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

Pat McCrory
Governor

John E. Skvarla, III
Secretary

November 4, 2014

Mr. Harry Sideris
Senior Vice-President
Environment, Health, and Safety
Duke Energy
526 South Church Street
Mail Code EC3XP
Charlotte, NC 28202

RE: Duke Energy Carolinas, LLC
Riverbend Steam Station
NPDES Permit No. NC0004961 – Gaston County
Review of Groundwater Assessment Work Plan

Dear Mr. Sideris:

On September 26, 2014, the Division of Water Resources (Division) received the Groundwater Assessment Work Plan (GAP) for the subject facility. The GAP was submitted in accordance with the August 13, 2014, Notice of Regulatory Requirements (NORR) and G.S. 130A-309.209(a)(1). After careful review, the Division has determined that the GAP is deficient in detailing a strategy to achieve compliance with NCAC 15A 2L .0106(g), the NORR issued to Duke, and (or) applicable general statutes. The plan as submitted fails to provide an adequate level of detail regarding the planned assessment activities, which if left unchanged may lead to an inadequate assessment of environmental conditions at the site. To assist you in drafting a complete GAP, the Division offers you the following review comments which must be addressed and incorporated into a revised groundwater assessment work plan. This review document is separated into comments applicable to all previously submitted plans followed by comments applicable to the referenced facility

General Comments Applicable to All Facilities

1. The Site Conceptual Model (SCM) section of the work plans does not provide sufficient detail needed for the Division to adequately review the proposed data collection efforts. The SCM section should include an "initial conceptual model" as described in Groundwater Modeling Policy, May 31, 2007, page 6, paragraph 2, which states, "*An initial conceptual model should be developed from available regional and local studies and information [existing site data], and initial site visits before significant site-specific*

data collection efforts are undertaken. This step is necessary to assure that adequate types and quantities of data are collected..." The initial conceptual model will be refined or modified later in the process as a result of data collection. The refined or modified model, the SCM, will then be used as the foundation upon which any numerical models are developed for the site. Importantly, the initial conceptual model should identify data gaps and provide the context and rationale for the types and amounts of data collection proposed in the work plans.

Refer to the Modeling policy, the Hydrogeologic Investigation and Reporting Policy (May 31, 2007), and other pertinent references such as ASTM E1689-95, for the elements expected in the initial conceptual model. Ensure also that the nature, sources, and sinks of site contaminants of concern, along with their mobility, retention, and transport characteristics are addressed.

2. The numerical modeling description presented in the GAP is inadequate. The draft GAP states that fate and transport modeling will be conducted using MODFLOW and MT3D or RT3D, with very little supporting rationale or information identified to justify the use of the chosen model or approach. Explaining the rationale for the chosen model type and design (including the inputs that will be needed for the model) will help make site assessment data collection more efficient and may highlight deficiencies in the initial conceptual model.

   To provide context and rationale for the chosen model(s) and proposed data collection efforts, provide in the GAP, at a minimum, the following information:

   a) the purpose of any proposed numerical modeling,
   b) the question(s) the model will help answer,
   c) basic information about the model (type, boundaries, layers, whether/how site heterogeneities will be modeled, etc.),
   d) a description of the partition coefficient (K_d), how, where, and at what depths it will be derived, and how/whether it will adequately account for the dominant mechanisms of contaminant retention,
   e) whether stream flow measurements are needed for the model and, if so, when, where, and how those would be measured,
   f) model limitations, and
   g) specific data gaps (types, general locations and depths, etc) that must be filled in order to develop the model(s).

   Refer to Groundwater Modeling Policy, May 31, 2007 for the elements expected in any numerical model developed for the site.

3. The proposed borings, core, and well installation work are inadequate to understand, characterize, and (or) model subsurface conditions at the sites. For piedmont and mountain sites, the GAP shall propose field work necessary to evaluate and document the following:

    a) presence/absence,
    b) areal extent and depth/thickness,
    c) flow and transport properties, and
    d) heterogeneity of the following groundwater flow zones: alluvial/fluvial, fill/residuum/saprolite, weathered rock (transition zone), and fresh, competent fractured bedrock. Specifically, continuous core shall be collected from land surface to a depth of at least 50 feet into fresh, competent bedrock at a sufficient number of locations inside and outside of ash basins to understand the flow system in areas proposed for modeling and (or) areas of contaminant concern. All cores shall be described/logged, photographed, and retained.

    Data previously obtained from existing voluntary and compliance well borings and wells shall also be used to understand and characterize the multipart flow system. Data collection should also be sufficient for the development of any proposed numerical models.

    Note: Drilling and coring methods shall be used to prevent potential cross contamination of flow zones, as stipulated in 15A NCAC 02C, and, where applicable, to maintain structural integrity of dam.

4. Rather than abandoning the cored locations, consideration should be given to converting borings to either a well nest/cluster or a piezometer nest/cluster. Nested/clustered wells shall be open to each of the dominant flow zones through the use of appropriately sized screens and discreet screened intervals and shall be installed to measure groundwater quality and properties that may affect contaminant mobility and transport. If the boring is not of sufficient diameter to install all of the necessary nested wells/piezometers, the remaining wells/piezometers should be installed in the immediate vicinity.

    In addition to the logging described in comment 3 above, each core location shall include the collection of a solid phase sample at the following intervals:

    a) immediately above the water table,
    b) immediately below the water table,
    c) within the saturated upper transition zone material (if not already included in a) or b) above), and
    d) from a primary, open, stained fracture within fresh bedrock, if these zones exist.

The sample(s) shall be analyzed, at a minimum, for the following:

> type of material, formation from which it came, minerals present, chemical composition as oxides, hydrous Fe, Mn, and Al oxides content, organic carbon content, organic carbonate content, cation exchange capacity, anion exchange capacity, surface area, moisture content, particle size analysis, Atterberg limits, specific gravity, porosity, permeability, and any other physical properties or analyses that may be required to estimate a batch partition coefficient K_d or otherwise serve as input to a chosen model.

In addition, total analytes (see comment #12), SPLP analytes (see comment #12), and speciation of selected inorganics shall be conducted for selected sample locations in sufficient quantity and distribution to characterize the solid and aqueous chemistry and geochemistry in locations and depths of contaminant concern, and this work shall be clearly defined in the GAP. Inorganic speciation typically will include Fe and Mn, along with others that may shed light on contaminant toxicity, mobility, and (or) prevailing geochemical conditions. Sulfide and methane shall also be collected at selected locations to evaluate geochemical conditions. Water and bed sediment samples from seeps and streams shall be treated and analyzed in a manner consistent with the description above.

If a given analysis is believed to be unnecessary at a given location or depth based on site conditions or assessment objectives, provide a detailed rationale for its omission for the Division's consideration. In general, the collection strategy for ash samples from cores inside of ash basins as described in the GAP appear to be adequate, along with the proposed total and SPLP analyses. The need for additional core locations, where applicable, is provided in the site-specific comment section below. Note that the chosen numerical model(s), extent of contamination, and size of site shall drive the number, distribution, and type of solid phase sample collection and analyses needed to understand the retention and mobility of constituents of concern.

5. Duke shall describe the batch partition coefficient K_d, the individual inorganics that will be tested, and whether multi-metals will be co-tested. Duke shall identify the approximate number, distribution, and depths/flow zones of solid phase samples used to derive the K_d(s) across the site.

6. The term "deep" as it relates to a well is subjective. For consistency and to avoid confusion as to whether a deep well is open to transition zone material or competent bedrock, please refer in all descriptions to each well as alluvial/fluvial, saprolite, transition zone, or bedrock. If one or more of these zones are relatively thick, contain more than one discreet flow zone, and should be thought of as "upper" and "lower", that qualifying designation is also appropriate (for example, upper transition zone and lower transition zone if the two intervals represent discreet flow intervals).

7. Surface water and bed sediment sampling are limited or are not proposed in the GAP. The Division expects base flow surface water and bed sediment sampling to be included in the site assessment and the GAP. These data will provide information on surface water

quality and will be useful in efforts to understand the interaction of ground and surface water at the site. Sample locations and distribution shall be based on site specific considerations, but seepage areas, key tributaries, and ash ponds should be given special emphasis. Surface water data collected by the Division during the March 2014 sampling event, and existing ground and surface water data collected by Duke should be used in the sample design and site assessment.

8. It is expected that Duke conduct assessment work, including borings, wells, and surface water/bed sediment sampling, *offsite* (outside of property boundaries) as needed for adherence to 15A NCAC 02L.0106 (g)(4) and (or) for the evaluation of background conditions. The plans as submitted do not adequately account for offsite assessment work or provide a justification that offsite work is not needed. Proposed offsite assessment locations should be described in the GAP.

9. It is expected that as data from wells, borings, and water samples are derived and evaluated, Duke will identify and sample additional locations as needed to complete the horizontal and vertical extent of impacts associated with coal ash to subsurface soils, saprolite, bedrock, and the ground and surface water resources. These activities and anticipated locations shall be proposed in the GAP and included in the assessment.

10. Please note that wells identified as "background" are subject to periodic review based on an increased understanding of site chemistry and hydrogeologic conditions. If a well currently identified or otherwise labeled as background does not, in fact, represent background conditions, it shall be excluded from further consideration as "background".

    The need for additional or replacement background wells shall be considered during site assessment and (or) as outlined in the site specific comment section below. However, in general, each facility must have a background well or wells screened or open to each of the dominant flow systems that occur at the site that are associated with groundwater contamination (e.g., alluvium, fluvial deposits, saprolite, transition zone, and (or) competent bedrock). Each of these wells must represent ambient background conditions unaffected by site or offsite activities. Offsite well placement will, in some cases, be expected depending on the position and proximity of waste, compliance, and property boundaries. At least four independent sampling events generally are needed for a well to be used in formal statistical testing.

11. Quality control samples shall be proposed in the GAP. These shall include but are not limited to, descriptions of field calibration procedures, collection of replicate measurements, use of field blanks, use of "blind" quality control samples, etc.

12. The analyte list for supply well sampling, compliance well sampling, and site assessment sampling shall include, but is not limited to, the following:

    Al, Sb, As, Ba, B, Be, Ca, Cd, Co, Cr, Cu, Fe, K, Pb, Mg, Mn, Mo, Hg, Na, Ni, Se, Sr, Tl, V, Zn, Cl, SO4, total dissolved solids (TDS), alkalinity, bicarbonate, carbonate, total suspended solids (TSS), turbidity, pH, temperature, specific conductance (SC), dissolved oxygen (DO), oxidation reduction potential (ORP), and water level (water level measurements in supply wells may be omitted if well head hardware prevents ready access). In addition, total combined radium (Ra-226 + Ra-228) shall be measured on at least one occasion in selected compliance wells of highest concern at each facility. *Note that 15A NCAC 02H.0804 requires certification for field parameters.*

    The GAP shall include the sampling frequency for each sample type. Justification must be provided for Division consideration for any sample types/locations in which a sample frequency of one is proposed.

13. Duke shall list and provide a detailed description of each coal combustion residuals (CCR) waste storage or disposal area (unit) at each facility. This description shall state the following:

    a) known or approximate quantities of CCR waste stored in the unit(s);
    b) details of the operational history of the unit(s), including years of use, all known waste types, methods of emplacement, rationale for formal or informal closure, and methods of closure or abandonment;
    c) whether the unit is already included in the facility's current NPDES permit;
    d) whether the unit was permitted and managed by an agency other than the Division and pertinent details of that permit;
    e) whether there are additional permitted or unpermitted waste storage areas *within* CCR waste storage areas;
    f) the location and distribution of any coal ash used as structural fill or other construction (i.e. roadbeds, storage pads, berms, etc.) both on and offsite (proximal to the site); and
    g) whether the existing compliance boundary captures all the CCR waste storage areas or if revisions need to be made.

    Based on requirements specified in 15A NCAC 02L .0107 and a review of the information discussed in a) to g) above, the Division will determine whether additional units or areas need to be included in an existing or a new compliance boundary.

14. It is expected that the reporting limits associated with all analytical methods proposed in the GAP be EPA approved and be *at or below* the state groundwater standards at 15A NCAC 2L or surface water standards at 15A NCAC 2B.

15. 15A NCAC 02C .0108(p) specifies that each non-water supply well be developed such that the level of turbidity or settleable solids does not preclude accurate chemical analyses of any fluid samples collected. The GAP shall acknowledge and state that well construction design will be based on site specific conditions and shall be actively modified in the field (alternate screen slot size, use of well sock, or others, for example) to accommodate the grain size of the formation, as needed to minimize turbidity or address other unforeseen issues. Any deviations from originally proposed protocols shall be fully documented and provided to the Division.

16. The GAP shall state that well development and purging protocols will be based on site specific conditions and shall be actively modified in the field as needed to minimize turbidity or address other unforeseen issues. In all cases, well development and purging prior to sample collection shall be conducted to specific field standards which shall be clearly stated in the GAP. Deviations from this protocol or from other proposed development and purging protocols shall be fully documented and provided to the Division. If the Division concludes that turbidity is impacting analytical results for any reason, a replacement well will, in some cases, be required.

17. Duke shall contact adjacent property owners for site access as needed to complete the assessment activities. If Duke is unable to obtain access from an owner, Duke shall request liaison assistance from the Division in writing. This request shall include all contact information, details of all prior discussions regarding access to the property for purposes of conducting site assessment, and results of those discussions. Duke shall provide the Division a copy of any formal access agreements proposed for use.

18. The statewide 1:500,000 geologic map is not a substitute for local, larger scale geologic mapping and site scale geologic information where available. The GAP shall propose the use of fracture trace analysis (where applicable) and onsite/near-site geologic mapping to better understand site geology. The scope of these efforts shall depend upon site conditions and existing geologic information.

19. If proposed, please provide a detailed rationale for the use of Rotosonic or similar drill method and why it is appropriate for use in the site assessments. Please address any potential issues (such as the consolidation of aquifer material in the vicinity of the well screen) that could affect aquifer or groundwater analyses.

20. The purpose, methods, and numbers (including anticipated depths/flow zone(s) and, where known, locations) of packer testing shall be clearly detailed in the GAP.

21. The use of statistics to help establish background concentrations of specific parameters shall be based on site-specific data and shall follow the methods approved for use by the Division. In most cases, the methods outlined in RCRA Unified Guidance (U.S. EPA, 2009, EPA 530/R-09-007) are considered to be appropriate for use at these sites. Background wells deemed appropriate for use in statistical analyses must be approved by the Division. Final background determinations are made by the Division Director based on available data and information.

22. As part of the GAP, provide an oversized summary table of all existing compliance and voluntary well data collected to date at the site. Please place all constituents, including DO, SC, ORP, and turbidity, as headings across the top of the table, and all wells and sample dates as rows along the left side of the table. Highlight in yellow those values that exceed a 2L standard. Please also include on this table any surface water, ash, and (or) ash leachate data relevant to the site. This table should be included in the GAP and also made available in electronic (Excel or similar) format.

23. As part of future site assessment reporting deliverables, provide at a minimum the following tables, graphs, and maps:

    a) box (whisker) plots, for locations sampled on four or more events (show min, 25, 50, 75, max); align plots for multiple locations on one chart; construct a similar chart for each constituent of concern (COC),
    b) stacked time-series plots (for each COC, stack multiple wells/locations using same x-axis to discern seasonal trends; construct similar chart for each COC; consider also showing turbidity, DO, ORP, or other constituent on plot to demonstrate influence,
    c) piper and (or) stiff diagrams showing selected monitor wells, supply wells, surface water locations, ash leachate as separate symbols,
    d) correlation charts, where applicable,
    e) orthophoto potentiometric maps for "like" flow zones (maps for bedrock wells likely will be plotted on a different map than maps for transition zone wells),
    f) orthophoto potentiometric difference maps, showing the difference in vertical heads between selected flow zones,
    g) orthophoto iso-concentration maps for selected COCs and flow zones,
    h) orthophoto map showing relationship between ground and surface water samples for selected COC(s),
    i) geologic cross sections,
    j) photographed borings/core for each boring location, and
    k) others as appropriate.

    For summary statistics tables, avoid presenting "average" value(s) unless the constituent(s) at the location in question is (are) normally distributed, in which case a mean and standard deviation are acceptable. For non-normal data, use of the median value is more appropriate. In either case, use of the maximum value is often misleading if it is a formally-tested outlier or is associated with high turbidity; footnote maximum values as appropriate.

24. With respect to the use of the terms "may" versus "will", the GAP shall use the term "will" or clearly state, in detail, why the qualifying term "may" is used. In either case, the Division reserves the right to request at any time additional work needed to meet site assessment objectives. During the assessment, if Duke decides that additional work is

needed at a facility, the Division shall be contacted immediately with a description of the proposed work and timeline.

25. Any assumptions or timelines stated in the GAP shall not be used as justification to circumvent the mandatory deadlines established by legislative order, Governor's Executive Action, or NORR.

Additional Comments Specific to the Referenced Facility

26. GAP Figures 2 and 3 depict the facility's northern property boundary on the northern and southern shores of the Catawba River/Mountain Island Lake, however, the compliance boundary has been drawn on these figures as though the northern shore property boundary is the actual property boundary. Previous figures on file for this site illustrate the northern property boundary on the southern shore line (S&ME, NPDES Permit NC0004961 Waste, Review, and Compliance Boundary, Figure 1, 4/27/09) and the northern shore line (Figure 2 from the Groundwater Monitoring Program – Sampling, Analysis, and Reporting Plan by HDR Engineering, Inc., 5/14/14). The location of the true northern property boundary will have an impact on the location of the facility's permitted compliance boundary. If the southern shore line is the actual property boundary, then the compliance boundary should be adjusted. As related to "All Facilities" Comment 13, the GAP shall include an accurate depiction of the facility's property boundary and provide detailed notes where this depiction has changed from previously provided information and where any property boundary changes would impact or necessitate the relocation of the compliance boundary. Specifically for the Riverbend facility, the GAP should illustrate and explain whether the northern property boundary lies along the northern or southern shore of the Catawba River/Mountain Island Lake. Does Duke Energy own the Catawba River/Mountain Island Lake and/or the riverbed and/or lakebed?

27. Although there are perimeter ash samples proposed around the Secondary Cell, there are no proposed locations from within the Secondary Cell. The GAP should include a discussion of whether ash is also present within the waters of the Secondary Cell. If ash is present with this cell, the GAP should include a proposal for characterization of the ash within this location or an explanation as to why ash samples are not needed or are unable to be obtained from this area.

28. The GAP proposed to collect solid phase "ash" samples from the 4-foot to 5-foot interval and at the 1-foot to 2-foot interval overlying the ash/native soil interface in the AB, AS, and C series borings within ash storage areas. For "ash" samples, at a minimum the GAP should also include samples and characterization of "ash' from middle range depths where ash thickness is expected to be greater than 30 feet.

29. The GAP proposed collecting native soil samples from immediately below the ash basins and storage areas in the AB, AS, and C series borings. Additional soil samples are also proposed from six "background" boring/monitoring well locations, however no details have been provided regarding from what depth intervals these soil samples will be

collected. The GAP should address this deficiency. Additionally, the GAP does not propose plans to collect soil samples from the GWA series boring/monitoring well locations because they will be located outside the waste boundary. Inclusion of soil samples from the GWA series borings will provide additional characterization of soil solid phase conditions outside the waste storage area and should be detailed in the GAP. In addition to soil samples, the GAP should include a sufficient number of borings and cores to understand, characterize, and (or) model subsurface conditions (both solid phase and groundwater) at the site at all depths of interest. The current GAP lacks sufficient detail, proposes an insufficient number of soil samples and a complete lack of bedrock core samples for characterization of the site's subsurface conditions. Please refer to "All Facilities" comments 3 and 4.

30. Three "background" borings/monitoring wells (BG-55S, BG-81S, BG-85S) are proposed in the GAP to assist in characterizing the site and to further define exceedances of the iron and manganese 15A NCAC 2L (2L) standards detected in the MW-8SID well nest. The proposed borings are all shallow and within immediate proximity of the on-site ash storage area. These locations may provide some useful information for the assessment but are very unlikely to be representative of background conditions that are clearly outside the influence of the ash waste storage areas. Additionally, exceedances of the iron and manganese 2L standards detected in the MW-8SID nest have historically been progressively higher in concentration as depth increases. The MW-8SID nest is located on the facility's compliance boundary and property boundary. The GAP shall include sufficient borings/monitoring well nests to characterize all zones of interest and this shall include off-site borings where necessary to delineate exceedances of the 2L standards. Please refer to "All Facilities" comments 7, 8 and 9.

Your assessment plan must be submitted to the DWR Mooresville Regional Office and Central Office for review within 30 days of the receipt of this letter. **A revised plan must be submitted that fully incorporates the responses to the above comments rather than a letter response intended to supplement the previously submitted plans.**

Please note that failure to conduct a complete assessment pursuant to the above referenced rule and statute will be considered a violation, subject to potential enforcement actions by the Division.

We appreciate your attention and prompt response in this matter. If you have questions, please do not hesitate to call Bruce Parris at 704-663-1699.

Sincerely,

S. Jay Zimmerman, P.G., Chief
Water Quality Regional Operations Section

Cc: WQROS – MRO
WQROS – Central Office
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