives appropriate for the site. Discuss the remediation alternatives likely to be selected. Note that for impacts to groundwater associated with permitted activities, corrective action pursuant to 15A NCAC 2L .0106(k), (l) and (m) is not applicable, unless provided for pursuant to 15A NCAC 2L .0106(c) and (e) or through a variance from the Environmental Management Commission (EMC).

N. Figures

- 71/2 minute USGS topographic quadrangle map showing an area
within a minimum of a 1,500-foot radius of the source of contamination and depicting the site location, all water supply wells, public water supplies, surface water intakes, surface water bodies, designated well head protection areas, and areas of recharge to deeper aquifers in the Coastal Plain that are or may be used as a source for drinking water;

- Site map locating source areas, site boundaries, buildings, all water supply wells within a minimum of 1,500 feet, named roads/easements/right-of-ways, subsurface utilities, product or chemical storage areas, basements and adjacent properties, scale and north arrow;

- At least two geologic cross sections through the saturated and unsaturated zones intersecting at or near right angles through the contaminated area using a reasonable vertical exaggeration. Indicate monitoring well/sample boring/sample locations and analytical results for soil samples. Identify the depth to the water table. Provide a site plan showing the locations of the cross sections;

- Site map(s) showing the results of all soil sampling conducted. Indicate sampling identifications, sampling depths, locations and analytical results;

- Site map(s) showing the results of all groundwater sampling conducted. Indicate sampling locations, monitoring well identifications, sample identifications, and analytical results;

- Separate groundwater contaminant iso-concentration contour maps showing total volatile organic compound concentrations, total semi-volatile organic compound concentrations and concentrations for the most extensive contaminant. Maps should depict the horizontal and vertical extent. Contour line for applicable 2L standard should be shown in bold;

- Site map(s) showing the elevation of groundwater in the monitoring wells and the direction of groundwater flow. Contour the groundwater elevations. Identify and locate the datum (arbitrary
100', USGS, NGVD) or benchmark. Indicate the dates that water level measurements were made. There should be one map for each series of water level measurements obtained;

- Groundwater contaminant iso-concentration contour cross-section;
- Site map(s) showing the monitoring wells.

NOTE: If possible, use a single base map to prepare site maps using a map scale of 1 inch = 40 feet (or a smaller scale for large sites, if necessary). Maps and figures should include conventional symbols, notations, labeling, legends, scales, and north arrows and should conform to generally accepted practices of map presentation such as those enumerated in the US Geological Survey pamphlet, "Topographic Maps".

O. Tables

- List all water supply wells, public or private, including irrigation wells and unused wells, (omit those that have been properly abandoned in accordance with 15A NCAC 2C .0100) within a minimum of 1500 feet of the known extent of contamination. For each well, include the well number (may use the tax map number), well owner and user names, addresses and telephone numbers, use of the well, well depth, well casing depth, well screen interval and distance from the source of contamination;

- List the names and addresses of property owners and occupants within or contiguous to the area containing contamination and all property owners and occupants within or contiguous to the area where the contamination is expected to migrate;

- List the results for groundwater samples collected including sample location; date of sampling; sample collection procedures (bailer, pump, etc.); sample identifications; sample analyses; and sample analytical results (list any contaminant detected above the method detection limit in bold); and

- List for each monitoring well, the monitoring well identification
numbers, date water levels were obtained, elevations of the water levels, the land surface, top of the well casing, screened interval and bottom of the well.

P Appendices

- Boring logs and lithological descriptions;
- Well construction records;
- Standard procedures used at site for sampling, field equipment decontamination, field screening, etc.;
- Laboratory reports and chain-of-custody documents;
- Copies of any permits or certificates obtained, permit number, permitting agency, and
- Modeling data and results;
- Slug/pumping test data; and
- Certification form for CSA
DIVISION OF WATER RESOURCES
Certification for the Submittal of a Comprehensive Site Assessment

Responsible Party and/or Permittee: ______________________________
Contact Person: ________________________________________________
Address: ______________________________________________________
City: __________________ State: _______ Zip Code: ________
Site Name: ____________________________________________________
Address: ______________________________________________________
City: __________________ State: _______ Zip Code: ________
Groundwater Incident Number (applicable): __________

I, ______________________, a Professional Engineer/Professional Geologist (circle one) for __________________ (firm or company of employment) do hereby certify that the information indicated below is enclosed as part of the required Comprehensive Site Assessment (CSA) and that to the best of my knowledge the data, assessments, conclusions, recommendations and other associated materials are correct, complete and accurate.

(Each item must be initialed by the certifying licensed professional)

1. _________ The source of the contamination has been identified. A list of all potential sources of the contamination are attached.

2. _________ Imminent hazards to public health and safety have been identified.

3. _________ Potential receptors and significant exposure pathways have been identified.

4. _________ Geological and hydrogeological features influencing the movement of groundwater have been identified. The chemical and physical character of the contaminants have been identified.

5. _________ The CSA sufficiently characterizes the cause, significance and extent of groundwater and soil contamination such that a Corrective Action Plan can be developed. If any of the above statements have been altered or items not initialed, provide a detailed explanation. Failure to initial any item or to provide written justification for the lack thereof will result in immediate return of the CSA to the responsible party.

(Please Affix Seal and Signature)