December 30, 2019

Ms. Sheila Holman
Assistant Secretary for Environment
North Carolina Department of Environmental Quality
1611 Mail Service Center
Raleigh, North Carolina 27699-1611

Subject: Submittal of Ash Basin Closure Plan and Corrective Action Plan Update
Belews Creek Steam Station

Dear Ms. Holman:

In accordance with the requirements of N.C.G.S. §§ 130A-309.211(b) and .214(a)(4), Duke Energy provides the following documents: (1) a plan for basin closure by excavation, and (2) a corrective action plan (CAP) for the Belews Creek site, which will address groundwater impacts regardless of the specific closure method.

Closure by Excavation
The enclosed excavation plan is in response to NCDEQ's April 1 order requiring excavation of the Belews Creek coal ash basin. After regulatory approval, excavating the basin ash would require 11 years to move the ash to a new lined landfill within plant property. The landfill would be located in the prior footprint of the ash basin adjacent to Pine Hall Road, rising about 125 feet above the road.

Continuing to Protect Water Resources
Robust scientific study, conducted under the direction of NCDEQ, demonstrates that drinking and recreational water supplies around the Belews Creek facility are well-protected from coal ash impacts and will only continue to improve during and after closure. Ongoing research and monitoring also provide a detailed understanding of groundwater conditions at the site, indicating that the impact is highly localized. The CAP designed for Belews Creek will achieve groundwater remediation through a combination of strategically placed groundwater extraction wells coupled with clean water infiltration wells.

Prior to submission, the closure plan was reviewed by the National Ash Management Advisory Board (NAMAB), which consists of nationally and internationally recognized and published experts with practical experience working with and for the private sector, federal government, and academia. NAMAB helped develop the guiding principles for safe basin closure and their feedback is incorporated herein.

Duke Energy remains committed to safely and permanently closing basins in ways that continue to protect people and the environment and welcomes the opportunity to work constructively with NCDEQ to move forward.
Ms. Sheila Holman  
December 30, 2019  
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Belews Creek Steam Station  
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Sincerely,

[Signature]

Paul Draovitch  
Senior Vice President  
Environmental, Health & Safety

Enclosure:  
- Corrective Action Plan Update  
- Closure by Excavation Closure Plan
DUKE ENERGY
BELEWS CREEK STEAM STATION
COAL COMBUSTION RESIDUALS SURFACE IMPOUNDMENT CLOSURE PLAN

CLOSURE BY EXCAVATION

CCR BASIN
Prepared for

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400 South Tryon Street
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December 18, 2019
Prepared by

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EXECUTIVE SUMMARY

As required by the North Carolina Department of Environmental Quality’s (NCDEQ) April 1, 2019 “Coal Combustion Residuals Surface Impoundment Closure Determination,” (Closure Determination) Duke Energy has prepared this Closure Plan to describe the closure of the coal combustion residuals (CCR) surface impoundment at the Belews Creek Steam Station (BCSS). This plan details closure by excavation of the BCSS CCR Basin (Basin) and placement of the excavated CCR in a new permitted, on-site lined CCR landfill. The excavation of CCR and the closure of the Basin will be in accordance with applicable provisions of the North Carolina Coal Ash Management Act of 2014 (CAMA), as amended (codified at N.C.G.S. § 130A-309.200 et seq.), and the federal Disposal of Coal Combustion Residuals from Electric Utilities rule (CCR Rule) (codified at 40 C.F.R. § 257.50 et seq.).

The BCSS is owned and operated by Duke Energy Carolinas (Duke Energy) in Stokes County, North Carolina along Belews Lake, a manmade lake constructed on Belews Creek in the early 1970s. BCSS is a two-unit, coal-fired power generation facility that is one of the largest steam plants in the Carolinas, with a capacity of 2,240 megawatts. It began commercial operation in 1974 and is currently in active operation.

BCSS operates one impoundment for storing wet sluiced CCR, which is referred to as the Basin. The Basin was constructed from 1970 to 1972 and has been operational since 1974. Based on Basin boundary delineated by Duke Energy, the boundary containing CCRs that practically requires closure is about 270 acres. Duke Energy has reported an in-place CCR tonnage of 11.97 million tons as of July 2019 for the Basin. The Basin includes two embankment structures functioning as dams, known as Ash Basin Main Dam and Pine Hall Road Embankment Dam, and regulated by NCDEQ (State ID STOKE-116). Process flows of CCR waste streams have ceased for the Basin and decanting operations have been initiated to remove bulk water.

Closure activities for the Basin have already begun with the initiation of decanting under the Special Order by Consent (SOC). Upon approval of the Closure Plan by NCDEQ additional actions will commence, including finalization of detailed designs, dewatering and removal of interstitial water, contracting and detailed planning for the closure work, development of the new lined landfill partially within the Basin footprint in conjunction with excavation of the CCR, final grading of the site and landfill, development of storm water features and vegetative covers, and dam removal.

Figures ES-1 and ES-2 illustrate the current state, and post-closure state of the CCR Basins as detailed by this Closure Plan.
The Basin CCR will be removed to a new lined landfill, located partially within the footprint of the Basin and adjacent to Pine Hall Road. The landfill would rise approximately 125 feet above Pine Hall Road. Post-excavation, the Basin site will resemble the land’s valley shape before the Basin was created. Soil will be graded to restore contours for stormwater flows, then planted with native grasses for erosion control. The existing Basin dam will be removed, replaced by a small retention dam for stormwater management. Stormwater flows will then make their way to the Dan River.

This document also includes a description of the Post-Closure care plan, which provides a description of the inspection, monitoring, and maintenance activities required to be performed throughout the 30-year post-closure care period for the closed basin at the BCSS.

This document provides a summary of properties of the site, as well as geotechnical properties of CCR and natural soils to support engineering analyses of the closure design. These analyses indicate that closure by excavation, as detailed in the Closure Plan, meets regulatory requirements for the stability of the site, management of surface water run-off, and access for effective maintenance over the post-closure care period. The Basin main dam will be removed, and the Pine Hall Road Embankment dam will be rendered hydraulically unnecessary as part of closure and removed from the state’s regulatory jurisdiction inventory.

In accordance with the requirements of N.C.G.S. § 130A-309.211(b)(1), Duke Energy separately submitted an updated Corrective Action Plan (CAP) in parallel with this Closure Plan; the updated CAP is herein incorporated in its entirety by this reference. Neither the updated CAP nor its content is the work product of AECOM. Although the Closure Plan contains references to the updated CAP, all specific relevant details to groundwater and related actions are found in the updated CAP itself and not in this Closure Plan.

As detailed in the updated CAP, Duke Energy has begun to implement, and will continue implementing, source control measures at the site, including (i) complete Ash Basin decanting to remove the hydraulic head, thereby mitigating the risk of potential COI migration into groundwater; and (ii) complete Ash Basin closure. In addition, Duke Energy intends to implement a robust groundwater remediation program that includes actively addressing COI in groundwater above applicable standards at or beyond the compliance boundary using a combination of groundwater extraction, clean water infiltration, and treatment. The CAP provides that these corrective action measures will most effectively achieve remediation of the groundwater through the use of extraction wells to the north and northwest of the Ash Basin and clean water infiltration wells to the north and northwest of the Ash Basin. Significantly, groundwater modeling simulations indicate these measures will control COI at the compliance boundary and meet the remedial objectives for COI beyond the compliance boundary.
1. INTRODUCTION

1.1 Background

The BCSS is located in Stokes County, North Carolina along Belews Lake, a manmade lake constructed on Belews Creek in the early 1970s. BCSS is a two-unit, coal-fired power generation facility that is one of the largest steam plants in the Carolinas, with a capacity of 2,240 megawatts. It began commercial operation in 1974 and is currently in active operation. CCR have historically been managed in the BCCS’ on-site Basin. The BCCS ceased all waste flows to the Basin in March 2019.

Figure 1-1 presents a Vicinity Map and Site Plan of the BCSS.

The Basin at the BCSS include dams regulated by the North Carolina Department of Environmental Quality (NCDEQ) and Dam Safety:

1. The Basin Main Dam (NCDEQ ID: STOKE-116); and
2. Pine Hall Road Embankment Dam (NCDEQ ID: STOKE-116).

As further discussed in Section 2 below, the closure method mandated by order of the NCDEQ for the Basin is closure by excavation.

1.2 Closure Plan Objectives

The objective of this Closure Plan is to address the closure by excavation of CCR from the Basin as directed by order of NCDEQ. AECOM understands Duke Energy does so without prejudice of its position that closure by excavation is not necessary for the Basin. Duke Energy notes that approval from NCDEQ is required to proceed and develop the additional details as described further within this Closure Plan to complete the necessary working documents to complete the closure actions. Duke Energy submits this Closure Plan with the knowledge that other details will follow, as necessary. This Closure Plan describes and communicates the key actions and activities necessary to close the Basin in accordance with the requirements for written Closure Plans for CCR surface impoundments presented in N.C.G.S. §130A-309.214(a)(4). Planned closure activities include:

- Decanting the Basin;
- Construction and operation of a temporary water management system (WMS) to manage all discharges in compliance with the NPDES permit during closure;
- Dewatering to support safe excavation of CCR from the Basin;
- Excavation of the CCR and establishing post-excavation final grades using soil fill where required;
- Breaching or removal of the Basin main dam;
- Construction of an onsite CCR landfill to permanently store the excavated CCR; and
- Restoration of disturbed areas.
1.3 Report Organization

This document is structured to follow the requirements provided in CAMA (G.S. §130A-309.214(a)(4)).

2. GOVERNING LAWS

In August 2014, the North Carolina General Assembly enacted CAMA, which contains specific statutory requirements applicable to the CCR basins. Subsequently, in July 2016, the North Carolina General Assembly enacted H.B. 630, Session Law 2016-95, which provides that impoundments be classified as “low-risk” if, by certain deadlines, the owner has established permanent alternative water supplies, as required, and has rectified any deficiencies identified by, and has otherwise complied with requirements of, any dam safety order. NCDEQ determined that Duke Energy met these criteria on November 13, 2018, and officially classified the Basin at the BCSS as “low-risk.”

On April 1, 2019, NCDEQ issued its Closure Determination mandating that the Basin be closed by excavation of the CCR pursuant to N.C.G.S. § 130A-309.214(a)(3)a. A closure plan is required for each CCR surface impoundment regardless of the risk classification. CAMA’s closure plan requirements and cross-referenced sections of this Closure Plan are summarized in Table 2-1. On April 26, 2019, Duke Energy filed a Petition for Contested Case Hearing before the North Carolina Office of Administrative Hearings appealing this determination, on May 24, 2019 Duke Energy filed amended petitions in the case. The petitions allege that in issuing its Closure Determination, NCDEQ failed to (i) follow the mandatory process and procedure outlined in CAMA and (ii) consider or apply the scientific and engineering evidence submitted and available to it in reaching its decision to require the most expensive closure method available despite scientific and engineering evidence demonstrating the availability of less expensive and more rapid closure options that would continue to fully protect human health and the environment. Certain decisions by the administrative law judge in that case are currently under appeal to the North Carolina Superior Court.

In addition to the closure plan requirements, CAMA sets out groundwater assessment and corrective action requirements. A Comprehensive Site Assessment (CSA) report was submitted to NCDEQ in September 2015, with supplemental report submitted in October 2017. A Corrective Action Plan (CAP) is expected to be submitted in parallel with this Closure Plan.

In addition to the above requirements, National Pollutant Discharge Elimination System (NPDES) permit program compliance, SOC (which commits Duke Energy to initiate and complete decanting of the basins by certain dates) compliance, dam safety approvals for modifications to regulated CCR basin dams, and environmental permitting requirements must be considered as part of closure.
3. FACILITY DESCRIPTION AND EXISTING SITE FEATURES

3.1 Surface Impoundment Description

This section provides details on the CCR-related impoundment features at the BCSS.

3.1.1 Site History and Operations

Figure 1-1 shows locations of the station, the Basin, the Basin Dams, and other CCR related facilities. Existing conditions and topography of the BCSS, including the bathymetry within the Basin, is presented on Figure 3-1. There are three active CCR facilities and two closed Landfill/Structural Fills at the BCSS site as described below:

**CCR Basin (ID STOKE-116)**

The Basin is located northwest of the BCSS. The Basin was formed by the two dams built at this basin, the Basin Main Dam and Pine Hall Road Embankment Dam which were constructed from 1970 to 1972. The Basin was commissioned in 1974 and there have been no expansions or raising of the dams since then. The Basin dam is approximately 1.900 ft long, with a crest width of about 20 feet, and a maximum height of 130 feet above the dam toe to a crest elevation of about 770 ft. Pine Hall Road Embankment dam is approximately 250 ft long, with a crest width of about 40 feet, and a maximum height of 75 feet above the dam toe to a crest elevation of about 790 ft. The Basin was initially constructed to receive sluiced CCR from coal burning at the BCSS. Fly ash was sluiced to the Basin from 1974 until the Pine Hall Road Landfill became operational in 1983. Fly ash was occasionally sluiced to the Basin during startup or maintenance after 1983. Bottom ash had been sluiced to the Basin since initial operation in 1974 until the system was converted to dry handling in 2018. The Basin was operated as an integral part of the station’s wastewater treatment system, which received flows from the bottom ash removal system, FGD processes, and other non-CCR waste streams until sluicing of CCR and other process water streams into the Basin were stopped in March 2019 with the startup of new dry bottom ash handling systems and utilization of the new Lined Retention Basins (LRB) as the treatment facilities.

The Basin encompasses approximately 350 acres at the full pool elevation of 760 feet. Based on the Basin boundary delineated by Duke Energy, the boundary containing CCRs that requires closure under CAMA (i.e. excluding the dam and the historical basin finger under the adjacent permitted and closed Pine Hall Road Landfill area) is about 270 acres. The maximum depth of CCR within the Basin is estimated to be approximately 80 feet. The Basin dams are regulated by NCDEQ Dam Safety Program under North Carolina State ID STOKE-116.

The discharge from the Basin was through a concrete riser structure located in the northwest portion of the basin. The concrete riser structure drained through a 24-inch diameter horizontal outlet pipe for approximately 1,600 feet and then discharged into a concrete flume box. The discharge was to an unnamed tributary or Tributary 52, that flowed northward to the Dan River. BCSS has stopped using the above described outfall (i.e. Outfall 003) in July 2019 and started using the new Outfall 006 which discharges to the Dan River via a pipeline from the Basin. No use of Outfall 003 for discharging is anticipated, unless required for emergency gravity discharges via the spillway riser during large storm events to maintain the integrity of the dams. The discharge from the Basin is permitted by the NCDEQ DWR under NPDES Permit NC0024406.
By comparing the historical topographic map (prepared using aerial photography taken in 1966) and the 2014 topographic map (surveyed in April 2014), it appears that the Basin was constructed in the valley area with the natural contours in place.

Additional Facilities

Other CCR facilities within the BCSS are shown in the attached Figure 3-1. The Pine Hall Road Landfill located adjacent to the Basin is discussed below. Other facilities are summarized in Section 3.2.3.

The Pine Hall Road Landfill (Permit No. 8503-INDUS-1984) was subject to North Carolina’s rules, 15A N.C.A.C. 13B § .0500, governing the permitting of solid waste disposal sites in the state, and was closed pursuant to those rules. As detailed in the documents developed as part of the permit process that culminated in NCDEQ’s issuance of Permit No. 8503-INDUS-1984, the areas underlying the Pine Hall Road Landfill became an intrinsic part of its design and ceased being “surface impoundment” at such time the unit was permitted by NCDEQ. Accordingly, the permitted Pine Hall Road Landfill is not subject to CAMA and, thus, is not addressed under this Closure Plan. However, Duke Energy will undertake additional closure measures exceeding the standards set forth in 15A N.C.A.C. 13B § .0500 as part of a separate regulatory process.

3.1.2 Estimated Volume of CCR in Impoundments

Based on CCR Inventory Data provided by Duke as of July 31, 2019 and upon a surface comparison calculation, performed within AutoCAD Civil 3D, comparing the approximate pre-development topography to the 2014 topographic and bathymetric survey, the approximate volume of CCR in the Basin is listed in the table below. To compute the estimated mass of CCR in place an assumed density of 1.2 tons per CY was used, which is the Duke Energy fleet wide assumption. See Appendix A for the Estimated Volume of CCR Material in Impoundment calculation.

<table>
<thead>
<tr>
<th>Impoundment</th>
<th>Estimated CCR Material Volume (CY)</th>
<th>Estimated CCR Material Weight (Tons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CCR Basin*</td>
<td>9,975,000</td>
<td>11,970,000</td>
</tr>
</tbody>
</table>

* The Basin boundary used to estimate in-place CCR is based on the unit boundary as prepared by SynTerra but excluded the dam area and the historical basin finger under the adjacent permitted and closed Pine Hall Road Landfill area.

3.1.3 Description of Surface Impoundment Structural Integrity

The purpose of this section is to summarize the Basins’ structural integrity evaluations based on current existing information. This section includes the Geotechnical, and Hydrology and Hydraulics (H&H) capacity analyses results. In summary, the structural integrity of the CCR impoundments and subsequent dam inspection reports meets the regulatory requirements of EPA’s CCR Rule (40 CFR 257.73). Duke Energy’s certifications of these requirements are available on Duke Energy's publicly-accessible CCR Rule Compliance Data and Information website.
Slope stability

For both Basin Main Dam and Pine Hall Road Embankment Dam, slope stability analysis results for the existing conditions indicated acceptable global factors of safety for static long-term maximum storage pool, static maximum surcharge pool, sudden drawdown conditions, and pseudo-static seismic conditions. Slope stability results for the Basin Main Dam and the Roadway Embankment, all under the four loading conditions mentioned above met regulatory requirements.

Liquefaction conditions (where susceptible) and Liquefaction potential

The liquefaction screening analysis for the Basin Main Dam found that the embankment and foundation soils are generally not susceptible to liquefaction, with calculated liquefaction triggering factors of safety being above 1.1.

The liquefaction screening analysis for the Pine Hall Road Embankment Dam found that the embankment and foundation soils are generally not susceptible to liquefaction.

For both, Basin Main Dam and Pine Hall Road Embankment Dam, seismically-induced deformations are expected to be negligible (e.g. 0.5 inch or less) and liquefaction-induced vertical settlements are also expected to be negligible.

Hydrology and hydraulics (H&H) capacity analyses

Hydrologic model results indicate that the Basin will contain and safely convey the Spillway Design Flood (SDF) during normal spillway operating conditions and in the event the existing conduit spillway becomes blocked.

Hydrologic model results indicate that the existing spillway system is not capable of removing 80 percent of the temporarily detained volume within 15 days following the design storm event, which does not meet North Carolina Dam Safety Rules (NCDSR), Title 15A, Subchapter 2K, Section .0205 (d)) (AECOM, 2016). Storm events based on the 6-hour and 72-hour storm events and scenarios with and without base flow were considered in the evaluation. Calculations performed were based on the NCDEQ waiver request on April 27, 2015 and approval on May 5, 2015 on spillway alternatives to mitigate the time to deficiency. These calculations show that following the completion of the weighted filter overlay construction, the Basin is capable of containing back-to-back design storms, while not causing stability or seepage concerns associated with the Basin Main Dam. It is noted that the weighted filter overlay project was completed in 2016.

Basin Main Dam Outlet Structure

- The outlet riser structure has adequate stability and strength to meet current North Carolina Dam Safety criteria. This includes overturning capacity, and wall and riser structure capacity.

3.1.4 Sources of Discharges into Surface Impoundments

Process flows no longer discharge into the Basin. Process flows are directed toward newly-constructed lined retention basins. The BCSS currently employs a dry ash handling system which allows for disposal of the CCR in on-site industrial landfills.

Historically runoff and process water streams from the bottom ash sluice, coal yard holding sumps, FGD wastewater treatment lagoons, stormwater, consolidated sump system, chemical
holding pond, and west holding sump were discharged into the Basin. The only inflow to the Basin currently is stormwater run-on from its watershed.

3.1.5 Existing Liner System

The Basin located at the Belews Creek Steam Station site is unlined and was constructed directly on top of the historical ground surface.

3.1.6 Inspection and Monitoring Summary

Weekly Basin inspections have been on-going since 2014, and include observation of upstream slopes and shorelines, crest, downstream slopes, toes, abutment contacts and adjacent drainage way(s), spillway(s) and associated structure(s), and other structures and features of the dams.

Monthly inspections of the Basin include the weekly monitoring elements with the addition of piezometer and observation well readings, water level gauges/sensors.

Daily inspections of the Basin are not routinely required, however, on a case-by-case basis, the Basin may be inspected daily beginning at such times and continued for the duration as specified by plant management. Such daily inspections might be initiated during a repair activity on the dam or in response to a specific imposed regulatory agency requirement.

The Basin is inspected annually by an independent third-party consultant. In a letter dated August 13, 2014, NCDEQ requires these inspections to be conducted annually at all of Duke Energy’s coal ash impoundments in North Carolina. These inspections are intended to confirm adequacy of the design, operation, and maintenance of the surface impoundments in accordance with accepted engineering standards. Reports are to be submitted to the NCDEQ within 30 days of the completion of the inspection.

The results of the annual inspections are used to identify needed repairs, repair schedules, to assess the safety and operational adequacy of the dam, and to assess compliance activities regarding applicable permits, environmental and dam regulations. Annual inspections are also performed to evaluate previous repairs. The annual inspections of the dams have been ongoing since 2009, with 5-year inspections conducted between 1979 and 2009.

The 2015 through 2019 annual inspections did not identify features or conditions in the Basin dams, or their outlet structures or spillways that indicate an imminent threat of impending failure hazard. Review of critical analyses indicated the design conforms to current engineering state of practice to a degree that no immediate actions are required other than the recent and ongoing surveillance and monitoring activities already underway.

Special, episodic inspections of the Basin may be performed during episodes of earthquake, emergency, or other extraordinary events. Visual inspections are performed after a heavy precipitation event when accumulation of four inches of rainfall or greater occurs within a 24-hour period. An internal inspection will be performed if an earthquake is felt locally or detected by the US Geological Survey measuring greater than a Magnitude 3 and with an epicenter within 50 miles of the dams. A special inspection would also be performed during an emergency, such as when a potential dam breach condition might be identified or when construction activities (e.g., basin cleanout) are planned on or near the dams. Special inspections are also conducted when the ongoing surveillance program identifies a condition or a trend that warrants special evaluation.
3.2 Site Maps

3.2.1 Existing CCR Impoundment-Related Structures

A site map showing property boundary, location of the BCSS, Basin and other CCR-related structures with their boundaries and topographic and bathymetric contours are shown on Figure 3.1.

3.2.2 Receptor Survey

This information is included as part of the CAP being prepared separately by SynTerra for Duke Energy and is being submitted in parallel to this Closure Plan. The CAP is herein incorporated by this reference but its content is not the work product of AECOM.

3.2.3 Existing On-Site Landfills

There are three landfills and one structural fill at the BCSS site, as identified in the table below. Figure 1-1 shows locations of these landfills.

<table>
<thead>
<tr>
<th>Landfill/Structural Fill</th>
<th>Permit Number</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pine Hall Road Landfill</td>
<td>8503</td>
<td>Closed Prior to the CCR Rule</td>
</tr>
<tr>
<td>Structural Fill</td>
<td>CCB0070</td>
<td>Closed Prior to the CCR Rule</td>
</tr>
<tr>
<td>Craig Road Landfill</td>
<td>8504</td>
<td>Active</td>
</tr>
<tr>
<td>FGD Gypsum Landfill</td>
<td>8505</td>
<td>Active</td>
</tr>
</tbody>
</table>

3.3 Monitoring and Sampling Location Plan

This information is included as part of the CAP being prepared separately by SynTerra for Duke Energy and is being submitted in parallel to this Closure Plan. The CAP is herein incorporated by this reference but its content is not the work product of AECOM.

Locations of the existing groundwater monitoring wells are shown in the Closure Plan Drawings, Appendix D, but the CAP should be consulted for details of well locations, names, and status.
4. RESULTS OF HYDROGEOLOGIC, GEOLOGIC, AND GEOTECHNICAL INVESTIGATIONS

4.1 Background

An overall boring and existing monitoring well location plan indicating the locations of recent and historical borings, monitoring wells, piezometers and Cone Penetration Test (CPT) sounding locations is shown on Drawing BLC_C999.002.005 included in Appendix D.

This chapter summarizes the site geology and hydrogeology; site stratigraphy of the geologic units underlying the surface impoundments, hydraulic conductivity of CCR and the soils underlying the surface impoundment geotechnical properties of the CCRs and the uppermost stratigraphic unit under the surface impoundment; CCR and CCR affected soils.

4.2 Hydrogeology and Geologic Descriptions

This information is included as part of the CAP being prepared separately by SynTerra for Duke Energy and is being submitted in parallel to this Closure Plan. The CAP is herein incorporated by this reference but its content is not the work product of AECOM.

4.3 Stratigraphy of the Geologic Units Underlying Surface Impoundments

This information is included as part of the CAP being prepared separately by SynTerra for Duke Energy and is being submitted in parallel to this Closure Plan. The CAP is herein incorporated by this reference but its content is not the work product of AECOM.

4.4 Geotechnical Properties

This section provides a summary of geotechnical conditions and properties found from investigations performed within the Basin and Basin dam areas. The presented information was obtained from previous geotechnical investigations at the site and recent investigation activities conducted to support the Closure Plan development. The geotechnical conditions within the Basin generally consist of CCR material (interbedded layers of fly ash and bottom ash) placed in the basin primarily by hydraulic sluicing underlain by residual soil, saprolite, partially weather rock (PWR), and bedrock.

For the purposes of discussion of the geotechnical properties of the materials, the saprolite material is described as residual material. General properties of the various materials encountered within and surrounding the Basin are described below. A range of measured geotechnical material properties of laboratory tests performed by AECOM, HDR, and SynTerra for the subsurface explorations completed within the Basin is presented in Appendix B. A summary of typical measured properties for different material types are presented in Table 4-1.

4.4.1 CCR Within Basin

The CCR within the Basin consists primarily of alternating layers and mixtures of bottom ash and fly ash. Bottom ash consists of loose, moist, dark gray, fine to coarse silty sand (SM), which appears to be the access road built in 2015 to access the boring locations. Fly ash
obtained beneath the bottom ash (access road) consists of very loose, wet, and gray silt and sandy silt (ML) material. CCR found within the areas that were under water during the 2018 investigation indicate mostly soft fly ash along the main former channel within the Basin. The higher elevation areas within the Basin that are under water were found to have no or very little CCR.

4.4.2 Liner Material Properties

The Basin is unlined so there are no associated material properties.

4.4.3 Subsurface Soil Properties

*Residual Soil:* Residual soil (including saprolite) consists of very loose to very dense and soft to hard; moist to wet; fine to coarse; brown, orange, and red silty sand or sandy silt with some plastic soil.

*Embankment Soil:* The embankment at the Pine Hall Road Embankment Dam generally consisted of silty sands (SM), sandy silts (ML), and lean clays (CL). The embankment was constructed using local borrow soils, which means they are residual soils developed from the weathering of the local bedrock. Historical subsurface investigations indicate that the embankment soils are layered and heterogeneous, with potentially alternating layers of differing index properties.

4.5 Chemical Analysis of Impoundment Water, CCR and CCR Affected Soil

This information is included as part of the CAP being prepared separately by SynTerra for Duke Energy and is being submitted in parallel to this Closure Plan. The CAP is herein incorporated by this reference but its content is not the work product of AECOM.

4.6 Historical Groundwater Sampling Results

This information is included as part of the CAP being prepared separately by SynTerra for Duke Energy and is being submitted in parallel to this Closure Plan. The CAP is herein incorporated by this reference but its content is not the work product of AECOM.

4.7 Groundwater Potentiometric Contour Maps

This information is included as part of the CAP being prepared separately by SynTerra for Duke Energy and is being submitted in parallel to this Closure Plan. The CAP is herein incorporated by this reference but its content is not the work product of AECOM.

4.8 Estimated Vertical and Horizontal Extent of CCR within the Impoundments

This information is included as part of the CAP being prepared separately by SynTerra for Duke Energy and is being submitted in parallel to this Closure Plan. The CAP is herein incorporated by this reference but its content is not the work product of AECOM.
5. **GROUNDWATER MODELING ANALYSIS**

In accordance with the requirements of N.C.G.S. § 130A-309.211(b)(1), Duke Energy separately submitted an updated Corrective Action Plan (CAP) in parallel with this Closure Plan; the updated CAP is herein incorporated in its entirety by this reference. Neither the updated CAP nor its content is the work product of AECOM. Although the Closure Plan contains references to the updated CAP, all specific relevant details to groundwater and related actions are found in the updated CAP itself and not in this Closure Plan.

The updated CAP evaluates the extent of, and remedies for, contaminants of interest (COI) in groundwater associated with the Ash Basin, focusing on constituent concentrations detected above the applicable 02L Standards, Interim Maximum Allowable Concentrations, or approved background threshold values at or beyond the compliance boundary to the north and northwest of the Ash Basin. In addition, the updated CAP considers the federal groundwater corrective action requirements at 40 C.F.R. §§ 257.96-.98.

As detailed in the updated CAP, Duke Energy has begun to implement, and will continue implementing, source control measures at the site, including (i) complete Ash Basin decanting to remove the hydraulic head, thereby mitigating the risk of potential COI migration into groundwater; and (ii) complete Ash Basin closure. In addition, Duke Energy intends to implement a robust groundwater remediation program that includes actively addressing COI in groundwater above applicable standards at or beyond the compliance boundary using a combination of groundwater extraction, clean water infiltration, and treatment. The CAP provides that these corrective action measures will most effectively achieve remediation of the groundwater through the use of extraction wells to the north and northwest of the Ash Basin and clean water infiltration wells to the north and northwest of the Ash Basin. Significantly, groundwater modeling simulations indicate these measures will control COI at the compliance boundary and meet the remedial objectives for COI beyond the compliance boundary.

5.1 **Site Conceptual Model Predictions**

This information is included as part of the CAP being prepared separately by SynTerra for Duke Energy and is being submitted in parallel to this Closure Plan. The CAP is herein incorporated by this reference but its content is not the work product of AECOM.

5.2 **Groundwater Chemistry Effects**

This information is included as part of the CAP being prepared separately by SynTerra for Duke Energy and is being submitted in parallel to this Closure Plan. The CAP is herein incorporated by this reference but its content is not the work product of AECOM.

5.3 **Groundwater Trend Analysis Methods**

This information is included as part of the CAP being prepared separately by SynTerra for Duke Energy and is being submitted in parallel to this Closure Plan. The CAP is herein incorporated by this reference but its content is not the work product of AECOM.
6. BENEFICIAL AND FUTURE USE

6.1 CCR Use

At this time, Duke Energy has not identified a beneficial use of CCR from the Basin at BCSS.

6.2 Site Future Use

At this time Duke Energy has not identified any future use of the land reclaimed by the dewatering and excavation of the Basin, except that a new CCR landfill is proposed to be partially built within the northern footprint of the excavated Basin.

7. CLOSURE DESIGN DOCUMENTS

7.1 Engineering Evaluations and Analyses

Engineering evaluations and analyses to support closure of the Basin at the BCSS, as detailed in this Closure Plan, are provided in Appendix C.

Based on the final post closure configuration of the Basin and the need to collect additional information to define the transition between the Basin and the closed Pine Hall Road Landfill, no geotechnical calculations have been included for the Closure Plan (approval stage) design. After completion of additional investigations near the above-mentioned transition area and based on additional information about constructability, geotechnical slope stability calculations will be performed for this area to support interim excavation and permanent closure conditions. Geotechnical calculations for the proposed CCR landfill design will be performed separately as part of its permit application, which will follow NCDEQ approval of this Closure Plan. Dam removal related calculations will be included in the dam modification permit applications, which will follow NCDEQ approval of this Closure Plan.

Safe and effective access to the Basin is critical to CCR excavation and the completion of closure. Access road locations into or across the Basin cannot be reliably established until detailed phasing of closure is developed and a contractor is selected to complete the work. A variety of mitigation techniques can be applied, such as installation of a geogrid and crushed stone aggregate, placement and spreading of dry CCR over the Basin surface to establish access, and use of low ground pressure or light weight construction equipment.

Areas for stockpiling or conditioning of CCR are generally needed. These areas must be established within the limits of the CCR unit and require placement or stacking of CCR excavated from other areas of the Basin. They can be established in areas where all or most of the CCR has been removed, or on areas where a significant depth of CCR remains in place. Sluiced CCR forming the foundation of stockpiles or conditioning areas may be subject to bearing capacity or slope failures from the additional vertical compressive stress imparted by the stacked CCR and hauling equipment.
During excavation of CCR, interim or temporary excavated CCR slopes are commonly created. These slopes vary in height and the duration they will have to stand. Some slopes are subject to potential loading from hauling or stockpiling operations. The location and geometry of such slopes cannot be established during design. These elements depend on the means and methods employed by the construction contractor, site conditions, schedule and other site conditions. Excavation in a deep valley fill creates safety risks that need further evaluation and will require the means and methods inputs from a contractor to fully address before closure excavation work commences. A detailed phasing and excavation plan will be developed after this Closure Plan is approved by NCDEQ.

7.2 Closure Plan Activities

The primary activities associated with closure by excavation are as follows:

- Decant by using floating pumps, screened intakes, and pumping through the discharge structure outlet.
- Install stormwater run-on diversion or retention controls, to minimize stormwater flow into the Basin to the extent practical.
- Construction and operation of a temporary water management system to manage all discharges in compliance with the NPDES permit during closure.
- Dewater the CCR to allow for access. CCR excavation and conditioning prior to placement in the on-site landfill.
- Start CCR excavation from the Basin, with sequencing determined for optimal progression. Construct landfill cells in coordination with CCR excavation. Place the excavated CCR in the on-site landfill and compact. Instrumentation and monitoring requirements to be developed prior to construction will be followed to verify construction phase stability. Construction dewatering to be used as needed to provide stable work areas and slopes.
- Maintain required hydraulic storage capacity though the excavation process and progressively breach the Basin dam as excavation advances.
- Complete closure by excavation verification. Grade the area to promote positive drainage and seed for vegetative growth.
- Sequence final dam breach with construction of proposed stormwater detention basins and inflow design flood management.

Additional information and details pertaining to the closure design are provided in the Closure Plan drawings, which can be found in Appendix D.

7.3 Closure Plan Drawings

The Closure Plan drawings found in Appendix D include the following:

- Cover Sheet
- General Notes
• Existing Conditions Plan
• Exploration Location Plan
• Demolition Plan
• Estimated Bottom of CCR Plan
• Final Grading Plan
• Final Grading Profiles, Cross-Sections, and Details
• Excavation Plan
• Excavation Profiles and Details
• On-Site Landfill Schematic Plan
• On-Site Landfill Schematic Cross-Sections
• Closure Details

These Closure Plan Drawings will be further developed and refined to develop construction level drawings during subsequent stages of the design. In addition, supplemental drawing sets will be prepared on an as needed basis to support dam modification and/or decommissioning permit, erosion and sediment control permit, NPDES permit modifications for dewatering, downstream flood impact related permits, and other related permits.

Once the excavation grades shown on the Closure Plan drawings are achieved the procedures described in the Duke Energy Excavation Soil Sampling Plan (Appendix E) will be followed to confirm that the Closure by Excavation has been achieved.

### 7.4 Description of a Construction Quality Assurance Plan

A Construction Quality Assurance (CQA) Plan will be developed following NCDEQ approval of the Closure Plan for closure of the Basin. The CQA Plan will be prepared to address G.S. §130A-309.214(a)(4)(g) of CAMA, and its purpose is to provide a description of the CQA program to be adhered to in execution of closure activities at the BCSS. The CQA Plan will present a description of the roles and responsibilities for monitoring and testing activities and provides guidance on the methodology to be used for evaluating whether the construction has been performed in accordance with the approved Closure Plan. The CQA Plan will also detail the material testing frequencies; methods for transportation, handling, and storage of materials; test methods and verifications; manufacturer, field, and laboratory testing; field activities for construction monitoring and oversight; and reporting and documentation requirements. Technical specifications to be developed as part of the construction level design packages for contractor bidding and will present specific material properties and specifications.

The CQA Plan will address materials and CQA activities associated with the following components:

- Earthwork
  - CCR Excavation
  - Structural Soil Fill
8. MANAGEMENT OF WASTEWATER AND STORMWATER

The BCSS manages wastewater and stormwater under the NPDES permit issued by the NCDEQ. Permit number NC0024406, issued March 21, 2019 (NCDEQ, 2019), permits the discharge of various process-related wastewaters in accordance with specified limits and monitoring requirements. This permit is effective from March 25, 2019 to February 28, 2024 and authorizes permitted discharges to receiving waters designated as the West Belews Creek/Belews Lake (Outfalls 001, 005, and 007), unnamed tributary to the Dan River (Outfalls 003 and 003A), and the Dan River (Outfall 006) in the Roanoke River Basin. West Belews Creek/Belews Lake and the unnamed tributary to Dan River are classified C and WS-IV waters, respectively. The limits and requirements stipulated for these outfalls can be found in the aforementioned permit.

The Basin discharge will continue to be in service to meet the NPDES permit discharge requirements as it goes through the phases of: (1) decanting: free (bulk) water removal, management, and discharge via the permitted outfall during closure initiation; and (2) dewatering: interstitial water treatment and discharge via permitted outfall during closure construction. With decanting underway, discharges from the Basin via the existing passive gravity discharge system have stopped. Decanting is proceeding via mechanical pumping. The pumping system is expected to draw down the stored water after storm events, route through the WMS if necessary, and discharge via the permitted outfall. When dewatering of the CCR begins, all discharge flows are anticipated to be routed through the WMS in order to meet the permitted discharge limits.

The Basin will continue to safely pass the PMP to meet dam safety requirements during closure. The Basin has almost a 20 feet freeboard under pre-decanting operating conditions, and once the free water is drawn down it is not expected to result in storm water discharges from the Basin via the passive riser outlet gravity discharge system. The dewatering system is expected to draw down the stored water after storm events, route through the WMS, and discharge via the permitted outfall.

As part of the closure, the Basin Main Dam will be removed by excavating an engineered breach. Pine Hall Road Embankment Dam will not impound water and structural fill will be used to grade the excavated former discharge canal behind Pine Hall Road Embankment Dam to promote surface water flow away from that dam. Under this post closure condition, there will be increased flow downstream of the Basin Main Dam compared to the existing conditions. The unnamed creek or Tributary 52 located downstream crosses the Middleton Loop Road and a Norfolk Southern Rail Road via culverts and discharges to the Dan River. Additional stormwater retention capacity will need to be provided following dam removal or the existing downstream culverts will need to be retrofitted to increase their conveyance capacities. The closure design proposed herein provides additional storage capacity following removal of the Basin Main Dam by the use of detention and retention basins. The concept designs for these proposed basins were based on
limiting post-closure downstream 100-year event stormwater flows to less than or equal to pre-
development (or pre-Basin Main Dam) stormwater flows. Detailed designs for these storm water
basins will be developed as part of the construction level design and to meet any supplemental
permit requirements after approval of this Closure Plan.

Wastewater from the Basin will be pumped, treated and discharged in two phases; the Decanting
phase and Dewatering phase. In the Decanting phase, free water above the settled ash layer will
be removed from the Basin without the mechanical disturbance of the ash. The WMS during this
phase consists of a temporary Level 1 physical-chemical treatment system designed to meet the
requirements of the discharge permit including continuous monitoring for pH and Total Suspended
Solids. The BCSS WMS has a designed flow rate of 3,500 gpm. Following the Decanting phase
and as the Closure schedule dictates, the work will advance into the Dewatering phase to remove
interstitial water from the Basin. During this phase, additional physical-chemical treatment
processes will be added to the WMS as necessary to maintain compliance with the requirements
of the discharge permit. During Dewatering phase, the WMS will have a designed flow rate of
800 to 1,000 gpm.

Dewatering is performed to remove the interstitial or pore water from the CCR to facilitate
excavation, to access in-place CCR or to establish safe slopes prior to and after CCR excavation.
It is anticipated that performance criteria will be established in the construction-level
documentation to identify required vertical and horizontal limits of interstitial water removal at
critical locations and for critical conditions during closure.

8.1 Anticipated Changes in Wastewater and Stormwater Management

All wastewater flows to the Basin have been diverted to the holding basin and lined retention basin
and CCR is being collected in a dry form.

A temporary WMS will be utilized at the Basin such that the NPDES Outfall effluent discharge
limits will be met throughout the duration of dewatering and closure.

Erosion and Sediment Control Plans for different phases of the construction will be developed as
part of the construction-level packages and formal erosion and sediment control plan permit
submittal. The details for the erosion and sediment control measures depicted on the drawings in
this Closure Plan submittal will be re-evaluated after the specific construction phasing is
established, which will follow NCDEQ approval of this Closure Plan. In addition, erosion and
sediment control measures may be installed and removed in phases as stabilization is achieved.

8.2 Wastewater and Stormwater Permitting Requirements

Additional information on required permits is described in Section 10.

9. DESCRIPTION OF FINAL DISPOSITION OF CCR

CCR will be placed into a new, approved and permitted, lined onsite CCR landfill. A permit
application for construction of the on-site landfill will be prepared and submitted to NCDEQ
Division of Waste Management following approval of this Closure Plan.
Vegetation encountered or removed during the progression of the work will be managed in accordance with state regulations for handling and disposal.

10. APPLICABLE PERMITS FOR CLOSURE

Refer to Table 10-1 for detailed information on the potential and applicable permitting/approval needed to implement this Closure Plan. Development of permitting package submittals and/or regulatory approval requests would follow NCDEQ approval of the Closure Plan.

11. DESCRIPTION OF POST-CLOSURE MONITORING AND CARE

A Post-Closure plan will be developed following NCDEQ approval of the Closure Plan for closure of the Basin. The purpose of the Post-Closure plan will be to provide a description of the inspection, monitoring, and maintenance activities required to be performed throughout the 30-year post-closure care period for the closed Basin.

The Post-Closure Care plan will be developed to meet the requirements of CAMA (G.S. §130A-309.214(a)(4)(k)). The items that will be in the Post-Closure Care plan for the BCSS site include:

- Name, address, phone number, and email address of the responsible office or person;
- Means and methods of managing affected groundwater and stormwater;
- Maintenance of the groundwater monitoring systems;
- Groundwater and surface water monitoring and assessment program (included as part of the CAP);
- Description of planned post-closure uses; and
- Financial assurance estimates for post-closure operations and maintenance and remedial action.

11.1 Groundwater Monitoring Program

This information is included as part of the CAP being prepared separately by SynTerra for Duke Energy and is being submitted in parallel to this Closure Plan. The CAP is herein incorporated by this reference but its content is not the work product of AECOM.

12. PROJECT MILESTONES AND COST ESTIMATES

12.1 Project Schedule

A Closure project high level milestone schedule has been prepared by Duke Energy and is provided below. The schedule defines the following anticipated activities and milestones:
• Engineering, decanting, dewatering  
• Submit plan and design for landfill construction permit  
• Start new landfill construction  
• Start CCR excavation for placement into landfill  
• Complete CCR excavation  
• Complete final closure and cover system of new landfill  
• Site final grading and vegetative cover

A detailed construction schedule will be developed following NCDEQ approval of this Closure Plan.

12.2 Closure and Post-Closure Cost Estimate

Cost estimates for closure and post-closure of the Basin at BCSS were developed by Duke Energy and provided to AECOM. These cost estimates are not a work product of AECOM. These are Class 5 estimates as the detailed and final design is not developed at this stage of the closure project. Following approval of this Closure Plan by NCDEQ and further development of the project plans and engineering designs the cost estimate will be refined and updated.

The cost to complete the closure by excavation, including the new CCR landfill, is estimated to be $453 million.

The cost to perform the 30-year post-closure activities and monitoring is estimated as $181 million.

The cost estimates prepared by Duke Energy include the following major activities:

• Mobilization and site preparation
• Dewatering, earthwork, and subgrade preparation
• CCR excavation
• Stormwater management, erosion and sediment control, and site restoration
• Engineering support (design and CQA)
• Post-closure – groundwater monitoring
• Post-closure – operations and maintenance
• Contingency

Corrective action costs are included as part of the CAP being prepared separately by SynTerra for Duke Energy and is being submitted in parallel to this Closure Plan. The CAP is herein incorporated by this reference but its content is not the work product of AECOM.
13. REFERENCED DOCUMENTS

PROFESSIONAL ENGINEER CERTIFICATION

I, Ramachandran Kulasingam, being a registered Professional Engineer in the state of North Carolina, do hereby certify to the best of my knowledge, information, and belief, that the information contained in this Closure Plan dated December 18, 2019, was developed pursuant to the requirements of N.C.G.S. § 130A-309-214(a)(4) and has been prepared pursuant to recognized and generally accepted good engineering practices.

SIGNATURE ___________________________ DATE 12/18/2019

AECOM Technical Services of North Carolina, Inc. (License: F-0342)
TABLES
<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Corresponding Closure Plan Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Site history and history of site operations, including details on the manner in which coal combustion residuals have been stored and disposed of historically.</td>
<td>3.1.1</td>
</tr>
<tr>
<td>2</td>
<td>Estimated volume of material contained in the impoundment.</td>
<td>3.1.2</td>
</tr>
<tr>
<td>3</td>
<td>Analysis of the structural integrity of dikes or dams associated with impoundment.</td>
<td>3.1.3</td>
</tr>
<tr>
<td>4</td>
<td>All sources of discharge into the impoundment, including volume and characteristics of each discharge.</td>
<td>3.1.4</td>
</tr>
<tr>
<td>5</td>
<td>Whether the impoundment is lined, and, if so, the composition thereof.</td>
<td>7.1</td>
</tr>
<tr>
<td>6</td>
<td>A summary of all information available concerning the impoundment as a result of inspections and monitoring conducted pursuant to this Part and otherwise available.</td>
<td>3.1.6</td>
</tr>
<tr>
<td>1</td>
<td>All structures associated with the operation of any coal combustion residuals surface impoundment located on the site. For purposes of this sub-subdivision, the term “site” means the land or waters within the property boundary of the applicable electric generating station.</td>
<td>3.2.1</td>
</tr>
<tr>
<td>2</td>
<td>All current and former coal combustion residuals disposal and storage areas on the site, including details concerning coal combustion residuals produced historically by the electric generating station and disposed of through transfer to structural fills.</td>
<td>3.3</td>
</tr>
<tr>
<td>3</td>
<td>The property boundary for the applicable site, including established compliance boundaries within the site.</td>
<td>3.3</td>
</tr>
<tr>
<td>4</td>
<td>All potential receptors within 2,640 feet from established compliance boundaries.</td>
<td>3.2.2</td>
</tr>
<tr>
<td>5</td>
<td>Topographic contour intervals of the site shall be selected to enable an accurate representation of site features and terrain and in most cases should be less than 20-foot intervals.</td>
<td>3.3</td>
</tr>
<tr>
<td>6</td>
<td>Locations of all sanitary landfills permitted pursuant to this Article on the site that are actively receiving waste or are closed, as well as the established compliance boundaries and components of associated groundwater and surface water monitoring systems.</td>
<td>3.2.3</td>
</tr>
<tr>
<td>7</td>
<td>All existing and proposed groundwater monitoring wells associated with any coal combustion residuals surface impoundment on the site.</td>
<td>3.3</td>
</tr>
<tr>
<td>8</td>
<td>All existing and proposed surface water sample collection locations associated with any coal combustion residuals surface impoundment on the site.</td>
<td>3.3</td>
</tr>
<tr>
<td>1</td>
<td>A description of the hydrogeology and geology of the site.</td>
<td>4.1</td>
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<tr>
<td>2</td>
<td>A description of the stratigraphy of the geologic units underlying each coal combustion residuals surface impoundment located on the site.</td>
<td>4.2</td>
</tr>
<tr>
<td>3</td>
<td>1. The saturated hydraulic conductivity for (i) the coal combustion residuals within any coal combustion residuals surface impoundment located on the site and (ii) the saturated hydraulic conductivity of any existing liner installed at an impoundment, if any.   2. The geotechnical properties for (i) the coal combustion residuals within any coal combustion residuals surface impoundment located on the site, (ii) the geotechnical properties of any existing liner installed at an impoundment, if any, and (iii) the uppermost identified stratigraphic unit underlying the impoundment, including the soil classification based upon the Unified Soil Classification System, in-place moisture content, particle size distribution, Atterberg limits, specific gravity, effective friction angle, maximum dry density, optimum moisture content, and permeability.</td>
<td>4.3</td>
</tr>
<tr>
<td>4</td>
<td>A chemical analysis of the coal combustion residuals surface impoundment, including water, coal combustion residuals, and coal combustion residuals-affected soil.</td>
<td>4.4</td>
</tr>
<tr>
<td>5</td>
<td>Identification of all substances with concentrations determined to be in excess of the groundwater quality standards for the substance established by Subchapter L of Chapter 2 of Title 15A of the North Carolina Administrative Code, including all laboratory results for these analyses.</td>
<td>4.5</td>
</tr>
<tr>
<td>6</td>
<td>Summary tables of historical records of groundwater sampling results.</td>
<td>4.6</td>
</tr>
<tr>
<td>7</td>
<td>A map that illustrates the potentiometric contours and flow directions for all identified aquifers underlying impoundments (shallow, intermediate, and deep) and the horizontal extent of areas where groundwater quality standards established by Subchapter L of Chapter 2 of Title 15A of the North Carolina Administrative Code for a substance are exceeded.</td>
<td>4.6</td>
</tr>
<tr>
<td>8</td>
<td>Cross-sections that illustrate the following: the vertical and horizontal extent of the coal combustion residuals within an impoundment; stratigraphy of the geologic units underlying an impoundment; and the vertical extent of areas where groundwater quality standards established by Subchapter L of Chapter 2 of Title 15A of the North Carolina Administrative Code for a substance are exceeded.</td>
<td>4.8</td>
</tr>
<tr>
<td>No.</td>
<td>Description</td>
<td>Corresponding Closure Plan Section</td>
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<tr>
<td>1</td>
<td>An account of the design of the proposed Closure Plan that is based on the site hydrogeologic conceptual model developed and includes (i) predictions on post-closure groundwater elevations and groundwater flow directions and velocities, including the effects on and from the potential receptors and (ii) predictions at the compliance boundary for substances with concentrations determined to be in excess of the groundwater quality standards for the substance established by Subchapter L of Chapter 2 of Title 15A of the North Carolina Administrative Code.</td>
<td>5.1</td>
</tr>
<tr>
<td>2</td>
<td>A description of the groundwater trend analysis methods used to demonstrate compliance with groundwater quality standards for the substance established by Subchapter L of Chapter 2 of Title 15A of the North Carolina Administrative Code and requirements for corrective action of groundwater contamination established by Subchapter L of Chapter 2 of Title 15A of the North Carolina Administrative Code.</td>
<td>5.2</td>
</tr>
<tr>
<td>3</td>
<td>A description of any plans for beneficial use of the coal combustion residuals in compliance with the requirements of Section .1700 of Subchapter B of Chapter 13 of Title 15A of the North Carolina Administrative Code (Requirements for Beneficial Use of Coal Combustion By-Products) and Section .1205 of Subchapter T of Chapter 2 of Title 15A of the North Carolina Administrative Code (Coal Combustion Products Management).</td>
<td>6.1</td>
</tr>
<tr>
<td>4</td>
<td>A description of the groundwater trend analysis methods used to demonstrate compliance with groundwater quality standards for the substance established by Subchapter L of Chapter 2 of Title 15A of the North Carolina Administrative Code.</td>
<td>7.1, 7.2</td>
</tr>
<tr>
<td>5</td>
<td>A description of the construction quality assurance and quality control program to be implemented in conjunction with the Closure Plan, including the responsibilities and authorities for monitoring and testing activities, sampling strategies, and reporting requirements.</td>
<td>7.3</td>
</tr>
<tr>
<td>6</td>
<td>A description of the provisions for disposal of wastewater and management of stormwater and the plan for obtaining all required permits.</td>
<td>8</td>
</tr>
<tr>
<td>7</td>
<td>A list of all permits that will need to be acquired or modified to complete closure activities.</td>
<td>9</td>
</tr>
<tr>
<td>8-10</td>
<td>A description of the plan for post-closure monitoring and care for an impoundment for a minimum of 30 years. The length of the post-closure care period may be (i) proposed to be decreased or the frequency and parameter list modified if the owner demonstrates that the reduced period or modifications are sufficient to protect public health, safety, and welfare; the environment; and natural resources and (ii) increased by the Department at the end of the post-closure monitoring and care period if there are statistically significant increasing groundwater quality trends or if contaminant concentrations have not decreased to a level protective of public health, safety, and welfare; the environment; and natural resources. If the owner determines that the post-closure care monitoring and care period is no longer needed and the Department agrees, the owner shall provide a certification, signed and sealed by a professional engineer, verifying that post-closure monitoring and care has been completed in accordance with the post-closure plan. If required by Chapter 89C of the General Statutes, the proposed plan for post-closure monitoring and care should be signed and sealed by a professional engineer. The plan shall include, at a minimum, all of the following:</td>
<td>11</td>
</tr>
</tbody>
</table>

- **A demonstration of the long-term control of all leachate, affected groundwater, and stormwater.**
- **An estimate of the milestone dates for all activities related to closure and post-closure.**
- **Projected costs of assessment, corrective action, closure, and post-closure care for each coal combustion residuals surface impoundment.**
- **A description of the anticipated future use of the site and the necessity for the implementation of institutional controls following closure, including property use restrictions, and requirements for recordation of notices documenting the presence of contamination, if applicable, or historical site use.**

Table 2-1: NC CAMA Closure Plan Requirements (continued)  
Summary and Cross Reference Table  
Duke Energy, Belews Creek Steam Station

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Corresponding Closure Plan Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>A description of the provisions for the final disposition of the coal combustion residuals. If the coal combustion residuals are to be removed, the owner must identify (i) the location and permit number for the coal combustion residuals landfill, industrial landfill, or municipal solid waste landfill in which the coal combustion residuals will be disposed and (ii) in the case where the coal combustion residuals are planned for beneficial use, the location and manner in which the residuals will be temporarily stored. If the coal combustion residuals are to be left in the impoundment, the owner must (i) in the case of closure pursuant to sub-subdivision (a)(1)a. of this section, provide a description of how the ash will be stabilized prior to completion of closure in accordance with closure and post-closure requirements established by Section .1627 of Subchapter B of Chapter 13 of Title 15A of the North Carolina Administrative Code and (ii) in the case of closure pursuant to sub-subdivision (a)(1)b. of this section, provide a description of how the ash will be stabilized pre- and post-closure. A description of the plan for post-closure monitoring and care for an impoundment for a minimum of 30 years. The length of the post-closure care period may be (i) proposed to be decreased or the frequency and parameter list modified if the owner demonstrates that the reduced period or modifications are sufficient to protect public health, safety, and welfare; the environment; and natural resources and (ii) increased by the Department at the end of the post-closure monitoring and care period if there are statistically significant increasing groundwater quality trends or if contaminant concentrations have not decreased to a level protective of public health, safety, and welfare; the environment; and natural resources. If the owner determines that the post-closure care monitoring and care period is no longer needed and the Department agrees, the owner shall provide a certification, signed and sealed by a professional engineer, verifying that post-closure monitoring and care has been completed in accordance with the post-closure plan. If required by Chapter 89C of the General Statutes, the proposed plan for post-closure monitoring and care should be signed and sealed by a professional engineer. The plan shall include, at a minimum, all of the following:</td>
<td>9</td>
</tr>
</tbody>
</table>

- **A demonstration of the long-term control of all leachate, affected groundwater, and stormwater.**
- **An estimate of the milestone dates for all activities related to closure and post-closure.**
- **Projected costs of assessment, corrective action, closure, and post-closure care for each coal combustion residuals surface impoundment.**
- **A description of the anticipated future use of the site and the necessity for the implementation of institutional controls following closure, including property use restrictions, and requirements for recordation of notices documenting the presence of contamination, if applicable, or historical site use.**

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Corresponding Closure Plan Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>A demonstration of the long-term control of all leachate, affected groundwater, and stormwater.</td>
<td>11.1</td>
</tr>
<tr>
<td>2</td>
<td>A description of a groundwater monitoring program that includes (i) post-closure groundwater monitoring, including parameters to be sampled and sampling schedules; (ii) any additional monitoring well installations, including a map with the proposed locations and well construction details; and (iii) the actions proposed to mitigate statistically significant increasing groundwater quality trends.</td>
<td>11.2</td>
</tr>
<tr>
<td>3</td>
<td>An estimate of the milestone dates for all activities related to closure and post-closure.</td>
<td>12.1, 12.2</td>
</tr>
<tr>
<td>4</td>
<td>Projected costs of assessment, corrective action, closure, and post-closure care for each coal combustion residuals surface impoundment.</td>
<td>12.3</td>
</tr>
<tr>
<td>5</td>
<td>A description of the anticipated future use of the site and the necessity for the implementation of institutional controls following closure, including property use restrictions, and requirements for recordation of notices documenting the presence of contamination, if applicable, or historical site use.</td>
<td>6.2</td>
</tr>
</tbody>
</table>

§ 130A-309.214(b)(1)(i) No later than 60 days after receipt of a proposed Closure Plan, the Department shall conduct a public meeting in the county or counties proposed Closure Plan and alternatives to the public.
Table 4-1: Summary of Typical Material Properties

<table>
<thead>
<tr>
<th>Properties</th>
<th>CCR/Ash within Ash Basin ¹</th>
<th>Foundation Soil (Residual) below Ash Basin ¹</th>
<th>Embankment Soil ²</th>
<th>Drainage Blanket ²</th>
<th>Foundation Soil (Residual) below Embankment Dams</th>
<th>Partially Weathered Rock (PWR) ³</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil Type</td>
<td>Silty Sand (SM) - Predominantly Bottom Ash, Silt/Sandy Silt (ML) Predominantly Fly Ash</td>
<td>Silty Sand (SM) or Sandy Silt (ML)</td>
<td>Silty Sand (SM), Sandy Silt (ML), Silty Clay (CL), and Clayey Silt (MH)</td>
<td>Silty Sand (SP and SM)</td>
<td>Silty Sand (SM) and Sandy Silt (ML)</td>
<td>Breaks down to Sandy Silt and Silty Sand with rock fragments</td>
</tr>
<tr>
<td>Color</td>
<td>Gray to Dark Gray</td>
<td>Brown, Orange, and Red</td>
<td>Brown, Orange, Red, Tan</td>
<td>Brown, Tan, Gray</td>
<td>Brown, Gray, Tan, White</td>
<td>---</td>
</tr>
<tr>
<td>Plasticity</td>
<td>Predominantly Non Plastic</td>
<td>Predominantly Non Plastic</td>
<td>Slightly Plastic</td>
<td>Non Plastic</td>
<td>Non plastic to Slightly Plastic</td>
<td>---</td>
</tr>
<tr>
<td>Natural Moisture Content (%)</td>
<td>23% - 48%</td>
<td>36%</td>
<td>15% - 49%</td>
<td>30%</td>
<td>15% - 22%</td>
<td>16% - 19%</td>
</tr>
<tr>
<td>Fines Content</td>
<td>21% - 99%</td>
<td>71%</td>
<td>28% - 74%</td>
<td>45%</td>
<td>44% - 65%</td>
<td>13% - 28%</td>
</tr>
<tr>
<td>Clay Content</td>
<td>14% - 23%</td>
<td>17%</td>
<td>24%*</td>
<td>18%</td>
<td>11% - 25</td>
<td>10 - 20</td>
</tr>
<tr>
<td>Specific Gravity</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>8 - 10**</td>
<td>&gt; 50/6&quot;</td>
</tr>
<tr>
<td>Moist Unit Weight - ( \gamma_m ) (pcf)</td>
<td>101 - 115 pcf</td>
<td>108</td>
<td>110 - 124 pcf</td>
<td>116</td>
<td>116 - 126 pcf</td>
<td>123 - 125 pcf</td>
</tr>
<tr>
<td>Moist Unit Weight - ( \gamma_d ) (pcf)</td>
<td>71 - 88 pcf</td>
<td>80</td>
<td>79 - 106 pcf</td>
<td>88</td>
<td>96 - 107 pcf</td>
<td>105 - 106 pcf</td>
</tr>
<tr>
<td>Speciﬁc Gravity</td>
<td>2.2 - 2.4</td>
<td>2.3</td>
<td>2.6 - 2.8</td>
<td>2.7</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Horizontal Hydraulic Conductivity (cm/sec)</td>
<td>3.3E-04 - 4.2E-03</td>
<td>1.0E-03</td>
<td>3.6E-03 - 4.7E-06</td>
<td>1.9E-04</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Vertical Hydraulic Conductivity (cm/sec)</td>
<td>6.1E-04 - 1.4E-05</td>
<td>7.6E-05</td>
<td>7.5E-05 - 1.4E-06</td>
<td>1.2E-05</td>
<td>3.4E-5 - 5.4E-7</td>
<td>5.10E-07</td>
</tr>
</tbody>
</table>

Notes:
- Outlier values are not included in the table above. Please refer to lab data summary sheet presented in Appendix C for all available values
- WOR: Weight of Rod
- bpf: Blows per foot
- *Only one lab test data available
- ** Below 670 Berm

¹ Data obtained from lab tests performed on material obtained from within the Ash Basin for the Closure Options/Plan study by AECOM and Groundwater Assessment Study by HDR, both in 2015.

² Data obtained from lab tests performed on material obtained from Active Ash Basin Main Dam and Pine Hall Road Embankment Dam presented in Phase 2 Report (AECOM, 2016) and Subsurface Exploration and Embankment Stability Analyses report (S&ME, 2010).

Additional site subsurface investigation and laboratory tests were conducted for the ash basin areas with open water in 2018 by AECOM. Moisture content values for ash measured were 39.9%, 44.0%, 42.0%, 36.9%, 47.2%, 32.8%, and 60.4%. Specific gravity 2.29. Fine content 93% and 91%. Clay content 6.5% and 6%. Non plastic. One 1D consolidation test was also conducted. Blow count WOR.
<table>
<thead>
<tr>
<th>General Permit Name or Subject</th>
<th>Regulating Agency</th>
<th>Existing Permit No. (if applicable)</th>
<th>Permit/Approval Type of Regulatory Approval Mechanism or Not Required</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Quality</td>
<td>NCDEQ</td>
<td>01983</td>
<td>Permit modification likely</td>
<td>Permit modification likely due to the increased heavy equipment vehicle traffic and potential dust generated during closure activities.</td>
</tr>
<tr>
<td>Building Permit</td>
<td>Stokes County</td>
<td>New Permit</td>
<td>A local building permit is required for installation of construction trailers.</td>
<td></td>
</tr>
<tr>
<td>CAMA Monitoring Plan</td>
<td>NCDEQ</td>
<td>Written NCDEQ DWR approval</td>
<td>Modification or abandonment of CAMA program monitoring wells require the approval of the Division of Water Resources (DWR).</td>
<td></td>
</tr>
<tr>
<td>CCR Impoundment Closure</td>
<td>US EPA</td>
<td>Self-Regulating</td>
<td>Required postings to Public Record.</td>
<td></td>
</tr>
<tr>
<td>CCR Impoundment Monitoring Network</td>
<td>US EPA</td>
<td>Self-Regulating</td>
<td>Maintain CCR GW monitoring network and requirements as stated in 257.90 - 257.98.</td>
<td></td>
</tr>
<tr>
<td>Clean Water Act 401</td>
<td>USACE</td>
<td>USACE DWR 401 Water Quality Permitting Section</td>
<td>It is anticipated that an individual permit will be required in relation to dam breaching and associated downstream impacts.</td>
<td></td>
</tr>
<tr>
<td>Clean Water Act 404</td>
<td>NCDEQ</td>
<td>STOKE-116 Certificate of Approval to Modify</td>
<td>It is anticipated that an individual permit will be required in relation to dam breaching and associated downstream impacts.</td>
<td></td>
</tr>
<tr>
<td>Cutting Trees</td>
<td>Applicable and to be covered as part of other permits</td>
<td>Permitting is required to modify or abandon wells and instrumentation on regulatory dams through the Division of Energy, Mineral, and Land Resources (DEMLR).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dam Safety</td>
<td>NCDEQ STOKE-116 Certificate of Approval to Modify</td>
<td>Ash Basin Dam - Permitting is required to modify the dam in accordance with the Dam Safety Law of 1967, 15A NCAC 02K.0201 (b)(2); an application must be filed with the Division of Energy, Mineral, and Land Resources (DEMLR).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dam Safety</td>
<td>NCDEQ STOKE-116 Certificate of Approval to Modify</td>
<td>Ash Basin Dam - Permitting is required to remove the dam in accordance with the Dam Safety Law of 1967, 15A NCAC 02K.0201 (b)(2); an application must be filed with the Division of Energy, Mineral, and Land Resources (DEMLR).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dam Safety</td>
<td>NCDEQ STOKE-116 Certificate of Approval to Modify</td>
<td>Pine Hall Road Embankment Dam - Permitting is required to remove the dam in accordance with the Dam Safety Law of 1967, 15A NCAC 02K.0201 (b)(2); an application must be filed with the Division of Energy, Mineral, and Land Resources (DEMLR).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DOT - General</td>
<td>Not anticipated at this time</td>
<td>Utilization of or modification to state or federal highways to transport CCR will require consultation or notification to relevant DOT agency.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Driveway Permit</td>
<td>NCDOT</td>
<td>Potential</td>
<td>Temporary access or driveway permits as needed.</td>
<td></td>
</tr>
<tr>
<td>Erosion and Sediment Control (E&amp;SC)</td>
<td>NCDEQ and Stokes County</td>
<td>New Permit</td>
<td>Land disturbance activities outside of the ash basin will exceed one acre, therefore in conformance with 15A NCAC 04, an E&amp;SC Permit is required from Land Quality prior to commencement of construction in those areas. Note that land disturbance includes tree clearing and grubbing and vehicular wheel or tracking as disturbance.</td>
<td></td>
</tr>
<tr>
<td>Fire Ants</td>
<td>Restriction not likely</td>
<td>The Stokes County Zoning Ordinance, Section 93 Floodplain District, establishes the use of the FEMA NFIP maps as the designated maps for purposes of development permits required for construction within the Floodplain District. Changes in the hydrologic and hydraulic parameters within the drainage divide as a result of the Ash Basin closure will result in changes to the designated Special Flood Hazard Areas delineated on the NFIP Map Panel 6982, requiring C-LOMR and LOMR.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Floodplain Development</td>
<td>Stokes County</td>
<td>New Permit</td>
<td>Removal from or import of material could be restricted dependent on the potential for fire ants and geographic regions involved.</td>
<td></td>
</tr>
<tr>
<td>Permit Type</td>
<td>Agency</td>
<td>Permit Type/Link</td>
<td>Notes</td>
<td></td>
</tr>
<tr>
<td>----------------------------------------------------------------------------</td>
<td>----------------</td>
<td>-----------------------------------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Large Capacity Water Supply Well</td>
<td>NCDEQ</td>
<td>New Permit possible</td>
<td>Permits are required to construct any water supply well or water well system with a design capacity equal to or greater than 100,00 gallons per day - for dewatering outside of the ash basin</td>
<td></td>
</tr>
<tr>
<td>Multi-State Agreement</td>
<td></td>
<td>Not required</td>
<td>If movement of CCR will cross state lines, multi-state regulations might apply</td>
<td></td>
</tr>
<tr>
<td>NPDES (National Pollution Discharge Elimination System) Industrial Stormwater</td>
<td>NCDEQ</td>
<td>Permit modification likely</td>
<td>Modification of NPDES may be necessary if new source or outfall is created.</td>
<td></td>
</tr>
<tr>
<td>NPDES (National Pollution Discharge Elimination System) Stormwater</td>
<td>NCDEQ</td>
<td>Permit revision likely</td>
<td>Revision to existing sitewide permit or new permit may be required for access roads, staging areas, etc.</td>
<td></td>
</tr>
<tr>
<td>NPDES (National Pollution Discharge Elimination System)</td>
<td>NCDEQ</td>
<td>New Permit possible</td>
<td>Permit required for temporary and permanent stormwater rerouting.</td>
<td></td>
</tr>
<tr>
<td>Noxious Weeds</td>
<td></td>
<td>Not anticipated at this time</td>
<td>Removal from or import of vegetated material could be restricted dependent on the vegetation and geographic regions involved</td>
<td></td>
</tr>
<tr>
<td>Railroad Easement, Access, or Crossing Permit</td>
<td></td>
<td>Not anticipated at this time</td>
<td>Construction activities adjacent to tracks/ballast or a new railroad crossing require an agreement or permit</td>
<td></td>
</tr>
<tr>
<td>SPCC (Spill Prevention Control and Countermeasure) Plan</td>
<td>EPA</td>
<td>Modification of existing plan</td>
<td>In accordance with the Federal Water Pollution Control Act (Clean Water Act) of 1974, Title 40, Code of Federal Regulations, Part 112.</td>
<td></td>
</tr>
<tr>
<td>Threatened or Endangered Species: Candidate Conservation Agreement</td>
<td>NCDEQ and EPA</td>
<td>It will be done as part of 401/404 process</td>
<td>Federal and/or state regulations may apply including agency consultation and performing site-specific surveys within the proper survey period (e.g., flowering period for listed plant) to determine if Threatened or Endangered Species or their habitat exist within the limits of disturbance</td>
<td></td>
</tr>
<tr>
<td>Solid Waste Site Suitability</td>
<td>NCDEQ</td>
<td>Approval by Letter</td>
<td>New CCR Landfill</td>
<td></td>
</tr>
<tr>
<td>Solid Waste Permit to Construct</td>
<td>NCDEQ</td>
<td>Permit</td>
<td>New CCR Landfill</td>
<td></td>
</tr>
<tr>
<td>Solid Waste Permit to Operate</td>
<td>NCDEQ</td>
<td>Permit</td>
<td>New CCR Landfill</td>
<td></td>
</tr>
<tr>
<td>County Approval - zoning</td>
<td>Stokes County</td>
<td>Permit</td>
<td>New CCR Landfill</td>
<td></td>
</tr>
</tbody>
</table>
FIGURES
1. AERIAL PHOTOGRAPH WAS OBTAINED FROM AUTODESK AND MICROSOFT BING DATED 2018.

2. PROPERTY BOUNDARY AND NDPES OUTFALL LOCATION PRESENTED IN THIS DRAWING ARE TAKEN FROM "COMPREHENSIVE SITE ASSESSMENT REPORT - BELEWS CREEK STEAM STATION ASH BASIN" PREPARED BY HDR FOR DUKE ENERGY AND SUBMITTED TO NCDEQ (NPDES PERMIT NO. NC0024406) ON SEPTEMBER 9, 2015.

3. CCR UNIT BOUNDARY LOCATION PRESENTED IN THIS DRAWING WAS PROVIDED BY SYNTERRA, SEPTEMBER 2018.

REFERENCE

FIGURE 1-1 VICINITY MAP AND SITE PLAN

BELEWS CREEK STEAM STATION
STOKES COUNTY, NORTH CAROLINA

ISSUED FOR REVIEW

FIGURE 1-1.DWG

FILENAME: FIGURE 1-1.DWG
FILENAME: FIGURE 1-1.DWG

DWG SIZE: 22.0"x34.0"
DWG TYPE: ANSI D

REVISION FOR DRAWING NO.
FILENAME:
FILENAME:

TITLE: BELEWS CREEK STEAM STATION
FILENAME: FIGURE 1-1.DWG
FILENAME: FIGURE 1-1.DWG

N.C. ENGINEERING LICENSE NO. F-0342

AECOM
DUKE ENERGY

ENGR:
APPD:

SD/KO:

09-18-2019

60603274

FIGURE 1-1
APPENDICES
APPENDIX A

ESTIMATED VOLUME OF CCR IN IMPOUNDMENT
APPENDIX B

GEOTECHNICAL DATA AND PROPERTIES
APPENDIX C

ENGINEERING EVALUATIONS AND ANALYSES
APPENDIX C1

STORMWATER
APPENDIX C2

SOIL QUANTITIES
APPENDIX D

CLOSURE PLAN DRAWINGS
APPENDIX E

EXCAVATION AND SAMPLING PLAN FOR CLOSURE-BY-EXCAVATION AREAS