DUKE ENERGY
MAYO STEAM ELECTRIC PLANT
COAL COMBUSTION RESIDUALS SURFACE IMPOUNDMENT CLOSURE PLAN

CLOSURE BY EXCAVATION

CCR BASIN

Prepared for

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TABLE OF CONTENTS

Tables

Figures

Appendices

EXECUTIVE SUMMARY

Duke Energy has prepared this Closure Plan to describe the closure of the coal combustion residuals (CCR) surface impoundments at the Mayo Steam Electric Plant (Mayo Plant). This plan details closure by excavation of the Mayo Plant Ash Basin (Basin) and flue gas desulfurization FGD Ponds (collectively, Basins) and placement of the excavated CCR in a new permitted, on-site, lined CCR landfill. The excavation of CCR and the closure of the basins will be in accordance with applicable provisions of the North Carolina Coal Ash Management Act of 2014, as amended (CAMA), (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 Mayo Plant is owned and operated by Duke Energy Progress (Duke Energy) in Person County, approximately 10 miles northeast of Roxboro, North Carolina. The Mayo Plant is a single-unit, 727-megawatt coal-fired plant located less than one-half mile south of the North Carolina-Virginia state line. It began commercial operation in 1983 with a single coal-fired unit, and the plant is currently in active operation.

Duke Energy has historically operated a single impoundment for storing wet sluiced coal ash referred to as the Basin at the Mayo Plant. The Basin was constructed during the early 1980s and was completed in 1982. The Basin was constructed above a section of Crutchfield Branch, which is part of the Roanoke River Basin. Based on the CCR unit boundary, the Mayo Plant Basin has a surface area of approximately 153 acres (including the Basin Dam). Based on topographic and bathymetric surveys performed in 2015 and updated with production data provided by Duke Energy as of July 31, 2019, the Basin is estimated to contain approximately 5.5 million cubic yards of CCR or an estimated 6.6 million tons as of June 2019. Two additional basins for storage of wet sluiced FGD process residuals (also CCR) were constructed in 2009 and collectively have a surface area of approximately 5 acres. These FGD Ponds are perched at the eastern edge of the Basin. Process flows of CCR waste streams have ceased for all 3 basins and decanting operations have been initiated to remove bulk water.

Closure activities for the Basin has already begun with the initiation of decanting under the Special Order by Consent (SOC). Upon approval of a 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 on-site in conjunction with excavation of the CCR, final grading of the site and landfill, and development of stormwater features and vegetative covers.

Figures ES-1 and ES-2 illustrate the current state, and post-closure state of the Basins as detailed by this Closure Plan.

Figure ES-1 Current View

Figure ES-2 Post Closure View

The Basin CCR would be removed to a new lined landfill within plant property, located partially within the prior footprint of the Basin, adjacent to Boston Road. The landfill would rise approximately 170 feet above Boston 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. A portion of the existing Basin dam will be removed, and detention basins constructed for stormwater management. Stormwater flows will then make their way into Crutchfield Branch.

This document also includes a description of the Post-Closure 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 Basins at the Mayo Plant.

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 stormwater run-off, and access for effective maintenance over the post-closure care period.

Mayo Plant is currently in compliance with North Carolina's regulations for the protection of groundwater at 15A NCAC 02L .0202 (02L Standards). Nevertheless, in accordance with the requirements of N.C.G.S. § 130A-309.211(b)(1), Duke Energy separately submitted an updated CAP in parallel with this Closure Plan, which CAP is herein incorporated in its entirety by this reference. Neither the CAP nor its content is the work product of AECOM. Although the Closure Plan contains references to the CAP, all specific relevant details to groundwater and related actions are found in the CAP itself and not in this Closure Plan.

As detailed in the updated CAP, groundwater quality data confirm, based on one year of quarterly monitoring results, that constituents of interest (COI) identified at the Mayo Plant do not exceed the applicable 02L Standards at or beyond the Basin compliance boundary. Accordingly, groundwater corrective action under 15A NCAC 02L.0106 is not triggered. However, Duke Energy has either implemented, or will implement, source control measures at the site, including (i) complete Basin decanting to remove the hydraulic head, thereby mitigating the risk of potential COI migration into groundwater; (ii) complete Basin closure; and (iii) continued operation of the dam toe-drain water collection system to reduce COI concentrations in surface water and in groundwater proximate to the system.

1. INTRODUCTION

1.1 Background

The primary objective of this Closure Plan is to address the closure of the Basin at the Mayo Plant which is a coal-fired electricity-generating facility owned and operated by Duke Energy Progress, LLC (Duke Energy). The Mayo Plant is located in Person County, approximately 10 miles northeast of Roxboro, North Carolina and is a single-unit, 727-megawatt coal-fired plant located less than one-half mile south of the North Carolina-Virginia line. It began commercial operation in 1983 with a single coal-fired unit, and the plant is currently in active operation. CCR has historically been managed in the Plant's on-site Basin and FGD Ponds. The Mayo Plant ceased all waste flows to the Basins in 2019.

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

Duke Energy uses three facilities to manage CCR at the Mayo Plant that include dams regulated by NCDEQ and Dam Safety:

1. The Basin Dam (NCDEQ ID: PERSO-035); and
2. The flue gas desulfurization (FGD) ponds containing the integrated FGD Settling Pond (NCDEQ ID: PERSO-036) and FGD Forward Flush Pond (NCDEQ ID: PERSO-037).

As further discussed in Section 2 below, the closure method mandated by order of the NCDEQ for the Basins 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 and FGD Ponds as directed by order of NCDEQ. AECOM understands Duke Energy does so without prejudice of its position that closure by excavation is neither necessary nor appropriate for either the Basin or FGD Ponds. Duke Energy also 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 Basins 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 discharges in compliance with the NPDES permit during closure;
- Dewatering to support safe excavation of CCR from the Basins;
- Excavation of the CCR and establishing post-excavation final grades using soil fill where required;
- Breaching of the Basin dam,
- Construction of an on-site CCR landfill to permanently store the excavated CCR,
- Modification of the Basin spillway/discharge channel; 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 14, 2018, and officially classified the Basin at Mayo Plant as "low-risk."

On April 1, 2019, NCDEQ issued its Closure Determination mandating that the Basins be closed by excavation of the Basins 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 report was submitted to NCDEQ in September 2015, with supplemental reports submitted August 2016 and October 2017. Duke Energy intends that a CAP will 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 dates certain) compliance, dam safety approvals for modifications to regulated Basin dams, and environmental permitting requirements must be considered as part of closure.

3. FACILITY DESCRIPTION AND EXISTING SITE FEATURES

3.1 Surface Impoundments Description

This section provides details on the CCR-related features at the Mayo Plant.

3.1.1 Site History and Operations

Figure 1-1 shows locations of the plant, the Basin, and the Basin Dam, and the FGD Ponds. Existing topography in the area of the Mayo Plant is presented on **Figure 3-1**, and also presents overall existing conditions including topography and bathymetry of the Basin.

Basin (Dam ID, PERSO-035):

The Basin is situated north of the plant area and its CCR boundary surface area approximately 153 acres (including the Basin Dam). The Basin is unlined, impounding a former valley area and operated at a normal pond elevation of El. 479.22. Basin Dam is approximately 2,300 ft in length, 400 ft wide at the base, with crest elevations of El. 489 ft, respectively. A survey conducted by AECOM in 2016 identified a maximum height above downstream toe of approximately 110 ft for the Basin Dam. The Basin was completed in October 1982. Based on the information available, the basin appears to have been originally constructed to its present configuration and has not been raised or expanded at any time subsequent to its original construction.

The Basin discharge flow is directed to the main cooling reservoir (Dam ID, PERSO-034) by a channel constructed at the northeast corner of the Basin. The Basin forebay embankment is used in the management of water quality and outflow monitoring efforts for the Basin. Three 24-inch diameter equalization pipes were constructed in the northeast corner of the forebay embankment in 2015. The pipes have upstream and downstream inverts of El. 477.23 ft and El. 477.03 ft, respectively. The original 48-inch corrugated metal pipe (CMP) riser and spillway pipe between the Basin and forebay embankment were grouted and abandoned in-place in December 2015.

There are two abandoned (grouted) 30-inch diameter CMP's through the forebay embankment located to the south of the riser. No pipes are known to be present that penetrate through the Basin dam structure. Toe drain collection piping was included in the original dam construction and extends along the length of downstream toe.

Normal flow passes through the equalizer culverts located in forebay embankment. The water level in the forebay area and the flow to the discharge channel are controlled by a submerged fixed concrete weir with a crest at approximate El. 478.6 ft. The submerged fixed weir is a reinforced concrete block that is keyed and doweled into the surrounding rock at the bottom and sides of the discharge channel. Higher flows from extreme rain events would pass over the forebay weir.

The Basin historically accepted bottom and fly ash generated from the Mayo Plant's coal combustion operations transported to the Basin via wet sluicing, along with various other waste water streams. Since Mayo Plant has been in operation, the Basin received fly ash, bottom ash, ash transport water, coal pile runoff, stormwater runoff, cooling tower blowdown, and low volume wastewater (Geosyntec, 2015). In 2013, the Plant converted from a wet to dry ash system. Modifications were completed in 2019 to re-direct waste and process flows and all such flows to the Basin have been ceased. In 2019, a project was also completed that re-directed a significant amount of stormwater from other parts of the plant site away from the Basin.

FGD Settling Pond (Dam ID, PERSO-036) and FGD Forward Flush Pond (Dam ID, PERSO-037):

The FGD Ponds (FGD Ponds) were completed in 2009. From 2009 until 2019, the Mayo Plant operated a FGD system that directed the FGD blowdown discharge to the FGD Settling Pond. Following processing, the wastewater discharge is routed into a Thermal Evaporator system.

Normal flows did not discharge into the Basin. An emergency discharge for the FGD settling pond discharges to the Basin (AMEC, 2015b). The FGD Ponds consist of perched soil dikes constructed in part over a portion of the Basin and in part over natural ground. The FGD Pond system has a combined and shared dam crest length of 2,145 ft and maximum dam height of 26 ft. Crest elevation is El. 506 ft and crest width is 15 ft. The FGD Settling Pond area is 4.36 acres and the Forward Flush Pond area is 0.56 acres. The portion of the dike that extends over the Basin was constructed by placing fill consisting of weathered rock and soil atop a geogrid layer. The Forward Flush Pond is mostly excavated into the natural ground bordering the Basin and partly on soil fill railroad embankment over natural ground. The FGD Ponds have a liner system consisting of a 200-mil double sided geocomposite overlain by a smooth flexible 60-mil HDPE membrane liner (FML) (Golder, 2009).

3.1.2 Estimated Volume of CCR in Impoundments

Based on CCR inventory data provided by Duke Energy as of July 31, 2019 and upon a surface comparison calculation, performed within AutoCAD Civil 3D, comparing the approximate pre-development topography to the existing topographic and bathymetric survey, the approximate volume of CCR in the Basins are 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 in Impoundment calculation.

Impoundment	Estimated CCR Volume (CY)	Estimated CCR Weight (Tons)
Basin*	5,500,000	6,600,000
FGD Settling Pond**	24,360	29,232
FGD Forward Flush Pond**	2,220	2,664
Total CCR Subject to Closure Plan	**5,526,580**	**6,631,896**

* The Basin boundary used to estimate in-place CCR includes the current FGD Settling and Flush Pond footprint and is based on the unit boundary as provided by Synterra, but excluded the dam area.

**Volumes provided by Duke Energy on November 5, 2019

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 Basins 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 the Basin Dam, and FGD Pond Dams, slope stability analysis results for the existing conditions global factors of safety for static long-term maximum storage pool, static maximum surcharge pool, sudden drawdown conditions, and pseudo-static seismic conditions meet regulatory and programmatic criteria. Slope stability results for the Basin Dam at four selected sections and forebay, and at the FGD Ponds under the loading conditions mentioned above met regulatory requirements (AECOM, 2016a).

- **Liquefaction conditions (where susceptible) and Liquefaction potential**

In 2016, AECOM performed a liquefaction screening analysis for the Basin Dam and the forebay embankment. Based on the screening analyses, the Basin Dam and its foundation soils, and the forebay discharge embankment and its foundation soils are not liquefaction-susceptible.

AECOM also evaluated seismically-induced deformations of the Basin Dam following the Makdisi and Seed (1977) procedure. The predicted deformations from these analyses are negligible, less than ½ inch. Because the Basin Dam and forebay embankments and foundation soils are not liquefaction-susceptible, AECOM expects no vertical seismically-induced settlements and negligible seismically-induced shear at these structures from the design event which is the event corresponding to a 2,500-year return period with a peak ground acceleration (PGA) of 0.053g and a mean earthquake moment magnitude of 5.1.

AECOM also conducted a liquefaction screening analysis and developed a probabilistic seismic hazard analysis (PSHA) for the Mayo Plant site. Liquefaction screening considered SPT-based, CPT-based, shear wave-based, and state parameter methods, and finite-element analyses utilizing ground motions from the PSHA. AECOM concluded that because the ground motions are relatively low for the 2,500 year design event, liquefaction triggering is unlikely and the 2,500 year MDE is unlikely to induce significant seismic deformation in the saturated ash below or adjacent to the FGD pond.

In 2016, AECOM performed an advanced liquefaction analysis for the FGD Ponds. Based on the advanced analysis, liquefaction triggering was calculated to be mainly in the area beyond the toe of the FGD Pond dams towards the Basin. Post liquefaction slope stability analysis was conducted for this condition and the calculated factor of safety met the regulatory requirements (AECOM, 2016c).

- **Hydrology and hydraulics (H&H) capacity analyses**

Hydrologic analysis performed by AECOM following the 2015 construction of equalization pipes between the Basin and outfall forebay show that the Basin can convey the Inflow Design Flood (IDF) event while maintaining adequate freeboard.

Per direction from NCDEQ, additional hydrologic modeling was conducted to evaluate whether the existing Basin and spillway system could convey the Spillway Design Flood (SDF) generated during the full Probable Maximum Precipitation (PMP) event without overtopping the dam. The PMP used for this analysis was developed and provided by Applied Weather Associates (AWA) in July 2019. The evaluation involved incorporation of updated drainage area characteristics, including upstream stormwater ponds under construction and other storage areas. The evaluation showed that the Basin and existing spillway system can convey the SDF generated during the full PMP without overtopping the dam.

Per direction from NCDEQ, additional hydrologic modeling was conducted to evaluate whether the FGD Ponds could convey the SDF generated during the full PMP without overtopping the dam. These analyses indicate that the dams will overtop during the full PMP unless the initial water surface elevation is maintained at or below 503.3 feet using active pumping which will need to be installed. However, the FGD Ponds are no longer in service since the water redirect project has been implemented (AECOM, 2019). As of October 18, 2019, the FGD Ponds were in a dewatered condition.

3.1.4 Sources of Discharges into Surface Impoundments

Process flows no longer discharge into the Basin or FGD Ponds. Process flows are directed toward newly-constructed lined retention basins and a new FGD settling pond. The Mayo Plant currently employs a dry ash handling system.

Historically runoff and process water streams from the coal pile, gypsum storage area, air preheater wash, cooling tower blowdown, and stormwater runoff from plant area were discharged into the Basin. All of these have been re-routed and no longer convey to the Basins.

3.1.5 Existing Liner System

The Mayo Plant Basin does not include a geomembrane or clay liner system and is considered to be unlined. The Basin was constructed directly on top of the historical ground surface. The FGD Ponds were completed in 2009 and are lined with a 200-mil double sided geocomposite overlain by a smooth flexible 60-mil HDPE membrane liner (FML) (Golder, 2009).

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

Daily inspections of basins are not routinely required, however, on a case-by-case basis, the basins 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 Basins are 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 CCR 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/dikes 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 Basins 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 Mayo Plant, Basins with their boundaries and topographic and bathymetric contours is 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 two landfills at the Mayo Plant site, as identified in the table below. **Figure 1-1** shows locations of these landfills.

Landfill	Permit Number	Comment
On-site Industrial Landfill	7305-INDUS-2012	Active
1981 C&D Landfill	73-B	Non-CCR, Closed

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 MAY_C999.003.005 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 Basins 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 Basins generally consist of CCR (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. Explorations in the FGD Ponds area encountered embankment fill underlain by CCR, residual soils, and PWR. The outlet forebay area exploration encountered embankment fill soils underlain by residual soils and PWR.

For 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 material properties of laboratory tests performed by AECOM, SynTerra, and Mactec for the subsurface explorations completed within the Basin is presented in **Table 4-1**. A summary of laboratory tests data performed at the Mayo Plant in support of the closure design is presented in **Appendix B-3**.

4.4.1 CCR Within the Basins

The CCR within the Basins consists primarily of alternating layers and mixtures of bottom ash and fly ash. Other CCR such as slag are also typically encountered. The bottom ash generally consists

of very loose to loose, moist to wet, dark gray to gray, silty sand (SM) or silt and sandy silt (ML). At some drilling locations, a surficial layer of CCR fill material (SP or SW or SW-SM) was encountered that was used for boring access road construction.

The fly ash generally consists of very soft to soft, moist to wet, light to medium gray sandy silt and silt (ML).

The CCR within the FGD Ponds consists primarily of FGD Blowdown (primary contributor of solids) and landfill leachate. When excavated, this material will be placed in an approved CCR landfill.

4.4.2 Liner Material Properties

The Basin is unlined so there are no associated material properties. The FGD Ponds have a liner system consisting of a 200-mil double sided geocomposite overlain by a smooth flexible 60-mil HDPE membrane liner (FML) (Golder, 2009).

4.4.3 Subsurface Soil Properties

- *Alluvium:* Alluvial soil was encountered beneath the sluiced CCR in one boring from about 43 to 48 ft. The alluvium soil consists of very loose, wet, light grayish green, sandy silt (ML). Alluvium was not encountered in other borings performed by AECOM within the Basins. SynTerra reported alluvial soils in some monitoring well boring locations of sandy clay (CL) and clayey sand (SC) to depths of about 7.5 ft.

- *Residuum*: The residuum (including saprolite) is the next layer encountered and generally consists of soft to hard sandy lean clay (CL), silty sand (SM), and sandy silt (ML).

- *Embankment Soil*: The embankment fill generally consists of medium dense silty sand (SM) and stiff to very stiff sandy silt (ML) with trace amounts of fine gravel and with occasional pockets and lenses of relatively clean sand (SP) and sandy clay (CL).

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

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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 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 CAP evaluates the extent of, and remedies for, COI in groundwater associated with the 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. In addition, the CAP considers the federal groundwater corrective action requirements at 40 C.F.R. §§ 257.96-.98.

As detailed in the CAP, groundwater quality data confirm, based on one year of quarterly monitoring results, that COI identified at the Mayo Plant do not exceed the applicable 02L Standards at or beyond the Basin compliance boundary. Accordingly, groundwater corrective action under 15A NCAC 02L.0106 is not triggered. However, Duke Energy has either implemented, or will implement, source control measures at the site, including (i) complete Basin decanting to remove the hydraulic head, thereby mitigating the risk of potential COI migration into groundwater; (ii) complete Basin closure; and (iii) continued operation of the dam toe-drain water collection system to reduce COI concentrations in surface water and in groundwater proximate to the system.

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 USE AND FUTURE USE

6.1 CCR Use

At this time, Duke Energy has not identified a beneficial use of CCR from the Basins at Mayo Plant.

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 Basins, except that a new CCR landfill is proposed to be partially built within the western footprint of the excavated Basin.

7. CLOSURE DESIGN DOCUMENTS

7.1 Engineering Evaluations and Analyses

Engineering evaluations and analyses to support closure of the Basins at the Mayo Plant, as detailed in this Closure Plan, are provided in **Appendix C**.

The FGD Ponds, including the liner material, will be fully removed down to grade. Based on the final post closure configuration of the Basin and absence of engineered fill features, no geotechnical calculations accompany the Closure Plan presented herein. 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 breach-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 Basins 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 (drying) 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:

- Lower free water level through the equalization pipes in the discharge forebay outlet under the existing NPDES permit.
- Decant by using floating pumps, screened intakes, and pumping through the discharge forebay outlet.
- Construction and operation of a temporary WMS to manage all discharges in compliance with the NPDES permit during closure.
- Dewater the CCR to allow for access. Excavate CCR and condition (drying) prior to placement in the on-site landfill.
- Start CCR excavation from the Basin, with sequencing determined for optimal progression. Manage and control of dust-generating activities through specific site planning and mitigation. 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 Design Drawings

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

- Cover sheet
- General notes
- Existing conditions plan with aerial photograph
- Existing conditions plan with topography
- Exploration location plan
- Demolition plan
- Estimated bottom of CCR contour plan

- Final grading plan
- Final grading profiles, cross-sections and details
- Excavation plan
- Excavation profiles and details
- On-site landfill schematic plans
- 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 following NCDEQ approval of the Closure Plan. In addition, supplemental drawing sets will be prepared on an as needed basis to support dam modification and/or decommissioning permits, erosion and sediment control permits, NPDES permit modifications, and other related permits.

Once the excavation grades shown on the Closure Plan drawings have been 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 and Plan

A Construction Quality Assurance (CQA) Plan will be developed following NCDEQ approval of the Closure Plan for closure of the Basins at Mayo Plant. The CQA Plan will be prepared to address G.S. §130A-309.214(a)(4)(g). Its purpose is to provide a description of the CQA program to be adhered to in execution of closure activities. 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 will present specific material properties and specifications.

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

- Earthwork
  - CCR Excavation
  - Soil Fill
- HDPE Piping
- As-Built Conditions
- Record Documentation Report

8. MANAGEMENT OF WASTEWATER AND STORMWATER

The Mayo Plant manages wastewater and stormwater under two separate the NPDES permits issued by the NCDEQ that authorizes two discharge points into the Mayo Lake Reservoir. The wastewater permit number is NC0038377 and the stormwater permit number is NCS000580.

The Basin discharge will continue to operate during closure to meet the NPDES permit discharge requirements as it goes through the phases of decanting and dewatering. 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 it through the treatment system if necessary, and discharge the water 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 currently has the capacity to contain the PMP storm event by maintaining the water surface level elevation at or below El. 486.4 ft, which provides a minimum freeboard of 2.6 ft. As part of the closure, the Basin Dam will be removed by excavating an engineered breach in the east portion. Under this post closure condition, there will be increased flow downstream of the Basin Dam compared to the existing conditions. Crutchfield Branch, located downstream of the dam, crosses the Mayo Lake Road via culvert and continues into Virginia. 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 breach of the Basin Dam using detention basins as described further below. The concept designs for these proposed basins were based on limiting post-closure downstream stormwater from the 100-year storm event flows to less than or equal to existing stormwater flows.

Dewatering is performed to remove the interstitial or pore water from the CCR to facilitate excavation, to access in-place CCR and 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.

Wastewater from the Basins will be pumped, treated as needed and discharged in two phases; the decanting phase and dewatering phase. In the decanting phase, free water above the settled CCR layer will be removed from the Basin without the mechanical disturbance of the CCR. The Mayo Plant WMS includes equipment that has a designed flow rate of 1,500 gpm. Following the decanting phase and as the Closure schedule dictates, the Mayo Plant site 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 designed flow rate may drop to 400-500 gpm.

The post-closure grades restore the historical flows from the surrounding landscape and route that flow toward the detention basins. The detention basins will be designed with a culvert to restrict releases under a large rain event that will result in a slower discharge release to Crutchfield Branch but with minimal retained pooling. Up to and including the last phase of closure before the

Basin Dam is breached, the Basin will maintain the capacity to contain the required storm size/flows.

The detention basin design criteria will be further refined for the construction-level documents based on actual field elevations reached in the excavated areas and discussions with NCDEQ with regards to the embankment heights, which will follow NCDEQ approval of this Closure Plan. The designs for the detention basins are limited to conceptual level at this time. These concept designs for the detention basin are based conservatively on 100 year storms. **Appendix C1** presents the results of the post-closure stormwater management calculations. Detail stormwater design for the proposed CCR on-site landfill will be developed as part of its permit design and not covered herein.

8.1 Anticipated Changes in Wastewater and Stormwater Management

Closure of the Basin has necessitated changes in the management of a number of wastewater and process streams. Wastewater and process streams previously discharging to the Basin have been rerouted to new lined retention basins as separate treatment systems.

A temporary WMS will be utilized such that the existing NPDES Outfall 002 effluent discharge limits will be met throughout the duration of decanting/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 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 dispositioned by placement into an approved and permitted lined CCR landfill. Duke Energy intends to construct a new on-site Landfill to accept CCR in completion of the NCDEQ-mandated closure by excavation. 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

Refer to **Table 10-1** for detailed information on the potential and applicable permitting/approval needed to implement this 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 Basins. 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 Basins at the Mayo Plant.

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 Mayo Plant 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;
- Regular inspection and maintenance of the final cover system;
- 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	Ongoing
Submit plan and design for landfill construction permit	Q4-2020
Start new landfill construction	Q4-2021
Start CCR excavation	Q1-2023
Complete CCR excavation	Q4-2028
Complete final closure and cover system of new landfill	Q4-2029
Site final grading and vegetative cover	Q4-2030

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 Basins at Mayo Plant 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 $249 million.

The cost to perform the 30 year post-closure activities and monitoring is estimated as $95 million.

The cost estimates provided 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

AECOM (2016a). Technical Memorandum-Issues MAY-119 & 122-REV01, Ash Basin Forebay Borings and Slope Stability Analyses, Mayo Plant, Person County, NC. May 17, 2016.

AECOM (2016c). MAY-502, Fluidized Gas and Desulfurization (FGD) Ponds, Site-Specific Seismic Analysis, Duke Energy, Person County, North Carolina, Mayo Plant. June 24, 2016.

AECOM (2019). Report for Full Probable Maximum Flood Elevation, FGD Forward Flush and the FGD Settling Ponds, Mayo Plant, Person County, NC. June 10, 2019.

AMEC (2015b). Mayo Steam Station Water Balance Model Report, September 11, 2015.

Geosyntec (2015). Settling Features Feasibility Study Report, Mayo Steam Electric Station, June 8, 2015.

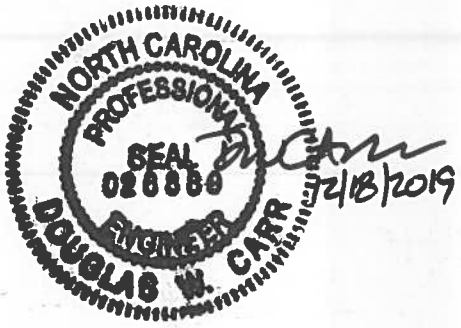
Golder (2009). Construction Certification Report, Progress Energy Mayo Facility, FGD Waste Pond. June 29, 2009.

PROFESSIONAL ENGINEER CERTIFICATION

I, Douglas Wilson Carr, 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 2-1: NC CAMA Closure Plan Requirements
Summary and Cross Reference Table
Duke Energy, Mayo Steam Electric Plant

No.	Description	Corresponding Closure Plan Section
Part II. Provisions for Comprehensive Management of Coal Combustion Residuals		
§ 130A-309.214(a)(4) Closure Plans for all impoundments shall include all of the following:		
a. Facility and coal combustion residuals surface impoundment description. – A description of the operation of the site that shall include, at a minimum, all of the following:		
1	Site history and history of site operations, including details on the manner in which coal combustion residuals have been stored and disposed of historically.	3.1.1
2	Estimated volume of material contained in the impoundment.	3.1.2
3	Analysis of the structural integrity of dikes or dams associated with impoundment.	3.1.3
4	All sources of discharge into the impoundment, including volume and characteristics of each discharge.	3.1.4
5	Whether the impoundment is lined, and, if so, the composition thereof.	7.1
6	A summary of all information available concerning the impoundment as a result of inspections and monitoring conducted pursuant to this Part and otherwise available.	3.1.6
b. Site maps, which, at a minimum, illustrate all of the following:		
1	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.	3.2.1
2	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.	3.3
3	The property boundary for the applicable site, including established compliance boundaries within the site.	3.3
4	All potential receptors within 2,640 feet from established compliance boundaries.	3.2.2
5	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.	3.3
6	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.	3.2.3
7	All existing and proposed groundwater monitoring wells associated with any coal combustion residuals surface impoundment on the site.	3.3
8	All existing and proposed surface water sample collection locations associated with any coal combustion residuals surface impoundment on the site.	3.3
c. The results of a hydrogeologic, geologic, and geotechnical investigation of the site, including, at a minimum, all of the following:		
1	A description of the hydrogeology and geology of the site.	4.1
2	A description of the stratigraphy of the geologic units underlying each coal combustion residuals surface impoundment located on the site.	4.2
3	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.	4.3
4	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.	4.4
5	A chemical analysis of the coal combustion residuals surface impoundment, including water, coal combustion residuals, and coal combustion residuals-affected soil.	4.5
6	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.	4.6
7	Summary tables of historical records of groundwater sampling results.	4.6
8	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.	4.7
9	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.	4.8

Table 2-1: NC CAMA Closure Plan Requirements
Summary and Cross Reference Table
Duke Energy, Mayo Steam Electric Plant

No.	Description	Corresponding Closure Plan Section
d.	**The results of groundwater modeling of the site that shall include, at a minimum, all of the following:**	
1	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.	5.1
2	Predictions that include the effects on the groundwater chemistry and should describe migration, concentration, mobilization, and fate 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 pre- and post-closure, including the effects on and from potential receptors.	5.2
3	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.	5.3
e.	**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).**	6.1
f.	**All engineering drawings, schematics, and specifications for the proposed Closure Plan. If required by Chapter 89C of the General Statutes, engineering design documents should be prepared, signed, and sealed by a professional engineer.**	7.1, 7.2
g.	**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.**	7.3
h.	**A description of the provisions for disposal of wastewater and management of stormwater and the plan for obtaining all required permits.**	8
i.	**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 landfills, industrial landfills, or municipal solid waste landfills 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. If the coal combustion residuals are to be left in the impoundment, the owner must provide an estimate of the volume of coal combustion residuals remaining.**	9
j.	**A list of all permits that will need to be acquired or modified to complete closure activities.**	10
k.	**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:**	11
1	A demonstration of the long-term control of all leachate, affected groundwater, and stormwater.	11.1
2	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.	11.2
l.	**An estimate of the milestone dates for all activities related to closure and post-closure.**	12.1
m.	**Projected costs of assessment, corrective action, closure, and post-closure care for each coal combustion residuals surface impoundment.**	12.2

Table 2-1: NC CAMA Closure Plan Requirements
Summary and Cross Reference Table
Duke Energy, Mayo Steam Electric Plant

No.	Description	Corresponding Closure Plan Section
n.	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.	6.2
§ 130A-309.214(b)(3) 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 Geotechnical Material Properties

Properties	*Within Ash Basin*			*Dam and outside Ash basin Area*	
	CCR/Ash	*Alluvium*	*Residuum*	*Embankment Fill*	*Residual Soil*
Soil Type	Silt (ML) and Sandy Silt (ML)	Sandy Silt (ML)*	Sandy Lean Clay (CL), Silty Sand (SM), and Sandy Silt (ML)	Silty Sand (SM) and Sandy Silt (ML)	Silt (ML), Sandy Silt (ML), and Sandy Clays (CL)
Color	Dark Gray to Gray	Light Grayish Green*	Light Brown, Red, Grayish Green	Light Brown, Red Brown, Gray, White, Tan	Brown, Red Brown, White, and Black
Plasticity	Predominantly non-plastic	Non Plastic*	Predominantly non-plastic	Non plastic to	Predominantly non-plastic
Liquid Limit	NP to 30	NP*	NP to 44	NP - 44	Predominantly non-plastic
Plasticity Index	NP to 4	NP*	NP to 19	NP - 16	Predominantly non-plastic
	Representative Range				
Natural Moisture Content (%)	6% - 53%	14%*	8% - 19%	11% - 35%	9% - 28%
Fines Content	11% - 99%	32%*	17% - 41%	27% - 73%	16% - 38%
Clay Content	1% - 13%	11%*	1% - 4%	3% - 25%	3% - 11%
Blow Count - Uncorrected N value (bpf)	WOR - 12 bpf	WOH*	10 to 50+ bpf	7 - 25 bpf	21 to 50+ bpf
Moist Unit Weight - γ_m (pcf)	89 - 111 pcf	134 pcf*	---	118 - 130 pcf	122 - 126 pcf
Dry Unit Weight - γ_d (pcf)	58 - 84 pcf	117 pcf*	---	89 - 114 pcf	90 - 95 pcf
Specific Gravity	2.15 - 2.78	2.66*	---	2.62 - 2.74	2.63 - 2.70
Horizontal Hydraulic Conductivity (cm/sec)	1.5E-3 - 1.7E-5	6.1E-06 - 8.5E-6	---	---	---
Vertical Hydraulic Conductivity (cm/sec)	6.6E-08 - 7.9E-04	---	---	---	1.1E-06 - 1.0E-05

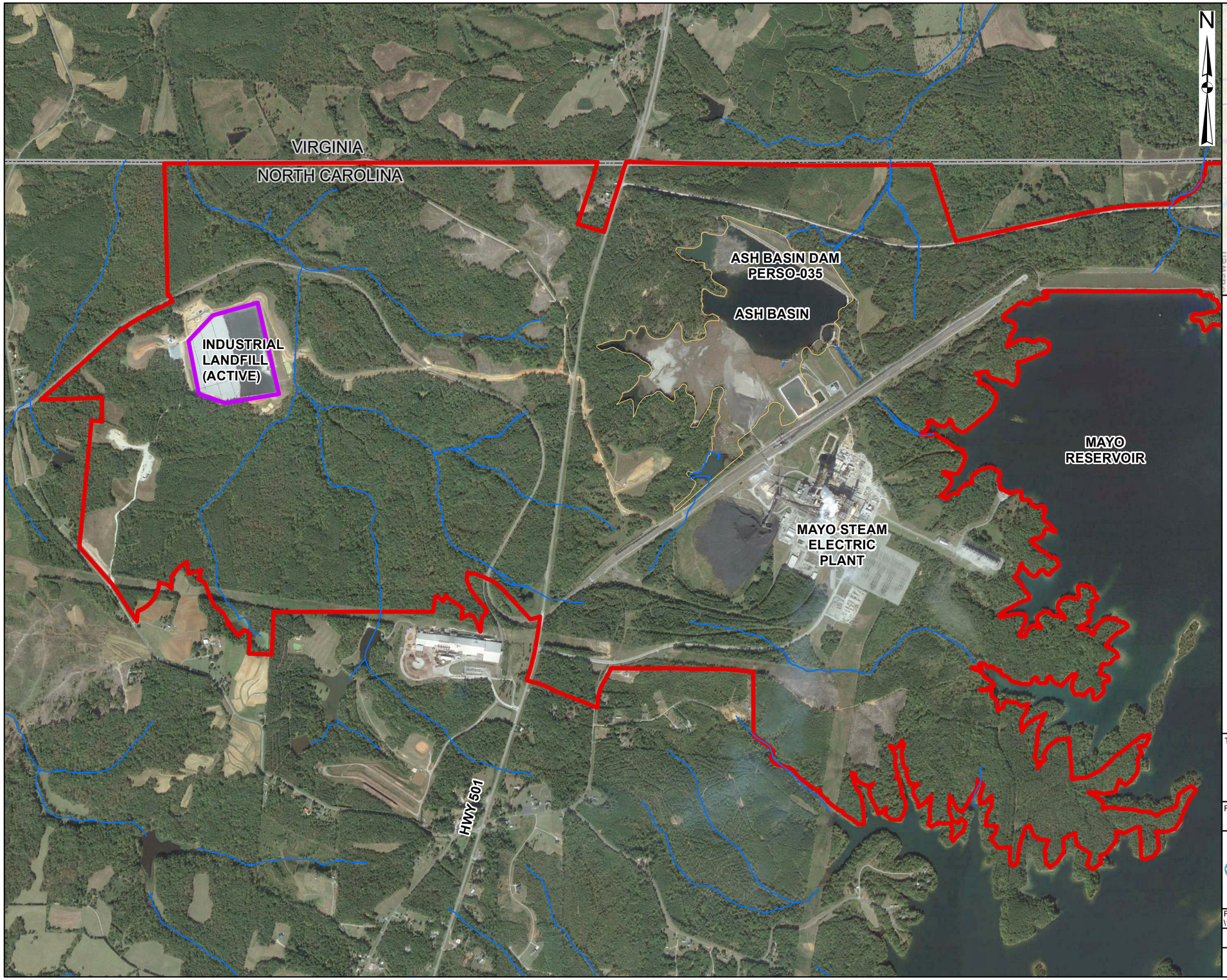
Notes:
Outlier values are not included in the table above
WOR: Weight of Rod, WOH: Weight of Hammer
bpf: Blows per foot
* Only one test was performed

Table 10-1 Mayo Steam Electric Plant Regulatory Permits, Approvals, or Requirements for Basin Closure by Excavation

General Permit Name or Subject	Regulating Agency	Existing Permit No. (if applicable)	Permit/Approval: Type of Regulatory Approval Mechanism or Not Required	Comments
Air Quality	NCDEQ		Permit modification likely	Permit modification likely due to the increased heavy equipment vehicle traffic and potential dust generated during closure activities
Building Permit	Person County		New Permit	A local building permit is required for installation of construction trailers
CAMA Monitoring Plan	NCDEQ		Written NCDEQ DWR approval	Modification or abandonment of CAMA program monitoring wells require the approval of the Division of Water Resources (DWR)
CCR Impoundment Closure	US EPA CCR Rule		Self Regulating	Required postings to Public Record
CCR Impoundment Monitoring Network	US EPA CCR Rule		Self Regulating	Maintain CCR GW monitoring network and requirements as stated in 257.90 - 257.98
Clean Water Act 401	NCDEQ		IP permit	IP likely to be required for impacts to jurisdictional areas
Clean Water Act 404	USACOE		IP permit	IP likely to be required for impacts to jurisdictional areas
Closure Plan	NCDEQ			Per CAMA
Cutting Trees	DEMLR		E&SC plan	include in E&SC plan approval
Dam Safety	NCDEQ	PERSO-035, PERSO, 036, PERSO-037	Certificate of Approval to Modify	Permitting is required to modify or abandon wells and instrumentation on regulatory dams through the Division of Energy, Mineral, and Land Resources (DEMLR)
Dam Safety	NCDEQ	PERSO-035	Certificate of Approval to Modify	Ash Basin Dam - Permitting is required to modify the dam in accordance with the Dam Safety Law of 1967, 15A NCAS 02K.0201 (b)(2); an application must be filed with the Division of Energy, Mineral, and Land Resources (DEMLR)
Dam Safety	NCDEQ	PERSO-036	Certificate of Approval to Modify	FGD Settling Pond Dam - Permitting is required to remove the dam in accordance with the Dam Safety Law of 1967, 15A NCAS 02K.0201 (b)(2); an application must be filed with the Division of Energy, Mineral, and Land Resources (DEMLR)
Dam Safety	NCDEQ	PERSO-037	Certificate of Approval to Modify	FGD Flush Pond Dam - Permitting is required to remove the dam in accordance with the Dam Safety Law of 1967, 15A NCAS 02K.0201 (b)(2); an application must be filed with the Division of Energy, Mineral, and Land Resources (DEMLR)
DOT - General			Not anticipated at this time	Utilization of or modification to state or federal highways to transport CCR will require consultation or notification to relevant DOT agency
Driveway Permit	NCDOT		Potential	Temporary access or driveway permits as needed
Erosion and Sediment Control (E&SC)	NCDEQ and Person County		New Permit	Land disturbance activities outside of the ash basin will exceed one acre, therefore in conformance with 15A NCAC 04, an E&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.
Fire Ants			Restriction not likely	Removal from or import of material could be restricted dependent on the potential for fire ants and geographic regions involved
Floodplain Development	Person County		New Permit	Flood Damage Prevention Ordinance of Person County, Article 3 General Provisions, Section C, requires a Floodplain Development Permit prior to any development activities within FEMA mapped Special Flood Hazard Areas for the Flood Insurance Rate Maps
Large Capacity Water Supply Well	NCDEQ		Not anticipated at this time	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
Multi-State Agreement			Not anticipated at this time	If movement of CCR will cross state lines, multi-state regulations might apply
NPDES (National Pollution Discharge Elimination System)	NCDEQ	NC0038377	Permit modification likely	Modification of NPDES may be necessary if new source or outfall is created.

General Permit Name or Subject	Regulating Agency	Existing Permit No. (if applicable)	Permit/Approval Type of Regulatory Approval Mechanism or Not Required	Comments
NPDES (National Pollution Discharge Elimination System) Industrial Stormwater	NCDEQ		Permit revision likely	Revision to existing sitewide permit or new permit may be required for access roads, staging areas, etc.
NPDES (National Pollution Discharge Elimination System) Stormwater	NCDEQ		New Permit possible	Permit required for temporary and permanent stormwater rerouting.
Noxious Weeds			Not anticipated at this time	Removal from or import of vegetated material could be restricted dependent on the vegetation and geographic regions involved
Railroad Easement, Access, or Crossing Permit			Not anticipated at this time	Construction activities adjacent to tracks/ballast or a new railroad crossing require an agreement or permit
SPCC (Spill Prevention Control and Countermeasure) Plan	NCDEQ		Modification of existing plan	In accordance with the Federal Water Pollution Control Act (Clean Water Act) of 1974, Title 40, Code of Federal Regulations, Part 112.
Threatened or Endangered Species: Candidate Conservation Agreement Avian Protection Plan(s) Bird and Bat Conservation Strategies Eagle Conservation Plan Eagle Take Permit	NCDEQ and EPA		Consultation will be covered in the 404/401 permitting process	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
Solid Waste Site Suitability	NCDEQ		Approval by Letter	New CCR Landfill
Solid Waste Permit to Construct	NCDEQ		Permit	New CCR Landfill
Solid Waste Permit to Operate	NCDEQ		Permit	New CCR Landfill
County Approval - zoning	Person County			New CCR Landfill, requires Special Use Permit

FIGURES



Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, © OpenStreetMap contributors, and the GIS User Community

Legend

- Streams
- INDUSTRIAL LANDFILL (ACTIVE)
- Approximate Duke Energy Property Boundary
- Streams
- Landfill 1
- Approximate Ash Basin Waste Boundary

NOTE:

1. STREAM LOCATIONS SHOWN FOR CLARITY, BUT ACTUAL EXTENTS ARE GOVERNED BY OFFICIAL USACE JURISDICTIONAL MAPS AND REPORTS PRODUCED UNDER SEPARATE COVER

2. DUKE ENERGY PROPERTY BOUNDARY PROVIDED TO AECOM BY SYNTERRA IN APRIL 2016.

0 750 1,500 3,000 Feet

AECOM

TITLE

VICINITY MAP AND SITE PLAN

DUKE ENERGY
MAYO STEAM ELECTRIC PLANT ASH BASIN CLOSURE
PERSON COUNTY, NORTH CAROLINA

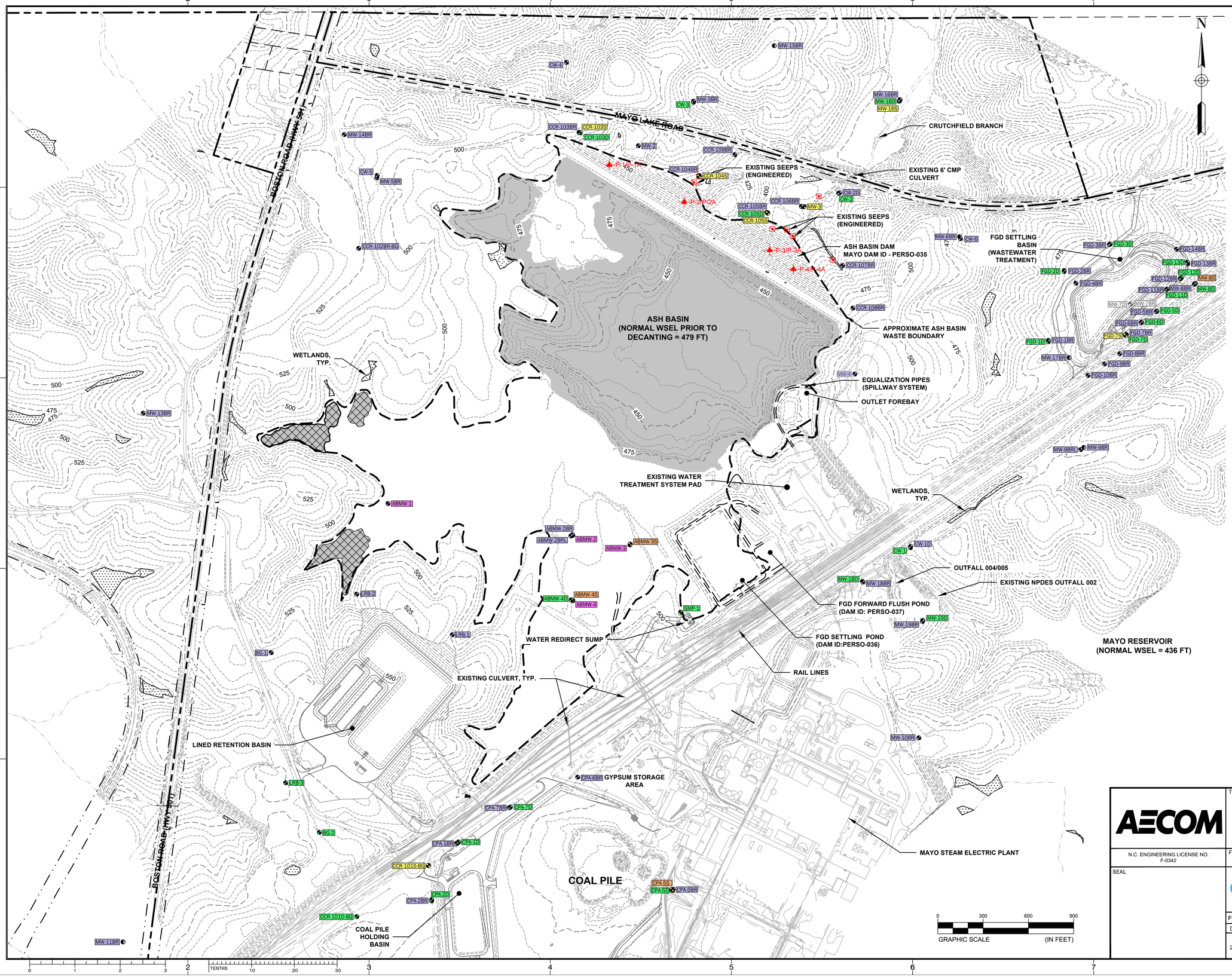
FOR

MAYO PLANT

DUKE ENERGY®

SCALE: 1" = 1,500'	DES:
DWG TYPE: GIS	DFTR: RGM
JOB NO. 60432144	CHKD: SW
DATE: 5/24/2016	ENGR: SW
FILENAME: G:\Data\200\DukeCCP\Mayo_Closure-60432144\11.0 GIS\MapDocuments\Site Map.mxd	APPD: SW

SIZE	DRAWING NO.	REVISION
11"x17"	FIGURE 1-1	0



LEGEND

- APPROXIMATE ASH BASIN WASTE BOUNDARY
- DUKE ENERGY PROPERTY BOUNDARY
- ADJACENT PROPERTY BOUNDARY
- RIGHT OF WAY
- EXISTING MINOR CONTOURS (5 FT)
- EXISTING MAJOR CONTOURS (25 FT)
- GROUNDWATER MONITORING WELL
- SEEPS (APPROX. LOCATION SEE REF. 6)
- EXISTING PIEZOMETER
- EXISTING WETLANDS
- EXISTING STREAM
- AREAS UNDER WATER DURING BATHYMETRY
- NO BATHYMETRY AVAILABLE

COMPLIANCE MONITORING WELL

- ABMW-2BR — WELL IN COMPETENT BEDROCK
- ABMW-2 — WELL IN ASH PORE WATER
- MW-16D — WELL IN TRANSITION ZONE
- MW-16S — WELL IN ALLUVIUM MATERIAL
- MW-8S — WELL IN SAPROLITE MATERIAL

REFERENCE

1. TOPOGRAPHIC DATA PRESENTED IN THIS DRAWING IS TAKEN FROM "AERIAL TOPOGRAPHIC SURVEY - MAYO PLANT" DATED OCTOBER 31, 2015 PREPARED BY WSP FOR DUKE ENERGY.
2. APPROXIMATE ASH BASIN WASTE BOUNDARY PRESENTED IN THIS DRAWING IS PREPARED BY SYNTERRA FOR DUKE ENERGY. UPDATED SEPTEMBER 2018
3. BATHYMETRIC SURVEYS CONDUCTED BY WSP IN AUGUST 2014 & FEBRUARY 2015. ISOLATED PONDS AROUND THE ASH BASIN ARE INACCESSIBLE FOR SURVEY.
4. NO UNDERGROUND UTILITIES HAVE BEEN LOCATED OR MAPPED FOR THIS PROJECT. THE LOCATION OF ANY AND ALL UTILITIES SHOWN HEREON WHETHER PUBLIC/PRIVATE, ARE BASED ON PHOTOGRAMMATIC MAPPING AND ARE APPROXIMATE ONLY.
5. BASIS OF BEARINGS: NC GRID NAD83/2011,ELEVATIONS ARE BASED ON NAVD88.
6. SEEP LOCATIONS DEPICTED ARE APPROXIMATE AND BASED ON "COMPREHENSIVE SITE ASSESSMENT REPORT - MAYO STEAM ELECTRIC PLANT " PREPARED BY SYNTERRA FOR DUKE ENERGY AND SUBMITTED TO NCDEQ (NPDES PERMIT NO. NC0038377) ON SEPTEMBER 2, 2015.
7. THE WATERS OF THE US HAVE NOT BEEN APPROVED BY THE US ARMY CORPS OF ENGINEERS AT THE TIME OF THE MAP CREATION. THIS MAP IS A PRELIMINARY JURISDICTIONAL DETERMINATION ONLY. THE PRELIMINARY WETLANDS AND STREAMS BOUNDARIES WERE OBTAINED FROM AMEC FOSTER WHEELER ENVIRONMENTAL & INFRASTRUCTURE, INC. NATURAL RESOURCE TECHNICAL REPORT FOR MAYO STEAM ELECTRIC PLANT DATED JANUARY 20, 2014.

NOT FOR CONSTRUCTION

AECOM

N.C. ENGINEERING LICENSE NO. F-0342

SEAL

TITLE

EXISTING CONDITIONS PLAN WITH TOPOGRAPHIC MAP
MAYO STEAM ELECTRIC PLANT
CLOSURE BY EXCAVATION CLOSURE PLAN
PERSON COUNTY, NORTH CAROLINA

FOR

ISSUED FOR APPROVAL

DUKE ENERGY®

SCALE: 1" = 300'	DES: DMS
DWG TYPE: .DWG	DFTR: DMS
JOB NO: 60603277	CHKD: KK
DATE: 11/20/2019	ENGR: DMS
FILENAME: 004-EXISTING CONDITION.DWG	APPD: DWC

DWG SIZE	DRAWING NO.	REVISION
ANSI D 22.0"x34.0"	FIGURE 3-1	A

FIGURE 3-1 REV. A

APPENDICES

APPENDIX A
ESTIMATED VOLUME OF CCR IN IMPOUNDMENT

APPENDIX B
GEOTECHNICAL DATA AND PROPERTIES

APPENDIX C
ENGINEERING EVALUATIONS AND ANALYSES

APPENDIX C1
STORMWATER MANAGEMENT CALCULATION MEMO

APPENDIX C2
SOIL QUANTITIES

APPENDIX D
CLOSURE PLAN DRAWINGS

APPENDIX E
FINAL CLOSURE BY EXCAVATION SAMPLING PLAN