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GENERAL ASSEMBLY OF NORTH CAROLINA
SESSION 2013

SESSION LAW 2014-122
SENATE BILL 729

AN ACT TO (1) PROHIBIT RECOVERY OF COSTS RELATED TO UNLAWFUL DISCHARGES FROM COAL COMBUSTION RESIDUALS SURFACE IMPOUNDMENTS; (2) ESTABLISH A MORATORIUM ON CERTAIN RATE CASES; (3) CREATE THE COAL ASH MANAGEMENT COMMISSION TO REVIEW AND APPROVE COAL COMBUSTION RESIDUALS SURFACE IMPOUNDMENTS CLASSIFICATIONS AND CLOSURE PLANS AND OTHERWISE STUDY AND MAKE RECOMMENDATIONS ON LAWS GOVERNING MANAGEMENT OF COAL COMBUSTION RESIDUALS; (4) REQUIRE EXPEDITED REVIEW BY THE DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES OF ANY PERMIT NECESSARY TO CONDUCT ACTIVITIES REQUIRED BY THIS ACT; (5) ESTABLISH VARIOUS REPORTING REQUIREMENTS TO THE GENERAL ASSEMBLY, INCLUDING A QUARTERLY REPORT FROM THE DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES ON ITS OPERATIONS, ACTIVITIES, PROGRAMS, AND PROGRESS WITH RESPECT TO ITS OBLIGATIONS UNDER THIS ACT FOR COAL COMBUSTION RESIDUALS SURFACE IMPOUNDMENTS; (6) PROHIBIT LOCAL GOVERNMENT REGULATION OF MANAGEMENT OF COAL COMBUSTION RESIDUALS OR COAL COMBUSTION PRODUCTS; (7) PROHIBIT CONSTRUCTION OF NEW OR EXPANSION OF EXISTING COAL COMBUSTION RESIDUALS SURFACE IMPOUNDMENTS EFFECTIVE OCTOBER 1, 2014; (8) PROHIBIT THE DISPOSAL OF COAL COMBUSTION RESIDUALS INTO COAL COMBUSTION RESIDUALS SURFACE IMPOUNDMENTS AT COAL-FIRED GENERATING UNITS THAT ARE NO LONGER PRODUCING COAL COMBUSTION RESIDUALS EFFECTIVE OCTOBER 1, 2014; (9) PROHIBIT DISPOSAL OF STORMWATER TO COAL COMBUSTION RESIDUALS SURFACE IMPOUNDMENTS EFFECTIVE DECEMBER 31, 2018; (10) REQUIRE ALL ELECTRIC GENERATING FACILITIES TO CONVERT TO GENERATION OF DRY FLY ASH ON OR BEFORE DECEMBER 31, 2017, AND DRY BOTTOM ASH ON OR BEFORE DECEMBER 31, 2020, OR RETIRE; (11) REQUIRE THE ASSESSMENT OF GROUNDWATER AT COAL COMBUSTION RESIDUALS SURFACE IMPOUNDMENTS; (12) REQUIRE CORRECTIVE ACTION FOR THE RESTORATION OF GROUNDWATER QUALITY AT COAL COMBUSTION RESIDUALS SURFACE IMPOUNDMENTS; (13) REQUIRE A SURVEY OF DRINKING WATER SUPPLY WELLS AND REPLACEMENT OF CONTAMINATED WATER SUPPLIES; (14) REQUIRE THE IDENTIFICATION, ASSESSMENT, AND CORRECTION OF UNPERMITTED DISCHARGES FROM COAL COMBUSTION RESIDUALS SURFACE IMPOUNDMENTS; (15) REQUIRE THE DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES TO, AS SOON AS PRACTICABLE, BUT NO LATER THAN DECEMBER 31, 2015, PRIORITIZE FOR THE PURPOSE OF CLOSURE AND REMEDIATION COAL COMBUSTION RESIDUALS SURFACE IMPOUNDMENTS, INCLUDING ACTIVE AND RETIRED SITES, BASED ON THESE SITES' RISKS TO PUBLIC HEALTH, SAFETY, AND WELFARE, THE ENVIRONMENT, AND NATURAL RESOURCES; (16) REQUIRE OWNERS OF COAL COMBUSTION RESIDUALS SURFACE IMPOUNDMENTS TO SUBMIT A PROPOSED PLAN FOR CLOSURE OF ALL IMPOUNDMENTS TO THE DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES; (17) REQUIRE CLOSURE AND REMEDIATION OF CERTAIN COAL COMBUSTION RESIDUALS SURFACE IMPOUNDMENTS AS SOON AS PRACTICABLE, BUT NO LATER THAN AUGUST 1, 2019; (18) REQUIRE THE

DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES TO ESTABLISH A SCHEDULE AND PROCESS FOR CLOSURE AND REMEDIATION OF ALL COAL COMBUSTION RESIDUALS SURFACE IMPOUNDMENTS BASED UPON THE DEPARTMENT'S RISK ASSESSMENT OF THESE SITES, BASELINE REQUIREMENTS SET BY THE GENERAL ASSEMBLY, EVALUATION OF PROPOSED CLOSURE PLANS SUBMITTED BY IMPOUNDMENT OWNERS, AND INPUT FROM THE PUBLIC AND OTHER STAKEHOLDERS; (19) ESTABLISH MINIMUM STATUTORY REQUIREMENTS FOR STRUCTURAL FILL PROJECTS USING COAL COMBUSTION PRODUCTS AND REQUIRE THE DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES TO INVENTORY AND INSPECT CERTAIN STRUCTURAL FILL PROJECTS; (20) PLACE A MORATORIUM ON CERTAIN PROJECTS USING COAL COMBUSTION PRODUCTS AS STRUCTURAL FILL UNTIL AUGUST 1, 2015, AND DIRECT THE DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES AND THE ENVIRONMENTAL MANAGEMENT COMMISSION TO STUDY THE ADEQUACY OF CURRENT LAW GOVERNING USE OF COAL COMBUSTION PRODUCTS AS STRUCTURAL FILL AND FOR BENEFICIAL USE; (21) PLACE A MORATORIUM ON THE EXPANSION AND CONSTRUCTION OF COAL COMBUSTION RESIDUALS LANDFILLS UNTIL AUGUST 1, 2015, AND DIRECT THE DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES TO ASSESS THE RISKS TO PUBLIC HEALTH, SAFETY, AND WELFARE, THE ENVIRONMENT, AND NATURAL RESOURCES OF COAL COMBUSTION RESIDUALS SURFACE IMPOUNDMENTS LOCATED BENEATH THESE LANDFILLS TO DETERMINE THE ADVISABILITY OF CONTINUED OPERATION OF THESE LANDFILLS; (22) STRENGTHEN THE REPORTING AND NOTIFICATION REQUIREMENTS APPLICABLE TO DISCHARGES OF WASTEWATER TO WATERS OF THE STATE; (23) REQUIRE CERTAIN EMERGENCY CALLS TO BE RECORDED; (24) REQUIRE DEVELOPMENT OF EMERGENCY ACTION PLANS FOR HIGH AND INTERMEDIATE HAZARD DAMS AND AMEND OTHER DAM SAFETY LAW REQUIREMENTS APPLICABLE TO COAL COMBUSTION RESIDUALS SURFACE IMPOUNDMENTS; (25) TRANSFER SOLID WASTE RULE-MAKING AUTHORITY FROM COMMISSION FOR PUBLIC HEALTH TO ENVIRONMENTAL MANAGEMENT COMMISSION; (26) AMEND COMPLIANCE BOUNDARY PROVISIONS; (27) PROVIDE FOR VARIOUS STUDIES; (28) REQUIRE THE STATE CONSTRUCTION OFFICE AND THE DEPARTMENT OF TRANSPORTATION TO DEVELOP TECHNICAL SPECIFICATIONS FOR USE OF COAL COMBUSTION PRODUCTS; AND (29) PROVIDE RESOURCES FOR IMPLEMENTATION OF THIS ACT.

The General Assembly of North Carolina enacts:

PART I. PROHIBIT RECOVERY OF COSTS RELATED TO UNLAWFUL DISCHARGES FROM COAL COMBUSTION RESIDUALS SURFACE IMPOUNDMENTS; MORATORIUM ON RATE CASES

SECTION 1.(a) Article 7 of Chapter 62 of the General Statutes is amended by adding a new section to read:

"**<u>§ 62-133.13. Recovery of costs related to unlawful discharges from coal combustion residuals surface impoundments to the surface waters of the State.</u>**

<u>The Commission shall not allow an electric public utility to recover from the retail electric customers of the State costs resulting from an unlawful discharge to the surface waters of the State from a coal combustion residuals surface impoundment, unless the Commission determines the discharge was due to an event of force majeure. For the purposes of this section, "coal combustion residuals surface impoundments" has the same meaning as in G.S. 130A-309.201. For the purposes of this section, "unlawful discharge" means a discharge that results in a violation of State or federal surface water quality standards.</u>"

SECTION 1.(b) Section 1(a) of this act is effective when it becomes law and applies to discharges occurring on or after January 1, 2014.

SECTION 2.(a) Moratorium on Cost Recovery. – The Utilities Commission shall not issue an order authorizing an electric public utility the recovery of any costs related to coal combustion residuals surface impoundments that were not included in the utility's cost of service approved in its most recent general rate case until the end of the moratorium provided in this section. Nothing in this section prohibits the utility from seeking, nor prohibits the Commission from authorizing under its existing authority, a deferral for costs related to coal ash combustion residual surface impoundments. The moratorium established under this section shall not apply to the net recovery of any fuel and fuel-related costs under G.S. 62-133.2. For the purposes of this section, "coal combustion residuals surface impoundments" has the same meaning as in G.S. 130A-309.201. The moratorium in this section shall end January 15, 2015.

SECTION 2.(b) Purpose of Moratorium. – The purpose of the moratorium is to allow the State to study the disposition of coal combustion residuals surface impoundments, including any final rules adopted by the United States Environmental Protection Agency on the regulation of coal combustion residuals.

PART II. PROVISIONS FOR COMPREHENSIVE MANAGEMENT OF COAL COMBUSTION RESIDUALS

SECTION 3.(a) Article 9 of Chapter 130A of the General Statutes is amended by adding a new Part to read:

"Part 2I. Coal Ash Management.

"Subpart 1. Short Title, Definitions, and General Provisions.

"**§ 130A-309.200. Title.**

This Part may be cited as the "Coal Ash Management Act of 2014."

"**§ 130A-309.201. Definitions.**

Unless a different meaning is required by the context, the definitions of G.S. 130A-290 and the following definitions apply throughout this Part:

(1) "Beneficial and beneficial use" means projects promoting public health and environmental protection, offering equivalent success relative to other alternatives, and preserving natural resources.

(2) "Boiler slag" means the molten bottom ash collected at the base of slag tap and cyclone type furnaces that is quenched with water. It is made up of hard, black, angular particles that have a smooth, glassy appearance.

(3) "Bottom ash" means the agglomerated, angular ash particles formed in pulverized coal furnaces that are too large to be carried in the flue gases and collect on the furnace walls or fall through open grates to an ash hopper at the bottom of the furnace.

(4) "Coal combustion products" means fly ash, bottom ash, boiler slag, or flue gas desulfurization materials that are beneficially used, including use for structural fill.

(5) "Coal combustion residuals" has the same meaning as defined in G.S. 130A-290.

(6) "Coal combustion residuals surface impoundment" means a topographic depression, excavation, or diked area that is (i) primarily formed from earthen materials; (ii) without a base liner approved for use by Article 9 of Chapter 130A of the General Statutes or rules adopted thereunder for a combustion products landfill or coal combustion residuals landfill, industrial landfill, or municipal solid waste landfill; and (iii) designed to hold accumulated coal combustion residuals in the form of liquid wastes, wastes containing free liquids, or sludges, and that is not backfilled or otherwise covered during periods of deposition. "Coal combustion residuals surface impoundment" shall only include impoundments owned by a public utility, as defined in G.S. 62-3. "Coal combustion residuals surface impoundment" includes all of the following:

a. An impoundment that is dry due to the deposited liquid having evaporated, volatilized, or leached.

b. An impoundment that is wet with exposed liquid.

c. Lagoons, ponds, aeration pits, settling ponds, tailings ponds, and sludge pits, when these structures are designed to hold accumulated coal combustion residuals.

d. A coal combustion residuals surface impoundment that has been covered with soil or other material after the final deposition of coal combustion residuals at the impoundment.

(7) "Commission" means the Environmental Management Commission.

(8) "Fly ash" means the very fine, powdery material, composed mostly of silica with nearly all particles spherical in shape, which is a product of burning finely ground coal in a boiler to produce electricity and is removed from the plant exhaust gases by air emission control devices.

(9) "Flue gas desulfurization material" means the material produced through a process used to reduce sulfur dioxide emissions from the exhaust gas system of a coal-fired boiler. The physical nature of these materials varies from a wet sludge to a dry powdered material, depending on the process, and their composition comprises either sulfites, sulfates, or a mixture thereof.

(10) "Minerals" means soil, clay, coal, phosphate, metallic ore, and any other solid material or substance of commercial value found in natural deposits on or in the earth.

(11) "Open pit mine" means an excavation made at the surface of the ground for the purpose of extracting minerals, inorganic and organic, from their natural deposits, which excavation is open to the surface.

(12) "Owner" or "owner of a coal combustion residuals surface impoundment" means a public utility, as defined in G.S. 62-3, that owns a coal combustion residuals surface impoundment.

(13) "Receptor" means any human, plant, animal, or structure which is, or has the potential to be, affected by the release or migration of contaminants. Any well constructed for the purpose of monitoring groundwater and contaminant concentrations shall not be considered a receptor.

(14) "Structural fill" means an engineered fill with a projected beneficial end use constructed using coal combustion products that are properly placed and compacted. For purposes of this Part, the term includes fill used to reclaim open pit mines and for embankments, greenscapes, foundations, construction foundations, and for bases or sub-bases under a structure or a footprint of a paved road, parking lot, sidewalk, walkway, or similar structure.

(15) "Use or reuse of coal combustion products" means the procedure whereby coal combustion products are directly used as either of the following:

a. As an ingredient in an industrial process to make a product, unless distinct components of the coal combustion products are recovered as separate end products.

b. In a function or application as an effective substitute for a commercial product or natural resource.

"**§ 130A-309.202. Coal Ash Management Commission.**

(a) Creation. – In recognition of the complexity and magnitude of the issues associated with the management of coal combustion residuals and the proper closure and remediation of coal combustion residuals surface impoundments, the Coal Ash Management Commission is hereby established.

(b) Membership. – The Commission shall consist of nine members as follows:

(1) One appointed by the General Assembly upon recommendation of the President Pro Tempore of the Senate in accordance with G.S. 120-121 who shall at the time of appointment be a resident of the State.

(2) One appointed by the General Assembly upon recommendation of the President Pro Tempore of the Senate in accordance with G.S. 120-121 who shall at the time of appointment have special training or scientific expertise in waste management, including solid waste disposal, hauling, or beneficial use.

(3) One appointed by the General Assembly upon recommendation of the President Pro Tempore of the Senate in accordance with G.S. 120-121 who shall at the time of appointment be a licensed physician or a person with experience in public health.

(4) One appointed by the General Assembly upon recommendation of the Speaker of the House of Representatives in accordance with G.S. 120-121

who shall at the time of appointment be a member of a nongovernmental conservation interest.

(5) One appointed by the General Assembly upon recommendation of the Speaker of the House of Representatives in accordance with G.S. 120-121 who shall at the time of appointment have special training or scientific expertise in waste management, including solid waste disposal, hauling, or beneficial use, or is a representative of or on the faculty of a State college or university that conducts coal ash research.

(6) One appointed by the General Assembly upon recommendation of the Speaker of the House of Representatives in accordance with G.S. 120-121 who shall at the time of appointment be a representative of an electric membership corporation organized under Article 2 of Chapter 117 of the General Statutes and have a background in power supply resource planning and engineering.

(7) One appointed by the Governor who shall at the time of appointment have experience in economic development.

(8) One appointed by the Governor who shall at the time of appointment have expertise in determining and evaluating the costs associated with electricity generation and establishing the rates associated with electricity consumption.

(9) One appointed by the Governor who shall at the time of appointment be a person with experience in science or engineering in the manufacturing sector.

(c) Chair. – The Governor shall appoint the Chair of the Commission from among the Commission's members, and that person shall serve at the pleasure of the Governor. The Chair shall serve two-year terms. The Governor shall make:

(1) The initial appointment of the Chair no later than October 1, 2014. If the initial appointment is not made by that date, the Chair shall be elected by a vote of the membership; and

(2) Appointments of a subsequent Chair, including appointments to fill a vacancy of the Chair created by resignation, dismissal, death, or disability of the Chair, no later than 30 days after the last day of the previous Chair's term. If an appointment of a subsequent Chair is not made by that date, the Chair shall be elected by a vote of the membership.

(d) Vacancies. – Any appointment to fill a vacancy on the Commission created by the resignation, dismissal, death, or disability of a member shall be for the balance of the unexpired term. The Governor may reappoint a gubernatorial appointee of the Commission to an additional term if, at the time of the reappointment, the member qualifies for membership on the Commission under subdivisions (7) through (9) of subsection (b) of this section. Appointments by the General Assembly shall be made in accordance with G.S. 120-121, and vacancies in those appointments shall be filled in accordance with G.S. 120-122.

(e) Removal. – The Governor shall have the power to remove any member of the Commission from office for misfeasance, malfeasance, or nonfeasance in accordance with the provisions of G.S. 143B-13 of the Executive Organization Act of 1973.

(f) Powers and Duties. – The Commission shall have all of the following powers and duties:

(1) To review and approve the classification of coal combustion residuals surface impoundments required by G.S. 130A-309.211.

(2) To review and approve Coal Combustion Residuals Surface Impoundment Closure Plans as provided in G.S. 130A-309.212.

(3) To review and make recommendations on the provisions of this Part and other statutes and rules related to the management of coal combustion residuals.

(4) To undertake any additional studies as requested by the General Assembly.

(g) Reimbursement. – The members of the Commission shall receive per diem and necessary travel and subsistence expenses in accordance with the provisions of G.S. 138-5.

(h) Quorum. – Five members of the Commission shall constitute a quorum for the transaction of business.

(i) Staff. – The Commission is authorized and empowered to employ staff as the Commission may determine to be necessary for the proper discharge of the Commission's duties and responsibilities. The Chair of the Commission shall organize and direct the work of the Commission staff. The salaries and compensation of all such personnel shall be fixed in the manner provided by law for fixing and regulating salaries and compensation by other State agencies. The Chair, within allowed budgetary limits and as allowed by law, shall authorize and approve travel, subsistence, and related expenses of such personnel incurred while traveling on official business. All State agencies, including the constituent institutions of The University of North Carolina, shall provide information and support to the Commission upon request.

(j) Conflicts of Interest; Disclosure. – The Governor shall require adequate disclosure of potential conflicts of interest by members. The Governor, by executive order, shall promulgate criteria regarding conflicts of interest and disclosure thereof for determining the eligibility of persons under this subsection, giving due regard to the requirements of federal legislation and, for this purpose, may promulgate rules, regulations, or guidelines in conformance with those established by any federal agency interpreting and applying provisions of federal law.

(k) Covered Persons. – All members of the Commission are covered persons for the purposes of Chapter 138A of the General Statutes, the State Government Ethics Act. As covered persons, members of the Commission shall comply with the applicable requirements of the State Government Ethics Act, including mandatory training, the public disclosure of economic interests, and ethical standards for covered persons. Members of the Commission shall comply with the provisions of the State Government Ethics Act to avoid conflicts of interest.

(l) Meetings. – The Commission shall meet at least once every two months and may hold special meetings at any time and place within the State at the call of the Chair or upon the written request of at least five members.

(m) Reports. – The Commission shall submit quarterly written reports as to its operation, activities, programs, and progress to the Environmental Review Commission. The Commission shall supplement the written reports required by this subsection with additional written and oral reports as may be requested by the Environmental Review Commission. The Commission shall submit the written reports required by this subsection whether or not the General Assembly is in session at the time the report is due.

(n) Administrative Location; Independence. – The Commission shall be administratively located in the Division of Emergency Management of the Department of Public Safety. The Commission shall exercise all of its powers and duties independently and shall not be subject to the supervision, direction, or control of the Division or Department.

(o) Terms of Members. – Members of the Commission shall serve terms of six years, beginning effective July 1 of the year of appointment.

"**§ 130A-309.203. Expedited permit review.**

(a) The Department shall act as expeditiously as practicable, but no later than the deadlines established under subsection (b) of this section, except in compliance with subsection (c) of this section, to issue all permits necessary to conduct activities required by this Part.

(b) Notwithstanding G.S. 130A-295.8(e), the Department shall determine whether an application for any permit necessary to conduct activities required by this Part is complete within 30 days after the Department receives the application for the permit. A determination of completeness means that the application includes all required components but does not mean that the required components provide all of the information that is required for the Department to make a decision on the application. If the Department determines that an application is not complete, the Department shall notify the applicant of the components needed to complete the application. An applicant may submit additional information to the Department to cure the deficiencies in the application. The Department shall make a final determination as to whether the application is complete within the later of (i) 30 days after the Department receives the application for the permit less the number of days that the applicant uses to provide the additional information or (ii) 10 days after the Department receives the additional information from the applicant. The Department shall issue a draft permit decision on an application for a permit within 90 days after the Department determines that the application is complete. The Department shall hold a public hearing and accept written comment on the draft permit decision for a period of not less than 30 or more than 60 days after the Department issues a draft permit decision. The Department shall issue a final permit decision on an application for a permit within 60 days after the comment period on the draft permit decision closes. If the

Department fails to act within any time period set out in this subsection, the applicant may treat the failure to act as a denial of the permit and may challenge the denial as provided in Chapter 150B of the General Statutes.

(c) If the Department finds that compliance with the deadlines established under subsection (b) of this section would result in insufficient review of a permit application that would pose a risk to public health, safety, and welfare; the environment; or natural resources, the applicable deadline shall be waived for the application as necessary to allow for adequate review. If a deadline is waived pursuant to this subsection, the Secretary shall issue a written declaration, including findings of fact, documenting the need for the waiver.

(d) Notwithstanding any other provision of this section or any other provision of law, the Department shall either issue or deny a permit required for dewatering of a retired impoundment within 90 days of receipt of a completed application, in such a form and including such information as the Department may prescribe, for the dewatering activities. The Department shall accept written comment on a draft permit decision for a period of not less than 30 days or more than 60 days prior to issuance or denial of such a permit. If the Department fails to act within any time period set out in this subsection, the applicant may treat the failure to act as a denial of the permit and may challenge the denial as provided in Chapter 150B of the General Statutes.

"**§ 130A-309.204. Reports.**

(a) The Department shall submit quarterly written reports to the Environmental Review Commission and the Coal Ash Management Commission on its operations, activities, programs, and progress with respect to its obligations under this Part concerning all coal combustion residuals surface impoundments. At a minimum, the report shall include information concerning the status of assessment, corrective action, prioritization, and closure for each coal combustion residuals surface impoundment and information on costs connected therewith. The report shall include an executive summary of each annual Groundwater Protection and Restoration Report submitted to the Department by the operator of any coal combustion residuals surface impoundments pursuant to G.S. 130A-309.209(d) and a summary of all groundwater sampling, protection, and restoration activities related to the impoundment for the preceding year. The report shall also include an executive summary of each annual Surface Water Protection and Restoration Report submitted to the Department by the operator of any coal combustion residuals surface impoundments pursuant to G.S. 130A-309.210(e) and a summary of all surface water sampling, protection, and restoration activities related to the impoundment for the preceding year, including the status of the identification, assessment, and correction of unpermitted discharges from coal combustion residuals surface impoundments to the surface waters of the State. The Department shall supplement the written reports required by this subsection with additional written and oral reports as may be requested by the Environmental Review Commission. The Department shall submit the written reports required by this subsection whether or not the General Assembly is in session at the time the report is due.

(b) On or before October 1 of each year, the Department shall report to each member of the General Assembly who has a coal combustion residuals surface impoundment in the member's district. This report shall include the location of each impoundment in the member's district, the amount of coal combustion residuals known or believed to be located in the impoundment, the last action taken at the impoundment, and the date of that last action.

(c) On or before October 1 of each year, a public utility generating coal combustion residuals and coal combustion products shall submit an annual summary to the Department. The annual summary shall be for the period of July 1 through June 30 and shall include all of the following:

(1) The volume of coal combustion residuals and products produced.
(2) The volume of coal combustion residuals disposed.
(3) The volume of coal combustion products used in structural fill projects.
(4) The volume of coal combustion products beneficially used, other than for structural fill.

"**§ 130A-309.205. Local ordinances regulating management of coal combustion residuals and coal combustion products invalid; petition to preempt local ordinance.**

(a) It is the intent of the General Assembly to maintain a uniform system for the management of coal combustion residuals and coal combustion products, including matters of disposal and beneficial use, and to place limitations upon the exercise by all units of local government in North Carolina of the power to regulate the management of coal combustion residuals and coal combustion products by means of ordinances, property restrictions, zoning regulations, or otherwise. Notwithstanding any authority granted to counties, municipalities, or other local authorities to adopt local ordinances, including those imposing taxes, fees, or charges or regulating health, environment, or land use, all provisions of local ordinances, including those regulating land use, adopted by counties, municipalities, or other local authorities that regulate or have the effect of regulating the management of coal combustion residuals and coal combustion products, including regulation of carbon burn-out plants, within the jurisdiction of a local government are invalidated, to the extent necessary to effectuate the purposes of this Part, that do the following:

(1) Place any restriction or condition not placed by this Part upon management of coal combustion residuals or coal combustion products within any county, city, or other political subdivision.

(2) Conflict or are in any manner inconsistent with the provisions of this Part.

(b) If a local zoning or land-use ordinance imposes requirements, restrictions, or conditions that are generally applicable to development, including, but not limited to, setback, buffer, and stormwater requirements, and coal combustion residuals and coal combustion products would be regulated under the ordinance of general applicability, the operator of the proposed activities may petition the Environmental Management Commission to review the matter. After receipt of a petition, the Commission shall hold a hearing in accordance with the procedures in subsection (c) of this section and shall determine whether or to what extent to preempt the local ordinance to allow for the management of coal combustion residuals and coal combustion products.

(c) When a petition described in subsection (b) of this section has been filed with the Environmental Management Commission, the Commission shall hold a public hearing to consider the petition. The public hearing shall be held in the affected locality within 60 days after receipt of the petition by the Commission. The Commission shall give notice of the public hearing by both of the following means:

(1) Publication in a newspaper or newspapers having general circulation in the county or counties where the activities are to be conducted, once a week for three consecutive weeks, the first notice appearing at least 30 days prior to the scheduled date of the hearing.

(2) First-class mail to persons who have requested notice. The Commission shall maintain a mailing list of persons who request notice in advance of the hearing pursuant to this section. Notice by mail shall be complete upon deposit of a copy of the notice in a postage-paid wrapper addressed to the person to be notified at the address that appears on the mailing list maintained by the Commission in a post office or official depository under the exclusive care and custody of the United States Postal Service.

(d) Any interested person may appear before the Environmental Management Commission at the hearing to offer testimony. In addition to testimony before the Commission, any interested person may submit written evidence to the Commission for the Commission's consideration. At least 20 days shall be allowed for receipt of written comment following the hearing.

(e) A local zoning or land-use ordinance is presumed to be valid and enforceable to the extent the zoning or land-use ordinance imposes requirements, restrictions, or conditions that are generally applicable to development, including, but not limited to, setback, buffer, and stormwater requirements, unless the Environmental Management Commission makes a finding of fact to the contrary. The Commission shall determine whether or to what extent to preempt local ordinances so as to allow the project involving management of coal combustion residuals and coal combustion products no later than 60 days after conclusion of the hearing. The Commission shall preempt a local ordinance only if the Commission makes all of the following findings:

(1) That there is a local ordinance that would regulate the management of coal combustion residuals and coal combustion products.

(2) That all legally required State and federal permits or approvals have been issued by the appropriate State and federal agencies or that all State and federal permit requirements have been satisfied and that the permits or approvals have been denied or withheld only because of the local ordinance.

(3) That local citizens and elected officials have had adequate opportunity to participate in the permitting process.

(4) That the project involving management of coal combustion residuals and coal combustion products will not pose an unreasonable health or environmental risk to the surrounding locality and that the operator has taken or consented to take reasonable measures to avoid or manage foreseeable risks and to comply to the maximum feasible extent with applicable local ordinances.

(f) If the Environmental Management Commission does not make all of the findings under subsection (e) of this section, the Commission shall not preempt the challenged local ordinance. The Commission's decision shall be in writing and shall identify the evidence submitted to the Commission plus any additional evidence used in arriving at the decision.

(g) The decision of the Environmental Management Commission shall be final, unless a party to the action files a written appeal under Article 3 of Chapter 150B of the General Statutes, as modified by this section, within 30 days of the date of the decision. The record on appeal shall consist of all materials and information submitted to or considered by the Commission, the Commission's written decision, a complete transcript of the hearing, the specific findings required by subsection (e) of this section, and any minority positions on the specific findings required by subsection (e) of this section. The scope of judicial review shall be as set forth in G.S. 150B-51, except as this subsection provides regarding the record on appeal.

(h) If the court reverses or modifies the decision of the Environmental Management Commission, the judge shall set out in writing, which writing shall become part of the record, the reasons for the reversal or modification.

(i) In computing any period of time prescribed or allowed by the procedure in this section, the provisions of Rule 6(a) of the Rules of Civil Procedure, G.S. 1A-1, shall apply.

"**§ 130A-309.206. Federal preemption; severability.**

The provisions of this Part shall be severable, and if any phrase, clause, sentence, or provision is declared to be unconstitutional or otherwise invalid or is preempted by federal law or regulation, the validity of the remainder of this Part shall not be affected thereby.

"**§ 130A-309.207. General rule making for Part.**

The Environmental Management Commission shall adopt rules as necessary to implement the provisions of the Part. Such rules shall be exempt from the requirements of G.S. 150B-19.3.

"Subpart 2. Management of Coal Ash Residuals; Closure of Coal Ash Impoundments.

"**§ 130A-309.208. Generation, disposal, and use of coal combustion residuals.**

(a) On or after October 1, 2014, the construction of new and expansion of existing coal combustion residuals surface impoundments is prohibited.

(b) On or after October 1, 2014, the disposal of coal combustion residuals into a coal combustion residuals surface impoundment at an electric generating facility where the coal-fired generating units are no longer producing coal combustion residuals is prohibited.

(c) On or after December 31, 2018, the discharge of stormwater into a coal combustion surface impoundment at an electric generating facility where the coal-fired generating units are no longer producing coal combustion residuals is prohibited.

(d) On or after December 31, 2019, the discharge of stormwater into a coal combustion surface impoundment at an electric generating facility where the coal-fired generating units are actively producing coal combustion residuals is prohibited.

(e) On or before December 31, 2018, all electric generating facilities owned by a public utility shall convert to the disposal of "dry" fly ash or the facility shall be retired. For purposes of this subsection, the term "dry" means coal combustion residuals that are not in the form of liquid wastes, wastes containing free liquids, or sludges.

(f) On or before December 31, 2019, all electric generating facilities owned by a public utility shall convert to the disposal of "dry" bottom ash or the facility shall be retired. For purposes of this subsection, the term "dry" means coal combustion residuals that are not in the form of liquid wastes, wastes containing free liquids, or sludges.

"**§ 130A-309.209. Groundwater assessment and corrective action; drinking water supply well survey and provision of alternate water supply; reporting.**

(a) Groundwater Assessment of Coal Combustion Residuals Surface Impoundments. – The owner of a coal combustion residuals surface impoundment shall conduct groundwater monitoring and assessment as provided in this subsection. The requirements for groundwater monitoring and assessment set out in this subsection are in addition to any other groundwater monitoring and assessment requirements applicable to the owners of coal combustion residuals surface impoundments.

(1) No later than December 31, 2014, the owner of a coal combustion residuals surface impoundment shall submit a proposed Groundwater Assessment Plan for the impoundment to the Department for its review and approval. The Groundwater Assessment Plan shall, at a minimum, provide for all of the following:

a. A description of all receptors and significant exposure pathways.

b. An assessment of the horizontal and vertical extent of soil and groundwater contamination for all contaminants confirmed to be present in groundwater in exceedance of groundwater quality standards.

c. A description of all significant factors affecting movement and transport of contaminants.

d. A description of the geological and hydrogeological features influencing the chemical and physical character of the contaminants.

e. A schedule for continued groundwater monitoring.

f. Any other information related to groundwater assessment required by the Department.

(2) The Department shall approve the Groundwater Assessment Plan if it determines that the Plan complies with the requirements of this subsection and will be sufficient to protect public health, safety, and welfare; the environment; and natural resources.

(3) No later than 10 days from approval of the Groundwater Assessment Plan, the owner shall begin implementation of the Plan.

(4) No later than 180 days from approval of the Groundwater Assessment Plan, the owner shall submit a Groundwater Assessment Report to the Department. The Report shall describe all exceedances of groundwater quality standards associated with the impoundment.

(b) Corrective Action for the Restoration of Groundwater Quality. – The owner of a coal combustion residuals surface impoundment shall implement corrective action for the restoration of groundwater quality as provided in this subsection. The requirements for corrective action for the restoration of groundwater quality set out in this subsection are in addition to any other corrective action for the restoration of groundwater quality requirements applicable to the owners of coal combustion residuals surface impoundments.

(1) No later than 90 days from submission of the Groundwater Assessment Report required by subsection (a) of this section, or a time frame otherwise approved by the Department not to exceed 180 days from submission of the Groundwater Assessment Report, the owner of the coal combustion residuals surface impoundment shall submit a proposed Groundwater Corrective Action Plan to the Department for its review and approval. The Groundwater Corrective Action Plan shall provide for the restoration of groundwater in conformance with the requirements of Subchapter L of Chapter 2 of Title 15A of the North Carolina Administrative Code. The Groundwater Corrective Action Plan shall include, at a minimum, all of the following:

a. A description of all exceedances of the groundwater quality standards, including any exceedances that the owner asserts are the result of natural background conditions.

b. A description of the methods for restoring groundwater in conformance with the requirements of Subchapter L of Chapter 2 of Title 15A of the North Carolina Administrative Code and a detailed explanation of the reasons for selecting these methods.

c. Specific plans, including engineering details, for restoring groundwater quality.

d. A schedule for implementation of the Plan.

e. A monitoring plan for evaluating the effectiveness of the proposed corrective action and detecting movement of any contaminant plumes.

f. Any other information related to groundwater assessment required by the Department.

(2) The Department shall approve the Groundwater Corrective Action Plan if it determines that the Plan complies with the requirements of this subsection and will be sufficient to protect public health, safety, and welfare; the environment; and natural resources.

(3) No later than 30 days from the approval of the Groundwater Corrective Action Plan, the owner shall begin implementation of the Plan in accordance with the Plan's schedule.

(c) Drinking Water Supply Well Survey and Provision of Alternate Water Supply. – No later than October 1, 2014, the owner of a coal combustion residuals surface impoundment shall conduct a Drinking Water Supply Well Survey that identifies all drinking water supply wells within one-half mile down-gradient from the established compliance boundary of the impoundment and submit the Survey to the Department. The Survey shall include well locations, the nature of water uses, available well construction details, and information regarding ownership of the wells. No later than December 1, 2014, the Department shall determine, based on the Survey, which drinking water supply wells the owner is required to sample and how frequently and for what period sampling is required. The Department shall require sampling for drinking water supply wells where data regarding groundwater quality and flow and depth in the area of any surveyed well provide a reasonable basis to predict that the quality of water from the surveyed well may be adversely impacted by constituents associated with the presence of the impoundment. No later than January 1, 2015, the owner shall initiate sampling and water quality analysis of the drinking water supply wells. A property owner may elect to have an independent third party selected from a laboratory certified by the Department's Wastewater/Groundwater Laboratory Certification program sample wells located on their property in lieu of sampling conducted by the owner of the coal combustion residuals surface impoundment. The owner of the coal combustion residuals surface impoundment shall pay for the reasonable costs of such sampling. Nothing in this subsection shall be construed to preclude or impair the right of any property owner to refuse such sampling of wells on their property. If the sampling and water quality analysis indicates that water from a drinking water supply well exceeds groundwater quality standards for constituents associated with the presence of the impoundment, the owner shall replace the contaminated drinking water supply well with an alternate supply of potable drinking water and an alternate supply of water that is safe for other household uses. The alternate supply of potable drinking water shall be supplied within 24 hours of the Department's determination that there is an exceedance of groundwater quality standards attributable to constituents associated with the presence of the impoundment. The alternate supply of water that is safe for other household uses shall be supplied within 30 days of the Department's determination that there is an exceedance of groundwater quality standards attributable to constituents associated with the presence of the impoundment. The requirement to replace a contaminated drinking water supply well with an alternate supply of potable drinking water and an alternate supply of water that is safe for other household uses set out in this subsection is in addition to any other requirements to replace a contaminated drinking water supply well with an alternate supply of potable drinking water or an alternate supply of water that is safe for other household uses applicable to the owners of coal combustion residuals surface impoundments.

(d) Reporting. – In addition to any other reporting required by the Department, the owner of a coal combustion residuals surface impoundment shall submit an annual Groundwater Protection and Restoration Report to the Department no later than January 31 of each year. The Report shall include a summary of all groundwater monitoring, protection, and restoration activities related to the impoundment for the preceding year, including the status of the Groundwater Assessment Plan, the Groundwater Assessment Report, the Groundwater Corrective Action Plan, the Drinking Water Supply Well Survey, and the replacement of any contaminated drinking water supply wells. The owner of a coal combustion residuals surface impoundment shall also submit all information required to be submitted to the Department pursuant to this section to the Coal Ash Management Commission.

"**§ 130A-309.210. Identification and assessment of discharges; correction of unpermitted discharges.**

(a) Identification of Discharges from Coal Combustion Residuals Surface Impoundments. –

(1) The owner of a coal combustion residuals surface impoundment shall identify all discharges from the impoundment as provided in this subsection. The requirements for identifying all discharges from an impoundment set out in this subsection are in addition to any other requirements for identifying discharges applicable to the owners of coal combustion residuals surface impoundments.

(2) No later than December 31, 2014, the owner of a coal combustion residuals surface impoundment shall submit a topographic map that identifies the location of all (i) outfalls from engineered channels designed or improved for the purpose of collecting water from the toe of the impoundment and (ii) seeps and weeps discharging from the impoundment that are not captured by engineered channels designed or improved for the purpose of collecting water from the toe of the impoundment to the Department. The topographic map shall comply with all of the following:

a. Be at a scale as required by the Department.

b. Specify the latitude and longitude of each toe drain outfall, seep, and weep.

c. Specify whether the discharge from each toe drain outfall, seep, and weep is continuous or intermittent.

d. Provide an average flow measurement of the discharge from each toe drain outfall, seep, and weep including a description of the method used to measure average flow.

e. Specify whether the discharge from each toe drain outfall, seep, and weep identified reaches the surface waters of the State. If the discharge from a toe drain outfall, seep, or weep reaches the surface waters of the State, the map shall specify the latitude and longitude of where the discharge reaches the surface waters of the State.

f. Include any other information related to the topographic map required by the Department.

(b) Assessment of Discharges from Coal Combustion Residuals Surface Impoundments to the Surface Waters of the State. – The owner of a coal combustion residuals surface impoundment shall conduct an assessment of discharges from the coal combustion residuals surface impoundment to the surface waters of the State as provided in this subsection. The requirements for assessment of discharges from the coal combustion residuals surface impoundment to the surface waters of the State set out in this subsection are in addition to any other requirements for the assessment of discharges from coal combustion residuals surface impoundments to surface waters of the State applicable to the owners of coal combustion residuals surface impoundments.

(1) No later than December 31, 2014, the owner of a coal combustion residuals surface impoundment shall submit a proposed Discharge Assessment Plan to the Department. The Discharge Assessment Plan shall include information sufficient to allow the Department to determine whether any discharge, including a discharge from a toe drain outfall, seep, or weep, has reached the surface waters of the State and has caused a violation of surface water quality standards. The Discharge Assessment Plan shall include, at a minimum, all of the following:

a. Upstream and downstream sampling locations within all channels that could potentially carry a discharge.

b. A description of the surface water quality analyses that will be performed.

c. A sampling schedule, including the frequency and duration of sampling activities.

d. Reporting requirements.

e. Any other information related to the assessment of discharges required by the Department.

(2) The Department shall approve the Discharge Assessment Plan if it determines that the Plan complies with the requirements of this subsection and will be sufficient to protect public health, safety, and welfare; the environment; and natural resources.

(3) No later than 30 days from the approval of the Discharge Assessment Plan, the owner shall begin implementation of the Plan in accordance with the Plan's schedule.

(c) Corrective Action to Prevent Unpermitted Discharges from Coal Combustion Residuals Surface Impoundments to the Surface Waters of the State. – The owner of a coal combustion residuals surface impoundment shall implement corrective action to prevent unpermitted discharges from the coal combustion residuals surface impoundment to the surface waters of the State as provided in this subsection. The requirements for corrective action to prevent unpermitted discharges from coal combustion residuals surface impoundments to the surface waters of the State set out in this subsection are in addition to any other requirements for corrective action to prevent unpermitted discharges from coal combustion residuals surface impoundments to the surface waters of the State applicable to the owners of coal combustion residuals surface impoundments.

(1) If the Department determines, based on information provided pursuant to subsection (a) or (b) of this section, that an unpermitted discharge from a coal combustion residuals surface impoundment, including an unpermitted discharge from a toe drain outfall, seep, or weep, has reached the surface waters of the State, the Department shall notify the owner of the impoundment of its determination.

(2) No later than 30 days from a notification pursuant to subdivision (1) of this subsection, the owner of the coal combustion residuals surface impoundment shall submit a proposed Unpermitted Discharge Corrective Action Plan to the Department for its review and approval. The proposed Unpermitted Discharge Corrective Action Plan shall include, at a minimum, all of the following:

a. One of the following methods of proposed corrective action:

1. Elimination of the unpermitted discharge.

2. Application for a National Pollutant Discharge Elimination System (NPDES) permit amendment pursuant to G.S. 143-215.1 and Subchapter H of Chapter 2 of Title 15A of the North Carolina Administrative Code to bring the unpermitted discharge under permit regulations.

b. A detailed explanation of the reasons for selecting the method of corrective action.

c. Specific plans, including engineering details, to prevent the unpermitted discharge.

d. A schedule for implementation of the Plan.

e. A monitoring plan for evaluating the effectiveness of the proposed corrective action.

f. Any other information related to the correction of unpermitted discharges required by the Department.

(3) The Department shall approve the Unpermitted Discharge Corrective Action Plan if it determines that the Plan complies with the requirements of this subsection and will be sufficient to protect public health, safety, and welfare; the environment; and natural resources.

(4) No later than 30 days from the approval of the Unpermitted Discharge Corrective Action Plan, the owner shall begin implementation of the Plan in accordance with the Plan's schedule.

(d) Identification of New Discharges. – No later than October 1, 2014, the owner of a coal combustion residuals surface impoundment shall submit a proposed Plan for the Identification of New Discharges to the Department for its review and approval as provided in this subsection.

(1) The proposed Plan for the Identification of New Discharges shall include, at a minimum, all of the following:

a. A procedure for routine inspection of the coal combustion residuals surface impoundment to identify indicators of potential new discharges, including toe drain outfalls, seeps, and weeps.

b. A procedure for determining whether a new discharge is actually present.

c. A procedure for notifying the Department when a new discharge is confirmed.

d. Any other information related to the identification of new discharges required by the Department.

(2) The Department shall approve the Plan for the Identification of New Discharges if it determines that the Plan complies with the requirements of this subsection and will be sufficient to protect public health, safety, and welfare; the environment; and natural resources.

(3) No later than 30 days from the approval of the Plan for the Identification of New Discharges, the owner shall begin implementation of the Plan in accordance with the Plan.

(e) Reporting. – In addition to any other reporting required by the Department, the owner of a coal combustion residuals surface impoundment shall submit an annual Surface Water Protection and Restoration Report to the Department no later than January 31 of each year. The Report shall include a summary of all surface water sampling, protection, and restoration activities related to the impoundment for the preceding year, including the status of the identification, assessment, and correction of unpermitted discharges from coal combustion residuals surface impoundments to the surface waters of the State. The owner of a coal combustion residuals surface impoundment shall also submit all information required to be submitted to the Department pursuant to this section to the Coal Ash Management Commission.

"**§ 130A-309.211. Prioritization of coal combustion residuals surface impoundments.**

(a) As soon as practicable, but no later than December 31, 2015, the Department shall develop proposed classifications for all coal combustion residuals surface impoundments, including active and retired sites, for the purpose of closure and remediation based on these sites' risks to public health, safety, and welfare; the environment; and natural resources and shall determine a schedule for closure and required remediation that is based on the degree of risk to public health, safety, and welfare; the environment; and natural resources posed by the impoundments and that gives priority to the closure and required remediation of impoundments that pose the greatest risk. In assessing the risk, the Department shall evaluate information received pursuant to G.S. 130A-309.209 and G.S. 130A-309.210 and any other information deemed relevant and, at a minimum, consider all of the following:

(1) Any hazards to public health, safety, or welfare resulting from the impoundment.

(2) The structural condition and hazard potential of the impoundment.

(3) The proximity of surface waters to the impoundment and whether any surface waters are contaminated or threatened by contamination as a result of the impoundment.

(4) Information concerning the horizontal and vertical extent of soil and groundwater contamination for all contaminants confirmed to be present in groundwater in exceedance of groundwater quality standards and all significant factors affecting contaminant transport.

(5) The location and nature of all receptors and significant exposure pathways.

(6) The geological and hydrogeological features influencing the movement and chemical and physical character of the contaminants.

(7) The amount and characteristics of coal combustion residuals in the impoundment.

(8) Whether the impoundment is located within an area subject to a 100-year flood.

(9) Any other factor the Department deems relevant to establishment of risk.

(b) The Department shall issue a proposed classification for each coal combustion residuals surface impoundment based upon the assessment conducted pursuant to subsection (a) of this section as high-risk, intermediate-risk, or low-risk. Within 30 days after a proposed classification has been issued, the Department shall issue a written declaration, including findings of fact, documenting the proposed classification. The Department shall provide for public participation on the proposed risk classification as follows:

(1) The Department shall make copies of the written declaration issued pursuant to this subsection available for inspection as follows:

a. A copy of the declaration shall be provided to the local health director.

b. A copy of the declaration shall be provided to the public library located in closest proximity to the site in the county or counties in which the site is located.

c. The Department shall post a copy of the declaration on the Department's Web site.

d. The Department shall place copies of the declaration in other locations so as to assure the reasonable availability thereof to the public.

(2) The Department shall give notice of the written declaration issued pursuant to this subsection as follows:

a. A notice and summary of the declaration shall be published weekly for a period of three consecutive weeks in a newspaper having general circulation in the county or counties where the site is located.

b. Notice of the written declaration shall be given by first-class mail to persons who have requested such notice. Such notice shall include a summary of the written declaration and state the locations where a copy of the written declaration is available for inspection. The Department shall maintain a mailing list of persons who request notice pursuant to this section.

c. Notice of the written declaration shall be given by electronic mail to persons who have requested such notice. Such notice shall include a summary of the written declaration and state the locations where a copy of the written declaration is available for inspection. The Department shall maintain a mailing list of persons who request notice pursuant to this section.

(3) No later than 60 days after issuance of the written declaration, the Department shall conduct a public meeting in the county or counties in which the site is located to explain the written declaration to the public. The Department shall give notice of the hearing at least 15 days prior to the date thereof by all of the following methods:

a. Publication as provided in subdivision (1) of this subsection, with first publication to occur not less than 30 days prior to the scheduled date of the hearing.

b. First-class mail to persons who have requested notice as provided in subdivision (2) of this subsection.

c. Electronic mail to persons who have requested notice as provided in subdivision (2) of this subsection.

(4) At least 30 days from the latest date on which notice is provided pursuant to subdivision (2) of this subsection shall be allowed for the receipt of written comment on the written declaration prior to issuance of a final risk classification. At least 20 days will be allowed for receipt of written comment following a hearing conducted pursuant to subdivision (3) of this subsection prior to issuance of a final risk classification.

(c) Within 30 days of the receipt of all written comment as required by subdivision (4) of subsection (b) of this section, the Department shall submit a proposed classification for a coal combustion residuals surface impoundment to the Coal Ash Management Commission established pursuant to G.S. 130A-309.202. The Commission shall evaluate all information submitted in accordance with this Part related to the proposed classification and any other information the Commission deems relevant. The Commission shall only approve the proposed classification if it determines that the classification was developed in accordance with this section and that the classification accurately reflects the level of risk posed by the coal combustion residuals surface impoundment. The Commission shall issue its determination in writing, including findings in support of its determination. If the Commission fails to act on a proposed classification within 60 days of receipt of the proposed classification, the proposed classification shall be deemed approved. Parties aggrieved by a final decision of the Commission pursuant to this subsection may appeal the decision as provided under Article 3 of Chapter 150B of the General Statutes.

"**§ 130A-309.212. Closure of coal combustion residuals surface impoundments.**

(a) An owner of a coal combustion residuals surface impoundment shall submit a proposed Coal Combustion Residuals Surface Impoundment Closure Plan for the Department's approval. If corrective action to restore groundwater has not been completed pursuant to the requirements of G.S. 130A-309.209(b), the proposed closure plan shall include provisions for completion of activities to restore groundwater in conformance with the requirements of Subchapter L of Chapter 2 of Title 15A of the North Carolina Administrative Code. In addition, the following requirements, at a minimum, shall apply to such plans:

(1) High-risk impoundments shall be closed as soon as practicable, but no later than December 31, 2019. A proposed closure plan for such impoundments must be submitted as soon as practicable, but no later than December 31, 2016. At a minimum, (i) impoundments located in whole above the seasonal high groundwater table shall be dewatered; (ii) impoundments located in whole or in part beneath the seasonal high groundwater table shall be dewatered to the maximum extent practicable; and (iii) the owner of an impoundment shall either:

a. Convert the coal combustion residuals impoundment to an industrial landfill by removing all coal combustion residuals and contaminated soil from the impoundment temporarily, safely storing the residuals on-site, and complying with the requirements for such landfills established by this Article and rules adopted thereunder. At a minimum, the landfills shall have a design with a leachate collection system, a closure cap system, and a composite liner system consisting of two components: the upper component shall consist of a minimum 30-ml flexible membrane (FML), and the lower components shall consist of at least a two-foot layer of compacted soil with a hydraulic conductivity of no more than 1×10^{-7} centimeters per second. FML components consisting of high density polyethylene (HDPE) shall be at least 60 ml thick. The landfill shall otherwise comply with the construction requirements established by Section .1624 of Subchapter B of Chapter 13 of Title 15A of the North Carolina Administrative Code, and the siting and design requirements for disposal sites established by Section .0503 of Subchapter B of Chapter 13 of Title 15A of the North Carolina Administrative Code, except with respect to those requirements that pertain to buffers. In lieu of the buffer requirement established by Section .0503(f)(2)(iii) of Subchapter B of Chapter 13 of Title 15A of the North Carolina Administrative Code, the owner of the impoundment shall establish and maintain a 300-foot buffer between surface waters and disposal areas. After the temporarily displaced coal combustion residuals have been returned for disposal in the industrial landfill constructed pursuant to the requirements of this sub-subdivision, the owner of the landfill shall comply with the closure and post-closure requirements established by Section .1627 of Subchapter B of Chapter 13 of Title 15A of the North Carolina Administrative Code. A landfill constructed pursuant to this sub-subdivision shall otherwise be subject to all applicable requirements of this Chapter and rules adopted thereunder. Prior to closure, the Department may allow the disposal of coal combustion residuals, in addition to those originally contained in the impoundment, to the landfill constructed pursuant to this sub-subdivision, if the Department determines that the site is suitable for additional capacity and that disposal of additional coal combustion residuals will not pose an unacceptable risk to public health, safety, welfare; the environment; and natural resources.

b. Remove all coal combustion residuals from the impoundment, return the former impoundment to a nonerosive and stable condition and (i) transfer the coal combustion residuals for disposal in a coal combustion residuals landfill, industrial landfill, or municipal solid waste landfill or (ii) use the coal combustion products in a structural fill or other beneficial use as allowed by law. The use of coal combustion products (i) as structural fill shall be conducted in accordance with the requirements of Subpart 3 of this Part and (ii) for other beneficial uses shall be conducted in accordance 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).

(2) Intermediate-risk impoundments shall be closed as soon as practicable, but no later than December 31, 2024. A proposed closure plan for such impoundments must be submitted as soon as practicable, but no later than December 31, 2017. At a minimum, such impoundments shall be dewatered, and the owner of an impoundment shall close the impoundment in any manner allowed pursuant to subdivision (1) of this subsection.

(3) Low-risk impoundments shall be closed as soon as practicable, but no later than December 31, 2029. A proposed closure plan for such impoundments must be submitted as soon as practicable, but no later than December 31, 2018. At a minimum, (i) impoundments located in whole above the seasonal high groundwater table shall be dewatered; (ii) impoundments located in whole or in part beneath the seasonal high groundwater table shall be dewatered to the maximum extent practicable; and (iii) the owner of an impoundment shall either:

a. Close in any manner allowed pursuant to subdivision (1) of this subsection.

b. Comply with the closure and post-closure requirements established by Section .1627 of Subchapter B of Chapter 13 of Title 15A of the North Carolina Administrative Code, except that such impoundments shall not be required to install and maintain a leachate collection system. Specifically, the owner of an impoundment shall install and maintain a cap system that is designed to minimize infiltration and erosion in conformance with the requirements of Section .1624 of Subchapter B of Chapter 13 of Title 15A of the North Carolina Administrative Code, and, at a minimum, shall be designed and constructed to (i) have a permeability no greater than 1×10^{-5} centimeters per second; (ii) minimize infiltration by the use of a low-permeability barrier that contains a minimum 18 inches of earthen material; and (iii) minimize erosion of the cap system and protect the low-permeability barrier from root penetration by use of an erosion layer that contains a minimum of six inches of earthen material that is capable of sustaining native plant growth. In addition, the owner of an impoundment shall (i) install and maintain a groundwater monitoring system; (ii) establish financial assurance that will ensure that sufficient funds are available for closure pursuant to this subdivision, post-closure maintenance and monitoring, any corrective action that the Department may require, and satisfy any potential liability for sudden and nonsudden accidental occurrences arising from the impoundment and subsequent costs incurred by the Department in response to an incident, even if the owner becomes insolvent or ceases to reside, be incorporated, do business, or maintain assets in the State; and (iii) conduct post-closure care for a period of 30 years, which period may be increased by the Department upon a determination that a longer period is necessary to protect public health, safety, welfare; the environment; and natural resources, or decreased upon a determination that a shorter period is sufficient to protect public health, safety, welfare; the environment; and natural resources. The Department may require implementation of any other measure it deems necessary to protect public health, safety, and welfare; the environment; and natural resources, including imposition of institutional controls that are sufficient to protect public health, safety, and welfare; the environment; and natural resources. The Department may not approve closure for an impoundment pursuant to sub-subdivision b. of subdivision (3) of this subsection unless the Department finds that the proposed closure plan includes design measures to prevent, upon the plan's full implementation, post-closure exceedances of groundwater quality standards beyond the compliance boundary that are attributable to constituents associated with the presence of the impoundment.

(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.
2. Estimated volume of material contained in the impoundment.
3. Analysis of the structural integrity of dikes or dams associated with impoundment.
4. All sources of discharge into the impoundment, including volume and characteristics of each discharge.
5. Whether the impoundment is lined, and, if so, the composition thereof.
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.

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.
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. The property boundary for the applicable site, including established compliance boundaries within the site.
4. All potential receptors within 2,640 feet from established compliance boundaries.
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.
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.
7. All existing and proposed groundwater monitoring wells associated with any coal combustion residuals surface impoundment on the site.
8. All existing and proposed surface water sample collection locations associated with any coal combustion residuals surface impoundment on the site.

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.
2. A description of the stratigraphy of the geologic units underlying each coal combustion residuals surface impoundment located on the site.
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. 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.
5. A chemical analysis of the coal combustion residuals surface impoundment, including water, coal combustion residuals, and coal combustion residuals-affected soil.
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.
7. Summary tables of historical records of groundwater sampling results.
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.
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.

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.

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.

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.

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).

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.

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.

h. A description of the provisions for disposal of wastewater and management of stormwater and the plan for obtaining all required permits.

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.

j. A list of all permits that will need to be acquired or modified to complete closure activities.

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:

1. A demonstration of the long-term control of all leachate, affected groundwater, and stormwater.
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.

l. An estimate of the milestone dates for all activities related to closure and post-closure.

m. Projected costs of assessment, corrective action, closure, and post-closure care for each coal combustion residuals surface impoundment.

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.

(b) The Department shall review a proposed Coal Combustion Residuals Surface Impoundment Closure Plan for consistency with the minimum requirements set forth in subsection (a) of this section and whether the proposed Closure Plan is protective of public health, safety, and welfare; the environment; and natural resources and otherwise complies with the requirements of this Part. Prior to issuing a decision on a proposed Closure Plan, the Department shall provide for public participation on the proposed Closure Plan as follows:

(1) The Department shall make copies of the proposed Closure Plan available for inspection as follows:

a. A copy of the proposed Closure Plan shall be provided to the local health director.

b. A copy of the proposed Closure Plan shall be provided to the public library located in closest proximity to the site in the county or counties in which the site is located.

c. The Department shall post a copy of the proposed Closure Plan on the Department's Web site.

d. The Department shall place copies of the declaration in other locations so as to assure the reasonable availability thereof to the public.

(2) Before approving a proposed Closure Plan, the Department shall give notice as follows:

a. A notice and summary of the proposed Closure Plan shall be published weekly for a period of three consecutive weeks in a newspaper having general circulation in the county or counties where the site is located.

b. Notice that a proposed Closure Plan has been developed shall be given by first-class mail to persons who have requested such notice. Such notice shall include a summary of the proposed Closure Plan and state the locations where a copy of the proposed Closure Plan is available for inspection. The Department shall maintain a mailing list of persons who request notice pursuant to this section.

c. Notice that a proposed Closure Plan has been developed shall be given by electronic mail to persons who have requested such notice. Such notice shall include a summary of the proposed Closure Plan and state the locations where a copy of the proposed Closure Plan is available for inspection. The Department shall maintain a mailing list of persons who request notice pursuant to this section.

(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 in which the site is located to explain the proposed Closure Plan and alternatives to the public. The Department shall give notice of the hearing at least 30 days prior to the date thereof by all of the following methods:

a. Publication as provided in subdivision (1) of this subsection, with first publication to occur not less than 30 days prior to the scheduled date of the hearing.

b. First-class mail to persons who have requested notice as provided in subdivision (2) of this subsection.

c. Electronic mail to persons who have requested notice as provided in subdivision (2) of this subsection.

(4) At least 30 days from the latest date on which notice is provided pursuant to subdivision (2) of this subsection shall be allowed for the receipt of written comment on the proposed Closure Plan prior to its approval. At least 20 days will be allowed for receipt of written comment following a hearing conducted pursuant to subdivision (3) of this subsection prior to the approval of the proposed Closure Plan.

(c) The Department shall disapprove a proposed Coal Combustion Residuals Surface Impoundment Closure Plan unless the Department finds that the Closure Plan is protective of public health, safety, and welfare; the environment; and natural resources and otherwise complies with the requirements of this Part. The Department shall provide specific findings to support its decision to approve or disapprove a proposed Closure Plan. If the Department disapproves a proposed Closure Plan, the person who submitted the Closure Plan may seek review as provided in Article 3 of Chapter 150B of the General Statutes. If the Department fails to approve or disapprove a proposed Closure Plan within 120 days after a complete Closure Plan has been submitted, the person who submitted the proposed Closure Plan may treat the Closure Plan as having been disapproved at the end of that time period. The Department may require a person who proposes a Closure Plan to supply any additional information necessary for the Department to approve or disapprove the Closure Plan.

(d) Within 30 days of its approval of a Coal Combustion Residuals Surface Impoundment Closure Plan, the Department shall submit the Closure Plan to the Coal Ash Management Commission. The Commission shall evaluate all information submitted in accordance with this Part related to the Closure Plan and any other information the Commission deems relevant. The Commission shall approve the Closure Plan if it determines that the Closure Plan was developed in accordance with this section, that implementation of the Closure Plan according to the Closure Plan's schedule is technologically and economically feasible, and the Closure Plan is protective of the public health, safety, and welfare; the environment; and natural resources. In addition, the Commission may consider any impact on electricity costs and reliability, but this factor may not be dispositive of the Commission's determination. The Commission shall issue its determination in writing, including findings in support of its determination. If the Commission fails to act on a Closure Plan within 60 days of receipt of the Closure Plan, the Closure Plan shall be deemed approved. Parties aggrieved by a final decision of the Commission pursuant to this subsection may appeal the decision as provided under Article 3 of Chapter 150B of the General Statutes.

(e) As soon as practicable, but no later than 60 days after a Coal Combustion Residuals Surface Impoundment Closure Plan has been approved by the Coal Ash Management

Commission, the owner of the coal combustion residuals impoundment shall begin implementation of the approved plan. Modifications to an approved Closure Plan may only be allowed in conformance with the requirements of this Part, upon written request of an owner of an impoundment, with the written approval of the Department, and after public notice of the change in accordance with the requirements of subdivision (2) of subsection (b) of this section. Provided, however, minor technical modifications may be made in accordance with standard Department procedures for such minor modifications and may be made without written approval of the Department or public notice of the change.

(f) Nothing in this section shall be construed to obviate the need for sampling, remediation, and monitoring activities at the site as required by G.S. 130A-309.209 and G.S. 130A-309.310.

"**§ 130A-309.213. Variance authority.**

(a) In recognition of the complexity and magnitude of the issues surrounding the management of coal combustion residuals and coal combustion residuals surface impoundments, the General Assembly authorizes the Commission to grant a variance to extend any deadline for closure of an impoundment established under G.S. 130A-309.212 in conformance with the requirements of this section. To request such a variance the owner of an impoundment shall, no earlier than two years prior to the applicable deadline, submit an application in a form acceptable to the Department which shall include, at a minimum, all of the following information: identification of the site, applicable requirements, and applicable deadlines for which a variance is sought, and the site-specific circumstances that support the need for the variance. The owner of the impoundment shall also provide detailed information that demonstrates (i) the owner has substantially complied with all other requirements and deadlines established by this Part; (ii) the owner has made good faith efforts to comply with the applicable deadline for closure of the impoundment; and (iii) that compliance with the deadline cannot be achieved by application of best available technology found to be economically reasonable at the time and would produce serious hardship without equal or greater benefits to the public. As soon as practicable, but no later than 60 days from receipt of an application, the Secretary shall evaluate the information submitted in conjunction with the application, and any other information the Secretary deems relevant, to determine whether the information supports issuance of a variance. After such evaluation, if the Secretary finds that the information supports issuance of a variance from the deadline, the Secretary shall issue a proposed variance. Within 10 days after a proposed variance has been issued, the Secretary shall issue a written declaration, including findings of fact, documenting the proposed variance. The Department shall provide for public participation on the proposed variance in the manner provided by G.S. 130A-309.212(b) and shall take the public input received through the process into account in its decision concerning the proposed variance. Within 30 days of the receipt of all public input received, the Department shall submit a proposed variance to the Coal Ash Management Commission. The Commission shall evaluate all information submitted in accordance with this section and any other information the Commission deems relevant. The Commission shall only approve a variance if it determines that compliance with the deadline cannot be achieved by application of best available technology found to be economically reasonable at the time and would produce serious hardship without equal or greater benefits to the public. The Commission shall issue its determination in writing, including findings in support of its determination. If the Commission fails to act on a variance request within 60 days of receipt, the variance shall be deemed denied. Parties aggrieved by a final decision of the Commission pursuant to this subsection may appeal the decision as provided under Article 3 of Chapter 150B of the General Statutes.

(b) A variance granted pursuant to this section shall not extend a deadline for closure of an impoundment more than three years beyond the date applicable to the impoundment as provided under G.S. 130A-309.212.

(c) No more than one variance may be granted pursuant to this section per impoundment.

"Subpart 3. Use of Coal Combustion Products in Structural Fill.

"**§ 130A-309.214. Applicability.**

The provisions of this Subpart shall apply to the siting, design, construction, operation, and closure of projects that utilize coal combustion products for structural fill.

"**§ 130A-309.215. Permit requirements for projects using coal combustion products for structural fill.**

(a) Permit Requirements. –

(1) Projects using coal combustion products as structural fill involving the placement of less than 8,000 tons of coal combustion products per acre or less than 80,000 tons of coal combustion products in total per project, which proceed in compliance with the requirements of this section and rules adopted thereunder, are deemed permitted. Any person proposing such a project shall submit an application for a permit to the Department upon such form as the Department may prescribe, including, at a minimum, the information set forth in subdivision (1) of subsection (b) of this section.

(2) No person shall commence or operate a project using coal combustion residuals as structural fill involving the placement of 8,000 or more tons of coal combustion products per acre or 80,000 or more tons of coal combustion products in total per project without first receiving an individual permit from the Department. Any person proposing such a project shall submit an application for a permit to the Department upon such form as the Department may prescribe, including, at a minimum, the information set forth in subdivisions (1) and (2) of subsection (b) of this section.

(b) Information to Be Provided to the Department. – At least 60 days before initiation of a proposed project using coal combustion products as structural fill, the person proposing the project shall submit all of the following information to the Department on a form as prescribed by the Department:

(1) For projects involving placement of less than 8,000 tons of coal combustion products per acre or less than 80,000 tons of coal combustion products in total per project, the person shall provide, at a minimum, the following information:

a. The description of the nature, purpose, and location of the project.

b. The estimated start and completion dates for the project.

c. An estimate of the volume of coal combustion products to be used in the project.

d. A Toxicity Characteristic Leaching Procedure analysis from a representative sample of each different coal combustion product's source to be used in the project for, at a minimum, all of the following constituents: arsenic, barium, cadmium, lead, chromium, mercury, selenium, and silver.

e. A signed and dated statement by the owner of the land on which the structural fill is to be placed, acknowledging and consenting to the use of coal combustion products as structural fill on the property and agreeing to record the fill in accordance with the requirements of G.S. 130A-390.219.

f. The name, address, and contact information for the generator of the coal combustion products.

g. Physical location of the project at which the coal combustion products were generated.

(2) For projects involving placement of 8,000 or more tons of coal combustion products per acre or 80,000 or more tons of coal combustion products in total per project, the person shall provide all information required pursuant to subdivision (1) of this subsection and shall provide construction plans for the project, including a stability analysis as the Department may require. If required by the Department, a stability analysis shall be prepared, signed, and sealed by a professional engineer in accordance with sound engineering practices. A construction plan shall, at a minimum, include a groundwater monitoring system and an encapsulation liner system in compliance with the requirements of G.S. 130A-309.216.

"**§ 130A-309.216. Design, construction, and siting requirements for projects using coal combustion products for structural fill.**

(a) Design, Construction, and Operation of Structural Fill Sites. –

(1) A structural fill site must be designed, constructed, operated, closed, and maintained in such a manner as to minimize the potential for harmful release

of constituents of coal combustion residuals to the environment or create a nuisance to the public.

(2) Coal combustion products shall be collected and transported in a manner that will prevent nuisances and hazards to public health and safety. Coal combustion products shall be moisture conditioned, as necessary, and transported in covered trucks to prevent dusting.

(3) Coal combustion products shall be placed uniformly and shall be compacted to standards, including in situ density, compaction effort, and relative density, specified by a registered professional engineer for a specific end-use purpose.

(4) Equipment shall be provided that is capable of placing and compacting the coal combustion products and handling the earthwork required during the periods that coal combustion products are received at the fill project.

(5) The coal combustion product structural fill project shall be effectively maintained and operated as a nondischarge system to prevent discharge to surface water resulting from the project.

(6) The coal combustion product structural fill project shall be effectively maintained and operated to ensure no violations of groundwater standards adopted by the Commission pursuant to Article 21 of Chapter 143 of the General Statutes due to the project.

(7) Surface waters resulting from precipitation shall be diverted away from the active coal combustion product placement area during filling and construction activity.

(8) Site development shall comply with the North Carolina Sedimentation Pollution Control Act of 1973, as amended.

(9) The structural fill project shall be operated with sufficient dust control measures to minimize airborne emissions and to prevent dust from creating a nuisance or safety hazard and shall not violate applicable air quality regulations.

(10) Coal combustion products utilized on an exterior slope of a structural fill shall not be placed with a slope greater than 3.0 horizontal to 1.0 vertical.

(11) Compliance with this subsection shall not insulate any of the owners or operators of a structural fill project from claims for damages to surface waters, groundwater, or air resulting from the operation of the structural fill project. If the project fails to comply with the requirements of this section, the constructor, generator, owner, or operator shall notify the Department and shall take any immediate corrective action as may be required by the Department.

(b) Liners, Leachate Collection System, Cap, and Groundwater Monitoring System Required for Large Structural Fills. – For projects involving placement of 8,000 or more tons of coal combustion products per acre or 80,000 or more tons of coal combustion products in total per project shall have an encapsulation liner system. The encapsulation liner system shall be constructed on and around the structural fill and shall be designed to efficiently contain, collect, and remove leachate generated by the coal combustion products, as well as separate the coal combustion products from any exposure to surrounding environs. At a minimum, the components of the liner system shall consist of the following:

(1) A base liner, which shall consist of one of the following designs:

a. A composite liner utilizing a compacted clay liner. This composite liner is one liner that consists of two components: a geomembrane liner installed above and in direct and uniform contact with a compacted clay liner with a minimum thickness of 24 inches (0.61 m) and a permeability of no more than 1.0×10^{-7} centimeters per second.

b. A composite liner utilizing a geosynthetic clay liner. This composite liner is one liner that consists of three components: a geomembrane liner installed above and in uniform contact with a geosynthetic clay liner overlying a compacted clay liner with a minimum thickness of 18 inches (0.46 m) and a permeability of no more than 1.0×10^{-5} centimeters per second.

(2) A leachate collection system, which is constructed directly above the base liner and shall be designed to effectively collect and remove leachate from the project.

(3) A cap system that is designed to minimize infiltration and erosion as follows:

a. The cap system shall be designed and constructed to (i) have a permeability less than or equal to the permeability of any base liner system or the in situ subsoils underlying the structural fill, or the permeability specified for the final cover in the effective permit, or a permeability no greater than 1 x 10^{-5} centimeters per second, whichever is less; (ii) minimize infiltration through the closed structural fill by the use of a low-permeability barrier that contains a minimum 18 inches of earthen material; and (iii) minimize erosion of the cap system and protect the low-permeability barrier from root penetration by use of an erosion layer that contains a minimum of six inches of earthen material that is capable of sustaining native plant growth.

b. The Department may approve an alternative cap system if the owner or operator can adequately demonstrate (i) the alternative cap system will achieve an equivalent or greater reduction in infiltration as the low-permeability barrier specified in sub-subdivision a. of this subdivision and (ii) the erosion layer will provide equivalent or improved protection as the erosion layer specified in sub-subdivision a. of this subdivision.

(4) A groundwater monitoring system, that shall be approved by the Department and, at a minimum, consists of all of the following:

a. A sufficient number of wells, installed at appropriate locations and depths, to yield groundwater samples from the uppermost aquifer that represent the quality of groundwater passing the relevant point of compliance as approved by the Department. A down-gradient monitoring system shall be installed at the relevant point of compliance so as to ensure detection of groundwater contamination in the uppermost aquifer.

b. A proposed monitoring plan, which shall be certified by a licensed geologist or professional engineer to be effective in providing early detection of any release of hazardous constituents from any point in a structural fill or leachate surface impoundment to the uppermost aquifer, so as to be protective of public health, safety, and welfare; the environment; and natural resources.

c. A groundwater monitoring program, which shall include consistent sampling and analysis procedures that are designed to ensure monitoring results that provide an accurate representation of groundwater quality at the background and down-gradient wells. Monitoring shall be conducted through construction and the post-closure care period. The sampling procedures and frequency shall be protective of public health, safety, and welfare; the environment; and natural resources.

d. A detection monitoring program for all Appendix I constituents. For purposes of this subdivision, the term "Appendix I" means Appendix I to 40 C.F.R. Part 258, "Appendix I Constituents for Detection Monitoring," including subsequent amendments and editions.

e. An assessment monitoring program and corrective action plan if one or more of the constituents listed in Appendix I is detected in exceedance of a groundwater protection standard.

(c) Siting for Structural Fill Facilities. – Coal combustion products used as a structural fill shall not be placed:

(1) Within 50 feet of any property boundary.

(2) Within 300 horizontal feet of a private dwelling or well.

(3) Within 50 horizontal feet of the top of the bank of a perennial stream or other surface water body.

(4) Within four feet of the seasonal high groundwater table.

(5) Within a 100-year floodplain except as authorized under G.S. 143-215.54A(b). A site located in a floodplain shall not restrict the flow of the 100-year flood, reduce the temporary water storage capacity of the floodplain or result in washout of solid waste so as to pose a hazard to human life, wildlife or land or water resources.

(6) Within 50 horizontal feet of a wetland, unless, after consideration of the chemical and physical impact on the wetland, the United States Army Corps of Engineers issues a permit or waiver for the fill.

"§ 130A-309.217. Financial assurance requirements for large projects using coal combustion products for structural fill.

(a) For projects involving placement of 8,000 or more tons of coal combustion products per acre or 80,000 or more tons of coal combustion products in total per project, the applicant for a permit or a permit holder to construct or operate a structural fill shall establish financial assurance that will ensure that sufficient funds are available for facility closure, post-closure maintenance and monitoring, any corrective action that the Department may require, and to satisfy any potential liability for sudden and nonsudden accidental occurrences, and subsequent costs incurred by the Department in response to an incident at a structural fill project, even if the applicant or permit holder becomes insolvent or ceases to reside, be incorporated, do business, or maintain assets in the State.

(b) To establish sufficient availability of funds under this section, the applicant for a permit or a permit holder may use insurance, financial tests, third-party guarantees by persons who can pass the financial test, guarantees by corporate parents who can pass the financial test, irrevocable letters of credit, trusts, surety bonds, or any other financial device, or any combination of the foregoing shown to provide protection equivalent to the financial protection that would be provided by insurance if insurance were the only mechanism used.

(c) The applicant for a permit or a permit holder and any parent, subsidiary, or other affiliate of the applicant, permit holder, or parent, including any joint venturer with a direct or indirect interest in the applicant, permit holder, or parent shall be a guarantor of payment for closure, post-closure maintenance and monitoring, any corrective action that the Department may require, and to satisfy any potential liability for sudden and nonsudden accidental occurrences arising from the operation of the hazardous waste facility.

(d) Assets used to meet the financial assurance requirements of this section shall be in a form that will allow the Department to readily access funds for the purposes set out in this section. Assets used to meet financial assurance requirements of this section shall not be accessible to the permit holder except as approved by the Department.

(e) The Department may provide a copy of any filing that an applicant for a permit or a permit holder submits to the Department to meet the financial responsibility requirements under this section to the State Treasurer. The State Treasurer shall review the filing and provide the Department with a written opinion as to the adequacy of the filing to meet the purposes of this section, including any recommended changes.

(f) In order to continue to hold a permit for a structural fill, a permit holder must maintain financial responsibility as required by this Part and must provide any information requested by the Department to establish that the permit holder continues to maintain financial responsibility.

(g) An applicant for a permit or a permit holder shall satisfy the Department that the applicant or permit holder has met the financial responsibility requirements of this Part before the Department is required to otherwise review the application.

"§ 130A-309.218. Closure of projects using coal combustion products for structural fill.

(a) Closure of Structural Fill Projects. –

(1) No later than 30 working days or 60 calendar days, whichever is less, after coal combustion product placement has ceased, the final cover shall be applied over the coal combustion product placement area.

(2) The final surface of the structural fill shall be graded and provided with drainage systems that do all of the following:

a. Minimize erosion of cover materials.

b. Promote drainage of area precipitation, minimize infiltration, and prevent ponding of surface water on the structural fill.

(3) Other erosion control measures, such as temporary mulching, seeding, or silt barriers shall be installed to ensure no visible coal combustion product migration to adjacent properties until the beneficial end use of the project is realized.

(4) The constructor or operator shall submit a certification to the Department signed and sealed by a registered professional engineer or signed by the Secretary of the Department of Transportation or the Secretary's designee certifying that all requirements of this Subpart have been met. The report shall be submitted within 30 days of application of the final cover.

(b) Additional Closure and Post-Closure Requirements for Large Structural Fill Projects. – For projects involving placement of 8,000 or more tons of coal combustion products per acre or 80,000 or more tons of coal combustion products in total per project, a constructor or operator shall conduct post-closure care. Post-closure care shall be conducted for 30 years, which period may be increased by the Department upon a determination that a longer period is necessary to protect public health, safety, and welfare; the environment; and natural resources, or decreased upon a determination that a shorter period is sufficient to protect public health, safety, and welfare; the environment; and natural resources. Additional closure and post-closure requirements include, at a minimum, all of the following:

(1) Submit a written closure plan that includes all of the following:

a. A description of the cap liner system and the methods and procedures used to install the cap that conforms to the requirement in G.S. 130A-309.216(b).

b. An estimate of the largest area of the structural fill project ever requiring the cap liner system at any time during the overall construction period that is consistent with the drawings prepared for the structural fill.

c. An estimate of the maximum inventory of coal combustion products ever on-site over the construction duration of the structural fill.

d. A schedule for completing all activities necessary to satisfy the closure criteria set forth in this section.

(2) Submit a written post-closure plan that includes all of the following:

a. A description of the monitoring and maintenance activities required for the project and the frequency at which these activities must be performed.

b. The name, address, and telephone number of the person or office responsible for the project during the post-closure period.

c. A description of the planned uses of the property during the post-closure period. Post-closure use of the property must not disturb the integrity of the cap system, base liner system, or any other components of the containment system or the function of the monitoring systems, unless necessary to comply with the requirements of this subsection. The Department may approve disturbance if the constructor or operator demonstrates that disturbance of the cap system, base liner system, or other component of the containment system will not increase the potential threat to public health, safety, and welfare; the environment; and natural resources.

d. The cost estimate for post-closure activities required under this section.

(3) Maintain the integrity and effectiveness of any cap system, including repairing the system as necessary to correct the defects of settlement, subsidence, erosion, or other events and preventing run-on and runoff from eroding or otherwise damaging the cap system.

(4) Maintain and operate the leachate collection system. The Department may allow the constructor or operator to stop managing leachate upon a satisfactory demonstration that leachate from the project no longer poses a threat to human health and the environment.

(5) Monitor and maintain the groundwater monitoring system in accordance with G.S. 130A-309.216 and monitor the surface water in accordance with 15A NCAC 13B .0602.

(c) Completion of Post-Closure Care. – Following completion of the post-closure care period, the constructor or operator shall submit a certification, signed by a registered professional engineer, to the Department, verifying that post-closure care has been completed in accordance with the post-closure plan, and include the certification in the operating record.

"**§ 130A-309.219. Recordation of projects using coal combustion products for structural fill.**

(a) The owner of land where coal combustion products have been used in volumes of more than 1,000 cubic yards shall file a statement of the volume and locations of the coal combustion residuals with the Register of Deeds in the county or counties where the property is located. The statement shall identify the parcel of land according to the complete legal description on the recorded deed, either by metes and bounds or by reference to a recorded plat map. The statement shall be signed and acknowledged by the landowners in the form prescribed by G.S. 47-38 through G.S. 47-43.

(b) Recordation shall be required within 90 days after completion of a structural fill project using coal combustion residuals.

(c) The Register of Deeds, in accordance with G.S. 161-14, shall record the notarized statement and index it in the Grantor Index under the name of the owner of the land. The original notarized statement with the Register's seal and the date, book, and page number of recording shall be returned to the Department after recording.

(d) When property with more than 1,000 cubic yards of coal combustion products is sold, leased, conveyed, or transferred in any manner, the deed or other instrument of transfer shall contain in the description section in no smaller type than used in the body of the deed or instrument a statement that coal combustion products have been used as structural fill material on the property.

"**§ 130A-309.220. Department of Transportation projects.**

The Department and the Department of Transportation may agree on specific design, construction, siting, operation, and closure criteria that may apply to the Department of Transportation structural fill projects.

"**§ 130A-309.221. Inventory and inspection of certain structural fill projects.**

No later than July 1, 2015, the Department shall prepare an inventory of all structural fill projects with a volume of 10,000 cubic yards or more. The Department shall update the structural fill project inventory at least annually. The Department shall inspect each structural fill project with a volume of 10,000 cubic yards or more at least annually to determine if the project or facility has been constructed and operated in compliance with 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 .1200 of Subchapter T of Chapter 2 of Title 15A of the North Carolina Administrative Code (Coal Combustion Products Management), as applicable.

"**§ 130A-309.222. Amendments required to rules.**

Requirements under existing rules governing the use of coal combustion products for structural fill that do not conflict with the provisions of this Subpart shall continue to apply to such projects. The Environmental Management Commission shall amend existing rules governing the use of coal combustion products for structural fill as necessary to implement the provisions of this Subpart. Such rules shall be exempt from the requirements of G.S. 150B-19.3.

"Subpart 4. Enforcement.

"**§ 130A-309.223. General enforcement.**

Except as otherwise provided in this Subpart, the provisions of this Part shall be enforced as provided in Article 1 of this Chapter.

"**§ 130A-309.224. Penalties for making false statements.**

Any person who knowingly makes any false statement, representation, or certification in any application, record, report, plan, or other document filed or required to be maintained under this Part or a rule implementing this Part shall be guilty of a Class 2 misdemeanor, which may include a fine not to exceed ten thousand dollars ($10,000)."

SECTION 3.(b) Notwithstanding G.S. 130A-309.211 or G.S. 130A-309.212, as enacted by Section 3(a) of this act, and except as otherwise preempted by the requirements of federal law, the following coal combustion residuals surface impoundments shall be deemed high-priority and, as soon as practicable, but no later than August 1, 2019, shall be closed in conformance with Section 3(c) of this act:

(1) Coal combustion residuals surface impoundments located at the Dan River Steam Station, owned and operated by Duke Energy Progress, and located in Rockingham County.

(2) Coal combustion residuals surface impoundments located at the Riverbend Steam Station, owned and operated by Duke Energy Carolinas, and located in Gaston County.

(3) Coal combustion residuals surface impoundments located at the Asheville Steam Electric Generating Plant, owned and operated by Duke Energy Progress, and located in Buncombe County.

(4) Coal combustion residuals surface impoundments located at the Sutton Plant, owned and operated by Duke Energy Progress, and located in New Hanover County.

SECTION 3.(c) The impoundments identified in subsection (b) of this section shall be closed as follows:

(1) Impoundments located in whole above the seasonal high groundwater table shall be dewatered. Impoundments located in whole or in part beneath the seasonal high groundwater table shall be dewatered to the maximum extent practicable.

(2) All coal combustion residuals shall be removed from the impoundments and transferred for (i) disposal in a coal combustion residuals landfill, industrial landfill, or municipal solid waste landfill or (ii) use in a structural fill or other beneficial use as allowed by law. Any disposal or use of coal combustion products pursuant to this section shall comply with the moratoriums enacted under Section 4(a) and Section 5(a) of this act and any extensions thereof. The use of coal combustion products (i) as structural fill, as authorized by Section 4(b) of this act, shall be conducted in accordance with the requirements of Subpart 3 of Part 2I of Article 9 of the General Statutes, as enacted by Section 3(a) of this act, and (ii) for other beneficial uses shall be conducted in accordance 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), as applicable.

(3) If restoration of groundwater quality is degraded as a result of the impoundment, corrective action to restore groundwater quality shall be implemented by the owner or operator as provided in G.S. 130A-309.204.

SECTION 3.(d) G.S. 130A-290(a) reads as rewritten:

"§ 130A-290. Definitions.

(a) Unless a different meaning is required by the context, the following definitions shall apply throughout this Article:

…

(2b) ~~"Combustion products"~~"Coal combustion residuals" means residuals, including fly ash, bottom ash, boiler slag, mill rejects, and flue gas desulfurization residue produced by a coal-fired generating ~~unit.~~unit destined for disposal. The term does not include coal combustion products as defined in G.S. 130A-309.201(4).

(2c) ~~"Combustion products landfill"~~"Coal combustion residuals landfill" means a facility or unit for the disposal of combustion products, where the landfill is located at the same facility with the coal-fired generating unit or units producing the combustion products, and where the landfill is located wholly or partly on top of a facility that is, or was, being used for the disposal or storage of such combustion products, including, but not limited to, landfills, wet and dry ash ponds, and structural fill facilities.

…

(3a) "Commission" means the Environmental Management Commission.

…

(20) "Open dump" means any facility or site where solid waste is disposed of that is not a sanitary landfill and that is not a coal combustion residuals surface impoundment or a facility for the disposal of hazardous waste.

…

(35) "Solid waste" means any hazardous or nonhazardous garbage, refuse or sludge from a waste treatment plant, water supply treatment plant or air pollution control facility, domestic sewage and sludges generated by the treatment thereof in sanitary sewage collection, treatment and disposal systems, and other material that is either discarded or is being accumulated, stored or treated prior to being discarded, or has served its original intended use and is generally discarded, including solid, liquid, semisolid or contained gaseous material resulting from industrial, institutional, commercial and agricultural operations, and from community activities. Notwithstanding sub-sub-subdivision b.3. of this subdivision, the term includes coal combustion residuals. The term does not include:

a. Fecal waste from fowls and animals other than humans.

b. Solid or dissolved material in:

1. Domestic sewage and sludges generated by treatment thereof in sanitary sewage collection, treatment and disposal systems which are designed to discharge effluents to the surface waters.

2. Irrigation return flows.

3. Wastewater discharges and the sludges incidental to and generated by treatment which are point sources subject to permits granted under Section 402 of the Water Pollution Control Act, as amended (P.L. 92-500), and permits granted under G.S. 143-215.1 by the ~~Environmental Management Commission.~~ Commission, including coal combustion products. However, any sludges that meet the criteria for hazardous waste under RCRA shall also be a solid waste for the purposes of this Article.

…."

SECTION 3.(e) The initial members of the Coal Ash Management Commission established pursuant to G.S. 130A-309.202, as enacted by Section 3(a) of this act, whose qualifications are described in subdivisions (3), (4), and (9) of G.S. 130A-309.202(b), shall be appointed for an initial term of two years beginning effective July 1, 2014, and subsequent appointments shall be for six-year terms. The initial members of the Coal Ash Management Commission established pursuant to G.S. 130A-309.202, as enacted by Section 3(a) of this act, whose qualifications are described in subdivisions (1), (6), and (8) of G.S. 130A-309.202(b), shall be appointed for an initial term of four years beginning effective July 1, 2014, and subsequent appointments shall be for six-year terms. The initial members of the Coal Ash Management Commission established pursuant to G.S. 130A-309.202, as enacted by Section 3(a) of this act, whose qualifications are described in subdivisions (2), (5), and (7) of G.S. 130A-309.202(b), shall be appointed for an initial term of six years beginning effective July 1, 2014, and subsequent appointments shall be for six-year terms.

SECTION 3.(f) This section is effective when it becomes law. G.S. 130A-309.202, as enacted by Section 3(a) of this act, is repealed June 30, 2030. Subpart 3 of Part 2I of Article 9 of the General Statutes, as enacted by Section 3(a) of this act, applies to the use of coal combustion products as structural fill contracted for on or after that date. The first report due under G.S. 130A-309.210, as enacted by Section 3(a) of this act, is due November 1, 2014. Members to be appointed pursuant to G.S. 130A-309.202(b), as enacted by Section 3(a) of this act, shall be appointed no later than October 1, 2014.

PART III. MORATORIUMS AND STUDY ON (1) USE OF COAL COMBUSTION PRODUCTS AS STRUCTURAL FILL AND (2) CONSTRUCTION OR EXPANSION OF COMBUSTION PRODUCTS LANDFILLS

SECTION 4.(a) Notwithstanding 15A NCAC 13B .1701, et seq., and except as provided in Section 4(b) of this act, the use of coal combustion products, as defined in

G.S. 130A-309.201, as structural fill is prohibited until August 1, 2015, in order to allow the Department of Environment and Natural Resources, the Environmental Management Commission, and the General Assembly time to review and evaluate the use of coal combustion residuals as structural fill.

SECTION 4.(b) Coal combustion products may be used as structural fill for any of the following types of projects:

(1) A project where the structural fill is used with a base liner, leachate collection system, cap liner, or groundwater monitoring system and where the constructor or operator establishes financial assurance, as required by G.S. 130A–309.217.

(2) As the base or sub-base of a concrete or asphalt paved road constructed under the authority of a public entity.

SECTION 4.(c) The use of coal combustion products (i) as structural fill as authorized by Section 4(b) of this act shall be conducted in accordance with the requirements of Subpart 3 of Part 2I of Article 9 of the General Statutes, as enacted by Section 3(a) of this act, and (ii) for other beneficial uses shall be conducted in accordance 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), as applicable.

SECTION 4.(d) The Department of Environment and Natural Resources and the Environmental Management Commission shall jointly review Subpart 3 of Part 2I of Article 9 of the General Statutes, as enacted by Section 3(a) of this act, and 15A NCAC 13B .1701, et seq. In conducting this review, the Department and Commission shall do all of the following:

(1) Review the uses of coal combustion products as structural fill and the regulation of this use under Subpart 3 of Part 2I of Article 9 of the General Statutes, as enacted by Section 3(a) of this act, to determine if the requirements are sufficient to protect public health, safety, and welfare; the environment; and natural resources.

(2) Review the uses of coal combustion products for other beneficial uses and the regulation of these uses under 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 .1200 of Subchapter T of Chapter 2 of Title 15A of the North Carolina Administrative Code (Coal Combustion Products Management), and other applicable rules, to determine if the rules are sufficient to protect public health, safety, and welfare; the environment; and natural resources.

(3) Evaluate additional opportunities for the use of coal combustion products as structural fill and for other beneficial uses that would reduce the volume of coal combustion residuals that are being disposed of in coal combustion residuals landfills, industrial landfills, or municipal solid waste landfills while still being protective of public health, safety, and welfare; the environment; and natural resources.

(4) Monitor any actions of the United States Environmental Protection Agency regarding the use of coal combustion products as structural fill or for other beneficial uses.

(5) Jointly report to the Environmental Review Commission no later than January 15, 2015, on their findings and recommendations regarding the use of coal combustion products as structural fill and for other beneficial uses.

SECTION 4.(e) All electric generating facilities owned by a public utility that produce coal combustion residuals and coal combustion products shall issue a request for proposals on or before December 31, 2014, for (i) the conduct of a market analysis for the concrete industry and other industries that might beneficially use coal combustion residuals and coal combustion products; (ii) the study of the feasibility and advisability of installation of technology to convert existing and newly generated coal combustion residuals to commercial-grade coal combustion products suitable for use in the concrete industry and other industries that might beneficially use coal combustion residuals; and (iii) an examination of all innovative technologies that might be applied to diminish, recycle or reuse, or mitigate the impact of existing and newly generated coal combustion residuals. All electric generating facilities shall present the materials and information received in response to a request for proposals issued pursuant to this section and an assessment of the materials and information, including a forecast of specific actions to be taken in response to the materials and information received, to the Environmental Management Commission and the Coal Ash Management Commission on or before August 1, 2016.

SECTION 4.(f) This section is effective when it becomes law and applies to the use of coal combustion residuals as structural fill contracted for on or after that date.

SECTION 5.(a) There is hereby established a moratorium on construction of new or expansion of existing coal combustion residuals landfills, as defined by G.S. 130A-290(2c) and amended by Section 3(d) of this act. The purpose of this moratorium is to allow the State to assess the risks to public health, safety, and welfare; the environment; and natural resources of coal combustion residuals impoundments located beneath coal combustion residuals landfills to determine the advisability of continued operation of these landfills.

SECTION 5.(b) The Department of Environment and Natural Resources shall evaluate each coal combustion residuals landfill currently operating in the State and, in particular, assess the risks to public health, safety, and welfare; the environment; and natural resources, of coal combustion residuals surface impoundments located beneath coal combustion residuals landfills to determine the advisability of continued operation of these landfills. The Department shall report to the Environmental Review Commission no later than January 15, 2015, on its findings and recommendations concerning the risk assessment of each of these sites and the advisability of continued operation of coal combustion residuals landfills.

SECTION 5.(c) This section is effective when it becomes law and expires August 1, 2015.

PART IV. STRENGTHEN THE REPORTING AND NOTIFICATION REQUIREMENTS APPLICABLE TO DISCHARGES OF WASTEWATER TO WATERS OF THE STATE; REQUIRE CERTAIN EMERGENCY CALLS TO BE RECORDED

SECTION 6.(a) G.S. 143-215.1C reads as rewritten:

"**§ 143-215.1C. Report to wastewater system customers on system performance; <u>report discharge of untreated wastewater to the Department;</u> publication of notice of discharge of untreated wastewater and waste.**

(a) Report to Wastewater System Customers. – The owner or operator of any wastewater collection or treatment works, the operation of which is primarily to collect or treat municipal or domestic wastewater and for which a permit is issued under this Part and having an average annual flow greater than 200,000 gallons per day, shall provide to the users or customers of the collection system or treatment works and to the Department an annual report that summarizes the performance of the collection system or treatment works and the extent to which the collection system or treatment works has violated the permit or federal or State laws, regulations, or rules related to the protection of water quality. The report shall be prepared on either a calendar or fiscal year basis and shall be provided no later than 60 days after the end of the calendar or fiscal year.

<u>(a1) Report Discharge of Untreated Wastewater to the Department. – The owner or operator of any wastewater collection or treatment works for which a permit is issued under this Part shall report a discharge of 1,000 gallons or more of untreated wastewater to the surface waters of the State to the Department as soon as practicable, but no later than 24 hours after the owner or operator has determined that the discharge has reached the surface waters of the State. This reporting requirement shall be in addition to any other reporting requirements applicable to the owner or operator of the wastewater collection or treatment works.</u>

(b) Publication of Notice of Discharge of Untreated Wastewater. – The owner or operator of any wastewater collection or treatment works, the operation of which is primarily to collect or treat municipal or domestic wastewater and for which a permit is issued under this Part shall:

(1) In the event of a discharge of 1,000 gallons or more of untreated wastewater to the surface waters of the State, issue a press release to all print and electronic news media that provide general coverage in the county where the discharge occurred setting out the details of the discharge. The owner or operator shall issue the press release within ~~48~~ <u>24</u> hours after the owner or operator has determined that the discharge has reached the surface waters of

the State. The owner or operator shall retain a copy of the press release and a list of the news media to which it was distributed for at least one year after the discharge and shall provide a copy of the press release and the list of the news media to which it was distributed to any person upon request.

(2) In the event of a discharge of 15,000 gallons or more of untreated wastewater to the surface waters of the State, publish a notice of the discharge in a newspaper having general circulation in the county in which the discharge occurs and in each county downstream from the point of discharge that is significantly affected by the discharge. The Secretary shall determine, at the Secretary's sole discretion, which counties are significantly affected by the discharge and shall approve the form and content of the notice and the newspapers in which the notice is to be published. The notice shall be captioned "NOTICE OF DISCHARGE OF UNTREATED SEWAGE". The owner or operator shall publish the notice within 10 days after the Secretary has determined the counties that are significantly affected by the discharge and approved the form and content of the notice and the newspapers in which the notice is to be published. The owner or operator shall file a copy of the notice and proof of publication with the Department within 30 days after the notice is published. Publication of a notice of discharge under this subdivision is in addition to the requirement to issue a press release under subdivision (1) of this subsection.

(c) Publication of Notice of Discharge of Untreated Waste. – The owner or operator of any wastewater collection or treatment works, other than a wastewater collection or treatment works the operation of which is primarily to collect or treat municipal or domestic wastewater, for which a permit is issued under this Part shall:

(1) In the event of a discharge of 1,000 gallons or more of untreated waste to the surface waters of the State, issue a press release to all print and electronic news media that provide general coverage in the county where the discharge occurred setting out the details of the discharge. The owner or operator shall issue the press release within ~~48~~ <u>24</u> hours after the owner or operator has determined that the discharge has reached the surface waters of the State. The owner or operator shall retain a copy of the press release and a list of the news media to which it was distributed for at least one year after the discharge and shall provide a copy of the press release and the list of the news media to which it was distributed to any person upon request.

(2) In the event of a discharge of 15,000 gallons or more of untreated waste to the surface waters of the State, publish a notice of the discharge in a newspaper having general circulation in the county in which the discharge occurs and in each county downstream from the point of discharge that is significantly affected by the discharge. The Secretary shall determine, at the Secretary's sole discretion, which counties are significantly affected by the discharge and shall approve the form and content of the notice and the newspapers in which the notice is to be published. The notice shall be captioned "NOTICE OF DISCHARGE OF UNTREATED WASTE". The owner or operator shall publish the notice within 10 days after the Secretary has determined the counties that are significantly affected by the discharge and approved the form and content of the notice and the newspapers in which the notice is to be published. The owner or operator shall file a copy of the notice and proof of publication with the Department within 30 days after the notice is published. Publication of a notice of discharge under this subdivision is in addition to the requirement to issue a press release under subdivision (1) of this subsection."

SECTION 6.(b) Section 6(a) of this act becomes effective October 1, 2014.

SECTION 6.(c) G.S. 166A-19.12(16) reads as rewritten:

"(16) Establishing and operating a 24-hour Operations Center to serve as a single point of contact for local governments to report the occurrence of emergency and disaster events and to coordinate local and State response assets.<u> The Division shall record all telephone calls to the 24-hour Operations Center</u>

emergency hotline and shall maintain the recording of each telephone call for at least one year."

PART V. REQUIRE NOTIFICATION OF THE DEPARTMENT OF EMERGENCY DAM REPAIRS; REQUIRE EMERGENCY ACTION PLANS FOR CERTAIN DAMS; REQUIRE INSPECTION OF DAMS AT COAL COMBUSTION RESIDUALS SURFACE IMPOUNDMENTS

SECTION 7. G.S. 143-215.27 reads as rewritten:

"**§ 143-215.27. Repair, alteration, or removal of dam.**

(a) Before commencing the repair, alteration or removal of a dam, application shall be made for written approval by the Department, except as otherwise provided by this Part. The application shall state the name and address of the applicant, shall adequately detail the changes it proposes to effect and shall be accompanied by maps, plans and specifications setting forth such details and dimensions as the Department requires. The Department may waive any such requirements. The application shall give such other information concerning the dam and reservoir required by the Department, such information concerning the safety of any change as it may require, and shall state the proposed time of commencement and completion of the work. When an application has been completed it may be referred by the Department for agency review and report, as provided by subsection (b) of G.S. 143-215.26 in the case of original construction.

(b) When emergency repairs are necessary to safeguard life and property they may be started immediately but the Department shall be notified ~~forthwith~~ of the proposed repairs and of the work ~~under way, and they~~underway as soon as possible, but not later than 24 hours after first knowledge of the necessity for the emergency repairs, and the emergency repairs shall be made to conform to ~~its~~ the Department's orders."

SECTION 7.1. Part 3 of Article 21 of Chapter 143 of the General Statutes is amended by adding a new section to read:

"**§ 143-215.27A. Closure of coal combustion residuals surface impoundments to render such facilities exempt from the North Carolina Dam Safety Law of 1967.**

(a) Decommissioning Request. – The owner of a coal combustion residuals surface impoundment, as defined by G.S. 130A-309.201, that seeks to decommission the impoundment shall submit a Decommissioning Request to the Division of Energy, Mineral, and Land Resources of the Department requesting that the facility be decommissioned. The Decommissioning Request shall include, at a minimum, all of the following:

(1) A proposed geotechnical investigation plan scope of work. Upon preliminary plan approval pursuant to subsection (b) of this section, the owner shall proceed with necessary field work and submit a geotechnical report with site-specific field data indicating that the containment dam and material impounded by the containment dam are stable, and that the impounded material is not subject to liquid flow behavior under expected static and dynamic loading conditions. Material testing should be performed along the full extent of the containment dam and in a pattern throughout the area of impounded material.

(2) A topographic map depicting existing conditions of the containment dam and impoundment area at two-foot contour intervals or less.

(3) If the facility contains areas capable of impounding by topography, a breach plan must be included that ensures that there shall be no place within the facility capable of impounding. The breach plan shall include, at a minimum, proposed grading contours superimposed on the existing topographic map as well as necessary engineering calculations, construction details, and construction specifications.

(4) A permanent vegetation and stabilization or capping plan by synthetic liner or other means, if needed. These plans shall include at minimum, proposed grading contours superimposed on the existing topographic map where applicable as well as necessary engineering calculations, construction details, construction specifications, and all details for the establishment of surface area stabilization.

(5) A statement indicating that the impoundment facility has not received sluiced coal combustion residuals for at least three years and that there are

no future plans to place coal combustion residuals in the facility by sluicing methods. The Division of Energy, Mineral, and Land Resources may waive the three-year requirement if proper evidence is presented by a North Carolina registered professional engineer indicating that the impounded material is not subject to liquid flow behavior.

(b) Preliminary Review and Approval. – The Decommissioning Request shall undergo a preliminary review by the Division for completeness and approval of the proposed geotechnical investigation plan scope of work. The owner shall be notified by letter with results of the preliminary review, including approval or revision requests relative to the proposed scope of work included in the geotechnical investigation plan. Upon receipt of a letter issued by the Division approving the preliminary geotechnical plan scope of work, the owner may proceed with field work and development of the geotechnical report.

(c) Final Determination and Approval. – Upon receipt of the geotechnical report, the Division shall complete the submittal review as provided in this subsection.

(1) If it is determined that sufficient evidence has been presented to clearly show that the facility no longer functions as a dam in its current state, a letter decommissioning the facility shall be issued by the Division, and the facility shall no longer be under jurisdiction of the Dam Safety Law of 1967.
(2) If modifications such as breach construction or implementation of a permanent vegetation or surface lining plan are needed, such plans shall be reviewed per standard procedures for consideration of a letter of approval to modify or breach.
(3) If approved, such plans shall follow standard procedure for construction, including construction supervision by a North Carolina registered professional engineer, as-built submittal by a North Carolina registered professional engineer, and follow up final inspection by the Division.
(4) Final approval shall be issued by the Division in the form of a letter decommissioning the facility, and the facility shall no longer be under jurisdiction of the Dam Safety Law of 1967."

SECTION 8.(a) G.S. 143-215.31 reads as rewritten:

"**§ 143-215.31. Supervision over maintenance and operation of dams.**

(a) The Commission shall have jurisdiction and supervision over the maintenance and operation of dams to safeguard life and property and to satisfy minimum streamflow requirements. The Commission may adopt standards for the maintenance and operation of dams as may be necessary for the purposes of this Part. The Commission may vary the standards applicable to various dams, giving due consideration to the minimum flow requirements of the stream, the type and location of the structure, the hazards to which it may be exposed, and the peril of life and property in the event of failure of a dam to perform its function.

(a1) The owner of a dam classified by the Department as a high-hazard dam or an intermediate-hazard dam shall develop an Emergency Action Plan for the dam as provided in this subsection.

(1) The owner of the dam shall submit a proposed Emergency Action Plan for the dam within 90 days after the dam is classified as a high-hazard dam or an intermediate-hazard dam to the Department and the Department of Public Safety for their review and approval. The Department and the Department of Public Safety shall approve the Emergency Action Plan if they determine that it complies with the requirements of this subsection and will protect public health, safety, and welfare; the environment; and natural resources.
(2) The Emergency Action Plan shall include, at a minimum, all of the following:
    a. A description of potential emergency conditions that could occur at the dam, including security risks.
    b. A description of actions to be taken in response to an emergency condition at the dam.
    c. Emergency notification procedures to aid in warning and evacuations during an emergency condition at the dam.
    d. A downstream inundation map depicting areas affected by a dam failure and sudden release of the impoundment.

(3) The owner of the dam shall update the Emergency Action Plan annually and shall submit it to the Department and the Department of Public Safety for their review and approval within one year of the prior approval.

(4) The Department shall provide a copy of the Emergency Action Plan to the regional offices of the Department that might respond to an emergency condition at the dam.

(5) The Department of Public Safety shall provide a copy of the Emergency Action Plan to all local emergency management agencies that might respond to an emergency condition at the dam.

(6) Information included in an Emergency Action Plan that constitutes sensitive public security information, as provided in G.S. 132-1.7, shall be maintained as confidential information and shall not be subject to disclosure under the Public Records Act. For purposes of this section, "sensitive public security information" shall include Critical Energy Infrastructure Information protected from disclosure under rules adopted by the Federal Energy Regulatory Commission in 18 C.F.R. § 333.112.

…."

SECTION 8.(b) Notwithstanding G.S. 143-215.31, as amended by Section 8(a) of this act, the owners of all high-hazard dams and intermediate-hazard dams in operation on the effective date of this act shall submit their proposed Emergency Action Plans to the Department of Environment and Natural Resources and the Department of Public Safety no later than March 1, 2015.

SECTION 8.(c) G.S. 143-215.30 reads as rewritten:

"**§ 143-215.30. Notice of completion; certification of final ~~approval.~~approval; notice of transfer.**

(a) Immediately upon completion, enlargement, repair, alteration or removal of a dam, notice of completion shall be given the Commission. As soon as possible thereafter supplementary drawings or descriptive matter showing or describing the dam as actually constructed shall be filed with the Department in such detail as the Commission may require.

(b) When an existing dam is enlarged, the supplementary drawings and descriptive matter need apply only to the new work.

(c) The completed work shall be inspected by the supervising engineers, and upon finding that the work has been done as required and that the dam is safe and satisfies minimum streamflow requirements, they shall file with the Department a certificate that the work has been completed in accordance with approved design, plans, specifications and other requirements. Unless the Commission has reason to believe that the dam is unsafe or is not in compliance with any applicable rule or law, the Commission shall grant final approval of the work in accordance with the certificate, subject to such terms as it deems necessary for the protection of life and property.

(d) Pending issuance of the Commission's final approval, the dam shall not be used except on written consent of the Commission, subject to conditions it may impose.

(e) The owner of a dam shall provide written notice of transfer to the Department within 30 days after title to the dam has been legally transferred. The notice of transfer shall include the name and address of the new dam owner."

SECTION 9. Section 3(b) of S.L. 2009-390 reads as rewritten:

"**SECTION 3.(b)** Any impoundments or other facilities that were in use ~~on the effective date of this section~~January 1, 2010, in connection with nonnuclear electric generating facilities under the jurisdiction of the North Carolina Utilities Commission, and that had been exempted under the provisions of G.S. 143-215.25A(4), prior to ~~amendment by Section 3(a) of this act,~~ January 1, 2010, shall be deemed to have received all of the necessary approvals from the Department of Environment and Natural Resources and the ~~Commission for Dam Safety, and shall not be required to submit application, certificate, or other materials in connection with the continued normal operation and maintenance of those facilities.~~Environmental Management Commission."

SECTION 10. G.S. 143-215.32 reads as rewritten:

"**§ 143-215.32. Inspection of dams.**

(a) The Department may at any time inspect any dam, including a dam that is otherwise exempt from this Part, upon receipt of a written request of any affected person or agency, or upon a motion of the Environmental Management Commission. Within the limits of available funds the Department shall endeavor to provide for inspection of all dams at intervals of approximately five years.

(a1) Coal combustion residuals surface impoundments, as defined by G.S. 130A-309.201, shall be inspected as provided in this subsection:

(1) The Department shall inspect each dam associated with a coal combustion residuals surface impoundment at least annually.

(2) The owner of a coal combustion residuals surface impoundment shall inspect the impoundment weekly and after storms to detect evidence of any of the following conditions:

a. Deterioration, malfunction, or improper operation of spillway control systems.

b. Sudden drops in the level of the contents of the impoundment.

c. Severe erosion or other signs of deterioration in dikes or other containment devices or structures.

d. New or enlarged seeps along the downstream slope or toe of the dike or other containment devices or structures.

e. Any other abnormal conditions at the impoundment that could pose a risk to public health, safety, or welfare; the environment; or natural resources.

(3) If any of the conditions described in subdivision (2) of this subsection are observed, the owner shall provide documentation of the conditions to the Department and a registered professional engineer. The registered professional engineer shall investigate the conditions and, if necessary, develop a plan of corrective action to be implemented by the owner of the impoundment. The owner of the impoundment shall provide documentation of the completed corrective action to the Department.

(4) The owner of a coal combustion residuals surface impoundment shall provide for the annual inspection of the impoundment by an independent registered professional engineer to ensure that the structural integrity and the design, operation, and maintenance of the impoundment is in accordance with generally accepted engineering standards. Within 30 days of the inspection, the owner shall provide to the Department the inspection report and a certification by the engineer that the impoundment is structurally sound and that the design, operation, and maintenance of the impoundment is in accordance with generally accepted engineering standards. The owner and the Department shall each place the inspection report and certification on a publicly accessible Internet Web site.

(b) If the Department upon inspection finds that any dam is not sufficiently strong, is not maintained in good repair or operating condition, is dangerous to life or property, or does not satisfy minimum streamflow requirements, the Department shall present its findings to the Commission and the Commission may issue an order directing the owner or owners of the dam to make at his or her expense maintenance, alterations, repairs, reconstruction, change in construction or location, or removal as may be deemed necessary by the Commission within a time limited by the order, not less than 90 days from the date of issuance of each order, except in the case of extreme danger to the safety of life or property, as provided by subsection (c) of this section.

(c) If at any time the condition of any dam becomes so dangerous to the safety of life or property, in the opinion of the Environmental Management Commission, as not to permit sufficient time for issuance of an order in the manner provided by subsection (b) of this section, the Environmental Management Commission may immediately take such measures as may be essential to provide emergency protection to life and property, including the lowering of the level of a reservoir by releasing water impounded or the destruction in whole or in part of the dam or reservoir. The Environmental Management Commission may recover the costs of such measures from the owner or owners by appropriate legal action.

(d) An order issued under this Part shall be served on the owner of the dam as provided in G.S. 1A-1, Rule 4."

PART VI. TRANSFER SOLID WASTE RULE-MAKING AUTHORITY FROM COMMISSION FOR PUBLIC HEALTH TO ENVIRONMENTAL MANAGEMENT COMMISSION

SECTION 11.(a) G.S. 130A-29 reads as rewritten:

"**§ 130A-29. Commission for Public Health – Creation, powers and duties.**

…

(c) The Commission shall adopt rules:

(1) Repealed by Session Laws 1983 (Regular Session, 1984), c. 1022, s. 5.

(2) Establishing standards for approving sewage-treatment devices and holding tanks for marine toilets as provided in G.S. 75A-6(o).

(3) Establishing specifications for sanitary privies for schools where water-carried sewage facilities are unavailable as provided in G.S. 115C-522.

(4) Establishing requirements for the sanitation of local confinement facilities as provided in Part 2 of Article 10 of Chapter 153A of the General Statutes.

(5) Repealed by Session Laws 1989 (Regular Session, 1990), c. 1075, s. 1.

(5a) Establishing eligibility standards for participation in Department reimbursement programs.

(6) ~~Requiring proper treatment and disposal of sewage and other waste from chemical and portable toilets.~~

(7) Establishing statewide health outcome objectives and delivery standards.

(8) Establishing permit requirements for the sanitation of premises, utensils, equipment, and procedures to be used by a person engaged in tattooing, as provided in Part 11 of Article 8 of this Chapter.

(9) Implementing immunization requirements for adult care homes as provided in G.S. 131D-9 and for nursing homes as provided in G.S. 131E-113.

(10) Pertaining to the biological agents registry in accordance with G.S. 130A-479.

(11) For matters within its jurisdiction that allow for and regulate horizontal drilling and hydraulic fracturing for the purpose of oil and gas exploration and development.

…."

SECTION 11.(b) G.S. 130A-291.1 reads as rewritten:

"**§ 130A-291.1. Septage management program; permit fees.**

…

(d) Septage shall be treated and disposed only at a wastewater system that has been approved by the Department under rules adopted by the Commission ~~or by the Environmental Management Commission~~ or at a site that is permitted by the Department under this section. A permit shall be issued only if the site satisfies all of the requirements of the rules adopted by the Commission.

…."

SECTION 11.(c) G.S. 130A-294(a)(4) reads as rewritten:

"**§ 130A-294. Solid waste management program.**

(a) The Department is authorized and directed to engage in research, conduct investigations and surveys, make inspections and establish a statewide solid waste management program. In establishing a program, the Department shall have authority to:

…

(4) a. Develop a permit system governing the establishment and operation of solid waste management facilities. A landfill with a disposal area of 1/2 acre or less for the on-site disposal of land clearing and inert debris is exempt from the permit requirement of this section and shall be governed by G.S. 130A-301.1. Demolition debris from the decommissioning of manufacturing buildings, including electric generating stations, that is disposed of on the same site as the decommissioned buildings, is exempt from the permit requirement of this section and rules adopted pursuant to this section and shall be governed by G.S. 130A-301.3. The Department shall not approve an application for a new permit, the renewal of a permit, or a substantial amendment to a permit for a sanitary landfill, excluding demolition

landfills as defined in the rules of the Commission, except as provided in subdivisions (3) and (4) of subsection (b1) of this section. No permit shall be granted for a solid waste management facility having discharges that are point sources until the Department has referred the complete plans and specifications to the ~~Environmental Management~~ Commission and has received advice in writing that the plans and specifications are approved in accordance with the provisions of G.S. 143-215.1. In any case where the Department denies a permit for a solid waste management facility, it shall state in writing the reason for denial and shall also state its estimate of the changes in the applicant's proposed activities or plans that will be required for the applicant to obtain a permit.

b. Repealed by Session Laws 2007-550, s. 1(a), effective August 1, 2007.

c. The Department shall deny an application for a permit for a solid waste management facility if the Department finds that:

1. Construction or operation of the proposed facility would be inconsistent with or violate rules adopted by the Commission.
2. Construction or operation of the proposed facility would result in a violation of water quality standards adopted by the ~~Environmental Management~~ Commission pursuant to G.S. 143-214.1 for waters, as defined in G.S. 143-213.
3. Construction or operation of the facility would result in significant damage to ecological systems, natural resources, cultural sites, recreation areas, or historic sites of more than local significance. These areas include, but are not limited to, national or State parks or forests; wilderness areas; historic sites; recreation areas; segments of the natural and scenic rivers system; wildlife refuges, preserves, and management areas; areas that provide habitat for threatened or endangered species; primary nursery areas and critical fisheries habitat designated by the Marine Fisheries Commission; and Outstanding Resource Waters designated by the ~~Environmental Management~~ Commission.

…."

SECTION 11.(d) G.S. 130A-300 reads as rewritten:

"**§ 130A-300. Effect on laws applicable to water pollution control.**

This Article shall not be considered as amending, repealing or in any manner abridging or interfering with those sections of the General Statutes of North Carolina relative to the control of water pollution as now administered by the ~~Environmental Management~~ Commission nor shall the provisions of this Article be construed as being applicable to or in any way affecting the authority of the ~~Environmental Management~~ Commission to control the discharges of wastes to the waters of the State as provided in Articles 21 and 21A, Chapter 143 of the General Statutes."

SECTION 11.(e) G.S. 130A-302 reads as rewritten:

"**§ 130A-302. Sludge deposits at sanitary landfills.**

Sludges generated by the treatment of wastewater discharges which are point sources subject to permits granted under Section 402 of the Federal Water Pollution Act, as amended (P.L. 92-500), or permits generated under G. S. 143-215.1 by the ~~Environmental Management~~ Commission shall not be deposited in or on a sanitary landfill permitted under this Article unless in a compliance with the rules concerning solid waste adopted under this Article."

SECTION 11.(f) G.S. 130A-310.3 reads as rewritten:

"**§ 130A-310.3. Remedial action programs for inactive hazardous substance or waste disposal sites.**

…

(b) Where possible, the Secretary shall work cooperatively with any owner, operator, responsible party, or any appropriate agency of the State or federal government to develop and implement the inactive hazardous substance or waste disposal site remedial action program. The Secretary shall not take action under this section to the extent that the ~~Environmental~~

~~Management~~ Commission, the Commissioner of Agriculture, or the Pesticide Board has assumed jurisdiction pursuant to Articles 21 or 21A of Chapter 143 of the General Statutes.

…

(d) In any inactive hazardous substance or waste disposal site remedial action program implemented hereunder, the Secretary shall ascertain the most nearly applicable cleanup standard as would be applied under CERCLA/SARA, and may seek federal approval of any such program to insure concurrent compliance with federal standards. State standards may exceed and be more comprehensive than such federal standards. The Secretary shall assure concurrent compliance with applicable standards set by the ~~Environmental Management~~ Commission.

…."

SECTION 11.(g) G.S. 130A-310.4(g) reads as rewritten:

"(g) The Commission ~~on Health Services [Commission for Public Health]~~ shall adopt rules prescribing the form and content of the notices required by this section. The proposed remedial action plan shall include a summary of all alternatives considered in the development of the plan. A record shall be maintained of all comment received by the Department regarding the remedial action plan."

SECTION 11.(h) G.S. 130A-310.31(b)(5) reads as rewritten:

"(5) "Unrestricted use standards" when used in connection with "cleanup", "remediated", or "remediation" means contaminant concentrations for each environmental medium that are considered acceptable for all uses and that comply with generally applicable standards, guidance, or established methods governing the contaminants that are established by statute or adopted, published, or implemented by the ~~Environmental Management Commission, the Commission,~~ Commission or the Department instead of the site-specific contaminant levels established pursuant to this Part."

SECTION 11.(i) G.S. 130A-310.65 reads as rewritten:

"**§ 130A-310.65. Definitions.**

As used in this Part:

(1) "Background standard" means the naturally occurring concentration of a substance in the absence of the release of a contaminant.

(2) ~~"Commission" means the Environmental Management Commission created pursuant to G.S. 143B-282.~~

…

(12) "Unrestricted use standards" means contaminant concentrations for each environmental medium that are acceptable for all uses; that are protective of public health, safety, and welfare and the environment; and that comply with generally applicable standards, guidance, or methods established by statute or adopted, published, or implemented by the ~~Commission, the Commission for Public Health,~~ Commission or the Department."

SECTION 11.(j) G.S. 113-391(a)(5)f. reads as rewritten:

"f. Management of wastes produced in connection with oil and gas exploration and development and use of horizontal drilling and hydraulic fracturing treatments for that purpose. Such rules shall address storage, transportation, and disposal of wastes that may contain radioactive materials or wastes that may be toxic or have other hazardous wastes' characteristics that are not otherwise regulated as a hazardous waste by the federal Resource Conservation and Recovery Act (RCRA), such as top-hole water, brines, drilling fluids, additives, drilling muds, stimulation fluids, well servicing fluids, oil, production fluids, and drill cuttings from the drilling, alteration, production, plugging, or other activity associated with oil and gas wells. Wastes generated in connection with oil and gas exploration and development and use of horizontal drilling and hydraulic fracturing treatments for that purpose that constitute hazardous waste under RCRA shall be subject to rules adopted by the Environmental Management Commission ~~for Public Health~~ to implement RCRA requirements in the State."

SECTION 11.(k) G.S. 113-415 reads as rewritten:

"**§ 113-415. Conflicting laws.**

No provision of this Article shall be construed to repeal, amend, abridge or otherwise ~~affect: (i)~~ affect the authority and ~~responsibility~~responsibility (i) vested in the Environmental Management Commission by Article 7 of Chapter 87 of the General Statutes, pertaining to the location, construction, repair, operation and abandonment of ~~wells, or the authority and responsibility~~ wells; (ii) vested in the Environmental Management Commission related to the control of water and air pollution as provided in Articles 21 and 21A of Chapter 143 of the General Statutes; ~~or (ii) the authority or responsibility~~(iii) vested in the Department and the Environmental Management Commission ~~for Public Health~~ by Article 10 of Chapter 130A of the General Statutes pertaining to public water-supply ~~requirements,~~requirements; or ~~the authority and responsibility~~(iv) vested in the Environmental Management Commission ~~for Public Health~~ related to the management of solid and hazardous waste as provided in Article 9 of Chapter 130A of the General Statutes."

SECTION 11.(l) The Revisor of Statutes shall make any conforming statutory changes necessary to reflect the transfer of rule-making authority under Article 9 of Chapter 130A of the General Statutes from the Commission for Public Health to the Environmental Management Commission.

SECTION 11.(m) The Codifier of Rules shall make any conforming rule changes necessary to reflect the transfer of rule-making authority under Article 9 of Chapter 130A of the General Statutes from the Commission for Public Health to the Environmental Management Commission.

PART VII. AMEND COMPLIANCE BOUNDARY PROVISIONS

SECTION 12.(a) G.S. 143-215.1 reads as rewritten:

"**§ 143-215.1. Control of sources of water pollution; permits required.**

…

(i) Any person subject to the requirements of this section who is required to obtain an individual permit from the Commission for a disposal system under the authority of G.S. 143-215.1 or Chapter 130A of the General Statutes shall have a compliance boundary as may be established by rule or permit for various categories of disposal systems and beyond which groundwater quality standards may not be exceeded.~~ The location of the compliance boundary shall be established at the property boundary, except as otherwise established by the Commission.~~ Multiple contiguous properties under common ownership and permitted for use as a disposal system shall be treated as a single property with regard to determination of a compliance ~~boundary under this subsection. Nothing in this subsection shall be interpreted to require a revision to an existing compliance boundary previously approved by rule or permit.~~boundary.

(j) ~~When operation of a disposal system permitted under this section results in an exceedance of the groundwater quality standards adopted in accordance with G.S. 143-214.1, the Commission shall require that the exceedances within the compliance boundary be remedied through cleanup, recovery, containment, or other response only when any of the following conditions occur:~~

~~(1) A violation of any water quality standard in adjoining classified waters of the State occurs or can be reasonably predicted to occur considering hydrogeological conditions, modeling, or any other available evidence.~~

~~(2) An imminent hazard or threat to the environment, public health, or safety exists.~~

~~(3) A violation of any standard in groundwater occurring in the bedrock, including limestone aquifers in Coastal Plain sediments, unless it can be demonstrated that the violation will not adversely affect, or have the potential to adversely affect, a water supply well.~~

(k) Where operation of a disposal system permitted under this section results in exceedances of the groundwater quality standards at or beyond the compliance ~~boundary established under subsection (i) of this section, exceedances shall be remedied through cleanup, recovery, containment, or other response as directed by the Commission.~~boundary, the Commission shall require the permittee to undertake corrective action, without regard to the date that the system was first permitted, to restore the groundwater quality by assessing the cause, significance, and extent of the violation of standards and submit the results of the investigation and a plan and proposed schedule for corrective action to the Director or the

Director's designee. The permittee shall implement the plan as approved by, and in accordance with, a schedule established by the Director or the Director's designee. In establishing a schedule the Director or the Director's designee shall consider any reasonable schedule proposed by the permittee."

SECTION 12.(b) Section 46(b) of S.L. 2013-413 is repealed.

SECTION 12.(c) The Environmental Management Commission shall review the compliance boundary and corrective action provisions of Subchapter 2L of Title 15A of the North Carolina Administrative Code for clarity and internal consistency. The Commission shall report the results of its review, including any recommendations, to the Environmental Review Commission no later than December 1, 2014.

PART VIII. OTHER STUDIES

SECTION 13.(a) The Coal Ash Management Commission, established pursuant to G.S. 130A-309.202, as enacted by Section 3(a) of this act, shall study whether and under what circumstances no further action or natural attenuation is appropriate for a coal combustion residuals surface impoundment that is classified as low-risk pursuant to G.S. 130A-309.211, as enacted by Section 3(a) of this act. In conducting this study, the Commission shall specifically consider whether there is any contact or interaction between coal combustion residuals and groundwater and surface water, whether the area has reverted to a natural state as evidenced by the presence of wildlife and vegetation, and whether no further action or natural attenuation would be protective of public health, safety, and welfare; the environment; and natural resources. The Commission shall report the results of its study, including any recommendations, to the Environmental Review Commission no later than October 1, 2015.

SECTION 13.(b) The Department of Environment and Natural Resources shall review and make recommendations on all deadlines established under Part 2I of Article 9 of Chapter 130A of the General Statutes, as enacted by Section 3(a) of this act. At a minimum, the Department shall identify all permits that may be required for closure requirements established under this act and expected time frames for issuance of these permits. The Department shall report the results of its study, including any recommendations, to the Environmental Review Commission no later than December 1, 2014.

SECTION 13.(c) The Coal Ash Management Commission, established pursuant to G.S. 130A-309.202, as enacted by Section 3(a) of this act, shall study how to promote, incentivize, and prioritize the beneficial use of coal combustion products over the disposal of coal combustion residuals. The Commission shall report the results of its study, including any recommendations, to the Environmental Review Commission no later than December 1, 2014.

SECTION 14. The Department of Transportation shall evaluate additional opportunities for the use of coal combustion products in the construction and maintenance of roads and bridges within the State. The Department shall report the results of its study, including any recommendations, to the Environmental Review Commission and the Joint Legislative Transportation Oversight Committee no later than December 1, 2014.

PART IX. PROVIDE RESOURCES FOR IMPLEMENTATION OF THIS ACT

SECTION 15.(a) Article 14 of Chapter 62 of the General Statutes is amended by adding a new section to read:

"**§ 62-302.1. Regulatory fee for combustion residuals surface impoundments.**

(a) Fee Imposed. – Each public utility with a coal combustion residuals surface impoundment shall pay a regulatory fee for the purpose of defraying the costs of oversight of coal combustion residuals. The fee is in addition to the fee imposed under G.S. 62-302. The fees collected under this section shall only be used to pay the expenses of the Coal Ash Management Commission and the Department of Environment and Natural Resources in providing oversight of coal combustion residuals.

(b) Rate. – The combustion residuals surface impoundment fee shall be three-hundredths of one percent (0.03%) of the North Carolina jurisdictional revenues of each public utility with a coal combustion residuals surface impoundment. For the purposes of this section, the term "North Carolina jurisdictional revenues" has the same meaning as in G.S. 62-302.

(c) When Due. – The fee shall be paid in quarterly installments. The fee is payable to the Coal Ash Management Commission on or before the 15th of the second month following the end of each quarter. Each public utility subject to this fee shall, on or before the date the fee is due for each quarter, prepare and render a report on a form prescribed by the Commission. The report shall state the public utility's total North Carolina jurisdictional revenues for the preceding quarter and shall be accompanied by any supporting documentation that the Coal Ash Management Commission may by rule require. Receipts shall be reported on an accrual basis.

(d) Use of Proceeds. – A special fund in the Office of State Treasurer and the Coal Ash Management Commission is created. The fees collected pursuant to this section and all other funds received by the Coal Ash Management Commission shall be deposited in the Coal Combustion Residuals Management Fund. The Fund shall be placed in an interest-bearing account, and any interest or other income derived from the Fund shall be credited to the Fund. Moneys in the Fund shall only be spent pursuant to appropriation by the General Assembly. The Commission shall be subject to the provisions of the State Budget Act, except that no unexpended surplus of the Coal Combustion Residuals Management Fund shall revert to the General Fund. All funds credited to the Fund shall be used only to pay the expenses of the Coal Ash Management Commission and the Department of Environment and Natural Resources in providing oversight of coal combustion residuals.

(e) Recovery of Fee. – The North Carolina Utilities Commission shall not allow an electric public utility to recover this fee from the retail electric customers of the State."

SECTION 15.(b) Notwithstanding G.S. 62-302.1, as enacted by this section, for the first two quarters of fiscal year 2014-2015, each public utility shall pay the fee in G.S. 62-302.1 on a monthly basis. The fee shall be paid by the 15th of the following month.

SECTION 15.(c) Twenty-five receipt-supported positions are created in the Department of Environment and Natural Resources to carry out the duties in Part 2I of Article 9 of Chapter 130A of the General Statutes. There is appropriated from the Coal Combustion Residuals Management Fund the sum of one million seven hundred fifty thousand dollars ($1,750,000) to the Department of Environment and Natural Resources to support the positions for the 2014-2015 fiscal year.

SECTION 15.(d) Five receipt-supported positions are created in the Division of Emergency Management of the Department of Public Safety to carry out the duties in G.S. 130A-309.202. The funds remaining in the Coal Combustion Residuals Management Fund after the appropriation to the Department of Environment and Natural Resources are appropriated to the Department of Public Safety for the 2014-2015 fiscal year. These positions shall be used to provide assistance to the Coal Ash Management Commission established by G.S. 130A-309.202, as enacted by Section 3(a) of this act. The positions shall be assigned in the following manner: one of the positions shall be the executive director of the staff, two positions shall be assigned as analysts, one position shall be assigned as a technician, and one position shall be assigned as administrative. The Division of Emergency Management in the Department of Public Safety shall consult with the Chair of the Commission in hiring the staff for the Coal Ash Management Commission. The Division of Emergency Management in the Department of Public Safety shall provide support to the Commission until the staff of the Commission is hired, including the designation of an individual to serve as an interim executive director of the staff.

SECTION 15.(e) Subsection (a) of this section becomes effective July 1, 2014, and expires April 1, 2030, and applies to jurisdictional revenues earned on or after July 1, 2014, and before April 1, 2030. The remainder of this section becomes effective July 1, 2014.

PART X. SPECIFICATIONS FOR USE OF COAL COMBUSTION PRODUCTS IN PUBLIC PROCUREMENT

SECTION 16. Article 3 of Chapter 143 of the General Statutes is amended by adding a new section to read:

"**§ 143-58.6. Specifications for use of coal combustion products.**

(a) State Construction Office to Develop Technical Specifications. – The State Construction Office shall develop recommended technical specifications for the use of coal combustion products that may be utilized in any construction by all State departments, institutions, agencies, community colleges, and local school administrative units, other than the Department of Transportation. The technical specifications shall address all products used in construction, including, but not limited to, the use of coal combustion products in concrete and cement products and in construction fill.

(b) Department of Transportation to Develop Technical Specifications. – The Department of Transportation shall develop recommended technical specifications for the use of coal combustion products that may be utilized in any construction by the Department of Transportation. The technical specifications shall address all products used in construction, including, but not limited to, the use of coal combustion products in concrete and cement products and in construction fill.

(c) Specification Factors. – The State Construction Office and the Department of Transportation shall consider safety, best practice engineering standards, quality, cost, and availability of an in-State source of coal combustion products in developing the recommended technical specifications pursuant to this section.

(d) Consultation. – The State Construction Office and the Department of Transportation shall consult with each other in the development of the recommended technical specifications pursuant to the provisions of this section in order to ensure that the recommended technical standards are uniform for similar types of construction. The goal of the Department of Administration and the Department of Transportation shall be to increase the usage and consumption of coal combustion products in their respective construction projects.

(e) Report of Recommended Specifications. – The State Construction Office and the Department of Transportation shall report the recommended technical specifications developed pursuant to this section to the Environmental Review Commission and the Joint Legislative Transportation Oversight Committee on or before February 1, 2015."

PART XI. SEVERABILITY CLAUSE AND EFFECTIVE DATE

SECTION 17. If any provision of this act or its application is held invalid, the invalidity does not affect other provisions or applications of this act that can be given effect without the invalid provisions or application, and to this end the provisions of this act are severable.

SECTION 18. Except as otherwise provided, this act is effective when it becomes law.

In the General Assembly read three times and ratified this the 20th day of August, 2014.

s/ Daniel J. Forest President of the Senate

s/ Thom Tillis
Speaker of the House of Representatives

This bill having been presented to the Governor for signature on the 20th day of August, 2014 and the Governor having failed to approve it within the time prescribed by law, the same is hereby declared to have become a law. This 20th day of September, 2014.

s/ Karen Jenkins Enrolling Clerk

GENERAL ASSEMBLY OF NORTH CAROLINA
SESSION 2015

I/A

SESSION LAW 2016-95
HOUSE BILL 630

A BILL TO BE ENTITLED

AN ACT TO (1) REQUIRE A COAL COMBUSTION RESIDUALS IMPOUNDMENT OWNER TO PROVIDE PERMANENT ALTERNATIVE WATER SUPPLIES FOR RESIDENTS IN AREAS SURROUNDING COAL COMBUSTION RESIDUALS SURFACE IMPOUNDMENTS; (2) REPEAL STATUTORY PROVISIONS RELATED TO THE COAL ASH MANAGEMENT COMMISSION; (3) MODIFY THE CLOSURE REQUIREMENTS FOR COAL COMBUSTION RESIDUALS SURFACE IMPOUNDMENTS UNDER THE COAL ASH MANAGEMENT ACT OF 2014; AND (4) MODIFY APPOINTMENTS TO THE MINING COMMISSION AND THE OIL AND GAS COMMISSION.

The General Assembly of North Carolina enacts:

SECTION 1. Part 2I of Article 9 of Chapter 130A of the General Statutes reads as rewritten:

"Part 2I. Coal Ash Management.

"Subpart 1. Short Title, Definitions, and General Provisions.

"§ 130A-309.200. Title.

This Part may be cited as the "Coal Ash Management Act of 2014."

"§ 130A-309.201. Definitions.

Unless a different meaning is required by the context, the definitions of G.S. 130A-290 and the following definitions apply throughout this Part:

(1) "Beneficial and beneficial use" means projects promoting public health and environmental protection, offering equivalent success relative to other alternatives, and preserving natural resources.

(2) "Boiler slag" means the molten bottom ash collected at the base of slag tap and cyclone type furnaces that is quenched with water. It is made up of hard, black, angular particles that have a smooth, glassy appearance.

(3) "Bottom ash" means the agglomerated, angular ash particles formed in pulverized coal furnaces that are too large to be carried in the flue gases and collect on the furnace walls or fall through open grates to an ash hopper at the bottom of the furnace.

(4) "Coal combustion products" it means fly ash, bottom ash, boiler slag, or flue gas desulfurization materials that are beneficially used, including use for structural fill.

(5) "Coal combustion residuals" has the same meaning as defined in G.S. 130A-290.

(6) "Coal combustion residuals surface impoundment" means a topographic depression, excavation, or diked area that is (i) primarily formed from earthen materials; (ii) without a base liner approved for use by Article 9 of Chapter 130A of the General Statutes or rules adopted thereunder for a combustion products landfill or coal combustion residuals landfill, industrial landfill, or municipal solid waste landfill; and (iii) designed to hold accumulated coal combustion residuals in the form of liquid wastes, wastes containing free liquids, or sludges, and that is not backfilled or otherwise covered during periods of deposition. "Coal combustion residuals surface impoundment" shall only include impoundments owned by a public utility, as defined in G.S. 62-3. "Coal combustion residuals surface impoundment" includes all of the following:

a. An impoundment that is dry due to the deposited liquid having evaporated, volatilized, or leached.

b. An impoundment that is wet with exposed liquid.

c. Lagoons, ponds, aeration pits, settling ponds, tailings ponds, and sludge pits, when these structures are designed to hold accumulated coal combustion residuals.

d. A coal combustion residuals surface impoundment that has been covered with soil or other material after the final deposition of coal combustion residuals at the impoundment.

(7) ~~"Commission" means the Coal Ash Management Commission.~~

(8) "Flue gas desulfurization material" means the material produced through a process used to reduce sulfur dioxide emissions from the exhaust gas system of a coal-fired boiler. The physical nature of these materials varies from a wet sludge to a dry powdered material, depending on the process, and their composition comprises either sulfites, sulfates, or a mixture thereof.

(9) "Fly ash" means the very fine, powdery material, composed mostly of silica with nearly all particles spherical in shape, which is a product of burning finely ground coal in a boiler to produce electricity and is removed from the plant exhaust gases by air emission control devices.

(10) "Minerals" means soil, clay, coal, phosphate, metallic ore, and any other solid material or substance of commercial value found in natural deposits on or in the earth.

(11) "Open pit mine" means an excavation made at the surface of the ground for the purpose of extracting minerals, inorganic and organic, from their natural deposits, which excavation is open to the surface.

(12) "Owner" or "owner of a coal combustion residuals surface impoundment" means a public utility, as defined in G.S. 62-3, that owns a coal combustion residuals surface impoundment.

(13) "Receptor" means any human, plant, animal, or structure which is, or has the potential to be, affected by the release or migration of contaminants. Any well constructed for the purpose of monitoring groundwater and contaminant concentrations shall not be considered a receptor.

(14) "Structural fill" means an engineered fill with a projected beneficial end use constructed using coal combustion products that are properly placed and compacted. For purposes of this Part, the term includes fill used to reclaim open pit mines and for embankments, greenscapes, foundations, construction foundations, and for bases or sub-bases under a structure or a footprint of a paved road, parking lot, sidewalk, walkway, or similar structure.

(15) "Use or reuse of coal combustion products" means the procedure whereby coal combustion products are directly used as either of the following:

a. As an ingredient in an industrial process to make a product, unless distinct components of the coal combustion products are recovered as separate end products.

b. In a function or application as an effective substitute for a commercial product or natural resource.

"~~**§ 130A-309.202. (Repealed effective June 30, 2030) Coal Ash Management Commission.**~~

~~(a) Creation. – In recognition of the complexity and magnitude of the issues associated with the management of coal combustion residuals and the proper closure and remediation of coal combustion residuals surface impoundments, the Coal Ash Management Commission is hereby established.~~

~~(b) Membership. – The Commission shall consist of nine members as follows:~~

~~(1) One appointed by the General Assembly upon recommendation of the President Pro Tempore of the Senate in accordance with G.S. 120-121 who shall at the time of appointment be a resident of the State.~~

~~(2) One appointed by the General Assembly upon recommendation of the President Pro Tempore of the Senate in accordance with G.S. 120-121 who shall at the time of appointment have special training or scientific expertise in waste management, including solid waste disposal, hauling, or beneficial use.~~

~~(3) One appointed by the General Assembly upon recommendation of the President Pro Tempore of the Senate in accordance with G.S. 120-121 who shall at the time of appointment be a licensed physician or a person with experience in public health.~~

~~(4) One appointed by the General Assembly upon recommendation of the Speaker of the House of Representatives in accordance with G.S. 120-121 who shall at the time of appointment be a member of a nongovernmental conservation interest.~~

~~(5) One appointed by the General Assembly upon recommendation of the Speaker of the House of Representatives in accordance with G.S. 120-121 who shall at the time of appointment have special training or scientific expertise in waste management, including solid waste disposal, hauling, or beneficial use, or is a representative of or on the faculty of a State college or university that conducts coal ash research.~~

~~(6) One appointed by the General Assembly upon recommendation of the Speaker of the House of~~

~~Representatives in accordance with G.S. 120-121 who shall at the time of appointment be a representative of an electric membership corporation organized under Article 2 of Chapter 117 of the General Statutes and have a background in power supply resource planning and engineering.~~

~~(7) One appointed by the Governor who shall at the time of appointment have experience in economic development.~~

~~(8) One appointed by the Governor who shall at the time of appointment have expertise in determining and evaluating the costs associated with electricity generation and establishing the rates associated with electricity consumption.~~

~~(9) One appointed by the Governor who shall at the time of appointment be a person with experience in science or engineering in the manufacturing sector.~~

~~(c) Chair. – The Governor shall appoint the Chair of the Commission from among the Commission's members, and that person shall serve at the pleasure of the Governor. The Chair shall serve two-year terms. The Governor shall make:~~

~~(1) The initial appointment of the Chair no later than October 1, 2014. If the initial appointment is not made by that date, the Chair shall be elected by a vote of the membership; and~~

~~(2) Appointments of a subsequent Chair, including appointments to fill a vacancy of the Chair created by resignation, dismissal, death, or disability of the Chair, no later than 30 days after the last day of the previous Chair's term. If an appointment of a subsequent Chair is not made by that date, the Chair shall be elected by a vote of the membership.~~

~~(d) Vacancies. – Any appointment to fill a vacancy on the Commission created by the resignation, dismissal, death, or disability of a member shall be for the balance of the unexpired term. The Governor may reappoint a gubernatorial appointee of the Commission to an additional term if, at the time of the reappointment, the member qualifies for membership on the Commission under subdivisions (7) through (9) of subsection (b) of this section. Appointments by the General Assembly shall be made in accordance with G.S. 120-121, and vacancies in those appointments shall be filled in accordance with G.S. 120-122.~~

~~(e) Removal. – The Governor shall have the power to remove any member of the Commission from office for misfeasance, malfeasance, or nonfeasance in accordance with the provisions of G.S. 143B-13 of the Executive Organization Act of 1973.~~

~~(f) Powers and Duties. – The Commission shall have all of the following powers and duties:~~

~~(1) To review and approve the classification of coal combustion residuals surface impoundments required by G.S. 130A-309.213.~~

~~(2) To review and approve Coal Combustion Residuals Surface Impoundment Closure Plans as provided in G.S. 130A-309.214.~~

~~(3) To review and make recommendations on the provisions of this Part and other statutes and rules related to the management of coal combustion residuals.~~

~~(4) To undertake any additional studies as requested by the General Assembly.~~

~~(g) Reimbursement. – The members of the Commission shall receive per diem and necessary travel and subsistence expenses in accordance with the provisions of G.S. 138-5.~~

~~(h) Quorum. – Five members of the Commission shall constitute a quorum for the transaction of business.~~

~~(i) Staff. – The Commission is authorized and empowered to employ staff as the Commission may determine to be necessary for the proper discharge of the Commission's duties and responsibilities. The Chair of the Commission shall organize and direct the work of the Commission staff. The salaries and compensation of all such personnel shall be fixed in the manner provided by law for fixing and regulating salaries and compensation by other State agencies. The Chair, within allowed budgetary limits and as allowed by law, shall authorize and approve travel, subsistence, and related expenses of such personnel incurred while traveling on official business. All State agencies, including the constituent institutions of The University of North Carolina, shall provide information and support to the Commission upon request.~~

~~(j) Repealed by Session Laws 2015-9, s. 1.1, effective April 27, 2015.~~

~~(k) Covered Persons; Conflicts of Interest; Disclosure. – All members of the Commission are covered persons for the purposes of Chapter 138A of the General Statutes, the State Government Ethics Act. As covered persons, members of the Commission shall comply with the applicable requirements of the State Government Ethics Act, including mandatory training, the public disclosure of economic interests, and ethical standards for covered persons. Members of the Commission shall comply with the provisions of the State Government Ethics Act to avoid conflicts of interest. The Governor may require additional disclosure of potential conflicts of interest by members. The Governor~~

~~may promulgate criteria regarding conflicts of interest and disclosure thereof for determining the eligibility of persons under this subsection, giving due regard to the requirements of federal legislation, and, for this purpose, may promulgate rules, regulations, or guidelines in conformance with those established by any federal agency interpreting and applying provisions of federal law.~~

~~(l) Meetings. – The Commission shall meet at least once every two months and may hold special meetings at any time and place within the State at the call of the Chair or upon the written request of at least five members.~~

~~(m) Reports. – The Commission shall submit quarterly written reports as to its operation, activities, programs, and progress to the Environmental Review Commission. The Commission shall supplement the written reports required by this subsection with additional written and oral reports as may be requested by the Environmental Review Commission. The Commission shall submit the written reports required by this subsection whether or not the General Assembly is in session at the time the report is due.~~

~~(n) Administrative Location; Independence. – The Commission shall be administratively located in the Division of Emergency Management of the Department of Public Safety. The Commission shall exercise all of its powers and duties independently and shall not be subject to the supervision, direction, or control of the Division or Department.~~

~~(o) Terms of Members. – Members of the Commission shall serve terms of six years, beginning effective July 1 of the year of appointment.~~

"§ 130A-309.203. Expedited permit review.

(a) The Department shall act as expeditiously as practicable, but no later than the deadlines established under subsection (b) of this section, except in compliance with subsection (c) of this section, to issue all permits necessary to conduct activities required by this Part.

(b) Notwithstanding G.S. 130A-295.8(e), the Department shall determine whether an application for any permit necessary to conduct activities required by this Part is complete within 30 days after the Department receives the application for the permit. A determination of completeness means that the application includes all required components but does not mean that the required components provide all of the information that is required for the Department to make a decision on the application. If the Department determines that an application is not complete, the Department shall notify the applicant of the components needed to complete the application. An applicant may submit additional information to the Department to cure the deficiencies in the application. The Department shall make a final determination as to whether the application is complete within the later of (i) 30 days after the Department receives the application for the permit less the number of days that the applicant uses to provide the additional information or (ii) 10 days after the Department receives the additional information from the applicant. The Department shall issue a draft permit decision on an application for a permit within 90 days after the Department determines that the application is complete. The Department shall hold a public hearing and accept written comment on the draft permit decision for a period of not less than 30 or more than 60 days after the Department issues a draft permit decision. The Department shall issue a final permit decision on an application for a permit within 60 days after the comment period on the draft permit decision closes. If the Department fails to act within any time period set out in this subsection, the applicant may treat the failure to act as a denial of the permit and may challenge the denial as provided in Chapter 150B of the General Statutes.

(c) If the Department finds that compliance with the deadlines established under subsection (b) of this section would result in insufficient review of a permit application that would pose a risk to public health, safety, and welfare; the environment; or natural resources, the applicable deadline shall be waived for the application as necessary to allow for adequate review. If a deadline is waived pursuant to this subsection, the Secretary shall issue a written declaration, including findings of fact, documenting the need for the waiver.

(d) Notwithstanding any other provision of this section or any other provision of law, the Department shall either issue or deny a permit required for dewatering of a retired impoundment within 90 days of receipt of a completed application, in such a form and including such information as the Department may prescribe, for the dewatering activities. The Department shall accept written comment on a draft permit decision for a period of not less than 30 days or more than 60 days prior to issuance or denial of such a permit. If the Department fails to act within any time period set out in this subsection, the applicant may treat the failure to act as a denial of the permit and may challenge the denial as provided in Chapter 150B of the General Statutes.

"§ 130A-309.204. Reports.

(a) The Department shall submit quarterly written reports to the Environmental Review Commission ~~and the Coal Ash Management Commission~~ on its operations, activities, programs, and progress with respect to its obligations under this Part concerning all coal combustion residuals surface impoundments. At a minimum, the report shall include information concerning the status of assessment, corrective action, prioritization, and closure for each coal combustion residuals surface impoundment and information on costs connected therewith. The report shall include an executive summary of each annual Groundwater Protection and Restoration Report submitted to the Department by the operator of any coal combustion residuals surface impoundments pursuant to G.S. 130A-309.211(d) and a summary of all groundwater sampling, protection, and restoration activities related to the impoundment for the preceding year. The report shall also include an executive summary of each annual Surface Water Protection and Restoration Report submitted to the Department by the operator of any coal combustion residuals surface impoundments pursuant to G.S. 130A-309.212(e) and a summary of all surface water sampling, protection, and restoration activities related to the impoundment for the preceding year, including the status of the identification, assessment, and correction of unpermitted discharges from coal combustion residuals surface impoundments to the surface waters of the State. The Department shall supplement the written reports required by this subsection with additional written and oral reports as may be requested by the Environmental Review Commission. The Department shall submit the written reports required by this subsection whether or not the General Assembly is in session at the time the report is due.

(b) On or before October 1 of each year, the Department shall report to each member of the General Assembly who has a coal combustion residuals surface impoundment in the member's district. This report shall include the location of each impoundment in the member's district, the amount of coal combustion residuals known or believed to be located in the impoundment, the last action taken at the impoundment, and the date of that last action.

(c) On or before October 1 of each year, a public utility generating coal combustion residuals and coal combustion products shall submit an annual summary to the Department. The annual summary shall be for the period of July 1 through June 30 and shall include all of the following:

(1) The volume of coal combustion residuals and products produced.
(2) The volume of coal combustion residuals disposed.
(3) The volume of coal combustion products used in structural fill projects.
(4) The volume of coal combustion products beneficially used, other than for structural fill.

"§ 130A-309.205. Local ordinances regulating management of coal combustion residuals and coal combustion products invalid; petition to preempt local ordinance.

(a) It is the intent of the General Assembly to maintain a uniform system for the management of coal combustion residuals and coal combustion products, including matters of disposal and beneficial use, and to place limitations upon the exercise by all units of local government in North Carolina of the power to regulate the management of coal combustion residuals and coal combustion products by means of ordinances, property restrictions, zoning regulations, or otherwise. Notwithstanding any authority granted to counties, municipalities, or other local authorities to adopt local ordinances, including those imposing taxes, fees, or charges or regulating health, environment, or land use, all provisions of local ordinances, including those regulating land use, adopted by counties, municipalities, or other local authorities that regulate or have the effect of regulating the management of coal combustion residuals and coal combustion products, including regulation of carbon burn-out plants, within the jurisdiction of a local government are invalidated and unenforceable, to the extent necessary to effectuate the purposes of this Part, that do the following:

(1) Place any restriction or condition not placed by this Part upon management of coal combustion residuals or coal combustion products within any county, city, or other political subdivision.
(2) Conflict or are in any manner inconsistent with the provisions of this Part.

(a1) As used in this section, "Commission" means the Environmental Management Commission.

(b) If a local zoning or land-use ordinance imposes requirements, restrictions, or conditions that are generally applicable to development, including, but not limited to, setback, buffer, and stormwater requirements, and coal combustion residuals and coal combustion products would be regulated under the ordinance of general applicability, the operator of the proposed activities may petition the Environmental Management Commission to review the matter. After receipt of a petition, the Commission shall hold a hearing in accordance with the procedures in subsection (c) of this section and shall determine whether or to what extent to preempt the local ordinance to allow for the management of coal combustion residuals and coal combustion products.

(c) When a petition described in subsection (b) of this section has been filed with the Environmental Management Commission, the Commission shall hold a public hearing to consider the petition. The public hearing shall be held in the affected locality within 60 days after receipt of the petition by the Commission. The Commission shall give notice of the public hearing by both of the following means:

(1) Publication in a newspaper or newspapers having general circulation in the county or counties where the activities are to be conducted, once a week for three consecutive weeks, the first notice appearing at least 30 days prior to the scheduled date of the hearing.
(2) First-class mail to persons who have requested notice. The Commission shall maintain a mailing list

of persons who request notice in advance of the hearing pursuant to this section. Notice by mail shall be complete upon deposit of a copy of the notice in a postage-paid wrapper addressed to the person to be notified at the address that appears on the mailing list maintained by the Commission in a post office or official depository under the exclusive care and custody of the United States Postal Service.

(d) Any interested person may appear before the Environmental Management Commission at the hearing to offer testimony. In addition to testimony before the Commission, any interested person may submit written evidence to the Commission for the Commission's consideration. At least 20 days shall be allowed for receipt of written comment following the hearing.

(e) A local zoning or land-use ordinance is presumed to be valid and enforceable to the extent the zoning or land-use ordinance imposes requirements, restrictions, or conditions that are generally applicable to development, including, but not limited to, setback, buffer, and stormwater requirements, unless the Environmental Management Commission makes a finding of fact to the contrary. The Commission shall determine whether or to what extent to preempt local ordinances so as to allow the project involving management of coal combustion residuals and coal combustion products no later than 60 days after conclusion of the hearing. The Commission shall preempt a local ordinance only if the Commission makes all of the following findings:

(1) That there is a local ordinance that would regulate the management of coal combustion residuals and coal combustion products.

(2) That all legally required State and federal permits or approvals have been issued by the appropriate State and federal agencies or that all State and federal permit requirements have been satisfied and that the permits or approvals have been denied or withheld only because of the local ordinance.

(3) That local citizens and elected officials have had adequate opportunity to participate in the permitting process.

(4) That the project involving management of coal combustion residuals and coal combustion products will not pose an unreasonable health or environmental risk to the surrounding locality and that the operator has taken or consented to take reasonable measures to avoid or manage foreseeable risks and to comply to the maximum feasible extent with applicable local ordinances.

(f) If the Environmental Management Commission does not make all of the findings under subsection (e) of this section, the Commission shall not preempt the challenged local ordinance. The Commission's decision shall be in writing and shall identify the evidence submitted to the Commission plus any additional evidence used in arriving at the decision.

(g) The decision of the Environmental Management Commission shall be final, unless a party to the action files a written appeal under Article 3 of Chapter 150B of the General Statutes, as modified by this section, within 30 days of the date of the decision. The record on appeal shall consist of all materials and information submitted to or considered by the Commission, the Commission's written decision, a complete transcript of the hearing, the specific findings required by subsection (e) of this section, and any minority positions on the specific findings required by subsection (e) of this section. The scope of judicial review shall be as set forth in G.S. 150B-51, except as this subsection provides regarding the record on appeal.

(h) If the court reverses or modifies the decision of the Environmental Management Commission, the judge shall set out in writing, which writing shall become part of the record, the reasons for the reversal or modification.

(i) In computing any period of time prescribed or allowed by the procedure in this section, the provisions of Rule 6(a) of the Rules of Civil Procedure, G.S. 1A-1, shall apply.

"§ 130A-309.206. Federal preemption; severability.

The provisions of this Part shall be severable, and if any phrase, clause, sentence, or provision is declared to be unconstitutional or otherwise invalid or is preempted by federal law or regulation, the validity of the remainder of this Part shall not be affected thereby.

"§ 130A-309.207. General rule making for Part.

The Environmental Management Commission shall adopt rules as necessary to implement the provisions of the Part. Such rules shall be exempt from the requirements of G.S. 150B-19.3.

"§ 130A-309.208: Reserved for future codification purposes.

"§ 130A-309.209: Reserved for future codification purposes.

"Subpart 2. Management of Coal Ash Residuals; Closure of Coal Ash Impoundments.

"§ 130A-309.210. Generation, disposal, and use of coal combustion residuals.

(a) On or after October 1, 2014, the construction of new and expansion of existing coal combustion residuals surface impoundments is prohibited.

(b) On or after October 1, 2014, the disposal of coal combustion residuals into a coal combustion residuals surface impoundment at an electric generating facility where the coal-fired generating units are no longer producing coal combustion residuals is prohibited.

(c) On or after December 31, 2018, the discharge of stormwater into a coal combustion surface impoundment at an electric generating facility where the coal-fired generating units are no longer producing coal combustion residuals is prohibited.

(d) On or after December 31, 2019, the discharge of stormwater into a coal combustion surface impoundment at an electric generating facility where the coal-fired generating units are actively producing coal combustion residuals is prohibited.

(e) On or before December 31, 2018, all electric generating facilities owned by a public utility shall convert to the disposal of "dry" fly ash or the facility shall be retired. For purposes of this subsection, the term "dry" means coal combustion residuals that are not in the form of liquid wastes, wastes containing free liquids, or sludges.

(f) On or before December 31, 2019, all electric generating facilities owned by a public utility shall convert to the disposal of "dry" bottom ash or the facility shall be retired. For purposes of this subsection, the term "dry" means coal combustion residuals that are not in the form of liquid wastes, wastes containing free liquids, or sludges.

"§ 130A-309.211. Groundwater assessment and corrective action; drinking water supply well survey and provision of alternate water supply; reporting.

(a) Groundwater Assessment of Coal Combustion Residuals Surface Impoundments. – The owner of a coal combustion residuals surface impoundment shall conduct groundwater monitoring and assessment as provided in this subsection. The requirements for groundwater monitoring and assessment set out in this subsection are in addition to any other groundwater monitoring and assessment requirements applicable to the owners of coal combustion residuals surface impoundments:

(1) No later than December 31, 2014, the owner of a coal combustion residuals surface impoundment shall submit a proposed Groundwater Assessment Plan for the impoundment to the Department for its review and approval. The Groundwater Assessment Plan shall, at a minimum, provide for all of the following:
   a. A description of all receptors and significant exposure pathways.
   b. An assessment of the horizontal and vertical extent of soil and groundwater contamination for all contaminants confirmed to be present in groundwater in exceedance of groundwater quality standards.
   c. A description of all significant factors affecting movement and transport of contaminants.
   d. A description of the geological and hydrogeological features influencing the chemical and physical character of the contaminants.
   e. A schedule for continued groundwater monitoring.
   f. Any other information related to groundwater assessment required by the Department.

(2) The Department shall approve the Groundwater Assessment Plan if it determines that the Plan complies with the requirements of this subsection and will be sufficient to protect public health, safety, and welfare; the environment; and natural resources.

(3) No later than 10 days from approval of the Groundwater Assessment Plan, the owner shall begin implementation of the Plan.

(4) No later than 180 days from approval of the Groundwater Assessment Plan, the owner shall submit a Groundwater Assessment Report to the Department. The Report shall describe all exceedances of groundwater quality standards associated with the impoundment.

(b) Corrective Action for the Restoration of Groundwater Quality. – The owner of a coal combustion residuals surface impoundment shall implement corrective action for the restoration of groundwater quality as provided in this subsection. The requirements for corrective action for the restoration of groundwater quality set out in this subsection are in addition to any other corrective action for the restoration of groundwater quality requirements applicable to the owners of coal combustion residuals surface impoundments:

(1) No later than 90 days from submission of the Groundwater Assessment Report required by subsection (a) of this section, or a time frame otherwise approved by the Department not to exceed 180 days from submission of the Groundwater Assessment Report, the owner of the coal combustion residuals surface impoundment shall submit a proposed Groundwater Corrective Action Plan to the Department for its review and approval. The Groundwater Corrective Action Plan shall provide for the restoration of groundwater in conformance with the requirements of Subchapter L of Chapter 2 of

Title 15A of the North Carolina Administrative Code. The Groundwater Corrective Action Plan shall include, at a minimum, all of the following:

a. A description of all exceedances of the groundwater quality standards, including any exceedances that the owner asserts are the result of natural background conditions.

b. A description of the methods for restoring groundwater in conformance with the requirements of Subchapter L of Chapter 2 of Title 15A of the North Carolina Administrative Code and a detailed explanation of the reasons for selecting these methods.

c. Specific plans, including engineering details, for restoring groundwater quality.

d. A schedule for implementation of the Plan.

e. A monitoring plan for evaluating the effectiveness of the proposed corrective action and detecting movement of any contaminant plumes.

f. Any other information related to groundwater assessment required by the Department.

(2) The Department shall approve the Groundwater Corrective Action Plan if it determines that the Plan complies with the requirements of this subsection and will be sufficient to protect public health, safety, and welfare; the environment; and natural resources.

(3) No later than 30 days from the approval of the Groundwater Corrective Action Plan, the owner shall begin implementation of the Plan in accordance with the Plan's schedule.

(c) Drinking Water Supply Well Survey and Provision of Alternate Water Supply. – No later than October 1, 2014, the owner of a coal combustion residuals surface impoundment shall conduct a Drinking Water Supply Well Survey that identifies all drinking water supply wells within one-half mile down-gradient from the established compliance boundary of the impoundment and submit the Survey to the Department. The Survey shall include well locations, the nature of water uses, available well construction details, and information regarding ownership of the wells. No later than December 1, 2014, the Department shall determine, based on the Survey, which drinking water supply wells the owner is required to sample and how frequently and for what period sampling is required. The Department shall require sampling for drinking water supply wells where data regarding groundwater quality and flow and depth in the area of any surveyed well provide a reasonable basis to predict that the quality of water from the surveyed well may be adversely impacted by constituents associated with the presence of the impoundment. No later than January 1, 2015, the owner shall initiate sampling and water quality analysis of the drinking water supply wells. A property owner may elect to have an independent third party selected from a laboratory certified by the Department's Wastewater/Groundwater Laboratory Certification program sample wells located on their property in lieu of sampling conducted by the owner of the coal combustion residuals surface impoundment. The owner of the coal combustion residuals surface impoundment shall pay for the reasonable costs of such sampling. Nothing in this subsection shall be construed to preclude or impair the right of any property owner to refuse such sampling of wells on their property. If the sampling and water quality analysis indicates that water from a drinking water supply well exceeds groundwater quality standards for constituents associated with the presence of the impoundment, the owner shall replace the contaminated drinking water supply well with an alternate supply of potable drinking water and an alternate supply of water that is safe for other household uses. The alternate supply of potable drinking water shall be supplied within 24 hours of the Department's determination that there is an exceedance of groundwater quality standards attributable to constituents associated with the presence of the impoundment. The alternate supply of water that is safe for other household uses shall be supplied within 30 days of the Department's determination that there is an exceedance of groundwater quality standards attributable to constituents associated with the presence of the impoundment. The requirement to replace a contaminated drinking water supply well with an alternate supply of potable drinking water and an alternate supply of water that is safe for other household uses set out in this subsection is in addition to any other requirements to replace a contaminated drinking water supply well with an alternate supply of potable drinking water or an alternate supply of water that is safe for other household uses applicable to the owners of coal combustion residuals surface impoundments.

(c1) Provision of Permanent Water Supply. – As soon as practicable, but no later than October 15, 2018, the owner of a coal combustion residuals surface impoundment shall establish permanent replacement water supplies for (i) each household that has a drinking water supply well located within a one-half mile radius from the established compliance boundary of a coal combustion residuals impoundment, and is not separated from the impoundment by the mainstem of a river, as that term is defined under G.S. 143-215.22G, or other body of water that would prevent the migration of contaminants through groundwater from the impoundment to a well and (ii) each household that has a drinking water supply well that is located in an area in which contamination resulting from constituents associated with the presence of a coal combustion residuals impoundment is expected to migrate, as demonstrated by groundwater modeling and hydrogeologic, geologic, and geotechnical investigations of the site, conducted in accordance with the requirements of

G.S. 130A-309.214(a)(4), and the results of other modeling or investigations that may have been submitted pursuant to G.S. 130A-309.213(b)(4). Preference shall be given to permanent replacement water supplies by connection to public water supplies; provided that (i) a household may elect to receive a filtration system in lieu of a connection to public water supplies and (ii) if the Department determines that connection to a public water supply to a particular household would be cost-prohibitive, the Department shall authorize provision of a permanent replacement water supply to that household through installation of a filtration system. For households for which filtration systems are installed, the impoundment owner shall be responsible for periodic required maintenance of the filtration system. No later than December 15, 2016, an impoundment owner shall submit information on permanent replacement water supplies proposed to be provided to each household to the Department, including, at a minimum, the type of permanent water supply proposed; the location of the household and its proximity to the nearest connection point to a public water supply; projected cost of the permanent water supply option proposed for the household; and any proposal to connect to a public water supply. The Department shall evaluate information submitted by the impoundment owner and render a final decision to approve or disapprove the plan, including written findings of fact, no later than January 15, 2017. If disapproved, an impoundment owner shall resubmit a plan for the Department's approval within 30 days. No later than April 15, 2017, an impoundment owner shall notify all residents identified in the approved plan of their eligibility for establishment of a permanent water supply. Until such time as an impoundment owner has established a permanent water supply for each household required by this subsection, the impoundment owner shall supply the household with an alternate supply of potable drinking water and an alternate supply of water that is safe for other household uses. Nothing in this section shall be construed to (i) require an eligible household to connect to a public water supply or receive a filtration system or (ii) obviate the need for other federal, State, and local permits and approvals. All State entities and local governments shall expedite any permits and approvals required for such projects. The Department may grant an impoundment owner an extension of time, not to exceed one year, to establish permanent water supplies as required by this section, if the Department determines that it is infeasible for the impoundment owner to establish a permanent water supply for a household by October 15, 2018, based on limitations arising from local government resources, including limitations on water supply capacity and staffing limitations for permitting and construction activities.

(d) Reporting. – In addition to any other reporting required by the Department, the owner of a coal combustion residuals surface impoundment shall submit an annual Groundwater Protection and Restoration Report to the Department no later than January 31 of each year. The Report shall include a summary of all groundwater monitoring, protection, and restoration activities related to the impoundment for the preceding year, including the status of the Groundwater Assessment Plan, the Groundwater Assessment Report, the Groundwater Corrective Action Plan, the Drinking Water Supply Well Survey, and the replacement of any contaminated drinking water supply wells. ~~The owner of a coal combustion residuals surface impoundment shall also submit all information required to be submitted to the Department pursuant to this section to the Coal Ash Management Commission.~~

"§ 130A-309.212. Identification and assessment of discharges; correction of unpermitted discharges.

(a) Identification of Discharges from Coal Combustion Residuals Surface Impoundments. –

(1) The owner of a coal combustion residuals surface impoundment shall identify all discharges from the impoundment as provided in this subsection. The requirements for identifying all discharges from an impoundment set out in this subsection are in addition to any other requirements for identifying discharges applicable to the owners of coal combustion residuals surface impoundments.

(2) No later than December 31, 2014, the owner of a coal combustion residuals surface impoundment shall submit a topographic map that identifies the location of all (i) outfalls from engineered channels designed or improved for the purpose of collecting water from the toe of the impoundment and (ii) seeps and weeps discharging from the impoundment that are not captured by engineered channels designed or improved for the purpose of collecting water from the toe of the impoundment to the Department. The topographic map shall comply with all of the following:

a. Be at a scale as required by the Department.

b. Specify the latitude and longitude of each toe drain outfall, seep, and weep.

c. Specify whether the discharge from each toe drain outfall, seep, and weep is continuous or intermittent.

d. Provide an average flow measurement of the discharge from each toe drain outfall, seep, and weep including a description of the method used to measure average flow.

e. Specify whether the discharge from each toe drain outfall, seep, and weep identified reaches the surface waters of the State. If the discharge from a toe drain outfall, seep, or weep reaches the surface waters of the State, the map shall specify the latitude and longitude of where the discharge reaches the surface waters of the State.

f. Include any other information related to the topographic map required by the Department.

(b) Assessment of Discharges from Coal Combustion Residuals Surface Impoundments to the Surface Waters of the State. – The owner of a coal combustion residuals surface impoundment shall conduct an assessment of discharges from the coal combustion residuals surface impoundment to the surface waters of the State as provided in this subsection. The requirements for assessment of discharges from the coal combustion residuals surface impoundment to the surface waters of the State set out in this subsection are in addition to any other requirements for the assessment of discharges from coal combustion residuals surface impoundments to surface waters of the State applicable to the owners of coal combustion residuals surface impoundments:

(1) No later than December 31, 2014, the owner of a coal combustion residuals surface impoundment shall submit a proposed Discharge Assessment Plan to the Department. The Discharge Assessment Plan shall include information sufficient to allow the Department to determine whether any discharge, including a discharge from a toe drain outfall, seep, or weep, has reached the surface waters of the State and has caused a violation of surface water quality standards. The Discharge Assessment Plan shall include, at a minimum, all of the following:

a. Upstream and downstream sampling locations within all channels that could potentially carry a discharge.

b. A description of the surface water quality analyses that will be performed.

c. A sampling schedule, including the frequency and duration of sampling activities.

d. Reporting requirements.

e. Any other information related to the assessment of discharges required by the Department.

(2) The Department shall approve the Discharge Assessment Plan if it determines that the Plan complies with the requirements of this subsection and will be sufficient to protect public health, safety, and welfare; the environment; and natural resources.

(3) No later than 30 days from the approval of the Discharge Assessment Plan, the owner shall begin implementation of the Plan in accordance with the Plan's schedule.

(c) Corrective Action to Prevent Unpermitted Discharges from Coal Combustion Residuals Surface Impoundments to the Surface Waters of the State. – The owner of a coal combustion residuals surface impoundment shall implement corrective action to prevent unpermitted discharges from the coal combustion residuals surface impoundment to the surface waters of the State as provided in this subsection. The requirements for corrective action to prevent unpermitted discharges from coal combustion residuals surface impoundments to the surface waters of the State set out in this subsection are in addition to any other requirements for corrective action to prevent unpermitted discharges from coal combustion residuals surface impoundments to the surface waters of the State applicable to the owners of coal combustion residuals surface impoundments:

(1) If the Department determines, based on information provided pursuant to subsection (a) or (b) of this section, that an unpermitted discharge from a coal combustion residuals surface impoundment, including an unpermitted discharge from a toe drain outfall, seep, or weep, has reached the surface waters of the State, the Department shall notify the owner of the impoundment of its determination.

(2) No later than 30 days from a notification pursuant to subdivision (1) of this subsection, the owner of the coal combustion residuals surface impoundment shall submit a proposed Unpermitted Discharge Corrective Action Plan to the Department for its review and approval. The proposed Unpermitted Discharge Corrective Action Plan shall include, at a minimum, all of the following:

a. One of the following methods of proposed corrective action:

1. Elimination of the unpermitted discharge.

2. Application for a National Pollutant Discharge Elimination System (NPDES) permit amendment pursuant to G.S. 143-215.1 and Subchapter H of Chapter 2 of Title 15A of the North Carolina Administrative Code to bring the unpermitted discharge under permit regulations.

b. A detailed explanation of the reasons for selecting the method of corrective action.

c. Specific plans, including engineering details, to prevent the unpermitted discharge.

d. A schedule for implementation of the Plan.

e. A monitoring plan for evaluating the effectiveness of the proposed corrective action.

f. Any other information related to the correction of unpermitted discharges required by the

Department.

(3) The Department shall approve the Unpermitted Discharge Corrective Action Plan if it determines that the Plan complies with the requirements of this subsection and will be sufficient to protect public health, safety, and welfare; the environment; and natural resources.

(4) No later than 30 days from the approval of the Unpermitted Discharge Corrective Action Plan, the owner shall begin implementation of the Plan in accordance with the Plan's schedule.

(d) Identification of New Discharges. – No later than October 1, 2014, the owner of a coal combustion residuals surface impoundment shall submit a proposed Plan for the Identification of New Discharges to the Department for its review and approval as provided in this subsection:

(1) The proposed Plan for the Identification of New Discharges shall include, at a minimum, all of the following:

a. A procedure for routine inspection of the coal combustion residuals surface impoundment to identify indicators of potential new discharges, including toe drain outfalls, seeps, and weeps.

b. A procedure for determining whether a new discharge is actually present.

c. A procedure for notifying the Department when a new discharge is confirmed.

d. Any other information related to the identification of new discharges required by the Department.

(2) The Department shall approve the Plan for the Identification of New Discharges if it determines that the Plan complies with the requirements of this subsection and will be sufficient to protect public health, safety, and welfare; the environment; and natural resources.

(3) No later than 30 days from the approval of the Plan for the Identification of New Discharges, the owner shall begin implementation of the Plan in accordance with the Plan.

(e) Reporting. – In addition to any other reporting required by the Department, the owner of a coal combustion residuals surface impoundment shall submit an annual Surface Water Protection and Restoration Report to the Department no later than January 31 of each year. The Report shall include a summary of all surface water sampling, protection, and restoration activities related to the impoundment for the preceding year, including the status of the identification, assessment, and correction of unpermitted discharges from coal combustion residuals surface impoundments to the surface waters of the State. ~~The owner of a coal combustion residuals surface impoundment shall also submit all information required to be submitted to the Department pursuant to this section to the Coal Ash Management Commission.~~

"§ 130A-309.213. Prioritization of coal combustion residuals surface impoundments.

(a) As soon as practicable, but no later than December 31, 2015, the Department shall develop proposed classifications for all coal combustion residuals surface impoundments, including active and retired sites, for the purpose of closure and remediation based on these sites' risks to public health, safety, and welfare; the environment; and natural resources and shall determine a schedule for closure and required remediation that is based on the degree of risk to public health, safety, and welfare; the environment; and natural resources posed by the impoundments and that gives priority to the closure and required remediation of impoundments that pose the greatest risk. In assessing the risk, the Department shall evaluate information received pursuant to G.S. 130A-309.211 and G.S. 130A-309.212 and any other information deemed ~~relevant and, at a minimum, consider all of the following:~~relevant.

(1) ~~Any hazards to public health, safety, or welfare resulting from the impoundment.~~

(2) ~~The structural condition and hazard potential of the impoundment.~~

(3) ~~The proximity of surface waters to the impoundment and whether any surface waters are contaminated or threatened by contamination as a result of the impoundment.~~

(4) ~~Information concerning the horizontal and vertical extent of soil and groundwater contamination for all contaminants confirmed to be present in groundwater in exceedance of groundwater quality standards and all significant factors affecting contaminant transport.~~

(5) ~~The location and nature of all receptors and significant exposure pathways.~~

(6) ~~The geological and hydrogeological features influencing the movement and chemical and physical character of the contaminants.~~

(7) ~~The amount and characteristics of coal combustion residuals in the impoundment.~~

(8) ~~Whether the impoundment is located within an area subject to a 100-year flood.~~

(9) ~~Any other factor the Department deems relevant to establishment of risk.~~

(b) The Department shall issue a proposed classification for each coal combustion residuals surface impoundment based upon the assessment conducted pursuant to subsection (a) of this section as high-risk, intermediate-risk, or low-risk. Within 30 days after a proposed classification has been issued, the Department shall issue a written declaration, including findings of fact, documenting the proposed classification. The Department shall provide for public participation on the proposed risk classification as follows:

(1) The Department shall make copies of the written declaration issued pursuant to this subsection available for inspection as follows:
   a. A copy of the declaration shall be provided to the local health director.
   b. A copy of the declaration shall be provided to the public library located in closest proximity to the site in the county or counties in which the site is located.
   c. The Department shall post a copy of the declaration on the Department's Web site.
   d. The Department shall place copies of the declaration in other locations so as to assure the reasonable availability thereof to the public.

(2) The Department shall give notice of the written declaration issued pursuant to this subsection as follows:
   a. A notice and summary of the declaration shall be published weekly for a period of three consecutive weeks in a newspaper having general circulation in the county or counties where the site is located.
   b. Notice of the written declaration shall be given by first-class mail to persons who have requested such notice. Such notice shall include a summary of the written declaration and state the locations where a copy of the written declaration is available for inspection. The Department shall maintain a mailing list of persons who request notice pursuant to this section.
   c. Notice of the written declaration shall be given by electronic mail to persons who have requested such notice. Such notice shall include a summary of the written declaration and state the locations where a copy of the written declaration is available for inspection. The Department shall maintain a mailing list of persons who request notice pursuant to this section.

(3) No later than 60 days after issuance of the written declaration, the Department shall conduct a public meeting in the county or counties in which the site is located to explain the written declaration to the public. The Department shall give notice of the hearing at least 15 days prior to the date thereof by all of the following methods:
   a. Publication as provided in subdivision (1) of this subsection, with first publication to occur not less than 30 days prior to the scheduled date of the hearing.
   b. First-class mail to persons who have requested notice as provided in subdivision (2) of this subsection.
   c. Electronic mail to persons who have requested notice as provided in subdivision (2) of this subsection.

(4) At least 30 days from the latest date on which notice is provided pursuant to subdivision (2) of this subsection shall be allowed for the receipt of written comment on the written declaration prior to issuance of a final risk classification. At least 20 days will be allowed for receipt of written comment following a hearing conducted pursuant to subdivision (3) of this subsection prior to issuance of a ~~final~~ preliminary risk classification.

(c) ~~Within 30 days of the receipt of all written comment as required by subdivision (4) of subsection (b) of this section, the Department shall submit a proposed classification for a coal combustion residuals surface impoundment to the Coal Ash Management Commission established pursuant to G.S. 130A-309.202. The Commission shall evaluate all information submitted in accordance with this Part related to the proposed classification and any other information the Commission deems relevant. The Commission shall only approve the proposed classification if it determines that the classification was developed in accordance with this section and that the classification accurately reflects the level of risk posed by the coal combustion residuals surface impoundment. The Commission shall issue its determination in writing, including findings in support of its determination. If the Commission fails to act on a proposed classification within 60 days of receipt of the proposed classification, the proposed classification shall be deemed approved. Parties aggrieved by a final decision of the Commission pursuant to this subsection may appeal the decision as provided under Article 3 of Chapter 150B of the General Statutes.~~

(d) No later than 30 days after expiration of the deadline set forth in G.S. 130A-309.211(c1), or any applicable extension granted by the Secretary pursuant G.S. 130A-309.211(c1), the Department shall issue a final classification for each impoundment as follows:

(1) The Department shall classify an impoundment as low-risk if the impoundment owner satisfies both of the following criteria:

a. Has established permanent water supplies as required for the impoundment pursuant to G.S. 130A-309.211(c1).

b. Has rectified any deficiencies identified by, and otherwise complied with the requirements of any dam safety order issued by the Environmental Management Commission for the impoundment pursuant to G.S. 143-215.32. No later than July 1, 2018, the Department shall conduct the annual inspection of each dam associated with a coal combustion residuals surface impoundment required for that year, to detect any deficiencies and to ascertain, at a minimum, whether the dam is sufficiently strong, maintained in good repair and operating condition, does not pose a danger to life or property, and satisfies minimum streamflow requirements. The Department shall issue written findings of fact for each inspection and present such findings to the Environmental Management Commission. If the Department detects any deficiencies, the Commission shall issue an order directing the owner of the dam to take action as may be deemed necessary by the Commission within a time limited by the order, but not later than 90 days after issuance of the order.

(2) All other impoundments shall be classified as intermediate-risk.

(e) Parties aggrieved by a final decision of the Department issued pursuant to subsection (d) of this section may appeal the decision as provided under Article 3 of Chapter 150B of the General Statutes.

"§ 130A-309.214. Closure of coal combustion residuals surface impoundments.

(a) An owner of a coal combustion residuals surface impoundment shall submit a proposed Coal Combustion Residuals Surface Impoundment Closure Plan for the Department's approval. If corrective action to restore groundwater has not been completed pursuant to the requirements of G.S. 130A-309.211(b), the proposed closure plan shall include provisions for completion of activities to restore groundwater in conformance with the requirements of Subchapter L of Chapter 2 of Title 15A of the North Carolina Administrative Code. In addition, the following requirements, at a minimum, shall apply to such plans:

(1) High-risk impoundments shall be closed as soon as practicable, but no later than December 31, 2019. A proposed closure plan for such impoundments must be submitted as soon as practicable, but no later than December 31, 2016. At a minimum, (i) impoundments located in whole above the seasonal high groundwater table shall be dewatered; (ii) impoundments located in whole or in part beneath the seasonal high groundwater table shall be dewatered to the maximum extent practicable; and (iii) the owner of an impoundment shall either:

a. Convert the coal combustion residuals impoundment to an industrial landfill by removing all coal combustion residuals and contaminated soil from the impoundment temporarily, safely storing the residuals on-site, and complying with the requirements for such landfills established by this Article and rules adopted thereunder. At a minimum, the landfills shall have a design with a leachate collection system, a closure cap system, and a composite liner system consisting of two components: the upper component shall consist of a minimum 30-ml flexible membrane (FML), and the lower components shall consist of at least a two-foot layer of compacted soil with a hydraulic conductivity of no more than 1 x 10^{-7} centimeters per second. FML components consisting of high density polyethylene (HDPE) shall be at least 60 ml thick. The landfill shall otherwise comply with the construction requirements established by Section .1624 of Subchapter B of Chapter 13 of Title 15A of the North Carolina Administrative Code, and the siting and design requirements for disposal sites established by Section .0503 of Subchapter B of Chapter 13 of Title 15A of the North Carolina Administrative Code, except with respect to those requirements that pertain to buffers. In lieu of the buffer requirement established by Section .0503(f)(2)(iii) of Subchapter B of Chapter 13 of Title 15A of the North Carolina Administrative Code, the owner of the impoundment shall establish and maintain a 300-foot buffer between surface waters and disposal areas. After the temporarily displaced coal combustion residuals have been returned for disposal in the industrial landfill constructed pursuant to the requirements of this sub-subdivision, the owner of the landfill shall comply with the closure and post-closure requirements established by Section .1627 of Subchapter B of Chapter 13 of Title 15A of the North Carolina Administrative Code. A landfill constructed pursuant to this sub-subdivision shall otherwise be subject to all applicable requirements of this Chapter and rules adopted thereunder. Prior to closure, the Department may allow the disposal of coal combustion residuals, in addition to those originally contained in the impoundment, to the landfill constructed pursuant to this sub-subdivision, if the Department determines that the site is suitable for additional capacity and that disposal of additional coal combustion residuals will not pose an unacceptable risk to public health, safety, welfare; the environment; and natural resources.

b. Remove all coal combustion residuals from the impoundment, return the former impoundment to a nonerosive and stable condition and (i) transfer the coal combustion residuals for disposal in a coal combustion residuals landfill, industrial landfill, or municipal solid waste landfill or (ii) use the coal combustion products in a structural fill or other beneficial use as allowed by law. The use of coal combustion products (i) as structural fill shall be conducted in accordance with the requirements of Subpart 3 of this Part and (ii) for other beneficial uses shall be conducted in accordance 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).

(2) Intermediate-risk impoundments shall be closed as soon as practicable, but no later than December 31, 2024. A proposed closure plan for such impoundments must be submitted as soon as practicable, but no later than December 31, ~~2017.~~2019. At a minimum, such impoundments shall be dewatered, and the owner of an impoundment shall close the impoundment in any manner allowed pursuant to subdivision (1) of this ~~subsection.~~subsection, or, if applicable, as provided in G.S. 130A-309.216.

(3) Low-risk impoundments shall be closed as soon as practicable, but no later than December 31, 2029. A proposed closure plan for such impoundments must be submitted as soon as practicable, but no later than December 31, ~~2018.~~2019. At a minimum, (i) impoundments located in whole above the seasonal high groundwater table shall be dewatered; (ii) impoundments located in whole or in part beneath the seasonal high groundwater table shall be dewatered to the maximum extent practicable; and (iii) at the election of the Department, the owner of an impoundment shall either:

a. Close in any manner allowed pursuant to subdivision (1) of this ~~subsection.~~subsection;

b. Comply with the closure and post-closure requirements established by Section .1627 of Subchapter B of Chapter 13 of Title 15A of the North Carolina Administrative Code, except that such impoundments shall not be required to install and maintain a leachate collection system. Specifically, the owner of an impoundment shall install and maintain a cap system that is designed to minimize infiltration and erosion in conformance with the requirements of Section .1624 of Subchapter B of Chapter 13 of Title 15A of the North Carolina Administrative Code, and, at a minimum, shall be designed and constructed to (i) have a permeability no greater than 1 x 10^{-5} centimeters per second; (ii) minimize infiltration by the use of a low-permeability barrier that contains a minimum 18 inches of earthen material; and (iii) minimize erosion of the cap system and protect the low-permeability barrier from root penetration by use of an erosion layer that contains a minimum of six inches of earthen material that is capable of sustaining native plant growth. In addition, the owner of an impoundment shall (i) install and maintain a groundwater monitoring system; (ii) establish financial assurance that will ensure that sufficient funds are available for closure pursuant to this subdivision, post-closure maintenance and monitoring, any corrective action that the Department may require, and satisfy any potential liability for sudden and nonsudden accidental occurrences arising from the impoundment and subsequent costs incurred by the Department in response to an incident, even if the owner becomes insolvent or ceases to reside, be incorporated, do business, or maintain assets in the State; and (iii) conduct post-closure care for a period of 30 years, which period may be increased by the Department upon a determination that a longer period is necessary to protect public health, safety, welfare; the environment; and natural resources, or decreased upon a determination that a shorter period is sufficient to protect public health, safety, welfare; the environment; and natural resources. The Department may require implementation of any other measure it deems necessary to protect public health, safety, and welfare; the environment; and natural resources, including imposition of institutional controls that are sufficient to protect public health, safety, and welfare; the environment; and natural resources. The Department may not approve closure for an impoundment pursuant to sub-subdivision b. of subdivision (3) of this subsection unless the Department finds that the proposed closure plan includes design measures to prevent, upon the plan's full implementation, post-closure exceedances of groundwater quality standards beyond the compliance boundary that are attributable to constituents associated with the presence of the ~~impoundment.~~impoundment; or

c. Comply with the closure requirements established by the United States Environmental Protection Agency as provided in 40 CFR Parts 257 and 261, "Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals From Electric Utilities."

(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.
2. Estimated volume of material contained in the impoundment.
3. Analysis of the structural integrity of dikes or dams associated with impoundment.
4. All sources of discharge into the impoundment, including volume and characteristics of each discharge.
5. Whether the impoundment is lined, and, if so, the composition thereof.
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.

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.
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. The property boundary for the applicable site, including established compliance boundaries within the site.
4. All potential receptors within 2,640 feet from established compliance boundaries.
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.
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.
7. All existing and proposed groundwater monitoring wells associated with any coal combustion residuals surface impoundment on the site.
8. All existing and proposed surface water sample collection locations associated with any coal combustion residuals surface impoundment on the site.

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.
2. A description of the stratigraphy of the geologic units underlying each coal combustion residuals surface impoundment located on the site.
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. 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.
5. A chemical analysis of the coal combustion residuals surface impoundment, including water, coal combustion residuals, and coal combustion residuals-affected soil.
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.
7. Summary tables of historical records of groundwater sampling results.
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.
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.

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.
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.
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.

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).

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.

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.

h. A description of the provisions for disposal of wastewater and management of stormwater and the plan for obtaining all required permits.

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.

j. A list of all permits that will need to be acquired or modified to complete closure activities.

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:

1. A demonstration of the long-term control of all leachate, affected groundwater, and stormwater.
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.

l. An estimate of the milestone dates for all activities related to closure and post-closure.

m. Projected costs of assessment, corrective action, closure, and post-closure care for each coal combustion residuals surface impoundment.

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.

(b) The Department shall review a proposed Coal Combustion Residuals Surface Impoundment Closure Plan for consistency with the minimum requirements set forth in subsection (a) of this section and whether the proposed Closure Plan is protective of public health, safety, and welfare; the environment; and natural resources and otherwise complies with the requirements of this Part. Prior to issuing a decision on a proposed Closure Plan, the Department shall provide for public participation on the proposed Closure Plan as follows:

(1) The Department shall make copies of the proposed Closure Plan available for inspection as follows:
  a. A copy of the proposed Closure Plan shall be provided to the local health director.
  b. A copy of the proposed Closure Plan shall be provided to the public library located in closest proximity to the site in the county or counties in which the site is located.
  c. The Department shall post a copy of the proposed Closure Plan on the Department's Web site.
  d. The Department shall place copies of the declaration in other locations so as to assure the reasonable availability thereof to the public.

(2) Before approving a proposed Closure Plan, the Department shall give notice as follows:
  a. A notice and summary of the proposed Closure Plan shall be published weekly for a period of three consecutive weeks in a newspaper having general circulation in the county or counties where the site is located.
  b. Notice that a proposed Closure Plan has been developed shall be given by first-class mail to persons who have requested such notice. Such notice shall include a summary of the proposed Closure Plan and state the locations where a copy of the proposed Closure Plan is available for inspection. The Department shall maintain a mailing list of persons who request notice pursuant to this section.
  c. Notice that a proposed Closure Plan has been developed shall be given by electronic mail to persons who have requested such notice. Such notice shall include a summary of the proposed Closure Plan and state the locations where a copy of the proposed Closure Plan is available for inspection. The Department shall maintain a mailing list of persons who request notice pursuant to this section.

(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 in which the site is located to explain the proposed Closure Plan and alternatives to the public. The Department shall give notice of the hearing at least 30 days prior to the date thereof by all of the following methods:
  a. Publication as provided in subdivision (1) of this subsection, with first publication to occur not less than 30 days prior to the scheduled date of the hearing.
  b. First-class mail to persons who have requested notice as provided in subdivision (2) of this subsection.
  c. Electronic mail to persons who have requested notice as provided in subdivision (2) of this subsection.

(4) At least 30 days from the latest date on which notice is provided pursuant to subdivision (2) of this subsection shall be allowed for the receipt of written comment on the proposed Closure Plan prior to its approval. At least 20 days will be allowed for receipt of written comment following a hearing conducted pursuant to subdivision (3) of this subsection prior to the approval of the proposed Closure Plan.

(c) The Department shall disapprove a proposed Coal Combustion Residuals Surface Impoundment Closure Plan unless the Department finds that the Closure Plan is protective of public health, safety, and welfare; the environment; and natural resources and otherwise complies with the requirements of this Part. The Department shall provide specific findings to support its decision to approve or disapprove a proposed Closure Plan. If the Department disapproves a proposed Closure Plan, the person who submitted the Closure Plan may seek review as provided in Article 3 of Chapter 150B of the General Statutes. If the Department fails to approve or disapprove a proposed Closure Plan within 120 days after a complete Closure Plan has been submitted, the person who submitted the proposed Closure Plan may treat the Closure Plan as having been disapproved at the end of that time period. The Department may require a person who proposes a Closure Plan to supply any additional information necessary for the Department to approve or disapprove the Closure Plan.

(d) ~~Within 30 days of its approval of a Coal Combustion Residuals Surface Impoundment Closure Plan, the Department shall submit the Closure Plan to the Coal Ash Management Commission. The Commission shall evaluate all information submitted in accordance with this Part related to the Closure Plan and any other information the Commission deems relevant. The Commission shall approve the Closure Plan if it determines that the Closure Plan was developed in accordance with this section, that implementation of the Closure Plan according to the Closure Plan's schedule is technologically and economically feasible, and the Closure Plan is protective of the public health, safety, and welfare; the environment; and natural resources. In addition, the Commission may consider any impact on electricity costs and reliability, but this factor may not be dispositive of the Commission's determination. The~~

~~Commission shall issue its determination in writing, including findings in support of its determination. If the Commission fails to act on a Closure Plan within 60 days of receipt of the Closure Plan, the Closure Plan shall be deemed approved. Parties aggrieved by a final decision of the Commission pursuant to this subsection may appeal the decision as provided under Article 3 of Chapter 150B of the General Statutes.~~

(e) As soon as practicable, but no later than 60 days after a Coal Combustion Residuals Surface Impoundment Closure Plan has been approved by the ~~Coal Ash Management Commission,~~Department, the owner of the coal combustion residuals impoundment shall begin implementation of the approved plan. Modifications to an approved Closure Plan may only be allowed in conformance with the requirements of this Part, upon written request of an owner of an impoundment, with the written approval of the Department, and after public notice of the change in accordance with the requirements of subdivision (2) of subsection (b) of this section. Provided, however, minor technical modifications may be made in accordance with standard Department procedures for such minor modifications and may be made without written approval of the Department or public notice of the change.

(f) Nothing in this section shall be construed to obviate the need for sampling, remediation, and monitoring activities at the site as required by G.S. 130A-309.211 and G.S. 130A-309.310 [G.S. 130A-309.212].

"§ 130A-309.215. Variance authority.

(a) In recognition of the complexity and magnitude of the issues surrounding the management of coal combustion residuals and coal combustion residuals surface impoundments, the General Assembly authorizes the ~~Commission~~ Secretary to grant a variance to extend any deadline ~~for closure of an impoundment established under G.S. 130A-309.214 in conformance with the requirements of this section. To request such a variance the owner of an impoundment~~ under this act, on the Secretary's own motion, or that of an impoundment owner, on the basis that compliance with the deadline cannot be achieved by application of best available technology found to be economically reasonable at the time and would produce serious hardship without equal or greater benefits to the public.

(a1) For variances requested by an impoundment owner, the owner shall, no earlier than ~~two years~~one year prior to the applicable deadline, submit an application in a form acceptable to the Department which shall include, at a minimum, all of the following information: identification of the site, applicable requirements, and applicable deadlines for which a variance is sought, and the site-specific circumstances that support the need for the variance. The owner of the impoundment shall also provide detailed information that demonstrates (i) the owner has substantially complied with all other requirements and deadlines established by this Part; (ii) the owner has made good faith efforts to comply with the applicable deadline for closure of the impoundment; and (iii) that compliance with the deadline cannot be achieved by application of best available technology found to be economically reasonable at the time and would produce serious hardship without equal or greater benefits to the public. As soon as practicable, but no later than 60 days from receipt of an application, the Secretary shall evaluate the information submitted in conjunction with the application, and any other information the Secretary deems relevant, to determine whether the information supports issuance of a variance. ~~After such evaluation, if the Secretary finds that the information supports issuance of a variance from the deadline, the Secretary shall issue a proposed variance. Within 10 days after a proposed variance has been issued, the Secretary shall issue a written declaration, including findings of fact, documenting the proposed variance.~~

(a2) The Department shall provide for public participation on ~~the~~a proposed variance in the manner provided by G.S. 130A-309.214(b) and shall take the public input received through the process into account in its decision concerning ~~the proposed~~issuance of a variance. ~~Within 30 days of the receipt of all public input received, the Department shall submit a proposed variance to the Coal Ash Management Commission. The Commission shall evaluate all information submitted in accordance with this section and any other information the Commission deems relevant.~~ The ~~Commission~~ Department shall only approve a variance if it determines that compliance with the deadline cannot be achieved by application of best available technology found to be economically reasonable at the time and would produce serious hardship without equal or greater benefits to the public. The ~~Commission~~ Department shall issue its determination in writing, including findings in support of its determination. If the ~~Commission~~ Department fails to act on a variance request within 60 days of receipt, the variance shall be deemed denied.

(a3) Parties aggrieved by a final decision of the Commission pursuant to this subsection may appeal the decision as provided under Article 3 of Chapter 150B of the General Statutes.

(b) ~~A variance granted pursuant to this section shall not extend a deadline for closure of an impoundment more than three years beyond the date applicable to the impoundment as provided under G.S. 130A-309.214.~~

(c) ~~No more than one variance may be granted pursuant to this section per impoundment.~~

"§ 130A-309.216. Ash beneficiation projects.

(a) On or before January 1, 2017, an impoundment owner shall (i) identify, at a minimum, impoundments at two sites located within the State with ash stored in the impoundments on that date that is suitable for processing for cementitious purposes and (ii) enter into a binding agreement for the installation and operation of an ash beneficiation project at each site capable of annually processing 300,000 tons of ash to specifications appropriate for cementitious products, with all ash processed to be removed from the impoundment(s) located at the sites. As soon as legally practicable thereafter, the impoundment owner shall apply for all permits necessary for the ash beneficiation projects from the Department. The Department shall expedite any State permits and approvals required for such projects. No later than 24 months after issuance of all necessary permits, operation of both ash beneficiation projects shall be commenced. An impoundment owner shall use commercially reasonable efforts to produce 300,000 tons of ash to specifications appropriate for cementitious products from each project.

(b) On or before July 1, 2017, an impoundment owner shall (i) identify an impoundment at an additional site located within the State with ash stored in the impoundment on that date that is suitable for processing for cementitious purposes and (ii) enter into a binding agreement for the installation and operation of an ash beneficiation project capable of annually processing 300,000 tons of ash to specifications appropriate for cementitious products, with all ash processed to be removed from the impoundment(s) located at the site. As soon as legally practicable thereafter, the impoundment owner shall apply for all permits necessary for the ash beneficiation project from the Department. The Department shall expedite any State permits and approvals required for such projects. No later than 24 months after issuance of all necessary permits, operation of the ash beneficiation project shall be commenced. An impoundment owner shall use commercially reasonable efforts to produce 300,000 tons of ash to specifications appropriate for cementitious products from the project.

(c) Notwithstanding any deadline for closure provided by G.S. 130A-309.214, any impoundment classified as intermediate- or low-risk that is located at a site at which an ash beneficiation project is installed, operating, and processing at least 300,000 tons of ash annually from the impoundment, shall be closed no later than December 31, 2029.

"**§ 130A-309.217: Reserved for future codification purposes.**"

SECTION 2. G.S. 62-302.1 reads as rewritten:

"**§ 62-302.1. Regulatory fee for combustion residuals surface impoundments.**

(a) Fee Imposed. – Each public utility with a coal combustion residuals surface impoundment shall pay a regulatory fee for the purpose of defraying the costs of oversight of coal combustion residuals. The fee is in addition to the fee imposed under G.S. 62-302. The fees collected under this section shall only be used to pay the expenses of the ~~Coal Ash Management Commission and the~~ Department of Environmental Quality in providing oversight of coal combustion residuals.

(b) Rate. – The combustion residuals surface impoundment fee shall be ~~three-hundredths of one percent (0.03%)~~ twenty-two thousandths of one percent (0.022%) of the North Carolina jurisdictional revenues of each public utility with a coal combustion residuals surface impoundment. For the purposes of this section, the term "North Carolina jurisdictional revenues" has the same meaning as in G.S. 62-302.

(c) When Due. – The fee shall be paid in quarterly installments. The fee is payable to the ~~Coal Ash Management Commission~~ Department of Environmental Quality on or before the 15th of the second month following the end of each quarter. Each public utility subject to this fee shall, on or before the date the fee is due for each quarter, prepare and render a report on a form prescribed by the ~~Coal Ash Management Commission.~~ Department of Environmental Quality. The report shall state the public utility's total North Carolina jurisdictional revenues for the preceding quarter and shall be accompanied by any supporting documentation that the ~~Coal Ash Management Commission~~Department of Environmental Quality may by rule require. Receipts shall be reported on an accrual basis.

(d) Use of Proceeds. – A special fund in the ~~Office of State Treasurer and the Coal Ash Management Commission~~ Department of Environmental Quality is created. The fees collected pursuant to this section ~~and all other funds received by the Coal Ash Management Commission~~ shall be deposited in the Coal Combustion Residuals Management Fund. The Fund shall be placed in an interest-bearing account, and any interest or other income derived from the Fund shall be credited to the Fund. Subject to appropriation by the General Assembly, ~~twenty-six and one-half percent (26.5%) of the moneys in the Fund shall be used by the Coal Ash Management Commission and the remainder~~ one hundred percent (100%) shall be used by the Department of Environmental Quality. ~~The Coal Ash Management Commission shall be subject to the provisions of the State Budget Act, except that no unexpended surplus of the Coal Combustion Residuals Management Fund shall revert to the General Fund.~~ All funds credited to the Fund shall be used only to pay the expenses of the ~~Coal Ash Management Commission and the~~ Department of Environmental Quality in providing oversight of coal combustion residuals.

(e) Recovery of Fee. – The North Carolina Utilities Commission shall not allow an electric public utility to recover this fee from the retail electric customers of the State."

SECTION 3.(a) Notwithstanding G.S. 130A-309.213 or G.S. 130A-309.214, as amended by Section 1 of this act, and except as otherwise preempted by the requirements of federal law, the following coal combustion residuals surface impoundments shall be deemed intermediate-risk and, as soon as practicable, but no later than August 1, 2028, shall be closed in conformance with Section 3(b) of this act:

(1) Coal combustion residuals surface impoundments located at the H.F. Lee Steam Station, owned and operated by Duke Energy Progress, and located in Wayne County.

(2) Coal combustion residuals surface impoundments located at the Cape Fear Steam Station, owned and operated by Duke Energy Progress, and located in Chatham County.

(3) Coal combustion residuals surface impoundments located at the Weatherspoon Steam Station, owned and operated by Duke Energy Progress, and located in New Hanover County.

SECTION 3.(b) The impoundments identified in subsection (a) of this section shall be closed as follows:

(1) Impoundments located in whole above the seasonal high groundwater table shall be dewatered. Impoundments located in whole or in part beneath the seasonal high groundwater table shall be dewatered to the maximum extent practicable.

(2) All coal combustion residuals shall be removed from the impoundments and transferred for (i) disposal in a coal combustion residuals landfill, industrial landfill, or municipal solid waste landfill or (ii) use in a structural fill or other beneficial use as allowed by law. The use of coal combustion products (i) as structural fill shall be conducted in accordance with the requirements of Subpart 3 of Part 2I of Article 9 of the General Statutes and (ii) for other beneficial uses shall be conducted in accordance 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 .1200 of Subchapter T of Chapter 2 of Title 15A of the North Carolina Administrative Code (Coal Combustion Products Management), as applicable.

(3) If restoration of groundwater quality is degraded as a result of the impoundment, corrective action to restore groundwater quality shall be implemented by the owner or operator as provided in G.S. 130A-309.211.

SECTION 4. There is appropriated a sum of up to four hundred fifty thousand dollars ($450,000) to the State Water Infrastructure Authority from the Coal Combustion Residuals Management Fund cash balance on June 30, 2016, to fund grants to local governments operating public water supplies in areas surrounding coal combustion residuals impoundments to provide moneys for additional staff for permitting and construction activities as may be needed to facilitate establishment of permanent water supplies to households eligible for connection to public water supplies pursuant to G.S. 130A-309.211(c1).

SECTION 5.(a) Section 3(e) of S.L. 2014-122 is repealed.

SECTION 5.(b) Section 4(e) of S.L. 2014-122 reads as rewritten:

"**SECTION 4.(e)** All electric generating facilities owned by a public utility that produce coal combustion residuals and coal combustion products shall issue a request for proposals on or before December 31, 2014, for (i) the conduct of a market analysis for the concrete industry and other industries that might beneficially use coal combustion residuals and coal combustion products; (ii) the study of the feasibility and advisability of installation of technology to convert existing and newly generated coal combustion residuals to commercial-grade coal combustion products suitable for use in the concrete industry and other industries that might beneficially use coal combustion residuals; and (iii) an examination of all innovative technologies that might be applied to diminish, recycle or reuse, or mitigate the impact of existing and newly generated coal combustion residuals. All electric generating facilities shall present the materials and information received in response to a request for proposals issued pursuant to this section and an assessment of the materials and information, including a forecast of specific actions to be taken in response to the materials and information received, to the Environmental Management Commission ~~and the Coal Ash Management Commission~~ on or before August 1, 2016."

SECTION 6.(a) G.S. 143B-291 reads as rewritten:

"**§ 143B-291. North Carolina Mining Commission – members; selection; removal; compensation; quorum; services.**

(a) Repealed by 2014-4, s. 5(a), effective July 31, 2015.

(a1) Members, Selection. – The North Carolina Mining Commission shall consist of eight members appointed as follows:

(1) One member who is the chair of the North Carolina State University Minerals Research Laboratory Advisory ~~Committee.~~Committee, ex officio and nonvoting.

(2) The State Geologist, ex officio and nonvoting.
(3) One member appointed by the Governor subject to confirmation in conformance with Section 5(8) of Article III of the North Carolina Constitution, who is a representative of the mining industry.
(4) One member appointed by the Governor subject to confirmation in conformance with Section 5(8) of Article III of the North Carolina Constitution, who is a representative of the mining industry.
(5) One member appointed by the ~~General Assembly upon recommendation of the Speaker of the House of Representatives~~ Governor subject to confirmation in conformance with Section 5(8) of Article III of the North Carolina Constitution, who is a representative of the mining industry.
(6) One member appointed by the ~~General Assembly upon recommendation of the President Pro Tempore of the Senate~~ Governor subject to confirmation in conformance with Section 5(8) of Article III of the North Carolina Constitution, who is a representative of the mining industry.
(7) One member appointed by the General Assembly upon recommendation of the Speaker of the House of Representatives in conformance with G.S. 120-121, who is a ~~member of~~ representative of a nongovernmental conservation ~~interests.~~interest.
(8) One member appointed by the General Assembly upon recommendation of the President Pro Tempore of the Senate in conformance with G.S. 120-121, who is a ~~member of~~representative of a nongovernmental conservation ~~interests.~~interest.

(a2) Process for Appointments by the Governor. – The Governor shall transmit to the presiding officers of the Senate and the House of Representatives, within four weeks of the convening of the session of the General Assembly in the year for which the terms in question are to expire, the names of the persons to be appointed by the Governor and submitted to the General Assembly for confirmation by joint resolution. If an appointment is required pursuant to this subsection when the General Assembly is not in session, the member may be appointed and serve on an interim basis pending confirmation by the General Assembly. For the purpose of this subsection, the General Assembly is not in session only (i) prior to convening of the regular session, (ii) during any adjournment of the regular session for more than 10 days, or (iii) after sine die adjournment of the regular session.

(b) Terms. – The term of office of a member of the Commission is ~~six years.~~four years, beginning effective January 1 of the year of appointment and terminating on December 31 of the year of expiration. At the expiration of each member's term, the appointing authority shall replace the member with a new member of like qualifications for a term of ~~six~~ four years. ~~The term of the member appointed under subdivision (5) of subsection (a1) of this section shall expire on June 30 of years that precede by one year those years that are evenly divisible by six. The term of members appointed under subdivisions (3) and (6) of subsection (a1) of this section shall expire on June 30 of years that follow by one year those years that are evenly divisible by six. The term of members appointed under subdivisions (4) and (7) of subsection (a1) of this section shall expire on June 30 of years that follow by three years those years that are evenly divisible by six. Upon the expiration of a six-year term, a member may continue to serve until a successor is appointed and duly qualified as provided by G.S. 128-7.~~In order to establish regularly overlapping terms, initial appointments shall be made effective June 1, 2016, or as soon as feasible thereafter, and expire as follows:

(1) The initial appointments made by the Governor:
a. Pursuant to subdivision (a1)(3) of this section shall expire December 31, 2020.
b. Pursuant to subdivision (a1)(4) of this section shall expire December 31, 2020.
c. Pursuant to subdivision (a1)(5) of this section shall expire December 31, 2019.
d. Pursuant to subdivision (a1)(6) of this section shall expire December 31, 2019.
(2) The initial appointment made by the General Assembly upon recommendation of the Speaker of the House of Representatives pursuant to subdivision (a1)(7) of this section shall expire December 31, 2018.
(3) The initial appointment made by the General Assembly upon recommendation of the President Pro Tempore of the Senate pursuant to subdivision (a1)(8) of this section shall expire December 31, 2018.

(c) Vacancies. – In case of death, incapacity, resignation, or vacancy for any other reason in the office of any member appointed by the Governor, prior to the expiration of the member's term of office, the name of the successor shall be submitted by the Governor within four weeks after the vacancy arises to the General Assembly for confirmation by the General Assembly. In case of death, incapacity, resignation, or vacancy for any other reason in the office of any member appointed by the General Assembly, vacancies in those appointments shall be filled in accordance with G.S. 120-122. If a vacancy arises or exists when the General Assembly is not in session, and the appointment is deemed urgent by the Governor, the member may be appointed by the Governor and serve on an interim basis pending confirmation or appointment by the General Assembly, as applicable. An appointment to fill a vacancy shall be for the unexpired balance of the term.

(d) Removal. – The Governor may remove any member of the Commission from office for misfeasance, malfeasance, or nonfeasance in accordance with the provisions of ~~G.S. 143B-13.~~ G.S. 143B-13, or for good cause.

(e) Compensation. – The members of the Commission shall receive per diem and necessary traveling and subsistence expenses in accordance with the provisions of G.S. 138-5.

(f) Quorum. – A majority of the Commission shall constitute a quorum for the transaction of business.

(g) Staff. – All clerical and other services required by the Commission shall be supplied by the Secretary of Environmental ~~Quality.~~Quality. The Commission staff shall be housed in the Department of Environmental Quality and supervised by the Secretary of Environmental Quality."

SECTION 6.(b) Notwithstanding the provisions of G.S. 143B-291(a2) and G.S. 143B-291(b), as enacted and amended by Section 6(a) of this act, initial appointments made by the Governor to the Commission shall not require confirmation by the General Assembly.

SECTION 7.(a) G.S. 143B-293.2 reads as rewritten:

"§ 143B-293.2. North Carolina Oil and Gas Commission – members; selection; removal; compensation; quorum; services.

(a) Repealed by Session Laws 2014-4, s. 4(a), effective July 31, 2015.

(a1) Members Selection. – The North Carolina Oil and Gas Commission shall consist of nine members appointed as follows:

(1) One appointed by the ~~General Assembly upon recommendation of the Speaker of the House of Representatives~~ Governor subject to confirmation in conformance with Section 5(8) of Article III of the North Carolina Constitution, who, at the time of initial appointment, is an elected official of a municipal government located in a region of North Carolina that has oil and gas potential. A person serving in this seat may complete a term on the Commission even if the person is no longer serving as an elected official of a municipal government but may not be reappointed to a subsequent term.

(2) One appointed by the General Assembly upon recommendation of the Speaker of the House of Representatives in conformance with G.S. 120-121, who shall be a geologist with experience in oil and gas exploration and development.

(3) One appointed by the General Assembly upon recommendation of the Speaker of the House of Representatives in conformance with G.S. 120-121, who is a ~~member~~ representative of a nongovernmental conservation interest.

(4) One appointed by the ~~General Assembly upon recommendation of the President Pro Tempore of the Senate~~ Governor subject to confirmation in conformance with Section 5(8) of Article III of the North Carolina Constitution, who, at the time of initial appointment, is a member of a county board of commissioners of a county located in a region of North Carolina that has oil and gas potential. A person serving in this seat may complete a term on the Commission even if the person is no longer serving as county commissioner but may not be reappointed to a subsequent term.

(5) One appointed by the General Assembly upon recommendation of the President Pro Tempore of the Senate in conformance with G.S. 120-121, who is a ~~member~~representative of a nongovernmental conservation interest.

(6) One appointed by the General Assembly upon recommendation of the President Pro Tempore of the Senate in conformance with G.S. 120-121, who shall be an engineer with experience in oil and gas exploration and development.

(7) One appointed by the Governor subject to confirmation in conformance with Section 5(8) of Article III of the North Carolina Constitution, who shall be a representative of a publicly traded natural gas company.

(8) One appointed by the Governor subject to confirmation in conformance with Section 5(8) of Article III of the North Carolina Constitution, who shall be a licensed attorney with experience in legal matters associated with oil and gas exploration and development.

(9) One appointed by the Governor subject to confirmation in conformance with Section 5(8) of Article III of the North Carolina Constitution, with experience in matters related to public health.

(a2) Process for Appointments by the Governor. – The Governor shall transmit to the presiding officers of the Senate and the House of Representatives, within four weeks of the convening of the session of the General Assembly in the year for which the terms in question are to expire, the names of the persons to be appointed by the Governor and submitted to the General Assembly for confirmation by joint resolution. If an appointment is required pursuant to this subsection when the General Assembly is not in session, the member may be appointed and serve on an interim basis pending confirmation by the General Assembly. For the purpose of this subsection, the General Assembly is not in session only (i) prior to convening of the regular session, (ii) during any adjournment of the regular session for more than 10 days, or (iii) after sine die adjournment of the regular session.

(b) Terms. – The term of office of members of the Commission is ~~three years.~~four years, beginning effective January 1 of the year of appointment and terminating on December 31 of the year of expiration. A member may be reappointed to no more than two consecutive ~~three-year~~four-year terms. The term of a member who no longer meets the qualifications of their respective appointment, as set forth in subsection ~~(a)~~(a1) of this section, shall terminate but the member may continue to serve until a new member who meets the qualifications is appointed. ~~The terms of members appointed under subdivisions (1), (4), and (7) of subsection (a1) of this section shall expire on June 30 of years evenly divisible by three. The terms of members appointed under subdivisions (2), (5), and (8) of subsection (a1) of this section shall expire on June 30 of years that precede by one year those years that are evenly divisible by three. The terms of members appointed under subdivisions (3), (6), and (9) of subsection (a1) of this section shall expire on June 30 of years that follow by one year those years that are evenly divisible by three.~~ In order to establish regularly overlapping terms initial appointments shall be made effective June 1, 2016, or as soon as feasible thereafter, and expire as follows:

(1) The initial appointments made by the Governor:
  a. Pursuant to subdivision (a1)(1) of this section shall expire December 31, 2020.
  b. Pursuant to subdivision (a1)(4) of this section shall expire December 31, 2020.
  c. Pursuant to subdivision (a1)(7) of this section shall expire December 31, 2020.
  d. Pursuant to subdivision (a1)(8) of this section shall expire December 31, 2019.
  e. Pursuant to subdivision (a1)(9) of this section shall expire December 31, 2019.
(2) The initial appointments made by the General Assembly upon recommendation of the Speaker of the House of Representatives:
  a. Pursuant to subdivision (a1)(2) of this section shall expire December 31, 2018.
  b. Pursuant to subdivision (a1)(3) of this section shall expire December 31, 2019.
(3) The initial appointments made by the General Assembly upon recommendation of the President Pro Tempore of the Senate:
  a. Pursuant to subdivision (a1)(5) of this section shall expire December 31, 2018.
  b. Pursuant to subdivision (a1)(6) of this section shall expire December 31, 2019.

(c) ~~Vacancies; Removal from Office. –~~ Vacancies. – In case of death, incapacity, resignation, or vacancy for any other reason in the office of any member appointed by the Governor, prior to the expiration of the member's term of office, the name of the successor shall be submitted by the Governor within four weeks after the vacancy arises to the General Assembly for confirmation by the General Assembly. In case of death, incapacity, resignation, or vacancy for any other reason in the office of any member appointed by the General Assembly, vacancies in those appointments shall be filled in conformance with G.S. 120-122. If a vacancy arises or exists when the General Assembly is not in session and the appointment is deemed urgent by the Governor, the member may be appointed by the Governor and serve on an interim basis pending confirmation or appointment by the General Assembly, as applicable. An appointment to fill a vacancy shall be for the unexpired balance of the term.

(c1) Removal. –

(1) ~~Any appointment by the Governor to fill a vacancy on the Commission created by the resignation, dismissal, death, or disability of a member shall be for the balance of the unexpired term.~~ The Governor shall have the power to remove any member of the Commission from office for misfeasance, malfeasance, or nonfeasance in accordance with the provisions of G.S. 143B-13 of the Executive Organization Act of ~~1973.~~1973, or for good cause.

(2) ~~Members appointed by the President Pro Tempore of the Senate and the Speaker of the House of Representatives shall be made in accordance with G.S. 120-121, and vacancies in those appointments shall be filled in accordance with G.S. 120-122. In accordance with Section 10 of Article VI of the North Carolina Constitution, a member may continue to serve until a successor is duly appointed.~~

(d) Compensation. – The members of the Commission shall receive per diem and necessary traveling and subsistence expenses in accordance with the provisions of G.S. 138-5.

(e) Quorum. – A majority of the Commission shall constitute a quorum for the transaction of business.

(f) Staff. – All staff support required by the Commission shall be supplied by the Division of Energy, Mineral, and Land Resources and the North Carolina Geological ~~Survey.~~ Survey, and supervised by the Secretary of Environmental Quality.

(g) Committees. – In addition to the Committee on Civil Penalty Remissions required to be established under G.S. 143B-293.6, the chair may establish other committees from members of the Commission to address specific issues as appropriate. No member of a committee may hear or vote on any matter in which the member has an economic interest. A majority of a committee shall constitute a quorum for the transaction of business.

(h) Office May Be Held Concurrently With Others. – Membership on the Oil and Gas Commission is hereby declared to be an office that may be held concurrently with other elective or appointive offices in addition to the maximum number of offices permitted to be held by one person under G.S. 128-1.1."

SECTION 7.(b) Notwithstanding the provisions of G.S. 143B-293.2(a1) and G.S. 143B-293.2(b), as enacted and amended by Section 7(a) of this act, initial appointments made by the Governor to the Commission shall not require confirmation by the General Assembly.

SECTION 7.(c) For purposes of the rules set forth in 15A NCAC 05H (Oil and Gas Conservation Rules), modifications made to the Oil and Gas Commission under Section 7(a) of this act shall, pursuant to G.S. 150B-21.7, be construed to (1) have repealed authority to adopt such rules given to previously constituted commissions and (2) transferred the authority to adopt such rules to the Oil and Gas Commission as modified by Section 7(b) of this act. Therefore, pursuant to G.S. 150B-21.7, rules set forth in 15A NCAC 05H (Oil and Gas Conservation Rules) shall be effective until the Oil and Gas Commission, as modified Section 7(a) of this act, amends or repeals the rules.

SECTION 8. The provisions of this act shall be severable, and if any phrase, clause, sentence, or provision is declared to be unconstitutional or otherwise invalid, the validity of the remainder of this act shall not be affected thereby.

SECTION 9. Except as otherwise provided, this act is effective when it becomes law. Requirements for establishment of a permanent alternative water supply under G.S. 130A-309.211(c1), as enacted by Section 1 of this act, shall apply only to households with drinking water supply wells in existence on the date this act becomes effective.

In the General Assembly read three times and ratified this
the 1st day of July, 2016.

s/ Philip E. Berger
President Pro Tempore of the Senate

s/ Tim Moore
Speaker of the House of Representatives

s/ Pat McCrory Governor

Approved 10:55 a.m. this 14th day of July, 2016

GENERAL ASSEMBLY OF NORTH CAROLINA SESSION 2015

SESSION LAW 2015-110
SENATE BILL 716

AN ACT TO: (1) DIRECT THE NORTH CAROLINA UTILITIES COMMISSION TO RENDER AN EXPEDITED DECISION, UNDER CERTAIN CONDITIONS, ON AN APPLICATION FOR A CERTIFICATE OF PUBLIC CONVENIENCE AND NECESSITY FOR AN APPLICANT TO CONSTRUCT A GENERATING FACILITY THAT USES NATURAL GAS AS THE PRIMARY FUEL AND (2) MODIFY CERTAIN REQUIREMENTS UNDER THE COAL ASH MANAGEMENT ACT OF 2014 FOR COAL ASH SURFACE IMPOUNDMENTS LOCATED ON SITES AT WHICH ALL COAL-FIRED GENERATING UNITS PRESENT ON THOSE SITES WILL PERMANENTLY CEASE OPERATIONS BY JANUARY 31, 2020.

The General Assembly of North Carolina enacts:

SECTION 1. Notwithstanding G.S. 62-110.1, the Commission shall provide an expedited decision on an application for a certificate to construct a generating facility that uses natural gas as the primary fuel if the application meets the requirements of this section. A public utility shall provide written notice to the Commission of the date the utility intends to file an application under this section no less than 30 days prior to the submission of the application. When the public utility applies for a certificate as provided in this section, it shall submit to the Commission an estimate of the costs of construction of the gas-fired generating unit in such detail as the Commission may require. G.S. 62-110.1(e) and G.S. 62-82(a) shall not apply to a certificate applied for under this section. The Commission shall hold a single public hearing on the application applied for under this section and require the applicant to publish a single notice of the public hearing in a newspaper of general circulation in Buncombe County. The Commission shall render its decision on an application for a certificate, including any related transmission line located on the site of the new generation facility, within 45 days of the date the application is filed if all of the following apply:

(1) The application for a certificate is for a generating facility to be constructed at the site of the Asheville Steam Electric Generating Plant located in Buncombe County.
(2) The public utility will permanently cease operations of all coal-fired generating units at the site on or before the commercial operation of the generating unit that is the subject of the certificate application.
(3) The new natural gas-fired generating facility has no more than twice the generation capacity as the coal-fired generating units to be retired.

SECTION 2.(a) Section 3(b) of S.L. 2014-122 reads as rewritten:

"**SECTION 3.(b)** Notwithstanding G.S. 130A-309.211 or G.S. 130A-309.212, as enacted by Section 3(a) of this act, and except as otherwise preempted by the requirements of federal law, the following coal combustion residuals surface impoundments shall be deemed high-priority ~~and, as soon as practicable, but no later than August 1, 2019,~~ and shall be closed in conformance with Section 3(c) of this ~~act:~~act as follows:

(1) Coal combustion residuals surface impoundments located at the Dan River Steam Station, owned and operated by Duke Energy Progress, and located in Rockingham ~~County.~~County, as soon as practicable, but no later than August 1, 2019.
(2) Coal combustion residuals surface impoundments located at the Riverbend Steam Station, owned and operated by Duke Energy Carolinas, and located in Gaston ~~County.~~County, as soon as practicable, but no later than August 1, 2019.

(3) Coal combustion residuals surface impoundments located at the Asheville Steam Electric Generating Plant, owned and operated by Duke Energy Progress, and located in Buncombe ~~County.~~County, as soon as practicable, but no later than August 1, 2022.

(4) Coal combustion residuals surface impoundments located at the Sutton Plant, owned and operated by Duke Energy Progress, and located in New Hanover ~~County.~~County, as soon as practicable, but no later than August 1, 2019."

SECTION 2.(b) The requirements of subsections (c) through (f) of G.S. 130A-309.210 shall not apply to coal combustion residuals surface impoundments and electric generating facilities located at the Asheville Steam Electric Generating Plant in Buncombe County.

SECTION 2.(c) This section becomes effective August 1, 2016, if, on or before that date, the North Carolina Utilities Commission has issued a certificate of public convenience and necessity to Duke Energy Progress for a new natural gas-fired generating facility, pursuant to Section 1 of this act, based upon written notice submitted to the Commission from Duke Energy Progress that it will permanently cease operations of all coal-fired generating units at the Asheville Steam Electric Generating Plant located in Buncombe County no later than January 31, 2020.

SECTION 3. Except as otherwise provided, this act is effective when it becomes law.

In the General Assembly read three times and ratified this the 15th day of June, 2015.

s/ Daniel J. Forest
President of the Senate

s/ Tim Moore
Speaker of the House of Representatives

s/ Pat McCrory
Governor

Approved 10:15 a.m. this 24th day of June, 2015

THE STATE OF SOUTH CAROLINA
BEFORE THE DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL

IN RE: DUKE ENERGY PROGRESS, INC.
H.B. ROBINSON STEAM ELECTRIC PLANT
DARLINGTON COUNTY

CONSENT AGREEMENT
15 – 23 – HW

This Consent Agreement is entered into between the South Carolina Department of Health and Environmental Control (SCDHEC or the Department) and Duke Energy Progress, Inc. (Duke Energy) with respect to the investigation and remediation of the inactive 1960 ash storage area at the H.B. Robinson Steam Electric Plant located at 3581 W. Entrance Road, Hartsville, South Carolina (Tax Map Number 018-00-02-001). The "Site" shall include the inactive 1960 ash storage area and all areas where ash, other coal combustion residuals, or their constituents, including contaminants, (collectively Coal Combustion Residuals or CCR or ash) may have potentially migrated from the 1960 ash storage area, collectively referred to as the "Site" as depicted on Exhibit A.

Duke Energy is entering into this Consent Agreement to assess and address any release or threat of release of Coal Combustion Residuals or other pollutants from the Site to the environment and to provide for the final disposition of the Site. Duke Energy will take all necessary steps in compliance with all environmental laws to prevent future releases from the Site. In the interest of resolving the matters herein without delay, Duke Energy agrees to the entry of this Consent Agreement without litigation and without the admission or adjudication of any issue of fact or law, except for purposes of enforcing this agreement. Duke Energy agrees that this Consent Agreement shall be deemed an admission of fact and law only as necessary for enforcement of this Consent Agreement by the Department or in subsequent actions relating to this Site by the Department.

FINDINGS OF FACT

Based on information known by the Department, the following findings of fact are asserted by the Department for purposes of this Consent Agreement:

1. Duke Energy Progress, Inc. owns and operates both:

   a. The H.B. Robinson Steam Electric Plant (Robinson Plant) located approximately 4.5 miles north of Hartsville, Darlington County, South Carolina. Development of the Robinson Plant facility began in the late 1950s when Black Creek was impounded to create Lake Robinson. Shortly thereafter, the 177 MW coal-fired unit (Unit 1) began commercial operation in 1960. That unit was retired in October 2012. A 710 MW nuclear unit began operation at the site in 1971 and continues to operate. The Tax Map Identification is 018-00-02-001.

   b. The Darlington Plant is located adjacent to the Robinson Plant in Darlington County, South Carolina. The Darlington Plant consists of 13 combustion turbine units and began operation in 1974. Coal has never been used as a fuel at the Darlington Plant. The Tax Map Identification is also 018-00-02-001.

2. The Robinson Plant coal ash management facilities include one ash basin (State Identification Number D3514) located northwest of the fossil and nuclear units; and a 1960 ash storage area located south of the permitted ash basin. The 1960 ash storage area was created in 1960, and received ash from Unit 1 until the permitted ash basin was constructed in the mid-1970s. The 1960 ash storage area covers a surficial area measuring approximately 25 acres with an estimated ash thickness ranging from 6 to 16 feet.

3. Preliminary Site assessment indicates that the preferred disposition of the CCR from the Site is in a South Carolina permitted Class 3 solid waste disposal facility located on the Darlington Plant site and/or the Robinson Site. However, if detailed closure planning

determines that beneficial reuse or disposal in an off-site waste disposal facility is a superior option, then Duke Energy may choose to pursue such options with the consent of the Department.

4. CCR located at the Site lies in an electric transmission corridor, and removal of the ash will require relocation of the transmission line, including its supporting structures. In order to relocate the transmission towers and structures in clean soil, the CCR must be removed in phases, with the first phase consisting of excavation, removal, and disposal of CCR in the area to which the transmission line will be relocated (the Sub-Site). The first phase will require confirmatory sampling to assure the CCR has been removed before erecting the transmission towers and supporting structures in this area. Any groundwater remediation needed for the Sub-Site shall be completed once CCR has been removed from the entire 1960 ash storage area.

CONCLUSIONS OF LAW

The Department has the authority to implement and enforce laws and related regulations pursuant to the South Carolina Hazardous Waste Management Act, S.C. Code Ann. §44-56-10, et seq. (Rev. 2002 and Supp. 2014), the Pollution Control Act, S.C. Code Ann. §48-1-10 et seq. (Rev. 2008 and Supp. 2014) and the South Carolina Solid Waste Policy and Management Act, S.C. Code Ann. §44-96-10, et seq. (Rev. 2002 and Supp. 2014). These Acts authorize the Department to issue orders; assess civil penalties; conduct studies, investigations, and research to abate, control and prevent pollution; and to protect the health of persons or the environment.

NOW, THEREFORE IT IS AGREED, with the consent of Duke Energy and the Department, and pursuant to the South Carolina Hazardous Waste Management Act, the Pollution Control Act, and/or the Solid Waste Policy and Management Act, that Duke Energy shall:

1. Submit an application to construct the Class 3 solid waste disposal facility to the Department no later than April 1, 2016. If a Class 3 solid waste disposal facility cannot be permitted at the Darlington Electric Power Plant and/or the Robinson Plant within five (5) years of the effective date of this agreement, Duke Energy shall dispose of the CCR by another Department approved method.
2. Dispose of all CCR at the Site within a South Carolina permitted Class 3 solid waste disposal facility located at the Darlington Electric Power Plant and/or the Robinson Plant, and complete disposal within eight (8) years following the execution of this Consent Agreement.
3. Within ninety (90) days of receipt of a final and non-appealable permit to construct a Class 3 solid waste disposal facility, commence construction of said solid waste disposal facility and submit to the Department for review and approval, an Ash Removal Plan for the Site. The Ash Removal Plan shall include a time schedule for implementation of all major activities required by the Plan. The Ash Removal Plan must include, but is not limited to, characterization of the ash, provisions for the safe removal of the ash, and management of storm water during the project. The Ash Removal Plan shall also include an evaluation of any stability issues expected to be encountered during ash removal activities. The Ash Removal Plan shall address the impacts to the existing transmission lines and municipal sewer lines and the plans to relocate these utilities as part of the project. Any comments generated through the Department's review of the Ash Removal Plan must be addressed in writing by Duke Energy within fifteen (15) days of Duke Energy's receipt of said comments. Upon the Department's approval of the Ash Removal Plan and the time schedule for implementation thereof, the Ash Removal Plan and schedule shall be incorporated herein and become an enforceable part of this Consent Agreement. The implementation schedule must include the calendar date when all ash will be removed from the Site, not to exceed eight (8) years as outlined in item 2. above.

4. Submit, along with but under separate cover from the Ash Removal Plan, a Health and Safety Plan (HASP) consistent with Occupational Safety and Health Administration regulations. The HASP shall be submitted to the Department in the form of one (1) electronic copy (pdf. format). Duke Energy agrees the HASP is submitted to the Department for informational purposes only. The Department expressly denies any liability that may result from Duke Energy's implementation of the HASP. Begin implementation of the Ash Removal Plan described in paragraph 3. within fifteen (15) days of Duke Energy's receipt of the Department's written approval of the Ash Removal Plan and all required permits, whichever is later, provided Duke Energy submits timely applications for any necessary permits.

5. Upon completion of the work approved at the Site or Sub-Site in accordance with the Ash Removal Plan, submit an Ash Removal Report to the Department. The Ash Removal Report shall summarize the activities taken during implementation of the Ash Removal Plan and shall contain appropriate documentation that ash has been removed from the Site or Sub-Site and properly disposed of in accordance with the Ash Removal Plan.

6. Within thirty (30) days of approval of the Ash Removal Report(s), submit an Assessment Plan to the Department. The Assessment Plan shall include, but is not limited to, the following: a description of work needed for the delineation of the vertical and horizontal extent of any contamination, including an assessment of surface water, groundwater, and soil underlying the Site; a conceptual site model to ensure assessment of all potential risks to human health and the environment; and a schedule for implementation.

7. Upon completion of the activities outlined in the approved Assessment Plan, within sixty (60) days submit to the Department an Assessment Report summarizing the findings of the investigations performed pursuant to the Assessment Plan, including an evaluation of all risks to human health and the environment. The Department shall review the Assessment Report to determine completion of the field investigation and sufficiency of

the documentation. If the Department determines that additional field investigation is necessary, Duke Energy shall conduct additional field investigation to complete such task. Alternatively, if the Department determines the field investigation to be complete, but the conclusions in Duke Energy's Assessment Report are not approved, Duke Energy shall submit a Revision to the Assessment Report within thirty (30) days after receipt of the Department's disapproval. The Revision shall address the Department's comments.

8. Within sixty (60) days of approval of all Assessment Reports, submit to the Department a Closure Plan which details the actions to be taken for the final disposition of the Site, and evaluates the need for additional remediation of soils, surface water and groundwater. If remedial actions are necessary, Duke Energy shall also submit to the Department for approval a Remedial Plan, which includes a proposed remedy, justification for the proposed remedy, the design of the proposed remedy and a schedule for implementation. The schedule of implementation must extend through full completion of the remedy. The Closure Plan and, if necessary, the Remedial Plan shall be based upon the results of the field investigation, ash removal activities and the following seven (7) criteria:

   a. Overall protection of human health and the environment;
   b. Compliance with applicable or relevant and appropriate standards;
   c. Long-term effectiveness and permanence;
   d. Reduction of toxicity, mobility or volume;
   e. Short-term effectiveness;
   f. Implementability; and
   g. Costs.

9. Address any comments generated through the Department's review of the Closure Plan and any required Remedial Plan in writing within fifteen (15) days of Duke Energy's receipt of said comments. This fifteen (15) day deadline may be extended by mutual agreement of the parties if the comment resolution requires extensive revision, such as

reengineering. Upon Department approval of the Closure Plan, Remedial Plan and the implementation schedule, the Closure Plan, Remedial Plan, and implementation schedule shall be incorporated herein and become an enforceable part of this Consent Agreement.

10. Begin to implement the Closure Plan and the Remedial Plan within forty-five (45) days of the Department's approval of the Plans; and thereafter, take all necessary and reasonable steps to ensure timely completion of the Plans.

11. Submit to the Department a written monthly progress report within thirty (30) days of the execution of this Consent Agreement and by the last business day of every month thereafter until completion of the work required under this Consent Agreement. The progress reports shall include the following: (a) a description of the actions which Duke Energy has taken toward achieving compliance with this Consent Agreement during the previous month; (b) results of sampling and tests, in summary format received by Duke Energy during the reporting period; (c) description of all actions which are scheduled for the next month to achieve compliance with this Consent Agreement, and other information relating to the progress of the work as deemed necessary or requested by the Department; and (d) information regarding the percentage of work completed and any delays encountered or anticipated that may affect the approved schedule for implementation of the terms of this Consent Agreement, and a description of efforts made to mitigate delays or avoid anticipated delays.

12. Prepare all Plans and perform all activities under this Consent Agreement following appropriate DHEC and EPA guidelines. All Plans and associated reports, with the exception of the Monthly Reports required by paragraph 12 and the HASP required by paragraph 4. above, shall be prepared in accordance with industry standards and endorsed by a Professional Engineer (P.E.) and/or Professional Geologist (P.G.) duly-licensed in South Carolina. Unless otherwise requested, one (1) paper copy and one (1) electronic copy (pdf. format) of each document prepared under this Consent Agreement shall be

submitted to the Department's Project Manager. Unless otherwise directed in writing, all correspondence, work plans and reports should be submitted to the Department's Project Manager at the following address:

Tim Hornosky
South Carolina Department of Health and Environmental Control
Bureau of Land and Waste Management
2600 Bull Street
Columbia, South Carolina 29201
hornostr@dhec.sc.gov

13. Reimburse the Department on a quarterly basis, for all past, present and future costs, direct and indirect, incurred by the Department pursuant to this Consent Agreement and as provided by law. Oversight Costs include, but are not limited to, the direct and indirect costs of negotiating the terms of this Consent Agreement, reviewing plans and reports, supervising corresponding work and activities, and costs associated with public participation. The Department shall provide documentation of its Oversight Costs in sufficient detail so as to show the personnel involved, amount of time spent on the project for each person, expenses, and other specific costs. Payments are due to the Department within thirty (30) days of the date of the Department's invoice; however, it is not a violation of this Consent Agreement if late payment is cured within thirty (30) additional days.

14. Meet with the Department's Project Manager at least quarterly to discuss progress toward schedule requirements and to anticipate any schedule delays.

15. Notify the Department in writing at least five (5) days before the scheduled deadline if any event occurs which causes or may cause a delay in meeting any of the above-scheduled dates for completion of any specified activity pursuant to this Consent Agreement. Duke Energy shall describe in detail the anticipated length of the delay, the precise cause or causes of delay, if ascertainable, the measures taken or to be taken to

prevent or minimize the delay, and the timetable by which Duke Energy proposes that those measures will be implemented. The Department shall provide written notice to Duke Energy as soon as practicable that a specific extension of time has been granted or that no extension has been granted. An extension shall be granted for any scheduled activity delayed by an event of *force majeure* which shall mean any event arising from causes beyond the control of Duke Energy that causes a delay in or prevents the performance of any of the conditions under this Consent Agreement including, but not limited to: a) acts of God, fire, war, insurrection, civil disturbance, explosion; b) adverse weather conditions that could not be reasonably anticipated causing unusual delay in transportation and/or field work activities; c) restraint by court order or order of public authority; d) inability to obtain, after exercise of reasonable diligence and timely submittal of all required applications, any necessary authorizations, approvals, permits, or licenses due to action or inaction of any governmental agency or authority, or litigation staying or reversing permit issuance or other governmental agency approvals; and e) delays caused by compliance with applicable statutes or regulations governing contracting, procurement or acquisition procedures, despite the exercise of reasonable diligence by Duke Energy. Events which are not *force majeure* include by example, but are not limited to, unanticipated or increased costs of performance, changed economic circumstances, normal precipitation events, or failure by Duke Energy to exercise due diligence in obtaining governmental permits or performing any other requirement of this Consent Agreement or any procedure necessary to provide performance pursuant to the provisions of this Consent Agreement. Any extension shall be granted at the sole discretion of the Department, incorporated by reference as an enforceable part of this Consent Agreement, and thereafter, be referred to as an attachment to the Consent Agreement.

16. Upon Duke Energy's successful completion of the terms of this Consent Agreement, submit to the Department a written Final Report. The Final Report shall contain all necessary documentation supporting Duke Energy's remediation of the Site and successful and complete compliance with this Consent Agreement. Once the Department has approved the Final Report, the Department will provide Duke Energy a written approval of completion that provides Covenant Not to Sue to Duke Energy for the response actions specifically covered in this Consent Agreement, approved by the Department and completed in accordance with the approved work plans and reports.

17. Notwithstanding any other provision of this Consent Agreement, including the Covenant Not to Sue, the Department reserves the right to require Duke Energy to perform any additional work at the Site or to reimburse the Department for additional work if Duke Energy declines to undertake such work, if: (i) conditions at the Site, previously unknown to the Department, are discovered after completion of the work approved by the Department pursuant to this Consent Agreement and warrant further assessment or remediation to address a release or threat of a release in order to protect human health or the environment, or (ii) information is received, in whole or in part, after completion of the work approved by the Department pursuant to this Consent Agreement, and these previously unknown conditions of this information indicate that the completed work is not protective of human health and the environment. In exigent circumstances, the Department reserves the right to perform the additional work and Duke Energy will reimburse the Department for the work.

18. In consideration for the Department's Covenant Not to Sue, Duke Energy agrees not to assert any claims or causes of action against the Department arising out of response activities undertaken at the Site, or to seek any other costs, damages or attorney's fees from the Department arising out of response activities undertaken at the Site except for those claims or causes of action resulting from the intentional or grossly negligent acts or

omissions of the Department. However, Duke Energy reserves all available defenses, not inconsistent with this Consent Agreement, to any claims or causes of action asserted against Duke Energy arising out of response activities undertaken at the Site by the Department.

19. Employees of the Department, their respective consultants and contractors will not be denied access during normal business hours or at any time work under this Consent Agreement is being performed or during any environmental emergency or imminent threat situation, as determined by the Department or as allowed by applicable law.

IT IS AGREED THAT this Consent Agreement shall be binding upon and inure to the benefit of Duke Energy and its officers, directors, agents, receivers, trustees, heirs, executors, administrators, successors, and assigns and to the benefit of the Department and any successor agency of the State of South Carolina that may have responsibility for and jurisdiction over the subject matter of this Consent Agreement. Duke Energy may not assign it rights or obligations under this Consent Agreement without the prior written consent of the Department.

IT IS FURTHER AGREED that failure to meet any deadline or to perform the requirements of this Consent Agreement without an approved extension of time and failure to timely cure as noted below, may be deemed a violation of the Pollution Control Act, the South Carolina Hazardous Waste Management Act and/or the Solid Waste Management and Policy Act, as amended. Upon ascertaining any such violation, the Department shall notify Duke Energy in writing of any such deemed violation and that appropriate action may be initiated by the Department in the appropriate forum to obtain compliance with the provisions of this Consent Agreement and the aforesaid Acts. Duke Energy shall have thirty (30) days to cure any deemed violations of this Consent Agreement. Applicable penalties may begin to accrue after issuance of the Department's determination that the alleged violation has not been cured during that thirty (30) day period.

(Signature Page Follows)

FOR THE SOUTH CAROLINA DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL

for Robert A. Stephens

Elizabeth A. Dieck
Director of Environmental Affairs

Date: 7/17/2015

Daphne G. Neel

Daphne G. Neel, Chief
Bureau of Land and Waste Management

Date: 7/16/15

Van Keisler, P.G., Director
Division of Compliance and Enforcement

Date: 7-16-15

Reviewed By:

Susan A. Lake

Attorney
Office of General Counsel

Date: 7/16/15

WE CONSENT:

DUKE ENERGY PROGRESS, INC.

(Signature)

Date: July 15, 2015

John Elnitsky, Senior V.P.

Please clearly print name and title

I/A

N

NOTES:

1. AERIAL PHOTOGRAPH SOURCE IS GOOGLE MAPS WITH PHOTOGRAMMETRY DATE OF 2013.
2. APPROXIMATE LIMITS SHOWN FOR THE ROBINSON 1960 ASH STORAGE AREA ARE BASED ON DELINEATION BY AMEC FOSTER WHEELER FROM FIELD INVESTIGATION PERFORMED IN 2014.

LOCATION MAP

GRAPHIC SCALE - IN FEET

200' 100' 0 200' 400'

REV	D	M	Y	ISSUE/REVISION DESCRIPTION	ENG.	APPR.

CLIENT LOGO: DUKE ENERGY.

CLIENT: DUKE ENERGY
526 SOUTH CHURCH STREET
CHARLOTTE, NC 28202

Amec Foster Wheeler Environment & Infrastructure, Inc.
4021 STIRRUP CREEK DRIVE, SUITE 100
DURHAM, NC 27703
TEL: (919) 381-9900 FAX: (919) 381-9901
LICENSURE: NC LIND: F-1253 NC GEOLOGY: C-247

amec foster wheeler

DATUM:	
PROJECTION:	
DRAWN BY:	RR
REVIEWED BY:	RSA
SCALE:	AS NOTED

PROJECT: EXHIBIT A
DUKE ENERGY - H. B. ROBINSON PLANT

TITLE: 1960 ASH STORAGE AREA
LOCATION MAP

PROJECT NO.:	
REVISION NO.:	0
DATE:	16 JULY 2015
DRAWING NO.:	EXHIBIT A

Prepared by:

DUKE ENERGY

ASHEVILLE STEAM ELECTRIC GENERATING PLANT

1982 ASH BASIN

1964 ASH BASIN

CLOSURE PLAN

MARCH 03, 2017

Certified by:

amec foster wheeler

Amec Foster Wheeler Environment & Infrastructure, Inc.

2030 Falling Waters Road, Suite 300

Knoxville, TN 37922

North Carolina License Number: F-1253

ASH_CLOSE_PLN

Rev. 1

Duke Energy Progress, LLC (Duke Energy) prepared this Closure Plan for the Coal Combustion Residuals (CCR) surface impoundments at the Asheville Steam Electric Generating Plant (Asheville) pursuant to the requirements of 40 C.F.R. § 257.102(b) of the Disposal of CCR from Electric Utilities rule, 80 Fed. Reg. 21302 (April 17, 2015). Amec Foster Wheeler was retained by Duke Energy to certify that this Closure Plan meets the requirements of 40 C.F.R. § 257.102. The information contained in this Closure Plan will be used to assist Duke Energy in the closure of the 1964 Ash Basin and 1982 Ash Basin (collectively, Ash Basins) located in Buncombe County, North Carolina, on property owned by Duke Energy. This Closure Plan was originally posted to the Duke Energy operating record on October 17, 2016, and has been revised to: update the in-place CCR inventory in Section 3, and update the closure schedule and closure initiation date for the 1982 Ash Basin in Section 5. This Closure Plan may be additionally amended pursuant to the requirements of 40 C.F.R. § 257.102(b)(3). Presented below are:

1. A narrative of closure activities;
2. A description of the procedures to remove CCR and decontaminate the CCR units;
3. An estimate of the in-place CCR inventory requiring closure;
4. An estimate of the largest area of the CCR units requiring a final cover (as needed);
5. A closure schedule; and
6. A written certification from a qualified professional engineer, licensed in North Carolina, that this Closure Plan meets the requirements of 40 C.F.R. § 257.102.

1 NARRATIVE OF CLOSURE ACTIVITIES

The purpose of this Closure Plan is to describe the steps required to close the Ash Basins at Asheville consistent with recognized and generally accepted good engineering practices. Closure is designed to reduce the need for long-term maintenance and control the post-closure release of constituents into environmental pathways (i.e., air, surface water, and groundwater).

The Ash Basins will be closed through the removal of CCR, and the closure will be performed pursuant to 40 C.F.R. § 257.102(c). CCR will be removed as described in the following section.

2 CCR REMOVAL AND DECONTAMINATION

The procedures to remove CCR from the Ash Basins include dewatering and utilizing appropriate equipment and methods to excavate and move the CCR to an off-site permitted landfill. Dewatering will include removal of bulk water/free liquids and interstitial/pore water (as needed) to allow for safe excavation.

The existing embankments will be breached pursuant to a North Carolina Department of Environmental Quality (NCDEQ) Dam Safety permit approval. The embankments will be re-graded so that the closure area will be filled to promote free drainage of stormwater from the closure area.

Existing appurtenant structures, such as ditches, culverts, and miscellaneous piping, will be decontaminated and abandoned in place, removed and disposed in a permitted disposal facility, or removed and placed in a beneficial use facility identified at the time of closure. Decontamination procedures may consist of pressure washing, scrubbing, or other generally accepted decontamination procedures.

Pursuant to 40 C.F.R. § 257.102(c), closure will be complete when groundwater monitoring concentrations do not exceed the applicable groundwater protection standard established pursuant to 40 C.F.R. § 257.95(h) for constituents listed in appendix IV to 40 C.F.R. Part 257.

3 ESTIMATE OF IN-PLACE CCR INVENTORY

The volumes of CCR present in the Ash Basins were calculated and are presented in Table 1 below, pursuant to 40 C.F.R. § 257.102(b)(1)(iv). On September 22, 2016, an independent qualified professional engineer concluded that visible primary source CCR had been removed from the 1982 Ash Basin. The volume of the 1964 Ash Basin is the estimated inventory of CCR that will be open (and require closure) at one time. The estimate is based on bathymetric surveys, historical topography, and soil borings as of December 2015 and an inventoried estimate of 303,667 cubic yards of CCR from the 1982 Ash Basin that was placed in the 1964 Ash Basin in 2016. The annual surface impoundment inspections completed, pursuant to 40 C.F.R. § 257.83(b), and posted to the Duke Energy CCR website, pursuant to 40 C.F.R. § 257.107(g)(5), contain the most recent estimates of CCR material in the Ash Basins.

Table 1. Estimated In-Place CCR Inventory

Basin	Quantity of CCR (cubic yards)
1964 Ash Basin	2,416,667
1982 Ash Basin	0
Estimated Total	**2,416,667**

4 ESTIMATE OF LARGEST AREA REQUIRING FINAL COVER

CCR will be removed from the Ash Basins pursuant to 40 C.F.R. § 257.102(c). Therefore, no final cover system will be needed in support of closure activities.

5 CLOSURE SCHEDULE

Closure of the 1964 Ash Basin will be initiated pursuant to 40 C.F.R. § 257.102(e) and is anticipated to be completed within five years of the commencement of closure pursuant to 40 C.F.R. § 257.102(f)(1)(ii). Closure of the 1982 Ash Basin was initiated on August 30, 2016, on which date the 1982 Ash Basin ceased receiving non-CCR waste streams pursuant to 40 C.F.R. § 257.102(e) and is anticipated to be completed within five years of the commencement of closure pursuant to 40 C.F.R. § 257.102(f)(1)(ii). Closure of the 1982 Ash Basin is anticipated to be completed by August 30, 2021, and closure of the 1964 Ash Basin is anticipated to be completed by August 1, 2022. These dates are within the five year period of closure after initiation.

Prior to commencing closure construction, design documents will be prepared to support applications for required local, state, and federal permits. Closure construction design documents will include construction drawings, technical specifications, and quality assurance testing work plans. The permits required for closure construction activities will be evaluated at the time of closure and are anticipated to include permits from NCDEQ and the U.S. Army Corps of Engineers. Preliminary time frames of anticipated closure activities are included below in Table 2.

Table 2. Estimated Time Frames for Closure Activities

Closure Activity	Time Frame (years)*	
	1964 Ash Basin	1982 Ash Basin
NCDEQ Closure Plan Approval	1	-
NCDEQ Permitting Approvals (NDPES, E&SC, Air)	1	-
Dewatering and Stabilization	5	-
CCR Excavation	5	-
NCDEQ Dam Breach Approval	0.5	-

*Estimated closure activity time frames may include some overlap.

6 QUALIFIED PROFESSIONAL ENGINEER CERTIFICATION

I, Daniel R. Smith, 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 written Closure Plan dated March 03, 2017, was developed pursuant to the requirements of 40 C.F.R. § 257.102 and has been prepared in accordance with recognized and generally accepted good engineering practices.

NORTH CAROLINA PROFESSIONAL SEAL 043443 ENGINEER DANIEL R. SMITH

SIGNATURE ________________ DATE 3/3/17

Prepared by:

DUKE ENERGY

H.F. LEE ENERGY COMPLEX

ACTIVE ASH BASIN

CLOSURE PLAN

JULY 19, 2019

Certified by:

Duke Energy Carolinas, LLC

400 South Tryon Street,

Charlotte, North Carolina 28202

License No. F-0566

HFLEE_CLOSE_PLN

Rev. 1

On October 10, 2016, Duke Energy Progress, LLC (Duke Energy) posted on its publicly accessible CCR Rule Compliance Data and Information website, a Closure Plan for the Coal Combustion Residuals (CCR) surface impoundment at the H.F. Lee Energy Complex (H.F. Lee) pursuant to the requirements of 40 C.F.R. § 257.102(b) of the Disposal of CCR from Electric Utilities rule, 80 Fed. Reg. 21302 (April 17, 2015). This plan is an amendment to the Closure Plan dated October 10, 2016, pursuant to the requirements of 40 C.F.R. § 257.102(b)(3). The information contained in this amended Closure Plan will be used to assist Duke Energy in the closure of the Active Ash Basin (Ash Basin) located in Wayne County, North Carolina, on property owned by Duke Energy. Presented below are:

1. A narrative of closure activities;
2. A description of the procedures to remove CCR and decontaminate the CCR units;
3. An estimate of the in-place CCR inventory requiring closure;
4. An estimate of the largest area of the CCR units requiring a final cover (as needed);
5. A closure schedule; and
6. A written certification from a qualified professional engineer, licensed in North Carolina, that this Closure Plan meets the requirements of 40 C.F.R. § 257.102.

1 NARRATIVE OF CLOSURE ACTIVITIES

The purpose of this Closure Plan is to describe the steps necessary to close the Ash Basin consistent with recognized and generally accepted good engineering practices. The Ash Basin will be closed by removal of CCR pursuant to 40 C.F.R. § 257.102(c). Duke Energy will use commercially reasonable efforts to process the CCR removed from the Ash Basin at an on-site CCR beneficiation facility processing 300,000 tons of CCR annually pursuant to North Carolina General Statutes (N.C.G.S) § 130A-309.216, as enacted by Section 1 of House Bill 630, Session Law 2016-95. To the extent there is any remaining CCR in the Ash Basin after beneficiation operations have permanently ceased at H.F. Lee, the CCR will be moved to a permitted disposal facility. Procedures for CCR removal and decontamination are described in the following section.

2 CCR REMOVAL AND DECONTAMINATION

The procedures to remove CCR from the Ash Basin include dewatering and utilizing appropriate equipment and methods to excavate and process the CCR at an on-site CCR beneficiation facility pursuant to N.C.G.S. § 130A-309.216, and, to the extent required, move any remaining CCR to a permitted disposal facility. Dewatering will include removal of bulk water/free liquids and interstitial/pore water (as needed) to allow for safe excavation and adequate compaction.

Select dams will be breached pursuant to a North Carolina Department of Environmental Quality (NCDEQ) Dam Safety permit approval. These breaches are intended to promote free drainage of stormwater from the closure area.

Existing appurtenant structures, such as ditches, culverts, and miscellaneous piping, will be decontaminated and abandoned in place, removed and disposed of in a permitted disposal facility, or removed and processed at a beneficial use facility identified at the time of closure. Decontamination procedures may consist of pressure washing, scrubbing, or other generally accepted decontamination procedures.

Pursuant to 40 C.F.R. § 257.102(c), closure will be complete when groundwater monitoring concentrations do not exceed the applicable groundwater protection standard established pursuant to 40 C.F.R. § 257.95(h) for constituents listed in appendix IV to 40 C.F.R. Part 257.

3 ESTIMATE OF IN-PLACE CCR INVENTORY

The volume of CCR present in the Ash Basin was calculated and is presented in Table 1 below, pursuant to 40 C.F.R. § 257.102(b)(1)(iv). The volume is the estimated inventory of CCR that will be open (and require closure) at one time, and the estimate is based on bathymetric surveys, historical topography and soil borings as of July 2016. The annual surface impoundment inspections completed, pursuant to 40 C.F.R. § 257.83(b), and posted to the Duke Energy CCR website, pursuant to 40 C.F.R. § 257.107(g)(5), contain the most recent estimates of CCR material in the Ash Basin.

Table 1. Estimated In-Place CCR Inventory

Basin	Quantity of CCR (cubic yards)
Active Ash Basin	4,520,000

4 ESTIMATE OF LARGEST AREA REQUIRING FINAL COVER

CCR will be removed from the Ash Basin pursuant to 40 C.F.R. § 257.102(c); therefore, no final cover system will be constructed in support of closure activities.

5 CLOSURE SCHEDULE

Closure of the Ash Basin was initiated on April 4, 2019, pursuant to 40 C.F.R. § 257.102(e)(1)(ii). Prior to commencing closure construction, design documents will be prepared to support applications for required local, state, and federal permits. Closure construction design documents will include construction drawings, technical specifications, and quality assurance testing work plans. The permits required for closure construction activities will be evaluated at the time of closure and are anticipated to include permits from NCDEQ and the U.S. Army Corps of Engineers. Preliminary time frames of anticipated closure activities for the Ash Basin pursuant to 40 C.F.R. § 257.102(b)(1)(vi) are included below in Table 2. Duke Energy estimates that the processing of CCR for beneficial use and closure activities for the Ash Basin will be completed by 2029.

Table 2. Estimated Time Frames for Closure Activities

Closure Activity	Time Frame (years)*
NCDEQ Closure Plan Approval	1
NCDEQ Permitting Approvals (NDPES, E&SC, Air)	1
Dewatering and Stabilization	4
NCDEQ Dam Decommissioning Approval	0.5
CCR Excavation	9

*Estimated closure activity time frames may include some overlap and do not include beneficial use activities.

6 QUALIFIED PROFESSIONAL ENGINEER CERTIFICATION

I, Sharat Chand Gollamudi, 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 written amended Closure Plan dated July 19, 2019, was developed pursuant to the requirements of 40 C.F.R. § 257.102 and has been prepared consistent with recognized and generally accepted good engineering practices.

SIGNATURE G. Sharatchand DATE: July 15, 2019

Sharat C. Gollamudi
North Carolina Professional Engineer No. 038977

I/A

CLOSURE PLAN

CLOSURE PLAN

Mayo CCR Monofill Landfill

Submitted To: Duke Energy Progress, LLC.
526 S. Church Street
Charlotte, NC 28202

Submitted By: Golder Associates NC, Inc.
5B Oak Branch Drive
Greensboro, NC 27407

NORTH CAROLINA PROFESSIONAL SEAL 042286 ENGINEER JAMES R. DIFRANCESCO 10-10-16

Distribution: Evan Andrews, PE (Duke Energy)

October 2016 **Project No. 1533278**

MAY_AM_CLOSE_LDFL_PLN

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1.0 INTRODUCTION

This Closure Plan was prepared for the Mayo Plant (Mayo) – Coal Combustion Residuals (CCR) Monofill. This Closure Plan was prepared in accordance with 40 C.F.R. Part 257, Subpart D and is consistent with the requirements of 40 C.F.R. §257.102(b) for closure of CCR landfills. The information contained in this Closure Plan will be used to assist Duke Energy Progress, LLC (Duke Energy) in the closure of active waste units. The Mayo CCR Monofill is owned and operated by Duke Energy. The landfill is located in Person County, North Carolina on Duke property, east of the Mayo Plant and the Mayo Reservoir. Duke Energy must obtain a written certification from a qualified professional engineer, licensed in the state in which the project work is conducted, that this written Closure Plan and any amendments thereto meet the requirements of 40 C.F.R. §257.102 (see Section 3.0).

2.0 CLOSURE PLAN

2.1 Overview of Closure Approach

The purpose of the Closure Plan is to outline the steps necessary to close the landfill phases consistent with recognized and generally accepted good engineering practices. Closure is designed to minimize the need for long-term maintenance and to control the post-closure release of contaminants. The facility will be closed in accordance with the requirements of 40 C.F.R. §257.102. Closure will occur within the time frames set out in 40 C.F.R. §257.102(f). This Closure Plan may be amended in accordance with the requirements of 40 C.F.R. §257.102(b)(3).

2.2 Estimated Maximum Inventory of CCR

The current landfill design provides approximately 16,900,000 cubic yards of gross capacity as measured from the top of the protective cover soil to the top of final cover. Currently, the only active portion of the landfill is Phase 1, which has a 31.0-acre footprint and a gross capacity estimated to be 1,592,000 cubic yards.

2.3 Largest Area Requiring Cover System

The Phase 1 permitted area of 31.0 acres is currently the largest area that will need to be capped.

2.4 Closure Performance Standard

2.4.1 Final Cover

The cover system has been designed to minimize infiltration into the landfill and to resist erosion. The permeability of the least permeable layer in the final cover system is 1×10^{-12} centimeter per second (cm/sec). This is equal to or less than the permeability of the least permeable layer in the bottom liner system and no greater than 1×10^{-5} cm/sec.

The final cover system for the closed phase will be certified by a qualified professional engineer as being designed in accordance with the requirements of 40 C.F.R. §257.102.

With the type of waste that has been landfilled and the controlled nature of the fill placement, no decomposition of the waste material is expected; therefore, minimum, if any, settlement is expected. Due to the high allowable strain of the geomembrane and the stable nature of the waste, the final cover system will accommodate any differential settlement that may occur in the waste during the post-closure care period.

The proposed final cover system will consist of the following, from top to bottom, and will be placed over the top of the landfilled CCR materials:

- 6-inch-thick vegetated erosion layer

- 18-inch-thick protective cover soil barrier
- Geocomposite drainage layer
- 40-mil-thick double-sided textured linear low density polyethylene (LLDPE) geomembrane
- 12 inches of intermediate soil cover

2.4.2 Alternate Final Cover

No alternate final cover system is proposed.

2.4.3 Performance Standard

Closure of the facility will be conducted in a manner that minimizes the need for further maintenance and controls, and minimizes or eliminates, to the extent necessary to protect human health and the environment, the post-closure escape of uncontrolled leachate, surface runoff, or waste products to the groundwater, surface water, or the atmosphere.

The final cover system consisting of a vegetated soil layer with run-on and run-off controls will minimize the need for post-closure maintenance. The final slopes of the landfill will promote runoff. Diversion berms and downslope pipes will convey surface runoff to sediment basins designed to remove sediment prior to discharge. Vegetation will be established and, along with the diversion berms and storm water conveyance channels, will minimize erosion of the final cover system.

A low-permeability final cover system will be constructed and maintained that minimizes the infiltration of precipitation into the waste mass. By minimizing infiltration, the final cover will minimize leachate generation.

The final slopes of the landfill will not be less than 5 percent to prevent ponding.

The CCR unit will be closed in a manner that provides for slope stability to prevent the sloughing or movement of the final cover system. Both global and veneer stability analyses were performed in order to determine the minimum factors of safety against failure.

The minimum factor of safety for global static stability was found to be greater than 1.5, and the minimum factor of safety for seismic global stability was found to be greater than 1.0 in accordance with sound engineering practices for landfill final cover design.

The minimum factor of safety for static veneer stability was found to be greater than 1.5, and the minimum factor of safety for seismic veneer stability was found to be greater than 1.0 in accordance with sound engineering practices for landfill final cover design.

The final cover system will be finished within 6 months following the beginning of closure construction unless otherwise approved. If more than 6 months are necessary, steps to prevent threats to human health and the environment from the unclosed landfill unit will be undertaken.

2.5 Schedule

In accordance with 40 C.F.R. §257.102(e), the facility will begin closure activities within 30 days after the known final receipt of waste, or if the landfill has remaining capacity and there is a reasonable likelihood that the landfill will receive additional wastes, no later than 2 years after the most recent receipt of wastes. Contractor mobilization will occur during the initial 30-day period after last known receipt of waste.

In accordance with 40 C.F.R. §257.102(g), no later than the date on which closure of the CCR unit is initiated, Duke Energy will prepare a notification of intent to close the unit, which includes the certification by a qualified professional engineer for the design of the final cover system required by §257.102(d)(3)(iii).

In accordance with 40 C.F.R. §257.102(h), within 30 days following completion of closure of the CCR unit, Duke Energy shall record a notation on the deed to the landfill property stating that the property has been used as a landfill and its use is restricted under the Post-closure Plan and the post-closure care requirements as provided by 40 C.F.R. §257.104(d)(1)(iii).

Within 30 days of recording the notation, Duke Energy shall prepare a notification stating that the notation has been recorded and placed in the facility's operating record. Pursuant to 40 C.F.R. §257.106(d), Duke Energy shall send to the appropriate regulatory agency the notification of intent to close, notification of closure completion, and notification of deed notation, within 30 days of placing each notification in the operating record.

An expected schedule for closure activities is as follows:

Schedule for Closure Activities	
Time	**Activity**
Prior to last receipt of waste	Permitting, detailed closure design, and contractor selection
Initial 30 days after last receipt of waste	Mobilization of contractor
Months 0-1 after beginning construction	Grading / preparing intermediate cover
Months 1-4 after beginning construction	Installation of geomembrane, geocomposite drainage layer, and protective cover soil and vegetation layer
Months 4-5 after beginning construction	Installation of diversion berms and downslope drainage pipes
Months 5-6 after beginning construction	Seed, fertilizer, and mulch

3.0 PROFESSIONAL ENGINEER CERTIFICATION

I, James R. DiFrancesco, being a registered Professional Engineer, in accordance with the North Carolina Professional Engineer's Registration, do hereby certify to the best of my knowledge, information, and belief, that the information contained in this report dated October 10, 2016, was prepared in accordance with the requirements of 40 C.F.R. §257.102, is true and correct, and was prepared in accordance with recognized and generally accepted good engineering practices.

The use of the word "certification" and/or "certify" in this document shall be interpreted and construed as a Statement of Professional Opinion, and is not and shall not be interpreted or construed as a guarantee, warranty, or legal opinion

GOLDER ASSOCIATES NC, INC.

Ron DiFrancesco, PE
Principal and Practice Leader

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Asia	+ 852 2562 3658
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Europe	+ 356 21 42 30 20
North America	+ 1 800 275 3281
South America	+ 56 2 2616 2000

solutions@golder.com
www.golder.com

Golder Associates NC, Inc.
5B Oak Branch Drive
Greensboro, NC 27407 USA
Tel: (336) 852-4903
Fax: (336) 852-4904

Golder Associates

Engineering Earth's Development, Preserving Earth's Integrity

CLOSURE PLAN
MAYO STEAM ELECTRIC PLANT
CCR UNIT: WASTEWATER TREATMENT (WWT) BASIN

Duke Energy Progress, LLC (Duke Energy) prepared this Closure Plan for a Coal Combustion Residuals (CCR) surface impoundment at the Mayo Steam Electric Plant (Mayo), constructed between 2017 and 2019, pursuant to the requirements of 40 C.F.R. § 257.102(b) of the Disposal of CCR from Electric Utilities rule, 80 Fed. Reg. 21302 (April 17, 2015). The information contained in this Closure Plan will be used to assist Duke Energy in the closure of the Wastewater Treatment (WWT) Basin to be located in Person County, North Carolina, on property owned by Duke Energy. This Closure Plan may be amended pursuant to the requirements of 40 C.F.R. § 257.102(b)(3).

Presented below are:

1. A narrative of closure activities;
2. A description of the procedures to remove CCR and decontaminate the WWT Basin;
3. An estimate of the in-place CCR inventory requiring closure;
4. An estimate of the largest area of the WWT Basin requiring a final cover;
5. A closure schedule; and
6. A written certification from a qualified professional engineer, licensed in North Carolina, that this Closure Plan meets the requirements of 40 C.F.R. § 257.102.

1 NARRATIVE OF CLOSURE ACTIVITIES

The purpose of this Closure Plan is to describe the steps necessary to close the WWT Basin consistent with recognized and generally accepted good engineering practices and Environmental Protection Agency (EPA) guidance. Closure is designed to reduce the need for long-term maintenance and control the post-closure release of constituents into environmental pathways (i.e., air, surface water, and groundwater).

The WWT Basin will be closed through the removal of CCR, and the closure will be performed pursuant to 40 C.F.R. §257.102(c). CCR will be removed as described in the following section.

2 CCR REMOVAL AND DECONTAMINATION

The procedures to remove CCR from the WWT Basin include dewatering and utilizing appropriate equipment and methods to excavate and move the CCR to the permitted on-site landfill. Dewatering will include removal of bulk water/free liquids and additional dewatering of the CCR solids prior to disposal.

The existing embankment will be breached pursuant to a North Carolina Department of Environmental Quality (NCDEQ) Dam Safety permit approval. This breach is intended to promote free drainage of storm water from the closure area.

Existing appurtenant structures, such as liners, concrete overlays, ditches, and miscellaneous piping, will be decontaminated and abandoned in place, removed and disposed in a permitted disposal facility, or removed and placed in a beneficial use facility identified at the time of closure. Decontamination procedures may consist of, including, but not limited to: pressure washing, scrubbing, or other generally accepted decontamination procedures.

Pursuant to 40 C.F.R. § 257.102(c), closure will be complete when groundwater monitoring concentrations do not exceed the applicable groundwater protection standard established pursuant to 40 C.F.R. § 257.95(h) for constituents listed in appendix IV to 40 C.F.R. Part 257.

3 ESTIMATE OF IN-PLACE CCR INVENTORY

The volume of CCR projected to be stored in the WWT Basin was calculated and is presented in Table 1 below, pursuant to 40 C.F.R. § 257.102(b)(1)(iv). The volume is the estimated inventory of CCR that will be open (and require closure) at one time. The estimate was provided by the Design Engineer of Record in October, 2018 based on operating criteria for the WWT Basin and represents the maximum theoretical CCR inventory during its design life.

Table 1. Projected In-Place CCR Inventory

Basin	Projected Quantity of CCR (cubic yards)
WWT Basin	42,000

4 ESTIMATE OF MAXIMUM AREA REQUIRING FINAL COVER

CCR will be removed from the WWT Basin pursuant to §257.102(c); therefore, no final cover system will be constructed in support of closure activities.

5 CLOSURE SCHEDULE

Closure of the WWT Basin will be initiated pursuant to 40 C.F.R. § 257.102(e) and is anticipated to be completed within five years of the commencement of closure activities, the duration specified in 40 C.F.R. § 257.102(f)(1)(ii).

Prior to commencing closure construction, design documents will be prepared to support applications for required local, state, and federal permits. Closure construction design documents will include construction drawings for closure, technical specifications, and quality testing work plans. The permits required for closure construction activities will be evaluated at the time of closure and are anticipated to include permits from the NCDEQ. Preliminary time frames for the anticipated closure activities are included below in Table 2.

Table 2. Estimated Time Frames for Closure Activities

Closure Activity	Time Frame (years)*
NCDEQ Closure Plan Approval	1
NCDEQ Permitting Approval (NPDES, E&SC, Air)	1
NCDEQ Landfill Permit Approval	0.5
NCDEQ Dam Decommissioning Approval	0.5
Dewatering	1
CCR Excavation	1

*Estimated closure activity time frames may include some overlap

6 CERTIFICATION

I, Michael B. Lazar, being a Registered Professional Engineer, in accordance with the North Carolina Professional Engineer's Registration, do hereby certify to the best of my knowledge, information and belief, that the initial assessment contained in this report dated January 8, 2019 meets the requirements of 40 C.F.R. § 257.74, is true and correct, and has been prepared in accordance with generally accepted good engineering practices.

NORTH CAROLINA
PROFESSIONAL
SEAL
041417
ENGINEER
MICHAEL B. LAZAR

SIGNATURE ______________ DATE 1/8/2019

Prepared by:

MAYO STEAM ELECTRIC PLANT

ASH BASIN

FGD FORWARD FLUSH POND

FGD SETTLING POND

CLOSURE PLAN

OCTOBER 10, 2016

Certified by:

6000 Fairview Road, Suite 200

Charlotte, NC 28210

License Number: C-2243

MAY_CLOSE_PLN

Rev. 0

Duke Energy Progress, LLC (Duke Energy) prepared this Closure Plan for the Coal Combustion Residuals (CCR) surface impoundment (Ash Basin) at the Mayo Steam Electric Plant (Mayo) pursuant to the requirements of 40 C.F.R. § 257.102(b) of the Disposal of CCR from Electric Utilities rule, 80 Fed. Reg. 21302 (April 17, 2015). URS Corporation – North Carolina (AECOM) was retained by Duke Energy to certify that this Closure Plan meets the requirements of 40 C.F.R. § 257.102. The information contained in this Closure Plan will be used to assist Duke Energy in the closure of the Ash Basin located in Person County, North Carolina, on property owned by Duke Energy. The Flue Gas Desulfurization (FGD) Forward Flush Pond and the FGD Settling Pond (collectively, FGD Ponds) are located within the Ash Basin footprint and will be included in its closure. This Closure Plan may be amended pursuant to the requirements of 40 C.F.R. § 257.102(b)(3). Presented below are:

1. A narrative of closure activities;
2. A description of the procedures to remove CCR and decontaminate the Ash Basin (as needed);
3. A description of the final cover system designed pursuant to 40 C.F.R. § 257.102(d), a description of the methods and procedures to be used to install the final cover, and a discussion of how the final cover system will achieve the performance standards specified in 40 C.F.R. § 257.102(d);
4. An estimate of the in-place CCR inventory requiring closure;
5. An estimate of the largest area of the Ash Basin requiring a final cover;
6. A closure schedule; and
7. A written certification from a qualified professional engineer, licensed in North Carolina, that this Closure Plan meets the requirements of 40 C.F.R. § 257.102.

1 NARRATIVE OF CLOSURE ACTIVITIES

The purpose of this Closure Plan is to describe the steps necessary to close the Ash Basin and FGD Ponds consistent with recognized and generally accepted good engineering practices. Closure is designed to reduce the need for long-term maintenance, control the post-closure infiltration of liquids into the in-place CCR materials, and control the post-closure release of constituents into environmental pathways (i.e., air, surface water, and groundwater).

Although, on May 18, 2016, the North Carolina Department of Environmental Quality (NCDEQ) ranked the Ash Basin “intermediate-risk,” which would require it to be dewatered and excavated pursuant to the North Carolina Coal Ash Management Act of 2014, as amended (CAMA), Duke Energy is in the process of establishing the permanent replacement water supplies required under N.C.G.S. § 130A-309.211(c1) and performing the applicable dam safety repair work required under Dam Safety Order 16-01 issued by the state of North Carolina pursuant to the North Carolina Dam Safety Law of 1967, specifically N.C.G.S. § 143-215.32. Pursuant to N.C.G.S. § 130A-309.213(d)(1), upon Duke Energy’s completion of these tasks within the required time frame set forth in CAMA, NCDEQ must classify the Ash Basin as low-risk, which will allow closure either pursuant to 40 C.F.R. § 257.102(c) or (d). Although CAMA charges NCDEQ with making the final determination regarding closure method, because science supports closure of the Ash Basin by leaving the CCR in place, Duke Energy contemplates that the Ash Basin will be closed pursuant to of 40 C.F.R. § 257.102(d).

The method to close the Ash Basin and FGD Ponds in place will include: removal and treatment of the bulk water/free liquids; interstitial/pore dewatering (as needed) and treatment; stabilization of remaining CCR materials sufficient to support the final cover system; grading of in-place CCR materials to promote positive drainage (no ponding) and prevent sloughing or movement of the final cover system; installation of a final cover system, including stormwater management controls; partial lowering of the dam; and post-closure groundwater monitoring and cover system maintenance. The final cover system will be designed to minimize infiltration and erosion to meet, or exceed, the requirements of the final cover system specified in 40 C.F.R. § 257.102(d)(3)(i). Typically, this involves the installation of a low permeability barrier layer and a vegetated soil cover to protect the barrier layer. Existing embankments will be lowered pursuant to a NCDEQ Dam Safety permit approval. This lowering is intended to promote free drainage of storm water from the closure area.

2 CCR REMOVAL AND DECONTAMINATION

There may be some areas, primarily located around the perimeter of the Ash Basin and FGD Ponds, where closure-by-removal is selected in order to enhance surface drainage and/or to allow for development of future plant infrastructure or transmission. In-place CCR in those areas will typically be dewatered (if needed), excavated, and consolidated (placed) into the remaining portion of the basin, which will be graded and closed-in-place pursuant to 40 C.F.R. § 257.102(d).

Existing appurtenant structures, such as ditches, culverts, and miscellaneous piping, will be decontaminated and abandoned in place, removed and disposed in a permitted disposal facility, or removed and placed in a beneficial use facility identified at the time of closure. Decontamination procedures may consist of pressure washing, scrubbing, or other generally accepted decontamination procedures.

Pursuant to 40 C.F.R. § 257.102(c), closure will be complete when groundwater monitoring concentrations do not exceed the applicable groundwater protection standard established pursuant to 40 C.F.R. § 257.95(h) for constituents listed in appendix IV to 40 C.F.R. Part 257.

3 FINAL COVER REQUIREMENTS

The final cover system for in-place closure of the Ash Basin and FGD Ponds will be designed pursuant to 40 C.F.R. § 257.102(d). Closure of the Ash Basin and FGD Ponds will be conducted in a manner that controls, minimizes, or eliminates, to the maximum extent feasible, the post-closure infiltration of liquids into the CCR and releases of CCR, leachate, or contaminated run-off to the ground or surface waters or to the atmosphere.

The final cover system being considered is a composite (soil and geosynthetics) cover system consisting of (from top to bottom):

- A six-inch layer of soil that is capable of sustaining native plant growth;
- An 18-inch thick protective soil cover layer;
- A geocomposite drainage layer or non-woven geotextile; and
- A 40-mil thick linear low-density polyethylene geomembrane barrier.

Alternative final cover systems are also under evaluation that would meet, or exceed, the requirements specified in 40 C.F.R. § 257.102(d)(3)(ii), which make use of the latest developments in final cover technology. The final cover system will serve to reduce erosion and post-closure maintenance. Various stormwater control measures (e.g., diversion berms, channels, downslope pipes, and/or downchutes) will convey surface run-off from the cover to sediment basins (as appropriate), prior to discharge until the site is stabilized by vegetation. The design of the stormwater conveyances will include armoring and energy dissipation measures, as necessary, to control erosion and reduce maintenance and repairs.

The final cover system, with an equivalent (or lower) permeability of any bottom liner system or natural subsoils present, or permeability no greater than $1x10^{-5}$ centimeters/second, will be constructed and maintained to minimize the infiltration of precipitation. By minimizing infiltration, the final cover will reduce the potential of leachate generation. The final cover system will be graded to preclude the probability of future impoundment of water, sediment, or slurry.

The Ash Basin and FGD Ponds will be closed in a manner resulting in stable slopes that prevent the sloughing or movement of the final cover system. The grades of the final cover system will be generally slight, sufficient to promote run-off while reducing the potential for sloughing. Instability potential (sliding or sloughing) is further reduced through the selection and use of cover system materials that have adequate drainage properties and sufficient internal and interface shear strengths. Construction quality assurance procedures will be completed to confirm conformance of the installed final cover system to the design.

Upon commencement of closure of the Ash Basin and FGD Ponds, final closure is anticipated to be completed in the shortest amount of time consistent with recognized and generally accepted good engineering practices. Section 6, Closure Schedule, of this Closure Plan describes estimated time frames.

3.1 FINAL COVER SYSTEM

Pursuant to 40 C.F.R. § 257.102(d)(3)(i)(A) through (D), the final cover system will be designed and constructed to meet, at a minimum, the following criteria:

(A) The permeability of the final cover system will be less than or equal to the permeability of any bottom liner system or natural subsoils present, or a permeability no greater than 1×10^{-5} centimeters/second, whichever is less.

The final cover system options being considered for the Ash Basin and FGD Ponds will meet or exceed these criteria. The geomembrane by itself results in a *lower effective infiltration rate than the 18 inches of 1x10^{-5} centimeters/second soil standard.*

(B) The infiltration of liquids through the Ash Basin and FGD Ponds will be minimized by the use of an infiltration layer that contains a minimum of 18 inches of earthen material.

The geomembrane component in the final cover system results in equivalent or better infiltration performance than 18 inches of earthen material. The proposed protective cover (18 inches) and vegetative layer soil will be obtained from local borrow sites and/or portions of the dams and dikes that will be lowered during closure. The gradation of the soil used in the cover will be such that it does not damage the geomembrane, provides drainage, resists erosion, and supports plant growth.

(C) The erosion of the final cover system will be minimized by the use of an erosion layer that contains a minimum of six inches of earthen material that is capable of sustaining native plant growth.

The materials proposed for the vegetative support layer in the composite cover system option, or the protective cover component of an alternate final cover system, will provide equivalent or better performance than a six-inch-thick erosion layer. In addition, and prior to the completion of closure, stormwater run-off and wastewaters generated from areas outside the Ash Basin and FGD Pond's drainage catchment (which had previously been routed through the basin when it was active) will be permanently diverted for treatment (as needed) and discharge at other locations within the site.

(D) The disruption of the integrity of the final cover system will be minimized through a design that accommodates settling and subsidence.

The materials proposed for the final cover systems will accommodate the amount of settlement and subsidence that is anticipated to be encountered during construction and post-closure. In addition, the cover grades and stormwater conveyance system grades will be designed to accommodate settlement during construction and post-closure care.

The methods and procedures used to install the final cover will include:

1. Completing necessary field characterizations and design analyses;
2. Obtaining necessary federal, state, and local permits;
3. Preparing bid documents and selecting a qualified contractor;
4. Mobilizing;
5. Installing erosion and sediment control measures;
6. Removing and treating (as needed) the bulk water/free liquid;
7. Decontaminating and abandoning in place or removing the appurtenant structures within the Ash Basin and FGD Ponds;
8. Clearing and grubbing;

9. Constructing laydown areas and access roads;
10. Interstitial/pore dewatering and treatment (as needed);
11. Grading CCR materials to achieve design cover system subgrade elevations;
12. Installing the cover system and associated stormwater management controls;
13. Stabilizing the site with appropriate vegetation and final erosion and sediment control measures;
14. Lowering of the dam; and
15. Commencing post-closure maintenance and monitoring of the site.

3.2 DRAINAGE AND STABILIZATION

Bulk water/free liquids will be removed from the Ash Basin and FGD Ponds throughout multiple phases of construction. Interstitial/pore water may be removed and treated during construction (as needed) to provide a workable surface for final cover system installation. With the diversion of wastewater and the stormwater discharged to the basin from other locations on the site, the volume of interstitial/pore water within the basin is expected to further decline over time. The dam will be lowered following the final phase of cover system installation. Combined, these measures (diversion of wastewater and stormwater, bulk dewatering, selective interstitial/pore dewatering, cover system installation, and dam lowering) will stabilize the CCR materials sufficiently to support the final cover system.

4 ESTIMATE OF IN-PLACE CCR INVENTORY

The volume of CCR present in the Ash Basin and FGD Ponds was calculated and is presented in Table 1 below, pursuant to 40 C.F.R. § 257.102(b)(1)(iv). The volume is the estimated inventory of CCR that will be open (and require closure) at one time, and the estimate is based on bathymetric surveys, historical topography, and soil borings as of December 2015. The annual surface impoundment inspections completed, pursuant to 40 C.F.R. § 257.83(b), and posted to the Duke Energy CCR website, pursuant to 40 C.F.R. § 257.107(g)(5), contain the most recent estimates of CCR material in the Ash Basin.

Table 1. Estimated In-Place CCR Inventory

Basin	**Quantity of CCR (cubic yards)**
Ash Basin	5,271,000
FGD Settling Pond	186,000
FGD Forward Flush Pond	43,000
Total Inventory Within Ash Basin Footprint	**5,500,000**

5 ESTIMATE OF LARGEST AREA REQUIRING FINAL COVER

Closure of the Ash Basin will be accomplished by leaving CCR in place pursuant to 40 C.F.R. § 257.102(d). The largest area of the Ash Basin that will be open (and require a final cover) at one time is estimated to be 140 acres. The FGD Ponds are located within the Ash Basin footprint and are included in the area requiring final cover.

6 CLOSURE SCHEDULE

Closure of the Ash Basin and FGD Ponds will be initiated pursuant to 40 C.F.R. § 257.102(e) and is anticipated to be completed within seven years of the commencement of closure activities. The closure time frame includes a two-year time extension beyond the time specified in 40 C.F.R. § 257.102(f)(1)(ii) on the basis that the anticipated time required to close the Ash Basin and FGD Ponds will need to be lengthened due to:

- The Ash Basin being larger than 40 acres (estimated 140 acres);
- The amount of imported material needed to close the Ash Basin and FGD Ponds (estimated to be greater than 250,000 cubic yards);
- The volume of CCR (greater than 1.1 million cubic yards will need to be excavated and placed as grading fill);
- The volume of bulk water/free liquids to dewater (greater than 450 million gallons);
- The surrounding geology (shallow rock resulting in limited soil volume per given area, limited availability of soil meeting the permeability requirements outlined in the CCR Rule, rocks in the soil that could damage the geomembrane would need to be removed, etc.); and
- The time required, after the removal of bulk liquids, for the surface of the basin to stabilize to the point that personnel and equipment can safely access the impoundment. Given the site-specific geometry and physical characteristics of the CCR in the impoundment, the rate at which the materials will drain will likely be slow and variable. As a result, installation of instrumentation and monitoring equipment may be necessary in some instances to ensure subgrade stability is adequate, and other measures may need to be employed to stabilize the surface of the impoundment (possibly including closely-spaced well points, deep wells, trenches, etc.) in a timely manner.

The completed demonstration establishing why it is not feasible to complete closure of the Ash Basin and FGD Ponds within the five-year time frame due to factors beyond the facility's control will be prepared and placed in the facility's operating record prior to the end of any two-year period pursuant to 40 C.F.R. § 257.102(f)(2).

Prior to commencing closure construction, design documents will be prepared to support applications for required local, state, and federal permits. Closure construction design documents will include construction drawings, technical specifications, and quality assurance testing work plans. The permits required for closure construction activities will be evaluated at the time of closure and are anticipated to include permits from NCDEQ and the U.S. Army Corps of Engineers. Preliminary time frames of anticipated closure activities for the Ash Basin and FGD Ponds are included below in Table 2. Duke Energy estimates that all of the closure activities for the Ash Basin and FGD Ponds will be completed by 2026.

Table 2. Estimated Time Frames for Closure Activities

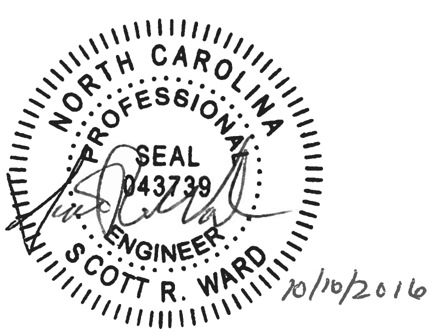
Closure Activity	Time Frame (years)*
NCDEQ Closure Plan Approval	1
NCDEQ Permitting Approvals (NDPES, E&SC, Air)	1
Dewatering and Stabilization	2.5
CCR Grading and Excavation	1.5
NCDEQ Dam Decommissioning Approval	0.5
Final Cover Installation	3.5

*Estimated closure activity time frames may include some overlap

7 QUALIFIED PROFESSIONAL ENGINEER CERTIFICATION

I, SCOTT R. WARD, 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 written Closure Plan dated October 10, 2016, was developed pursuant to 40 C.F.R. § 257.102 and has been prepared in accordance with recognized and generally accepted good engineering practices.

SIGNATURE ______________________ DATE 10/10/2016



Prepared by:

H.B. ROBINSON STEAM ELECTRIC PLANT

ASH BASIN

CLOSURE PLAN

OCTOBER 10, 2016

Certified by:

HDR Engineering, Inc. of the Carolinas

440 S. Church Street, Suite 1000

Charlotte, NC 28202

South Carolina Certificate of Authorization No. C0318

ROB_CLOSE_PLN

Rev. 0

Duke Energy Progress, LLC (Duke Energy) prepared this Closure Plan for the Coal Combustion Residuals (CCR) surface impoundment (Ash Basin) at the H.B. Robinson Steam Electric Plant (Robinson) pursuant to the requirements of 40 C.F.R. § 257.102(b) of the Disposal of CCR from Electric Utilities rule, 80 Fed. Reg. 21302 (April 17, 2015) (CCR Rule). HDR Engineering, Inc. of the Carolinas (HDR) was retained by Duke Energy to certify that this Closure Plan meets the requirements of 40 C.F.R. § 257.102. The information contained in this Closure Plan will be used to assist Duke Energy in the closure of the Ash Basin located in Darlington County, South Carolina, on property owned by Duke Energy. This Closure Plan may be amended pursuant to the requirements of 40 C.F.R. § 257.102(b)(3). Presented below are:

1. A narrative of closure activities;
2. A description of the procedures to remove CCR and decontaminate the CCR unit;
3. An estimate of the in-place CCR inventory requiring closure;
4. An estimate of the largest area of the CCR unit requiring a final cover (as needed);
5. A closure schedule; and
6. A written certification from a qualified professional engineer, licensed in South Carolina, that this Closure Plan meets the requirements of 40 C.F.R. § 257.102.

1 NARRATIVE OF CLOSURE ACTIVITIES

The purpose of this Closure Plan is to describe the steps required to close the Ash Basin at Robinson consistent with recognized and generally accepted good engineering practices. Closure of the Ash Basin will be designed to reduce the need for long-term maintenance and control the post-closure release of constituents into environmental pathways (i.e., air, surface water, groundwater).

The Ash Basin will be closed through the removal of CCR, and the closure will be performed pursuant to 40 CFR § 257.102(c). CCR will be removed as described in the following section.

2 CCR REMOVAL AND DECONTAMINATION

The procedures to remove CCR from the Ash Basin include dewatering and utilizing appropriate equipment and methods to excavate and move the CCR to a permitted on-site landfill. Dewatering will include removal of bulk water/free liquids and interstitial/pore water (as needed) to allow for safe excavation.

The existing embankment will be breached pursuant to a South Carolina Department of Health and Environmental Control (SCDHEC) Dam Safety permit approval. This breach is intended to promote free drainage of storm water from the closure area.

Existing appurtenant structures, such as ditches, culverts, and miscellaneous piping, will be decontaminated and abandoned in place, or removed and disposed in a permitted disposal facility, or placed in a beneficial use facility identified at the time of closure. Decontamination procedures may consist of pressure washing, scrubbing, or other generally accepted decontamination procedures.

Pursuant to 40 C.F.R. § 257.102(c), closure will be complete when groundwater monitoring concentrations do not exceed the applicable groundwater protection standard established pursuant to 40 C.F.R. § 257.95(h) for constituents listed in appendix IV to 40 C.F.R. Part 257.

3 ESTIMATE OF IN-PLACE CCR INVENTORY

The volume of CCR present in the Ash Basin was calculated and is presented in Table 1 below, pursuant to 40 C.F.R. § 257.102(b)(1)(iv). The volume is the estimated inventory of CCR that will be open (and require closure) at one time, and the estimate is based on bathymetric surveys, historical topography, and soil borings as of May 2016. The annual surface impoundment inspections completed, pursuant to 40 C.F.R. § 257.83(b), and posted to the Duke Energy CCR website, pursuant to 40 C.F.R. § 257.107(g)(5), contain the most recent estimates of CCR material in the Ash Basin.

Table 1. Estimated In-Place CCR Inventory

Basin	Quantity of CCR (cubic yards)
Ash Basin	2,632,000

4 ESTIMATE OF LARGEST AREA REQUIRING FINAL COVER

Closure of the Ash Basin will be accomplished by closure-by-removal pursuant to 40 C.F.R. § 257.102(c); therefore, no final cover will be constructed in support of closure.

5 CLOSURE SCHEDULE

Closure of the Ash Basin will be initiated pursuant to 40 C.F.R. § 257.102(e) and is anticipated to be completed within seven years of the commencement of closure activities. The closure time frame includes a two-year time extension beyond the time specified in 40 C.F.R. § 257.102(f)(1)(ii) on the basis that the anticipated time required to close the Ash Basin will need to be lengthened due to:

- The Ash Basin being larger than 40 acres (estimated 72 acres); and
- The need to relocate transmission lines to close a non-CCR-Rule-regulated ash storage area subject to Consent Agreement 15 – 23 – HW with the state of South Carolina.

The completed demonstration establishing why it is not feasible to complete closure of the Ash Basin within the five-year time frame due to factors beyond the facility’s control will be prepared and placed in the facility’s operating record prior to the end of any two-year period pursuant to 40 C.F.R. § 257.102(f)(2).

Prior to commencing closure construction, design documents will be prepared to support applications for required local, state, and federal permits. Closure construction design documents will include construction drawings, technical specifications, and quality assurance testing work plans. The permits required for closure construction activities will be evaluated at the time of closure, and but are anticipated to include permits from SCDHEC and the U.S. Army Corps of Engineers. Preliminary time frames of anticipated closure activities are included below in Table 2. Duke Energy estimates that all of the closure activities for the Ash Basin will be completed by 2026.

Table 2. Estimated Time frames for Closure Activities

Closure Activity	Time Frame (years)*
SCDHEC Closure Plan Approval	1
SCDHEC Landfill Permit Approval	1.5
SCDHEC Permitting Approvals (NDPES, E&SC, Air)	1
Dewatering and Stabilization	1.5
SCDHEC Dam Decommissioning Approval	0.5
CCR Excavation	3

*Estimated closure activity time frames may include some overlap.

6 QUALIFIED PROFESSIONAL ENGINEER CERTIFICATION

I, Philip A. Westmoreland being a registered Professional Engineer in the state of South Carolina, do hereby certify to the best of my knowledge, information, and belief, that the information contained in this written Closure Plan dated October 10, 2016, was developed pursuant to the requirements of 40 C.F.R. § 257.102 and has been prepared in accordance with recognized and generally accepted good engineering practices.

SIGNATURE ____________________ DATE Oct 10, 2016

CLOSURE PLAN

ROXBORO INDUSTRIAL LANDFILL

DUKE ENERGY – ROXBORO STEAM STATION

SEMORA, NORTH CAROLINA

Prepared for

DUKE ENERGY PROGRESS

NORTH CAROLINA PROFESSIONAL SEAL 025671 ENGINEER THOMAS B. MAIER

10/7/16

Duke Energy
550 South Tryon Street
Charlotte, North Carolina 28202

October 7, 2016
ROX_AL_CLOSE_LDFL_PLN

amec foster wheeler

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1.0 INTRODUCTION

This Closure Plan was prepared for the Roxboro Steam Station – Roxboro Industrial Landfill. This Closure Plan was prepared in accordance with 40 C.F.R. Part 257, Subpart D and is consistent with the requirements of 40 C.F.R. § 257.102(b) for closure of coal combustion residuals landfills. The information contained in this Closure Plan will be used to assist Duke Energy Progress, LLC (Duke Energy) in the closure of active waste units. The Roxboro Industrial Landfill is owned and operated by Duke Energy. The landfill is located in Person County, North Carolina on Duke property, southeast of the Roxboro Steam Plant, within the drainage area of the East Ash Basin. Duke Energy must obtain a written certification from a qualified professional engineer, licensed in the state in which the project work is conducted, that this written Closure Plan and any amendments thereto meet the requirements of 40 C.F.R. § 257.102.

2.0 CLOSURE PLAN

2.1 Overview of Closure Approach

The purpose of the Closure Plan is to outline the sequence for closing the landfill phases consistent with recognized and generally accepted good engineering practices. Closure is designed to minimize the need for long term maintenance and to control the post-closure release of contaminants. The facility will be closed in accordance with the requirements of 40 C.F.R. § 257.102. Closure will occur within the time frames set out in 40 C.F.R. § 257.102(f). This Closure Plan may be amended in accordance with the requirements of 40 C.F.R. § 257.102(b)(3).

2.2 Estimated Maximum Inventory of CCR

The currently permitted landfill design for Phases 1 through 6 provides approximately 7,448,000 cubic yards of gross capacity as measured from the top of the protective cover soil to the top of final cover.

2.3 Largest Area Requiring Cover System

The largest area that will need to be capped is the area of Phases 1 through 6, which is stated as 93.0 acres in the facility's solid waste permit.

2.4 Closure Performance Standard

2.4.1 Final Cover

The cover system has been designed to reduce infiltration into the landfill and to resist erosion, and to meet the requirements of 40 C.F.R. § 257.102(d)(3)(i). The permeability of the least permeable layer (a polyethylene geomembrane) is on the order of 10^{-12} cm/s. This is equal to or less than the permeability of the polyethylene geomembrane in the bottom liner system and no greater than 1×10^{-5} cm/sec.

The final cover system for the closed phase will be certified by a professional engineer as being designed in accordance with the requirements of 40 C.F.R. § 257.102.

With the type of waste that has been landfilled and the controlled nature of the fill placement, no decomposition of the waste material is expected, therefore minimum, if any, settlement is expected. Due to the high allowable strain of the geomembrane and the stable nature of the waste, the final cover system will accommodate any differential settlement that may occur in the waste during the post closure care period.

The proposed final cover system will consist of the following from top to bottom and will be placed over the existing intermediate soil cover:

- a 6-inch thick vegetative soil cover;
- an 18-inch thick soil cover;
- a geocomposite drainage layer; and
- a 40-mil thick double-sided textured linear low density polyethylene (LLDPE) geomembrane.

2.4.2 Alternate Final Cover

No alternate final cover system is proposed.

2.4.3 Performance Standards

Closure of the facility will be conducted in a manner that minimizes the need for further maintenance and controls, minimizes or eliminates, to the extent necessary to protect human health and the environment, the post-closure escape of uncontrolled leachate, surface runoff, or waste decomposition products to the groundwater, surface water, or the atmosphere.

The final cover system consisting of a vegetated soil layer with run-on and run-off controls will minimize the need for post-closure maintenance. The final slopes of the landfill will promote runoff. Diversion berms and downslope pipes will convey surface runoff to conveyances with non-erodible linings or, if applicable, to sediment basins designed for removal of sediment prior to discharge. A hardy stand of vegetation will be established and, along with the diversion berms and storm water conveyance channels, will minimize erosion of the final cover system.

A low-permeability final cover system will be constructed and maintained that minimizes the infiltration of precipitation into the waste mass. By minimizing infiltration, the final cover will minimize leachate generation.

The final slopes of the landfill will be five percent or greater to prevent ponding.

2.4.4 Stability

The CCR unit will be closed in a manner that provide for slope stability to prevent the sloughing or movement of the final cover system. In order to maintain stable slopes for the final cover, the internal and interface friction angles of all the components must be greater than the slope angle by a margin called a factor of safety. Since the maximum regulatory slopes are 3:1, only materials with friction angles greater than 26.6^{o} will be used, providing a minimum factor of safety of 1.5. To ensure the stability of the vegetative support layer in the final cover system, adequate drainage must be provided to prevent the soil from becoming saturated and subject to seepage forces.

An analysis was also performed to demonstrate the stability of proposed cap section during seismic conditions. An acceptable factor of safety is 1.0 or greater to guard against slope failure. The analysis was performed in accordance with the requirements of 40 C.F.R. § 257.63 and the seismic factor of safety was found to be greater than 1.0.

2.4.5 Closure Time Frame

The final cover system will be finished within six months following the beginning of closure construction unless otherwise approved. If more than six months are necessary, steps to prevent threats to human health and the environment from the unclosed landfill unit will be undertaken.

2.5 Schedule

In accordance with 40 C.F.R. § 257.102(e), the facility will begin closure activities within 30 days after final receipt of waste, or if the landfill has remaining capacity and there is a reasonable likelihood that the landfill will receive additional wastes, no later than two years after the most recent receipt of wastes. Contractor mobilization will occur during the initial 30 day period after last receipt of waste.

In accordance with 40 C.F.R. § 257.102(f)(1), the final cover system will be completed within six months following the beginning of closure construction unless a deadline extension is approved.

In accordance with 40 C.F.R. § 257.102(g), no later than the date on which closure of the CCR unit is initiated, prepare a notification of intent to close the unit, which includes the certification by a qualified professional engineer for the design of the final cover system required by § 257.102(d)(3)(iii).

In accordance with 40 C.F.R. § 257.102(h), within 30 days of completion of closure, Duke Energy shall record a notation on the deed to the landfill property stating that the property has been used as a landfill and its use is restricted under the Closure/Post-Closure Plan and the post-closure care requirements as provided by 40 C.F.R. § 257.104(d)(1)(iii).

Within 30 days of recording the notation, Duke Energy shall prepare a notification stating that that the notation has been recorded and placed it into the facility's operating record. Pursuant to 40 C.F.R. § 257.106(d), Duke Energy shall send to the appropriate regulatory agency the notification of intent to close, notification of closure completion, and notification of deed notation, within 30 days of placing each such notification in the operating record.

An expected schedule for closure activities is as follows:

<u>Time</u>	<u>Activity</u>
Prior to last receipt of waste	Permitting, detailed closure design and selection contractor
Initial 30 days after last receipt of waste	Mobilization of contractor
Months 0-1 after beginning construction	Grading /preparation of intermediate cover
Months 1-4 after beginning construction	Placement of soil layer and/or flexible membrane liner, and soil protective layers
Months 4-5 after beginning construction	Installation of diversion berms and downslope pipes
Months 5-6 after beginning construction	Seed, fertilize and mulch

3.0 QUALIFIED PROFESSIONAL ENGINEER CERTIFICATION

I, Thomas B. Maier, being a registered Professional Engineer, in accordance with the North Carolina Professional Engineer's Registration do hereby certify to the best of my knowledge, information, and belief, that this report dated October 7, 2016 was prepared in accordance with the requirements of 40 C.F.R. § 257.102, is true and correct, and has been prepared in accordance with recognized and generally accepted good engineering practices.

Prepared by:

ROXBORO STEAM ELECTRIC PLANT

EAST ASH BASIN

WEST ASH BASIN

EAST FGD SETTLING POND

WEST FGD SETTLING POND

FGD FORWARD FLUSH POND

CLOSURE PLAN

OCTOBER 12, 2016

Certified by:

Amec Foster Wheeler Environment & Infrastructure, Inc.

2801 Yorkmont Road Suite #100

Charlotte, NC 28208

License Number: F-1253

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Rev. 0

Duke Energy Progress, LLC (Duke Energy) prepared this Closure Plan for the Coal Combustion Residuals (CCR) surface impoundments at the Roxboro Steam Electric Plant (Roxboro) pursuant to with the requirements of 40 C.F.R. § 257.102(b) of the Disposal of CCR from Electric Utilities rule, 80 Fed. Reg. 21302 (April 17, 2015). Amec Foster Wheeler Environment & Infrastructure, Inc. (Amec Foster Wheeler) was retained by Duke Energy to certify that this Closure Plan meets the requirements of 40 C.F.R. § 257.102. The information contained in this Closure Plan will be used to assist Duke Energy in the closure of the East Ash Basin and West Ash Basin (collectively, Ash Basins) located in Person County, North Carolina, on property owned by Duke Energy. The East Flue Gas Desulfurization (FGD) Settling Pond, West FGD Settling Pond, and the FGD Forward Flush Pond are located within the West Ash Basin footprint and are included in its closure (collectively, FGD Ponds). This Closure Plan may be amended pursuant to the requirements of 40 C.F.R. § 257.102(b)(3). Presented below are:

1. The narrative of closure activities;
2. A description of the procedures to remove CCR and decontaminate the CCR units (as needed);
3. A description of the final cover system designed pursuant to 40 C.F.R. § 257.102(d), a description of the methods and procedures to be used to install the final cover, and a discussion of how the final cover system will achieve the performance standards specified in 40 C.F.R. § 257.102(d);
4. An estimate of the in-place CCR inventory requiring closure;
5. An estimate of the largest area of the CCR units requiring a final cover;
6. A closure schedule; and
7. A written certification from a qualified professional engineer, licensed in North Carolina, that this Closure Plan meets the requirements of 40 C.F.R. § 257.102.

1 NARRATIVE OF CLOSURE ACTIVITIES

The purpose of this Closure Plan is to describe the steps necessary to close the Ash Basins and FGD Ponds consistent with recognized and generally accepted good engineering practices. Closure is designed to reduce the need for long-term maintenance, control the post-closure infiltration of liquids into the in-place CCR materials, and control the post-closure release of constituents into environmental pathways (i.e., air, surface water, and groundwater).

Although, on May 18, 2016, the North Carolina Department of Environmental Quality (NCDEQ) ranked the Ash Basins “intermediate-risk,” which would require them to be dewatered and excavated pursuant to the North Carolina Coal Ash Management Act of 2014, as amended (CAMA), Duke Energy is in the process of establishing the permanent replacement water supplies required under N.C.G.S. § 130A-309.211(c1) and performing the applicable dam safety repair work required under Dam Safety Order 16-01 issued by the state of North Carolina pursuant to the North Carolina Dam Safety Law of 1967, specifically N.C.G.S. § 143-215.32. Pursuant to N.C.G.S. § 130A-309.213(d)(1), upon Duke Energy’s completion of these tasks within the required time frame set forth in CAMA, NCDEQ must classify the Ash Basins as low-risk, which will allow closure either pursuant to 40 C.F.R. § 257.102(c) or (d). Although CAMA charges NCDEQ with making the final determination regarding closure method, because science supports closure of the Ash Basins by leaving the CCR in place, Duke Energy contemplates that the Ash Basins will be closed in accordance with the requirements of 40 C.F.R. § 257.102(d).

The method to close the Ash Basins and FGD Ponds in place will include: removal and treatment of the bulk water/free liquids; interstitial/pore dewatering (as needed) and treatment; stabilization of remaining CCR materials sufficient to support the final cover system; grading of in-place CCR materials to promote positive drainage (no ponding) and prevent sloughing or movement of the final cover system; installation of a final cover system, including stormwater management controls; partial breaching of the dam; and post-closure groundwater monitoring and cover system maintenance. The final cover system will be designed to minimize infiltration and erosion and meet, or exceed, the requirements of the final cover system specified in 40 C.F.R. § 257.102(d)(3)(i). Typically, this involves the installation of a low permeability barrier layer and a vegetated soil cover to protect the barrier layer. The existing embankments will be breached pursuant to a NCDEQ Dam Safety permit approval. This breach is intended to promote free drainage of storm water from the closure area.

2 CCR REMOVAL AND DECONTAMINATION

There may be some areas, primarily located around the perimeter of the Ash Basins, where closure-by-removal is selected in order to enhance surface drainage and/or to allow for development of future plant infrastructure or transmission. In-place CCR in those areas will typically be dewatered (if needed), excavated, and then consolidated (placed) into the remaining portion of the basin, which will be graded and closed-in-place pursuant to 40 C.F.R. § 257.102(d).

Existing appurtenant structures, such as ditches, culverts and miscellaneous piping, will be decontaminated and abandoned in place, removed and disposed in a permitted disposal facility, or removed and recycled in a beneficial use facility identified at the time of closure. Decontamination procedures may consist of pressure washing, scrubbing, or other generally accepted decontamination procedures.

Pursuant to 40 C.F.R. § 257.102(c), closure will be complete when groundwater monitoring concentrations do not exceed the applicable groundwater protection standard established pursuant to 40 C.F.R. § 257.95(h) for constituents listed in appendix IV to 40 C.F.R. Part 257.

3 FINAL COVER REQUIREMENTS

The final cover system for in-place closure of the Ash Basins and FGD Ponds will be designed pursuant to 40 C.F.R. § 257.102(d). Closure of the Ash Basins and FGD Ponds will be conducted in a manner that controls, minimizes, or eliminates, to the maximum extent feasible, the post-closure infiltration of liquids into the CCR and releases of CCR, leachate, or contaminated run-off to the ground or surface waters or to the atmosphere.

The final cover system being considered is a composite (soil and geosynthetics) cover system consisting of (from top to bottom):

- A six-inch layer of soil that is capable of sustaining native plant growth;
- An 18-inch thick protective soil cover layer;
- A geocomposite drainage layer or non-woven geotextile; and
- A 40-mil thick linear low-density polyethylene geomembrane barrier.

Alternative final cover systems are also under evaluation that would meet, or exceed, the requirements specified in 40 C.F.R. § 257.102(d)(3)(ii), which make use of the latest developments in final cover technology. The final cover system will serve to reduce erosion and post-closure maintenance. Various stormwater control measures (e.g., diversion berms, channels, downslope pipes, and/or downchutes) will convey surface run-off from the cover, then to sediment basins (as appropriate), prior to discharge. The design of the stormwater conveyances will include armoring and energy dissipation measures, as necessary, to control erosion and reduce maintenance and repairs.

The final cover system, with an equivalent (or lower) permeability of any bottom liner system or natural subsoils present, or a permeability no greater than $1x10^{-5}$ centimeters/second, will be constructed and maintained to minimize the infiltration of precipitation. By minimizing infiltration, the final cover will reduce leachate generation. The final cover system will be graded to preclude the probability of future impoundment of water, sediment, or slurry.

The Ash Basins and FGD Ponds will be closed in a manner resulting in stable slopes that prevent the sloughing or movement of the final cover system. The grades of the final cover system will be generally slight, sufficient to promote run-off while reducing the potential for sloughing. Instability potential (sliding or sloughing) will be further reduced through the selection and use of cover system materials that have adequate drainage properties and sufficient internal and interface shear strengths. Construction quality assurance procedures will be completed to confirm conformance of the installed final cover system to the design.

Upon commencement of closure of the Ash Basins and FGD Ponds, final closure is anticipated to be completed in the shortest amount of time consistent with recognized and generally accepted good engineering practices. Section 6, Closure Schedule, of this Closure Plan describes the estimated time frames.

3.1 FINAL COVER SYSTEM

Pursuant to 40 C.F.R. § 257.102(d)(3)(i)(A) through (D), the final cover system will be designed and constructed to meet, at a minimum, the following criteria:

(A) The permeability of the final cover system will be less than or equal to the permeability of any bottom liner system or natural subsoils present, or a permeability no greater than 1×10^{-5} centimeters/second, whichever is less.

The final cover system options being considered for the Ash Basins and FGD Ponds *will meet or exceed these criteria. The geomembrane by itself results in a lower effective infiltration rate than the 18 inches of $1x10^{-5}$ centimeters/second soil standard.*

(B) The infiltration of liquids through the Ash Basins and FGD Ponds will be minimized by the use of an infiltration layer that contains a minimum of 18 inches of earthen material.

The geomembrane component in the final cover system results in equivalent or better infiltration performance than 18 inches of earthen material. The proposed protective cover (18 inches) and vegetative layer soil will be obtained from local borrow sites and/or portions of the dams and dikes that will be breached during closure. The gradation of the soil used in the cover will be such that it does not damage the geomembrane, provides drainage, resists erosion, and supports plant growth.

(C) The erosion of the final cover system will be minimized by the use of an erosion layer that contains a minimum of six inches of earthen material that is capable of sustaining native plant growth.

The materials proposed for the vegetative support layer in the composite cover system option, or the protective cover component of an alternate final cover system, will provide equivalent or better performance than a six-inch-thick erosion layer. In addition, and prior to the completion of closure, stormwater run-off and wastewaters generated from areas outside the Ash Basins and FGD Ponds*' drainage catchment (which had previously been routed through the basins when they were active) will be permanently diverted for treatment (as needed) and discharge at other locations within the site.*

(D) The disruption of the integrity of the final cover system will be minimized through a design that accommodates settling and subsidence.

The materials proposed for the final cover systems will accommodate the amount of settlement and subsidence that is anticipated to be encountered during construction and post-closure. In addition, the cover grades and stormwater conveyance system grades will be designed to accommodate settlement during construction and post-closure care.

The methods and procedures used to install the final cover will include:

1. Completing necessary field characterizations and design analyses;
2. Obtaining necessary federal, state, and local permits;
3. Preparing bid documents and selecting a qualified contractor;
4. Mobilizing;

5. Installing erosion and sediment control measures;
6. Removing and treating (as needed) the bulk water/free liquid;
7. Decontaminating, abandoning in place, or removing the appurtenant structures within the Ash Basins and FGD Ponds;
8. Clearing and grubbing;
9. Constructing laydown areas and access roads;
10. Interstitial/pore dewatering and treatment (as needed)
11. Grading CCR materials to achieve design cover system subgrade;
12. Installing the cover system and associated stormwater management controls;
13. Stabilizing the site with appropriate vegetation and final erosion and sediment control measures;
14. Breaching of the dam; and
15. Commencing post-closure maintenance and monitoring of the site.

3.2 DRAINAGE AND STABILIZATION

Bulk water/free liquids will be removed from the Ash Basins and FGD Ponds during the initial phases of construction. Interstitial/pore water may be removed and treated during construction as needed to provide a workable surface for final cover system installation. With the diversion of wastewater and the stormwater discharged to the basins from other locations on the site, the volume of interstitial/pore water within the basins is expected to further decline over time. The dam will be breached following the final phase of cover system installation. Combined, these measures (diversion of wastewater and stormwater, bulk dewatering, selective interstitial/pore dewatering, cover system installation, and dam breaching) will stabilize the CCR materials sufficiently to support the final cover system.

4 ESTIMATE OF IN-PLACE CCR INVENTORY

The volumes of CCR present in the Ash Basins and FGD Ponds were calculated pursuant to 40 C.F.R. § 257.102(b)(1)(iv) and are presented in Table 1 below. The volumes represent the most recently available estimated inventory of CCR that will be open (and require closure) at one time and were obtained with reference to reports for annual surface impoundment inspections completed pursuant to 40 C.F.R. § 257.83(b). These reports are posted to the Duke Energy CCR website, pursuant to 40 C.F.R § 257.107(g)(5). For the East Ash Basin, the estimate of CCR volume includes sluiced ash material and ash stacked within the unit. The East Ash Basin estimate does not include ash material placed within the permitted landfill areas. The FGD Ponds are located within the West Ash Basin footprint; their inventories are typically reported as West Ash Basin quantities.

Table 1. Estimated In-Place CCR Inventory

Basin	Quantity of CCR (cubic yards)
East Ash Basin	**3,240,000**
West Ash Basin	8,875,000
West FGD Settling Pond	955,700
East FGD Settling Pond	300,300
FGD Forward Flush Pond	251,000
Total Inventory Within West Ash Basin Footprint	**10,382,000**
Estimated Total	**13,622,000**

5 ESTIMATE OF LARGEST AREA REQUIRING FINAL COVER

Closure of the Ash Basins and FGD Ponds will be accomplished by leaving CCR in place pursuant to 40 C.F.R. § 257.102(d). The largest area of the West Ash Basin and East Ash Basin that will be open (and require a final cover) at one time is estimated to be a combined 250 acres (186 and 64 acres, respectively). The FGD Ponds are located within the West Ash Basin footprint and are included in the area requiring final cover.

6 CLOSURE SCHEDULE

Closure of the Ash Basins and FGD Ponds will be initiated pursuant to 40 C.F.R. § 257.102(e) and is anticipated to be completed within nine years of the commencement of closure pursuant to 40 C.F.R. § 257.102(f)(1)(ii) and 40 C.F.R. § 257.102(f)(2). The closure time frame includes two two-year time extensions beyond the time specified in 40 C.F.R. § 257.102(f)(1)(ii) on the basis that the anticipated time required to close the Ash Basins and FGD Ponds will need to be lengthened due to:

- The Ash Basins and FGD Ponds being larger than 40 acres (estimated 76 acres for the East Ash Basin and 186 for the West Ash Basin);
- The amount of material needed to close the Ash Basins and FGD Ponds (greater than 750,000 cubic yards);
- The volume of CCR (greater than 1.5 million cubic yards to be graded);
- The volume of bulk water/free liquids to dewater (more than 150 million gallons);
- The surrounding geology (shallow rock resulting in limited soil volume per given area, limited availability of soil meeting the permeability requirements outlined in the CCR Rule, rocks in the soil that could damage the geomembrane would need to be removed, etc.); and
- The time required, after the removal of bulk liquids, for the surface of the basin to stabilize to the point that personnel and equipment can safely access the impoundment. Given the site-specific geometry and physical characteristics of the CCR in the impoundment, the rate at which the materials will drain will likely be slow and variable. As a result, installation of instrumentation and monitoring equipment may be necessary in some instances to ensure

subgrade stability is adequate, and other measures may need to be employed to stabilize the surface of the impoundment (possibly including closely-spaced well points, deep wells, trenches, etc.) in a timely manner.

The completed demonstration establishing why it is not feasible to complete closure of the Ash Basins and FGD Ponds within the five-year time frame due to factors beyond the facility's control will be prepared and placed in the facility's operating record prior to the end of any two-year period pursuant to 40 C.F.R. § 257.102(f)(2).

Prior to commencing closure construction, design documents will be prepared to support applications for required local, state, and federal permits. Closure construction design documents will include construction drawings, technical specifications, and quality assurance testing work plans. The permits required for closure construction activities will be evaluated at the time of closure and are anticipated to include permits from NCDEQ and the U.S. Army Corps of Engineers. Preliminary time frames of anticipated closure activities for both the Ash Basins and FGD Ponds are included below in Table 2. Duke Energy estimates that all of the closure activities for the Ash Basins and FGD Ponds will be completed by 2028.

Table 2. Estimated Time Frames for Closure Activities

Closure Activity	Time Frame (years)*
NCDEQ Closure Plan Approval	1
NCDEQ Permitting Approvals (NPDES, E&SC, Air)	1
Dewatering and Stabilization	4
CCR Grading and Excavation	4
NCDEQ Dam Decommissioning Approval	0.5
Final Cover Installation	6

*Estimated closure activity time frames may include some overlap.

7 QUALIFIED PROFESSIONAL ENGINEER CERTIFICATION

I, David Garrett, 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 written Closure Plan dated October 12, 2016 was developed pursuant to the requirements of 40 C.F.R. § 257.102 and has been prepared in accordance with recognized and generally accepted good engineering practices.

NORTH CAROLINA PROFESSIONAL SEAL 25462 ENGINEER G. DAVID GARRETT

SIGNATURE ____________________ DATE 10-12-2016

Prepared by:

L.V. SUTTON ENERGY COMPLEX

1971 ASH BASIN

1984 ASH BASIN

CLOSURE PLAN

JUNE 4, 2018

Certified by:

Geosyntec Consultants of NC, PC

1300 South Mint Street, Suite 300

Charlotte, North Carolina 28203

License No. C-3500

SUT_CLOSE_PLN

Rev. 3

Duke Energy Progress, LLC (Duke Energy) prepared this Closure Plan for the Coal Combustion Residuals (CCR) surface impoundments at the L.V. Sutton Energy Complex (Sutton) pursuant to the requirements of 40 C.F.R. § 257.102(b) of the Disposal of CCR from Electric Utilities rule, 80 Fed. Reg. 21302 (April 17, 2015). Geosyntec Consultants of NC, PC (Geosyntec) was retained by Duke Energy to certify that this Closure Plan meets the requirements of 40 C.F.R. § 257.102. The information contained in this Closure Plan will be used to assist Duke Energy in the closure of the 1971 Ash Basin and 1984 Ash Basin (Ash Basins) located in New Hanover County, North Carolina, on property owned by Duke Energy. This Closure Plan was originally posted to the Duke Energy operating record on October 17, 2016. The Closure Plan presented herein has been revised to reflect that the CCR Landfill and Ash Basins are considered a single unit, as presented in Section 1. This Closure Plan may be further amended pursuant to the requirements of 40 C.F.R. § 257.102(b)(3). Presented below are:

1. a narrative of closure activities;
2. a description of the procedures to remove CCR and decontaminate the CCR units;
3. an estimate of the in-place CCR inventory requiring closure;
4. an estimate of the largest area of the CCR units requiring a final cover (as needed);
5. a closure schedule; and
6. a written certification from a qualified professional engineer, licensed in North Carolina, that this Closure Plan meets the requirements of 40 C.F.R. § 257.102.

1 NARRATIVE OF CLOSURE ACTIVITIES

The purpose of this Closure Plan is to describe the steps necessary to close the Ash Basins consistent with recognized and generally accepted good engineering practices and Environmental Protection Agency (EPA) guidance. Closure is designed to reduce the need for long-term maintenance and control the post-closure release of constituents into environmental pathways (i.e., air, surface water, and groundwater).

Duke Energy has designated the Ash Basins and contiguous CCR Landfill as a single CCR unit for closure purposes. During closure, sluiced water from the 1971 Basin to the 1984 Basin will be recirculated back to the 1971 Basin to limit the amount of groundwater recharge within the 1971 Basin. This movement of water, CCR, and other wastes between the individual units will occur throughout the closure period to facilitate CCR dewatering, conditioning, and removal activities. The Ash Basins will be closed through the removal of CCR, and the closure will be performed pursuant to 40 C.F.R. § 257.102(c). CCR will be removed as described in the following section.

2 CCR REMOVAL AND DECONTAMINATION

The procedures to remove CCR from the Ash Basins include dewatering and utilizing appropriate equipment and methods to excavate and move the CCR to permitted off-site and on-site landfills. Dewatering will include removal of bulk water/free liquids and interstitial/pore water (as needed) to allow for safe excavation.

The existing embankments will be breached pursuant to a North Carolina Department of Environmental Quality (NCDEQ) Dam Safety permit approval. This breach is intended to promote free drainage of storm water from the closure area.

Existing appurtenant structures, such as ditches, culverts, and miscellaneous piping, will be decontaminated and abandoned in place, removed and disposed in a permitted disposal facility, or removed and placed in a beneficial use facility identified at the time of closure. Decontamination procedures may consist of pressure washing, scrubbing, or other generally accepted decontamination procedures.

Pursuant to 40 C.F.R. § 257.102(c), closure will be complete when groundwater monitoring concentrations do not exceed the applicable groundwater protection standard established pursuant to 40 C.F.R. § 257.95(h) for constituents listed in appendix IV to 40 C.F.R. Part 257.

3 ESTIMATE OF IN-PLACE CCR INVENTORY

The volumes of CCR present in the Ash Basins were calculated and are presented in Table 1 below, pursuant to 40 C.F.R. § 257.102(b)(1)(iv). The volumes are the estimated inventory of CCR that will be open (and require closure) at one time, and the estimates are based on bathymetric surveys, historical topography, and soil borings as of March 2015. The estimates do not include any material discharged into or removed from the Ash Basins after March 2015. The annual surface impoundment inspections completed, pursuant to 40 C.F.R. § 257.83(b), and posted to the Duke Energy CCR website, pursuant to 40 C.F.R. § 257.107(g)(5), contain the most recent estimates of CCR material in the Ash Basins.

Table 1. Estimated In-Place CCR Inventory On-Site

Basin	Quantity of CCR (cubic yards)
1971 Ash Basin	3,184,000
1984 Ash Basin	2,362,000
TOTAL	**5,546,000**

4 ESTIMATE OF MAXIMUM AREA REQUIRING FINAL COVER

CCR will be removed from the Ash Basins pursuant to §257.102(c); therefore, no final cover system will be constructed in support of closure activities.

5 CLOSURE SCHEDULE

The Ash Basins ceased receiving non-CCR waste streams on July 6, 2016 (receipt of CCR waste streams ceased prior to this date). Closure of the Ash Basins initiated on July 6, 2016, within 30 days of final receipt of CCR or non-CCR waste streams pursuant to 40 C.F.R. § 257.102(e). However, limited CCR excavation operations began prior to that date. Closure of the Ash Basins will be extended due to the delayed receipt of the on-site landfill permit to construct but is anticipated to be completed by February 2020 (i.e., still within five years of the commencement of closure pursuant to 40 C.F.R. § 257.102(f)(1)(ii)). Throughout the closure process, Duke Energy will continue to evaluate and take, as appropriate, commercially reasonable measures to expedite environmentally protective closure of the Ash Basins.

Prior to commencing closure construction, design documents will be prepared to support applications for required local, state, and federal permits. Closure construction design documents will include construction drawings for closure, technical specifications, and quality testing work plans. The permits required for closure construction activities will be evaluated at the time of closure and are anticipated to include permits from the NCDEQ and the U.S. Army Corps of Engineers. Preliminary time frames for the anticipated closure activities are included below in Table 2.

Table 2. Estimated Time Frames for Closure Activities

Closure Activity	Time Frame (years)*
NCDEQ Closure Plan Approval	1
NCDEQ Permitting Approvals (NDPES, E&SC, Air)	1
Dewatering and Stabilization	4.5
NCDEQ Landfill Permit Approval	1.5
CCR Excavation	4.5
NCDEQ Dam Decommissioning Approval	0.5

*Estimated closure activity time frames may include some overlap.

6 QUALIFIED PROFESSIONAL ENGINEER CERTIFICATION

I, Victor M. Damasceno, 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 written Closure Plan dated June 4, 2018, was developed pursuant to the requirements of 40 C.F.R. § 257.102 and has been prepared in accordance with recognized and generally accepted good engineering practices.

NORTH CAROLINA PROFESSIONAL SEAL 042284 ENGINEER M. DAMASCENO

SIGNATURE DocuSigned by: 378F90B458C5465... DATE 6/4/2018 8:45:46 AM PDT

Prepared for

Duke Energy Progress, LLC
526 South Church Street
Charlotte, North Carolina 28202

CLOSURE PLAN
Revision 1

L.V. SUTTON ENERGY COMPLEX ONSITE COAL COMBUSTION RESIDUALS LANDFILL

Wilmington, North Carolina

Prepared by

Geosyntec Consultants of NC, PC
1300 South Mint Street, Suite 300
Charlotte, North Carolina 28203
License No. C-3500

Project No. GC6005

June 2017

NORTH CAROLINA PROFESSIONAL SEAL 042284 ENGINEER VICTOR M. DAMASCENO

Victor M. Damasceno, Ph.D., P.E.
North Carolina Registration No. 042284
Date: 27 June 2017

1. INTRODUCTION

This Closure Plan was prepared for the coal combustion residuals (CCR) landfill at L.V. Sutton Energy Complex (Sutton). This Closure Plan was prepared in accordance with 40 C.F.R. Part 257, Subpart D and is consistent with the requirements of 40 C.F.R. § 257.102(b) for closure of CCR landfills. The information contained in this Closure Plan will be used to assist Duke Energy Progress, LLC (Duke Energy) in the closure of existing CCR basins at Sutton. The proposed CCR landfill is owned and operated by Duke Energy. The landfill is located in Wilmington, North Carolina on Duke Energy property, east of the existing CCR basins at Sutton. Duke Energy must obtain a written certification from a qualified professional engineer, licensed in the state in which the project work is conducted, that this written Closure Plan and any amendments thereto meet the requirements of 40 C.F.R. § 257.102.

2. CLOSURE PLAN

2.1 Overview of Closure Approach

The purpose of the Closure Plan is to outline the steps necessary to close the CCR landfill consistent with recognized and generally accepted good engineering practices. Closure is designed to minimize the need for long-term maintenance and to control the post-closure release of contaminants. The facility will be closed in accordance with the requirements of 40 C.F.R. § 257.102. Closure will occur within the time frames set out in 40 C.F.R. § 257.102(f). This Closure Plan may be amended in accordance with the requirements of 40 C.F.R. § 257.102(b)(3).

2.2 Estimated Maximum Inventory of CCR

The current landfill design provides approximately 8.3 million cubic yards of gross capacity measured from the top of protective soil to the bottom of final cover. Phase 1 is estimated to provide 4.2 million cubic yards of gross capacity.

2.3 Largest Area Requiring Cover System

The permitted area of Phase 1 is 56.1 acres, which is currently the largest area that will need to be capped.

2.4 Closure Performance Standard

2.4.1 Final Cover System

The final cover system has been designed to reduce infiltration into the landfill and to resist erosion. The least permeable layer is impermeable. This is equal to or less than the permeability of the bottom liner system, natural subsoils present, and no greater than 1×10^{-5} cm/sec.

The final cover system for the closed phase will be certified by a qualified professional engineer as being designed in accordance with the requirements of 40 C.F.R. § 257.102.

The proposed final cover system will consist of the following from top to bottom and will be placed over the existing intermediate soil cover:

- 6-inch thick vegetated erosion layer;
- 18-inch thick soil barrier;
- 40-mil thick double-sided textured linear low density polyethylene (LLDPE) geomembrane; and
- 6-inch thick bedding layer/interim cover (liner can be directly on waste material if grading is not needed).

The proposed final cover system on the 3H:1V side slopes of the landfill will consist of the following from top to bottom:

- 6-inch thick vegetated erosion layer;
- 18-inch thick protective soil layer;
- double-sided geocomposite lateral drainage layer;
- 40-mil thick textured LLDPE geomembrane; and
- 6-inch thick bedding layer/interim cover.

The surface of the final cover system bedding layer will be graded and compacted to prepare a smooth base for installation of the final cover geomembrane. The bedding layer/interim cover layer may be comprised of soil and/or CCR.

With the type of waste that will be landfilled and the controlled nature of the fill placement, no decomposition of the waste material is expected; therefore minimum, if any, settlement is expected. Due to the high allowable strain of the geomembrane and the stable nature of the waste, the final cover system will accommodate expected differential settlement that may occur in the waste during the post closure care period.

2.4.2 Alternate Final Cover System

An alternate final cover system is not proposed for the CCR landfill at Sutton.

2.4.3 Performance Standards

Closure of the facility will be conducted in a manner that minimizes the need for maintenance and controls, minimizes or eliminates, to the extent necessary to protect human health and the environment, the post-closure escape of uncontrolled leachate, surface runoff, or waste decomposition products to the groundwater, surface water, or the atmosphere.

The final cover system, consisting of a vegetated soil layer with run-on and run-off controls, will minimize the need for post-closure maintenance. The final slopes of the landfill will promote runoff. Diversion berms and downslope pipes will convey surface runoff to sediment basins designed for removal of sediment prior to discharge. A hardy stand of vegetation will be established and, along with the diversion berms and storm water conveyance channels, will minimize erosion of the final cover system.

A low-permeability final cover system will be constructed and maintained that minimizes the infiltration of precipitation into the waste mass. By minimizing infiltration, the final cover will minimize leachate generation.

The final slopes of the landfill will not be less than five percent to prevent ponding.

The CCR unit will be closed in a manner that provides for slope stability to prevent the sloughing or movement of the final cover system. To maintain stable slopes for the final cover, the internal and interface friction angle of all the components must be greater than the slope angle by a margin called the factor of safety. Since the maximum regulatory slopes are 3H:1V, only materials with friction angles greater than 26.6° will be used, providing a factor of safety of 1.5. To ensure the stability of the vegetative erosion layer in the final cover system, adequate drainage must be provided to prevent the soil from becoming saturated and subject to seepage forces.

During seismic conditions, an acceptable factor of safety of 1.0 or greater is required to guard against slope failure. Seismic analysis, if applicable, are required pursuant to 40 C.F.R. § 257.63. However, Sutton is not situated within a Seismic Impact Zone, as such seismic slope stability was not evaluated.

The final cover system will be finished within six months following the beginning of closure construction unless otherwise approved. If more than six months are necessary, steps to prevent threats to human health and the environment from the unclosed landfill unit will be undertaken.

2.5 Schedule

In accordance with 40 C.F.R. § 257.102(e), the facility will begin closure activities within 30 days after the known final receipt of CCR, or if the landfill has remaining capacity and there is a reasonable likelihood that the landfill will receive additional CCR, no later than two years after the most recent receipt of CCR. Contractor mobilization will occur during the initial 30-day period after last known receipt of CCR.

In accordance with 40 C.F.R. § 257.102(g), no later than the date on which closure of the CCR unit is initiated, prepare a notification of intent to close the unit, which includes the certification by a qualified professional engineer for the design of the final cover system required by § 257.102(d)(3)(iii).

In accordance with 40 C.F.R. § 257.102(h), within 30 days following completion of closure of the CCR unit, Duke Energy shall record a notation on the deed to the landfill property stating that the property has been used as a landfill and its use is restricted under the Post-Closure Plan and the post-closure care requirements as provided by 40 C.F.R. § 257.104(d)(1)(iii).

Within 30 days of recording the notation, Duke Energy shall prepare a notification stating that that the notation has been recorded and placed it into the facility's operating record. Pursuant to 40 C.F.R. § 257.106(d), Duke Energy shall send to the appropriate regulatory agency the notification of intent to close, notification of closure completion, and notification of deed notation, within 30 days of placing each such notification in the operating record.

An expected schedule for closure activities is as follows:

Time	Activity
Prior to last receipt of waste	Permitting, detailed closure design and contractor selection
Initial 30 days after last receipt of waste	Mobilization of contractor
Months 0-1 after beginning construction	Grading /preparation of intermediate cover
Months 1-4 after beginning construction	Placement of soil layer and/or flexible membrane liner, and soil protective layers
Months 4-5 after beginning construction	Installation of diversion berms and downslope pipes
Months 5-6 after beginning construction	Seed, fertilize, and mulch

3. QUALIFIED PROFESSIONAL ENGINEER CERTIFICATION

I, Victor M. Damasceno, being a registered Professional Engineer, in accordance with the North Carolina Professional Engineer's Registration, do hereby certify to the best of my knowledge, information, and belief, that the information contained in this report dated June 2017 was conducted in accordance with the requirements of 40 C.F.R. § 257.102, is true and correct, and has been prepared in accordance with recognized and generally accepted good engineering practices.

I/A

Prepared by:

DUKE ENERGY

WEATHERSPOON STEAM ELECTRIC PLANT

1979 ASH BASIN

CLOSURE PLAN

OCTOBER 10, 2016

Certified by:

S&ME

S&ME, Inc.

9751 Southern Pine Boulevard

Charlotte, NC 28273

Project No. 7235-15-028

WSPN_CLOSE_PLN

Rev. 0

Duke Energy Progress, LLC (Duke Energy) prepared this Closure Plan for the Coal Combustion Residuals (CCR) surface impoundment at the Weatherspoon Steam Electric Plant (Weatherspoon) pursuant to the requirements of 40 C.F.R. § 257.102(b) of the Disposal of CCR from Electric Utilities rule, 80 Fed. Reg. 21302 (April 17, 2015). S&ME, Inc. was retained by Duke Energy to certify that this Closure Plan meets the requirements of 40 C.F.R. § 257.102. The information contained in this Closure Plan will be used to assist Duke Energy in the closure of the 1979 Ash Basin (Ash Basin) located in Robeson County, North Carolina, on property owned by Duke Energy. This Closure Plan may be amended pursuant to the requirements of 40 C.F.R. § 257.102(b)(3). Presented below are:

1. A narrative of closure activities;
2. A description of the procedures to remove CCR and decontaminate the CCR unit;
3. An estimate of the in-place CCR inventory requiring closure;
4. An estimate of the largest area of the CCR unit requiring a final cover (as needed);
5. A closure schedule; and
6. A written certification from a qualified professional engineer, licensed in North Carolina, that this Closure Plan meets the requirements of 40 C.F.R. § 257.102.

1 NARRATIVE OF CLOSURE ACTIVITIES

The purpose of this Closure Plan is to describe the steps necessary to close the Ash Basin consistent with recognized and generally accepted good engineering practices. Closure is designed to reduce the need for long-term maintenance and control the post-closure release of constituents into environmental pathways (i.e., air, surface water, and groundwater). This Closure Plan may be amended pursuant to the requirements of 40 C.F.R. § 257.102(b)(3).

The Ash Basin will be closed through the removal of CCR, and the closure will be performed pursuant to 40 C.F.R. § 257.102(c). CCR will be removed as described in the following section.

Duke Energy is assessing the potential to site Weatherspoon for an ash beneficiation project pursuant to North Carolina General Statutes (N.C.G.S.) § 130A-309.216, as enacted by Section 1 of House Bill 630, Session Law 2016-95. If Duke Energy selects Weatherspoon for beneficiation purposes, to the extent that there is any remaining CCR in the Ash Basin after beneficiation operations have permanently ceased, the CCR will be moved to a permitted disposal facility.

2 CCR REMOVAL AND DECONTAMINATION

The procedures to remove CCR from the Ash Basin include dewatering and utilizing appropriate equipment and methods to excavate and move the CCR to a permitted disposal location. Dewatering will include removal of bulk water/free liquids and interstitial/pore water (as needed) to allow for safe excavation. The existing embankments will be removed pursuant to a North Carolina Department of Environmental Quality (NCDEQ) Dam Safety permit approval. This removal is intended to promote free drainage of stormwater from the closure area.

Existing appurtenant structures, such as ditches, culverts, and miscellaneous piping, will be decontaminated and abandoned in place, removed and disposed of in a permitted disposal facility, or removed and placed in a beneficial use facility identified at the time of closure. Decontamination procedures may consist of pressure washing, scrubbing, or other generally accepted decontamination procedures.

Pursuant to 40 C.F.R. § 257.102(c), closure will be complete when groundwater monitoring concentrations do not exceed the applicable groundwater protection standard established pursuant to 40 C.F.R. § 257.95(h) for constituents listed in appendix IV to 40 C.F.R. Part 257.

3 ESTIMATE OF IN-PLACE CCR INVENTORY

The volume of CCR present in the Ash Basin was calculated and is presented in Table 1 below, pursuant to 40 C.F.R. § 257.102(b)(1)(iv). The volume is the estimated inventory of CCR that will be open (and require closure) at one time, and the estimate is based on historical topography and soil borings as of 2015. The annual surface impoundment inspections completed, pursuant to 40 C.F.R. § 257.83(b), and posted to the Duke Energy CCR website, pursuant to 40 C.F.R. § 257.107(g)(5), contain the most recent estimates of CCR material in the Ash Basin.

Table 1. Estimated In-Place CCR Inventory

Basin	Quantity of CCR (cubic yards)
Ash Basin	2,040,000

4 ESTIMATE OF LARGEST AREA REQUIRING FINAL COVER

CCR will be removed from the Ash Basin pursuant to 40 C.F.R. § 257.102(c); therefore, no final cover system will be constructed in support of closure activities.

5 CLOSURE SCHEDULE

Closure of the Ash Basin was initiated in November 2015 and is anticipated to be completed within nine years of the commencement of closure activities. The closure time frame includes two two-year time extensions beyond the time specified in 40 C.F.R. § 257.102(f)(1)(ii) on the basis that the anticipated time required to close the Ash Basin will need to be lengthened due to

- The Ash Basin being larger than 40 acres (estimated 58 acres); and
- The time required to develop a lined CCR placement solution in accordance with state and federal law.

The completed demonstration establishing why it is not feasible to complete closure of the Ash Basin within the five-year time frame due to factors beyond the facility's control will be prepared and placed in the facility's operating record prior to the end of any two-year period pursuant to 40 C.F.R. § 257.102(f)(2).

Prior to commencing closure construction, design documents will be prepared to support applications for required local, state, and federal permits. Closure construction design documents will include construction drawings, technical specifications, and quality assurance testing work plans. The permits required for closure construction activities will be evaluated at the time of closure and are anticipated to include permits from NCDEQ and the U.S. Army Corps of Engineers. Preliminary time frames of anticipated closure activities for the Ash Basin are included below in Table 2. Duke Energy estimates that all of the closure activities for the Ash Basin will be completed by 2024. However, Duke Energy is assessing the potential to site an ash beneficiation project at Weatherspoon pursuant to N.C.G.S. § 130A-309.216. If deemed feasible, commencement of closure would not be initiated until the known final volume of CCR is removed from the CCR unit for the purpose of beneficial use pursuant to 40 C.F.R. § 257.102(e)(1)(ii). In such case, all of the closure activities for the Ash Basin will be completed by 2029. In the event Weatherspoon is selected as a beneficiation site, Duke Energy will amend this Closure Plan pursuant to the requirements of 40 C.F.R. § 257.102(b)(3).

Table 2. Estimated Time Frames for Closure Activities

Closure Activity	Time Frame (year)*
NCDEQ Closure Plan Approval	1
NCDEQ Permitting Approvals (NDPES, E&SC, Air)	1
Dewatering and Stabilization	2
CCR Excavation	3
NCDEQ Dam Decommissioning Approval	0.5

*Estimated closure activity time frames may include some overlap.

6 QUALIFIED PROFESSIONAL ENGINEER CERTIFICATION

I, Mark Anderson Taylor, 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 written Closure Plan dated October 10, 2016, was developed pursuant to the requirements of 40 C.F.R. § 257.102 and has been prepared in accordance with recognized and generally accepted good engineering practices.

NORTH CAROLINA PROFESSIONAL SEAL 10975 ENGINEER MARK A. TAYLOR

SIGNATURE Mark A Taylor DATE 10/10/2016

Roxboro Steam Electric Plant West Ash Basin (WAB) Closure Options Analysis Summary Report

This summary report (Report) presents the Closure Options Evaluation for the Roxboro West Ash Basin (WAB) located at Duke Energy Progress Roxboro Steam Electric Plant, located at 1700 Dunnaway Road, Semora, Person County, North Carolina. The Closure Options Evaluation involved developing ash basin closure strategies and evaluating these options relative to one another to determine which option to advance to more detailed engineering and closure plan development. The strategies discussed in the Closure Options Evaluation are representative of the range of possible approaches for basin closure, and do not constitute final closure plans as described in N.C. Gen. Stat. sec. 130A-309.214(a)(4). Final closure plans will be submitted in 2019, as required by law, supported by detailed engineering designs and any necessary updates to groundwater modeling and related analysis.

Duke Energy developed programmatic guidance for the closure analysis effort in early 2016 to provide fleet-wide consistency to ash basin closure plan development. Duke Energy developed a relative weighting and scoring system with input from the National Ash Management Advisory Board (NAMAB). Using this system, Duke Energy evaluated and scored the alternatives using an options analysis framework designed to identify the solution that balances environmental protection, cost, schedule and local community impacts. It is noted that internal working draft versions of these 2015-2016 options analyses for Allen, Belews Creek, Cliffside, Marshall, Mayo, and Roxboro were provided to NCDEQ, at its request, in May and June 2018.

The 2016 internal working draft options analysis identified closure-in-place as the preferred solution for Roxboro West Ash Basin (WAB) that is protective of the environment, safely closes the ash basin, minimizes the other associated risks, and was the least cost to customers. A permit-level design was developed for that option in 2016. The company then paused that work, pending determination that the site would meet the requirements for a low-risk impoundment classification pursuant to CAMA, as amended by House Bill 630. Duke Energy has completed those requirements at the Roxboro WAB site for a low-risk classification and now has updated this analysis.

SITE BACKGROUND

The Roxboro Steam Electric Plant consists of four coal-fired units with a combined generating capacity of 2,422 megawatts. The plant began operation in 1966, with capacity additions in 1973 and 1980, and is currently in active operation. Fly ash material is currently conveyed from operating units by a pneumatic (dry) handling system for disposal on-site or commercial reuse off-site. For on-site disposal, the dry fly ash is conveyed to silos, transferred to trucks, and then hauled for final disposal at an on-site permitted industrial landfill area within the inactive East Ash Basin (EAB) area. For commercial reuse, the dry fly ash is loaded on trucks from the collection silos and then transported off-site. Bottom ash and pyrite CCR material are currently conveyed by wet sluicing methods for operating units and deposited within the active WAB. Flue gas desulfurization (FGD) technology has been installed to reduce sulfur dioxide emissions for the operating units. Gypsum material produced by scrubber operations is either reused by a nearby commercial wallboard production plant or transported to the on-site industrial landfill for disposal. Wastewater from scrubber operations is conveyed to the FGD Pond and bioreactor treatment facilities, located within and/or adjacent to the WAB. Discharge from the Roxboro WAB flows into the plant heated water discharge canal, which is part of the wastewater treatment system under the NPDES permit. The discharge flow is ultimately released into Hyco Lake through NPDES Outfall 003. The scope of WAB closure will also include the WAB Southern Extension Impoundment area located south of the WAB Dike No. 1.

The West Ash Basin has two dams which are regulated by the North Carolina Department of Environmental Quality (NCDEQ):WAB Main Dam State ID PERSO-038 and WAB Dike No. 1 - State ID PERSO-039.

In addition, the Roxboro WAB site includes FGD Pond features that are regulated as dams by the NCDEQ including: FGD West Settling Pond Dikes - PERSO-040, FGD East Settling Pond Dikes - PERSO-041, and FGD Forward Flush Pond Dikes - PERSO-042. The FGD Pond dikes will be decommissioned prior to implementation of WAB closure. Figure 1 below presents the West Ash Basin and other related site features.

Figure 1. West Ash Basin and Related Site Features

CLOSURE OPTIONS

For the Roxboro West Ash Basin, under the direction of Duke Energy, Wood Environment & Infrastructure Solutions, Inc. (Wood) developed the following conceptual closure options that remain under evaluation:

- WAB Option 1: Closure-by-Removal (On-Site new Landfill)
- WAB Option 2: Closure-by-Removal (to Mayo Landfill)
- WAB Option 4: Closure-in-Place Hybrid (Partial Removal and Capping)
- WAB Option 5: Closure-in-Place

It should be noted that WAB Option 1: Closure-by-Removal (On-site new Landfill) was initially evaluated as not feasible because of the space being reserved for future CCR-related features. This has been re-evaluated and is presented as a current option. Prior alternatives that had been listed as Option 3 (Closure-by-Removal with On-Site EAB Landfill) and Option 6 (Closure-in-Place Hybrid Option using a combination of close-in-place and On-Site EAB Landfill) were removed from consideration from the Options Analysis. Option 3 was removed since it was assumed that if the WAB was required to be excavated then it was also assumed that the EAB would need to be excavated as well and the logistics of trying to install a new lined landfill in the EAB footprint and also excavate the EAB at the same time would be very difficult compared to the remaining options. Option 6 was removed due to the complexity of conducting an excavation in the EAB and then constructing a new landfill in this footprint while at the same time performing a partial removal of the WAB to move to the new EAB landfill.

WAB Option 1 consists of excavating all ash material and impacted soil within the limits of the WAB and placing the material in a permitted industrial landfill area constructed on-site west of the WAB. This industrial landfill would be constructed with a base liner system and an infiltration barrier/cap system meeting the requirements of the Federal Coal Combustion Residuals (CCR) Rule and N.C. Coal Ash Management Act (CAMA). The scope also includes removal and disposal of ash and impacted soil/sediment material within the WAB Southern Extension Impoundment. This option is represented by the attached Figure WAB 1.1 and Figure WAB 1.2.

WAB Option 2 consists of excavating all ash material and impacted soil within the limits of the WAB and placing the material in a permitted industrial landfill area located at Duke Energy's Mayo Steam Electric Plant. This industrial landfill would be constructed with a base liner system and an infiltration barrier/cap system meeting the requirements of the Federal Coal Combustion Residuals (CCR) Rule and N.C. Coal Ash Management Act (CAMA). The scope also includes removal and disposal of ash and impacted soil/sediment material within the WAB Southern Extension Impoundment. This option is represented by the attached Figure WAB 2.1 and Figure WAB 2.2.

WAB Option 4 consists of excavating and consolidating ash material on the northwest side of the pond area in the vicinity of the existing FGD Pond features. The consolidated ash fill will be graded for drainage and closed with an infiltration barrier/cap system meeting the requirements of the Federal CCR Rule and CAMA. The scope also includes modification of Dike No. 1 for seepage control, and removal and disposal of ash and impacted soil/sediment material within the WAB Southern Extension Impoundment. This option is represented by the attached Figure WAB 4.1, Figure WAB 4.2, and Figure WAB 4.3.

WAB Option 5 consists of leaving the ash material within the ash basin, which would be capped with an infiltration barrier/cap system meeting the requirements of the Federal CCR Rule and CAMA. The scope also includes modification of Dike No. 1 for seepage control, and removal and disposal of ash and impacted soil/sediment material within the WAB Southern Extension Impoundment. This option is represented by the attached Figure WAB 5.1.

Tables 1, 2, and 3 of this report represent a tabulated summary of each evaluated closure option, estimated quantities of ash and soil materials associated with each closure option, and a more detailed overview of each closure option presented.

Attachment A of this report includes figures and reference drawings to support conceptual review and scope development for each closure option as follows:

- Figure WAB 1.1 – WAB Closure Option 1 Concept Plan
- Figure WAB 1.2 – Proposed Landfill Area A
- Figure WAB 2.1 – Location for Off-site Mayo Industrial Landfill & Haul Path
- Figure WAB 2.2 – WAB Closure Option 2 Concept Plan
- Figure WAB 4.1 – WAB Closure Option 4 Concept Plan (2016 Concept)
- Figure WAB 4.2 – WAB Closure Option 4 Concept Profiles Sheet 1 of 2 (2016 Concept)
- Figure WAB 4.3 – WAB Closure Option 4 Concept Profiles Sheet 2 of 2 (2016 Concept)
- Figure WAB 5.1 – WAB Closure Option 5 Concept Plan (2018 Concept)

Attachment B includes rough order of magnitude (ROM) cost estimates for each closure option.

Attachment C contains the scoring matrix which summarizes the composite scores of the various closure options, the assumptions of which are outlined in Table 3 for each particular option.

METHODOLOGY

A scoring matrix was prepared to provide consistent evaluation of closure options for each of the various site locations. This scoring evaluation tool can be found in Attachment C and considers the following primary criteria:

- Environmental Protection and Impacts
- Cost
- Schedule
- Regional Factors
- Constructability

Rough Order of Magnitude Costs

A rough order of magnitude (ROM) Class 5 cost estimate was prepared for each of the closure options, based on information and quantities developed during the conceptual design activities. The estimated costs include construction, permitting, engineering design, post-construction O&M, and groundwater monitoring. A tabulated summary of the preliminary closure cost estimates for the options considered is provided below:

Summary of Current ROM Cost Estimates

Closure Option	Option Description	Estimated Construction Cost	Estimated O&M Cost (30 Years)
WAB Option 1	Closure-by-Removal (On-site new Landfill)	$401,836,116	$9,728,764
WAB Option 2	Closure-by-Removal (with Off-site Mayo Plant Landfill)	$537,198,399	$10,740,222

WAB Option 4	Closure-in-Place Hybrid Option	$206,191,143	$8,029,098
WAB Option 5	Closure-in-Place Option	$77,217,637	$19,394,964

As indicated by the cost estimate summary, WAB Option 5 - Closure-in-Place has the lowest total estimated cost. Options 1 and 2 have the highest costs, which are, primarily attributed to the additional cost for dewatering, excavation, hauling, and landfill development associated with other options considered. Detailed tabulated ROM cost estimates are included in Attachment B.

Schedule

Within the scoring evaluation, estimates of the length of time required to initiate closure activities and the anticipated construction duration are provided for each option. For the Closure-By-Removal options, a substantial amount of effort is anticipated for site preparation and dewatering activities, which dictates the longer estimated initiation times.

Option 1 is estimated to take 198 months or 16.5 years. Option 2 is estimated to take 198 months or 16.5 years. Option 4 is estimated to take 111 months or 9.3 years. Option 5 is estimated to take 79 months, or 6.6 years

A major driver in the estimated construction durations is the assumed material excavation/movement of 1 million cubic yards/year; therefore, the Closure-By-Removal options have a longer construction duration, as it requires the movement of all ash materials, compared to the Hybrid and Closure-In-Place options where material movement quantities are less and assumed capping rates (50 ac/year) would overlap schedule-wise with excavation and/or grading. The excavation scenarios would extend beyond both the current CAMA deadline of 2029 and the CCR deadline of 2034. Option 4 would be challenged to complete by the current CAMA deadline of 2029 unless work were to begin in early 2020.

Option 5 is the only option which is estimated to enable completion prior to CAMA deadline of 2029.

Evaluation Criteria

This options analysis was developed as a decision-making tool in selection of closure options when multiple methods are allowed under applicable regulations. The intent was to develop a decision framework that used weighted scorings to balance environmental factors, cost, and the safety of workers and the public. The options analysis incorporates Duke Energy's obligation as a regulated utility to ensure that its closure decisions are protective of the environment and communities, while also being prudent from a cost-effectiveness perspective.

The analysis considered multiple aspects in each criterion, including surface water impacts, groundwater impacts, air emissions, greenfield disturbance, construction duration, imported soil needs, transportation and noise impacts, stormwater management, long-term maintenance needs and post-closure monitoring.

The company then combined these elements to provide a weighted sum for each criterion using the following weights: environmental considerations (30%), cost (35%), schedule (15%), regional/community factors (15%) and constructability (5%.). Duke Energy placed primary emphasis on environmental factors and cost, which were approximately equal in weight. When considering all of the criteria and associated weightings, the environmental considerations have a slightly higher weight than cost with the inclusion of certain regional/community factors (transportation impact, noise impact, view impact) which are effectively environmental considerations.

The scoring matrix provided in Attachment C, scores each option on a scale of 0 (least favorable) to 10 (most favorable) for each of the specified criteria. The scores for each option are then summed based on specified criterion weighting, resulting in an overall weighted score for each option. The results of the scoring evaluation for the Roxboro WAB closure options are summarized in the following table:

Criterion	**Option**			
	1	**2**	**4**	**5**
Environmental Protection and Impacts	2.7	2.7	2.6	2.6
Cost	1.4	0.5	2.7	2.8
Schedule	0.0	0.0	1.2	1.5
Regional Factors	1.1	0.2	1.2	1.2
Constructability	0.4	0.4	0.0	0.5
Total Score	**5.6**	**3.8**	**7.8**	**8.6**

DISCUSSION

The options analysis finds relatively similar rankings for environmental protection and impacts which considers impacts to groundwater, surface water, air emissions based on miles driven, and avoidance of greenfield disturbance. The analysis incorporates the latest groundwater modeling of the Roxboro WAB that demonstrates groundwater near the basin responds similarly for several decades in all closure options evaluated. The current modeling does not incorporate capping or removal of other potential sources, subject to different legal requirements. If these additional areas were included, the closure would take longer, cost more, and potentially disturb more habitat. The most effective step the company can take to improve groundwater is to safely decant the free water from the ash basin, which will occur in any closure approach.

In terms of duration of work and closure time, the Closure-In-Place Option 5 scenario is expected to complete in 6.6 years, while the Closure-By-Removal Options 1 and 2 are expected to take 16.5 years, and would extend beyond the current CAMA deadline of 2029 and the CCR deadline of 2034. These remain in our Options Analysis despite this for full transparency of the excavation alternatives.

Other aspects considered include regional impacts to the community related to imported soil needs, transportation and noise. For the off-site landfill option, the Mayo landfill is located 15 miles from the

Roxboro site off of a public two-lane highway, which would present a degree of safety risk and road congestion issues in the Option 2 excavation scenario.

Closure-By-Removal Option 1 is five times the estimated cost of the Closure-In-Place option and nearly double the estimated cost of the Hybrid Option. Closure-by-Removal Option 2 is almost seven times the estimated cost of the Closure-In-Place and is more than double the estimated cost of the Hybrid Option. While long-term modeling indicates a quicker reduction in the boron plume within the immediate vicinity of the basin footprint for the Closure-By-Removal scenarios, compared to the Closure-in-Place and hybrid scenarios, the modeled concentration points evaluated over time at downstream locations are nearly identical for all the closure options. Moreover, the quicker reduction is partially offset by the fact that the modeled improvement is delayed in the Closure-By-Removal scenarios, compared to the Closure-in-Place scenario, due to the extended construction time. In any event, the minor change in modeled plume size, within the immediate vicinity of the basin footprint, is not enough to justify the cost of the Closure-by-Removal scenarios, particularly when the impact and improvement do not materially affect neighbors or other potential receptors.

The Hybrid Closure option ranks closely with Closure-In-Place, but also does not appear to produce environmental benefits commensurate with the added cost. In addition, the Hybrid Closure option presents concerns for construction feasibility associated with partial removal of ash, and slope stabilization.

CONCLUSION

Based on the conceptual designs for the selected closure options and evaluation of the criteria established (environmental protection/impacts, cost, schedule, regional factors and constructability), Closure-In-Place option (#5) or the Hybrid option (#4) were identified as the preferred options that best balance the various considerations associated with basin closure.

ATTACHMENTS

- Table 1 – Closure Option Summary (Identification of Options)
- Table 2 – Estimated Quantity Summary
- Table 3 – Closure Options Detail Descriptions
- Attachment A – Figures and Reference Drawings
- Attachment B - Rough Order of Magnitude (ROM) Cost Estimates
- Attachment C – Closure Options Evaluation Scoring Matrix

Option	Description
1. Closure-by-Removal Option (On-site new Landfill)	West Ash Basin (WAB) Option 1 consists of excavating ash material and a 1-ft thick soil layer within the limits of the WAB and placing the material in an on-site newly constructed permitted industrial landfill located west of the WAB (Landfill Area A). This industrial landfill would be constructed with a base liner system and an infiltration barrier/cap system meeting the requirements of the Federal Coal Combustion Residuals (CCR) Rule and the N.C. Coal Ash Management Act (CAMA). The scope also includes removal and disposal of ash and impacted soil/sediment material within the WAB Southern Extension.
2. Closure-by-Removal Option (with Off-site Landfill at Mayo Plant)	WAB Option 2 consists of excavating all ash material and impacted soil within the limits of the WAB and placing the material in an off-site permitted industrial landfill area located at Duke Energy's Mayo Steam Electric Plant. This industrial landfill would be constructed with a base liner system and an infiltration barrier/cap system meeting the requirements of the Federal Coal Combustion Residuals (CCR) Rule and N.C. Coal Ash Management Act (CAMA). The scope also includes removal and disposal of ash and impacted soil/sediment material within the WAB Southern Extension Impoundment.
4. Close-in-Place Hybrid Option (Partial Removal and Capping)	WAB Option 4 consists of excavating and consolidating ash material on the northwest side of the pond area in the vicinity of the existing FGD Pond features. The consolidated ash fill will be graded for drainage and closed with an infiltration barrier/cap system meeting the requirements of the Federal CCR Rule and CAMA. The scope also includes modification of Dike No. 1 for seepage control, and removal and disposal of ash and impacted soil/sediment material within the WAB Southern Extension Impoundment.
5. Close-in-Place Option (With minimum excavation)	WAB Option 5 consists of leaving the ash material within the Ash Basin, which would be capped with an infiltration barrier/cap system meeting the requirements of the Federal CCR Rule and CAMA. The scope also includes modification of Dike No. 1 for seepage control, and removal ash and impacted soil/sediment material from within the WAB Southern Extension Impoundment and placing in the WAB.

Table 2 – Quantity Summary

Ash Basin Closure Options Evaluation
Roxboro Steam Electric Plant
Roxboro West Ash Basin
Duke Energy

Item	Volume	Units	Area (Acres)
Existing Ash			
Ash Basin Area (regulatory boundary)	NA		183.08
Ash Basin Area – Southern Extension Impoundment (regulatory boundary)	NA		42.11
In Place Ash Volume – Ash Basin Area	15,599,000 12,966,000	Tons CY	186
In Place Ash Volume – Southern Extension Impoundment	241,774 201,478	Tons CY	37.2
Ash Basin Dam Soil Volume	NA	CY	NA
WAB Option 1 : Closure-by-Removal (On-site New Landfill)			
Ash Excavation Volume (Excavated Area)	12,966,000	CY	186
Over Excavation Volume (1 ft.)	300,080	CY	186
Ash Volume in Final Closure Footprint - Southern Extension Impoundment	201,478	CY	37.2
Ash and Soil Disposal from East Ash Basin	444,191	CY	NA
Proposed On-Site Landfill Area	NA		93.3
Soil Needed (18" Backfill Excavated Area and 18" Onsite Landfill Soil for Closure Cap)	675,906	CY	279.3
Offsite Topsoil Needed (6" over Closure-by-Removal Area and Onsite Landfill Closure Cap)	225,302	CY	279.3
WAB Option 2 : Closure by Removal (with Off-site Landfill at Mayo Plant)			
Ash Volume in Final Closure Footprint - Ash Basin Area	12,966,000	CY	186
Ash Volume in Final Closure Footprint - Southern Extension Impoundment	201,478	CY	37.2
Ash Excavation Volume (Excavated Area) - Ash Basin Area *For off-site disposal*	12,966,000	CY	186
Ash Excavation Volume (Excavated Area) - Southern Extension Impoundment *For off-site disposal*	201,478	CY	186
Over Excavation Volume (1 ft.) – *For off-site disposal*	300,080	CY	186
Ash Regrading	0	CY	
Dam Soil Cut Volume	Not estimated	CY	
Soil Needed (Backfill Excavated Area and 18" Cover Soil)	450,120	CY	186

Item	Volume	Units	Area (Acres)
Offsite Topsoil Needed (6” for Final Cover)	150,040	CY	186
Estimated Off-site Landfill Area (Footprint)			103
Off-site Landfill Soil (assume 2’ for liner and 18” for cover)	581,607	CY	103
Off-site Landfill Topsoil (assume 6” for cover)	83,087	CY	103
WAB Option 4 : Hybrid Option			
Ash Volume in Final Closure Footprint - Ash Basin Area	12,966,000	CY	77
Ash Volume in Final Closure Footprint - Southern Extension Impoundment	201,478	CY	37.2
Ash Excavation Volume (Excavated Area) - Ash Basin Area *For off-site disposal*	0	CY	186
Ash Excavation Volume (Excavated Area) - Southern Extension Impoundment *For on-site disposal*	201,478	CY	37.2
Over Excavation Volume (1 ft.) – *For off-site disposal*	175,853	CY	109
Ash Regrading	5,517,976	CY	77
Dam Soil Cut Volume	Not estimated	CY	
Soil Needed (Backfill Excavated Area and 18” Cover Soil)	984,639	CY	77
Offsite Topsoil Needed (6” for Final Cover)	150,040	CY	77
WAB Option 5 : Closure-in-Place			
Ash Volume in Final Closure Footprint - Ash Basin Area	12,966,000	CY	186
Ash Volume in Final Closure Footprint - Southern Extension Impoundment	201,478	CY	37.2
Ash Excavation Volume (Excavated Area) - *For off-site disposal*	0	CY	
Ash Excavation Volume (Excavated Area) - Southern Extension Impoundment *For on-site disposal*	201,478	CY	186
Over Excavation Volume (1 ft.) – *For off-site disposal*	0	CY	
Ash Regrading – Ash Basin Area	1,314,364	CY	37.2
Dam Soil Cut Volume	Not estimated	CY	
Soil Needed (Backfill Excavated Area and 18” Cover Soil)	450,120	CY	186
Offsite Topsoil Needed (6” for Final Cover)	150,040	CY	186

*Volumes will be determined as part of the final design if the respective option is selected as the closure option.

Option	Description
1. Closure-by-Removal Option (On-site new Landfill)	Closure-by-removal will be accomplished removal of the ash along with a 1-ft thick soil layer within the limits of the WAB. This closure option also assumes ash will also be removed from within the limits of the WAB Southern Extension and permanently placed in a newly constructed onsite landfill (Landfill Area A). The estimated volume of ash moved for closure is 12,966,000 cy, and the estimated volume of impacted soil moved is 300,080 cy. The West Ash Basin Main Dam will be breached to allow stormwater flow to discharge into the Heated Water Discharge Canal, and ultimately Hyco Lake. WAB Dike No. 1 (Filter Dike) Modification – For this option, we have assumed WAB Dike No. 1 will remain in place after completion of WAB Closure-by-Removal to direct upstream flow into the existing discharge outlet channel. The existing discharge outlet channel will then convey the upstream flow to the Heated Water Discharge Canal, which is part of the wastewater treatment system under the NPDES permit. The flow is then discharged to Hyco Lake through NPDES Outfall 003. No modifications of the existing dike will be performed. WAB Southern Extension Impoundment Closure – For this option, the WAB Southern Extension Impoundment will be closed with a Closure-by-Removal approach. Removal of ash and impacted soil/sediment material will be performed by dredging methods. The estimated quantity of ash and impacted soil/sediment to be removed is 201,478 cubic yards. The waste material will be deposited by sluicing within the limits of the WAB and will subsequently be removed as part of the WAB Closure-by-Removal plan. Excavated settlement pits or containment berms will be provided within the WAB for collection of the dredged material. Figures and reference drawings representing this option are as follows: • Figure WAB 1.1 – Closure-by-Removal • Figure WAB 1.2 – Proposed Landfill Area A <u>Environmental Protection and Impacts Considerations</u> • Estimated quantities used for cost estimates are summarized in Table 2. <u>Cost Considerations</u> The total estimated construction cost is $401,836,116, and the estimated post-closure O&M cost (30 years) is $9,728,764. <u>Schedule Considerations</u> For this option, the total estimated closure construction duration is 16.5 years, and the time to start ash removal is 2.5 years. <u>Regional Factors</u> • Ash basin closure area could be reused without consideration of cover system after completion of closure by removal.

Option	Description
	• The estimated quantity of imported soil are included in Table 2. • There are currently no plans for beneficial reuse of ash after closure. • Noise impact considered more significant than Closure-in-Place due to duration, hauling and truck traffic but less significant than removal to an off-site facility due to the reduced haul distance and reduced public road use • View impact for the site considered more significant than Closure-in-Place and removal to off-site facility due to 200+ feet height of proposed on-site landfill facility created on-site. <u>Constructability</u> • Closure-by-Removal has the second highest constructability score of 8 and is very close to Close-in-Place which has the highest overall score for constructability of 10. • Requires development of new landfill space to accommodate ash removal. • Option may require additional haul road or access improvements at the site. • Closure-by-removal has additional challenges due to longer duration and larger amount of excavation and transport for removal of ash.
2. Closure-by-Removal Option (with Off-site Landfill at Mayo Plant)	This closure option assumes all ash material will be removed from within the limits of the WAB and permanently disposed of in the off-site permitted and lined landfill area located at Duke Energy's Mayo Steam Electric Plant. The estimated volume of ash material removed/hauled for closure is 12,966,000 cy, and the estimated volume of impacted soil removed/hauled is 300,080 cy. For this option, the WAB Main Dam will be breached to allow stormwater flow to discharge into the Heated Water Discharge Canal, which is part of the wastewater treatment system under the NPDES permit. The flow is then discharged to Hyco Lake through NPDES Outfall 003. WAB Dike No. 1 (Filter Dike) Modification – For this option, we have assumed WAB Dike No. 1 will remain in place after completion of WAB Closure-by-Removal to direct upstream flow into the existing discharge outlet channel. The existing discharge outlet channel will then convey the upstream flow to the Heated Water Discharge Canal, which is part of the wastewater treatment system under the NPDES permit. The flow is then discharged to Hyco Lake through NPDES Outfall 003. No modifications of the existing dike will be performed. WAB Southern Extension Impoundment Closure – For this option, the WAB Southern Extension Impoundment will be closed with a Closure-by-Removal approach. Removal of ash and impacted soil/sediment material will be performed by dredging methods. The estimated quantity of ash and impacted soil/sediment to be removed is 201,478 cubic yards. The waste material will be deposited by sluicing within the limits of the WAB and will subsequently be removed as part of the WAB Closure-by-Removal plan. Excavated settlement

Option	Description
	pits or containment berms will be provided within the WAB for collection of the dredged material. Figures and reference drawings representing this option are as follows: • Figure WAB 2.1 – Location for Off-site Mayo Industrial Landfill & Haul Path • Figure WAB 2.2 – Option 2 Concept Plan <u>Environmental Protection and Impacts Considerations</u> • Estimated quantities used for cost estimated for this option are summarized in Table 2. This table also includes estimates for expected miles driven for on-site and off-site hauling operations and disturbed acres of greenfield to be used for the options evaluation. <u>Cost Considerations</u> For this option, the total estimated construction cost is $537,198,399, and the estimate post-closure O&M cost (30 years) is $10,740,222. <u>Schedule Considerations</u> For this option, the total estimated closure construction duration is 16.5 years, and the time to start ash removal is 2.5 years. This option will not meet the CAMA deadline of 2029. <u>Regional Factors</u> • Entire site could be reused without consideration of cover system after completion of Closure-by-Removal. • The requirements for imported soil are included in Table 2. • There are currently no plans for beneficial reuse of ash material after closure. • Estimated miles driven for closure is included in Table 2. • Noise impact considered highest for removal. • View impact considered highest for removal. <u>Constructability</u> • Closure-by-Removal has the second highest constructability score of 8 and is very close to Close-in-Place which has the highest overall score for constructability of 10.
4. Close-in-Place Hybrid Option (Partial Removal and Capping)	For this option, ash material will be consolidated on the northwest side of the pond area in the vicinity of the FGD Pond features. The consolidated ash fill will be closed by placement of an engineered cover system. Site drainage will be provided by a constructed/stabilized channel that runs the length of the pond area and discharges through a breach in the WAB Main Dam. The

Option	Description
	flow will then be released into the Heated Water Discharge Canal, which is part of the wastewater treatment system under the NPDES permit. The flow is then discharged to Hyco Lake through NPDES Outfall 003. WAB Dike No. 1 (Filter Dike) Modification – For this option, WAB Dike No. 1 will be modified to effectively control seepage by placement of a soil fill buttress on the interior slope of the dike. A liner will be placed on the slope of the proposed buttress berm. The existing discharge outlet channel will convey the upstream flow to the Heated Water Discharge Canal, which is part of the wastewater treatment system under the NPDES permit. The flow is then discharged to Hyco Lake through NPDES Outfall 003. WAB Southern Extension Impoundment Closure – For this option, the WAB Southern Extension Impoundment will be closed with a Closure-by-Removal approach. For this option, removal of ash and impacted soil/sediment material will be performed by dredging methods. The estimated quantity of ash and impacted soil/sediment to be removed is 201,478 cubic yards. The waste material will be deposited by sluicing within the limits of the WAB and will be incorporated into the final ash fill and grading plan. Excavated settlement pits or containment berms will be provided within the WAB for collection of the dredged material. Figures and reference drawings representing this option are as follows: • Figure WAB 4.1 – WAB Closure Option 4 Concept Plan • Figure WAB 4.2 – WAB Closure Option 4 Concept Profiles Sheet 1 of 2 • Figure WAB 4.3 – WAB Closure Option 4 Concept Profiles Sheet 2 of 2 <u>Environmental Protection and Impacts Considerations</u> • Estimated quantities used for cost estimated for this option are summarized in Table 2. This table also includes estimates for expected miles driven for on-site and off-site hauling operations and disturbed acres of greenfield to be used for the options evaluation. <u>Cost Considerations</u> For this option, the total estimated construction cost is $206,191,143, and the estimate post-closure O&M cost (30 years) is $8,029,098. <u>Schedule Considerations</u> For this option, the total estimated closure construction duration is 9.3 years, and the time to start ash removal is 2.1 years. This option will likely not meet the CAMA deadline of 2029. <u>Regional Factors</u> • A portion of the site would be available for reuse after excavation with this option.

Option	Description
	• The requirements for imported soil are included in Table 2. • There are currently no plans for beneficial reuse of ash material after closure. • Estimated miles driven for closure is included in Table 2. • Noise impact higher than Close-in-Place but less the Closure-by-Removal which has the highest impact. • View impact higher than Close-in-Place but less the Closure-by-Removal which has the highest impact. <u>Constructability</u> • Hybrid option has a significant constructability and feasibility concern associated with potential for standing water over the final cover system.
5. Close-in-Place Option (With minimum excavation)	This closure option represents the approach of minimizing the excavation and relocation of ash material within the WAB. For this option, the existing ash deposits will generally be graded in the direction of the WAB Main Dam and Dike No. 1. After completion of site grading, the entire closure area will be closed by placement of an engineered cover system. Site drainage will be provided by a stabilized channel that run the length of the pond area. The flow will be discharged through a breach in WAB Main Dam and Dike No. 1. The flow will then be released into the Heated Water Discharge Canal, which is part of the wastewater treatment system under the NPDES permit. The flow is then discharged to Hyco Lake through NPDES Outfall 003. WAB Dike No. 1 (Filter Dike) Modification – For this option, WAB Dike No. 1 will be modified to effectively control seepage by placement of a soil fill buttress berm on the interior slope of the dike. A liner will be placed on the slope of the proposed buttress berm. The existing discharge outlet channel will convey the upstream flow to the Heated Water Discharge Canal, which is part of the wastewater treatment system under the NPDES permit. The flow is then discharged to Hyco Lake through NPDES Outfall 003. WAB Southern Extension Impoundment Closure – For this option, the WAB Southern Extension Impoundment will be closed with a Closure-by-Removal approach. Removal of ash and impacted soil/sediment material will be performed by dredging methods. The estimated quantity of ash and impacted soil/sediment to be removed is 201,478 cubic yards. The waste material will be deposited by sluicing within the limits of the WAB and will be incorporated into the final ash fill and grading plan. Excavated settlement pits or containment berms will be provided within the WAB for collection of the dredged material.

Option	Description
	Figures and reference drawings representing this option are as follows: • Figure WAB 5.1 – WAB Closure Option 5 Concept Plan Environmental Protection and Impacts Considerations • Estimated quantities used for cost estimated for this option are summarized in Table 2. This table also includes estimates for expected miles driven for on-site and off-site hauling operations and disturbed acres of greenfield to be used for the options evaluation. Cost Considerations For this option, the total estimated construction cost is $77,217,637, and the estimate post-closure O&M cost (30 years) is $19,394,964. Schedule Considerations For this option, the total estimated closure construction duration is 6.6 years, and the time to start ash removal is 2.1 years. This is the only option that would be able to meet the CAMA deadline of 2029. Regional Factors • Cover system could limit potential for site reuse. • The requirements for imported soil are included in Table 2. • There are currently no plans for beneficial reuse of ash material after closure. • Estimated miles driven for closure is included in Table 2. • Noise impact was the lowest for the options considered. • View impact was the lowest for the options considered. Constructability • Close-in-Place has highest overall score for constructability followed by removal options.

Attachment A - Figures and Reference Drawings

WAB 1.1

LEGEND

— — — — (red dashed)	APPROXIMATE LIMITS OF CCR BOUNDARY
————	SURVEYED POND AREA
—— · ——	SURVEYED STREAM/CHANNEL AREA
—— OHE ——	EXISTING TRANSMISSION LINES

REFERENCES:

1. ASH BASIN FACILITY BOUNDARIES TAKEN FROM SYNTERRA, COMPREHENSIVE SITE ASSESSMENT REPORT, ROXBORO STEAM ELECTRIC PLANT, SEPTEMBER 2015 AND PHASE 2 RECONSTITUTION OF ASH POND DESIGNS FINAL REPORT, REV 0, JUNE 16, 2015. BOUNDARIES ARE APPROXIMATE.
2. EXISTING TOPOGRAPHIC INFORMATION WAS PRODUCED FROM PHOTOGRAMMETRIC METHODS FROM AERIAL PHOTOGRAPHY OBTAINED ON APRIL 16, 2014 BY WSP.

REV	DATE	JOB NO.	PROJECT TYPE	DES	DFTR	CHKD	ENGR	APPD	DESCRIPTION
A	10/22/2018	7810181107	CIVIL DESIGN PLAN	DMS	DMS	BCL	DG	DG	NOT RELEASED FOR CONSTRUCTION

wood.

Environment & Infrastructure Solutions
4021 STIRRUP CREEK DRIVE, SUITE 100 DURHAM NC 27703
TEL: (919) 381-9900
FAX: (919) 381-9901
LICENSURE:
NC ENG: F-1253
NC GEOLOGY: C-247

SEAL

TITLE
ROXBORO ASH BASIN CLOSURE PROJECT
ROXBORO WEST ASH BASIN (WAB)
WAB CLOSURE OPTION 1 CONCEPT PLAN

FOR
NOT RELEASED FOR CONSTRUCTION

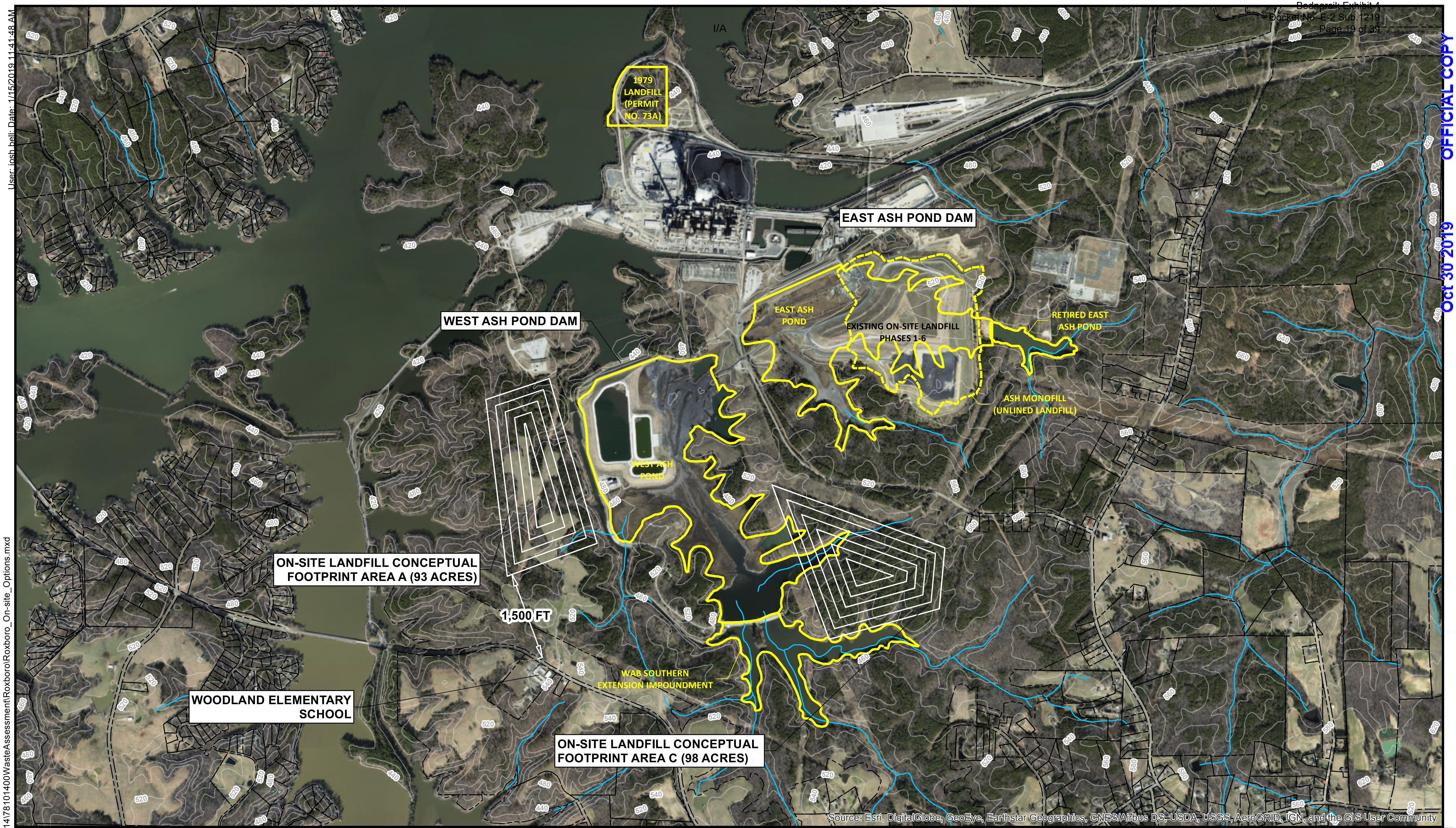
DUKE ENERGY®

SCALE:	AS SHOWN	DES:	DMS
DWG TYPE:	DWG	DFTR:	VRD
JOB NO:	7810181107	CHKD:	DMS
DATE:	10/26/2018	ENGR:	DG
FILENAME:	WAB 2.2/3.2.DWG	APPD:	DG

DWG SIZE	DRAWING NO.	REVISION
ANSI D 22"x34"	WAB 1.1	B

REV. B

INCHES 1 2 3 TENTHS 10 20 30



Source: NC Natural Heritage Program, 2014; NCDENR Division of Water Resources, 2013; NCDOT LiDar Data, 2008; USFWS National Wetlands Inventory Maps, April 2014; Person County GIS Datasets, 2014.

APPROXIMATE CONCEPTUAL LANDFILL FOOTPRINT
APPROXIMATE ASH BOUNDARY
1% ANNUAL CHANCE FLOOD HAZARD
NATIONAL WETLAND INVENTORY
CONTOUR (20 FOOT)
STREAMS

wood.

N
0 750 1,500
Feet

ON-SITE LANDFILL OPTION

CLOUSRE OPTIONS
ROXBORO STEAM STATION
NORTH CAROLINA

PREPARED BY/DATE	JOB NUMBER	FIGURE
JMB 1/14/2019	7810-18-1107	WAB 1.2

WAB-2.1

wood.

Environment & Infrastructure Solutions
4021 STIRRUP CREEK DRIVE, SUITE 100 DURHAM
NC 27703
TEL: (919) 381-9900
FAX: (919) 381-9901
LICENSURE:
NC ENG: F-1253
NC GEOLOGY: C-247

SEAL

TITLE
ROXBORO ASH BASIN CLOSURE PROJECT
ROXBORO WEST ASH BASIN (WAB)
WAB CLOSURE OPTION 2

FOR
NOT RELEASED FOR CONSTRUCTION

DUKE ENERGY

SCALE:	AS SHOWN	DES:	DMS
DWG TYPE:	DWG	DFTR:	VRD
JOB NO:	7810181107	CHKD:	DMS
DATE:	10/22/2018	ENGR:	DG
		APPD:	DG

FILENAME: ROXBORO CLOSURE OPTION 2 FIGURE WAB-2.1.dwg

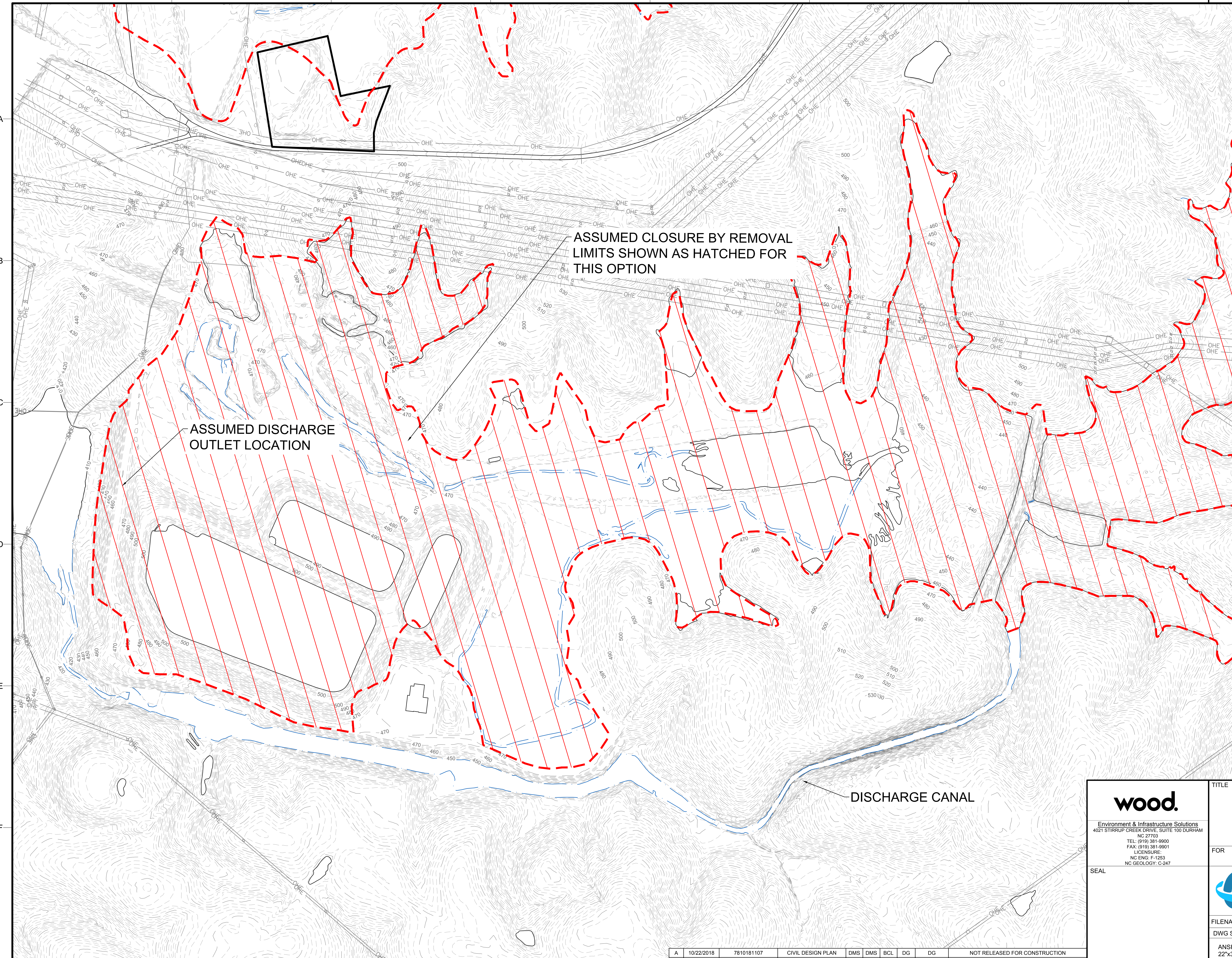
DWG SIZE	DRAWING NO.	REVISION
ANSI D 22"x34"	WAB-2.1	0

WAB-2.1

REV. B

INCHES 1 2 3
TENTHS 10 20 30

WAB 2.2/3.2



LEGEND

- APPROXIMATE LIMITS OF ASH BASIN CCR BOUNDARY
- SURVEYED POND AREA
- OHE — EXISTING TRANSMISSION LINES

REFERENCES:

1. ASH BASIN FACILITY BOUNDARIES TAKEN FROM SYNTERRA, COMPREHENSIVE SITE ASSESSMENT REPORT, ROXBORO STEAM ELECTRIC PLANT, SEPTEMBER 2015 AND PHASE 2 RECONSTITUTION OF ASH POND DESIGNS FINAL REPORT, REV 0, JUNE 16, 2015. BOUNDARIES ARE APPROXIMATE.
2. EXISTING TOPOGRAPHIC INFORMATION WAS PRODUCED FROM PHOTOGRAMMETRIC METHODS FROM AERIAL PHOTOGRAPHY OBTAINED ON APRIL 16, 2014 BY WSP.

250 0 250 500 FT

REV	DATE	JOB NO.	PROJECT TYPE	DES	DFTR	CHKD	ENGR	APPD	DESCRIPTION
A	10/22/2018	7810181107	CIVIL DESIGN PLAN	DMS	DMS	BCL	DG	DG	NOT RELEASED FOR CONSTRUCTION

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LICENSURE:
NC ENG: F-1253
NC GEOLOGY: C-247

SEAL

TITLE
ROXBORO ASH BASIN CLOSURE PROJECT
ROXBORO WEST ASH BASIN (WAB)
WAB CLOSURE OPTION 2 CONCEPT PLAN

FOR
NOT RELEASED FOR CONSTRUCTION

DUKE ENERGY

SCALE:	AS SHOWN	DES:	DMS
DWG TYPE:	DWG	DFTR:	VRD
JOB NO:	7810181107	CHKD:	DMS
DATE:	10/26/2018	ENGR:	DG
FILENAME:	WAB 2.2/3.2.DWG	APPD:	DG

DWG SIZE	DRAWING NO.	REVISION
ANSI D 22"x34"	WAB 2.2	B

WAB-4.1 REV. 0

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DURHAM
(919) 381-9900
(919) 381-9901
LICENSURE:
NC ENG: F-1253
NC GEOLOGY:C-247

amec foster wheeler

TITLE
ROXBORO ASH BASIN CLOSURE PROJECT
ROXBORO WEST ASH BASIN (WAB)
WAB CLOSURE OPTION 4 CONCEPT PLAN

FOR
NOT RELEASED FOR CONSTRUCTION

SEAL
NOT FOR CONSTRUCTION

DUKE ENERGY

SCALE: AS SHOWN		DES:	SRA
DWG TYPE: DWG		DFTR:	DMS & SS
JOB NO: 7810-15-0347		CHKD:	SRA
DATE: 02/08/2016		ENGR:	DMS
FILENAME: WAB - 4.x.dwg		APPD:	SRA
DWG SIZE	DRAWING NO.		REVISION
ANSI D 22"x34"	WAB-4.1		0

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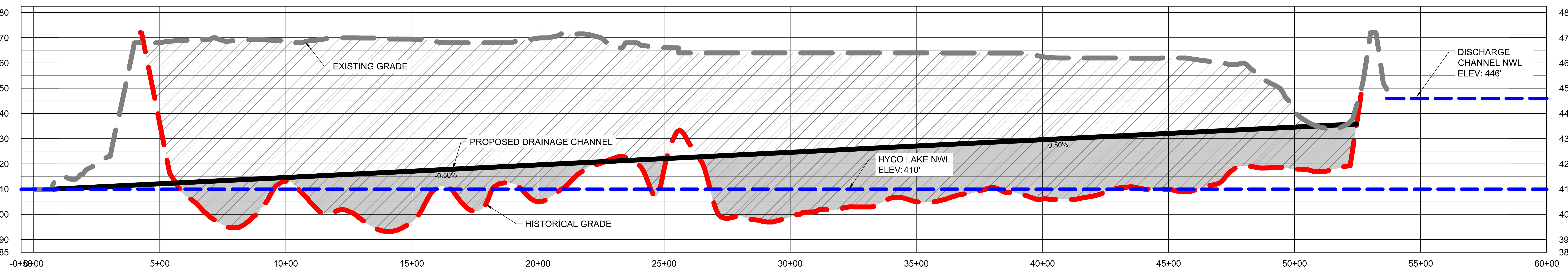
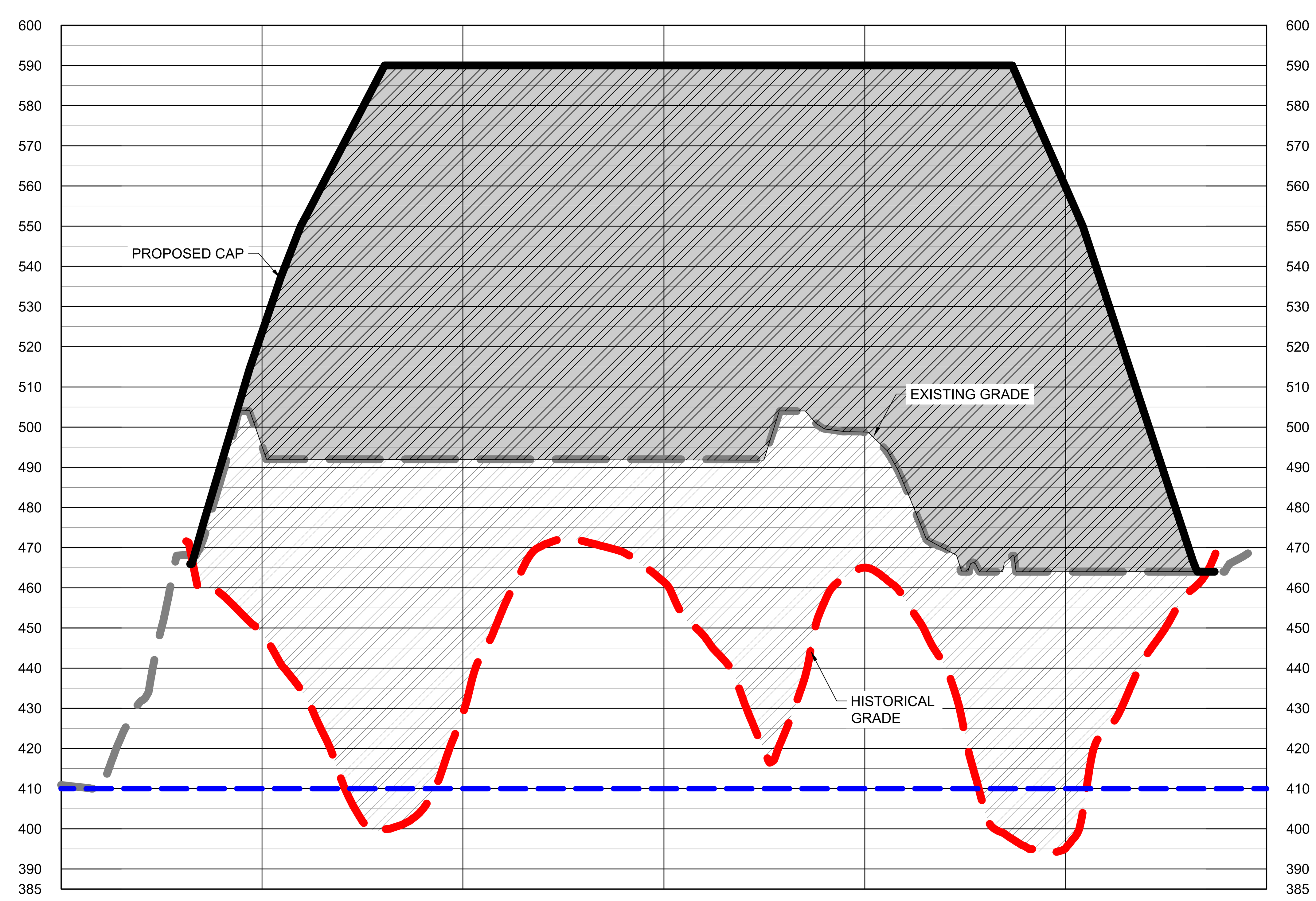


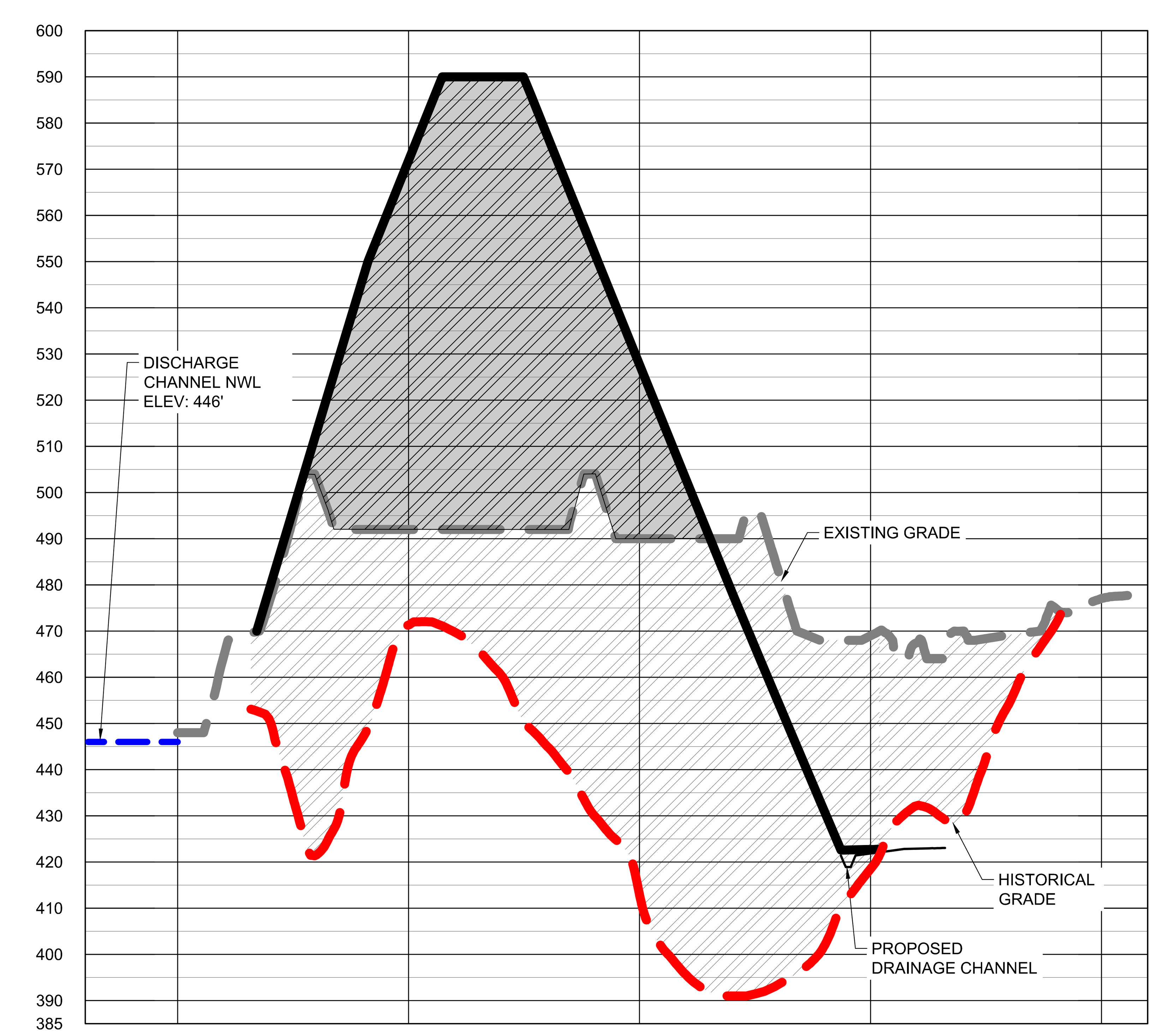
SECTION 1-1

ASH REMOVAL

ASH REMOVAL / SOIL FILL



SECTION 2-2



SECTION 3-3

250 0 250 500 FT

40 20 0 20 FT

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NC GEOLOGY:C-247

SEAL

NOT FOR CONSTRUCTION

TITLE

ROXBORO ASH BASIN CLOSURE PROJECT

ROXBORO WEST ASH BASIN (WAB)

WAB CLOSURE OPTION 4 CONCEPT PROFILES (SHEET 1 OF 2)

FOR

NOT RELEASED FOR CONSTRUCTION

DUKE ENERGY

SCALE: AS SHOWN	DES: SRA
DWG TYPE: DWG	DFTR: DMS & SS
JOB NO: 7810-15-0347	CHKD: SRA
DATE: 02/08/2016	ENGR: DMS
	APPD: SRA

FILENAME: WAB - 4.x.dwg

DWG SIZE	DRAWING NO.	REVISION
ANSI D 22"x34"	WAB-4.2	0

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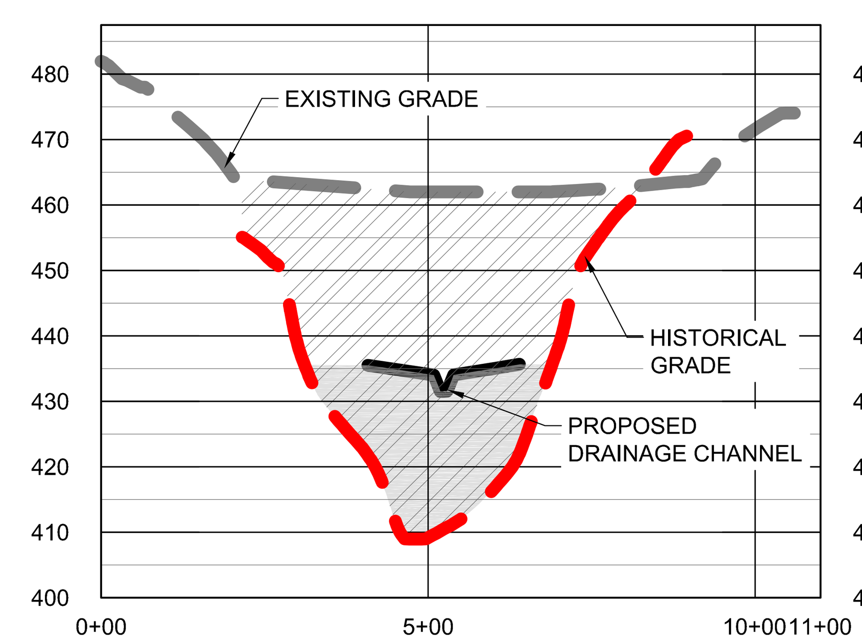
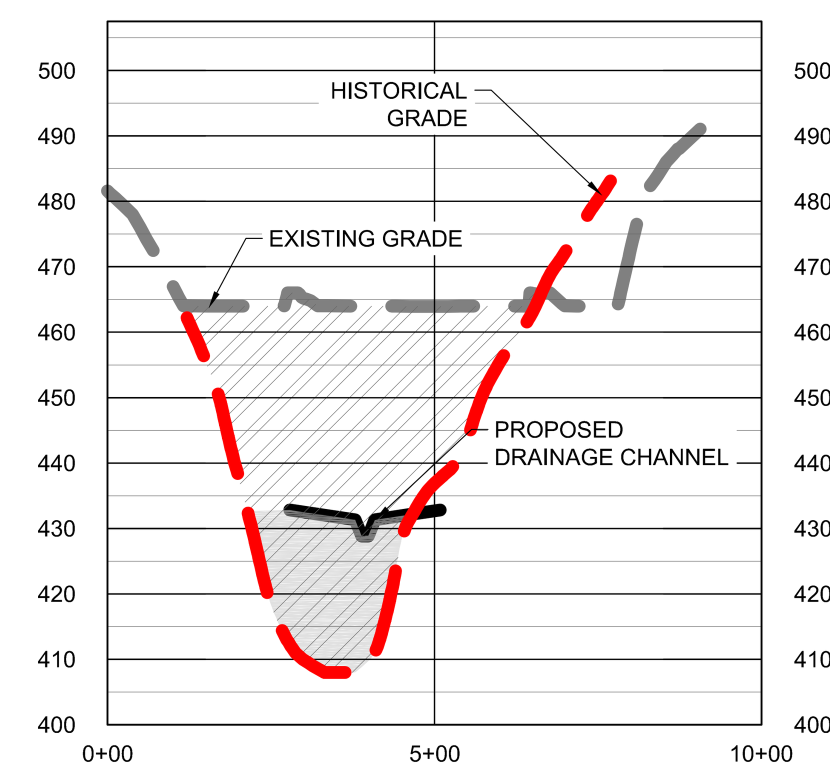
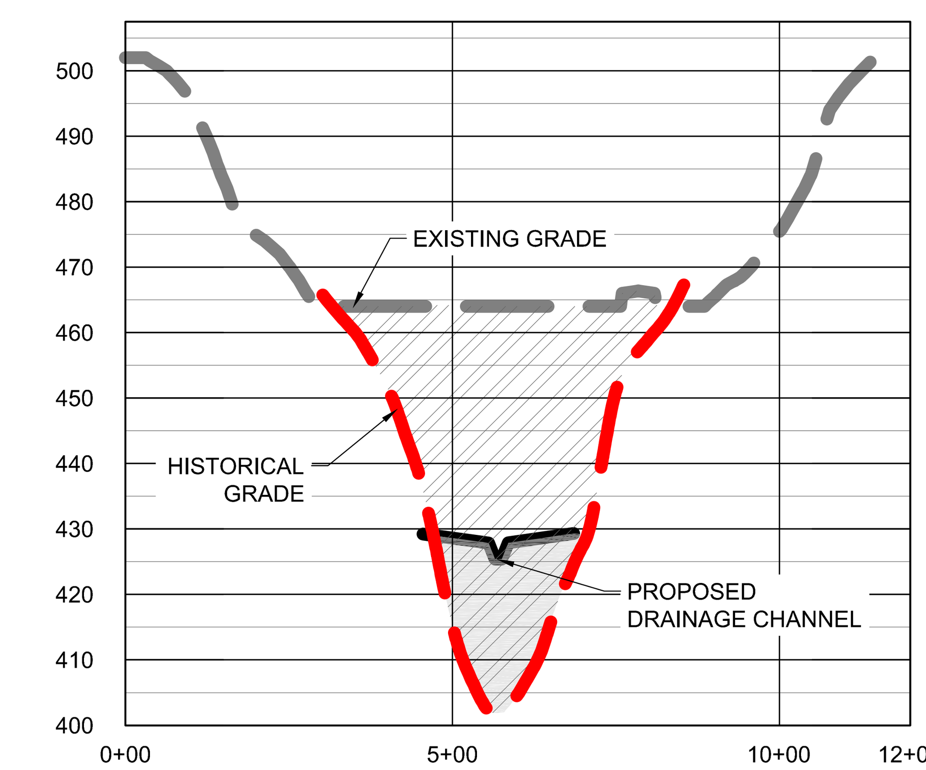


SECTION 4-4



SECTION 5-5



SECTION 6-6

ASH REMOVAL

ASH REMOVAL / SOIL FILL

40 FT
20
0
20

250 0 250 500 FT

Environment & Infrastructure

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DURHAM
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(919) 381-9901
LICENSURE:
NC ENG: F-1253
NC GEOLOGY:C-247

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TITLE

ROXBORO ASH BASIN CLOSURE PROJECT

ROXBORO WEST ASH BASIN (WAB)

WAB CLOSURE OPTION 4 CONCEPT PROFILES (SHEET 2 OF 2)

FOR

NOT RELEASED FOR CONSTRUCTION

SEAL

NOT FOR CONSTRUCTION

DUKE ENERGY

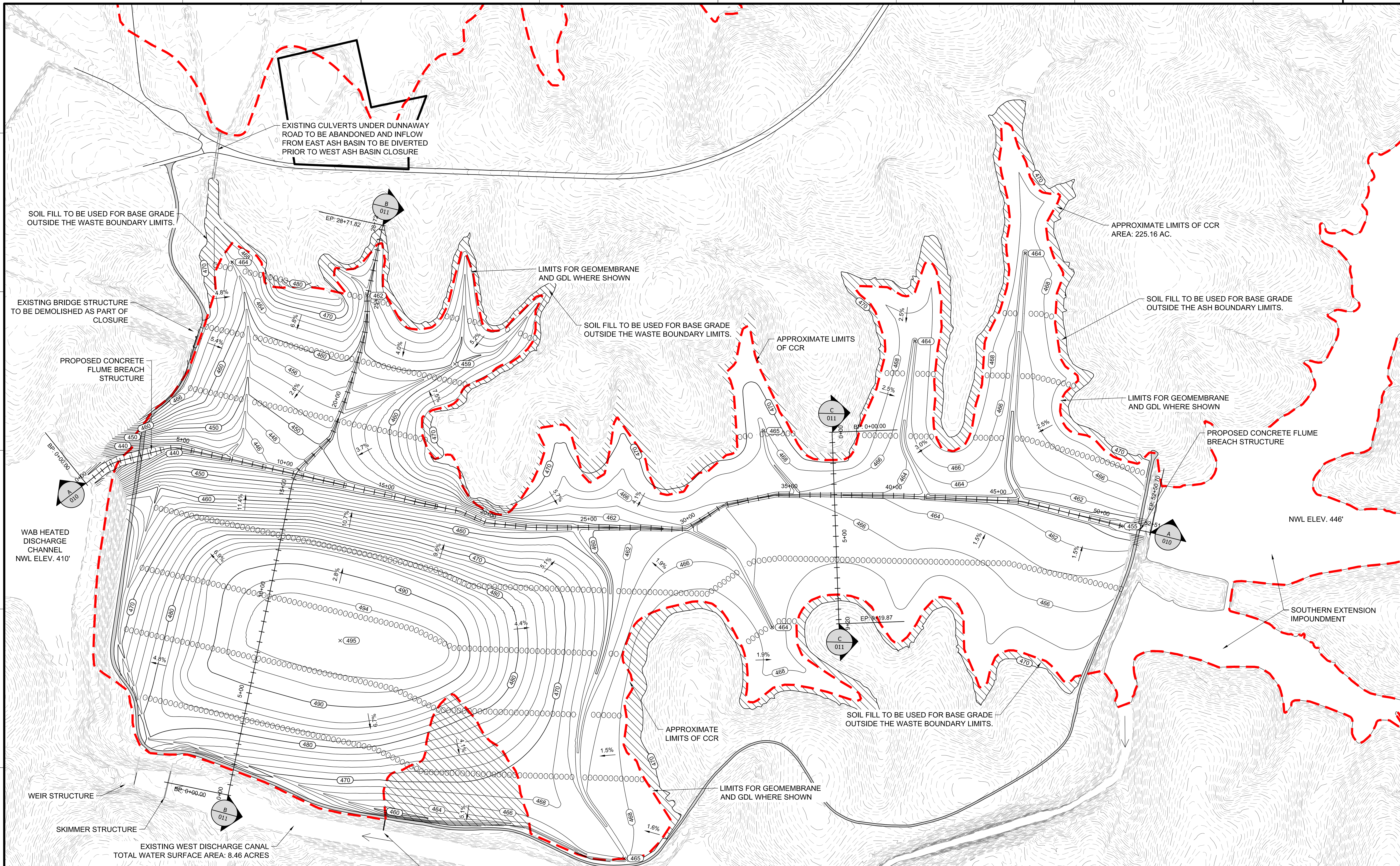
SCALE: AS SHOWN	DES: SRA
DWG TYPE: DWG	DFTR: DMS & SS
JOB NO: 7810-15-0347	CHKD: SRA
DATE: 02/08/2016	ENGR: DMS
FILENAME: WAB - 4.x.dwg	APPD: SRA

DWG SIZE	DRAWING NO.	REVISION
ANSI D 22"x34"	WAB-4.3	0

REV	DATE	JOB NO.	PROJECT TYPE	DES	DFTR	CHKD	ENGR	APPD	DESCRIPTION

ABSAT ISSUE #	DATE	DESIGN

Plotted By:Deberardinis, Victoria Sheet Set:Roxboro Ash Basin Closure Options Concepts Plan (WAB) Layout:5 WAB - 4.3 October 31, 2018 01:22:52pm Q:\Duke Energy\Roxboro\7810150347 Roxboro Ash Basin Closure Plan\CAD\Concept\WAB - 4.x.dwg



LEGEND

- EXISTING MAJOR CONTOURS
- EXISTING MINOR CONTOURS
- PROPOSED GRADING MAJOR CONTOURS
- PROPOSED GRADING MINOR CONTOURS
- APPROXIMATE LIMITS OF CCR BOUNDARY
- SOIL FILL LIMITS
- FLOW DIRECTION ARROWS
- ACCESS ROAD
- MIDSLOPE COVER SYSTEM GEOCOMPOSITE OUTLET (TYP.)

REFERENCES:
1. ASH BASIN FACILITY BOUNDARIES TAKEN FROM SYNTERRA, COMPREHENSIVE SITE ASSESSMENT REPORT, ROXBORO STEAM ELECTRIC PLANT, SEPTEMBER 2015 AND PHASE 2 RECONSTRUCTION OF ASH POND DESIGNS FINAL REPORT, REV 0, JUNE 16, 2015. BOUNDARIES ARE APPROXIMATE.
2. EXISTING TOPOGRAPHIC INFORMATION WAS PRODUCED FROM PHOTOGRAMMETRIC METHODS FROM AERIAL PHOTOGRAPHY OBTAINED ON APRIL 16, 2014 BY WSP.

NOTES:
1. THIS DRAWING REPRESENTS THE REQUIREMENTS FOR SITE GRADING PRIOR TO PLACEMENT OF THE GEOMEMBRANE GDL AND SOIL COVER FOR ASH BASIN CLOSURE.

250 0 250 500 FT

ESTIMATED QUANTITIES (THIS DRAWING)

DESCRIPTION	UNITS	ESTIMATED QUANTITY
ASH BASIN BOUNDARY AREA	ACRES	186
GEOMEMBRANE & GDL (2-D) BOUNDARY AREA	ACRES	203
EARTH WORK (ASH) CUT VOL	CU YARDS	1,334,041
EARTH WORK (ASH) FILL VOL	CU YARDS	1,278,377
SOIL FILL (OUTSIDE ASH BASIN BOUNDARY) VOLUME	CU YARDS	97,000
SOIL COVER VOLUME	CU YARDS	654,400

REV	DATE	JOB NO.	PROJECT TYPE	DES	DFTR	CHKD	ENGR	APPD	DESCRIPTION
A	10/22/2018	7810181107	CIVIL DESIGN PLAN	DMS	DMS	BCL	DG	DG	NOT RELEASED FOR CONSTRUCTION

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LICENSURE:
NC ENG: F-1253
NC GEOLOGY: C-247

SEAL

TITLE
ROXBORO ASH BASIN CLOSURE PROJECT
ROXBORO WEST ASH BASIN (WAB)
WAB CLOSURE OPTION 5 CONCEPT PLAN

FOR
NOT RELEASED FOR CONSTRUCTION

DUKE ENERGY

SCALE:	AS SHOWN	DES:	DMS
DWG TYPE:	DWG	DFTR:	VRD
JOB NO:	7810181107	CHKD:	DMS
DATE:	10/26/2018	ENGR:	DG
FILENAME:	WAB 5.1.dwg	APPD:	DG

DWG SIZE	DRAWING NO.	REVISION
ANSI D 22"x34"	WAB-5.1	B

Attachment B - Rough Order of Magnitude (ROM) Cost Estimates

Roxboro WAB Closure Option 1 - Closure by Removal (On-Site new Landfill)

Closure Option Opinion of Probable Cost (ROM)

Duke Energy - Roxboro Steam Station

Person County, NC

	Quantity	Unit	Unit Cost	Total Cost	Estimate Note
GENERAL					
Surveying	186	Acres	$ 2,000	$ 372,000	Excavate and remove, including off-site disposal of existing storm water structures/piping. Price at $8k/day at 5 days per week for 4 weeks.
Abandon WAB Discharge Outlet Structures/Piping	1	EA	$ 200,000	$ 200,000	Unit Rate By Duke
SUBTOTALGENERAL				$ 572,000	
EROSION/SEDIMENT CONTROL AND STORMWATER MANAGEMENT					
West Ash Basin Sediment Control and Stormwater Management	186	Acres	$14,000.00	$ 2,604,000	Unit Rate By Duke
Permanent Stabilization Measures	186	Acres	$3,787.00	$ 704,382	Unit Rate By Duke
SUBTOTAL EROSION/SEDIMENT CONTROL AND STORMWATER MANAGEMENT				$ 3,308,382	
EARTHWORK					
Ash Basin Earthwork					
Construction Entrance	50	LF	$65	$ 3,250	Amec Foster Wheeler experience based on $20/LF for 12-inch thick ABC and supporting geotextile at 20-foot width.
Clearing and Grubbing		Acres	$5,000	$ -	Clear and remove vegetation including trees, brush, shrubs.
Breaching Main Dam	1	LS	$1,000,000	$ 1,000,000	Unit Rate By Duke
Earthwork Cut to Fill		CY	$6.87	$ -	Unit Rate By Duke
Topsoil Stripping		Acres	$4,000.00	$ -	Unit Rate By Duke
Topsoil Material; if required (6-inch thick un-compacted fill, source material off-site)	150040	CY	$11	$ 1,617,431	Unit Rate By Duke
				$ -	
Landfill Earthwork					
Landfill Construction	93.3	Acres	$400,000	$ 37,320,000	Unit Rate By Duke
Landfill Closure	93.3	Acres	$150,000	$ 13,995,000	Unit Rate By Duke
SUBTOTAL EARTHWORK				$ 53,935,681	
ASH BASIN DEWATERING, EXCAVATION, HAULING AND PLACEMENT					
Temporary Dewatering (Ash Basin) Free Water	2	Mo	$416,667.00	$ 833,334	Unit Rate By Duke
Temporary Dewatering (Ash Basin) Construction Water	162	Mo	$583,333.00	$ 94,272,852	Unit Rate By Duke
Haul Road Construction	500	LF	$60.00	$ 30,000	Unit Rate By Duke
Excavation of Pond Ash and Loading in Trucks	13,167,478	CY	$8.43	$ 111,001,840	Unit Rate By Duke
Excavation of Residual Adjacent and Subsurface Soils and Loading in Trucks	300080	CY	$10	$ 3,000,800	Unit Rate By Duke
Hauling, Placement, and Compaction of Pond Ash and Residual Soils to Landfill Area A Landfill	13,467,558	CY	$4	$ 47,136,453	Unit Rate By Duke
Truck Wash	1	LS	$150,000.00	$ 150,000	Truck wash necessary to clean tires and undercarriage of trucks for over-the-road hauling. ROM costs based on experience with Duke facilities.
SUBTOTAL ASH BASIN DEWATERING, EXCAVATION, HAULING AND PLACEMENT				$ 256,425,279	
SUBTOTAL FINAL CLOSURE CONSTRUCTION COST				**$ 314,241,342**	
Estimate Mobilization Cost (2.5% of Final Closure Construction Cost)				**$ 7,856,034**	
OTHER COST					
Design, Permitting and CQA					
Closure Design/Engineering/Permitting (5% of Final Closure Construction Costs)	1	LS	$15,712,067.09	$ 15,712,067	
Construction Quality Assurance (CQA) (5% of Final Closure Construction Costs)	1	LS	$15,712,067.09	$ 15,712,067	
Subtotal Design, Permitting and CQA				**$ 31,424,134**	
Post Closure Operations and Maintenance (analysis based on 30 year duration)					
Landfill Area Maintenance	30	YR	$ 324,292	$ 9,728,764	Estimate at $3475.8/acre/year of capped area.
Landfill Area Monitoring	0	YR		$ -	
Subtotal Post Closure Operations and Maintenance				**$ 9,728,764**	
Additional Costs					
Contingency (15% of Final Closure Construction Costs)	1	LS	$ 48,314,606	$ 48,314,606	Amec Foster Wheeler experience from previous projects
Subtotal Additional Costs				**$ 48,314,606**	
TOTAL OPINION OF PROBABLE CLOSURE COST				**$ 411,564,880**	Rough Order of Magniture Cost Estimate
OPINION OF PROBABLE CLOSURE COST PER CY				**$ 31.26**	Based on Volume Placed in landfill
OPINION OF PROBABLE CLOSURE COST PER TON				**$ 26.05**	Based on Moist Unit Weight of 1.2 Tons/CY
OPINION OF PROBABLE CLOSURE COST PER ACRE				**$ 2,212,714**	Based on Estimated Closue Area

ESTIMATED QUANTITIES

Description	Est Quantity	Units
Estimated Landfill Property Area:	103	Acres
Estimated Landfill Development Area (including buffer and borrow area):	213	Acres
Estimated Lined Landfill Area:	93	Acres
Estimated West Ash Basin Closure Area:	186	Acres
Estimated WAB Restoration Area (after ash removal):	186	Acres
Estimated Ash Material Removed/Hauled Volume:	13,167,478	CY
Estimated Ash Material Removed/Hauled Moist Wt:	15,800,974	Tons (bsed on 1.2 Tons/CY Moist Unit Wt)
Estimated Contaminated Soil Removed/Hauled Volume (WAB):	300,080	CY
Estimated Contaminated Soil Removed/Hauled Moist Wt:	450,120	Tons (based on 1.5 Tons/CY Moist Unit Wt)
Total Estimated Ash and Contaminated Soil Removed/Hauled Volume:	13,467,558	CY
Total Estimated Ash and Contaminated Soil Removed/Hauled Moist Wt:	16,251,094	Tons (based on Moist Unit Wt)
Total Estimated Ash and Contaminated Soil Placed in Landfill Volume:	10,774,046	Tons (based on 0.8 x Volume Hauled)

Estimate Notes:

1. This estimate is represented as Rough Order of Magnitude (ROM).

Roxboro WAB Closure Option 2 - Closure by Removal (with Off-Site Landfill at Mayo Plant)

Closure Option Opinion of Probable Cost (ROM)

Duke Energy - Roxboro Steam Station

Person County, NC

	Quantity	Unit	Unit Cost	Total Cost	Estimate Note
PROPERTY ACQUISTION					
Property Acquisition Cost (Landfill)	0	Acres	$3,000	$ -	Best estimate of property values in area from review of tax values and for sale listing for large tracts in Person County.
SUBTOTAL PROPERTY ACQUISTION				$ -	
GENERAL					
Surveying	186	Acres	$ 2,000	$ 372,000	
Abandon WAB Discharge Outlet Structures	1	LS	$ 200,000	$ 200,000	Existing discharge outlet features have already been abandoned. Assume cost for removal and disposal of existing discharge outlet pipe and emergency spillway features at WAB Dike No. 1. In addition, Duke has requested removal of the existing weir structure as part of the WAB closure plan. The existing skimmer structure will remain in place. For estimating purposes, assume 5 person crew x 10 hr/day x $40/hr including OH&profit = $2000/day. Est equipment cost at $6000/day to support work scope. Total est daily rate = . $2000 + $6000 = $8,000. Est 5 wks duration for wors x 5 days/wk x $8000/day = $200,000.
Bridge or Embankment (with culverts) for discharge channel crossing	1	LS	$500,000	$ 500,000	Place holder for cost with no technical basis.
Breaching WAB Main Dam	1	LS	$1,000,000	$ 1,000,000	Place holder for cost with no technical basis. .
SUBTOTALGENERAL				$ 2,072,000	
EROSION/SEDIMENT CONTROL AND STORMWATER MANAGEMENT					
West Ash Basin Sediment Control and Stormwater Management	186	Acres	$14,000.00	$ 2,604,000	Unit Cost based on Amec Foster Wheeler experience and previous closure option cost estimates. Includes silt fence, wattles, surface water diversions, sediment basins, temporary seeding and permanent seeding.
Landfill Area Sediment Control and Stormwater Management	0	Acres	$14,000.00	$ -	Unit Cost based on Amec Foster Wheeler experience and previous closure option cost estimates. Includes silt fence, wattles, surface water diversions, sediment basins, temporary seeding and permanent seeding.
Permanent Surface Stabilization Measures (WAB)	186	Acres	$3,787	$ 704,336	Unit rate obtained from Duke Energy estimate summary data was used for consistency.
SUBTOTAL EROSION/SEDIMENT CONTROL AND STORMWATER MANAGEMENT				$ 3,308,336	
DIKE NO. 1 (FILTER DIKE) SEEPAGE CONTROL MODIFICATION					**Not required for this option**
Excavation of ash within limits of soil fill		CY		$ -	
Foundation excavation and preparation		CY		$ -	
Place graded stone fill against interior slope		CY		$ -	
Place soil fill material		CY		$ -	
Install liner material on interior slope		CY		$ -	
SUBTOTAL DIKE NO. 1 (FILTER DIKE) SEEPAGE CONTROL MODIFICATION				$ -	
WAB SOUTHERN EXTENSION IMPOUNDMENT CLOSURE BY REMOVAL					
Mobilize and stage dredging operations	1	LS	$300,000.00	$ 300,000	
Perform dredging for removal of ash & impacted sediment	201,478	CY	$12.49	$ 2,516,460	
(On-Road) Hauling of Pond Ash and Impacted Soils to Mayo Plant	201,478	CY	$14.50	$ 2,921,431	Unit Cost based on Duke Energy estimate averages was used for consistency.
(Off Road) Hauling of Pond Ash and Impacted Soils (within basin)		CY	$2.00	$ -	Unit Cost based on Duke Energy estimate averages was used for consistency.
Placement of Ash and Impacted Soils In Landfill	201,478	CY	$1.50	$ 302,217	Unit Cost based on Duke Energy estimate averages was used for consistency.
SUBTOTAL WAB SOUTHERN EXTENSION IMPOUNDMENT CLOSURE BY REMOVAL				$ 6,040,108	
EARTHWORK					
Ash Basin Earthwork					
Construction Entrance	1000	LF	$65	$ 65,000	Unit Cost based on Amec Foster Wheeler experience and previous closure option cost estimates.
Clearing and Grubbing	5	Acres	$5,000	$ 25,000	Clear and remove vegetation including trees, brush, schrubs. Unit Cost based on Amec Foster Wheeler experience and previous closure option cost estimates. Increased to $5000/acre from review by NWH.
Topsoil Stripping	5	Acres	$4,000	$ 20,000	Strip topsoil to a minimum 6-inch depth and place in stockpile. Unit Cost based on Amec Foster Wheeler experience and previous closure option cost estimates. Incresed to $4000/acre from review by NWH.
Clearing and Grubbing	5	Acres	$5,000	$ 25,000	Clear and remove vegetation including trees, brush, schrubs. Unit Cost based on Amec Foster Wheeler experience and previous closure option cost estimates. Increased to $5000/acre from review by NWH.
Earthwork Cut to Waste	0	CY	$9.24	$ -	Unit Cost based on Duke Energy estimate averages was used for consistency.
Earthwork Cut to Fill	10,000	CY	$9.24	$ 92,400	Unit Cost based on Duke Energy estimate average was used for consistency.
Soil Fill Material		CY	$13	$ -	Unit Cost based on Duke Energy estimate averages was used for consistency. No change in estimate.
Topsoil Material		CY	$13	$ -	Unit Cost based on Duke Energy estimate averages was used for consistency. No change in estimate.
SUBTOTAL EARTHWORK				$ 227,400	
ASH BASIN DEWATERING, EXCAVATION, HAULING AND PLACEMENT					
Haul Road Construction (1 mile)	6,000	LF	$60	$ 360,000	Amec Foster Wheeler experience based on 12-inch thick ABC and supporting geotextile at 20-foot width. Unit Cost based on Amec Foster Wheeler experience and previous closure option cost estimates.
Removal & Filtration of Free Water	3	Mo	$ 416,667	$ 1,250,001	Est pumping rate = 2500/gpm. Est dewatering volume = 162,000,000 gals. Est pumping duration = 162,000,000 gal/2500 gal/min = 64,000 min/60 x24 = 45 days. Use 3 month duration for estimating purposes. Unit rate obtained from Duke Energy summary data was used for consistency.
Removal & Treatment of Pore Water	120	Mo	$ 583,333	$ 69,999,960	Assume required for duration of construction. Estimated duration 10 years. Unit rate obtained from Duke Energy summary data fo consistency.
Excavation and Loading of Pond Ash for Truck Hauling	10,805,000	CY	$8.43	$ 91,086,150	Unit Cost based on Duke Energy estimate averages was used for consistency.
Excavation and Loading of Subsurface Soils for Truck Hauling	300,080	CY	$10.00	$ 3,000,800	Unit Cost based on Duke Energy estimate averages was used for consistency.
(On-Road) Hauling of Pond Ash and Impacted Soils to Mayo Plant	11,306,558	CY	$14.50	$ 163,945,091	Unit Cost based on Duke Energy estimate averages was used for consistency.
(Off Road) Hauling of Pond Ash and Impacted Soils for On-site Landfill		CY		$ -	
Placement of Pond Ash and Impacted Soils In Landfill	11,306,558	CY	$1.50	$ 16,959,837	Unit Cost based on Duke Energy estimate averages was used for consistency. No change in estimate.
Truck Wash	4	EA	$150,000	$ 600,000	Truck wash necessary to clean tires and undercarriage of trucks for over-the-road hauling. Unit Cost based on Amec Foster Wheeler experience and previous closure option cost estimates.
Bridge Repair and Maintenance	1	LS	$500,000	$ 500,000	Placed holder estimate for potential bridge repair and maintenance cost. NOT VERIFIED.
Paved Haul Road Repair	79,200	LF	$120	$ 9,504,000	Unit Cost based on Amec Foster Wheeler experience and previous closure option cost estimates.
SUBTOTAL ASH BASIN DEWATERING, EXCAVATION, HAULING AND PLACEMENT				$ 357,205,839	
LANDFILL & CLOSE IN PLACE COVER CONSTRUCTION					
Landfill Development Cost					
Landfill Construction	103	Acres	$400,000	$ 41,200,000	Unit Cost based on Duke Energy estimate averages was used for consistency. No change in estimate.
Landfill Closure	103	Acres	$150,000	$ 15,450,000	Unit Cost based on Duke Energy estimate averages was used for consistency. No change in estimate.
Close in Place Option Cover System Construction					
Subgrade Preparation		Acres	$5,000.00	$ -	Grade surface of subbase prior to installation of final cover system. Unit costs from construction contractor
Anchor Trench		LF	$6.00	$ -	Furnish and install geotextile as a cushion layer. Unit costs from Glover; costs typically include material, QC testing, and installation
8 oz/sy Non-Woven Geotextile		SY	3.00	$ -	Furnish and install geotextile as a cushion layer. Unit costs from Glover; costs typically include material, QC testing, and installation
Cover System Geosynthetics (40-mil LLDPE Geomembrane and Geocomposite Drainage Layer		SF	$1.02	$ -	Unit Cost based on Duke Energy estimate averages was used for consistency. Includes $0.42/sf for liner and $0.60/sf for GCL layer ($1.02/sf total)
Cover System 18" Soil Cover		CY	$13	$ -	Unit Cost based on Duke Energy estimate averages was used for consistency. No change in estimate.

Roxboro WAB Closure Option 2 - Closure by Removal (with Off-Site Landfill at Mayo Plant)

Closure Option Opinion of Probable Cost (ROM)

Duke Energy - Roxboro Steam Station

Person County, NC

	Quantity	Unit	Unit Cost	Total Cost	Estimate Note
Cover System Top Soil Placement		CY	$13	$ -	Unit Cost based on Duke Energy estimate averages was used for consistency. No change in estimate.
SUBTOTAL LANDFILL & CLOSE IN PLACE COVER CONSTRUCTION				**$ 56,650,000**	
SUBTOTAL FINAL CLOSURE CONSTRUCTION COST				**$ 425,503,683**	
MOBILIZATION COST				**$ 4,255,037**	Estimate at 1% of Final Closure Construction Cost
TOTAL CLOSURE CONSTRUCTION COST (WITH MOBILIZATION)				**$ 429,758,720**	
OTHER COST					
Design, Permitting and CQA					
Closure Design/Engineering/Permitting (5% of Total Closure Construction Cost)	1	LS	$ 21,487,936	$ 21,487,936	Revised to 5%
Construction Quality Assurance (CQA) (5% of Total Closure Construction Cost)	1	LS	$ 21,487,936	$ 21,487,936	Revised to 5%
Subtotal Design, Permitting and CQA				**$ 42,975,872**	
Post Closure Operations and Maintenance (analysis based on 30 year duration)					
Close in Place (Capped) Area Maintenance	0	YR	$ -	$ -	Unit Cost based on Duke Energy estimate averages was used for consistency. Estimate $3,475.80/ac/year.
Close in Place (Capped) Area Monitoring	0	YR		$ -	Not included in estimate per Duke Energy direction.
Landfill Area Maintenance (103 acres)	30	YR	$ 358,007	$ 10,740,222	Unit Cost based on Duke Energy estimate averages was used for consistency. Estimate $3,475.80/ac/year.
Landfill Area Monitoring	0	YR		$ -	Not included in estimate per Duke Energy direction.
Subtotal Post Closure Operations and Maintenance				**$ 10,740,222**	
Additional Costs					
Contingency (15% of Total Closure Construction Cost)	1	LS	$ 64,463,808	$ 64,463,808	Amec Foster Wheeler experience from previous projects
Subtotal Additional Costs				**$ 64,463,808**	
TOTAL OPINION OF PROBABLE CLOSURE COST				**$ 547,938,621**	Rough Order of Magniture Cost Estimate
OPINION OF PROBABLE CLOSURE COST PER CY				**$ 50.71**	Based on Volume Placed in landfill
OPINION OF PROBABLE CLOSURE COST PER TON				**$ 42.26**	Based on Moist Unit Weight of 1.2 Tons/CY
OPINION OF PROBABLE CLOSURE COST PER ACRE				**$ 2,945,907**	Based on Estimated Closue Area

ESTIMATED QUANTITIES

Description	Est Quantity	Units
Estimated Lined Landfill Area:	103	Acres
Estimated West Ash Basin Closure Area:	186	Acres
Estimated WAB Restoration Area (after ash removal):	186	Acres
Estimated Ash Material Removed/Hauled Volume (WAB):	10,805,000	CY Revised 10/1/18
Estimated Ash Material Removed/Hauled Moist Wt (WAB):	12,966,000	Tons (based on 1.2 Tons/CY Moist Unit Wt) Revised 10/1/18
Estimated Ash/Sediment Material Removed/Hauled Volume (SEI):	201,478	CY
Estimated Ash/Sediment Material Removed/Hauled Moist Wt (SEI):	241,774	Tons (based on 1.2 Tons/CY Moist Unit Wt)
Estimated Contaminated Soil Removed/Hauled Volume (WAB):	300,080	CY
Estimated Contaminated Soil Removed/Hauled Volume (Disch Channel):	0	CY
Estimated Contaminated Soil Removed/Hauled Moist Wt:	450,120	Tons (based on 1.5 Tons/CY Moist Unit Wt)
Total Estimated Ash and Contaminated Soil Removed/Hauled Volume:	11,306,558	CY
Total Estimated Ash and Contaminated Soil Removed/Hauled Moist Wt:	13,657,894	Tons (based on Moist Unit Wt)
Total Estimated Ash and Contaminated Soil Placed in Landfill Volume:	9,045,246	Tons (based on 0.8 x Volume Hauled)

Estimate Notes:

1. This estimate is represented as Rough Order of Magnitude (ROM).

Roxboro WAB Closure Option 4 - Close in Place Hybrid (CAP Concept)

Closure Option Opinion of Probable Cost (ROM)

Duke Energy - Roxboro Steam Station

Person County, NC

	Quantity	Unit	Unit Cost	Total Cost	Estimate Note
PROPERTY ACQUISTION					
Property Acquition Cost		Acres	$3,000	$ -	Best estimate of property values in area from review of tax values and for sale listing for large tracts in Person County. NOT VERIFIED.
			SUBTOTAL PROPERTY ACQUISTION	$ -	
GENERAL					
Mobilization	1	LS		$ -	Estimate at 5% of Final Closure Construction Cost (see below)
Surveying	186	Acres	$ 2,000	$ 372,000	
Abandon WAB Discharge Outlet Structures	1	LS	$ 200,000	$ 200,000	Existing discharge outlet features have already been abandoned. Assume cost for removal and disposal of existing discharge outlet pipe and emergency spillway features at WAB Dike No. 1. In addition, Duke has requested removal of the existing weir structure as part of the WAB closure plan. The existing skimmer structure will remain in place. For estimating purposes, assume 5 person crew x 10 hr/day x $40/hr including OH&profit = $2000/day. Est equipment cost at $6000/day to support work scope. Total est daily rate = . $2000 + $6000 = $8,000. Est 5 wks duration for wors x 5 days/wk x $8000/day = $200,000.
Bridge or Embankment (with culverts) for discharge channel crossing	1	LS	$500,000	$ 500,000	Place holder for cost with no technical basis.
Breaching WAB Main Dam	1	LS	$1,000,000	$ 1,000,000	Place holder for cost with no technical basis. .
Breaching WAB Dike No. 1	1	LS	$500,000	$ 500,000	Place holder for cost with no technical basis. .
			SUBTOTALGENERAL	$ 2,572,000	
EROSION/SEDIMENT CONTROL AND STORMWATER MANAGEMENT					
West Ash Basin Sediment Control and Stormwater Management	186	Acres	$14,000.00	$ 2,604,000	Unit Cost based on Amec Foster Wheeler experience and previous closure option cost estimates. Includes silt fence, wattles, surface water diversions, sediment basins, temporary seeding and permanent seeding.
Permanent Surface Stabilization Measures	186	Acres	$3,787	$ 704,336	Unit rate obtained from Duke Energy summary data was used for consistency.
Permanent Riprap Stormwater Channels	10,000	LF	$56	$ 555,600	Unit rate obtained from Duke Energy summary data was used for consistency. Est 10' wide x 1.5' depth = 15 cf/ft length/27 cf/cy = .56 cy/ft length. .56 cy/ft x 2 tons/cy = 1.1 tons/ft length. Est $50/ton x 1.1 ton/ft = $55.56/lf.
Permanent Discharge Outlet Structure (Main Dam)	1	LS	$500,000	$ 500,000	Place holder for cost.
			SUBTOTAL EROSION/SEDIMENT CONTROL AND STORMWATER MANAGEMENT	$ 4,363,936	
DIKE NO. 1 (FILTER DIKE) SEEPAGE CONTROL MODIFICATION					**Assume required for this option. For this option, WAB Dike No. 1 will be modified to effectively control seepage by placement of a soil fill buttress on the interior slope of the dike. In addition, Duke Energy has requested that a liner be placed on the slope of the proposed buttress berm.**
Excavation of ash within limits of soil fill	50,000	CY	$8.43	$ 421,500	Estimate 100' wide x 15' deep avg x 900' length/27 = 50,000 cy
Foundation excavation and preparation	8,333	CY	$9.24	$ 76,997	Estimate 50' wide x 5' deep x 900'/27 = 8333 cy
Place graded stone fill against interior slope	3,333	CY	$13	$ 43,329	Estimate 2' stone fill depth x 50' slope length x 900'/27 = 3333 cy
Place soil fill material	21,333	CY	$13	$ 277,329	Estimate (30' +2')/2 x 40' x 900'/27 = 21,333 cy
Install liner material on interior slope	45,000	SF	$1.02	$ 45,900	Estimate 40' avg slope length x 900' = 45,000 sf
			SUBTOTAL DIKE NO. 1 (FILTER DIKE) SEEPAGE CONTROL MODIFICATION	$ 865,055	
WAB SOUTHERN EXTENSION IMPOUNDMENT CLOSURE BY REMOVAL					
Mobilize and stage dredging operations	1	LS	$300,000.00	$ 300,000	
Perform dredging for removal of ash & impacted sediment	201,478	CY	$25.00	$ 5,036,950	
Excavation and Loading of Pond Ash for Truck Hauling	175,853	CY	$8.43	$ 1,482,441	Unit Cost based on Duke Energy estimate averages was used for consistency. Assume loading/hauling required to support site grading.
(Off Road) Hauling of Pond Ash and Impacted Soils (within basin)	175,853	CY	$2.05	$ 360,499	Unit Cost based on Duke Energy estimate averages was used for consistency. Assume loading/hauling required to support site grading.
Placement of Pond Ash and Impacted Soils	175,853	CY	$9.24	$ 1,624,882	For this option, assume placement similar to landfill for cost estimating. Loading & hauling estimate provided separately. Unit Cost based on Duke Energy estimate averages used for consistency. Use cut to fill unit cost for estimating purposes.
			SUBTOTAL WAB SOUTHERN EXTENSION IMPOUNDMENT CLOSURE BY REMOVAL	$ 5,336,950	
EARTHWORK					
Ash Basin Earthwork					
Construction Entrance	1000	LF	$65	$ 65,000	Unit Cost based on Amec Foster Wheeler experience and previous closure option cost estimates.
Clearing and Grubbing	5	Acres	$5,000	$ 25,000	Clear and remove vegetation including trees, brush, schrubs. Unit Cost based on Amec Foster Wheeler experience and previous closure option cost estimates. Increased to $5000/acre from review by NWH.
Topsoil Stripping	5	Acres	$4,000	$ 20,000	Strip topsoil to a minimum 6-inch depth and place in stockpile. Unit Cost based on Amec Foster Wheeler experience and previous closure option cost estimates. Increased to $4000/acre from review by NWH.
Earthwork Cut to Waste	0	CY	$9.24	$ -	Unit Cost based on Duke Energy estimate averages was used for consistency.
Earthwork Cut to Fill (for grading and placement for drainage channel)	534,539	CY	$9.24	$ 4,939,140	Unit Cost based on Duke Energy estimate average was used for consistency.
Soil Material (fill required for drainage channel)	534,539	CY	$13	$ 6,949,007	Unit Cost based on Duke Energy estimate averages was used for consistency. No change in estimate.
Topsoil Material; if required (6-inch thick un-compacted fill, source material off-site)		CY	$13	$ -	Unit Cost based on Duke Energy estimate averages was used for consistency. No change in estimate.
			SUBTOTAL EARTHWORK	$ 11,998,147	
ASH BASIN DEWATERING, EXCAVATION, HAULING AND PLACEMENT					
Haul Road Construction (1 mile)	6,000	LF	$60	$ 360,000	Amec Foster Wheeler experience based on 12-inch thick ABC and supporting geotextile at 20-foot width. Unit Cost based on Amec Foster Wheeler experience and previous closure option cost estimates.
Removal & Filtration of Free Water	3	Mo	$ 416,667	$ 1,250,001	Est pumping rate = 2500/gpm. Est dewatering volume = 162,000,000 gals. Est pumping duration = 162,000,000 gal/2500 gal/min = 64,000 min/60 x24 = 45 days. Use 3 month duration for estimating purposes. Unit rate obtained from Duke Energy summary data was used for consistency.
Removal & Treatment of Pore Water	32	Mo	$ 583,333	$ 18,899,989	Assume required for duration of construction for this option because of excavation requirements.. Estimated duration 2.7 years. Unit rate obtained from Duke Energy summary data fo consistency.
Excavation and Loading of Pond Ash for Truck Hauling	5,140,645	CY	$8.43	$ 43,335,637	Unit Cost based on Duke Energy estimate averages was used for consistency. Assume loading/hauling required to support site grading.
Excavation and Loading of Subsurface Soils for Truck Hauling	261,708	CY	$10.00	$ 2,617,080	Unit Cost based on Duke Energy estimate averages was used for consistency. Assume loading/hauling required to support site grading.
(On-Road) Hauling of Pond Ash and Impacted Soils for Off-site Landfill		CY		$ -	
(Off Road) Hauling of Pond Ash and Impacted Soils for On-site Landfill (within basin closure area)	5,603,831	CY	$2.00	$ 11,207,662	Unit Cost based on Duke Energy estimate averages was used for consistency. Assume loading/hauling required to support site grading.
Placement of Pond Ash and Impacted Soils	5,603,831	CY	$9.24	$ 51,779,398	For this option, assume placement similar to landfill for cost estimating. Loading & hauling estimate provided separately. Unit Cost based on Duke Energy estimate averages was used for consistency. Use cut to fill unit cost for estimating purposes.
Truck Wash	4	EA	$150,000	$ 600,000	Truck wash necessary to clean tires and undercarriage of trucks for over-the-road hauling. Unit Cost based on Amec Foster Wheeler experience and previous closure option cost estimates.
Bridge Repair and Maintenance	0	LS	$500,000	$ -	Placed holder estimate for potential bridge repair and maintenance cost. NOT VERIFIED.
Paved Haul Road Repair	1,000	LF	$120	$ 120,000	Unit Cost based on Amec Foster Wheeler experience and previous closure option cost estimates.
			SUBTOTAL ASH BASIN DEWATERING, EXCAVATION, HAULING AND PLACEMENT	$ 130,169,768	
CLOSE IN PLACE COVER CONSTRUCTION					
Close in Place Option Cover System Construction					
Subgrade Preparation	77	Acres	$5,000.00	$ 385,000	Grade surface of subbase prior to installation of final cover system. Unit costs from construction contractor
Anchor Trench	9,000	LF	$6.00	$ 54,000	Furnish and install geotextile as a cushion layer. Unit costs from Glover; costs typically include material, QC testing, and installation
Geosynthetic Clay Liner (GCL) - Not required	0	SF	$0.73	$ -	Furnish and install geotextile as a cushion layer. Unit costs from Glover; costs typically include material, QC testing, and installation
8 oz/sy Non-Woven Geotextile	372,680	SY	3.00	$ 1,118,040	Furnish and install geotextile as a cushion layer. Unit costs from Glover; costs typically include material, QC testing, and installation
Cover System Geosynthetics (40-mil LLDPE Geomembrane and Geocomposite Drainage Layer	3,354,120	SF	$1.02	$ 3,421,202	Unit Cost based on Duke Energy estimate averages was used for consistency. Includes $0.42/sf for liner and $0.60/sf for GCL layer ($1.02/sf total)
Cover System 18" Soil Cover	186,340	CY	$13	$ 2,422,420	Unit Cost based on Duke Energy estimate averages was used for consistency. No change in estimate.

Roxboro WAB Closure Option 4 - Close in Place Hybrid (CAP Concept)

Closure Option Opinion of Probable Cost (ROM)

Duke Energy - Roxboro Steam Station

Person County, NC

	Quantity	Unit	Unit Cost	Total Cost	Estimate Note
Cover System Top Soil Placement	62,113	CY	$13	$ 807,473	Unit Cost based on Duke Energy estimate averages was used for consistency. No change in estimate.
SUBTOTAL COVER SYSTEM CONSTRUCTION				**$ 8,208,136**	
SUBTOTAL CLOSURE CONSTRUCTION COST				**$ 163,513,992**	
MOBILIZATION COST				**$ 1,635,140**	Estimate at 1% of Final Closure Construction Cost
TOTAL CLOSURE CONSTRUCTION COST (WITH MOBILIZATION)				**$ 165,149,131**	
OTHER COST					
Design, Permitting and CQA					
Closure Design/Engineering/Permitting (5% of Total Closure Construction Cost)	1	LS	$ 8,257,457	$ 8,257,457	Revised to 5%
Construction Quality Assurance (CQA) (5% of Total Closure Construction Cost)	1	LS	$ 8,257,457	$ 8,257,457	Revised to 5%
Subtotal Design, Permitting and CQA				**$ 16,514,913**	
Post Closure Operations and Maintenance (analysis based on 30 year duration)					
Close in Place (Capped) Area Maintenance (77 acres)	30	YR	$ 267,637	$ 8,029,098	Unit Cost based on Duke Energy estimate averages was used for consistency. Estimate $3,475.80/ac/year.
Close in Place (Capped) Area Monitoring	0	YR		$ -	Not included in estimate per Duke Energy direction.
Landfill Area Maintenance	0	YR	$ -	$ -	Unit Cost based on Duke Energy estimate averages was used for consistency. Estimate $3,475.80/ac/year.
Landfill Area Monitoring	0	YR		$ -	Not included in estimate per Duke Energy direction.
Subtotal Post Closure Operations and Maintenance				**$ 8,029,098**	
Additional Costs					
Contingency (15% of Final Closure Construction Costs)	1	LS	$ 24,527,099	$ 24,527,099	Amec Foster Wheeler experience from previous projects
Subtotal Additional Costs				**$ 24,527,099**	
TOTAL OPINION OF PROBABLE CLOSURE COST				**$ 214,220,241**	Rough Order of Magniture Cost Estimate
OPINION OF PROBABLE CLOSURE COST PER CY				**$ 41.67**	Based on Volume Placed in landfill
OPINION OF PROBABLE CLOSURE COST PER TON				**$ 34.73**	Based on Moist Unit Weight of 1.2 Tons/CY
OPINION OF PROBABLE CLOSURE COST PER ACRE				**$ 1,151,722**	Based on Estimated Closue Area

ESTIMATED QUANTITIES

Description	Est Quantity	Units
Estimated Lined Landfill Area:	0	Acres
Estimated West Ash Basin Closure Area:	186	Acres
Estimated WAB Restoration Area (after ash removal):	109	Acres
Estimated Close in Place Area:	77	Acres
Estimated Ash Material Removed/Hauled Volume (WAB):	5,140,645	CY
Estimated Ash Material Removed/Hauled Moist Wt (WAB):	6,168,774	Tons (bsed on 1.2 Tons/CY Moist Unit Wt)
Estimated Ash/Sediment Material Removed/Hauled Volume (SEI):	201,478	CY
Estimated Ash/Sediment Material Removed/Hauled Moist Wt (SEI):	241,774	Tons (bsed on 1.2 Tons/CY Moist Unit Wt)
Estimated Contaminated Soil Removed/Hauled Volume (WAB):	175,853	CY
Estimated Contaminated Soil Removed/Hauled Volume (Disch Channel):	85,855	CY
Estimated Contaminated Soil Removed/Hauled Moist Wt:	392,562	Tons (based on 1.5 Tons/CY Moist Unit Wt)
Total Estimated Ash and Contaminated Soil Removed/Hauled Volume:	5,603,831	CY
Total Estimated Ash and Contaminated Soil Removed/Hauled Moist Wt:	6,803,110	Tons (based on Moist Unit Wt)

Estimate Notes:

1. This estimate is represented as Rough Order of Magnitude (ROM).

Roxboro WAB Closure Option 5 - Close in Place (Minimum Excavation)

Closure Option Opinion of Probable Cost (ROM)

Duke Energy - Roxboro Steam Station

Person County, NC

	Quantity	Unit	Unit Cost	Total Cost	Estimate Note
PROPERTY ACQUISTION					
Property Acquition Cost		Acres	$3,000	$ -	Best estimate of property values in area from review of tax values and for sale listing for large tracts in Person County. NOT VERIFIED.
SUBTOTAL PROPERTY ACQUISTION				$ -	
GENERAL					
Mobilization	1	LS		$ -	Estimate at 5% of Final Closure Construction Cost (see below)
Surveying	186	Acres	$ 2,000	$ 372,000	
Bridge or Embankment (with culverts) for discharge channel crossing	1	LS	$500,000	$ 500,000	Place holder for cost with no technical basis.
Breaching WAB Main Dam	1	LS	$1,000,000	$ 1,000,000	Place holder for cost with no technical basis. .
Abandon WAB Discharge Outlet Structures	2	EA	$ 150,000	$ 300,000	Estimate at $150k/riser
Breaching WAP Dike No. 1	1	LS	$500,000	$ 500,000	Place holder for cost with no technical basis. NOT VERIFIED…..
SUBTOTALGENERAL				$ 2,672,000	
EROSION/SEDIMENT CONTROL AND STORMWATER MANAGEMENT					
West Ash Basin Sediment Control and Stormwater Management	186	Acres	$14,000.00	$ 2,604,000	Unit Cost based on Amec Foster Wheeler experience and previous closure option cost estimates. Includes silt fence, wattles, surface water diversions, sediment basins, temporary seeding and permanent seeding.
Permanent Drainage and Surface Stabilization Measures	186	Acres	$3,787	$ 704,336	Unit rate obtained from Duke Energy summary data was used for consistency.
Permanent Riprap Stormwater Channels	10,000	LF	$56	$ 555,600	Unit rate obtained from Duke Energy summary data was used for consistency. Est 10' wide x 1.5' depth = 15 cf/ft length/27 cf/cy = .56 cy/ft length. .56 cy/ft x 2 tons/cy = 1.1 tons/ft length. Est $50/ton x 1.1 ton/ft = $55.56/lf.
Permanent Discharge Outlet Structure (Main Dam)	1	LS	$500,000	$ 500,000	Place holder for cost.
SUBTOTAL EROSION/SEDIMENT CONTROL AND STORMWATER MANAGEMENT				$ 4,363,936	
DIKE NO. 1 (FILTER DIKE) SEEPAGE CONTROL MODIFICATION					**Assume required for this option. For this option, WAB Dike No. 1 will be modified to effectively control seepage by placement of a soil fill buttress on the interior slope of the dike. In addition, Duke Energy has requested that a liner be placed on the slope of the proposed buttress berm.**
Excavation of ash within limits of soil fill	50,000	CY	$8.43	$ 421,500	Estimate 100' wide x 15' deep avg x 900' length/27 = 50,000 cy
Foundation excavation and preparation	8,333	CY	$9.24	$ 76,997	Estimate 50' wide x 5' deep x 900'/27 = 8333 cy
Place graded stone fill against interior slope	3,333	CY	$13	$ 43,329	Estimate 2' stone fill depth x 50' slope length x 900'/27 = 3333 cy
Place soil fill material	21,333	CY	$13	$ 277,329	Estimate (30' +2')/2 x 40' x 900'/27 = 21,333 cy
Install liner material on interior slope	45,000	SF	$1.02	$ 45,900	Estimate 40' avg slope length x 900' = 45,000 sf
SUBTOTAL DIKE NO. 1 (FILTER DIKE) SEEPAGE CONTROL MODIFICATION				$ 865,055	
WAB SOUTHERN EXTENSION IMPOUNDMENT CLOSURE BY REMOVAL					
Mobilize and stage dredging operations	1	LS	$300,000.00	$ 300,000	
Perform dredging for removal of ash & impacted sediment	201,478	CY	$25.00	$ 5,036,950	
Excavation and Loading of Pond Ash for Truck Hauling	201,478	CY	$8.43	$ 1,698,460	Unit Cost based on Duke Energy estimate averages was used for consistency. Assume loading/hauling required to support site grading.
(Off Road) Hauling of Pond Ash and Impacted Soils (within basin)	201,478	CY	$2.05	$ 413,030	
Placement of Pond Ash and Impacted Soils	201,478	CY	$9.24	$ 1,861,657	For this option, assume placement similar to landfill for cost estimating. Loading & hauling estimate provided separately. Unit Cost based on Duke Energy estimate averages used for consistency. Use cut to fill unit cost for estimating purposes.
SUBTOTAL WAB SOUTHERN EXTENSION IMPOUNDMENT CLOSURE BY REMOVAL				$ 5,336,950	
EARTHWORK					
Ash Basin Earthwork					
Construction Entrance	1000	LF	$65	$ 65,000	Unit Cost based on Amec Foster Wheeler experience and previous closure option cost estimates.
Clearing and Grubbing	5	Acres	$5,000	$ 25,000	Clear and remove vegetation including trees, brush, schrubs. Unit Cost based on Amec Foster Wheeler experience and previous closure option cost estimates. Increased to $5000/acre from review by NWH.
Topsoil Stripping	5	Acres	$4,000	$ 20,000	Strip topsoil to a minimum 6-inch depth and place in stockpile. Unit Cost based on Amec Foster Wheeler experience and previous closure option cost estimates. Increased to $4000/acre from review by NWH.
Earthwork Cut to Waste	0	CY	$9.24	$ -	Unit Cost based on Duke Energy estimate averages was used for consistency.
Earthwork Cut to Fill		CY	$9.24	$ -	Unit Cost based on Duke Energy estimate averages was used for consistency.
Soil Material (18 inches, minimum, source material on-site)		CY	$13	$ -	Unit Cost based on Duke Energy estimate averages was used for consistency.
Topsoil Material; if required (6-inch thick un-compacted fill, source material off-site)		CY	$13	$ -	Unit Cost based on Duke Energy estimate averages was used for consistency.
SUBTOTAL EARTHWORK				$ 110,000	
ASH BASIN DEWATERING, EXCAVATION, HAULING AND PLACEMENT					
Haul Road Construction	6,000	LF	$60	$ 360,000	Amec Foster Wheeler experience based on 12-inch thick ABC and supporting geotextile at 20-foot width. Unit Cost based on Amec Foster Wheeler experience and previous closure option cost estimates.
Removal & Filtration of Free Water (Initial Dewatering)	3	Mo	$ 416,667	$ 1,250,001	Est pumping rate = 2500/gpm. Est dewatering volume = 162,000,000 gals. Est pumping duration = 162,000,000 gal/2500 gal/min = 64,000 min/60 x24 = 45 days. Use 3 month duration for estimating purposes. Unit rate obtained from Duke Energy summary data fo consistency.
Removal & Treatment of Pore Water	0	Mo	$ 583,333	$ -	Assume not required for In-place closure option.
Excavation and Loading of Pond Ash for Truck Hauling	1,314,364	CY	$8.43	$ 11,080,089	Unit Cost based on Duke Energy estimate averages was used for consistency. Assume loading/hauling required to support site grading.
Excavation and Loading of Subsurface Soils for Truck Hauling	0	CY	$10.00	$ -	Unit Cost based on Duke Energy estimate averages was used for consistency. Assume loading/hauling required to support site grading.
(On-Road) Hauling of Pond Ash and Impacted Soils for Off-site Landfill __ miles		CY		$ -	
(Off Road) Hauling of Pond Ash and Impacted Soils (within basin closure area)	1,314,364	CY	$2.00	$ 2,628,728	Unit Cost based on Duke Energy estimate averages was used for consistency. Assume loading/hauling required to support site grading.
Placement of Pond Ash and Impacted Soils	1,314,364	CY	$9.24	$ 12,144,723	For this option, assume placement similar to landfill for cost estimating. Loading & hauling estimate provided separately. Unit Cost based on Duke Energy estimate averages was used for consistency. Use cut to fill unit cost for estimating purposes.
Truck Wash	4	EA	$150,000	$ 600,000	Truck wash necessary to clean tires and undercarriage of trucks for over-the-road hauling. Unit Cost based on Amec Foster Wheeler experience and previous closure option cost estimates.
Bridge Repair and Maintenance	0	LS	$500,000	$ -	Placed holder estimate for potential bridge repair and maintenance cost. NOT VERIFIED.
Paved Haul Road Repair	0	LF	$120	$ -	Unit Cost based on Amec Foster Wheeler experience and previous closure option cost estimates.
SUBTOTAL ASH BASIN DEWATERING, EXCAVATION, HAULING AND PLACEMENT				$ 28,063,541	
CLOSE IN PLACE COVER CONSTRUCTION					
Close in Place Option Cover System Construction					
Subgrade Preparation	186	Acres	$5,000.00	$ 930,000	Grade surface of subbase prior to installation of final cover system. Unit costs from construction contractor
Anchor Trench	9,000	LF	$6.00	$ 54,000	Furnish and install geotextile as a cushion layer. Unit costs from Glover; costs typically include material, QC testing, and installation
Geosynthetic Clay Liner (GCL) - Not required	0	SF	$0.73	$ -	Furnish and install geotextile as a cushion layer. Unit costs from Glover; costs typically include material, QC testing, and installation
8 oz/sy Non-Woven Geotextile	900,240	SY	3.00	$ 2,700,720	Furnish and install geotextile as a cushion layer. Unit costs from Glover; costs typically include material, QC testing, and installation
Cover System Geosynthetics (40-mil LLDPE Geomembrane and Geocomposite Drainage Layer	8,102,160	SF	$1.02	$ 8,264,203	Unit Cost based on Duke Energy estimate averages was used for consistency. Includes $0.42/sf for liner and $0.60/sf for GCL layer ($1.02/sf total)
Cover System 18" Soil Cover	450,120	CY	$13	$ 5,851,560	Unit Cost based on Duke Energy estimate averages was used for consistency. No change in estimate.
Cover System Top Soil Placement	150,040	CY	$13	$ 1,950,520	Unit Cost based on Duke Energy estimate averages was used for consistency. No change in estimate.

Roxboro WAB Closure Option 5 - Close in Place (Minimum Excavation)

Closure Option Opinion of Probable Cost (ROM)

Duke Energy - Roxboro Steam Station

Person County, NC

	Quantity	Unit	Unit Cost	Total Cost	Estimate Note
SUBTOTAL COVER SYSTEM CONSTRUCTION				**$ 19,751,003**	
SUBTOTAL CLOSURE CONSTRUCTION COST				**$ 61,162,485**	
MOBILIZATION COST				**$ 611,625**	Estimate at 1% of Final Closure Construction Cost
TOTAL CLOSURE CONSTRUCTION COST (WITH MOBILIZATION)				**$ 61,774,109**	
OTHER COST					
Design, Permitting and CQA					
Closure Design/Engineering/Permitting (5% of Total Closure Construction Cost)	1	LS	$ 3,088,705	$ 3,088,705	Revised to 5%
Construction Quality Assurance (CQA) (5% of Total Closure Construction Cost)	1	LS	$ 3,088,705	$ 3,088,705	Revised to 5%
Subtotal Design, Permitting and CQA				**$ 6,177,411**	
Post Closure Operations and Maintenance (analysis based on 30 year duration)					
Close in Place (Capped) Area Maintenance (186 acres)	30	YR	$ 646,499	$ 19,394,964	Unit Cost based on Duke Energy estimate averages was used for consistency. Estimate $3,475.80/ac/year.
Close in Place (Capped) Area Monitoring	0	YR		$ -	Not included in estimate per Duke Energy direction.
Landfill Area Maintenance	0	YR	$ -	$ -	Unit Cost based on Duke Energy estimate averages was used for consistency. Estimate $3,475.80/ac/year.
Landfill Area Monitoring	0	YR		$ -	Not included in estimate per Duke Energy direction.
Subtotal Post Closure Operations and Maintenance				**$ 19,394,964**	
Additional Costs					
Contingency (15% of Final Closure Construction Costs)	1	LS	$ 9,266,116	$ 9,266,116	Amec Foster Wheeler experience from previous projects
Subtotal Additional Costs				**$ 9,266,116**	
TOTAL OPINION OF PROBABLE CLOSURE COST				**$ 96,612,601**	Rough Order of Magniture Cost Estimate
OPINION OF PROBABLE CLOSURE COST PER CY				**$ 73.51**	Based on Volume Placed in landfill
OPINION OF PROBABLE CLOSURE COST PER TON				**$ 61.25**	Based on Moist Unit Weight of 1.2 Tons/CY
OPINION OF PROBABLE CLOSURE COST PER ACRE				**$ 519,423**	Based on Estimated Closue Area

ESTIMATED QUANTITIES

Description	Est Quantity	Units
Estimated Lined Landfill Area:	0	Acres
Estimated West Ash Basin Closure Area:	186	Acres
Estimated WAB Restoration Area (after ash removal):	0	Acres
Estimated Close in Place Area	186	Acres
Estimated Ash Material Removed/Hauled Volume (WAB):	1,314,364	CY
Estimated Ash Material Removed/Hauled Moist Wt (WAB):	1,577,237	Tons (bsed on 1.2 Tons/CY Moist Unit Wt)
Estimated Ash/Sediment Material Removed/Hauled Volume (SEI):	201,478	CY
Estimated Ash/Sediment Material Removed/Hauled Moist Wt (SEI):	241,774	Tons (bsed on 1.2 Tons/CY Moist Unit Wt)
Estimated Contaminated Soil Removed/Hauled Volume (WAB):	0	CY
Estimated Contaminated Soil Removed/Hauled Moist Wt:	0	Tons (based on 1.5 Tons/CY Moist Unit Wt)
Total Estimated Ash and Contaminated Soil Removed/Hauled Volume:	1,515,842	CY
Total Estimated Ash and Contaminated Soil Removed/Hauled Moist Wt:	1,819,010	Tons (based on Moist Unit Wt)

1. This estimate is represented as Rough Order of Magnitude (ROM).

Attachment C - Closure Options Evaluation Scoring Matrix

Scoring for Evaluation of Closure Options
Closure Options Evaluation Worksheet
Roxboro Ash Basin Closure Project - Roxboro West Ash Basin (WAB)
Duke Energy

Site Name: Roxboro Station

1	= Option-Specific User Input
1	= Calculated Value

Placeholder values have been entered in "User Input" cells to prevent division by zero error text in calculated score cells.

Threshold Criteria: All closure options must comply with the following threshold criteria based on Duke Energy Guiding Principals for Ash Basin Closure
1. Provide continued geotechnical stability meeting appropriate safety factors under applicable loading conditions
2. Provide flow capacity and erosion resistance during design storm and flooding conditions
3. Effectively mitigate groundwater impacts (in conjunction with GW remediation where present)
4. Comply with applicable state and federal regulations (e.g. North Carolina Coal Ash Management Act)

Option	Description	Revision Notes
1	WAB Option 1 - Closure by Removal (with On-site Landfill)	
2	WAB Option 2 - Closure by Removal (to Mayo Landfill)	
3	WAB Option 3 - Closure by Removal (with EAB Landfill Phases 7-9)	
4	WAB Option 4 - Close in Place Hybrid Option (Partial Removal and Capping)	
5	WAB Option 5 - Close in Place Option (with Minimum Excavation)	
6	WAB Option 6 - Hybrid Closure (Combination of Close in Place/Landfill)	

Not carried through for further consideration

Environmental Protection and Impacts	Weight:	30%						Value that Scores 10	Value that Scores 0					Criterion Weight	Contribution to Total Score
Criterion	Scoring System	Required Input	Units	Option 1	Option 2	Option 4	Option 5			Option 1	Option 2	Option 4	Option 5		
Modeled Plume Intersecting Surface Water	Refer to EM Sub-Scoring Sheet	This Area Not Used For Interpretation of Environmental Modeling Results								10	10	10	10	24%	7.20%
Groundwater Impact Beyond the current Compliance Boundary	Refer to EM Sub-Scoring Sheet	This Area Not Used For Interpretation of Environmental Modeling Results								10	10	10	10	24%	7.20%
Modeled Off-site Impact	Refer to EM Sub-Scoring Sheet	This Area Not Used For Interpretation of Environmental Modeling Results								10	10	10	10	24%	7.20%
Rank per relative environmental impact to groundwater	Refer to EM Sub-Scoring Sheet	This Area Not Used For Interpretation of Environmental Modeling Results								10	10	5	0	13%	3.90%
Air emissions off-site (based on miles driven)	Interpolation. Zero miles scores 10.	Truck miles driven	Miles	883,052	20,699,857	1,174,459	900,240	883,052	20,699,857	10	0	10	10	5%	1.50%
Air emissions on-site from closure implementation (based on miles driven)	Interpolation. Zero gallons scores 10.	Truck miles driven	Miles	887,756	0	315,513	86,620	0	887,756	0	10	6	9	5%	1.50%
Avoidance of greenfield disturbance	Interpolation. Zero acres scores 10.	Disturbed acres of greenfield	Acres	106	117	32	25	25	117	1	0	9	10	5%	1.50%
Weighted Totals (Contribution to Total Score)										**2.7**	**2.7**	**2.7**	**2.6**	100%	30.00%

Cost	Weight:	35%						Value that Scores 10	Value that Scores 0					Criterion Weight	Contribution to Total Score
Criterion	Scoring System	Required Input	Units	Option 1	Option 2	Option 4	Option 5			Option 1	Option 2	Option 4	Option 5		
Closure Cost	Interpolation. Min value scores 10. Max value scores 0.	Closure Cost	Million $	$401.8	$537.2	$206.2	$77.2	$ 77.20	$ 537.20	2.9	0.0	7.2	10.0	80%	28.00%
Operation, Maintenance and Monitoring Cost (Evalluated for 30 years)		OM&M Cost	Million $	$9.7	$10.7	$8.0	$19.4	$ 8.00	$ 19.40	8.5	7.6	10.0	0.0	20%	7.00%
Weighted Totals (Contribution to Total Score)										**1.4**	**0.5**	**2.7**	**2.8**	100%	35.00%

Schedule	Weight:	15%						Value that Scores 10	Value that Scores 0					Criterion Weight	Contribution to Total Score
Criterion	Scoring System	Required Input	Units	Option 1	Option 2	Option 4	Option 5			Option 1	Option 2	Option 4	Option 5		
Initiation Time	Interpolation Minimum value scores 10	Time to move first ash	Years	2.5	2.5	2.1	2.1	2.1	2.5	0	0	10	10	30%	4.50%
Project Duration (to completion of closure)	Interpolation Minimum value scores 10	Estimated durations	Years	16.5	16.5	9.3	6.6	6.6	16.5	0	0	7	10	70%	10.50%

Scoring for Evaluation of Closure Options
Closure Options Evaluation Worksheet
Roxboro Ash Basin Closure Project - Roxboro West Ash Basin (WAB)
Duke Energy

Site Name: Roxboro Station

1	= Option-Specific User Input
1	= Calculated Value

Placeholder values have been entered in "User Input" cells to prevent division by zero error text in calculated score cells.

Weighted Totals (Contribution to Total Score)										**0.0**	**0.0**	**1.2**	**1.5**	100%	15.00%
Regional Factors	**Weight:**	**15%**						**Value that Scores 10**	**Value that Scores 0**					**Criterion Weight**	**Contribution to Total Score**
Criterion	**Scoring System**	**Required Input**	**Units**	**Option 1**	**Option 2**	**Option 4**	**Option 5**			**Option 1**	**Option 2**	**Option 4**	**Option 5**		
Plan or potential for beneficial reuse of site	Subjective	Not Used For Subjective Scoring								10	10	5	0	5%	0.75%
Imported soil needs	Interpolation Min value scores 10 Max value scores 0	Soil Imported	CY	451,088	332,347	782,972	600,160	332,347	782,972	7	10	0	4	5%	0.75%
Beneficial reuse of CCR (not considered applicable)	Interpolation. Maximum value scores 10.	Fraction Used	None	0	0	0	0	0	0	10	10	10	10	0%	0.00%
Transportation impact (based on miles driven)	Interpolation Min value scores 10 Max value scores 0	Miles Driven	Miles	1,471,753	34,499,762	1,957,431	1,500,400	1,471,753	34,499,762	10	0	10	10	65%	9.75%
Noise impact due to on-site activity (based on proximity of neighbors to on-site work areas)	Subjective 0 to 10	Not Used For Subjective Scoring								0	0	6	8	5%	0.75%
View impact (based on final height of storage facility and land uses within viewshed)	Subjective 0 to 10									0	0	5	5	20%	3.00%
Weighted Totals (Contribution to Total Score)										**1.1**	**0.2**	**1.2**	**1.2**	100%	15.00%
Constructability	**Weight:**	**5%**						**Value that Scores 10**	**Value that Scores 0**						
Criterion	**Scoring System**	**Required Input**	**Units**	**Option 1**	**Option 2**	**Option 4**	**Option 5**			**Option 1**	**Option 2**	**Option 4**	**Option 5**		
Consider stormwater management, geotechnical, and dewatering	Subjective 0 to 10: 10 is the easiest while 0 is the riskiest	Not Used For Subjective Scoring								8	8	0	10	100%	5.00%
Weighted Totals (Contribution to Total Score)										**0.4**	**0.4**	**0.0**	**0.5**		
Total Score For Each Option (On a Scale of 0 to 10)										**5.6**	**3.8**	**7.8**	**8.6**		

Criteria for Evaluation of Closure Options
Closure Options Evaluation Worksheet
Ash Basin Closure - Master Programmatic Document
Duke Energy

Threshold Criteria: All closure options must comply with the following threshold criteria based on Duke Energy Guiding Principals for Ash Basin Closure
1. Provide continued geotechnical stability under applicable loading conditions and safety factors
2. Provide flow capacity and erosion resistance during design storm and flooding conditions
3. Effectively mitigate groundwater impacts
4. Comply with applicable state and federal regulations (e.g. North Carolina Coal Ash Management Act)

Category	Criterion	Guidance
Environmental Protection and Impacts	Modeled Plume Intersecting Surface Water	Refer to scoring system on Environmental Modeling (EM) Sub-Scoring worksheet.
	Groundwater Impact Beyond the Current Compliance Boundary	Refer to scoring system on Environmental Modeling (EM) Sub-Scoring worksheet.
	Modeled Off-site Impact	Refer to scoring system on Environmental Modeling (EM) Sub-Scoring worksheet.
	Relative rank based on visual interpretation of modeled boron plume	Refer to scoring system on Environmental Modeling (EM) Sub-Scoring worksheet.
	Air emissions off-site	Based on truck miles driven for hauling CCR and soil.
	Air emissions on-site from closure implementation	Based on total cubic yards of cut and fill on site as a surrogate for gallons of fuel consumed
	Avoidance of greenfield disturbance	Refer to Scoring System and Required Input columns on scoring sheet.
Cost	Capital Cost	From rough order-of-magnitude cost estimate or detailed cost estimate.
	Operation, Maintenance and Monitoring Cost	
Schedule	Initiation Time	From preliminary schedule for designing, permitting, bidding and constructing the option.
	Construction Duration	
Regional Factors	Plan or potential for beneficial reuse of site	Refer to Scoring System and Required Input columns on scoring sheet.
	Imported soil needs	Refer to Scoring System and Required Input columns on scoring sheet.
	Beneficial reuse of CCR	Refer to Scoring System and Required Input columns on scoring sheet.
	Transportation impact	Based on truck miles driven for hauling CCR and soil.
	Noise impact due to on-site activity	Based on proximity of neighbors to specific on-site work areas.
	View impact	Based on final height of storage facility and land uses within viewshed.
Constructability	Consider stormwater management, geotechnical, and dewatering	Subjective and relative comparison to other options

Environmental Groundwater Sub-scoring Worksheet
Closure Options Evaluation
Duke Energy

Roxboro West Ash Basin Groundwater Sub-Scoring Document

Station/Plant Name: Roxboro Steam Electric Plant

Scored by: TH, RC, KW on 1/14/2019

Evaluation Criteria:

Criteria 1. Modeled Plume Intersecting Surface Water	Score				
Modeled plume[1] does not intersect surface waters after 10 years	10				
Modeled plume[1] does not intersect surface waters after 100 years	5				
Modeled plume[1] does not intersect surface waters after 200 years	0	(Option 1)	(Option 2)	(Option 4)	(Option 5)
		Closure by Removal (on-site new landfill)	Closure by Removal (off-site disposal)	Close-in-Place Hybrid	Closure in Place
	Criteria 1 Score	10	10	10	10

Criteria 2. Groundwater Impact Beyond the current[2] Compliance Boundary	Score				
Modeled plume[1] is within current compliance boundary after 10 years	10				
Modeled plume[1] is within current compliance boundary after 100 years	5				
Modeled plume[1] is within current compliance boundary after 200 years	0	(Option 1)	(Option 2)	(Option 4)	(Option 5)
		Closure by Removal (on-site new landfill)	Closure by Removal (off-site disposal)	Close-in-Place Hybrid	Closure in Place
	Criteria 2 Score	10	10	10	10

Criteria 3. Modeled Off-site Impact	Score				
Modeled plume[1] does not go off-site	10				
Modeled plume[1] is predicted to remain off-site after 100 years	5				
Modeled plume[1] is predicted to remain off-site after 200 years	0				
		(Option 1)	(Option 2)	(Option 4)	(Option 5)
		Closure by Removal (on-site new landfill)	Closure by Removal (off-site disposal)	Close-in-Place Hybrid	Closure in Place
	Criteria 3 Score	10	10	10	10

Criteria 4. Relative rank based on visual interpretation of modeled boron plume	Score				
Ranked #1 among the three Closure Options based on visual interpretation of modeled boron plume	10				
Ranked #2 among the three Closure Options based on visual interpretation of modeled boron plume	5				
Ranked #3 among the three Closure Options based on visual interpretation of modeled boron plume	0				
		(Option 1)	(Option 2)	(Option 4)	(Option 5)
		Closure by Removal (on-site new landfill)	Closure by Removal (off-site disposal)	Close-in-Place Hybrid	Closure in Place
	Criteria 4 Score	10	9	5	9

Note 1: Based on avaliable data at the time of scoring, the modeled plume considered boron at a concentration of 4,000 ug/l or greater; 4,000 µg/L does not represent a remediation goal, however this concentration does represent the EPA Tap Water Regional Screening Level (RSL) in resident tapwater for boron.

Note 2: The current compliance boundary is the compliance boundary found in the figure "Waste and Compliance Boundaries" provided to NCDEQ on 2/15/18

Environmental Groundwater Sub-scoring Worksheet
Closure Options Evaluation
Duke Energy

Roxboro West Ash Basin Groundwater Sub-Scoring Document Justification

Justification Notes	(Option 1) Closure by Removal (on-site new landfill)	(Option 2) Closure by Removal (off-site disposal)	(Option 4) Close-in-Place Hybrid	(Option 5) Closure in Place
Criteria 1. Modeled Plume Intersecting Surface Water	**10** Based on the predictive model for the year 2017, found in the January 2019 version of the Preliminary Updated Revised Steam Electric Plant Groundwater Flow and Transport Modeling Report for Roxboro Steam Electric Plant, West Ash Basin, simulated boron concentrations for the Closure by removal (on-site new landfill) scenario with natural attenuation does not show boron of 4,000 ppb or greater intercepting surface water bodies.	**10** Based on the predictive model for the year 2017, found in the January 2019 version of the Preliminary Updated Revised Steam Electric Plant Groundwater Flow and Transport Modeling Report for Roxboro Steam Electric Plant, West Ash Basin, West Ash Basin, simulated boron concentrations for the Closure by Removal (off-site disposal) scenario with natural attenuation does not show boron of 4,000 ppb or greater intercepting surface water bodies.	**10** Based on the predictive model for the year 2017, found in the January 2019 version of the Preliminary Updated Revised Steam Electric Plant Groundwater Flow and Transport Modeling Report for Roxboro Steam Electric Plant, West Ash Basin, simulated boron concentrations for the Close-in-Place Hybrid scenario with natural attenuation does not show boron of 4,000 ppb or greater intercepting surface water bodies.	**10** Based on the predictive model for the year 2017, found in the January 2019 version of the Preliminary Updated Revised Steam Electric Plant Groundwater Flow and Transport Modeling Report for Roxboro Steam Electric Plant, West Ash Basin, simulated boron concentrations for the Closure-in-Place scenario with natural attenuation does not show boron of 4,000 ppb or greater intercepting surface water bodies.
Criteria 2. Groundwater Impact Beyond the Current Compliance Boundary	**10** Based on the predictive model for the year 2017, found in the January 2019 version of the Preliminary Updated Revised Groundwater Flow and Transport Modeling Report for Roxboro Steam Electric Plant, East Ash Basin, simulated boron concentrations for the Closure-in-Place scenario with natural attenuation does not show boron of 4,000 ppb or greater at or beyond the current (2018) compliance boundary.	**10** Based on the predictive model for the year 2017, found in the January 2019 Revised Groundwater Flow and Transport Modeling Report for Roxboro Steam Electric Plant, West Ash Basin, simulated boron concentrations for the Close-in-Place scenario with natural attenuation does not show boron of 4,000 ppb or greater at or beyond the current (2018) compliance boundary.	**10** Based on the predictive model for the year 2017, found in the January 2019 Revised Groundwater Flow and Transport Modeling Report for Roxboro Steam Electric Plant, West Ash Basin, simulated boron concentrations for the Close-in-Place Hybrid scenario with natural attenuation does not show boron of 4,000 ppb or greater at or beyond the current (2018) compliance boundary.	**10** Based on the predictive model for the year 2017, found in the January 2019 Revised Groundwater Flow and Transport Modeling Report for Roxboro Steam Electric Plant, West Ash Basin, simulated boron concentrations for the Close-in-Place scenario with natural attenuation does not show boron of 4,000 ppb or greater at or beyond the current (2018) compliance boundary.
Criteria 3. Modeled Off-site Impact	**10** Based on the predictive model for the year 2017, found in the January 2019 Preliminary Updated Revised Groundwater Flow and Transport Modeling Report for Roxboro Steam Electric Plant, West Ash Basin, simulated boron concentrations for the Closure by Removal scenario with natural attenuation does not show boron of 4,000 ppb or greater off of Duke Energy property.	**10** Based on the predictive model for the year 2017, found in the January 2019 Preliminary Updated Revised Groundwater Flow and Transport Modeling Report for Roxboro Steam Electric Plant, West Ash Basin, simulated boron concentrations for the Close-in-Place scenario with natural attenuation does not show boron of 4,000 ppb or greater off of Duke Energy property.	**10** Based on the predictive model for the year 2017, found in the January 2019 Preliminary Updated Revised Groundwater Flow and Transport Modeling Report for Roxboro Steam Electric Plant, West Ash Basin, simulated boron concentrations for the Close-in-Place Hybrid scenario with natural attenuation does not show boron of 4,000 ppb or greater off of Duke Energy property.	**10** Based on the predictive model for the year 2017, found in the January 2019 Preliminary Updated Revised Groundwater Flow and Transport Modeling Report for Roxboro Steam Electric Plant, West Ash Basin, simulated boron concentrations for the Close-in-Place scenario with natural attenuation does not show boron of 4,000 ppb or greater off of Duke Energy property.
Criteria 4. Relative rank based on visual interpretation of modeled boron plume	**10** Based on a review of boron concentrations found in the January 2019 Preliminary Updated Revised Groundwater Flow and Transport Modeling Report for Roxboro Steam Electric Plant, this scenario is marginally better than Option 2 (identical except landfills on-site), Option 4 Close in Place Hybrid, and Options 5 Closure-in-place.	**9** Based on a review of boron concentrations found in the January 2019 Preliminary Updated Revised Groundwater Flow and Transport Modeling Report for Roxboro Steam Electric Plant, this scenario is marginally better than Option 2 (identical except landfills on-site), Option 4 Close in Place Hybrid, and Options 5 Closure-in-place.	**5** Based on a review of boron concentrations found in the January 2019 Preliminary Updated Revised Groundwater Flow and Transport Modeling Report for Roxboro Steam Electric Plant, this scenario is marginally better than Option 5 Closure-in-Place.	**9** Based on review of the predictive model for the year 2017, found in the January 2019 version of the Preliminary Updated Revised Groundwater Flow and Transport Modeling Report for Roxboro Steam Electric Plant, West Ash Basin, this scenario is not marginally better than Option 1/2 Closure by Removal or Options 4 Close-in-Place Hybrid.

Notes:

1. Based on avaliable data at the time of scoring, the modeled plume considered boron at a concentration of 4,000 ug/l or greater; 4,000 µg/L does not represent a remediation goal, however this concentration does represent the EPA Tap Water Regional Screening Level (RSL) in resident tapwater for boron.
2. The current compliance boundary, as of 10/9/18, was used for all scenarios for criteria 2.

Mayo Plant Ash Basin Closure Options Analysis

Summary Report

This summary report (Report) presents the Closure Options evaluation for the ash basin located at Duke Energy Progress Mayo Station, located at 10660 Boston Road, near Roxboro, Person County, North Carolina. The Closure Options Evaluation involved developing ash basin closure strategies and evaluating these options relative to one another to determine which option to advance to more detailed engineering and closure plan development. The strategies discussed in the Closure Options evaluation are representative of the range of possible approaches for basin closure, and do not constitute final closure plans as described in N.C. Gen. Stat. sec. 130A-309.214(a)(4). Final closure plans will be submitted in 2019, as required by law, supported by detailed engineering designs and any necessary updates to groundwater modeling and related analysis.

Duke Energy developed programmatic guidance for the closure analysis effort in early 2016 to provide fleet-wide consistency to ash basin closure plan development. Duke Energy developed a relative weighting and scoring system with input from the National Ash Management Advisory Board. Using this system, Duke Energy evaluated and scored the alternatives using an options analysis framework designed to identify the best solution that balances environmental protection, cost, schedule and local community impacts. It is noted that internal working draft versions of these 2015-2016 Options Analyses for Allen, Belews Creek, Cliffside, Marshall, Mayo, and Roxboro were provided to NCDEQ at its request in May and June 2018.

The 2016 internal working draft Options Analysis identified closure-in-place as the preferred solution for Mayo that is protective of the environment, safely closes the Ash Basin, minimizes the other associated risks, and was the least cost to customers. A permit-level design was developed for that option in 2016. The company then paused that work, pending determination that the site would meet the requirements for a low-risk impoundment classification pursuant to N.C. Coal Ash Management Act (CAMA), as amended by House Bill 630. Duke Energy has completed those requirements at the Mayo site for a low-risk classification. Stormwater management (downstream impacts) was identified as a concern for the closure-in-place option in the 2016 analysis. In 2018, the grading plan for the Closure-in-Place option has been revised to direct the majority of stormwater runoff towards Mayo Reservoir rather than down Crutchfield Branch.

SITE BACKGROUND

Duke Energy's Mayo Station is a single-unit, 727-megawatt coal-fired plant located near Roxboro, N.C, less than one-half mile south of the North Carolina-Virginia line. It began commercial operation in 1983, and the station is currently in active operation. Mayo operates one impoundment for storing wet-sluiced ash, which is referred to as the Active Ash Basin (Ash Basin). Historically, both bottom ash and fly ash have been sluiced to the Ash Basin, but in 2013/2014 Mayo converted to dry ash handling systems. Bottom ash and fly ash have been disposed of in the on-site lined landfill starting in 2014.

The station has two related facilities considered and regulated as dams by the North Carolina Department of Environmental Quality (DEQ): a single ash basin (NCDENR ID=PERSO-035), and two dams associated with the FGD Pond (NCDENR ID=PERSO-036, NCDENR ID=PERSO-037) which are shown in the figure below.

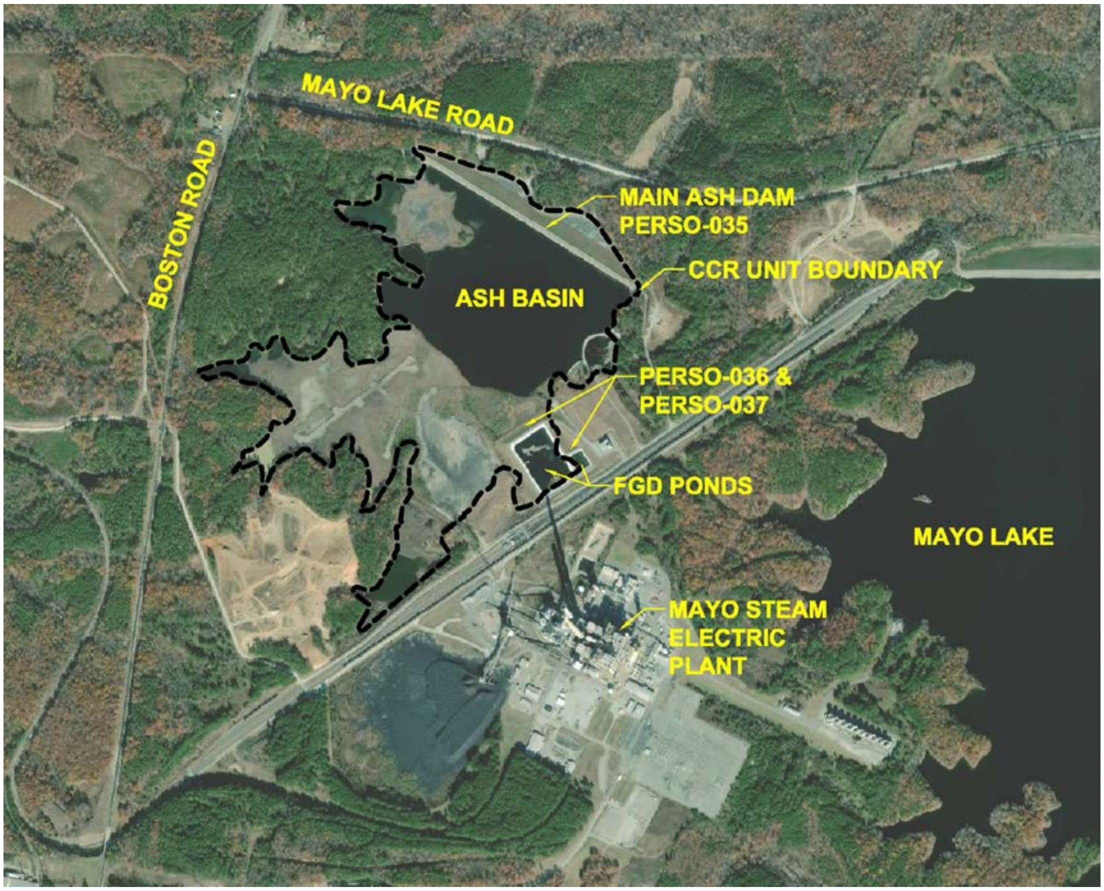

Figure 1. Ash Basin

CLOSURE OPTIONS

For the Mayo Station, under the direction of Duke Energy, AECOM developed the following conceptual closure options that remain under evaluation:

- Option 1: Hybrid Closure
- Option 2: Closure-In-Place
- Option 3: Closure-By-Removal (Existing On-Site Landfill)

Option 1 consists of excavating ash materials from the proposed Closure-by-Removal Areas depicted on Figures A1A and A1B and the subsequent placement of these ash materials within the proposed consolidated Hybrid Ash Closure Area. The Hybrid Ash Closure Area reduces the Ash Basin footprint, but due to site geometry, also incorporates a lateral lined expansion into a small greenfield area outside the current basin boundary. Following these excavation and placement activities, the Hybrid Ash Closure Area will be capped with an infiltration barrier/cover system meeting the requirements of the Federal Coal Combustion Residuals (CCR) Rule and CAMA (Figure A4). The Ash Basin dam will be breached as a final step in this option to enable release of stormwater.

Option 2 consists of leaving the ash material within the Ash Basin, graded to facilitate stormwater drainage which will be capped with an infiltration barrier/cover system meeting the requirements of the Federal CCR Rule and CAMA as shown on Figures A2A, A2B, and A4. The Ash Basin dam will remain in place and stormwater is routed through a modification of the current discharge channel to Mayo Lake.

Option 3 consists of excavating all ash materials from the Ash Basin, and placing these ash materials in a new, lined phase which would be permitted and constructed within the existing landfill Site Suitable area as depicted in Figure A3. This 30-acre phase would be constructed with a base liner system and an infiltration barrier/cover system meeting the requirements of the Federal CCR Rule and CAMA (Figure A4). The Ash Basin dam will be breached as a final step in this option to enable release of stormwater.

Options earlier evaluated but not carried forward included Option 3B (closure-by-removal with existing and new on-site landfill) and Option 4 (closure-by-removal with off-site landfill) which were removed from consideration from the Options Analysis for reasons of availability of on-site landfill space and excessive schedule/cost.

Tables 1, 2, and 3 of this report present a tabulated summary of each evaluated closure option, estimated quantities of ash and soil materials associated with each closure option, and a more detailed overview of each closure option presented.

Attachment A of this report includes figures depicting conceptual-level plan drawings and cross sections/details for each closure option.

The figures included in Attachment A are as follows:

- Figure A1A – Option 1 Hybrid Closure Plan View
- Figure A1B – Option 1 Hybrid Closure Profile and Section Views
- Figure A2A – Option 2 Closure-In-Place Plan View
- Figure A2B – Option 2 Closure-In-Place Profile and Section Views
- Figure A3 – Option 3 Closure-By-Removal to Existing On-Site Landfill Plan View
- Figure A4 – Cover and Liner System Details

Attachment B includes rough order of magnitude (ROM) cost estimates for each closure option.

Attachment C contains the scoring matrix which summarizes the composite scores of the various closure options, the assumptions of which are outlined in Table 3 for each particular option.

METHODOLOGY

A scoring matrix was prepared to provide consistent evaluation of closure options for each of the various site locations. This scoring evaluation tool can be found in Attachment C and considers the following primary criteria:

- Environmental Protection and Impacts
- Cost
- Schedule
- Regional Factors
- Constructability

Rough Order of Magnitude Costs

A rough order of magnitude (ROM) Class 5 cost estimate was prepared for each of the closure options, based on information and quantities developed during the conceptual design activities. The estimated costs include construction, permitting, engineering design, post-construction O&M, and groundwater monitoring. A tabulated summary of the preliminary closure cost estimates is provided below:

Current Estimates (October 2018)

Option	Closure Option	Estimated Construction Cost	Estimated O&M Cost (30 Years)
1	Hybrid Closure	$109,290,046	$32,093,144
2	Closure-In-Place	$74,626,681	$40,408,995
3	Closure-By-Removal (Existing On-Site Landfill)	$199,751,368	$24,637,553

Option 2: Closure-In-Place has the lowest estimated construction cost which is primarily due to the substantial reduction in material excavation and associated dewatering activities. Detailed tabulated ROM cost estimates are included in Attachment B.

Schedule

Within the scoring evaluation, estimates of the length of time required to initiate closure activities and the anticipated construction duration are provided for each option.

Option 1 is estimated to take 96 months or 8 years. Option 2 is estimated to take 66 months or 5.5 years. Option 3 is estimated to take 120 months, or 10 years.

A major driver in the estimated construction durations is the assumed material excavation/ movement rate of 1,000,000 cubic yards/year; therefore, the Closure-By-Removal option has longer construction duration, due to the requirement to move all ash materials, compared to the Hybrid and Closure-In-Place options where material movement quantities are less. Another driver is the assumed capping rate of 50 acres/year for completing the closure system for the Hybrid and Closure-In-Place options.

Options 1 and 2 are the only options that could be completed by the CAMA deadline of 2029, assuming work could begin in 2020.

Evaluation Criteria

This Options Analysis was developed as a decision-making tool to assist in selection of closure options when multiple methods are allowed under applicable regulations. The intent was to develop a decision framework that used weighted scorings to balance environmental factors, cost, and the safety of workers and the public. The Options Analysis incorporates Duke Energy's obligation as a regulated utility to ensure that its closure decisions are protective of the environment and communities, while also being prudent from a cost-effectiveness perspective.

The analysis considered multiple aspects in each criterion, including surface water impacts, groundwater impacts, air emissions, greenfield disturbance, construction duration, imported soil needs, transportation and noise impacts, stormwater management, long-term maintenance needs and post-closure monitoring.

These elements were combined to provide a weighted sum for each criterion using the following weights: environmental considerations (30%); cost (35%); schedule (15%); regional/ community factors (15%) and constructability (5%.). Duke Energy placed primary emphasis on environmental factors and cost, which were approximately equal in weight. When considering all of the criteria and associated weightings, the environmental considerations have a slightly higher weight than cost with the inclusion of certain regional/community factors (transportation impact, noise impact, view impact) which are effectively environmental considerations.

The scoring matrix provided in Attachment C, rates each option on a scale of 0 (least favorable) to 10 (most favorable) for each of the specified criteria. The scores for each option are then summed based on specified criterion weighting, resulting in an overall weighted score for each option. The results of the scoring evaluation for the Mayo closure options are summarized below:

Scoring Summary (October 2018)

Criterion	Option		
	1	**2**	**3**
Environmental Protection and Impacts	2.75	2.44	2.55
Cost	2.39	2.80	0.70
Schedule	0.74	1.50	0.00
Regional Factors	1.16	1.12	0.14
Constructability	0.15	0.40	0.30
Total Score	7.18	8.26	3.69

DISCUSSION

The Options Analysis finds relatively similar rankings for environmental considerations, such as impacts to groundwater, surface water, and avoidance of greenfield disturbance. The analysis incorporates the latest groundwater modeling at Mayo that demonstrates groundwater near the basin responds similarly for several decades in all closure options evaluated. The most effective step the company can take to improve groundwater is to safely decant the free water from the ash basin, which will occur in any closure approach.

In terms of duration of work and closure time, the Closure-In-Place option (#2) and Hybrid option (#1) scenarios would be expected to be completed in 5.5 years and 8 years, respectively and could be completed by the CAMA deadline of 2029, while the Closure-By-Removal option (#3) is expected to take 10 years. The excavation scenario (#3) would extend beyond the current CAMA deadline of 2029. However, it remains in our options analysis despite this for full transparency of the alternatives.

Other aspects the company considered are regional impacts to the surrounding community related to traffic and noise generated by each of the options. Traffic to and from the site will occur through the duration for each option noted above. That will include workers, trucks for deliveries or movement of soil, topsoil, stone, and geosynthetics. For the Closure-In-Place option (#2) and Hybrid option (#1) traffic will be mingled with typical traffic on the main roads leading to Mayo Station and Boston Road in particular. Closure-By-Removal option (#3) requires a significant number of truck crossings per work day of Boston Road over the approximate 10-year excavation period to access the landfill. The noise generated for each the options would be similar to someone near the site, but the duration of the work and the exposure to that noise varies directly with the time required for each option and would be longer for Closure-by-Removal. Along with increased duration and truck trips comes higher levels of emissions for the Closure-by-Removal option as well. At the Mayo site, the on-site landfill is located across a public highway, which would present a degree of safety risk and road congestion issues in excavation scenarios.

The Closure-By-Removal option is at least double the estimated cost of the Closure-In-Place option and causes other unnecessary community impacts with little compelling environmental benefit. While long-term modeling indicates a quicker reduction in the boron plume within the immediate vicinity of the basin footprint for the Closure-By-Removal scenario, compared to the Closure-in-Place scenario, the modeled concentrations at downstream points are nearly identical for all the closure options at each evaluated point in time. Moreover, the quicker reduction is partially offset by the fact that the modeled improvement is delayed in the Closure-By-Removal scenario, compared to the Closure-in-Place scenario, due to the extended construction time. In any event, the minor change in modeled plume size, within the immediate vicinity of the basin footprint, is not enough to justify the cost of the Closure-by-Removal scenario - particularly when the impact and improvement do not materially affect neighbors or other potential receptors.

The Hybrid Closure option ranks most closely with Closure-In-Place but does not appear to produce environmental benefits commensurate with the added cost and closure time. It also brings potential construction difficulties with development of the closure area stability slope or wall.

CONCLUSION

Based on the concept designs for the selected closure options and evaluation of the criteria established (environmental protection/impacts, cost, schedule, regional factors and constructability), Closure-In-Place option (#2) or the Hybrid option (#1) were identified as the preferred options that best balance the various considerations associated with basin closure.

Attachments:
A – Closure Options Figures
B – Closure Options Cost Estimates
C – Closure Options Scoring Matrix and Groundwater Sub-Scoring Worksheet

Table 1 – Closure Options Summary
Ash Basin Closure Options Evaluation
Mayo Station
Duke Energy

Option	Description
Option 1- Hybrid	• Install stormwater controls • Install free water decanting and water treatment system • Decant free water • Perform interstitial dewatering of ash material as needed to provide stable working surfaces • Install deep soil mixing method wall and/or stabilized soil wedge • Excavate ash, and place excavated ash material within the Hybrid ash closure area • Remove one foot of residual soil in the ash excavation areas • Install new liner system over about 4.5 acres of natural ridge that would need to be incorporated as a lateral expansion in order to facilitate a more consolidated cover geometry. • Install closure cover system • Removal of dam • Groundwater corrective action and long-term monitoring pursuant to CAMA/CCR
Option 2- Closure-in-Place	• Install stormwater controls • Install free water decanting and water treatment system • Decant free water • Perform interstitial dewatering of ash material as needed to provide stable working surfaces • Regrade ash basin waste boundary and construct closure cover • Balance of cover material required from off-site borrow source with greenfield disturbance area of 30 acres. • Minimal dam material removed and restore disturbed areas. • Groundwater corrective action and long-term monitoring pursuant to CAMA/CCR
Option 3- Closure-by-Removal (Existing On-Site Landfill)	• Install stormwater controls • Install free water decanting and water treatment system • Decant free water • Perform interstitial dewatering of ash material as needed to provide stable working surfaces • Excavate the ash and one foot of residual soil from the basin, place all 5.73 million CY in the existing landfill with new cell areas (greenfield disturbance) of 30 acres, within permitted boundary. • Remove dam, regrade closure-by-removal area, and restore disturbed areas. • Groundwater corrective action and long-term monitoring pursuant to CAMA/CCR

Existing Ash			
Ash Basin – Ash	6,600,000	5,500,000	140
1-Foot Over-Excavation (Entire Footprint, including upstream dam face)	271,000	226,000	140
Existing Ash Total	6,871,000	5,726,000	
Free Water Volume	N/A	485,000,000 (gal)	
Option 1 (Hybrid)			
Hybrid Closure Area (Ash to Remain in Place)	4,620,000	3,850,000	82
Closure-by-Removal (Includes 1-ft Over-Excavation)	2,091,600	1,743,500	58
Liner System over Lateral Expansion Areas			4.5
Option 2 (Closure-In-Place)			
Closure-In-Place	6,600,000	5,500,000	140
Relocation of Ash	1,200,000	1,000,000	
Option 3 (Closure-by-Removal – Existing On-Site Landfill)			
Closure-by-Removal (Includes 1-ft Over-Excavation)	6,871,000	5,726,000	140
Existing Soil			
Dam Soil Volume (total)	960,000	800,000	
Dam Soil Volume (partial removal for Option 2)	60,000	50,000	
Near-Site Soil Borrow Area Needed (Option 2 only)	482,400	402,000	

Soil Needed			
Option 1 (Hybrid)			
Hybrid Closure Area Cap System (2-ft thick)	318,000	265,000	82
Closure-by-Removal Area Backfill/Regrading (1-ft thick)	112,800	93,500	58
Option 1 Total Soil Needed	**430,800**	**358,500**	
Option 2 (Closure-In-Place)			
Closure-In-Place Cap System (2-ft thick)	542,400	452,000	140
Option 2 Total Soil Needed	**542,400**	**452,000**	
Option 3 (Closure-by-Removal – Existing On-Site Landfill)			
Closure-by-Removal Area Backfill/ Regrading (1-ft thick)	271,000	226,000	140
Industrial Landfill Subgrade (1-ft thick)	57,600	48,000	30
Industrial Landfill Cap System (2-ft thick)	115,200	96,000	30
Option 3 Total Soil Needed	**444,000**	**370,000**	

Subject	Description
Description	1. Install stormwater controls 2. Install free water decanting and water treatment system 3. Decant free water 4. Perform interstitial dewatering of ash material as needed to provide stable working surfaces 5. Install deep mixing method wall and/or stabilized soil wedge as needed 6. Excavate ash, and place excavated ash material within the Hybrid ash closure area 7. Install new liner system over lateral expansion areas = 4.5 acres. The 4.5 acres of natural ridge would need to be incorporated as a lateral expansion in order to facilitate consolidated mound geometry. 8. Install closure cap system 9. Removal of dam 10. Groundwater corrective action and long-term monitoring pursuant to CAMA/CCR
Details	1. Install stormwater run-on controls to divert stormwater from the ash basin where possible. 2. Design and install temporary water treatment system to manage decanting, interstitial dewatering, and (contact) stormwater. 3. Decanting & treatment of free water. 4. Construct the deep mixing method (DMM) wall and/or stabilized soil wedge to stabilize the cut-slope at the close-in-place / closure-by-removal interface; Approximately 1,500 LF long. 5. Removal & treatment of interstitial pore water in ash material as needed to provide stable working surfaces during construction within the closure-in-place and closure-by-removal areas. 6. Permit and construct new liner system over the lateral expansion areas; approximately 4.5 acres. The 4.5 acres of natural ridge would need to be incorporated as a lateral expansion in order to facilitate consolidated mound geometry. 7. Excavate an estimated 1,980,000 tons (1,650,000 CY) of ash material from within the closure-by-removal area, and place the excavated ash material within the Hybrid ash closure area. 8. Excavate an estimated 93,500 CY of residual soil material (1 foot below ash) from the closure-by-removal area (including the upstream dam face), and place the excavated material within the Hybrid ash closure area (Total excavation = 1,743,500 CY). 9. Remove dam down to natural grade; approximately 800,000 CY of clean fill material generated. 10. Leave in place an estimated 4,620,000 tons (3,850,000 CY) of ash material beneath the consolidated hybrid “mound” and within the ash

Subject	Description
	basin "fingers," and install closure cap system (approximately 82 acres) utilizing material generated by removal of the existing dam (approximately 265,000 CY needed). 11. Regrade the closure-by-removal area to direct stormwater to new permitted outfall, utilizing an estimated 93,500 CY of soils generated by removal of the existing dam. Total clean fill volume required = 358,500 CY. (The remaining dam material will be utilized to reclaim the ash basin footprint, as reflected in the cost spreadsheet.) 12. Restore areas disturbed during closure; approximately 145 acres (disturbed area). 13. Decommission temporary water treatment facility. 14. Groundwater corrective action and long-term monitoring pursuant to CAMA/CCR
Environmental Protection and Impacts	1. Air emissions off-site (based on miles driven) = N/A (not driving off-site). 2. Air emissions on-site (based on gallons of fuel consumed) from closure implementation = Assumed that the highest volume of material (ash / residual soil / clean fill) excavation/movement will result in the highest fuel consumption. Material excavation/movement = 2,543,500 CY. 3. Greenfield disturbance = Approximately 4.5 acres
Cost	1. Capital costs = $109,290,046. 2. Long-term O&M and monitoring = $1,069,771 annual. 3. Avoided costs = Off-site ash hauling and costs managed through minimizing material handling.
Schedule	1. Initiation time (to begin ash removal) = 36 months (includes dewatering and design/permitting and is a function of the stabilization construction). 2. Design and permitting = 12 months. 3. Construction = 60 months 4. Post-closure = 30 years.
Regional Factors	1. Plan or potential for beneficial reuse of site = None. 2. Imported soil needs = None (everything is available from removal of existing dam). 3. Transportation impact (based on miles driven) = N/A (not driving off-site). 4. Noise impact due to on-site activity (based on proximity of neighbors) = Slight impact during construction, but no change post construction (construction noise level approximately equivalent for each option, therefore scoring is based on construction duration). 5. Visual impact (based on final height of storage facility, land uses within the viewshed) = Peak of hybrid mound anticipated at 554 feet, compared to current dam crest at 488 feet.

Subject	Description
Constructability	1. High internal slopes within the basin will require stabilization. 2. Dewatering will include free water removal and treatment and (as needed to provide a stable working surface) interstitial pore water removal and treatment as part of ash excavation and cover system placement. 3. Construction of the lateral expansion liner system and its leachate collection system will be a challenge.

Subject	Description
Description	1. Install stormwater controls 2. Install free water decanting and water treatment system 3. Decant free water 4. Perform interstitial dewatering of ash material as needed to provide stable working surfaces 5. Regrade ash basin waste boundary and construct closure cap. 6. Partial dam material removed and restore disturbed areas. 7. Groundwater corrective action and long-term monitoring pursuant to CAMA/CCR
Details	1. Install stormwater run-on controls to divert stormwater from the ash basin where possible. 2. Design and install temporary water treatment system to manage decanting, interstitial dewatering, and (contact) stormwater. 3. Decanting & treatment of free water. 4. Removal & treatment of interstitial pore water in ash material as needed to provide stable working surfaces during construction within the closure-in-place area. 5. Regrade the close-in-place area to direct stormwater to the existing permitted outfall. 6. Remove Dam down to elevation 474 feet approximately 50,000 CY of clean fill material generated. 7. Install closure cap system over the close-in-place area, utilizing an estimated 452,000 CY of soils from borrow source (50,000 CY comes from dam, preferably remaining 402,000 CY comes from near-site borrow source). 8. Relocate an estimated 1,200,000 tons (1,000,000 CY) of ash material from within the closure-in-place area to achieve proposed grades. 9. Restore areas disturbed during closure; approximately 140 acres (disturbed area). 10. Decommission temporary water treatment facility. 11. Groundwater corrective action and long term monitoring pursuant to CAMA/CCR.
Environmental Protection and Impacts	1. Air emissions off-site (based on miles driven) = N/A (not driving off-site). 2. Air emissions on-site (based on gallons of fuel consumed) from closure implementation = Assumed that the highest volume of material (ash / residual soil / clean fill) excavation/movement will result in the highest gallons of fuel consumed. Material excavation/movement = 1,050,000 CY. 3. Greenfield disturbance = Approximately 30 acres for borrow.

Subject	Description
Cost	1. Capital costs = $74,626,681. 2. Long-term O&M and monitoring = $1,346,967 annual. 3. Avoided costs = Off-site ash hauling, costs managed through minimizing material handling.
Schedule	1. Initiation time (to begin ash removal) = 18 months (includes design/permitting and dewatering. 2. Design and permitting = 12 months. 3. Construction = 48 months 4. Post-closure = 30 years.
Regional Factors	1. Plan or potential for beneficial reuse of site = none. 2. Imported soil needs = 402,000 CY (from unidentified borrow source, preferably near-site). 3. Transportation impact (based on miles driven) = N/A (not driving off-site). 4. Noise impact due to on-site activity (based on proximity of neighbors) = Slight impact during construction, but no change post construction (construction noise level approximately equivalent for each option, therefore scoring is based on construction duration). 5. Visual impact (based on final height of storage facility, land uses within the viewshed) = equivalent to current conditions.
Constructability	1. Dewatering will include free water removal and treatment and (as needed to provide a stable working surface) interstitial pore water removal and treatment as part of ash excavation and cover system placement. 2. No internal ash slopes to stabilize

Subject	Description
Description	1. Install stormwater controls 2. Install free water decanting and water treatment system 3. Decant free water 4. Perform interstitial dewatering of ash material as needed to provide stable working surfaces 5. Construct 30-acre phase of existing landfill. 6. Excavate the ash from the basin, place in the existing landfill. Trucks would cross Boston Road/Highway 501 to the existing landfill location numerous times per day on average for nearly 7 years. 7. Remove dam, regrade closure-by-removal area, and restore disturbed areas. 8. Groundwater corrective action and long-term monitoring pursuant to CAMA/CCR.
Details	1. Install stormwater run-on controls to divert stormwater from the ash basin and industrial landfill areas where possible. 2. Design and install temporary water treatment system to manage decanting, interstitial dewatering, and (contact) stormwater. 3. Decanting & treatment of free water. 4. Removal & treatment of interstitial pore water in ash material as needed to provide stable working surfaces during construction within the closure-by-removal area. 5. Permit and construct a new landfill and a new 30-acre phase of liner for the industrial landfill utilizing an estimated 48,000 CY of soils from the removal of the existing dam. 6. Excavate the ash material from within the closure-by-removal area (ash basin waste boundary area), an estimated 6,600,000 tons (5,500,000 CY), and place in the existing Landfill. 7. Excavate an estimated 225,900 CY of residual soil material (1 foot below ash) from the ash basin, and place in the existing Landfill. (Total excavation = 5,725,900 CY). 8. Install landfill cap system over new phase of existing industrial landfill utilizing an estimated 96,000 CY of soil by removal of the dam. 9. Remove dam down to elevation 380 feet; approximately 800,000 CY of clean fill material generated for use in cap and reclamation. 10. Regrade the closure-by-removal area to direct stormwater to the new permitted outfall utilizing an estimated 226,000 CY of soils generated by removal of the existing dam. The remaining dam material (approximately 430,000 CY) will be left in place or utilized to reclaim the ash basin footprint and the pond area will be graded to drain.

Subject	Description
	11. Restore areas disturbed during closure; approximately 140 acres (disturbed area). 12. Decommission temporary water treatment facility. 13. Groundwater corrective action and long-term monitoring pursuant to CAMA/CCR
Environmental Protection and Impacts	1. Air emissions off-site (based on miles driven) = 2 miles (round trip). 2. Air emissions on-site (based on gallons of fuel consumed) from closure implementation = Assume the highest volume of material (ash / residual soil / clean fill) excavation/movement will result in the highest gallons of fuel consumed. Material excavation/movement = 6,526,000 CY 3. Greenfield disturbance = Approximately 30 acres for additional phase within permitted landfill.
Cost	1. Capital costs = $199,751,368. 2. Long-term O&M and monitoring = $821,252 annual.
Schedule	1. Initiation time (to begin ash removal) = 36 months (includes dewatering and design and permitting) 2. Design and permitting = 12 months. 3. Construction = 84 months 4. Post-closure = 30 years.
Regional Factors	1. Plan or potential for beneficial reuse of site = None. 2. Imported soil needs = None (everything is available from removal of existing dam). 3. CCR beneficial reuse = None. 4. Transportation impact (based on miles driven) = 2 mile (round trip crossing highway). 5. Noise impact due to on-site activity (based on proximity of neighbors) = Slight impact during construction, but no change post construction (construction noise level approximately equivalent for each option, therefore scoring is based on construction duration). 6. Visual impact (based on final height of storage facility, land uses within the viewshed) = 672 feet (Final height of the existing landfill).
Constructability	1. Relatively manageable construction option. 2. Dewatering will include free water removal and treatment and (as needed to provide a stable working surface) interstitial pore water removal and treatment as part of ash excavation and cover system placement.

Attachment A

REV. 1

N

LEGEND

- CCR UNIT BOUNDARY
- CLOSURE BY REMOVAL AND CLOSURE IN PLACE AREA BOUNDARY
- DMM WALL LOCATION (APPROX)
- LATERAL EXPANSION AREA (APPROX. 4.5 AC)
- FGD SETTLING AND FLUSH POND TO BE DECOMMISSIONED AND CAPPED AS REQUIRED.

TITLE

HYBRID CLOSURE
PLAN VIEW
MAYO STEAM ELECTRIC PLANT
ASH BASIN CLOSURE OPTIONS EVALUATION
PERSON COUNTY, NORTH CAROLINA

FOR

MAYO PLANT

DUKE ENERGY®

SCALE: 1" = 300'	DES: CLD
DWG TYPE: 09 DWG TYPE	DFTR: CLD
JOB NO: 60432013	CHKD: DS
DATE: 10/18/2018	ENGR:
FILENAME: HYBRID REDESIGN16.6 PERCENT	APPD:

DWG SIZE	DRAWING NO.	REVISION
ANSI D 22.0"x34.0"	FIGURE A1A	1

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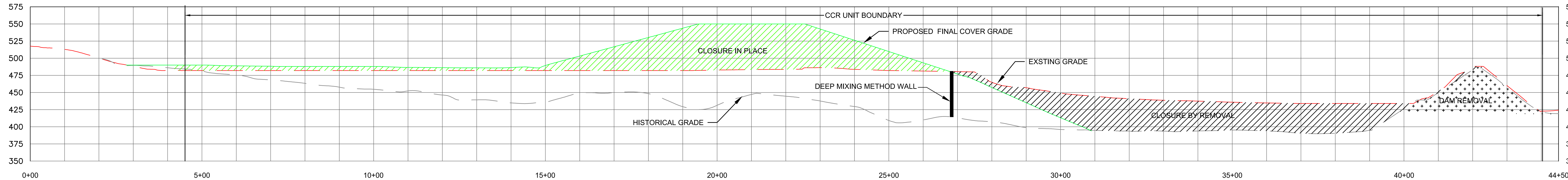
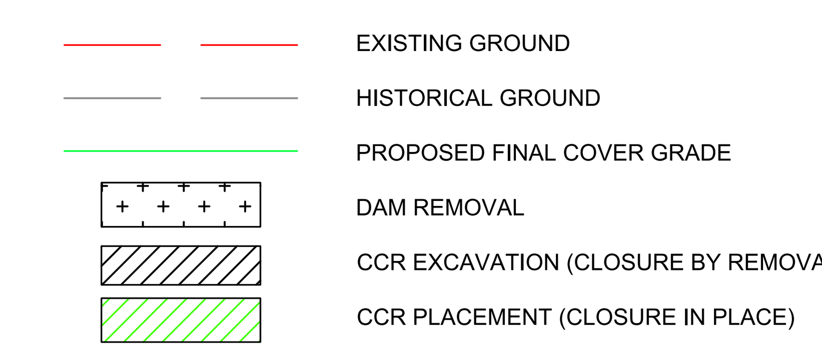
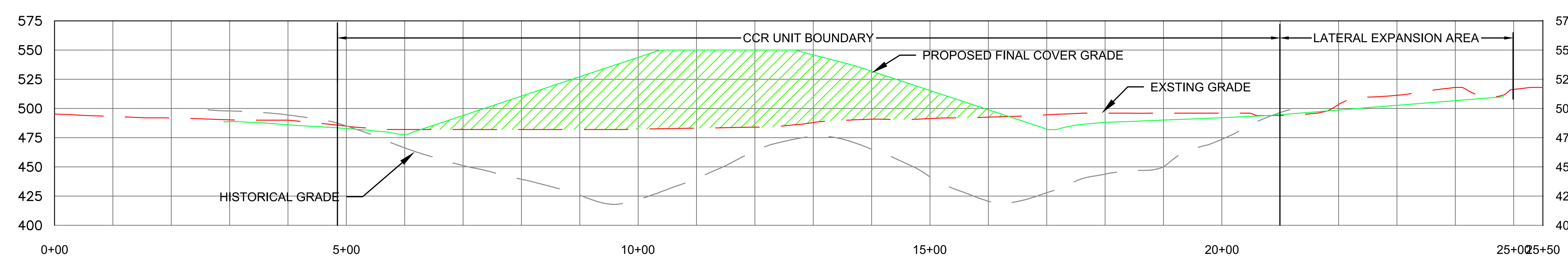


SECTION A-A

LEGEND





SECTION B-B

TITLE

HYBRID CLOSURE PROFILE AND SECTION VIEW
MAYO STEAM ELECTRIC PLANT
ASH BASIN CLOSURE OPTIONS EVALUATION
PERSON COUNTY, NORTH CAROLINA

FOR

MAYO PLANT

DUKE ENERGY	SCALE:	DES: CLD
	DWG TYPE: 09 DWG TYPE	DFTR: CLD
	JOB NO: 60432013	CHKD: ARS
	DATE: 10/18/2018	ENGR:
FILENAME:	HYBRID REDESIGN16.6 PERCENT	APPD:
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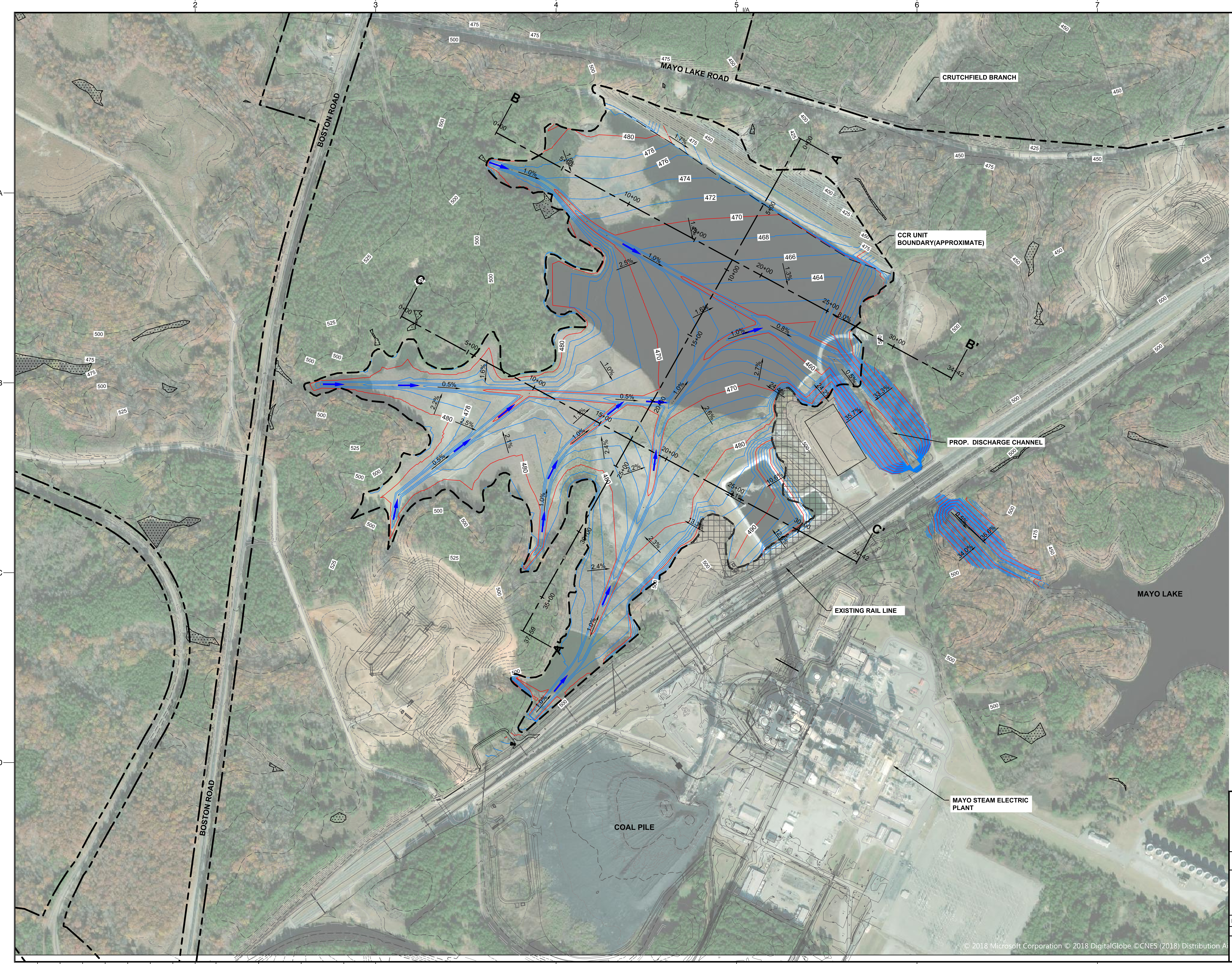
ANSI D 22.0"x34.0"	**FIGURE A1B**	1

REV. 1

REV. 0



N

LEGEND

CCR UNIT BOUNDARY
DUKE ENERGY PROPERTY BOUNDARY
EXISTING MINOR CONTOURS (5 FT)
EXISTING MAJOR CONTOURS (25 FT)
FINAL COVER MINOR CONTOURS (2 FT)
FINAL COVER MAJOR CONTOURS (10 FT)
DITCH CENTERLINE AND FLOW DIRECTION
2.0% FINAL COVER SLOPE
IN FIELD CCR LIMITS VERIFICATION AREA (SEE NOTE 1)

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.
3. ASH BASIN WASTE BOUNDARY PRESENTED IN THIS DRAWING IS PREPARED BY SYNTERRA FOR DUKE ENERGY. UPDATED SEPTEMBER 2018
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. DEPICTED WETLANDS AND PROPERTY BOUNDARY ARE BASED ON JURISDICTIONAL WATERS FIGURES PREPARED FOR DUKE ENERGY BY WOOD PLC, JULY 18,2018.

NOTE

1. FINAL COVER CAP SYSTEM IS ONLY REQUIRED WITHIN THE ASH BASIN BOUNDARY. LIMITS OF ASH BASIN BOUNDARY WILL NEED TO BE REFINED THROUGH GEOTECHNICAL INVESTIGATION TO BE PERFORMED AT LATER DATE.

0 300 600 900
GRAPHIC SCALE (IN FEET)

REV. 0

TITLE

CLOSURE IN PLACE GRADING PLAN

MAYO STEAM ELECTRIC PLANT
ASH BASIN CLOSURE OPTIONS EVALUATION
PERSON COUNTY, NORTH CAROLINA

FOR

MAYO PLANT

DUKE ENERGY

SCALE:	1" = 300'	DES:	RD
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DATE:	11-20-18	ENGR:	CP
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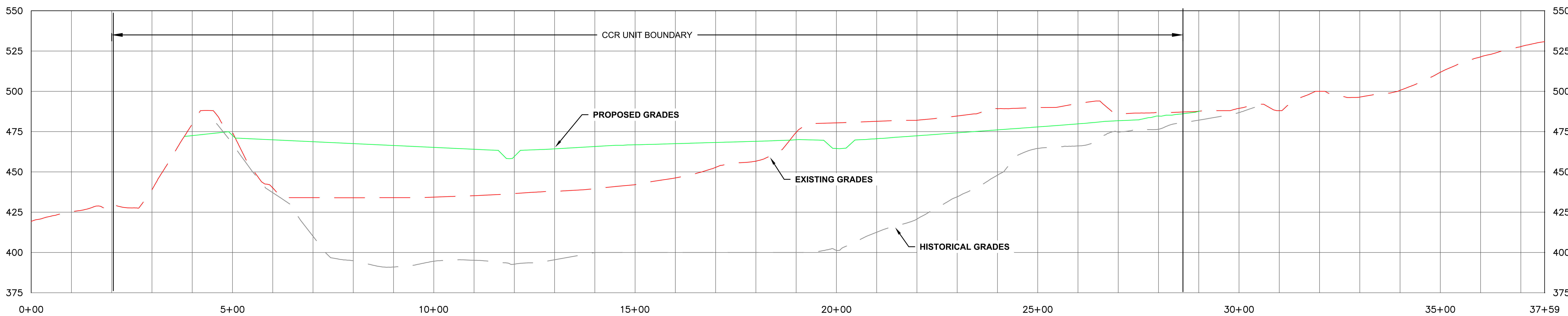
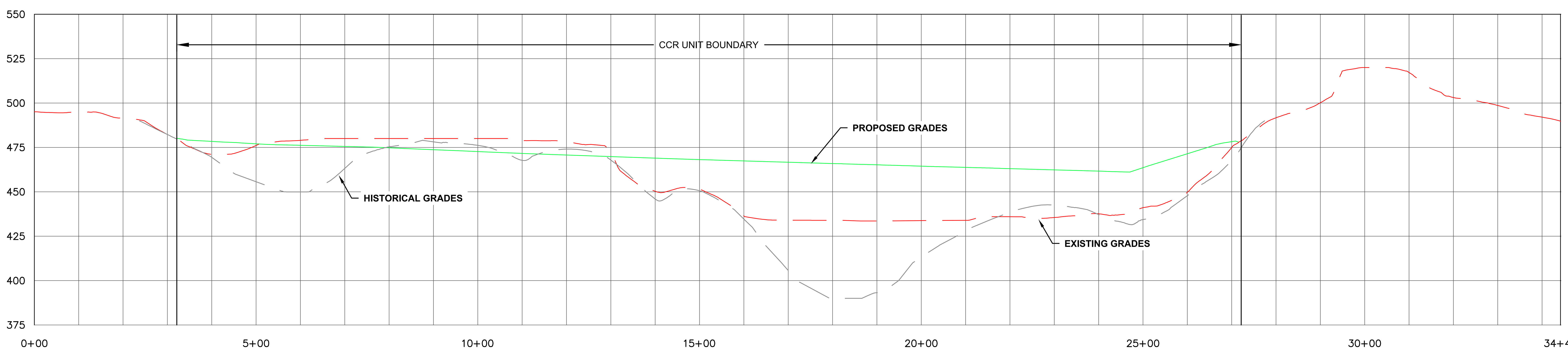
FIGURE A2B REV. 0



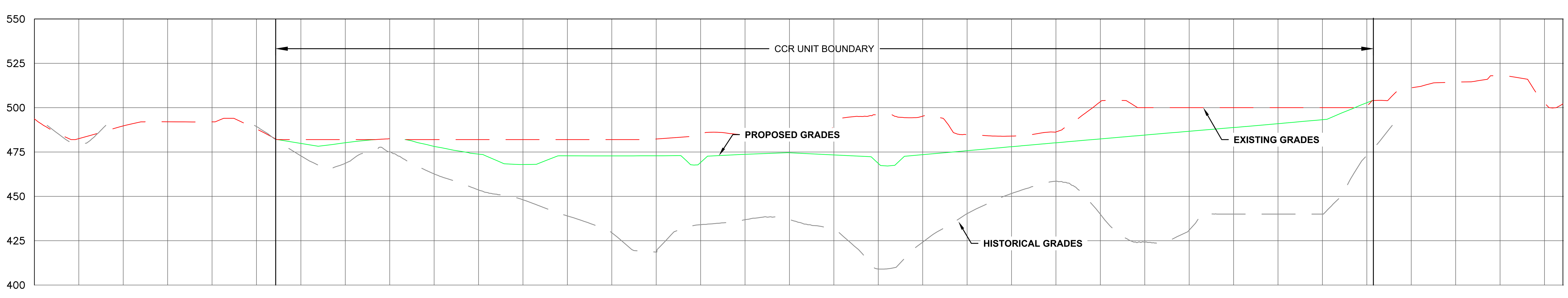
SECTION A

LEGEND

- EXISTING GROUND
- HISTORICAL GROUND
- PROPOSED FINAL CAP GRADES



SECTION B



SECTION C

TITLE	CLOSURE IN PLACE CROSS SECTIONS MAYO STEAM ELECTRIC PLANT ASH BASIN CLOSURE OPTIONS EVALUATION PERSON COUNTY, NORTH CAROLINA		
FOR	MAYO PLANT		
DUKE ENERGY	SCALE: 1" = 150'	DES: RD	
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DWG SIZE	DRAWING NO.		REVISION
ANSI D 22.0"x34.0"	FIGURE A2B		0

REV. 2

N

LEGEND

- PERMITTED LANDFILL BOUNDARY
- RELOCATED CCR FROM ASH BASIN

TITLE

CLOSURE BY REMOVAL ONSITE LANDFILLS
MAYO STEAM ELECTRIC PLANT
ASH BASIN CLOSURE OPTIONS EVALUATION
PERSON COUNTY, NORTH CAROLINA

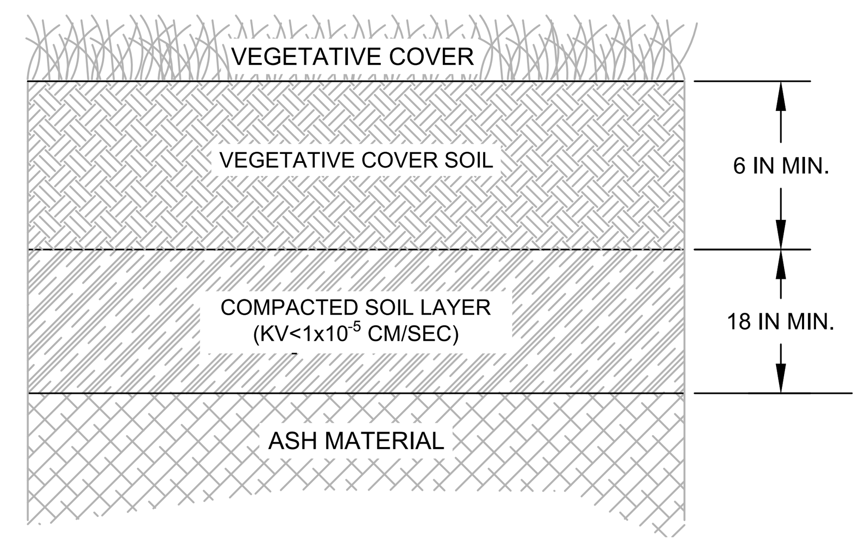
FOR
MAYO PLANT

DUKE ENERGY

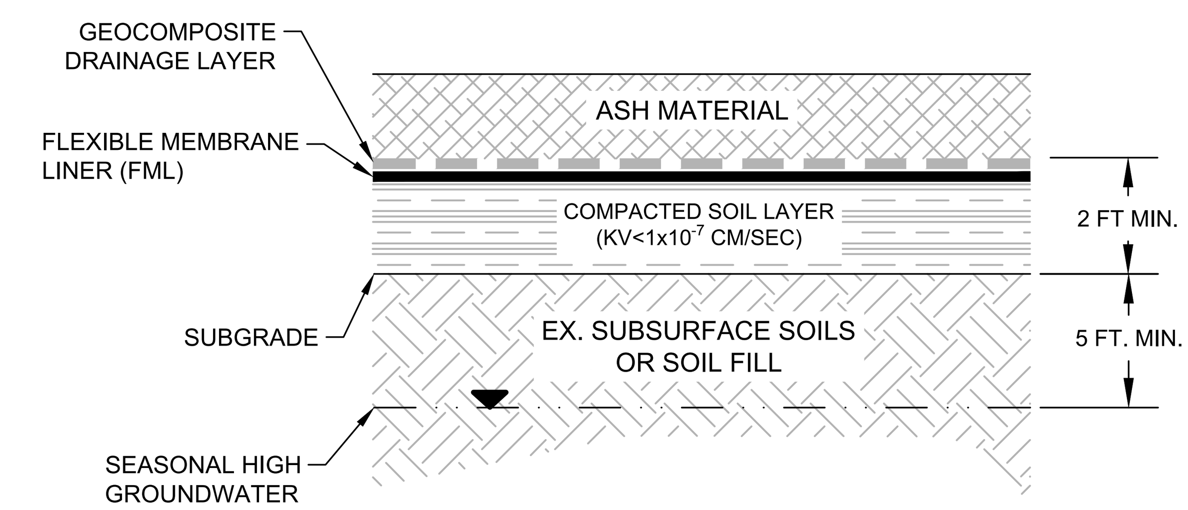
SCALE: 1" = 300'	DES: CLD
DWG TYPE: 09 DWG TYPE	DFTR: CLD
JOB NO: 60432013	CHKD: DS
DATE: 10/18/2018	ENGR:
FILENAME: CBR_OPTIONS	APPD:

DWG SIZE	DRAWING NO.	REVISION
ANSI D 22.0"x34.0"	FIGURE A3	2

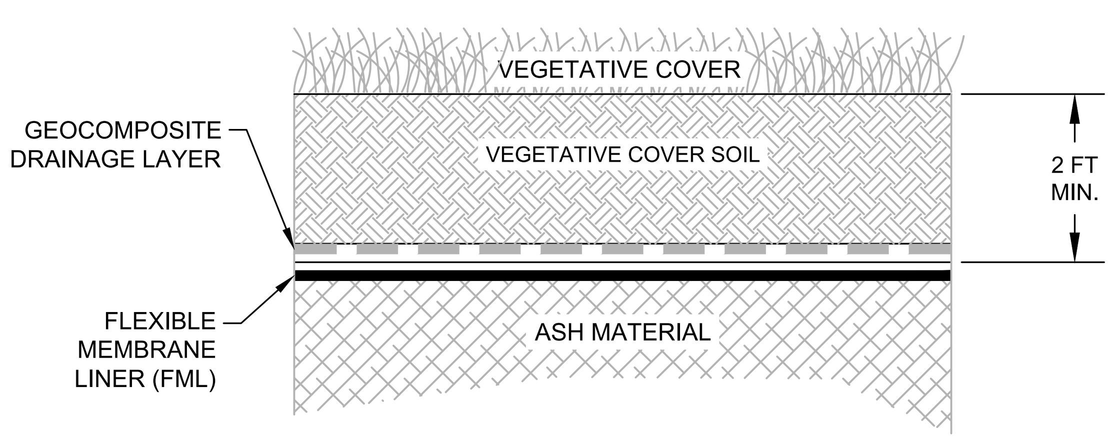
REV. 0



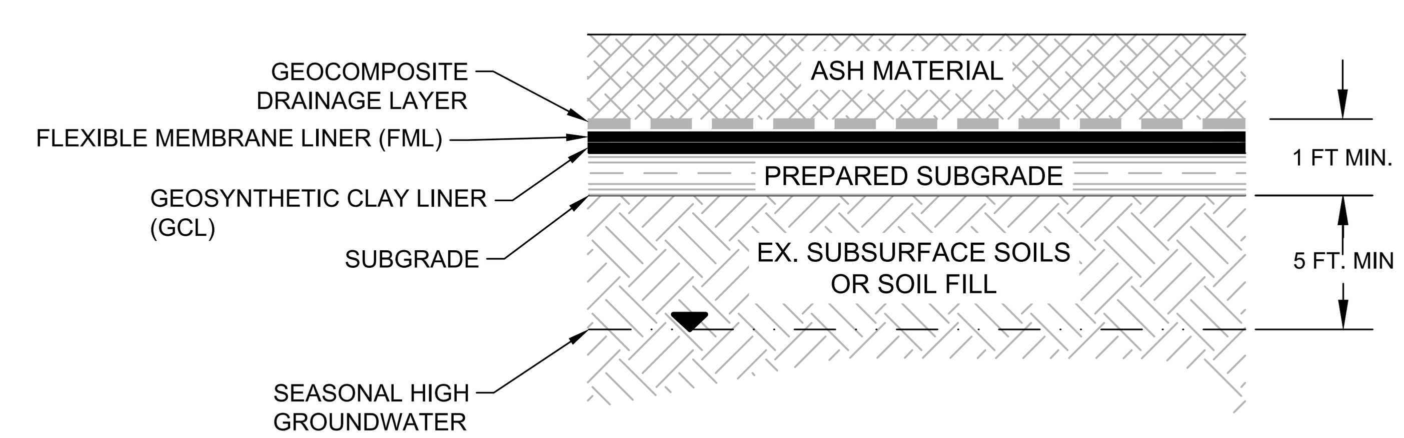
STANDARD ASH BASIN CLOSURE CAP SYSTEM
N.T.S



STANDARD LANDFILL LINER SYSTEM
N.T.S



ALTERNATE ASH BASIN CLOSURE CAP SYSTEM
N.T.S



ALTERNATE LANDFILL LINER SYSTEM
N.T.S

NOTE:

EITHER STANDARD ASH BASIN CLOSURE AND CAP SYSTEM OR ALTERNATE ASH BASIN CLOSURE AND CAP SYSTEM WILL BE USED IN:
- IN-PLACE CLOSURE OPTION
- 2015/2016 HYBRID CLOSURE OPTION
- 2018 HYBRID CLOSURE OPTION

LANDFILL COVER SYSTEM WILL BE DEVELOPED BASED ON SELECTED LINER SYSTEM

NOTE:

EITHER STANDARD LANDFILL LINER SYSTEM OR ALTERNATE LANDFILL LINER SYSTEM WILL BE USED IN:
- ONSITE LANDFILL INSIDE EXCAVATED ASH BASIN
- ONSITE LANDFILL OUTSIDE THE EXCAVATED ASH BASIN

COVER AND LINER SYSTEM DETAILS

DUKE ENERGY
MAYO PLANT ASH BASIN CLOSURE
PERSON CO., NORTH CAROLINA

FOR
MAYO PLANT

DUKE ENERGY

SCALE: N.T.S.	DES: NP
DWG TYPE:	DFTR: NP
JOB NO: 60572891	CHKD: KK
DATE: 10/18/2018	ENGR: KK/NP
FILENAME: FIGURE A6	APPD: KK

DWG SIZE	DRAWING NO.	REVISION
ANSI D 22.0"x34.0"	FIGURE A4	0

Attachment B

I/A

AECOM CALCULATION SHEET	PROJECT: CCR IMPOUNDMENT CLOSURE ESTIMATES FOR DUKE ENERGY	PLANT NAME: Mayo	CLOSURE TYPE: CCR Rule & CAMA Compliant	SHEET: Cost Summary	REV. NO.: 4
	SUBJECT: Preliminary Project Costs Sheets	IMPOUNDMENT NAME: Ash Basin	CLOSURE METHOD: Hybrid		AECOM JOB NO.: 60432144
	ACTIVITY: Cost Summary: Hybrid Cost Estimate for CCR Impoundment	CLOSURE OPTION: 1	LAST UPDATED BY: Claudia Prado	DATE LAST MODIFIED: 11/8/2018	REVIEWED BY: KK

MAYO PLANT - OPTION 1 HYBRID CLOSURE
Closure & Post Closure Cost Summary

Closure Tasks	Cost (2018 Dollars)
Mobilization / Site Prep / Demobilization	$5,638,640
Dewatering / Excavation for Closure by Removal / Convey Material	$51,351,289
Dewatering / Earthwork for Close-in-Place	$13,365,422
Lateral Expansion Areas	$3,614,603
Closure System Construction	$7,447,321
Stormwater Management / E&S Controls / Site Restoration	$2,414,762
Contingency (25%)	$20,958,009
Engineering Support (Design & CQA)	$4,500,000
Total Closure Cost of CCR Impoundment =	**$109,290,046**

Post-Closure Tasks	Cost (2018 Dollars)
Groundwater Monitoring	$14,790,000
Operations & Maintenance (O&M)	$8,550,468
Contingency (25%)	$5,835,117
Engineering Costs (10%)	$2,917,559
Total Post-Closure of CCR Impoundment =	**$32,093,144**

Total Closure & Post-Closure of CCR Impoundment Cost =	**$141,383,190**

I/A

AECOM CALCULATION SHEET	PROJECT: CCR IMPOUNDMENT CLOSURE ESTIMATES FOR DUKE ENERGY	PLANT NAME: Mayo	CLOSURE TYPE: CCR Rule & CAMA Compliant	SHEET: Hybrid Costs	REV. NO.: 4
	SUBJECT: Preliminary Project Costs Sheets	IMPOUNDMENT NAME: Ash Basin	CLOSURE METHOD: Hybrid		AECOM JOB NO.: 60432144
	ACTIVITY: Hybrid Closure Costs	CLOSURE OPTION: 1	LAST UPDATED BY: Claudia Prado	DATE LAST MODIFIED: 11/08/18	REVIEWED BY: JDP

BASIS OF THE ESTIMATE				
YEAR COST BASIS	2018			
TOTAL IMPOUNDMENT AREA (AC)	140			
TOTAL AREA TO BE RESTORED (AC)	145		VOLUME OF FREE WATER IN IMPOUNDMENT (GAL)	Not Used
IMPOUNDMENT AREA TO BE CLOSED-IN-PLACE (AC)	82		IMPOUNDMENT AREA TO BE CLOSURE BY REMOVAL (AC)	58
EXISTING ASH VOLUME IN AREA TO BE CLOSED-IN-PLACE (CY)	3,850,000		TOTAL ASH VOLUME FROM CLOSURE BY REMOVAL (CY)	1,650,000
TOTAL (FINAL) ASH VOLUME TO BE CLOSED-IN-PLACE (CY)	4,877,950		℥TH OF CUT-SLOPE AT CLOSE-IN-PLACE / CLOSURE BY REMOVAL INTERFACE	1,100

HYBRID ESTIMATED COSTS

	TASK	ITEM	UNIT	QUANTITY	INSTALLED UNIT COST	IMPOUNDMENT CLOSURE COST	NOTES
MOBILIZATION/ SITE PREP/ DEMOBILIZATION	**MOBILIZATION / SITE PREP / DEMOBILIZATION**						
	1	MOBILIZATION / DEMOBILIZATION	LS	1	$903,462	$903,462	Mob/Demob & insurance: (1% of Total Bid Price) includes administration (mtgs, health & safety, trailer, phone/fax/electricity, temporary facilities, utilities, roll off boxes, waste disposal, and cleanup).
	2	REMOVAL OF OUTLET STRUCTURES / PIPING	LS	1	$994,112	$994,112	Assume outlet structures and piping will be excavated and removed.
	3	REMOVAL & FILTRATION OF FREE WATER	MONTHS	36.0	$103,919	$3,741,066	Based on Initiation time
DEWATERING / EXCAVATION FOR CLOSURE BY REMOVAL / CONVEY MATERIAL	**DEWATERING / EXCAVATION FOR CLOSURE BY REMOVAL / CONVEY MATERIAL**						
	4	REMOVAL & TREATMENT OF PORE WATER WITHIN ASH IN CLOSURE BY REMOVAL AREA	MONTHS	60.0	$225,832	$13,549,937	Based on Construction time
	5	EXCAVATE ASH FOR CLOSURE BY REMOVAL / STOCKPILE ASH	CY	1,650,000	$8.00	$13,200,000	Assume CCR material must be stockpiled within impoundment area to decant prior to loading. Done in conjunction with Step 1. Decant water collected and treated along with pore water from Step 1.
	6	EXCAVATE ASH FROM STOCKPILE / LOAD / HAUL ASH TO CLOSE-IN-PLACE AREA	CY	1,027,950	$8.43	$8,665,619	Once material has decanted, CCRs must be excavated out of stockpile, loaded on trucks and hauled to close-in-place area. Quantity takes into consideration reduction of volume due to dewatering of ash down to 30% moisture content.
	7	OVER EXCAVATE SOIL FROM CLOSURE BY REMOVAL AREA / LOAD / HAUL CCR-IMPACTED SOIL TO CLOSE-IN-PLACE AREA	CY	93,573	$10	$935,733	Assume 1 foot of additional material to be removed over total closure by removal impoundment area.
	8	DEEP MIXING METHOD (DMM) WALL TO STABILIZE CUT-SLOPE AT CLOSE-IN-PLACE / CLOSURE BY REMOVAL INTERFACE	L.F.	1,500	$10,000	$15,000,000	Assume DMM wall for large ponds that require excavating a portion of the pond and stacking excavated material on remaining portion.
	9	EXCAVATE / LOAD / HAUL CCR MATERIAL (OFF-SITE)	CY	0	$60	$0	include if applicable
	10	EXCAVATE / LOAD / HAUL CCR-IMPACTED SOIL (OFF-SITE)	CY	0	$57	$0	include if applicable

I/A

AECOM CALCULATION SHEET	PROJECT: CCR IMPOUNDMENT CLOSURE ESTIMATES FOR DUKE ENERGY	PLANT NAME: Mayo	CLOSURE TYPE: CCR Rule & CAMA Compliant	SHEET: Hybrid Costs	REV. NO.: 4
	SUBJECT: Preliminary Project Costs Sheets	IMPOUNDMENT NAME: Ash Basin	CLOSURE METHOD: Hybrid		AECOM JOB NO.: 60432144
	ACTIVITY: Hybrid Closure Costs	CLOSURE OPTION: 1	LAST UPDATED BY: Claudia Prado	DATE LAST MODIFIED: 11/08/18	REVIEWED BY: JDP

BASIS OF THE ESTIMATE				
YEAR COST BASIS	2018			
TOTAL IMPOUNDMENT AREA (AC)	140			
TOTAL AREA TO BE RESTORED (AC)	145		VOLUME OF FREE WATER IN IMPOUNDMENT (GAL)	Not Used
IMPOUNDMENT AREA TO BE CLOSED-IN-PLACE (AC)	82		IMPOUNDMENT AREA TO BE CLOSURE BY REMOVAL (AC)	58
EXISTING ASH VOLUME IN AREA TO BE CLOSED-IN-PLACE (CY)	3,850,000		TOTAL ASH VOLUME FROM CLOSURE BY REMOVAL (CY)	1,650,000
TOTAL (FINAL) ASH VOLUME TO BE CLOSED-IN-PLACE (CY)	4,877,950		‑TH OF CUT-SLOPE AT CLOSE-IN-PLACE / CLOSURE BY REMOVAL INTERFACE	1,100

HYBRID ESTIMATED COSTS

	TASK	ITEM	UNIT	QUANTITY	INSTALLED UNIT COST	IMPOUNDMENT CLOSURE COST	NOTES
DEWATERING / EARTHWORK FOR CLOSE-IN-PLACE	DEWATERING / EARTHWORK FOR CLOSE-IN-PLACE						
	11	REMOVAL & TREATMENT OF PORE WATER WITHIN ASH	MONTHS	0.0	$225,832	$0	Accounted for in closure by removal time frame.
	12	SPREAD AND COMPACT MATERIAL FROM CLOSURE BY REMOVAL AREA	CY	1,027,950	$7.56	$7,771,302	Spread dewatered ash excavated from CLOSURE BY REMOVAL area in thin lifts over close-in-place area. Quantity takes into consideration reduction of volume due to dewatering of ash down to 30% moisture content.
	13	ASH REGRADING TO ESTABLISH CROWN AND SURROUNDING POSITIVE DRAINAGE	CY	500,000	$9.24	$4,620,000	Quantity of earthwork (cut-to-fill) using existing ash to achieve min. 3% slope prior to installation of closure system. Quantity calculated using AutoCAD.
	14	RING DRAIN INSTALLATION	L.F.	14,000	$58	$806,120	Linear feet around the close-in-place area
	15	PERIMETER DITCH / TEMP. DIVERSION BERM GRADING	L.F.	14,000	$12	$168,000	Linear feet around the perimeter of impoundment.
LATERAL EXPANSION AREAS	LATERAL EXPANSION AREAS						
	16	LATERAL EXPANSION AREAS	AC	4.5	$803,245	$3,614,603	In areas where ash will be placed outside of the existing ash basin waste boundary, this will be considered a Lateral Expansion per the CCR regulations and will require a composite liner system with leachate collection.
CLOSURE SYSTEM CONSTRUCTION	CLOSURE SYSTEM CONSTRUCTION						
	17	FLEXIBLE MEMBRANE LINER (FML)	SQ. FT.	3,929,112	$0.42	$1,650,227	Flexible membrane liner placed over close-in-place area. Assume quantity needed is 10% more than close-in-place area.
	18	GEOCOMPOSITE DRAINAGE LAYER	SQ. FT.	3,929,112	$0.60	$2,357,467	Geocomposite drainage layer placed over close-in-place area. Assume quantity needed is 10% more than close-in-place area.
	19	GEOSYNTHETIC CLAY LINER (GCL)	SQ. FT.	0	$0.72	$0	not used
	20	18" PROTECTIVE COVER SOIL	CY	198,440	$13	$2,579,720	18 inches of common soil placed over closure by in place area
	21	6" TOPSOIL	CY	66,147	$13	$859,907	6 inches of topsoil placed over closure in place area.
	22	COMPACTED LOW PERM. SOILS (Kv<1x10^-5 cm/sec)	CY	0	$12	$0	not used:

I/A

AECOM CALCULATION SHEET	PROJECT: CCR IMPOUNDMENT CLOSURE ESTIMATES FOR DUKE ENERGY	PLANT NAME: Mayo	CLOSURE TYPE: CCR Rule & CAMA Compliant	SHEET: Hybrid Costs	REV. NO.: 4
	SUBJECT: Preliminary Project Costs Sheets	IMPOUNDMENT NAME: Ash Basin	CLOSURE METHOD: Hybrid		AECOM JOB NO.: 60432144
	ACTIVITY: Hybrid Closure Costs	CLOSURE OPTION: 1	LAST UPDATED BY: Claudia Prado	DATE LAST MODIFIED: 11/08/18	REVIEWED BY: JDP

BASIS OF THE ESTIMATE				
YEAR COST BASIS	2018			
TOTAL IMPOUNDMENT AREA (AC)	140			
TOTAL AREA TO BE RESTORED (AC)	145		VOLUME OF FREE WATER IN IMPOUNDMENT (GAL)	Not Used
IMPOUNDMENT AREA TO BE CLOSED-IN-PLACE (AC)	82		IMPOUNDMENT AREA TO BE CLOSURE BY REMOVAL (AC)	58
EXISTING ASH VOLUME IN AREA TO BE CLOSED-IN-PLACE (CY)	3,850,000		TOTAL ASH VOLUME FROM CLOSURE BY REMOVAL (CY)	1,650,000
TOTAL (FINAL) ASH VOLUME TO BE CLOSED-IN-PLACE (CY)	4,877,950		ŞTH OF CUT-SLOPE AT CLOSE-IN-PLACE / CLOSURE BY REMOVAL INTERFACE	1,100

HYBRID ESTIMATED COSTS

	TASK	ITEM	UNIT	QUANTITY	INSTALLED UNIT COST	IMPOUNDMENT CLOSURE COST	NOTES
STORMWATER MANAGEMENT / E&S CONTROLS / SITE RESTORATION	STORMWATER MANAGEMENT / E&S CONTROLS / SITE RESTORATION						
	23	PERMANENT RIPRAP STORMWATER CHANNELS	TON	7,250	$50	$362,500	Assume 10,000 lf x 10 ft. wide x 1 ft. thick, 145 pcf riprap lined stormwater channels.
	24	SITE EROSION AND SEDIMENT CONTROL	ACRE	145	$2,000	$289,000	Assume total area to be restored will require site erosion and sediment control.
	25	BACKFILL AND REGRADING OF CLOSURE BY REMOVAL AREA	CY	93,767	$13	$1,218,967	Assume 12-inches of additional soil material graded over total closure by removal area, to account for material removed by 1 foot overexcavation of CCR impacted soils.
	26	TOPSOIL	CY	0	$13	$0	Assume 6-inches of top soil needed to establish vegetative stabilization over total closure by removal area.
	27	SEED / FERTILIZE / MULCH	ACRE	145	$3,767	$544,295	Assume total area of disturbance will be mulched, fertilized, and seeded.
CONTINGENCY / ENGINEERING SUPPORT	CONTINGENCY / ENGINEERING SUPPORT						
	28	CONTINGENCY (25%)	LS	1	$20,958,009	$20,958,009	
	29	ENGINEERING SUPPORT (DESIGN & CQA)	LS	1	$4,500,000	$4,500,000	
POST-CLOSURE	POST-CLOSURE						
	30	GROUNDWATER MONITORING	ANNUAL	30	$493,000	$14,790,000	Annual groundwater monitoring costs for each CCR impoundment are based on current groundwater monitoring system
	31	OPERATIONS & MAINTENANCE (O&M)	ANNUAL	30	$285,016	$8,550,468	Annual O&M costs are 3475.80/ac/yr. Based on Q3 2018 Post Closure Maintenance data
CONTINGENCY / ENGINEERING COST	CONTINGENCY / ENGINEERING COST						
		CONTINGENCY (25%)	LS	1	$5,835,117	$5,835,117	
		ENGINEERING COST (10%)	LS	1	$2,917,559	$2,917,559	
		TOTAL				$141,383,190	

AECOM CALCULATION SHEET	PROJECT: CCR IMPOUNDMENT CLOSURE ESTIMATES FOR DUKE ENERGY	PLANT NAME: Mayo	CLOSURE TYPE: CCR Rule & CAMA Compliant	SHEET: Hybrid Assumptions	REV. NO.: 4
	SUBJECT: Preliminary Project Costs Sheets	IMPOUNDMENT NAME: Ash Basin	CLOSURE METHOD: Hybrid	CLOSURE YEAR: 0	AECOM JOB NO.: 60432144
	ACTIVITY: Hybid Closure Assumptions	CLOSURE OPTION: 1	LAST UPDATED BY: Claudia Prado	DATE LAST MODIFIED: 11/08/18	REVIEWED BY: JDP

KEY ASSUMPTIONS

The following key assumptions and limitations are associated with the project design, implementation and performance:

1	The cost estimates were prepared using 2018 dollars and do not include any escalation.
2	A 25% contingency has been included for this cost estimate.
3	The cost for Engineering Support (Design & CQA) for the Hybrid option assumes $3M for design and $1.5M for CQA (assuming CQA cost is $25K/month for 5 years)
4	The unit rate costs are based on AECOM & Duke experience.
5	Pore water to be partially removed from ash in closure by removal area using combination of open pit dewatering and rim-ditch/wet stack methods until material can be excavated and stockpiled. Assume saturated ash must be dewatered down to 30% moisture content to haul and place in close-in-place area. Assume treatment for TSS, pH, Arsenic & Selenium. Costs based on AECOM's estimates from Duke's dewatering projects.
6	Assume pore water removal and treatment is accounted for within close-in-place area time frame. Surface area to be regraded and limited surficial dewatering will be necessary prior to receipt of ash from closure-by-removal area.
7	Removal of existing structures/piping includes the excavation and disposal of existing structures within the limits of waste and the bulkheading or grouting of existing outlet pipes that extend beyond the limits of waste. This will be performed during the closure by removal of an impoundment.
8	Assumed all CCR material excavated must be stockpiled in close proximity to the impoundment to be decanted. After decanting, the material will be excavated, loaded, and hauled to an on-site impoundment to be closed-in-place.
9	Assume all material excavated from areas to be closed by removal will be used for crown construction/soil regrading for closed-in-place areas.
10	Assume an over-excavation of 1 foot is necessary to achieve closure by removal conditions.
11	Cap cross section for the CCR impoundment will consist of (from bottom to top): ash / geomembrane / geocomposite drainage layer / 24" protective cover soil. The top 6-inches will be topsoil, or soil ammended to enable vegetative growth.
12	Common soil for embankment and protective cover soil construction are available near-site and topsoil would come from offsite
13	Groundwater monitoring costs for CCR impoundment is based on current groundwater monitoring system, as provided by Duke.
14	O&M costs provided by Duke.
15	Statements of Probable Construction Cost prepared by AECOM represent AECOM's judgment as a design professional familiar with the construction industry. It is recognized, however, that neither AECOM nor the Owner has control over the cost of labor, materials or equipment nor over the contractor's methods of determining the bid price or other competitive bidding, market, or negotiating conditions. Accordingly, AECOM cannot and does not warrant or represent that proposals, bids or actual construction costs will not vary from any statement of Probable Construction Cost or other estimates or evaluations prepared by AECOM.

AECOM CALCULATION SHEET	PROJECT: CCR IMPOUNDMENT CLOSURE ESTIMATES FOR DUKE ENERGY	PLANT NAME: Mayo	CLOSURE TYPE: CCR Rule & CAMA Compliant	SHEET: Cost Summary	REV. NO.: 4
	SUBJECT: Preliminary Project Costs Sheets	IMPOUNDMENT NAME: Ash Basin	CLOSURE METHOD: Close-in-Place		AECOM JOB NO.: 60432144
	ACTIVITY: Cost Summary: Close-in-Place Cost Estimate for CCR Surface Impoundment	CLOSURE OPTION: 2	LAST UPDATED BY: Claudia Prado	DATE LAST MODIFIED: 11/8/2018	REVIEWED BY: KK

MAYO PLANT - OPTION 2 CLOSURE-IN-PLACE
Closure & Post Closure Cost Summary

Close-in-Place Tasks	Cost (2018 Dollars)
Mobilization / Site Prep	**$3,497,862**
Dewatering / Earthwork / Subgrade Prep.	**$21,819,450**
Closure System Construction	**$12,714,938**
Stormwater Management / E&S Controls / Site Restoration	**$19,349,095**
Contingency (25%)	**$14,345,336**
Engineering Support (Design and CQA)	**$2,900,000**
Total Closure Cost of CCR Impoundment =	**$74,626,681**

Post-Closure Tasks	Cost (2018 Dollars)
Groundwater Monitoring	**$14,790,000**
Operations & Maintenance (O&M)	**$14,598,360**
Contingency (25%)	**$7,347,090**
Engineering Costs (10%)	**$3,673,545**
Total Post-Closure of CCR Impoundment =	**$40,408,995**
Total Closure & Post-Closure of CCR Impoundment Cost =	**$115,035,676**

AECOM CALCULATION SHEET	PROJECT: CCR IMPOUNDMENT CLOSURE ESTIMATES FOR DUKE ENERGY	PLANT NAME: Mayo	CLOSURE TYPE: CCR Rule & CAMA Compliant	SHEET: Cost Summary	REV. NO.: 4
	SUBJECT: Preliminary Project Costs Sheets	IMPOUNDMENT NAME: Ash Basin	CLOSURE METHOD: Close-in-Place		AECOM JOB NO.: 60432144
	ACTIVITY: Close-in-Place Costs	CLOSURE OPTION: 2	LAST UPDATED BY: Claudia Prado	DATE LAST MODIFIED: 11/08/18	REVIEWED BY: JDP

BASIS OF THE ESTIMATE				
YEAR COST BASIS	2018		AREA OF OPEN FREE WATER IN IMPOUNDMENT (AC)	Not Used
TOTAL AREA TO BE RESTORED (AC)	140		AVG. DEPTH OF FREE WATER (FT)	Not Used
TOTAL IMPOUNDMENT AREA (AC)	140		VOLUME OF FREE WATER IN IMPOUNDMENT (GAL)	Not Used
VOLUME OF ASH IN IMPOUNDMENT (CY)	5,500,000			

CLOSE-IN-PLACE ESTIMATED COSTS

	TASK	ITEM	UNIT	QUANTITY	INSTALLED UNIT COST	IMPOUNDMENT CLOSURE COST	NOTES
MOBILIZATION/ SITE PREP	MOBILIZATION / SITE PREP						
	1	MOBILIZATION	LS	1	$633,217	$633,217	Mob/Demob & insurance: (1% of closure tasks) includes administration (mtgs, health & safety, trailer, phone/fax/electricity, temporary facilities, utilities, roll off boxes, waste disposal, and cleanup).
	2	ABANDON OUTLET STRUCTURES / PIPING	LS	1	$994,112	$994,112	Abandon existing outlet structures and piping.
	3	REMOVAL & FILTRATION OF FREE WATER	MONTHS	18.0	$103,919	$1,870,533	Initiation time
DEWATERING / EARTHWORK / SUBGRADE PREP	DEWATERING / EARTHWORK / SUBGRADE PREP						
	4	REMOVAL & TREATMENT OF PORE WATER WITHIN ASH	MONTHS	48.0	$225,832	$10,839,950	Construction Time
	5	RING DRAIN INSTALLATION	L.F.	25,000	$58	$1,439,500	Linear feet around the proposed cap.
	6	ASH REGRADING TO ESTABLISH CROWN	CY	1,000,000	$9.24	$9,240,000	Quantity of earthwory (cut-to-fill) using existing ash to achieve min. 1.5% valley profile prior to installation of closure system. Quantity calculated using AutoCAD.
	7	PERIMETER DITCH / TEMP. DIVERSION BERM GRADING	L.F.	25,000	$12	$300,000	Linear feet around the perimeter of impoundment.
CLOSURE SYSTEM CONSTRUCTION	CLOSURE SYSTEM CONSTRUCTION						
	8	FLEXIBLE MEMBRANE LINER (FML)	SQ. FT.	6,708,240	$0.42	$2,817,461	Flexible membrane liner placed over close-in-place area. Assume quantity needed is 10% more than close-in-place area.
	9	GEOCOMPOSITE DRAINAGE LAYER	SQ. FT.	6,708,240	$0.60	$4,024,944	Geocomposite drainage layer placed over close-in-place area. Assume quantity needed is 10% more than close-in-place area.
	10	GEOSYNTHETIC CLAY LINER (GCL)	SQ. FT.	0	$0.72	$0	not used
	11	18" PROTECTIVE COVER SOIL	CY	338,800	$13	$4,404,400	18 inches of common soil placed over closure by removal area
	12	6" TOPSOIL	CY	112,933	$13	$1,468,133	6 inches of topsoil placed over total impoundment area.
	13	COMPACTED LOW PERM. SOILS (Kv<1x10^-5 cm/sec)	CY	0	$12	$0	not used:

I/A

AECOM CALCULATION SHEET	PROJECT: CCR IMPOUNDMENT CLOSURE ESTIMATES FOR DUKE ENERGY	PLANT NAME: Mayo	CLOSURE TYPE: CCR Rule & CAMA Compliant	SHEET: Cost Summary	REV. NO.: 4
	SUBJECT: Preliminary Project Costs Sheets	IMPOUNDMENT NAME: Ash Basin	CLOSURE METHOD: Close-in-Place		AECOM JOB NO.: 60432144
	ACTIVITY: Close-in-Place Costs	CLOSURE OPTION: 2	LAST UPDATED BY: Claudia Prado	DATE LAST MODIFIED: 11/08/18	REVIEWED BY: JDP

BASIS OF THE ESTIMATE				
YEAR COST BASIS	2018		AREA OF OPEN FREE WATER IN IMPOUNDMENT (AC)	Not Used
TOTAL AREA TO BE RESTORED (AC)	140		AVG. DEPTH OF FREE WATER (FT)	Not Used
TOTAL IMPOUNDMENT AREA (AC)	140		VOLUME OF FREE WATER IN IMPOUNDMENT (GAL)	Not Used
VOLUME OF ASH IN IMPOUNDMENT (CY)	5,500,000			

CLOSE-IN-PLACE ESTIMATED COSTS

	TASK	ITEM	UNIT	QUANTITY	INSTALLED UNIT COST	IMPOUNDMENT CLOSURE COST	NOTES
STORMWATER MANAGEMENT / E&S CONTROLS / SITE RESTORATION	STORMWATER MANAGEMENT / E&S CONTROLS / SITE RESTORATION						
	14	EROSION AND SEDIMENT CONTROL	ACRE	140	$2,000	$280,000	Assume total area to be restored will require site erosion and sediment control.
	15	STORMWATER MANAGEMENT / CHANNELS / LET-DOWNS	L.F.	25,000	$742	$18,541,750	Assume rip-rap lined stormwater conveyance channels and rip-rap lined let-downs off of cap. Quantity assumed at 3 times perimeter
	16	SEED / FERTILIZE / MULCH	ACRE	140	$3,767	$527,345	Assume total area to be restored will be mulched, fertilized, and seeded.
CONTINGENCY / ENGINEERING SUPPORT	CONTINGENCY / ENGINEERING SUPPORT						
		CONTINGENCY (25%)	LS	1	$14,345,336	$14,345,336	
		ENGINEERING SUPPORT (DESIGN & CQA)	LS	1	$2,900,000	$2,900,000	
POST-CLOSURE	POST-CLOSURE						
	17	GROUNDWATER MONITORING	ANNUAL	30	$493,000	$14,790,000	Annual groundwater monitoring costs for each CCR impoundment are based on current groundwater monitoring system
	18	OPERATIONS & MAINTENANCE (O&M)	ANNUAL	30	$486,612	$14,598,360	Annual O&M costs are 3475.80/ac/yr. Based on Q3 2018 Post Closure Maintenance data
CONTINGENCY / ENGINEERING COST	CONTINGENCY / ENGINEERING COST						
		CONTINGENCY (25%)	LS	1	$7,347,090	$7,347,090	
		ENGINEERING COST (10%)	LS	1	$3,673,545	$3,673,545	
		TOTAL				$115,035,676	

AECOM CALCULATION SHEET	PROJECT	PLANT NAME:	CLOSURE TYPE:	SHEET	REV. NO.
	CCR IMPOUNDMENT CLOSURE ESTIMATES FOR DUKE ENERGY	Mayo	CCR Rule & CAMA Compliant	Close-in-Place Assumptions	4
	SUBJECT	**IMPOUNDMENT NAME:**	**CLOSURE METHOD:**		**AECOM JOB NO.**
	Preliminary Project Costs Sheets	Ash Basin	Close-in-Place		60432144
	ACTIVITY	**CLOSURE OPTION:**	**LAST UPDATED BY:**	**DATE LAST MODIFIED:**	**REVIEWED BY:**
	Close-in-Place Assumptions	2	Claudia Prado	11/08/18	JDP

KEY ASSUMPTIONS

The following key assumptions and limitations are associated with the project design, implementation and performance:

1	The cost estimates were prepared using 2018 dollars and do not include any escalation.
2	A 25% contingency has been included for this cost estimate.
3	The cost for Engineering Support (Design & CQA) for the Close-in-Place option assumes $2M for design and $900K for CQA (assuming CQA cost is $25K/month for 3 years)
4	The unit rate costs are based on AECOM & Duke experience.
5	Surface area to be regraded and limited surficial dewatering will be necessary.
6	Abandonment of existing structures/piping includes the demolition in-place or bulkheading of existing pipes and inlets/outlet structures, grouting of outlet pipes that extend beyond the limits of waste, and backfilling of existing structures in-place for the purposes of a close-in-place closure of an impoundment.
7	To establish the minimum top slopes of 2% (post settlement), assume existing ash will be utilized to establish crown.
8	Cap cross section for the CCR impoundment will consist of (from bottom to top): ash / geomembrane / geocomposite drainage layer / 24" protective cover soil. The top 6-inches will be topsoil, or soil
9	Common soil for embankment and protective cover soil construction are available onsite and topsoil would come from offsite
10	Groundwater monitoring costs are based on values provided by Duke.
11	O&M costs are based on values provided by Duke.
12	Statements of Probable Construction Cost prepared by AECOM represent AECOM's judgment as a design professional familiar with the construction industry. It is recognized, however, that neither AECOM nor the Owner has control over the cost of labor, materials or equipment nor over the contractor's methods of determining the bid price or other competitive bidding, market, or negotiating conditions. Accordingly, AECOM cannot and does not warrant or represent that proposals, bids or actual construction costs will not vary from any statement of Probable Construction Cost or other estimates or evaluations prepared by AECOM.

I/A

AECOM CALCULATION SHEET	PROJECT: CCR IMPOUNDMENT CLOSURE ESTIMATES FOR DUKE ENERGY	PLANT NAME: Mayo	CLOSURE TYPE: CCR Rule & CAMA Compliant	SHEET: Cost Summary	REV. NO.: 4
	SUBJECT: Preliminary Project Costs Sheets	IMPOUNDMENT NAME: Ash Basin	CLOSURE METHOD: Closure by Removal		AECOM JOB NO.: 60432144
	ACTIVITY: Cost Summary: Closure by Removal Cost Estimate for CCR Impoundment	CLOSURE OPTION: 3	LAST UPDATED BY: Claudia Prado	DATE LAST MODIFIED: 11/8/2018	REVIEWED BY: KK

MAYO PLANT - OPTION 3 CLOSURE BY REMOVAL: EXISTING ON-SITE LANDFILL

Closure & Post Closure Cost Summary

Closure by Removal Tasks	Cost (2018 Dollars)
Mobilization / Site Prep / Demobilization	**$6,349,444**
Dewatering / Excavation / Convey Material	**$93,563,111**
Onsite Landfill Construction, Disposal and Closure	**$51,709,494**
Stormwater Management / E&S Controls / Site Restoration	**$4,179,045**
Contingency (25%)	**$38,950,274**
Engineering Support (Design & CQA)	**$5,000,000**
Total Closure Cost of CCR Impoundment =	**$199,751,368**

Post-Closure Tasks	Cost (2018 Dollars)
Groundwater Monitoring	**$14,790,000**
Operations & Maintenance (O&M)	**$3,128,220**
Contingency (25%)	**$4,479,555**
Engineering Costs (10%)	**$2,239,778**
Total Post-Closure of CCR Impoundment =	**$24,637,553**

Total Closure & Post-Closure of CCR Impoundment Cost =	**$224,388,921**

AECOM CALCULATION SHEET	PROJECT: CCR IMPOUNDMENT CLOSURE ESTIMATES FOR DUKE ENERGY	PLANT NAME: Mayo	CLOSURE TYPE: CCR Rule & CAMA Compliant	SHEET: Closure by Removal Costs	REV. NO.: 4
	SUBJECT: Preliminary Project Costs Sheets	IMPOUNDMENT NAME: Ash Basin	CLOSURE METHOD: Closure by Removal		AECOM JOB NO.: 60432144
	ACTIVITY: Closure By Removal Costs	CLOSURE OPTION: 1/3/1900	LAST UPDATED BY: Claudia Prado	DATE LAST MODIFIED: 11/08/18	REVIEWED BY: KK

BASIS OF THE ESTIMATE				
YEAR COST BASIS	2018		AREA OF OPEN FREE WATER IN IMPOUNDMENT (AC)	Not Used
TOTAL AREA TO BE RESTORED (AC)	140		AVG. DEPTH OF FREE WATER (FT)	Not Used
TOTAL IMPOUNDMENT AREA (AC)	140		VOLUME OF FREE WATER IN IMPOUNDMENT (GAL)	Not Used
VOLUME OF ASH IN IMPOUNDMENT (CY)	5,500,000			

CLOSURE BY REMOVAL ESTIMATED COSTS

	TASK	ITEM	UNIT	QUANTITY	INSTALLED UNIT COST	IMPOUNDMENT CLOSURE COST	NOTES
	MOBILIZATION / SITE PREP / DEMOBILIZATION						
MOBILIZATION/ SITE PREP/ DEMOBILIZATION	1	MOBILIZATION / DEMOBILIZATION	LS	1	$1,614,266	$1,614,266	Mob/Demob & insurance: (1% of Total EPC Bid Price) includes administration (mtgs, health & safety, trailer, phone/fax/electricity, temporary facilities, utilities, roll off boxes, waste disposal, and cleanup).
	2	REMOVAL OF OUTLET STRUCTURES / PIPING	LS	1	$994,112	$994,112	Assume outlet structures and piping will be excavated and removed.
	3	REMOVAL & FILTRATION OF FREE WATER	MONTHS	36.0	$103,919	$3,741,066	Based on Initiation Time
	DEWATERING / EXCAVATION / CONVEY MATERIAL						
ACHIEVE CLOSURE BY REMOVAL/ CONVEY MATERIAL	4	REMOVAL & TREATMENT OF PORE WATER WITHIN ASH	MONTHS	84.0	$225,832	$18,969,912	Based on Construction Time
	5	EXCAVATE ASH FOR CLOSURE BY REMOVAL / STOCKPILE ASH	CY	5,500,000	$8	$44,000,000	Assume CCR material must be stockpiled within impoundment area to decant prior to loading. Done in conjunction with Step 1. Decant water collected and treated along with pore water from Step 1.
	6	EXCAVATE ASH FROM STOCKPILE / LOAD / HAUL ASH (DISPOSE ON-SITE)	CY	3,426,500	$8	$28,885,395	Once material has decanted, CCRs must be excavated out of stockpile, loaded on trucks and hauled to onsite disposal site. Quantity takes into consideration reduction of volume due to dewatering of ash down to 30% moisture content.
	7	EXCAVATE / LOAD / HAUL CCR-IMPACTED SOIL (ON-SITE)	CY	225,900	$8	$1,707,804	Assume 1 foot of additional material to be removed over total impoundment area (including upstream dam face).
	8	EXCAVATE / LOAD / HAUL CCR MATERIAL (OFF-SITE LF)	TON	0	$60	$0	Only include if disposing CCRS at an off-site landfill (assume density of 1.2 tons/cy)
	9	EXCAVATE / LOAD / HAUL CCR-IMPACTED SOIL (OFF-SITE LF)	TON	0	$57	$0	Only include if disposing CCRS at an off-site landfill (assume density of 1.2 tons/cy)
	ONSITE LANDFILL CONSTRUCTION, DISPOSAL AND CLOSURE						
ONSITE LANDFILL CONSTRUCTION, DISPOSAL AND CLOSURE	10	CONSTRUCT ON-SITE LANDFILL AND ASSOCIATED COMPONENTS	AC	30	$803,245	$24,097,350	Assume existing landfill designed and constructed in accordance with CAMA and CCR Rules. Additional acreage of liner needed to store an additional 5.5 million CY of CCR. Cost includes landfill construction and all associated components, including: liner system, leachate management, stormwater management, access roads, closure system and all associated components,etc.
	11	DISPOSE/SPREAD/COMPACT ASH AND CCR-IMPACTED MATERIALS FROM CLOSURE BY REMOVAL AREA IN ON-SITE LANDFILL	CY	3,652,400	$8	$27,612,144	Place, spread and compact in thin lifts dewatered ash and CCR-impacted materials excavated from closure by removal area into landfill.

I/A

AECOM CALCULATION SHEET	PROJECT: CCR IMPOUNDMENT CLOSURE ESTIMATES FOR DUKE ENERGY	PLANT NAME: Mayo	CLOSURE TYPE: CCR Rule & CAMA Compliant	SHEET: Closure by Removal Costs	REV. NO.: 4
	SUBJECT: Preliminary Project Costs Sheets	IMPOUNDMENT NAME: Ash Basin	CLOSURE METHOD: Closure by Removal		AECOM JOB NO.: 60432144
	ACTIVITY: **Closure By Removal Costs**	CLOSURE OPTION: 1/3/1900	LAST UPDATED BY: Claudia Prado	DATE LAST MODIFIED: 11/08/18	REVIEWED BY: KK

BASIS OF THE ESTIMATE				
YEAR COST BASIS	2018		AREA OF OPEN FREE WATER IN IMPOUNDMENT (AC)	Not Used
TOTAL AREA TO BE RESTORED (AC)	140		AVG. DEPTH OF FREE WATER (FT)	Not Used
TOTAL IMPOUNDMENT AREA (AC)	140		VOLUME OF FREE WATER IN IMPOUNDMENT (GAL)	Not Used
VOLUME OF ASH IN IMPOUNDMENT (CY)	5,500,000			

CLOSURE BY REMOVAL ESTIMATED COSTS

	TASK	ITEM	UNIT	QUANTITY	INSTALLED UNIT COST	IMPOUNDMENT CLOSURE COST	NOTES
STORMWATER MANAGEMENT / E&S CONTROLS / SITE RESTORATION	**STORMWATER MANAGEMENT / E&S CONTROLS / SITE RESTORATION**						
	10	PERMANENT RIPRAP STORMWATER CHANNELS	TON	8,700	$50	$435,000	Assume 12,000 lf x 10 ft. wide x 1 ft. thick, 145 pcf riprap lined stormwater channels.
	11	SITE EROSION AND SEDIMENT CONTROL	ACRE	140	$2,000	$280,000	Assume total area to be restored will require site erosion and sediment control.
	12	BACKFILL AND REGRADING	CY	225,900	$13	$2,936,700	Assumes entire restoration area with 1 foot of backfill material
	13	TOPSOIL	CY	0	$13	$0	Assume 6-inches of top soil needed to establish vegetative stabilization over total closure by removal area.
	14	SEED / FERTILIZE / MULCH	ACRE	140	$3,767	$527,345	Assume total area of disturbance will be mulched, fertilized, and seeded.
CONTINGENCY / ENGINEERING SUPPORT	**CONTINGENCY / ENGINEERING SUPPORT**						
		CONTINGENCY (25%)	LS	1	$38,950,274	$38,950,274	
		ENGINEERING SUPPORT (DESIGN & CQA)	LS	1	$5,000,000	$5,000,000	
POST-CLOSURE	**POST-CLOSURE**						
	15	GROUNDWATER MONITORING	ANNUAL	30	$493,000	$14,790,000	Annual groundwater monitoring costs for each CCR unit are based on current groundwater monitoring system
	16	OPERATIONS & MAINTENANCE (O&M)	ANNUAL	30	$104,274	$3,128,220	Annual O&M costs are 3475.80/ac/yr. Based on Q3 2018 Post Closure Maintenance data
CONTINGENCY / ENGINEERING COST	**CONTINGENCY / ENGINEERING COST**						
		CONTINGENCY (25%)	LS	1	$4,479,555	$4,479,555	
		ENGINEERING COST (10%)	LS	1	$2,239,778	$2,239,778	
		TOTAL				**$224,388,922**	

AECOM CALCULATION SHEET	PROJECT: CCR IMPOUNDMENT CLOSURE ESTIMATES FOR DUKE ENERGY	PLANT NAME: Mayo	CLOSURE TYPE: CCR Rule & CAMA Compliant	SHEET: Closure by Removal Assumptions	REV. NO.: 4
	SUBJECT: Preliminary Project Costs Sheets	IMPOUNDMENT NAME: Ash Basin	CLOSURE METHOD: Closure by Removal		AECOM JOB NO.: 60432144
	ACTIVITY: **Closure by Removal Assumptions**	CLOSURE OPTION: 3	LAST UPDATED BY: Claudia Prado	DATE LAST MODIFIED: 11/08/18	REVIEWED BY: KK

KEY ASSUMPTIONS

The following key assumptions and limitations are associated with the project design, implementation and performance:

1	The cost estimates were prepared using 2018 dollars and do not include any escalation.
2	A 25% contingency has been included for this cost estimate.
3	The cost for Engineering Support (Design & CQA) for the Closure by Removal w/ Onsite Landfill option assumes \$3.5M for design and \$1.5M for CQA (assuming CQA cost is \$25K/month for 5 years)
4	The unit rate costs are based on AECOM & Duke experience.
5	Removal of existing structures/piping includes the excavation and disposal of existing structures within the limits of waste and the bulkheading or grouting of existing outlet pipes that extend beyond the limits of waste. This will be performed during the closure by removal of an impoundment.
6	Pore water to be partially removed using combination of open pit dewatering and rim-ditch/wet stack methods until material can be excavated and stockpiled. Assume saturated ash must be dewatered down to 30% moisture content to haul and dispose on site. Assume treatment for TSS, pH, Arsenic & Selenium. Costs based on AECOM' estimates from Duke's dewatering projects.
7	Assumed all CCR material excavated must be stockpiled in close proximity to the impoundment to be decanted. After decanting, the material will be excavated, loaded, and hauled to the on-site landfill for disposal.
8	Costs for onsite landfill construction based on current construction and closure cost, as provided by Duke.
9	AECOM has assumed an over-excavation of 1 foot is necessary to achieve closure by removal conditions.
10	Groundwater monitoring costs for CCR unit is based on current groundwater monitoring system, as provided by Duke.
11	O&M costs provided by Duke.
12	Statements of Probable Construction Cost prepared by AECOM represent AECOM's judgment as a design professional familiar with the construction industry. It is recognized, however, that neither AECOM nor the Owner has control over the cost of labor, materials or equipment nor over the contractor's methods of determining the bid price or other competitive bidding, market, or negotiating conditions. Accordingly, AECOM cannot and does not warrant or represent that proposals, bids or actual construction costs will not vary from any statement of Probable Construction Cost or other estimates or evaluations prepared by AECOM.

Attachment C

Preliminary Scoring for Evaluation
Closure Options Evaluation
Ash Basin Closure - Master
Duke Energy

Zero (0) values have been entered in "Calculated or User Selected Score" under Beneficial Reuse to prevent division by zero error text in calculated score cells.

Site Name: Mayo Plant
11/13/2018

1	= Option-Specific User Input
1	= Calculated Value

Threshold Criteria: All closure options must comply with the following threshold criteria based on Duke Energy Guiding Principles for Ash Basin Closure
1. Provide continued geotechnical stability meeting appropriate safety factors under applicable loading conditions
2. Provide flow capacity and erosion resistance during design storm and flooding conditions
3. Effectively mitigate groundwater impacts (in conjunction with GW remediation where present)
4. Comply with applicable state and federal regulations (e.g. North Carolina Coal Ash Management Act)

Option	
1	Hybrid Closure
2	Closure In Place
3	Cosure By Removal: Existing On-site Landfill

Environmental Protection and Impacts	Weight:	30%	Units	User Input			Value that Scores 10	Value that Scores 0	Calculated or User Selected Score			Criterion Weight	Contribution to Total Score
Criterion	**Scoring System**	**Required Input**		**Option 1**	**Option 2**	**Option 3**			**Option 1**	**Option 2**	**Option 3**		
Modeled plume intersecting surface water	Refer to GW Sub-Scoring Sheet	Please refer to the Groundwater Sub-Scoring Document for details							10	10	10	23.8%	7.1%
Modeled groundwater impact beyond the current compliance boundary	Refer to GW Sub-Scoring Sheet	Please refer to the Groundwater Sub-Scoring Document for details							10	10	10	23.8%	7.1%
Modeled off-site groundwater impact	Refer to GW Sub-Scoring Sheet	Please refer to the Groundwater Sub-Scoring Document for details							10	10	10	23.8%	7.1%
Relative rank based on visual interpretation of modeled boron plume	Refer to GW Sub-Scoring Sheet	Please refer to the Groundwater Sub-Scoring Document for details							5	0	10	13.6%	4.1%
Air emissions off-site (based on miles driven round-trip)	Interpolation. Min value scores 10. Max value scores 0.	Truck miles driven	Miles	0	0	2	0	2	10	10	0	5.0%	1.5%
Air emissions on-site cubic yards of excavation/movement	Interpolation. Min value scores 10. Max value scores 0.	Volume of material excavation/movement	Cu.Yds	2,520,000	1,050,000	6,526,000	1,050,000	6,526,000	7	10	0	5.0%	1.5%
Avoidance of greenfield disturbance	Interpolation. Min value scores 10. Max value scores 0.	Disturbed acres of greenfield	Acres	4.5	30	30	4.5	30	10	0	0	5.0%	1.5%
Weighted Totals (Contribution to Total Score)									**2.75**	**2.44**	**2.55**		

Cost	Weight:	35%	Units	User Input			Value that Scores 10	Value that Scores 0	Calculated or User Selected Score			Criterion Weight	Contribution to Total Score
Criterion	**Scoring System**	**Required Input**		**Option 1**	**Option 2**	**Option 3**			**Option 1**	**Option 2**	**Option 3**		
Closure Cost	Interpolation. Min value scores 10. Max value scores 0.	Closure Cost	USD	$109,290,046	$74,626,681	$199,751,368	$ 74,626,681	$ 199,751,368	7.2	10.0	0.0	80.0%	28.0%
Operation, Maintenance and Monitoring Cost		OM&M Cost	USD	$32,093,144	$40,408,995	$24,637,553	$ 24,637,553	$ 40,408,995	5.3	0.0	10.0	20.0%	7.0%
Weighted Totals (Contribution to Total Score)									**2.39**	**2.80**	**0.70**		

I/A

Preliminary Scoring for Evaluation
Closure Options Evaluation
Ash Basin Closure - Master
Duke Energy

Zero (0) values have been entered in "Calculated or User Selected Score" under Beneficial Reuse to prevent division by zero error text in calculated score cells.

Site Name: Mayo Plant
11/13/2018

1 = Option-Specific User Input
1 = Calculated Value

Schedule	Weight:	15%	Units	User Input			Value that Scores 10	Value that Scores 0	Calculated or User Selected Score			Criterion Weight	Contribution to Total Score
Criterion	Scoring System	Required Input		Option 1	Option 2	Option 3			Option 1	Option 2	Option 3		
Initiation Time	Interpolation. Min value scores 10. Max value scores 0.	Time to move first ash	Months	36	18	36	18	36	0	10	0	30.0%	4.5%
Construction Duration		Estimated durations	Months	60	48	84	48	84	7	10	0	70.0%	10.5%
Weighted Totals (Contribution to Total Score)									**0.74**	**1.50**	**0.00**		

Regional Factors	Weight:	15%	Units	User Input			Value that Scores 10	Value that Scores 0	Calculated or User Selected Score			Criterion Weight	Contribution to Total Score
Criterion	Scoring System	Required Input		Option 1	Option 2	Option 3			Option 1	Option 2	Option 3		
Plan or potential for beneficial reuse of site	Subjective	Not Used For Subjective Scoring							0	0	0	5.0%	0.8%
Imported soil needs	Interpolation. Min value scores 10. Max value scores 0.	Soil Imported	CY	0	402,000	0	0	402,000	10	0	10	5.0%	0.8%
Beneficial reuse of CCR	Interpolation. Max value scores 10. Zero value scores 0.	Fraction Used	None	0	0	0	0	0	0	0	0	15.0%	2.3%
Transportation impact (based on miles driven)	Interpolation. Min value scores 10. Max value scores 0.	Miles Driven	Miles	0	0	2	0	2	10	10	0	65.0%	9.8%
Noise impact due to on-site activity (based on proximity of neighbors to on-site work areas)	Subjective 0 to 10: 10 is the least noise; 0 is the most noise.	Not Used For Subjective Scoring							7	10	0	5.0%	0.8%
View impact (based on final height of storage facility and land uses within viewshed)	Subjective 0 to 10; 10 is the least visual; 0 is the most visual.								7	9	8	5.0%	0.7%
Weighted Totals (Contribution to Total Score)									**1.16**	**1.12**	**0.14**		

Constructability	Weight:	5%	Units	User Input			Value that Scores 10	Value that Scores 0	Calculated or User Selected Score				
Criterion	Scoring System	Required Input		Option 1	Option 2	Option 3			Option 1	Option 2	Option 3		
Consider stormwater management, geotechnical, and dewatering	Subjective 0 to 10: 10 is the least complicated; 0 is the most complicated	Not Used For Subjective Scoring							3	8	6	100.0%	5.0%
Weighted Totals (Contribution to Total Score)									**0.15**	**0.40**	**0.30**		
Total Score For Each Option (On a Scale of 0 to 10)									**7.18**	**8.26**	**3.69**		

Criteria for Evaluation of Closure Options
Closure Options Evaluation Worksheet
Ash Basin Closure - Master Programmatic Document
Duke Energy

Threshold Criteria: All closure options must comply with the following threshold criteria based on Duke Energy Guiding Principles for Ash Basin Closure
1. Provide continued geotechnical stability under applicable loading conditions and safety factors
2. Provide flow capacity and erosion resistance during design storm and flooding conditions
3. Effectively mitigate groundwater impacts
4. Comply with applicable state and federal regulations (e.g. North Carolina Coal Ash Management Act)

Category	Criterion	Guidance
Environmental Protection and Impacts	Modeled plume intersecting surface water	Please refer to the Groundwater Sub-Scoring Document for details
	Modeled groundwater impact beyond the current compliance boundary	Please refer to the Groundwater Sub-Scoring Document for details
	Modeled off-site groundwater impact	Please refer to the Groundwater Sub-Scoring Document for details
	Relative rank based on visual interpretation of modeled boron plume	Please refer to the Groundwater Sub-Scoring Document for details
	Air emissions off-site (based on miles driven round-trip)	Based on truck miles driven for hauling CCR and soil.
	Air emissions on-site cubic yards of excavation/movement	Based on total cubic yards of cut and fill on site as a surrogate for gallons of fuel consumed.
	Avoidance of greenfield disturbance	Refer to Scoring System and Required Input columns on scoring sheet.
Cost	Capital Cost	From rough order-of-magnitude cost estimate or detailed cost estimate.
	Operation, Maintenance and Monitoring Cost	
Schedule	Initiation Time	From preliminary schedule for designing, permitting, bidding and constructing the option.
	Construction Duration	
Regional Factors	Plan or potential for beneficial reuse of site	Refer to Scoring System and Required Input columns on scoring sheet.
	Imported soil needs	Refer to Scoring System and Required Input columns on scoring sheet.
	Beneficial reuse of CCR	Refer to Scoring System and Required Input columns on scoring sheet.
	Transportation impact	Based on truck miles driven for hauling CCR and CCR-contaminated soil.
	Noise impact due to on-site activity	Based on proximity of neighbors to specific on-site work areas.
	View impact	Based on final height of storage facility and land uses within viewshed.
Constructability	Consider stormwater management, geotechnical, and dewatering	Subjective and relative comparison to other options

Environmental Groundwater Sub-scoring Worksheet
Closure Options Evaluation
Duke Energy

Mayo Ash Basin Groundwater Sub-Scoring Document

Station/Plant Name: Mayo Steam Electric Plant

Scored by: TH, RC, KW on 11/9/18

Evaluation Criteria:

Criteria 1. Modeled Plume Intersecting Surface Water	Score			
Modeled plume[1] does not intersect surface waters after 10 years	10			
Modeled plume[1] does not intersect surface waters after 100 years	5			
Modeled plume[1] does not intersect surface waters after 200 years	0	(Option 1)	(Option 2)	(Option 3)
		Hybrid Closure	Closure In Place	Closure By Removal: Existing Onsite Landfill
Criteria 1 Score		10	10	10

Criteria 2. Groundwater Impact Beyond the current[2] Compliance Boundary	Score			
Modeled plume[1] is within current compliance boundary after 10 years	10			
Modeled plume[1] is within current compliance boundary after 100 years	5			
Modeled plume[1] is within current compliance boundary after 200 years	0	(Option 1)	(Option 2)	(Option 3)
		Hybrid Closure	Closure In Place	Closure By Removal: Existing Onsite Landfill
Criteria 2 Score		10	10	10

Criteria 3. Modeled Off-site Impact	Score			
Modeled plume[1] does not go off-site	10			
Modeled plume[1] is predicted to remain off-site after 100 years	5			
Modeled plume[1] is predicted to remain off-site after 200 years	0			
		(Option 1)	(Option 2)	(Option 3)
		Hybrid Closure	Closure In Place	Closure By Removal: Existing Onsite Landfill
Criteria 3 Score		10	10	10

Criteria 4. Relative rank based on visual interpretation of modeled boron plume	Score			
Ranked #1 among the three Closure Options based on visual interpretation of modeled boron plume	10			
Ranked #2 among the three Closure Options based on visual interpretation of modeled boron plume	5			
Ranked #3 among the three Closure Options based on visual interpretation of modeled boron plume	0			
		(Option 1)	(Option 2)	(Option 3)
		Hybrid Closure	Closure In Place	Closure By Removal: Existing Onsite Landfill
Criteria 4 Score		5	0	10

Note 1: Based on avaliable data at the time of scoring, the modeled plume considered boron at a concentration of 4,000 ug/l or greater; 4,000 µg/L does not represent a remediation goal, however this concentration does represent the EPA Tap Water Regional Screening Level (RSL) in resident tapwater for boron.

Note 2: The current compliance boundary is the compliance boundary found in the figure "Waste and Compliance Boundaries" provided to NCDEQ on 2/15/18

Environmental Groundwater Sub-scoring Worksheet
Closure Options Evaluation
Duke Energy

Mayo Ash Basin Groundwater Sub-Scoring Document Justification

Justification Notes	(Option 1) Hybrid Closure	(Option 2) Closure In Place	(Option 3) Closure By Removal: Existing Onsite Landfill
Criteria 1. Modeled Plume Intersecting Surface Water	**10** Based on the predictive model for the year 2027, found in the November 2018 Preliminary Updated Groundwater Flow and Transport Modeling Report for Mayo Steam Electric Plant, simulated boron concentrations for the Hybrid Closure scenario with natural attenuation did not show boron of 4,000 ppb or greater intercepting surface water bodies.	**10** Based on the predictive model for the year 2027, found in the November 2018 Preliminary Updated Groundwater Flow and Transport Modeling Report for Mayo Steam Electric Plant, simulated boron concentrations for the Closure-In-Place scenario with natural attenuation did not show boron of 4,000 ppb or greater intercepting surface water bodies.	**10** Based on the predictive model for the year 2027, found in the November 2018 Preliminary Updated Groundwater Flow and Transport Modeling Report for Mayo Steam Electric Plant, simulated boron concentrations for the Closure By Removal scenario with natural attenuation did not show boron of 4,000 ppb or greater intercepting surface water bodies.
Criteria 2. Groundwater Impact Beyond the Current Compliance Boundary	**10** Based on the predictive model summary of concentrations over time, model found in the November 2018 Preliminary Updated Groundwater Flow and Transport Modeling Report for Mayo Steam Electric Plant, simulated boron concentrations for theHybrid Closure scenario with natural attenuation did not show boron of 4,000 ppb or greater beyond the current (2018) compliance boundary (Point 1).	**10** Based on the predictive model summary of concentrations over time, found in the November 2018 Preliminary Updated Groundwater Flow and Transport Modeling Report for Mayo Steam Electric Plant, simulated boron concentrations for the Closure-In-Place scenario with natural attenuation did not show boron of 4,000 ppb or greater beyond the current (2018) compliance boundary (Point 1).	**10** Based on the predictive model summary of concentrations over time, found in the November 2018 Preliminary Updated Groundwater Flow and Transport Modeling Report for Mayo Steam Electric Plant, simulated boron concentrations for the Closure By Removalscenario with natural attenuation did not show boron of 4,000 ppb or greater beyond the current (2018) compliance boundary (Point 1).
Criteria 3. Modeled Off-site Impact	**10** Based on the predictive model for the year 2017 and beyond, found in the November 2018 Preliminary Updated Groundwater Flow and Transport Modeling Report for Mayo Steam Electric Plant, simulated boron concentrations for the Hybrid Closure scenario with natural attenuation did not show boron of 4,000 ppb or greater off of Duke Energy property.	**10** Based on the predictive model for the year 2017 and beyond, found in the November 2018 Preliminary Updated Groundwater Flow and Transport Modeling Report for Mayo Steam Electric Plant, simulated boron concentrations for the Closure-In-Place scenario with natural attenuation did not show boron of 4,000 ppb or greater off of Duke Energy property.	**10** Based on the predictive model for the year 2017 and beyond, found in the November 2018 Preliminary Updated Groundwater Flow and Transport Modeling Report for Mayo Steam Electric Plant, simulated boron concentrations for the Closure By Removal scenario with natural attenuation did not show boron of 4,000 ppb or greater off of Duke Energy property.
Criteria 4. Relative rank based on visual interpretation of modeled boron plume	**5** Based on a review of boron concentrations found in the November 2018 Preliminary Updated Groundwater Flow and Transport Modeling Report for Mayo Steam Electric Plant, this scenario is marginally better than Option 2 Closure-in-Place.	**0** Based on a review of boron concentrations found in the November 2018 Preliminary Updated Groundwater Flow and Transport Modeling Report for Mayo Steam Electric Plant, this scenario is not marginally better than Option 1 Hybrid Closure or Options 3 Closure By Removal.	**10** Based on a review of boron concentrations found in the November 2018 Preliminary Updated Groundwater Flow and Transport Modeling Report for Mayo Steam Electric Plant, this scenario is marginally better than Option 1 Hybrid Closure and Option 2 Close-In-Place.

Notes:
1. Based on avaliable data at the time of scoring, the modeled plume considered boron at a concentration of 4,000 ug/l or greater; 4,000 µg/L does not represent a remediation goal, however this concentration does represent the EPA Tap Water Regional Screening Level (RSL) in resident tapwater for boron.
2. The current compliance boundary, as of 10/9/18, was used for all scenarios for criteria 2.

Roxboro Steam Electric Plant East Ash Basin (EAB) Closure Options Analysis Summary Report

This summary report (Report) presents the Closure Options Evaluation for the Roxboro East Ash Basin (EAB) located at Duke Energy Progress Roxboro Steam Electric Plant, located at 1700 Dunnaway Road, Semora, Person County, North Carolina. The Closure Options Evaluation involved developing ash basin closure strategies and evaluating these options relative to one another to determine which option to advance to more detailed engineering and closure plan development. The strategies discussed in the Closure Options Evaluation are representative of the range of possible approaches for basin closure, and do not constitute final closure plans as described in N.C. Gen. Stat. sec. 130A-309.214(a)(4). Final closure plans will be submitted in 2019, as required by law, supported by detailed engineering designs and any necessary updates to groundwater modeling and related analysis.

Duke Energy developed programmatic guidance for the closure analysis effort in early 2016 to provide fleet-wide consistency to ash basin closure plan development. Duke Energy developed a relative weighting and scoring system with input from the National Ash Management Advisory Board (NAMAB). Using this system, Duke Energy evaluated and scored the alternatives using an options analysis framework designed to identify the solution that balances environmental protection, cost, schedule and local community impacts. It is noted that internal working draft versions of these 2015-2016 options analyses for Allen, Belews Creek, Cliffside, Marshall, Mayo, and Roxboro were provided to NCDEQ,at its request, in May and June 2018.

The 2016 internal working draft options analysis identified Closure-in-Place as the preferred solution for Roxboro East Ash Basin (EAB) that is protective of the environment, safely closes the ash basin, minimizes the other associated risks, and was the least cost to customers. A permit-level design was developed for that option in 2016. The company then paused that work, pending determination that the site would meet the requirements for a low-risk impoundment classification pursuant to CAMA, as amended by House Bill 630. Duke Energy has completed those requirements at the Roxboro EAB site for a low-risk classification and now has updated this analysis.

SITE BACKGROUND

The Roxboro Steam Electric Plant consists of four coal-fired units with a combined generating capacity of 2,422 megawatts. The plant began operation in 1966, with capacity additions in 1973 and 1980, and is currently in active operation. Fly ash material is currently conveyed from operating units by a pneumatic (dry) handling system for disposal on-site or commercial reuse off-site. For on-site disposal, the dry fly ash is conveyed to silos, transferred to trucks, and then hauled for final disposal at an on-site permitted industrial landfill area within the EAB area. For commercial reuse, the dry fly ash is loaded on trucks from the collection silos and then transported off-site. Bottom ash and pyrite CCR material are currently conveyed by wet sluicing methods for operating units and deposited within the active West Ash Basin (WAB). Flue gas desulfurization (FGD) technology has been installed to reduce sulfur dioxide emissions for the operating units. Gypsum material produced by scrubber operations is either reused by a nearby commercial wallboard production plant or transported to the on-site industrial landfill for disposal. Wastewater from scrubber operations is conveyed to the FGD Pond and bioreactor treatment facilities, located within the WAB. Stormwater and landfill leachate discharge from the Roxboro EAB currently flows into the WAB and then is released into the plant heated water discharge canal, which is part of the wastewater treatment system under the NPDES permit. The discharge flow is ultimately released into Hyco Lake through NPDES Outfall 003. The scope of EAB closure will also include the EAB Eastern Extension Impoundment area located east of the EAB Industrial Landfill area.

The East Ash Basin has one dam that is regulated by the North Carolina Department of Environmental Quality (NCDEQ): EAB Main Dam – State ID PERSO-033.

Figure 1 below presents the East Ash Basin and other related site features.

Figure 1. East Ash Basin and Related Site Features

CLOSURE OPTIONS

For the Roxboro East Ash Basin, under the direction of Duke Energy, Wood developed the following conceptual closure options that remain under evaluation:

- EAB Option 1: Closure-in-Place
- EAB Option 2: Closure-by-Removal (with Off-site disposal at Mayo Landfill)
- EAB Option 3: Closure-in-Place Hybrid (Partial Removal/Off-site disposal at Mayo Landfill)
- EAB Option 4: Closure-by-Removal (On-site new Landfill)

EAB Option 1 consists of closure for the EAB with the exception of the area within the limits of the permitted overfill landfill. For the EAB closure area, the ash deposits will be graded for proper drainage, and then capped with an infiltration barrier/cap system meeting the requirements of the Federal Coal Combustion Residuals (CCR) Rule and N.C. Coal Ash Management Act (CAMA). The scope also includes removal and disposal of ash and impacted soil/sediment material within the EAB Eastern Extension Impoundment and stabilization of the separator berm located on the east side of the EAB Industrial Landfill adjacent to the EAB Eastern Extension Impoundment. This option is represented by the attached Figure EAB 1.1, Figure REAB 0.1, and Figure REAB 2B.2.

EAB Option 2 consists of closure for the EAB including the removal of the existing overfill landfill and the deposited ash and impacted soil beneath it. For the EAB closure area, the ash and impacted soil will be excavated, transported and placed in a permitted landfill located at the Mayo Steam Electric Plant. This industrial landfill would be constructed with a base liner system and an infiltration barrier/cap system meeting the requirements of the Federal CCR Rule and CAMA. The scope also includes removal and disposal of ash and impacted soil/sediment material within the EAB Eastern Extension Impoundment, and removal of the separator berm and the ash and impacted soil beneath it, located on the east side of the EAB Industrial Landfill adjacent to EAB Eastern Extension Impoundment. This option is represented by the attached Figure EAB 2.1/3.1, Figure EAB 2.2, Figure REAB 0.1, and Figure REAB 2B.2.

EAB Option 3 consists of closure for the EAB with the exception of the area within the limits of the permitted overfill landfill. For the EAB closure area, a limited area of the existing ash deposits will be designated for Closure-by-Removal for possible use as a future expansion site for the EAB industrial landfill. For this option, the ash and impacted soil will be excavated, transported, and placed in a permitted landfill located at the Mayo Steam Electric Plant. This industrial landfill would be constructed with a base liner system and an infiltration barrier/cap system meeting the requirements of the Federal CCR Rule and CAMA. The remaining ash deposits within the unexcavated EAB closure area will be graded for proper drainage and then capped with an infiltration barrier/cap system meeting the requirements of the Federal CCR Rule and CAMA. The scope also includes removal and disposal of ash and impacted soil/sediment material within the EAB Eastern Extension Impoundment, and stabilization of the Separator Berm located on the east side of the EAB Industrial Landfill adjacent to the EAB Eastern Extension Impoundment. This option is represented by the attached Figure EAB 2.1/3.1, Figure EAB 3.2, Figure REAB 0.1, and Figure REAB 2B.2.

EAB Option 4 consists of closure for the EAB including the removal of the existing overfill landfill and the deposited ash and impacted soil beneath it. For the EAB closure area, the ash and impacted soil will be excavated, transported and placed in a permitted landfill located on-site to the south of the EAB and immediately east of the WAB. This industrial landfill would be constructed with a base liner system and an infiltration barrier/cap system meeting the requirements of the Federal CCR Rule and CAMA. It would require a finger of the WAB to be excavated and backfilled first to establish the applicable base design. The scope also includes removal and disposal of ash and impacted soil/sediment material within the EAB Eastern Extension Impoundment, and removal of the separator berm and the ash and impacted soil beneath it, located on the east side of the EAB Industrial Landfill adjacent to EAB Eastern Extension Impoundment. This option is represented by the attached Figure EAB 4.1, Figure EAB 4.2, Figure REAB 0.1, and Figure REAB 2B.2.

Tables 1, 2, and 3 of this report represent a tabulated summary of each evaluated closure option, estimated quantities of ash and soil materials associated with each closure option, and a more detailed overview of each closure option presented.

Attachment A of this report includes figures and reference drawings to support conceptual review and scope development for each closure option as follows:

- Figure EAB 1.1 - EAB Closure Option 1 Concept Plan
- Figure EAB 2.1/3.1 – EAB Closure Options 2 & 3 - Location for Off-site Mayo Industrial Landfill & Haul Path
- Figure EAB 2.2 - EAB Closure Option 2 Concept Plan
- Figure EAB 3.2 - EAB Closure Option 3 Concept Plan
- Figure EAB 4.1 – EAB Closure Option 4 Concept Plan
- Figure EAB 4.2 – Proposed Landfill Area C
- Figure REAB 0.1 –Existing Conditions Plan for EAB Eastern Extension Impoundment
- Figure REAB 2B.2 –Schematic Section for Closure-by-Removal of EAB Eastern Extension Impoundment)

Attachment B includes rough order of magnitude (ROM) cost estimates for each closure option.

Attachment C contains the scoring matrix which summarizes the composite scores of the various closure options, the assumptions of which are outlined in Table 3 for each particular option.

METHODOLOGY

A scoring matrix was prepared to provide consistent evaluation of closure options for each of the various site locations. This scoring evaluation tool can be found in Attachment C and considers the following primary criteria:

- Environmental Protection and Impacts
- Cost
- Schedule
- Regional Factors
- Constructability

Rough Order of Magnitude Costs

Rough order of magnitude (ROM) Class 5 cost estimates were prepared for each of the closure options, based on information and quantities developed during the conceptual design activities. The estimated costs include construction, permitting, engineering design, post-construction O&M, and groundwater monitoring. A tabulated summary of the preliminary closure cost estimates for the options considered is provided the following table:

Summary of Current ROM Cost Estimates

Closure Option	Option Description	Total Estimated Cost	Estimated Post-Closure Maintenance Cost (30 Years)
EAB Option 1	Closure-in-Place	$26,867,192	$6,569,262
EAB Option 2	Closure-by-Removal (to Mayo Landfill)	$757,555,868	$10,250,134
EAB Option 3	Closure-in-Place Hybrid (Partial Removal to Mayo Landfill)	$50,308,911	$7,820,550
EAB Option 4	Closure-by-Removal (On-site new Landfill)	$503,782,503	$10,250,134

As indicated by the cost estimate summary, EAB Option 1 - Closure-in-Place has the lowest total estimated cost, which is primarily attributed to the additional cost for dewatering, excavation, hauling, and landfill development associated with other options considered. Option 4 reflects the lower estimated costs associated with on-site disposal compared to transportation off-site as estimated in Option 2. Detailed tabulated ROM cost estimates are included in Attachment B. Options 1 and 3 don't include the final cover of the landfill because that final cover closure requirement is part of the landfill permit. This is the reason why those cost estimates are so much less .

Schedule

Within the scoring evaluation, estimates of the length of time required to initiate closure activities and the anticipated construction duration are provided for each option.

The construction durations were estimated based on an assumed material excavation/movement of 1 million cubic yards/year; therefore, Options 2 and 4 - Closure-By-Removal have longer construction durations, as they require the movement of all ash materials, compared to the Hybrid and Closure-In-Place options.

Option 1 is estimated to take 52 months or 4.4 years. Option 2 is estimated to take 202 months or 16.9 years. Option 3 is estimated to take 58 months, or 4.8 years. Option 4 is estimated to take 202 months, or 16.9 years.

Options 2 and 4 as estimated would extend beyond the current CAMA deadline of 2029 but are included for transparency of the full excavation scenarios.

Evaluation Criteria

This options analysis was developed as a decision-making tool in selection of closure options when multiple methods are allowed under applicable regulations. The intent was to develop a decision framework that used weighting factors to balance environmental factors, cost, and the safety of workers and the public. The options analysis incorporates Duke Energy's obligation as a public utility to ensure that its closure decisions are protective of the environment and communities, while also being prudent from a cost-effectiveness perspective.

The analysis considered multiple aspects in each criterion, including surface water impacts, groundwater impacts, air emissions, greenfield disturbance, construction duration, imported soil needs, transportation and noise impacts, stormwater management, long-term maintenance needs and post-closure monitoring.

The company then combined these elements to provide a weighted sum for each criterion using the following weights: environmental considerations (30%), cost (35%), schedule (15%), regional/community factors (15%) and constructability (5%.). Duke Energy placed primary emphasis on environmental factors and cost, which were approximately equal in weight. When considering all of the criteria and associated weightings, the environmental considerations have a slightly higher weight than cost with the inclusion of certain regional/community factors (transportation impact, noise impact, view impact) which are effectively environmental considerations.

The scoring matrix provided in Attachment C, scores each option on a scale of 0 (least favorable) to 10 (most favorable) for each of the specified criteria. The scores for each option are then summed based on specified criterion weighting, resulting in an overall weighted score for each option. The results of the scoring evaluation for the Roxboro EAB closure options are summarized in the following table:

Summary of Closure Options Evaluation Scoring

Criterion	**Option**			
	1	**2**	**3**	**4**
Environmental Protection and Impacts	1.74	1.83	1.94	1.9
Cost	3.50	0.00	3.19	1.0
Schedule	1.50	0.0	1.05	0.0
Regional Factors	1.41	0.04	1.31	1.0
Constructability	0.50	0.00	0.25	0.00
Total Score	**8.65**	**1.87**	**7.74**	**3.9**

DISCUSSION

The options analysis finds relatively similar rankings for environmental protection and impacts which considers impacts to groundwater, surface water, air emissions based on miles driven, and avoidance of greenfield disturbance. The analysis incorporates the latest groundwater modeling of the Roxboro EAB that demonstrates groundwater near the basin responds similarly for several decades in all closure options evaluated. The current modeling does not incorporate capping or removal of other potential sources, subject to different legal requirements. If these additional areas were included, the closure would take longer, cost more, and potentially disturb more habitat.

In terms of duration of work and closure time, the Closure-In-Place scenario is expected to be completed in 4.4 years, compared to the Closure-By-Removal options 2 and 4 which are expected to take 16.9 years.

Other aspects considered include regional impacts to the community related to imported soil needs, transportation and noise. For the off-site landfill option, the Mayo landfill is located 15 miles from the Roxboro site off a public two-lane highway, which would present a degree of safety risk and road congestion issues in an excavation scenario as shown in Option 2.

The Closure-By-Removal options are many multiples of the estimated cost of the Closure-In-Place option and cause other unnecessary community impacts with little compelling environmental benefit. While long-term modeling indicates a quicker reduction in the boron plume within the immediate vicinity of the basin footprint for the Closure-By-Removal scenarios, compared to the Closure-in-Place and Hybrid scenarios, the modeled concentration points evaluated over time at downstream locations are nearly identical for all the closure options. Moreover, the quicker reduction is partially offset by the fact that the modeled improvement is delayed in the Closure-By-Removal scenarios, compared to the Closure-in-Place scenario, due to the extended construction time. In any event, the minor change in modeled plume size, within the immediate vicinity of the basin footprint, is not enough to justify the cost of the Closure-by-Removal scenarios, particularly when the impact and improvement do not materially affect neighbors or other potential receptors.

The Hybrid Closure option ranks closely with Closure-In-Place but also does not appear to produce environmental benefits commensurate with the added cost. In addition, the Hybrid Closure option presents concerns for construction feasibility associated with partial removal of ash and slope stabilization.

CONCLUSION

Based on the conceptual designs for the selected closure options and evaluation of the criteria established (environmental protection/impacts, cost, schedule, regional factors and constructability), Closure-In-Place option (#1) or the Hybrid option (#3) were identified as the preferred options that best balance the various considerations associated with basin closure.

ATTACHMENTS

- Table 1 – Closure Option Summary (Identification of Options)
- Table 2 – Estimated Quantity Summary
- Table 3 – Closure Options Detail Descriptions
- Attachment A – Figures and Reference Drawings
- Attachment B - Rough Order of Magnitude (ROM) Cost Estimates
- Attachment C – Closure Options Evaluation Scoring Matrix

Option	Description
EAB Option 1 – Closure-in-Place Option	EAB Option 1 consists of closure for the EAB with the exception of the area within the limits of the permitted overfill landfill. For the EAB closure area, the ash deposits will be graded for proper drainage, and then capped with an infiltration barrier/cap system meeting the requirements of the Federal Coal Combustion Residuals (CCR) Rule and N.C. Coal Ash Management Act (CAMA). The scope also includes removal and disposal of ash and impacted soil/sediment material within the EAB Eastern Extension Impoundment, and stabilization of the Separator Berm located on the east side of the EAB Industrial Landfill adjacent to the EAB Eastern Extension Impoundment.
EAB Option 2 – Closure-by-Removal Option	EAB Option 2 consists of excavating ash material and a 1-ft thick soil layer within the limits for the EAB area including the limits of the permitted landfill area, both ash material in the landfill phases and the pond ash below the landfill. For the EAB closure area, the ash and impacted soil will be excavated, transported and placed in a permitted landfill located at the Mayo Steam Electric Plant. This industrial landfill would be constructed with a base liner system and an infiltration barrier/cap system meeting the requirements of the Federal CCR Rule and CAMA. The scope also includes removal and disposal of ash and impacted soil/sediment material within the EAB Eastern Extension Impoundment, and removal of the Separator Berm and the underlying ash and impacted soil located on the east side of the EAB Industrial Landfill adjacent to the EAB Eastern Extension Impoundment.
EAB Option 3 – Closure-in-Place Hybrid Option (Partial Removal)	EAB Option 3 consists of closure for the EAB with the exception of the area within the limits of the permitted overfill landfill. For the EAB closure area, a limited area of the existing ash deposits will be designated for Closure-by-Removal, which would support possible use of the area as a future expansion site for the EAB Industrial Landfill. For this option, the ash and impacted soil will be excavated, transported, and placed in a permitted landfill located at the Mayo Steam Electric Plant. This industrial landfill would be constructed with a base liner system and an infiltration barrier/cap system meeting the requirements of the Federal CCR Rule and CAMA. The remaining ash deposits within the unexcavated EAB closure area will be graded for proper drainage, and then capped with an infiltration barrier/cap system meeting the requirements of the Federal CCR Rule and CAMA. The scope also includes removal of ash and impacted soil/sediment material within the EAB Eastern Extension Impoundment and placing it in the EAB, and stabilization of the Separator Berm located on the east side of the EAB Industrial Landfill adjacent to the EAB Eastern Extension Impoundment.
EAB Option 4 – Closure-by-Removal Option (On-site new Landfill)	EAB Option 4 consists of excavating ash material and a 1-ft thick soil layer within the limits for the EAB area including the limits of the permitted landfill area, both ash material in the landfill phases and the pond ash below the landfill. For the EAB closure area, the ash and impacted soil will be excavated, transported and placed in a permitted landfill located south of the EAB (Landfill Area C). This industrial landfill would be constructed with a base liner system and an infiltration barrier/cap system meeting the requirements of the Federal CCR Rule and CAMA. The scope also includes removal and disposal of ash and impacted soil/sediment material within the EAB Eastern Extension Impoundment, and removal of the Separator Berm and the underlying ash and impacted soil located on the east side of the EAB Industrial Landfill adjacent to the EAB Eastern Extension Impoundment. A portion of the ash and soil (444,191 CY) from the EAB excavation will be

Option	Description
	placed into proposed Landfill Area A. Construction and closure costs for Landfill Area A are accounted for within the West Ash Basin Closure Option 1.

Table 2 – Quantity Summary

Ash Basin Closure Options Evaluation
Roxboro Steam Electric Plant
Roxboro East Ash Basin
Duke Energy

Item	Volume	Units	Area (Acres)
Existing Ash (Excluding Existing Permitted Landfill – Options 1 and 3)			
Ash Basin Area (regulatory boundary)	NA		61.08
Ash Basin Area – Eastern Extension Impoundment (regulatory boundary)	NA		8.77
In Place Ash Volume – Ash Basin Area	3,888,000 3,240,000	Tons CY	63
In Place Ash Volume – Eastern Extension Impoundment	117,481 97,901	Tons CY	9.4
Ash Basin Dam Soil Volume	NA	CY	NA
Existing Ash (Including Existing Permitted Landfill – Options 2 and 4)			
Ash Basin Area (regulatory boundary)	NA		223.1
In Place Ash Volume	16,832,522	CY	223.1
Option 1: Closure-in-Place			
Ash Volume in Final Closure Footprint - Ash Basin Area	3,240,000	CY	63
Ash Volume in Final Closure Footprint - Eastern Extension Impoundment	97,901	CY	9.4
Ash Excavation Volume (Excavated Area) - *For off-site disposal*	0	CY	
Ash Excavation Volume (Excavated Area) - Eastern Extension Impoundment *For on-site disposal*	97,901	CY	9.4
Over Excavation Volume (1 ft.) – *For off-site disposal*	0	CY	
Ash Regrading – Ash Basin Area (Negative value indicates soil fill required)	-230,600	CY	
Dam Soil Cut Volume	Not estimated	CY	
Soil Needed (Backfill Excavated Area and 18" Cover Soil)	361,135	CY	63
Offsite Topsoil Needed (6" for Final Cover)	50,820	CY	63
Option 2: Closure by Removal			
Ash Volume in Final Closure Footprint - Ash Basin Area	16,734,621	CY	213.7
Ash Volume in Final Closure Footprint - Eastern Extension Impoundment	97,901	CY	9.4
Ash Excavation Volume (Excavated Area) -	16,734,621	CY	213.7

Item	Volume	Units	Area (Acres)
Ash Basin Area *For off-site disposal*			
Ash Excavation Volume (Excavated Area) - Eastern Extension Impoundment *For off-site disposal*	97,901	CY	9.4
Over Excavation Volume (1 ft.) – *For off-site disposal*	359,773	CY	223.1
Ash Regrading	0	CY	
Dam Soil Cut Volume	Not estimated	CY	
Soil Needed (Backfill Excavated Area and 18" Cover Soil)	517,154	CY	213.7
Offsite Topsoil Needed (6" for Final Cover)	172,385	CY	213.7
Estimated Off-site Landfill Area (Footprint)			98
Off-site Landfill Soil (assume 2' for liner and 18" for cover)	553,373		98
Off-site Landfill Topsoil (assume 6" for cover)	79,053		98
Option 3: Hybrid Option			
Ash Volume in Final Closure Footprint - Ash Basin Area	3,240,000	CY	63
Ash Volume in Final Closure Footprint - Eastern Extension Impoundment	97,901	CY	9.4
Ash Excavation Volume (Excavated Area) - Ash Basin Area *For off-site disposal*	393,531	CY	22.1
Ash Excavation Volume (Excavated Area) - Eastern Extension Impoundment *For on-site disposal*	97,901	CY	9.4
Over Excavation Volume (1 ft.) – *For off-site disposal*	33,655	CY	22.1
Ash Regrading	287,467	CY	41
Dam Soil Cut Volume	Not estimated	CY	
Soil Needed (Backfill Excavated Area and 18" Cover Soil)	228,436	CY	63
Offsite Topsoil Needed (6" for Final Cover)	86,475	CY	12
Estimated Off-site Landfill Area (Footprint)			12
Off-site Landfill Soil Fill (assume 2' for liner and 18" for cover)	67,760		12
Off-site Landfill Topsoil (assume 6" for cover)	9,680		12
Option 4: Closure-by-Removal (On-site new Landfill)			
Ash Excavation Volume (Excavated Area)	16,734,621	CY	213.7
Ash Excavation Volume (Excavated Area) - Eastern Extension Impoundment	97,901	CY	9.4
Over Excavation Volume (1 ft.)	359,773	CY	223.1
Proposed On-site Landfill Area (Footprint)			98.3

Item	Volume	Units	Area (Acres)
Proposed Material Placed in Landfill Area C	16,748,104	CY	98.3
Proposed Material Placed in Landfill Area A	444,191		NA
Soil Needed (Backfill Excavated Area and 18” Cover Soil)	517,154	CY	213.7
Offsite Topsoil Needed (6” for Final Cover)	172,385	CY	213.7
Off-site Landfill Soil (assume 2’ for liner and 18” for cover)	555,067		98.3
Off-site Landfill Topsoil (assume 6” for cover)	79,295		98.3

*Volumes will be determined as part of the final design if the respective option is selected as the closure option.

Option	Description
EAB Option 1 – Closure-in-Place Option	This option consists of closure for the EAB with the exception of the area within the limits of the permitted overfill landfill. For EAB closure, the ash deposits will be consolidated and graded for proper drainage. The EAB closure area will then be closed with an engineered cover system. Internal drainage features for the EAB closure area will be stabilized for the expected design storm flow conditions. A new discharge outlet will be constructed by breaching the EAB Main Dam. Flow will be released into the existing concrete lined discharge channel and then into the Heated Water Discharge Canal, which is part of the wastewater treatment system under the NPDES permit. The flow is then discharged to Hyco Lake through NPDES Outfall 003. EAB Industrial Landfill Separator Berm Modification – This modification will be provided to stabilize the toe of the landfill in the vicinity of the existing Separator Berm as required for closure of the EAB Eastern Extension Impoundment. For this option, the standing water will initially be removed from the ponded area and ash-impacted sediment material will be excavated within the limits of the proposed stabilization embankment. Ash and ash impacted sediment will be excavated at a minimum slope of 5H:1V. It is assumed the stabilization embankment will be constructed on the existing residual soil foundation. Further geotechnical review is required to confirm foundation requirements. Soil will be placed and compacted to form the stabilization embankment which will be partially placed over remaining ash material. It is assumed the exterior slope will be 2.5H:1V and that riprap be placed over the exterior slope for erosion protection. The proposed crest level for the berm will be at Elevation 472’, and the crest width will be 15’ minimum. The fill material for the stabilization embankment will be graded to drain in the direction of the outlet channel. An engineered cover system will be placed over the fill area consistent with cover provided for ash basin closure. EAB Eastern Extension Impoundment Closure – For this option, the EAB Eastern Extension Impoundment will be closed with a Closure-by-Removal approach. Removal of ash and impacted soil/sediment material will be performed by dredging methods. The waste material will be deposited by sluicing within the limits of the EAB and will subsequently be incorporated into the subgrade fill for the EAB closure plan. Excavated settlement pits or containment berms will be provided within the EAB for collection of the sluiced waste material. Figures and reference drawings representing this option are as follows: • Figure EAB 1.1 - EAB Closure Option 1 Concept Plan • Figure REAB 0.1 – Existing Conditions Plan for EAB Eastern Extension Impoundment • Figure REAB 2B.2 – Schematic Section for Closure-by-Removal of EAB Eastern Extension Impoundment <u>Environmental Protection and Impacts Considerations</u>

Option	Description
	• Estimated quantities used for cost estimating for this option are summarized in Table 2. This table also includes estimates for expected miles driven for on-site and off-site hauling operations and disturbed acres of greenfield to be used for the options evaluation. <u>Cost Considerations</u> For this option, the total estimated construction cost is $26,867,192, and the estimate post-closure O&M cost (30 years) $6,569,262. <u>Schedule Considerations</u> For this option, the total estimated closure construction duration is 4.4 years, and the time to start ash removal is 2.1 years. <u>Regional Factors</u> • For this option, the cover system could limit potential reuse of the site. • The requirements for imported soil are included in Table 2. • There are currently no plans for beneficial reuse of ash material after closure. • Estimated miles driven for closure is included in Table 2. • Noise impact was the lowest for the options considered. • View impact was the lowest for the options considered. <u>Constructability</u> • In place closure has highest overall score for constructability.
EAB Option 2 – Closure-by-Removal Option	Closure-by-removal Option 2 will be accomplished by removal of the ash along with a 1-ft thick soil layer within the limits of the EAB. This closure option also assumes ash will also be removed from within the limits of the existing lined and unlined landfills located on the EAB along with the ash material underlying those facilities. The estimated volume of ash moved for closure is 16,832,522 cy, and the estimated volume of impacted soil moved is 359,773 cy. For this option, the ash and impacted sediment will be removed and transported to the permitted and lined landfill located at the Mayo Steam Electric Plant. The EAB Main Dam will be breached for discharge of stormwater outflow after completion of closure. Flow will be released into the existing concrete lined discharge channel and then into the Heated Water Discharge Canal, which is part of the wastewater treatment system under the NPDES permit. The flow is then discharged to Hyco Lake through NPDES Outfall 003. Included is the EAB Eastern Extension Impoundment Closure. The EAB Eastern Extension Impoundment will be closed with a Closure-by-Removal approach. Removal of ash and impacted soil/sediment material will be performed by dredging methods. The waste material will be deposited by sluicing within the limits of the EAB and excavated settlement pits or containment berms will be provided within the EAB for collection of the sluiced

Option	Description
	waste material. These materials will be excavated and transported to the permitted and lined landfill located at the Mayo Steam Electric Plant. The stabilization berm that separates the EAB Industrial landfill from the EAB Eastern Extension Impoundment will be removed and the underlying ash and impacted soil will be excavated and transported to the permitted and lined landfill located at the Mayo Steam Electric Plant. Figures and reference drawings representing this option are as follows: • Figure EAB 2.1/3.1 – EAB Closure Options 2 & 3 - Location for Off-site Mayo Industrial Landfill & Haul Path • Figure EAB 2.2 – EAB Closure Option 2 Concept Plan <u>Environmental Protection and Impacts Considerations</u> • Estimated quantities used in cost estimating for this option are summarized in Table 2. This table also includes estimates for expected miles driven for on-site and off-site hauling operations and disturbed acres of greenfield to be used for the options evaluation. <u>Cost Considerations</u> For this option, the total estimated construction cost is $757,555,868, and the estimate post-closure O&M cost (30 years) $10,250,130. <u>Schedule Considerations</u> For this option, the total estimated closure construction duration is 14.9 years, and the time to start ash removal is 2.5 years. <u>Regional Factors</u> • Closure-by-Removal option is considered to have greatest potential for reuse of site in evaluation. • The requirements for imported soil are included in Table 2. • There are currently no plans for beneficial reuse of ash material after closure. • Estimated miles driven for closure is included in Table 2. • Noise impact considered highest for removal • View impact considered highest for removal. <u>Constructability</u> • There are significant concerns for constructability and feasibility for Closure-by-Removal. Further review of stabilization requirements for adjacent landfill is needed to confirm feasibility.
EAB Option 3 – Closure-in-Place	This option consists of partial removal of the ash deposits and closure in place for the remaining ash deposits. For this option, a limited area of the existing ash deposits will be designated for closure by removal which will

Option	Description
Hybrid Option (Partial Removal)	provide a potential future expansion site for the EAB industrial landfill. It is anticipated that the excavated area would later receive soil fill as part of the landfill expansion development. The evaluation of this option does not include consideration of requirements for stabilization of the remaining ash deposits and the EAB industrial landfill area. For this option, the ash and impacted soil will be removed and transported to a permitted and lined landfill located at the Mayo Steam Electric Plant. The remaining EAB closure area will then be closed in place with an engineered cover system. Internal drainage features for the EAB closure area will be stabilized for the expected design flow conditions. A new discharge outlet will be constructed by breaching the EAB Main Dam. Flow will be released into the existing concrete lined discharge channel and then into the Heated Water Discharge Canal, which is part of the wastewater treatment system under the NPDES permit. The flow is then discharged to Hyco Lake through NPDES Outfall 003. . EAB Industrial Landfill Separator Berm Modification – This modification will be provided to stabilize the toe of the landfill in the vicinity of the existing Separator Berm as required for closure of the EAB Eastern Extension Impoundment. For this option, the standing water will initially be removed from the ponded area and ash-impacted sediment material will be excavated within the limits of the proposed stabilization embankment. Ash and ash impacted sediment will be excavated at a minimum slope of 5H:1V. It is assumed the stabilization embankment will be constructed on the existing residual soil foundation. Further geotechnical review is required to confirm foundation requirements. Soil will be placed and compacted to form the stabilization embankment which will be partially placed over remaining ash material. It is assumed the exterior slope will be 2.5H:1V and that riprap be placed over the exterior slope for erosion protection. The proposed crest level for the berm will be at Elevation 472', and the crest width will be 15' minimum. The fill material for the stabilization embankment will be graded to drain in the direction of the outlet channel. An engineered cover system will be placed over the fill area consistent with cover provided for ash basin closure. EAB Eastern Extension Impoundment Closure – For this option, the EAB Eastern Extension Impoundment will be closed with a Closure-by-Removal approach. Removal of ash and impacted soil/sediment material will be performed by dredging methods. The waste material will be deposited by sluicing within the limits of the EAB and will subsequently be incorporated into the subgrade fill for the EAB closure plan. Excavated settlement pits or containment berms will be provided within the EAB for collection of the sluiced waste material. Figures and reference drawings representing this option are as follows: • Figure EAB 2.1/3.1 – EAB Closure Options 2 & 3 - Location for Off-site Mayo Industrial Landfill & Haul Path • Figure EAB 3.2 - EAB Option 3 Concept Plan • Figure REAB 0.1 and REAB 2B.2 (same as EAB Option 1) <u>Environmental Protection and Impacts Considerations</u>

Option	Description
	• Estimated quantities used in cost estimating for this option are summarized in Table 2. This table also includes estimates for expected miles driven for on-site and off-site hauling operations and disturbed acres of greenfield to be used for the options evaluation. <u>Cost Considerations</u> For this option, the total estimated construction cost is $50,308,911, and the estimate post-closure O&M cost (30 years) $7,820,550. <u>Schedule Considerations</u> For this option, the total estimated closure construction duration is 4.8 years, and the time to start ash removal is 2.5 years. <u>Regional Factors</u> • For Option 3, the excavated portion of site could be reused for development of landfill area. • The requirements for imported soil are included in Table 2. • There are currently no plans for beneficial reuse of ash material after closure. • Estimated miles driven for closure is included in Table 2. • Noise impact is higher than Close-in-Place but less the Closure-by-Removal which has the highest impact. • View impact is higher than Close-in-Place but less the Closure-by-Removal which has the highest impact. <u>Constructability</u> • There are significant concerns for constructability and feasibility for this hybrid option. Further review of stabilization requirements for adjacent landfill is needed to confirm feasibility.
EAB Option 4 – Closure-by-Removal (On-site new Landfill)	Closure-by-removal Option 4 will be accomplished by removal of the ash along with a 1-ft thick soil layer within the limits of the EAB. This closure option also assumes ash will also be removed from within the limits of the existing lined and unlined landfills located on the EAB along with the ash material underlying those facilities. The estimated volume of ash moved for closure is 16,832,522 cy, and the estimated volume of impacted soil moved is 359,773 cy. This closure option assumes 16,748,104 cy of ash and soil will be permanently placed in the proposed Landfill Area C. The East Ash Basin Main Dam will be breached to allow stormwater flow to discharge into Hyco Lake. Included is the EAB Eastern Extension Impoundment Closure. The EAB Eastern Extension Impoundment will be closed with a Closure-by-Removal approach. Removal of ash and impacted soil/sediment material will be performed by dredging methods. The waste material will be deposited by sluicing within the limits of the EAB and excavated settlement pits or containment berms will be provided within the EAB for collection of the sluiced

Option	Description
	waste material. These materials will be excavated and placed in the new permitted and lined on-site landfill. The stabilization berm that separates the EAB Industrial landfill from the EAB Eastern Extension Impoundment will be removed and the underlying ash and impacted soil will be excavated and placed in the new permitted and lined on-site landfill. Figures and reference drawings representing this option are as follows: • Figure EAB 4.1 – Closure-by-Removal • Figure EAB 4.2 – Proposed Landfill Area C <u>Environmental Protection and Impacts Considerations</u> • Estimated quantities used for cost estimates are summarized in Table 2. <u>Cost Considerations</u> The total estimated construction cost is $503,782,503, and the estimated post-closure O&M cost (30 years) is $10,250,130. <u>Schedule Considerations</u> For this option, the total estimated closure construction duration is 14.9 years, and the time to start ash removal is 2.5 years. <u>Regional Factors</u> • Ash basin closure area could be reused without consideration of cover system after completion of closure by removal. • The requirements for imported soil are included in Table 2. • There are currently no plans for beneficial reuse of ash after closure. • Noise impact considered more significant than Closure-in-Place due to hauling and truck traffic but less significant than removal to an off-site facility due to the reduced haul distance. • View impact for the site considered more significant than Closure-in-Place and removal to off-site facility due to 200+ feet height of proposed on-site landfill facility created on-site. <u>Constructability</u> • Requires development of new landfill space to accommodate ash removal. A portion of this space requires the excavation and backfill soil replacement of a finger of the WAB. • Closure-by-removal has additional challenges due to longer duration and larger amount of excavation and transport for removal of ash.

Attachment A - Figures and Reference Drawings

REFERENCES:
1. ASH BASIN FACILITY BOUNDARIES TAKEN FROM SYNTERRA, COMPREHENSIVE SITE ASSESSMENT REPORT, ROXBORO STEAM ELECTRIC PLANT, SEPTEMBER 2015 AND PHASE 2 ARE APPROXIMATE.
2. EXISTING TOPOGRAPHIC INFORMATION WAS PRODUCED FROM PHOTOGRAMMETRIC METHODS FROM AERIAL PHOTOGRAPHY OBTAINED ON APRIL 16, 2014 BY WSP.

wood.
Environment & Infrastructure Solutions
4021 STIRRUP CREEK DRIVE, SUITE 100 DURHAM NC 27703
TEL: (919) 381-9900
FAX: (919) 381-9901
LICENSURE:
NC ENG: F-1253
NC GEOLOGY: C-247

SEAL

TITLE
ROXBORO ASH BASIN CLOSURE PROJECT
ROXBORO EAST ASH BASIN (EAB)
EAB CLOSURE-BY-REMOVAL OPTION 2

FOR
NOT RELEASED FOR CONSTRUCTION

DUKE ENERGY

SCALE: AS SHOWN		DES:	NP
DWG TYPE: DWG		DFTR:	BB
JOB NO: 7810181107		CHKD:	NP
DATE: 12/07/2018		ENGR:	DG
FILENAME: EAB Closure Option.dwg		APPD:	DG

DWG SIZE	DRAWING NO.	REVISION
ANSI D 22"x34"	EAB 2.2	0

REV	DATE	JOB NO.	PROJECT TYPE	DES	DFTR	CHKD	ENGR	APPD	DESCRIPTION
									NOT RELEASED FOR CONSTRUCTION

EAB 2.2

EAB-2.1/3.1

wood.
Environment & Infrastructure Solutions
4021 STIRRUP CREEK DRIVE, SUITE 100 DURHAM NC 27703
TEL: (919) 381-9900
FAX: (919) 381-9901
LICENSURE:
NC ENG: F-1253
NC GEOLOGY: C-247

SEAL

TITLE
ROXBORO ASH BASIN CLOSURE PROJECT
ROXBORO WEST ASH BASIN (WAB)
EAB CLOSURE OPTIONS 2&3

FOR
NOT RELEASED FOR CONSTRUCTION

DUKE ENERGY

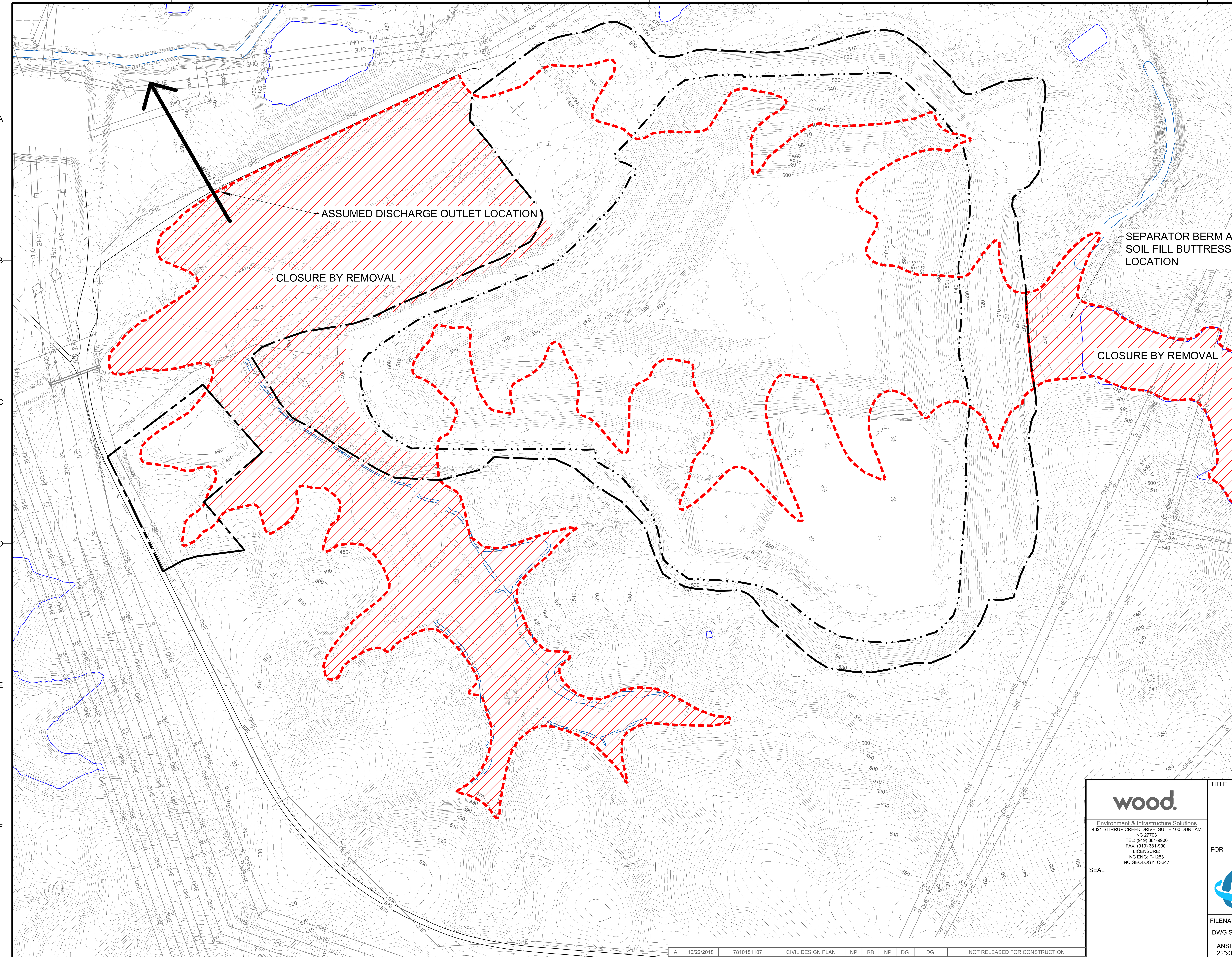
SCALE:	AS SHOWN	DES:	DMS
DWG TYPE:	DWG	DFTR:	VRD
JOB NO:	7810181107	CHKD:	DMS
DATE:	10/22/2018	ENGR:	DG
		APPD:	DG

FILENAME: ROXBORO CLOSURE OPTION 2 FIGURE WAB-2.1.dwg

DWG SIZE	DRAWING NO.	REVISION
ANSI D 22"x34"	EAB-2.1/3.1	0

EAB-2.1/3.1
REV. B

EAB 2.2



LEGEND

- APPROXIMATE LIMITS OF CCR BOUNDARY
- LIMIT OF UNLINED PORTION OF THE INDUSTRIAL LANDFILL
- LIMIT OF LINED PORTION OF THE INDUSTRIAL LANDFILL
- LCID LANDFILL LIMIT BOUNDARY
- SURVEYED POND AREA
- SURVEYED STREAM/CHANNEL AREA
- EXISTING TRANSMISSION LINES
- AREA A CLOSURE EVENT 1 LIMIT

REFERENCES:
1. ASH BASIN FACILITY BOUNDARIES TAKEN FROM SYNTERRA, COMPREHENSIVE SITE ASSESSMENT REPORT, ROXBORO STEAM ELECTRIC PLANT, SEPTEMBER 2015 AND PHASE 2 RECONSTITUTION OF ASH POND DESIGNS FINAL REPORT, REV 0, JUNE 16, 2015. BOUNDARIES ARE APPROXIMATE.
2. EXISTING TOPOGRAPHIC INFORMATION WAS PRODUCED FROM PHOTOGRAMMETRIC METHODS FROM AERIAL PHOTOGRAPHY OBTAINED ON APRIL 16, 2014 BY WSP.

200 0 200 400 FT

N

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TEL: (919) 381-9900
FAX: (919) 381-9901
LICENSURE:
NC ENG: F-1253
NC GEOLOGY: C-247

SEAL

TITLE
ROXBORO ASH BASIN CLOSURE PROJECT
ROXBORO EAST ASH BASIN (EAB)
EAB CLOSURE OPTION 2 CONCEPT PLAN

FOR
NOT RELEASED FOR CONSTRUCTION

DUKE ENERGY

SCALE: AS SHOWN		DES:	NP
DWG TYPE: DWG		DFTR:	BB
JOB NO: 7810181107		CHKD:	NP
DATE: 10/22/2018		ENGR:	DG
		APPD:	DG

FILENAME: EAB Closure Option 2.dwg

DWG SIZE	DRAWING NO.	REVISION
ANSI D 22"x34"	EAB 2.2	B

REV	DATE	JOB NO.	PROJECT TYPE	DES	DFTR	CHKD	ENGR	APPD	DESCRIPTION
A	10/22/2018	7810181107	CIVIL DESIGN PLAN	NP	BB	NP	DG	DG	NOT RELEASED FOR CONSTRUCTION

EAB 2.2
REV. B

EAB-3.2

EARTHWORK CALCS

	AREA	VOL
ASH CUT VOL	16.58 ACRES	547,442 CY
PROPOSED GRADING (ASH) CUT VOL	40.9 ACRES	34,146 CY
PROPOSED GRADING (ASH) FILL VOL	40.9 ACRES	321,613 CY

LEGEND

- EXISTING MAJOR CONTOURS
- EXISTING MINOR CONTOURS
- PROPOSED MAJOR CONTOURS
- PROPOSED MINOR CONTOURS
- ASSUMED ASH BASIN WASTE BOUNDARY
- LIMIT OF LINED PORTION OF THE INDUSTRIAL LANDFILL
- LIMIT OF UNLINED PORTION OF THE INDUSTRIAL LANDFILL
- LCID LANDFILL LMIITS
- CAP IN PLACE AREA

200 0 200 400 FT

SCALE: 1"=200'

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NC 27703
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NC ENG: F-1253
NC GEOLOGY: C-247

SEAL

TITLE

ROXBORO ASH BASIN CLOSURE PROJECT
ROXBORO EAST ASH BASIN (EAB)
EAB CLOSURE OPTION 3 CONCEPT PLAN

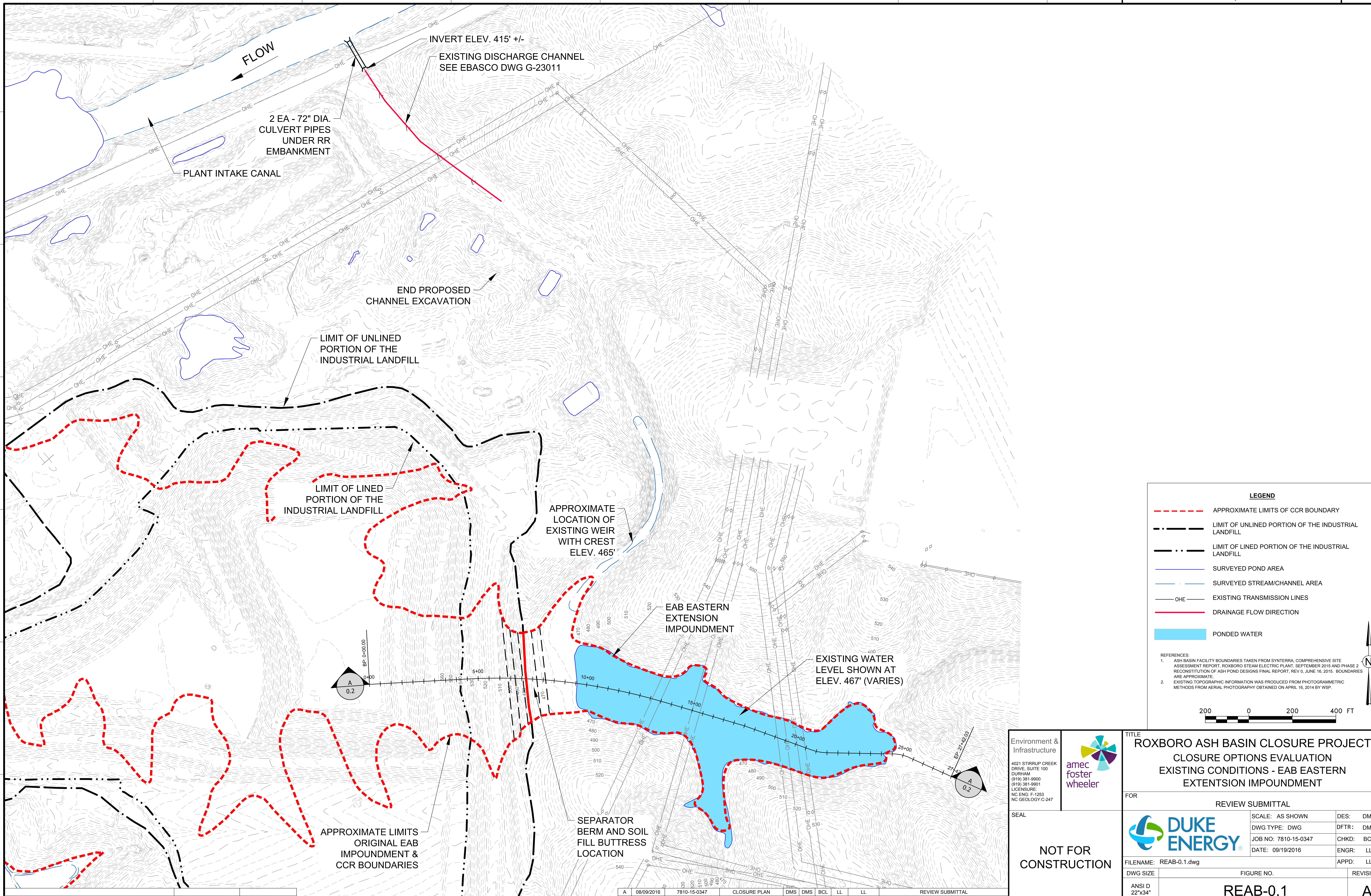
FOR

NOT RELEASED FOR CONSTRUCTION

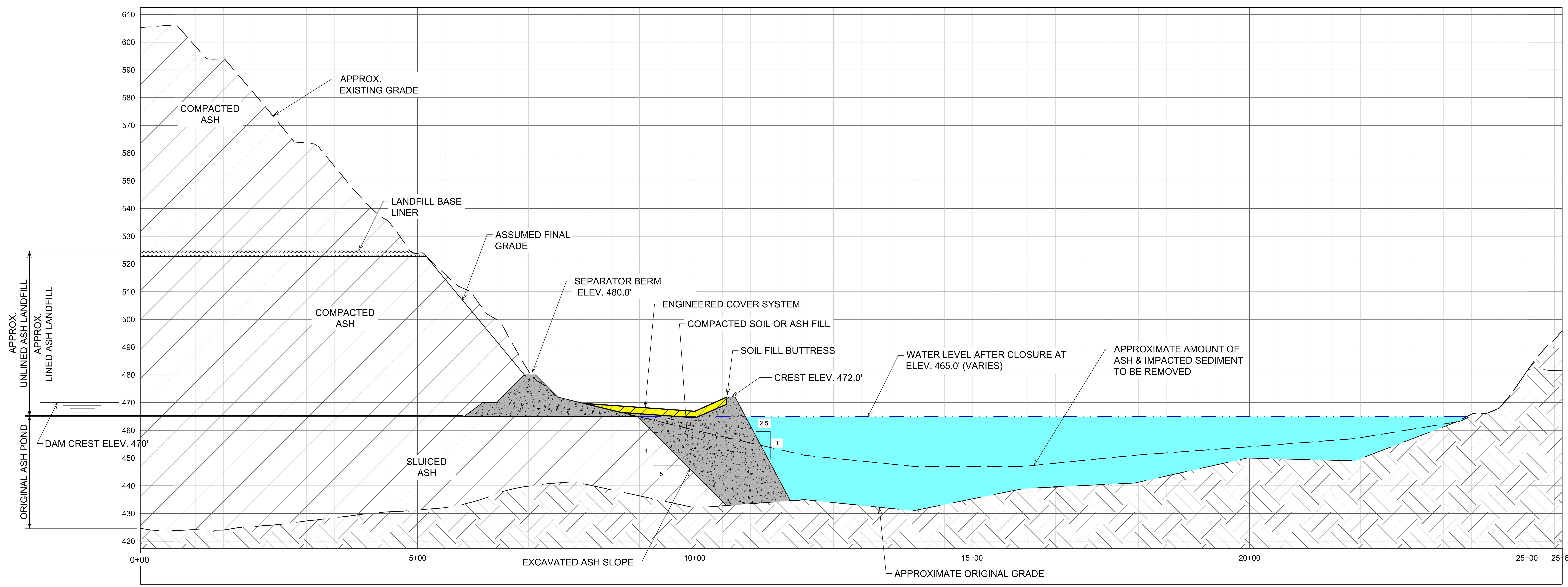
SCALE:	AS SHOWN	DES:	DMS
DWG TYPE:	DWG	DFTR:	VRD
JOB NO:	7810181107	CHKD:	DMS
DATE:	10/22/2018	ENGR:	SA
		APPD:	SA

FILENAME: EAB Closure Option 3.dwg

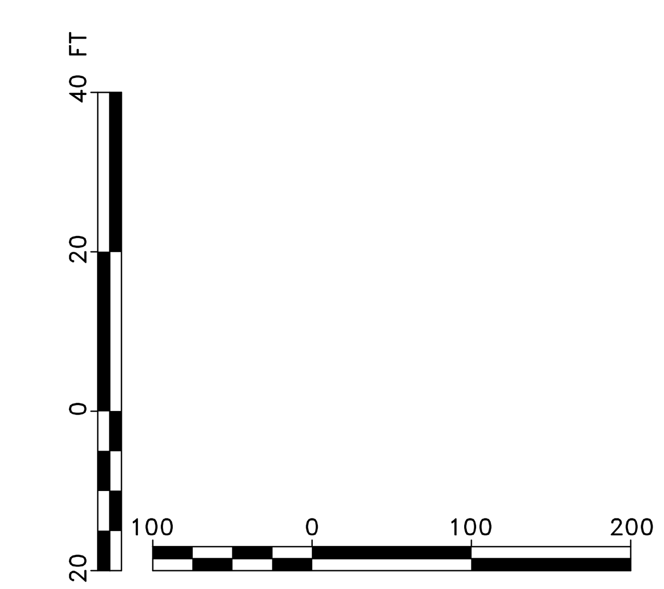
DWG SIZE	DRAWING NO.	REVISION
ANSI D 22"x34"	EAB-3.2	B



Plotted By:Bowden, Brooke Sheet Set:EAB Remnant Pond Options Layout:REAB-0.1 October 31, 2018 03:06:25pm P:\Projects\CLIENTS\Duke Energy__7810181107_Roxboro_EAB Closure Plan\00_PROJECT_SPECS\Eng_Design\Drawings\Exhibit\Conceptual Submittal 10.31.18\REAB-0.1.dwg



SECTION A
HORIZONTAL SCALE: 1"=100'
VERTICAL SCALE: 1"=20'



LEGEND:

- EXISTING GRADE
- ORIGINAL GRADE
- PROPOSED GRADE
- ORIGINAL FOUNDATION MATERIALS (SOIL, WEATHERED ROCK)
- ASH MATERIALS
- ASH, SILT AND IMPACTED SOIL
- ENGINEERED COVER
- WATER SURFACE
- SOIL FILL

Environment & Infrastructure
4021 STIRRUP CREEK DRIVE, SUITE 100
DURHAM
(919) 381-9900
(919) 381-9901
LICENSURE:
NC ENG: F-1253
NC GEOLOGY:C-247

amec foster wheeler

SEAL

NOT FOR CONSTRUCTION

TITLE
ROXBORO ASH BASIN CLOSURE PROJECT
CLOSURE OPTIONS EVALUATION
SCHEMATIC SECTION FOR CLOSURE-BY-REMOVAL OF EASTERN EXTENSION IMPOUNDMENT

FOR
REVIEW SUBMITTAL

DUKE ENERGY

SCALE: AS SHOWN		DES:	DMS
DWG TYPE: DWG		DFTR:	DMS
JOB NO: 7810-18-1107		CHKD:	BCL
DATE: 09/24/2018		ENGR:	LL
FILENAME: REAB-2B.2DWG		APPD:	LL

DWG SIZE	FIGURE NO.	REVISION
ANSI D 22"x34"	REAB-2B.2	A

REV	DATE	JOB NO.	PROJECT TYPE	DES	DFTR	CHKD	ENGR	APPD	DESCRIPTION
A	08/09/2016	7810-15-0347	CLOSURE PLAN	DMS	DMS	BCL	LL	LL	REVIEW SUBMITTAL

ABSAT ISSUE #	DATE	DESIGN

REV. A

EAB 4.1

LEGEND

- APPROXIMATE LIMITS OF CCR BOUNDARY
- APPROXIMATE LIMITS OF EASTERN EXTENSION IMPOUNDMENT
- OUTER LIMIT OF UNLINED LANDFILL AND SUBGRADE FILL
- LINED LANDFILL BOUNDARY
- SURVEYED POND AREA
- SURVEYED STREAM/CHANNEL AREA
- EXISTING TRANSMISSION LINES

N

REFERENCES:
1. ASH BASIN FACILITY BOUNDARIES TAKEN FROM SYNTERRA, COMPREHENSIVE SITE ASSESSMENT REPORT, ROXBORO STEAM ELECTRIC PLANT, SEPTEMBER 2015 AND PHASE 2 ARE APPROXIMATE.
2. EXISTING TOPOGRAPHIC INFORMATION WAS PRODUCED FROM PHOTOGRAMMETRIC METHODS FROM AERIAL PHOTOGRAPHY OBTAINED ON APRIL 16, 2014 BY WSP.

200 0 200 400 FT

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Environment & Infrastructure Solutions
4021 STIRRUP CREEK DRIVE, SUITE 100 DURHAM
NC 27703
TEL: (919) 381-9900
FAX: (919) 381-9901
LICENSURE:
NC ENG: F-1253
NC GEOLOGY: C-247

SEAL

TITLE
ROXBORO ASH BASIN CLOSURE PROJECT
ROXBORO EAST ASH BASIN (EAB)
EAB CLOSURE-BY-REMOVAL OPTION 4

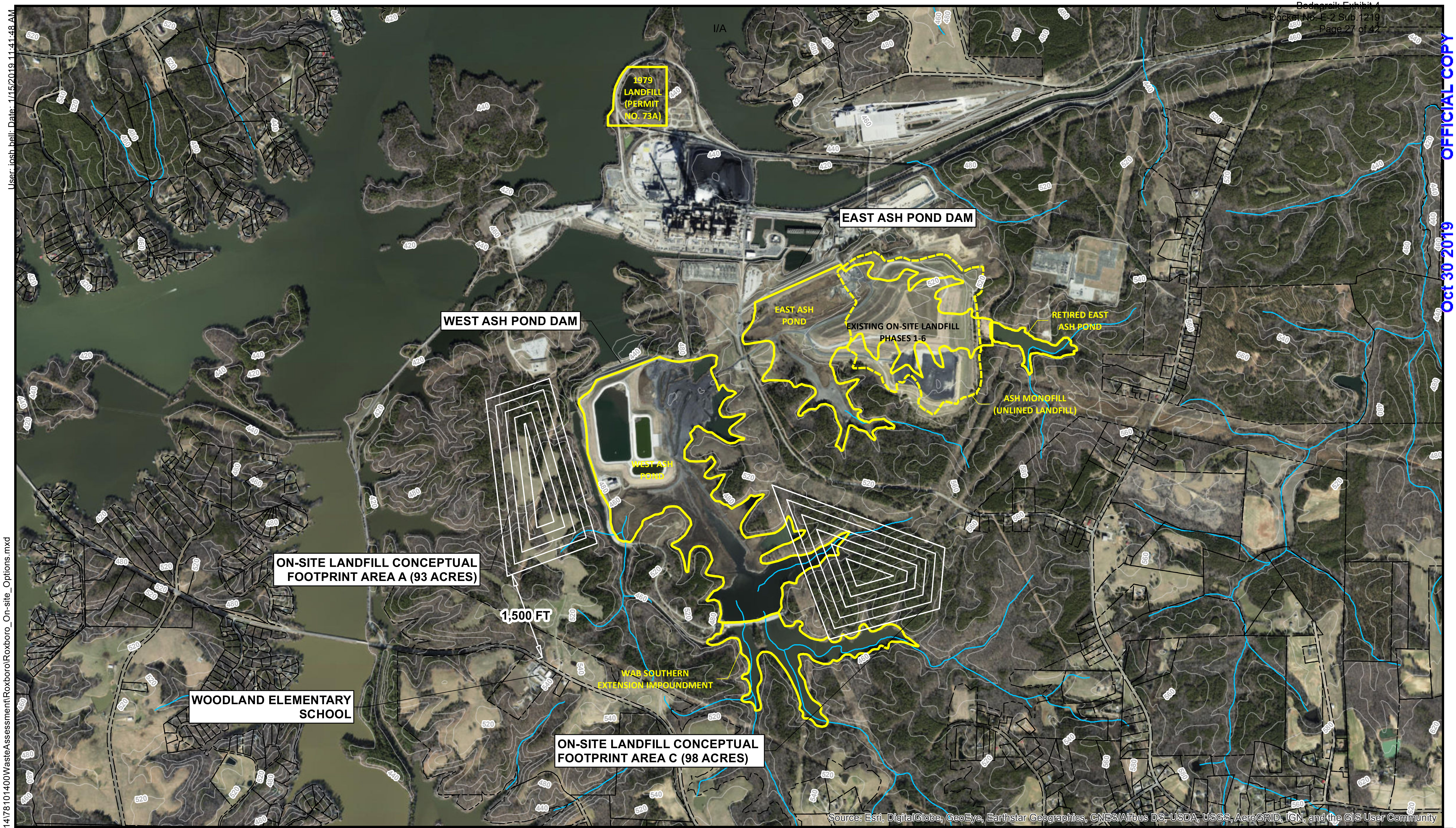
FOR
NOT RELEASED FOR CONSTRUCTION

DUKE ENERGY

SCALE: AS SHOWN	DES: NP
DWG TYPE: DWG	DFTR: BB
JOB NO: 7810181107	CHKD: NP
DATE: 12/07/2018	ENGR: DG
FILENAME: EAB Closure Option.dwg	APPD: DG

DWG SIZE	DRAWING NO.	REVISION
ANSI D 22"x34"	EAB 4.1	0

REV	DATE	JOB NO.	PROJECT TYPE	DES	DFTR	CHKD	ENGR	APPD	DESCRIPTION
									NOT RELEASED FOR CONSTRUCTION



Source: NC Natural Heritage Program, 2014; NCDENR Division of Water Resources, 2013; NCDOT LiDar Data, 2008; USFWS National Wetlands Inventory Maps, April 2014; Person County GIS Datasets, 2014.

APPROXIMATE CONCEPTUAL LANDFILL FOOTPRINT
APPROXIMATE ASH BOUNDARY
1% ANNUAL CHANCE FLOOD HAZARD
NATIONAL WETLAND INVENTORY
CONTOUR (20 FOOT)
STREAMS

wood.

N
0 750 1,500
Feet

ON-SITE LANDFILL OPTION

CLOUSRE OPTIONS
ROXBORO STEAM STATION
NORTH CAROLINA

PREPARED BY/DATE	JOB NUMBER	FIGURE
JMB 1/14/2019	7810-18-1107	EAB 4.2

Attachment B - Rough Order of Magnitude (ROM) Cost Estimates

Roxboro EAB Closure Option 1 - Close in Place (Minimum Excavation)

Closure Option Opinion of Probable Cost (ROM)

Duke Energy - Roxboro Steam Station

	Quantity	Unit	Unit Cost	Total Cost	Estimate Note
PROPERTY ACQUISTION					
Property Acquition Cost	0	Acres	$3,000	$ -	Best estimate of property values in area from review of tax values and for sale listing for large tracts in Person County. NOT VERIFIED.
SUBTOTAL PROPERTY ACQUISTION				$ -	
GENERAL					
Surveying	63	Acres	$ 2,000	$ 126,000	
Removal & Filtration of Free Water (Initial Dewatering)	0	Mo	$ 416,667	$ -	Assume not required for EAB
Removal & Treatment of Pore Water	0	Mo	$ 583,333	$ -	Assume not required for In-place closure option.
Breaching EAB Main Dam	1	LS	$1,000,000	$ 1,000,000	Place holder for cost with no technical basis. .
SUBTOTALGENERAL				$ 1,126,000	
EROSION/SEDIMENT CONTROL AND STORMWATER MANAGEMENT					
East Ash Basin Sediment Control and Stormwater Management	63	Acres	$14,000.00	$ 882,000	Unit Cost based on Amec Foster Wheeler experience and previous closure option cost estimates. Includes silt fence, wattles, surface water diversions, sediment basins, temporary seeding and permanent seeding.
Landfill Area Sediment Control and Stormwater Management	0	Acres	$14,000.00	$ -	Unit Cost based on Amec Foster Wheeler experience and previous closure option cost estimates. Includes silt fence, wattles, surface water diversions, sediment basins, temporary seeding and permanent seeding.
Permanent Drainage and Surface Stabilization Measures	63	Acres	$3,787	$ 238,565	Unit rate obtained from Duke Energy summary data was used for consistency.
Permanent Riprap Stormwater Channels	6,000	LF	$56	$ 333,360	Unit rate obtained from Duke Energy summary data fo consistency. Est 10' wide x 1.5' depth = 15 cf/ft length/27 cf/cy = .56 cy/ft length. .56 cy/ft x 2 tons/cy = 1.1 tons/ft length. Est $50/ton x 1.1 ton/ft = $55.56/lf.
Permanent Discharge Outlet Structure (Main Dam)	1	LS	$500,000	$ 500,000	Place holder for cost.
SUBTOTAL EROSION/SEDIMENT CONTROL AND STORMWATER MANAGEMENT				$ 1,953,925	
SEPARATOR BERM EARTH FILL STABILIZATION BUTTRESS					**Not required for this option**
Earth Fill Buttress Construction					
Rock Cut (for bypass channel excavation)	5,556	CY	$30.00	$ 166,680	Unit cost for rock cut revised to $30/cy based on estimate review by KD. Estimate by-pass channel excavation as follows: 300' channel length for excavation x 50' avg width (40' existing) x 10' avg cut depth /27 = 5556 cy. Note that excavated material may be used as fill for construction of the proposed new berm.
Haul & Dispose of Rock On-site <1.0 mile (for bypass channel excavation)	5,556	CY	$3.00	$ 16,668	Estimate by-pass channel excavation as follows: 300' channel length for excavation x 50' avg width (40' existing) x 10' avg cut depth /27 = 5556 cy. Note that excavated material may be used as fill for construction of the proposed new berm.
Soil Fill Material (for embankment)	66,296	CY	$13	$ 861,848	Estimate dike volume based on maximum embankment height of 40', crest width 15',exterior slope 2.5H:1V, length 250'.
Earth Fill Buttress Cover System					
Subgrade Preparation	3.0	Acres	$5,000.00	$ 15,000	Grade surface of subbase prior to installation of final cover system. Unit costs from construction contractor
8 oz/sy Non-Woven Geotextile	0	SY	3.00	$ -	Furnish and install geotextile as a cushion layer. Unit costs from Glover; costs typically include material, QC testing, and installation
Cover System Geosynthetics (40-mil LLDPE Geomembrane and Geocomposite Drainage Layer	130,680	SF	$1.45	$ 189,486	Unit Cost based on Amec Foster Wheeler experience and previous landfill cost estimates.
Cover System 18" Soil Cover	7,260	CY	$13.00	$ 94,380	Unit Cost based on Amec Foster Wheeler experience and previous landfill cost estimates.
Cover System Top Soil Placement	2,420	CY	$13.00	$ 31,460	Unit Cost based on Amec Foster Wheeler experience and previous landfill cost estimates.
SUBTOTAL SEPARATOR BERM EARTH FILL STABILIZATION BUTTRESS				$ 1,375,522	
EAB EASTERN EXTENSION IMPOUNDMENT CLOSURE BY REMOVAL					
Mobilize and stage dredging operations	1	LS	$300,000.00	$ 300,000	
Perform dredging for removal of ash & impacted sediment	97,901	CY	$14.99	$ 1,467,536	Unit Cost based on Duke Energy estimate averages was used for consistency. Assume Unit Cost = $12.49/ton x 1.2 tons/cy = $14.99/cy.
(On-Road) Hauling of Pond Ash and Impacted Soils to landfill		CY	$14.50	$ -	Unit Cost based on Duke Energy estimate averages was used for consistency.
(Off Road) Hauling of Pond Ash and Impacted Soils (within basin)	97,901	CY	$2.00	$ 195,802	Unit Cost based on Duke Energy estimate averages was used for consistency.
Placement of Ash and Impacted Soils In Landfill		CY	$1.50	$ -	Unit Cost based on Duke Energy estimate averages was used for consistency.
SUBTOTAL EAB EASTERN EXTENSION IMPOUNDMENT CLOSURE BY REMOVAL				$ 1,963,338	
EARTHWORK					
Ash Basin Earthwork					
Construction Entrance	1000	LF	$65	$ 65,000	Unit Cost based on Amec Foster Wheeler experience and previous closure option cost estimates.
Clearing and Grubbing	5	Acres	$5,000	$ 25,000	Clear and remove vegetation including trees, brush, schrubs. Unit Cost based on Amec Foster Wheeler experience and previous closure option cost estimates. Increased to $5000/acre from review by NWH.
Topsoil Stripping	5	Acres	$4,000	$ 20,000	Strip topsoil to a minimum 6-inch depth and place in stockpile. Unit Cost based on Amec Foster Wheeler experience and previous closure option cost estimates. Increased to $4000/acre from review by NWH.
Earthwork Cut to Waste	0	CY	$9.24	$ -	Unit Cost based on Duke Energy estimate averages was used for consistency.
Earthwork Cut to Fill	140,740	CY	$9.24	$ 1,300,438	Unit Cost based on Duke Energy estimate average was used for consistency.
Net Required Soil Fill Material (assume off-site borrow source)	230,600	CY	$13	$ 2,997,800	Unit Cost based on Duke Energy estimate averages was used for consistency. No change in estimate.
Topsoil Material; if required (6-inch thick un-compacted fill, source material off-site)		CY	$13	$ -	Unit Cost based on Duke Energy estimate averages was used for consistency. No change in estimate.
SUBTOTAL EARTHWORK				$ 4,408,238	
ASH BASIN DEWATERING, EXCAVATION, HAULING AND PLACEMENT					
Haul Road Construction	6,000	LF	$60	$ 360,000	Amec Foster Wheeler experience based on 12-inch thick ABC and supporting geotextile at 20-foot width. Unit Cost based on Amec Foster Wheeler experience and previous closure option cost estimates.
Excavation and Loading of Pond Ash for Truck Hauling	140,740	CY	$8.43	$ 1,186,438	Unit Cost based on Duke Energy estimate averages used for consistency. Assume loading/hauling required to support site grading.
Excavation and Loading of Subsurface Soils for Truck Hauling	0	CY	$10.00	$ -	Unit Cost based on Duke Energy estimate averages used for consistency. Assume loading/hauling required to support site grading.
(On-Road) Hauling of Pond Ash and Impacted Soils for Off-site Landfill __ miles	0	CY	$6.50	$ -	
(Off Road) Hauling of Pond Ash and Impacted Soils (within basin)	140,740	CY	$2.00	$ 281,480	Unit Cost based on Duke Energy estimate averages used for consistency. Assume loading/hauling required to support site grading.
Ash Placement Cut to Fill	140,740	CY	$9.24	$ 1,300,438	For this option, assume placement similar to landfill for cost estimating. Loading & hauling estimate provided separately. Unit Cost based on Duke Energy estimate averages was used for consistency. Use cut to fill unit cost for estimating purposes.
Truck Wash	4	EA	$150,000	$ 600,000	Truck wash necessary to clean tires and undercarriage of trucks for over-the-road hauling. Unit Cost based on Amec Foster Wheeler experience and previous closure option cost estimates.
Bridge Repair and Maintenance	0	LS	$500,000	$ -	Placed holder estimate for potential bridge repair and maintenance cost. NOT VERIFIED.
Paved Haul Road Repair	0	LF	$120	$ -	Unit Cost based on Amec Foster Wheeler experience and previous closure option cost estimates.
SUBTOTAL ASH BASIN DEWATERING, EXCAVATION, HAULING AND PLACEMENT				$ 3,728,356	
CLOSE IN PLACE COVER CONSTRUCTION					
Close in Place Option Cover System Construction					
Subgrade Preparation	63	Acres	$5,000.00	$ 315,000	Grade surface of subbase prior to installation of final cover system. Unit costs from construction contractor
Anchor Trench	9,000	LF	$6.00	$ 54,000	Furnish and install geotextile as a cushion layer. Unit costs from Glover; costs typically include material, QC testing, and installation
Geosynthetic Clay Liner (GCL) - Not required	0	SF	$0.73	$ -	Furnish and install geotextile as a cushion layer. Unit costs from Glover; costs typically include material, QC testing, and installation
8 oz/sy Non-Woven Geotextile	304,920	SY	3.00	$ 914,760	Furnish and install geotextile as a cushion layer. Unit costs from Glover; costs typically include material, QC testing, and installation
Cover System Geosynthetics (40-mil LLDPE Geomembrane and Geocomposite Drainage Layer	2,744,280	SF	$1.02	$ 2,799,166	Unit Cost based on Duke Energy estimate averages was used for consistency. Includes $0.42/sf for liner and $0.60/sf for GCL layer ($1.02/sf total)
Cover System 18" Soil Cover	152,460	CY	$13	$ 1,981,980	Unit Cost based on Duke Energy estimate averages was used for consistency. No change in estimate.

Roxboro EAB Closure Option 1 - Close in Place (Minimum Excavation)

Closure Option Opinion of Probable Cost (ROM)

Duke Energy - Roxboro Steam Station

	Quantity	Unit	Unit Cost	Total Cost	Estimate Note
Cover System Top Soil Placement	50,820	CY	$13	$ 660,660	Unit Cost based on Duke Energy estimate averages was used for consistency. No change in estimate.
SUBTOTAL COVER SYSTEM CONSTRUCTION				**$ 6,725,566**	
SUBTOTAL CLOSURE CONSTRUCTION COST				**$ 21,280,944**	
MOBILIZATION COST				**$ 212,809**	Estimate at 1% of Final Closure Construction Cost
TOTAL CLOSURE CONSTRUCTION COST (WITH MOBILIZATION)				**$ 21,493,754**	
OTHER COST					
Design, Permitting and CQA					
Closure Design/Engineering/Permitting (5% of Total Closure Construction Cost)	1	LS	$ 1,074,688	$ 1,074,688	Revised to 5%
Construction Quality Assurance (CQA) (5% of Total Closure Construction Cost)	1	LS	$ 1,074,688	$ 1,074,688	Revised to 5%
Subtotal Design, Permitting and CQA				**$ 2,149,375**	
Post Closure Operations and Maintenance (analysis based on 30 year duration)					
Closure Area Maintenance (63 acres)	30	YR	$ 218,975	$ 6,569,262	Unit Cost based on Duke Energy estimate averages was used for consistency. Estimate $3,475.80/ac/year.
Closure Area Monitoring	0	YR		$ -	Not included in estimate per Duke Energy direction.
Landfill Area Maintenance (0 acres)	0	YR	$ -	$ -	Unit Cost based on Duke Energy estimate averages was used for consistency. Estimate $3,475.80/ac/year.
Landfill Area Monitoring	0	YR		$ -	Not included in estimate per Duke Energy direction.
Subtotal Post Closure Operations and Maintenance				**$ 6,569,262**	
Additional Costs					
Contingency (15% of Final Closure Construction Costs)	1	LS	$ 3,224,063	$ 3,224,063	Amec Foster Wheeler experience from previous projects
Subtotal Additional Costs				**$ 3,224,063**	
TOTAL OPINION OF PROBABLE CLOSURE COST				**$ 33,436,454**	Rough Order of Magniture Cost Estimate
OPINION OF PROBABLE CLOSURE COST PER CY				**$ 10.32**	Based on Volume of Ash Stored
OPINION OF PROBABLE CLOSURE COST PER TON				**$ 8.60**	Based on Moist Unit Weight of Ash Stored
OPINION OF PROBABLE CLOSURE COST PER ACRE				**$ 530,737**	Based on Estimated Closue Area

ESTIMATED QUANTITIES

Description	Est Quantity	Units
Estimated Landfill Property Area:	0	Acres
Estimated Landfill Development Area (including buffer and borrow area):	0	Acres
Estimated Lined Landfill Area:	0	Acres
Estimated East Ash Basin Closure Area:	63	Acres
Estimated EAB Restoration Area (after ash removal):	0	Acres
Estimated Close in Place Area	63	Acres
Estimated Ash Material Stored Volume:	3,240,000	CY
Estimated Ash Material Stored Moist Wt:	3,888,000	Tons (based on 1.2 Tons/CY Moist Unit Wt)
Estimated Ash/Sediment Material Removed/Hauled Volume (EEI):	97,901	CY
Estimated Ash/Sediment Material Removed/Hauled Moist Wt (EEI):	117,481	Tons (based on 1.2 Tons/CY Moist Unit Wt)
Estimated Ash Cut Volume:	140,740	CY
Estimated Fill Volume:	371,340	
Estimate Net Soil Fill Volume:	230,600	CY
Estimated EAB Closure Soil Cover Volume:	203,280	CY
EAB Eastern Extension Impoundment Soil Fill	75,976	CY
Total Estimated Soil Fill Volume:	509,856	CY
Estimated Borrow Area:	21.1	Acres (Assume 15' max excavartion depth based on Duke guidelines.)

Estimate Notes:

1. This estimate is represented as Rough Order of Magnitude (ROM).

I/A

Roxboro EAB Closure Option 2 - Closure by Removal (with Off-Site Landfill at Mayo Plant)

Closure Option Opinion of Probable Cost (ROM)

Duke Energy - Roxboro Steam Station

	Quantity	Unit	Unit Cost	Total Cost	Estimate Note
PROPERTY ACQUISTION					
Property Acquition Cost		Acres	$3,000	$ -	Best estimate of property values in area from review of tax values and for sale listing for large tracts in Person County. NOT VERIFIED.
SUBTOTAL PROPERTY ACQUISTION				$ -	
GENERAL					
Mobilization	1	LS		$ -	Estimate at 5% of Final Closure Construction Cost (see below)
Surveying	63	Acres	$ 2,000	$ 126,000	
Removal & Filtration of Free Water (Initial Dewatering)	0	Mo	$ 416,667	$ -	Assume not required for EAB
Removal & Treatment of Pore Water	36	Mo	$ 583,333	$ 20,999,988	Assume required for duration of construction. Estimated duration 3 years. Unit rate obtained from Duke Energy summary data fo consistency.
Breaching EAB Main Dam	1	LS	$1,000,000	$ 1,000,000	Place holder for cost with no technical basis. .
SUBTOTALGENERAL				$ 22,125,988	
EROSION/SEDIMENT CONTROL AND STORMWATER MANAGEMENT					
East Ash Basin Sediment Control and Stormwater Management	63	Acres	$14,000.00	$ 882,000	Unit Cost based on Amec Foster Wheeler experience and previous closure option cost estimates. Includes silt fence, wattles, surface water diversions, sediment basins, temporary seeding and permanent seeding.
Permanent Drainage and Surface Stabilization Measures (EAB)	63	Acres	$3,787	$ 238,565	Unit rate obtained from Duke Energy summary data was used for consistency.
SUBTOTAL EROSION/SEDIMENT CONTROL AND STORMWATER MANAGEMENT				$ 1,120,565	
SEPARATOR BERM EARTH FILL STABILIZATION BUTTRESS					**Not required for this option**
Earth Fill Buttress Construction					
Rock Cut (for bypass channel excavation)	5,556	CY	$30.00	$ 166,680	Unit cost for rock cut revised to $30/cy based on estimate review by KD. Estimate by-pass channel excavation as follows: 300' channel length for excavation x 50' avg width (40' existing) x 10' avg cut depth /27 = 5556 cy. Note that excavated material may be used as fill for construction of the proposed new berm.
Haul & Dispose of Rock On-site <1.0 mile (for bypass channel excavation)	5,556	CY	$3.00	$ 16,668	Estimate by-pass channel excavation as follows: 300' channel length for excavation x 50' avg width (40' existing) x 10' avg cut depth /27 = 5556 cy. Note that excavated material may be used as fill for construction of the proposed new berm.
Soil Fill Material (for embankment)	66,296	CY	$13	$ 861,848	Estimate dike volume based on maximum embankment height of 40', crest width 15',exterior slope 2.5H:1V, length 250'.
Earth Fill Buttress Cover System					
Subgrade Preparation	3.0	Acres	$5,000.00	$ 15,000	Grade surface of subbase prior to installation of final cover system. Unit costs from construction contractor
8 oz/sy Non-Woven Geotextile	0	SY	3.00	$ -	Furnish and install geotextile as a cushion layer. Unit costs from Glover; costs typically include material, QC testing, and installation
Cover System Geosynthetics (40-mil LLDPE Geomembrane and Geocomposite Drainage Layer	130,680	SF	$1.45	$ 189,486	Unit Cost based on Amec Foster Wheeler experience and previous landfill cost estimates.
Cover System 18" Soil Cover	7,260	CY	$13.00	$ 94,380	Unit Cost based on Amec Foster Wheeler experience and previous landfill cost estimates.
Cover System Top Soil Placement	2,420	CY	$13.00	$ 31,460	Unit Cost based on Amec Foster Wheeler experience and previous landfill cost estimates.
SUBTOTAL SEPARATOR BERM EARTH FILL STABILIZATION BUTTRESS				$ 1,375,522	
EAB EASTERN EXTENSION IMPOUNDMENT CLOSURE BY REMOVAL					
Mobilize and stage dredging operations	1	LS	$300,000.00	$ 300,000	
Perform dredging for removal of ash & impacted sediment	97,901	CY	$14.99	$ 1,467,536	Unit Cost based on Duke Energy estimate averages used for consistency. Assume Unit Cost = $12.49/ton x 1.2 tons/cy = $14.99/cy.
(On-Road) Hauling of Pond Ash and Impacted Soils to landfill		CY	$14.50	$ -	Unit Cost based on Duke Energy estimate averages was used for consistency.
(Off Road) Hauling of Pond Ash and Impacted Soils (within basin)	97,901	CY	$2.00	$ 195,802	Unit Cost based on Duke Energy estimate averages was used for consistency.
Placement of Ash and Impacted Soils In Landfill		CY	$1.50	$ -	Unit Cost based on Duke Energy estimate averages was used for consistency.
SUBTOTAL EAB EASTERN EXTENSION IMPOUNDMENT CLOSURE BY REMOVAL				$ 1,963,338	
EARTHWORK					
Ash Basin Earthwork					
Construction Entrance	1000	LF	$65	$ 65,000	Unit Cost based on Amec Foster Wheeler experience and previous closure option cost estimates.
Clearing and Grubbing	5	Acres	$5,000	$ 25,000	Clear and remove vegetation including trees, brush, schrubs. Unit Cost based on Amec Foster Wheeler experience and previous closure option cost estimates. Increased to $5000/acre from review by NWH.
Topsoil Stripping	5	Acres	$4,000	$ 20,000	Strip topsoil to a minimum 6-inch depth and place in stockpile. Unit Cost based on Amec Foster Wheeler experience and previous closure option cost estimates. Increased to $4000/acre from review by NWH.
Earthwork Cut to Waste	0	CY	$9.24	$ -	Unit Cost based on Duke Energy estimate averages was used for consistency.
Earthwork Cut to Fill	10,000	CY	$9.24	$ 92,400	Unit Cost based on Duke Energy estimate average was used for consistency.
Soil Fill Material (assume off-site borrow source)		CY	$13	$ -	Unit Cost based on Duke Energy estimate averages was used for consistency. No change in estimate.
Topsoil Material; if required (6-inch thick un-compacted fill, source material off-site)		CY	$13	$ -	Unit Cost based on Duke Energy estimate averages was used for consistency. No change in estimate.
SUBTOTAL EARTHWORK				$ 202,400	
ASH BASIN DEWATERING, EXCAVATION, HAULING AND PLACEMENT					
Haul Road Construction	6,000	LF	$60	$ 360,000	Amec Foster Wheeler experience based on 12-inch thick ABC and supporting geotextile at 20-foot width. Unit Cost based on Amec Foster Wheeler experience and previous closure option cost estimates.
Excavation and Loading of Pond Ash for Truck Hauling	3,240,000	CY	$8.43	$ 27,313,200	Unit Cost based on Duke Energy estimate averages was used for consistency.
Excavation and Loading of Subsurface Soils for Truck Hauling	233,933	CY	$10.00	$ 2,339,333	Unit Cost based on Duke Energy estimate averages was used for consistency.
Hauling of Pond Ash and Impacted Soils to off-site landfill at Mayo Plant	3,439,541	CY	$14.50	$ 49,873,345	Unit Cost based on Duke Energy estimate averages was used for consistency.
(Off Road) Hauling of Pond Ash and Impacted Soils 0.7 miles		CY	$2.00	$ -	Unit Cost based on Duke Energy estimate averages was used for consistency.
Placement of Pond Ash and Impacted Soils	3,439,541	CY	$1.50	$ 5,159,312	Unit Cost based on Duke Energy estimate averages was used for consistency.
Truck Wash	4	EA	$150,000	$ 600,000	Truck wash necessary to clean tires and undercarriage of trucks for over-the-road hauling. Unit Cost based on Amec Foster Wheeler experience and previous closure option cost estimates.
Bridge Repair and Maintenance	0	LS	$500,000	$ -	Placed holder estimate for potential bridge repair and maintenance cost. NOT VERIFIED.
Paved Haul Road Repair	79,200	LF	$120	$ 9,504,000	Unit Cost based on Amec Foster Wheeler experience and previous closure option cost estimates. 15 miles used for planning.
SUBTOTAL ASH BASIN DEWATERING, EXCAVATION, HAULING AND PLACEMENT				$ 95,149,189	
LANDFILL & CLOSE IN PLACE COVER CONSTRUCTION					
Landfill Development					
Landfill Construction	41	Acres	$400,000	$ 16,400,000	Unit Cost based on Duke Energy estimate averages was used for consistency. No change in estimate.
Landfill Closure	41	Acres	$150,000	$ 6,150,000	Unit Cost based on Duke Energy estimate averages was used for consistency. No change in estimate.
Close in Place Option Cover System Construction					
Subgrade Preparation	0	Acres	$5,000.00	$ -	Grade surface of subbase prior to installation of final cover system. Unit costs from construction contractor
Anchor Trench	0	LF	$6.00	$ -	Furnish and install geotextile as a cushion layer. Unit costs from Glover; costs typically include material, QC testing, and installation
8 oz/sy Non-Woven Geotextile	0	SY	3.00	$ -	Furnish and install geotextile as a cushion layer. Unit costs from Glover; costs typically include material, QC testing, and installation
Cover System Geosynthetics (40-mil LLDPE Geomembrane and Geocomposite Drainage Layer	0	SF	$1.02	$ -	Unit Cost based on Duke Energy estimate averages was used for consistency. Includes $0.42/sf for liner and $0.60/sf for GCL layer ($1.02/sf total)
Cover System 18" Soil Cover	0	CY	$13	$ -	Unit Cost based on Duke Energy estimate averages was used for consistency. No change in estimate.

Roxboro EAB Closure Option 2 - Closure by Removal (with Off-Site Landfill at Mayo Plant)

Closure Option Opinion of Probable Cost (ROM)

Duke Energy - Roxboro Steam Station

	Quantity	Unit	Unit Cost	Total Cost	Estimate Note
Cover System Top Soil Placement	0	CY	$13	$ -	Unit Cost based on Duke Energy estimate averages was used for consistency. No change in estimate.
SUBTOTAL LANDFILL CONSTRUCTION				**$ 22,550,000**	
SUBTOTAL CLOSURE CONSTRUCTION COST				**$ 144,487,003**	
MOBILIZATION COST				**$ 1,444,870**	Estimate at 1% of Final Closure Construction Cost
TOTAL CLOSURE CONSTRUCTION COST (WITH MOBILIZATION)				**$ 145,931,873**	
OTHER COST					
Design, Permitting and CQA					
Closure Design/Engineering/Permitting (5% of Total Closure Construction Cost)	1	LS	$ 7,296,594	$ 7,296,594	Revised to 5%
Construction Quality Assurance (CQA) (5% of Total Closure Construction Cost)	1	LS	$ 7,296,594	$ 7,296,594	Revised to 5%
Subtotal Design, Permitting and CQA				**$ 14,593,187**	
Post Closure Operations and Maintenance (analysis based on 30 year duration)					
Closure Area Maintenance (63 acres)	30	YR	$ 218,975	$ 6,569,262	Unit Cost based on Duke Energy estimate averages used for consistency. Estimate $3,475.80/ac/year.
Closure Area Monitoring	0	YR		$ -	Not included in estimate per Duke Energy direction.
Landfill Area Maintenance (41 acres)	30	YR	$ 142,508	$ 4,275,234	Unit Cost based on Duke Energy estimate averages used for consistency. Estimate $3,475.80/ac/year.
Landfill Area Monitoring	0	YR		$ -	Not included in estimate per Duke Energy direction.
Subtotal Post Closure Operations and Maintenance				**$ 10,844,496**	
Additional Costs					
Contingency (15% of Final Closure Construction Costs)	1	LS	$ 21,889,781	$ 21,889,781	Amec Foster Wheeler experience from previous projects
Subtotal Additional Costs				**$ 21,889,781**	
TOTAL OPINION OF PROBABLE CLOSURE COST				**$ 193,259,337**	Rough Order of Magniture Cost Estimate
OPINION OF PROBABLE CLOSURE COST PER CY				**$ 59.65**	Based on Volume of Ash Stored
OPINION OF PROBABLE CLOSURE COST PER TON				**$ 49.71**	Based on Moist Unit Weight of Ash Stored
OPINION OF PROBABLE CLOSURE COST PER ACRE				**$ 3,067,609**	Based on Estimated Closue Area

ESTIMATED QUANTITIES

Description	Est Quantity	Units
Estimated Lined Landfill Area:	41	Acres
Estimated East Ash Basin Closure Area:	63	Acres
Estimated EAB Restoration Area (after ash removal):	63	Acres
Estimated Close in Place Area	0	Acres
Estimated Ash Material Stored Volume:	3,240,000	CY
Estimated Ash Material Removed/Hauled Moist Wt:	3,888,000	Tons (bsed on 1.2 Tons/CY Moist Unit Wt)
Estimated Ash/Sediment Material Removed/Hauled Volume (EEI):	97,901	CY
Estimated Ash/Sediment Material Removed/Hauled Moist Wt (EEI):	117,481	Tons (based on 1.2 Tons/CY Moist Unit Wt)
Estimated Contaminated Soil Removed/Hauled Volume:	101,640	CY
Total Estimated Ash and Contaminated Soil Removed/Hauled Volume:	3,439,541	CY
EAB Eastern Extension Impoundment Soil Fill Volume:	75,976	CY
Total Estimated Landfill Soil Cover Volume:	132,293	CY
Total Estimated Soil Fill Volume:	208,269	CY
Estimated Borrow Area:	8.6	Acres (Assume 15' max excavartion depth based on Duke guidelines.)

Estimate Notes:

1. This estimate is represented as Rough Order of Magnitude (ROM).

Roxboro EAB Closure Option 3 - Close in Place Hybrid

Closure Option Opinion of Probable Cost (ROM)

Duke Energy - Roxboro Steam Station

	Quantity	Unit	Unit Cost	Total Cost	Estimate Note
PROPERTY ACQUISTION					
Property Acquition Cost		Acres	$3,000	$ -	Best estimate of property values in area from review of tax values and for sale listing for large tracts in Person County. NOT VERIFIED.
			SUBTOTAL PROPERTY ACQUISTION	$ -	
GENERAL					
Surveying	63	Acres	$ 2,000	$ 126,000	
Removal & Filtration of Free Water (Initial Dewatering)	0	Mo	$ 416,667	$ -	Assume not required for this options.
Removal & Treatment of Pore Water	6	Mo	$ 583,333	$ 3,499,998	Assume required for duration of construction. Estimated duration 6 months. Unit rate obtained from Duke Energy summary data fo consistency.
Breaching EAB Main Dam	1	LS	$1,000,000	$ 1,000,000	Place holder for cost with no technical basis. .
			SUBTOTALGENERAL	$ 4,625,998	
EROSION/SEDIMENT CONTROL AND STORMWATER MANAGEMENT					
East Ash Basin Sediment Control and Stormwater Management	41	Acres	$14,000.00	$ 572,600	Unit Cost based on Amec Foster Wheeler experience and previous closure option cost estimates. Includes silt fence, wattles, surface water diversions, sediment basins, temporary seeding and permanent seeding.
Permanent Drainage and Surface Stabilization Measures (EAB)	41	Acres	$3,787	$ 154,878	Unit rate obtained from Duke Energy summary data was used for consistency.
			SUBTOTAL EROSION/SEDIMENT CONTROL AND STORMWATER MANAGEMENT	$ 727,478	
SEPARATOR BERM EARTH FILL STABILIZATION BUTTRESS					**Not required for this option**
Earth Fill Buttress Construction					
Rock Cut (for bypass channel excavation)	5,556	CY	$30.00	$ 166,680	Unit cost for rock cut revised to $30/cy based on estimate review by KD. Estimate by-pass channel excavation as follows: 300' channel length for excavation x 50' avg width (40' existing) x 10' avg cut depth /27 = 5556 cy. Note that excavated material may be used as fill for construction of the proposed new berm.
Haul & Dispose of Rock On-site <1.0 mile (for bypass channel excavation)	5,556	CY	$3.00	$ 16,668	Estimate by-pass channel excavation as follows: 300' channel length for excavation x 50' avg width (40' existing) x 10' avg cut depth /27 = 5556 cy. Note that excavated material may be used as fill for construction of the proposed new berm.
Soil Fill Material (for embankment)	66,296	CY	$13	$ 861,848	Estimate dike volume based on maximum embankment height of 40', crest width 15',exterior slope 2.5H:1V, length 250'.
Earth Fill Buttress Cover System					
Subgrade Preparation	3.0	Acres	$5,000.00	$ 15,000	Grade surface of subbase prior to installation of final cover system. Unit costs from construction contractor
8 oz/sy Non-Woven Geotextile	0	SY	3.00	$ -	Furnish and install geotextile as a cushion layer. Unit costs from Glover; costs typically include material, QC testing, and installation
Cover System Geosynthetics (40-mil LLDPE Geomembrane and Geocomposite Drainage Layer	130,680	SF	$1.45	$ 189,486	Unit Cost based on Amec Foster Wheeler experience and previous landfill cost estimates.
Cover System 18" Soil Cover	7,260	CY	$13.00	$ 94,380	Unit Cost based on Amec Foster Wheeler experience and previous landfill cost estimates.
Cover System Top Soil Placement	2,420	CY	$13.00	$ 31,460	Unit Cost based on Amec Foster Wheeler experience and previous landfill cost estimates.
			SUBTOTAL SEPARATOR BERM EARTH FILL STABILIZATION BUTTRESS	$ 1,375,522	
EAB EASTERN EXTENSION IMPOUNDMENT CLOSURE BY REMOVAL					
Mobilize and stage dredging operations	1	LS	$300,000.00	$ 300,000	
Perform dredging for removal of ash & impacted sediment	97,901	CY	$14.99	$ 1,467,536	Unit Cost based on Duke Energy estimate averages was used for consistency. Assume Unit Cost = $12.49/ton x 1.2 tons/cy = $14.99/cy.
(On-Road) Hauling of Pond Ash and Impacted Soils to landfill		CY	$14.50	$ -	Unit Cost based on Duke Energy estimate averages was used for consistency.
(Off Road) Hauling of Pond Ash and Impacted Soils (within basin)	97,901	CY	$2.00	$ 195,802	Unit Cost based on Duke Energy estimate averages was used for consistency.
Placement of Ash and Impacted Soils In Landfill		CY	$1.50	$ -	Unit Cost based on Duke Energy estimate averages was used for consistency.
			SUBTOTAL EAB EASTERN EXTENSION IMPOUNDMENT CLOSURE BY REMOVAL	$ 1,963,338	
EARTHWORK					
Ash Basin Earthwork					
Construction Entrance	1000	LF	$65	$ 65,000	Unit Cost based on Amec Foster Wheeler experience and previous closure option cost estimates.
Clearing and Grubbing	5	Acres	$5,000	$ 25,000	Clear and remove vegetation including trees, brush, schrubs. Unit Cost based on Amec Foster Wheeler experience and previous closure option cost estimates. Increased to $5000/acre from review by NWH.
Topsoil Stripping	5	Acres	$4,000	$ 20,000	Strip topsoil to a minimum 6-inch depth and place in stockpile. Unit Cost based on Amec Foster Wheeler experience and previous closure option cost estimates. Incresed to $4000/acre from review by NWH.
Earthwork Cut to Waste	0	CY	$9.24	$ -	Unit Cost based on Duke Energy estimate averages was used for consistency.
Earthwork Cut to Fill	287,467	CY	$9.24	$ 2,656,195	Unit Cost based on Duke Energy estimate average was used for consistency.
Soil Fill Material (assume off-site borrow source)	0	CY	$13	$ -	Unit Cost based on Duke Energy estimate averages was used for consistency. No change in estimate.
Topsoil Material; if required (6-inch thick un-compacted fill, source material off-site)		CY	$13	$ -	Unit Cost based on Duke Energy estimate averages was used for consistency. No change in estimate.
			SUBTOTAL EARTHWORK	$ 2,766,195	
ASH BASIN DEWATERING, EXCAVATION, HAULING AND PLACEMENT					
Haul Road Construction	6,000	LF	$60	$ 360,000	Amec Foster Wheeler experience based on 12-inch thick ABC and supporting geotextile at 20-foot width. Unit Cost based on Amec Foster Wheeler experience and previous closure option cost estimates.
Excavation and Loading of Pond Ash for Truck Hauling	34,146	CY	$8.43	$ 287,851	Unit Cost based on Duke Energy estimate averages was used for consistency.
Excavation and Loading of Subsurface Soils for Truck Hauling	35,655	CY	$10.00	$ 356,547	Unit Cost based on Duke Energy estimate averages was used for consistency.
Hauling of Pond Ash and Impacted Soils to off-site landfill at Mayo Plant	393,531	CY	$14.50	$ 5,706,195	Unit Cost based on Duke Energy estimate averages was used for consistency.
(Off Road) Hauling of Pond Ash and Impacted Soils 0.7 miles		CY	$2.00	$ -	Unit Cost based on Duke Energy estimate averages was used for consistency.
Placement of Pond Ash and Impacted Soils	393,531	CY	$1.50	$ 590,296	Unit Cost based on Duke Energy estimate averages was used for consistency.
Truck Wash	4	EA	$150,000	$ 600,000	Truck wash necessary to clean tires and undercarriage of trucks for over-the-road hauling. Unit Cost based on Amec Foster Wheeler experience and previous closure option cost estimates.
Bridge Repair and Maintenance	0	LS	$500,000	$ -	Placed holder estimate for potential bridge repair and maintenance cost. NOT VERIFIED.
Paved Haul Road Repair	79,200	LF	$120	$ 9,504,000	Unit Cost based on Amec Foster Wheeler experience and previous closure option cost estimates. 15 miles used for planning
			SUBTOTAL ASH BASIN DEWATERING, EXCAVATION, HAULING AND PLACEMENT	$ 17,404,888	
LANDFILL & CLOSE IN PLACE COVER CONSTRUCTION					
Landfill Development					
Landfill Construction	12	Acres	$400,000	$ 4,800,000	Unit Cost based on Duke Energy estimate averages was used for consistency. No change in estimate.
Landfill Closure	12	Acres	$150,000	$ 1,800,000	Unit Cost based on Duke Energy estimate averages was used for consistency. No change in estimate.
Close in Place Option Cover System Construction					
Subgrade Preparation	41	Acres	$5,000.00	$ 204,500	Grade surface of subbase prior to installation of final cover system. Unit costs from construction contractor
Anchor Trench	9,000	LF	$6.00	$ 54,000	Furnish and install geotextile as a cushion layer. Unit costs from Glover; costs typically include material, QC testing, and installation
8 oz/sy Non-Woven Geotextile	197,956	SY	3.00	$ 593,868	Furnish and install geotextile as a cushion layer. Unit costs from Glover; costs typically include material, QC testing, and installation
Cover System Geosynthetics (40-mil LLDPE Geomembrane and Geocomposite Drainage Layer	1,781,604	SF	$1.02	$ 1,817,236	Unit Cost based on Duke Energy estimate averages was used for consistency. Includes $0.42/sf for liner and $0.60/sf for GCL layer ($1.02/sf total)
Cover System 18" Soil Cover	98,978	CY	$13	$ 1,286,714	Unit Cost based on Duke Energy estimate averages was used for consistency. No change in estimate.
Cover System Top Soil Placement	32,993	CY	$13	$ 428,905	Unit Cost based on Duke Energy estimate averages was used for consistency. No change in estimate.

Roxboro EAB Closure Option 3 - Close in Place Hybrid

Closure Option Opinion of Probable Cost (ROM)

Duke Energy - Roxboro Steam Station

	Quantity	Unit	Unit Cost	Total Cost	Estimate Note
SUBTOTAL LANDFILL & CLOSE IN PLACE COVER CONSTRUCTION				**$ 10,985,223**	
SUBTOTAL CLOSURE CONSTRUCTION COST				**$ 39,848,642**	
MOBILIZATION COST				**$ 398,486**	Estimate at 1% of Final Closure Construction Cost
TOTAL CLOSURE CONSTRUCTION COST (WITH MOBILIZATION)				**$ 40,247,128**	
OTHER COST					
Design, Permitting and CQA					
Closure Design/Engineering/Permitting (5% of Total Closure Construction Cost)	1	LS	$ 2,012,356	$ 2,012,356	Revised to 5%
Construction Quality Assurance (CQA) (5% of Total Closure Construction Cost)	1	LS	$ 2,012,356	$ 2,012,356	Revised to 5%
Subtotal Design, Permitting and CQA				**$ 4,024,713**	
Post Closure Operations and Maintenance (analysis based on 30 year duration)					
Closure Area Maintenance (63 acres)	30	YR	$ 218,975	$ 6,569,262	Unit Cost based on Duke Energy estimate averages used for consistency. Estimate $3,475.80/ac/year.
Closure Area Monitoring	0	YR		$ -	Not included in estimate per Duke Energy direction.
Landfill Area Maintenance (12 acres)	30	YR	$ 41,710	$ 1,251,288	Unit Cost based on Duke Energy estimate averages used for consistency. Estimate $3,475.80/ac/year.
Landfill Area Monitoring	0	YR		$ -	Not included in estimate per Duke Energy direction.
Subtotal Post Closure Operations and Maintenance				**$ 7,820,550**	
Additional Costs					
Contingency (15% of Final Closure Construction Costs)	1	LS	$ 6,037,069	$ 6,037,069	Amec Foster Wheeler experience from previous projects
Subtotal Additional Costs				**$ 6,037,069**	
TOTAL OPINION OF PROBABLE CLOSURE COST				**$ 58,129,461**	Rough Order of Magniture Cost Estimate
OPINION OF PROBABLE CLOSURE COST PER CY				**$ 17.94**	Based on Volume of Ash Stored
OPINION OF PROBABLE CLOSURE COST PER TON				**$ 14.95**	Based on Moist Unit Weight of Ash Stored
OPINION OF PROBABLE CLOSURE COST PER ACRE				**$ 922,690**	Based on Estimated Closue Area

ESTIMATED QUANTITIES

Description	Est Quantity	Units
Estimated Lined Landfill Area:	12	Acres
Estimated East Ash Basin Closure Area:	63	Acres
Estimated EAB Restoration Area (after ash removal):	22	Acres
Estimated Close in Place Area	41	Acres
Estimated Ash Material Stored Volume:	3,240,000	CY
Estimated Ash Material Stored Moist Wt:	3,888,000	Tons (based on 1.2 Tons/CY Moist Unit Wt)
Estimated Ash/Sediment Material Removed/Hauled Volume (EEI):	97,901	CY
Estimated Ash/Sediment Material Removed/Hauled Moist Wt (EEI):	117,481	Tons (based on 1.2 Tons/CY Moist Unit Wt)
Estimated Ash Material Excavated/Removed Volume:	547,442	CY (Estimated volume removed from GB man area)
Estimated Total Ash Removed/Hauled Volume:	645,343	CY
Estimated Ash Grade Cut Volume:	34,146	CY
Estimated Ash Grade Fill Volume:	321,613	CY
Estimated Net Fill Required Volume:	287,467	
Estimated Ash Material Removed/Hauled Volume:	357,876	
Estimated Contaminated Soil Removed/Hauled Volume:	35,655	CY
Total Estimated Ash and Contaminated Soil Removed/Hauled Volume:	393,531	CY
EAB Eastern Extension Impoundment Soil Fill Volume:	75,976	CY
Estimated Landfill Soil Cover Volume:	38,720	CY
Estimated EAB Closure Soil Cover Volume:	131,971	CY
Total Estimated Soil Fill Volume:	246,667	CY
Estimated Borrow Area:	10.2	Acres (Assume 15' max excavartion depth based on Duke guidelines.)

Estimate Notes:

1. This estimate is represented as Rough Order of Magnitude (ROM).

Roxboro EAB Closure Option 2 - Closure by Removal (Off-Site Landfill)

Closure Option Opinion of Probable Cost (ROM)

Duke Energy - Roxboro Steam Station

Person County, NC

	Quantity	Unit	Unit Cost	Total Cost	Estimate Note
GENERAL					
Surveying	223	Acres	$ 2,000	$ 446,200	Excavate and remove, including off-site disposal of existing storm water structures/piping. Price at $8k/day at 5 days per week for 4 weeks.
Abandon WAB Discharge Outlet Structures/Piping	1	EA	$ 200,000	$ 200,000	Unit Rate By Duke
			SUBTOTALGENERAL	$ 646,200	
EROSION/SEDIMENT CONTROL AND STORMWATER MANAGEMENT					
West Ash Basin Sediment Control and Stormwater Management	223	Acres	$14,000.00	$ 3,123,400	Unit Rate By Duke
Permanent Stabilization Measures	223	Acres	$3,787.00	$ 844,880	Unit Rate By Duke
			SUBTOTAL EROSION/SEDIMENT CONTROL AND STORMWATER MANAGEMENT	$ 3,968,280	
EARTHWORK					
Ash Basin Earthwork					
Construction Entrance	50	LF	$65	$ 3,250	Amec Foster Wheeler experience based on $20/LF for 12-inch thick ABC and supporting geotextile at 20-foot width.
Clearing and Grubbing		Acres	$5,000	$ -	Clear and remove vegetation including trees, brush, shrubs.
Breaching Main Dam	1	LS	$1,000,000	$ 1,000,000	Unit Rate By Duke
Earthwork Cut to Fill		CY	$6.87	$ -	Unit Rate By Duke
Topsoil Stripping		Acres	$4,000.00	$ -	Unit Rate By Duke
Regrading Material; if required (18-inch thick un-compacted fill, source material off-site)	517,154.0	CY	$11	$ 5,574,920	Unit Rate By Duke
Topsoil Material; if required (6-inch thick un-compacted fill, source material off-site)	172,384.7	CY	$11	$ 1,858,307	Unit Rate By Duke
				$ -	
Landfill Earthwork					
Landfill Construction	98	Acres	$400,000	$ 39,200,000	Unit Rate By Duke
Landfill Closure	98	Acres	$150,000	$ 14,700,000	Unit Rate By Duke
			SUBTOTAL EARTHWORK	$ 62,336,477	
ASH BASIN DEWATERING, EXCAVATION, HAULING AND PLACEMENT					
Temporary Dewatering (Ash Basin) Free Water	2	Mo	$416,667.00	$ 833,334	Unit Rate By Duke
Temporary Dewatering (Ash Basin) Construction Water	206	Mo	$583,333.00	$ 120,166,598	Unit Rate By Duke
Haul Road Construction	500	LF	$60.00	$ 30,000	Unit Rate By Duke
Excavation of Pond Ash and Loading in Trucks	16,832,522	CY	$8.43	$ 141,898,160	Unit Rate By Duke
Excavation of Residual Adjacent and Subsurface Soils and Loading in Trucks	359,773	CY	$10	$ 3,597,730	Unit Rate By Duke
Hauling, Placement, and Compaction of Pond Ash and Residual Soils to Offsite Landfill	17,192,295	CY	$14.50	$ 249,288,278	Unit Rate By Duke
Paved Haul Road Repair	79,200	LF	$120	$ 9,504,000	
Truck Wash	1	LS	$150,000.00	$ 150,000	Truck wash necessary to clean tires and undercarriage of trucks for over-the-road hauling. ROM costs based on experience with Duke facilities.
			SUBTOTAL ASH BASIN DEWATERING, EXCAVATION, HAULING AND PLACEMENT	$ 525,468,100	
			SUBTOTAL FINAL CLOSURE CONSTRUCTION COST	**$ 592,419,056**	
			Estimate Mobilization Cost (2.5% of Final Closure Construction Cost)	**$ 14,810,476**	
OTHER COST					
Design, Permitting and CQA					
Closure Design/Engineering/Permitting (5% of Final Closure Construction Costs)	1	LS	$ 29,620,952.82	$ 29,620,953	
Construction Quality Assurance (CQA) (5% of Final Closure Construction Costs)	1	LS	$ 29,620,952.82	$ 29,620,953	
			Subtotal Design, Permitting and CQA	**$ 59,241,906**	
Post Closure Operations and Maintenance (analysis based on 30 year duration)					
Landfill Area Maintenance	30	YR	$ 341,671	$ 10,250,130	Estimate at $3475.8/acre/year of capped area.
Landfill Area Monitoring	0	YR		$ -	
			Subtotal Post Closure Operations and Maintenance	**$ 10,250,130**	
Additional Costs					
Contingency (15% of Final Closure Construction Costs)	1	LS	$ 91,084,430	$ 91,084,430	Amec Foster Wheeler experience from previous projects
			Subtotal Additional Costs	**$ 91,084,430**	
			TOTAL OPINION OF PROBABLE CLOSURE COST	**$ 767,805,998**	Rough Order of Magniture Cost Estimate
			OPINION OF PROBABLE CLOSURE COST PER CY	**$ 45.61**	Based on Volume Placed in landfill
			OPINION OF PROBABLE CLOSURE COST PER TON	**$ 38.01**	Based on Moist Unit Weight of 1.2 Tons/CY
			OPINION OF PROBABLE CLOSURE COST PER ACRE	**$ 3,441,533**	Based on Estimated Closue Area

ESTIMATED QUANTITIES

Description	Est Quantity	Units
Estimated Landfill Property Area:	108	Acres
Estimated Landfill Development Area (including buffer and borrow area):	108	Acres
Estimated Lined Landfill Area:	98	Acres
Estimated West Ash Basin Closure Area:	223	Acres
Estimated WAB Restoration Area (after ash removal):	223	Acres
Estimated Ash Material Removed/Hauled Volume:	16,832,522	CY
Estimated Ash Material Removed/Hauled Moist Wt:	20,199,026	Tons (bsed on 1.2 Tons/CY Moist Unit Wt)
Estimated Contaminated Soil Removed/Hauled Volume (WAB):	359,773	CY
Estimated Contaminated Soil Removed/Hauled Moist Wt:	539,660	Tons (based on 1.5 Tons/CY Moist Unit Wt)
Total Estimated Ash and Contaminated Soil Removed/Hauled Volume:	17,192,295	CY
Total Estimated Ash and Contaminated Soil Removed/Hauled Moist Wt:	20,738,686	Tons (based on Moist Unit Wt)
Total Estimated Ash and Contaminated Soil Placed in Landfill Volume:	13,753,836	Tons (based on 0.8 x Volume Hauled)

Estimate Notes:

1. This estimate is represented as Rough Order of Magnitude (ROM).

Roxboro EAB Closure Option 4 - Closure by Removal (On-Site new Landfill)
Closure Option Opinion of Probable Cost (ROM)
Duke Energy - Roxboro Steam Station
Person County, NC

	Quantity	Unit	Unit Cost	Total Cost	Estimate Note
GENERAL					
Surveying	223	Acres	$ 2,000	$ 446,200	Excavate and remove, including off-site disposal of existing storm water structures/piping. Price at $8k/day at 5 days per week for 4 weeks.
Abandon WAB Discharge Outlet Structures/Piping	1	EA	$ 200,000	$ 200,000	Unit Rate By Duke
SUBTOTALGENERAL				$ 646,200	
EROSION/SEDIMENT CONTROL AND STORMWATER MANAGEMENT					
West Ash Basin Sediment Control and Stormwater Management	223	Acres	$14,000.00	$ 3,123,400	Unit Rate By Duke
Permanent Stabilization Measures	223	Acres	$3,787.00	$ 844,880	Unit Rate By Duke
SUBTOTAL EROSION/SEDIMENT CONTROL AND STORMWATER MANAGEMENT				$ 3,968,280	
EARTHWORK					
Ash Basin Earthwork					
Construction Entrance	50	LF	$65	$ 3,250	Amec Foster Wheeler experience based on $20/LF for 12-inch thick ABC and supporting geotextile at 20-foot width.
Clearing and Grubbing		Acres	$5,000	$ -	Clear and remove vegetation including trees, brush, shrubs.
Breaching Main Dam	1	LS	$1,000,000	$ 1,000,000	Unit Rate By Duke
Earthwork Cut to Fill		CY	$6.87	$ -	Unit Rate By Duke
Topsoil Stripping		Acres	$4,000.00	$ -	Unit Rate By Duke
Regrading Material; if required (18-inch thick un-compacted fill, source material off-site)	517,154.0	CY	$11	$ 5,574,920	Unit Rate By Duke
Topsoil Material; if required (6-inch thick un-compacted fill, source material off-site)	172,384.7	CY	$11	$ 1,858,307	Unit Rate By Duke
				$ -	
Landfill Earthwork					
Landfill Construction	98.3	Acres	$400,000	$ 39,320,000	Unit Rate By Duke
Landfill Closure	98.3	Acres	$150,000	$ 14,745,000	Unit Rate By Duke
SUBTOTAL EARTHWORK				$ 62,501,477	
ASH BASIN DEWATERING, EXCAVATION, HAULING AND PLACEMENT					
Temporary Dewatering (Ash Basin) Free Water	2	Mo	$416,667.00	$ 833,334	Unit Rate By Duke
Temporary Dewatering (Ash Basin) Construction Water	206	Mo	$583,333.00	$ 120,166,598	Unit Rate By Duke
Haul Road Construction	500	LF	$60.00	$ 30,000	Unit Rate By Duke
Excavation of Pond Ash and Loading in Trucks	16,832,522	CY	$8.43	$ 141,898,160	Unit Rate By Duke
Excavation of Residual Adjacent and Subsurface Soils and Loading in Trucks	359,773	CY	$10	$ 3,597,730	Unit Rate By Duke
Hauling, Placement, and Compaction of Pond Ash and Residual Soils to Landfill Area A Landfill	17,192,295	CY	$4	$ 60,173,033	Unit Rate By Duke
Truck Wash	1	LS	$150,000.00	$ 150,000	Truck wash necessary to clean tires and undercarriage of trucks for over-the-road hauling. ROM costs based on experience with Duke facilities.
SUBTOTAL ASH BASIN DEWATERING, EXCAVATION, HAULING AND PLACEMENT				$ 326,848,855	
SUBTOTAL FINAL CLOSURE CONSTRUCTION COST				**$ 393,964,811**	
Estimate Mobilization Cost (2.5% of Final Closure Construction Cost)				**$ 9,849,120**	
OTHER COST					
Design, Permitting and CQA					
Closure Design/Engineering/Permitting (5% of Final Closure Construction Costs)	1	LS	$ 19,698,240.57	$ 19,698,241	
Construction Quality Assurance (CQA) (5% of Final Closure Construction Costs)	1	LS	$ 19,698,240.57	$ 19,698,241	
Subtotal Design, Permitting and CQA				**$ 39,396,481**	
Post Closure Operations and Maintenance (analysis based on 30 year duration)					
Landfill Area Maintenance	30	YR	$ 341,671	$ 10,250,130	Estimate at $3475.8/acre/year of capped area.
Landfill Area Monitoring	0	YR		$ -	
Subtotal Post Closure Operations and Maintenance				**$ 10,250,130**	
Additional Costs					
Contingency (15% of Final Closure Construction Costs)	1	LS	$ 60,572,090	$ 60,572,090	Amec Foster Wheeler experience from previous projects
Subtotal Additional Costs				**$ 60,572,090**	
TOTAL OPINION OF PROBABLE CLOSURE COST				**$ 514,032,633**	Rough Order of Magniture Cost Estimate
OPINION OF PROBABLE CLOSURE COST PER CY				**$ 30.54**	Based on Volume Placed in landfill
OPINION OF PROBABLE CLOSURE COST PER TON				**$ 25.45**	Based on Moist Unit Weight of 1.2 Tons/CY
OPINION OF PROBABLE CLOSURE COST PER ACRE				**$ 2,304,046**	Based on Estimated Closue Area

ESTIMATED QUANTITIES

Description	Est Quantity	Units
Estimated Landfill Property Area:	108	Acres
Estimated Landfill Development Area (including buffer and borrow area):	108	Acres
Estimated Lined Landfill Area:	98	Acres
Estimated West Ash Basin Closure Area:	223	Acres
Estimated WAB Restoration Area (after ash removal):	223	Acres
Estimated Ash Material Removed/Hauled Volume:	16,832,522	CY
Estimated Ash Material Removed/Hauled Moist Wt:	20,199,026	Tons (bsed on 1.2 Tons/CY Moist Unit Wt)
Estimated Contaminated Soil Removed/Hauled Volume (WAB):	359,773	CY
Estimated Contaminated Soil Removed/Hauled Moist Wt:	539,660	Tons (based on 1.5 Tons/CY Moist Unit Wt)
Total Estimated Ash and Contaminated Soil Removed/Hauled Volume:	17,192,295	CY
Total Estimated Ash and Contaminated Soil Removed/Hauled Moist Wt:	20,738,686	Tons (based on Moist Unit Wt)
Total Estimated Ash and Contaminated Soil Placed in Landfill Volume:	13,753,836	Tons (based on 0.8 x Volume Hauled)

Estimate Notes:

1. This estimate is represented as Rough Order of Magnitude (ROM).

Attachment C - Closure Options Evaluation Scoring Matrix

Scoring for Evaluation of Closure Options
Closure Options Evaluation Worksheet
Ash Basin Closure - Master Programmatic Document
Duke Energy

Site Name: Roxboro East Ash Basin (EAB)

1	= Option-Specific User Input
1	= Calculated Value

Threshold Criteria: All closure options must comply with the following threshold criteria based on Duke Energy Guiding Principals for Ash Basin Closure
1. Provide continued geotechnical stability meeting appropriate safety factors under applicable loading conditions
2. Provide flow capacity and erosion resistance during design storm and flooding conditions
3. Effectively mitigate groundwater impacts (in conjunction with GW remediation where present)
4. Comply with applicable state and federal regulations (e.g. North Carolina Coal Ash Management Act)

Option	Description
1	In Place Closure
2	Closure by Removal
3	Hybrid Closure (Partial Removal)
4	Closure by Removal (On-site new Landfill)

Environmental Protection and Impacts	Weight:	30%		User Input				Value that Scores 10	Value that Scores 0	Calculated or User Selected Score				Criterion Weight	Contribution to Total Score
Criterion	Scoring System	Required Input	Units	1	2	3	4			1	2	3	4		
Modeled Plume Intersecting Surface	Refer to EM Sub-Scoring Sheet	This Area Not Used For Interpretation of Environmental Modeling Results								10	10	10	10	24%	7.20%
Groundwater Impact Beyond the Current Compliance Boundary	Refer to EM Sub-Scoring Sheet	This Area Not Used For Interpretation of Environmental Modeling Results								0	0	0	0	24%	7.20%
Modeled Off-site Impact	Refer to EM Sub-Scoring Sheet	This Area Not Used For Interpretation of Environmental Modeling Results								10	10	10	10	24%	7.20%
Relative rank based on visual interpretation of modeled boron plume	Refer to EM Sub-Scoring Sheet	This Area Not Used For Interpretation of Environmental Modeling Results								0	10	5	9	13%	3.90%
Air emissions off-site (based on miles driven)	Interpolation. Zero miles scores 10.	Truck miles driven	Miles	764,784	27,231,731	1,013,779	1,985,852	764,784	27,231,731	10	0	10	10	5%	1.50%
Air emissions on-site (based on miles driven)	Interpolation. Zero gallons scores 10.	Truck miles driven	Miles	5,594	5,594	5,594	5,594	5,594	5,594	0	0	0	0	5%	1.50%
Avoidance of greenfield disturbance	Interpolation. Zero acres scores 10.	Disturbed acres of greenfield	Acres	21.0	107.6	22.0	107.9	21	107.9	10	0	10	0	5%	1.50%
Weighted Totals (Contribution to Total Score)										**1.74**	**1.83**	**1.94**	**1.9**		

Cost	Weight:	35%		User Input				Value that Scores 10	Value that Scores 0	Calculated or User Selected Score				Criterion Weight	Contribution to Total Score
Criterion	Scoring System	Required Input	Units	1	2	3	4			1	2	3	4		
Closure Cost	Interpolation. Min value scores 10. Max value scores 0.	Closure Cost ($million)	USD	$26.9	$757.6	$50.3	$503.8	$ 26.90	$ 757.56	10.0	0.0	9.7	3.5	80%	28.00%
Operation, Maintenance and Monitoring Cost		OM&M Cost ($million)	USD	$6.6	$10.3	$7.8	$10.3	$ 6.60	$ 10.30	10.0	0.0	6.8	0.1	20%	7.00%
Weighted Totals (Contribution to Total Score)										**3.50**	**0.00**	**3.19**	**1.0**		

Schedule	Weight:	15%		User Input				Value that Scores 10	Value that Scores 0	Calculated or User Selected Score				Criterion Weight	Contribution to Total Score
Criterion	Scoring System	Required Input	Units	1	2	3	4			1	2	3	4		
Initiation Time	Interpolation Minimum value scores 10	Time to move first ash	Years	2.1	2.5	2.5	2.5	2.1	2.5	10	0	0	0	30%	4.50%
Construction Duration	Interpolation Minimum value scores 10	Estimated durations	Years	4.4	16.9	4.8	16.9	4.4	16.9	10	0	10	0	70%	10.50%

Scoring for Evaluation of Closure Options
Closure Options Evaluation Worksheet
Ash Basin Closure - Master Programmatic Document
Duke Energy

Site Name: Roxboro East Ash Basin (EAB)

1 = Option-Specific User Input
1 = Calculated Value

Weighted Totals (Contribution to Total Score)										**1.50**	**0.00**	**1.05**	**0.0**		
Regional Factors	**Weight:**	**15%**		**User Input**				**Value that Scores 10**	**Value that Scores 0**	**Calculated or User Selected Score**				**Criterion Weight**	**Contribution to Total Score**
Criterion	**Scoring System**	**Required Input**	**Units**	**1**	**2**	**3**	**4**			**1**	**2**	**3**	**4**		
Plan or potential for beneficial reuse of site	Subjective	Not Used For Subjective Scoring								0	5	10		5%	0.75%
Imported soil needs	Interpolation Min value scores 10 Max value scores 0	Soil Imported	CY	509,856	1,321,965	246,667	1,323,901	246,667	1,323,901	8	0	10	0	5%	0.75%
Beneficial reuse of CCR	Interpolation. Maximum value scores 10.	Fraction Used	CY	0	0	0	0	0	0	0	0	0	0	0%	0.00%
Transportation impact (based on miles driven)	Interpolation Min value scores 10 Max value scores 0	Miles Driven	Miles	770,378	27,231,731	1,019,373	1,985,852	770,378	27,231,731	10	0	10	10	65%	9.75%
Noise impact due to on-site activity (based on proximity of neighbors to on-site work areas)	Subjective 0 to 10	Not Used For Subjective Scoring								10	0	5	0	5%	0.75%
View impact (based on final height of storage facility and land uses within viewshed)	Subjective 0 to 10									10	0	5	0	20%	3.00%
Weighted Totals (Contribution to Total Score)										**1.41**	**0.04**	**1.31**	**1.0**		
Constructability	**Weight:**	**5%**		**User Input**				**Value that Scores 10**	**Value that Scores 0**	**Calculated or User Selected Score**					
Criterion	**Scoring System**	**Required Input**	**Units**	**1**	**2**	**3**	**4**			**1**	**2**	**3**	**4**		
Consider stormwater management, geotechnical, and dewatering	Subjective 0 to 10: 10 is the easiest while 0 is the riskiest	Not Used For Subjective Scoring								10	0	5	0	100%	5.00%
Weighted Totals (Contribution to Total Score)										**0.50**	**0.00**	**0.25**	**0.00**		
Total Score For Each Option (On a Scale of 0 to 10)										**8.65**	**1.87**	**7.74**	**3.9**		

Criteria for Evaluation of Closure Options
Closure Options Evaluation Worksheet
Ash Basin Closure - Master Programmatic Document
Duke Energy

Threshold Criteria: All closure options must comply with the following threshold criteria based on Duke Energy Guiding Principals for Ash Basin Closure
1. Provide continued geotechnical stability under applicable loading conditions and safety factors
2. Provide flow capacity and erosion resistance during design storm and flooding conditions
3. Effectively mitigate groundwater impacts
4. Comply with applicable state and federal regulations (e.g. North Carolina Coal Ash Management Act)

Category	Criterion	Guidance
Environmental Protection and Impacts	Modeled Plume Intersecting Surface Water	Refer to scoring system on Environmental Modeling (EM) Sub-Scoring worksheet.
	Groundwater Impact Beyond the Current Compliance Boundary	Refer to scoring system on Environmental Modeling (EM) Sub-Scoring worksheet.
	Modeled Off-site Impact	Refer to scoring system on Environmental Modeling (EM) Sub-Scoring worksheet.
	Relative rank based on visual interpretation of modeled boron plume	Refer to scoring system on Environmental Modeling (EM) Sub-Scoring worksheet.
	Air emissions off-site	Based on truck miles driven for hauling CCR and soil.
	Air emissions on-site from closure implementation	Based on total cubic yards of cut and fill on site as a surrogate for gallons of fuel consumed.
	Avoidance of greenfield disturbance	Refer to Scoring System and Required Input columns on scoring sheet.
Cost	Capital Cost	From rough order-of-magnitude cost estimate or detailed cost estimate.
	Operation, Maintenance and Monitoring Cost	
Schedule	Initiation Time	From preliminary schedule for designing, permitting, bidding and constructing the option.
	Construction Duration	
Regional Factors	Plan or potential for beneficial reuse of site	Refer to Scoring System and Required Input columns on scoring sheet.
	Imported soil needs	Refer to Scoring System and Required Input columns on scoring sheet.
	Beneficial reuse of CCR	Refer to Scoring System and Required Input columns on scoring sheet.
	Transportation impact	Based on truck miles driven for hauling CCR and soil.
	Noise impact due to on-site activity	Based on proximity of neighbors to specific on-site work areas.
	View impact	Based on final height of storage facility and land uses within viewshed.
Constructability	Consider stormwater management, geotechnical, and dewatering	Subjective and relative comparison to other options

Environmental Groundwater Sub-scoring Worksheet
Closure Options Evaluation
Duke Energy

Roxboro East Ash Basin Groundwater Sub-Scoring Document

Station/Plant Name: Roxboro Steam Electric Plant

Scored by: TH, RC, KW on 1/15/2019

Evaluation Criteria:

Criteria 1. Modeled Plume Intersecting Surface Water	Score				
Modeled plume[1] does not intersect surface waters after 10 years	10				
Modeled plume[1] does not intersect surface waters after 100 years	5				
Modeled plume[1] does not intersect surface waters after 200 years	0	(Option 1)	(Option 2)	(Option 3)	(Option 4)
		Closure-in-Place	Closure by Removal (off-site disposal)	Closure-in-place (Hybrid)	Closure by Removal (on-site new landfill)
Criteria 1 Score		10	10	10	10

Criteria 2. Groundwater Impact Beyond the current[2] Compliance Boundary	Score				
Modeled plume[1] is within current compliance boundary after 10 years	10				
Modeled plume[1] is within current compliance boundary after 100 years	5				
Modeled plume[1] is within current compliance boundary after 200 years	0	(Option 1)	(Option 2)	(Option 3)	(Option 3)
		Closure-in-Place	Closure by Removal (off-site disposal)	Closure-in-place (Hybrid)	Closure by Removal (on-site new landfill)
Criteria 2 Score		0	0	0	0

Criteria 3. Modeled Off-site Impact	Score				
Modeled plume[1] does not go off-site	10				
Modeled plume[1] is predicted to remain off-site after 100 years	5				
Modeled plume[1] is predicted to remain off-site after 200 years	0				
		(Option 1)	(Option 2)	(Option 3)	(Option 4)
		Closure-in-Place	Closure by Removal (off-site disposal)	Closure-in-place (Hybrid)	Closure by Removal (on-site new landfill)
Criteria 3 Score		10	10	10	10

Criteria 4. Relative rank based on visual interpretation of modeled boron plume	Score				
Ranked #1 among the three Closure Options based on visual interpretation of modeled boron plume	10				
Ranked #2 among the three Closure Options based on visual interpretation of modeled boron plume	5				
Ranked #3 among the three Closure Options based on visual interpretation of modeled boron plume	0				
		(Option 1)	(Option 2)	(Option 3)	(Option 4)
		Closure-in-Place	Closure by Removal (off-site disposal)	Closure-in-place (Hybrid)	Closure by Removal (on-site new landfill)
\		0	10	5	9

Note 1: Based on avaliable data at the time of scoring, the modeled plume considered boron at a concentration of 4,000 ug/l or greater; 4,000 µg/L does not represent a remediation goal, however this concentration does represent the EPA Tap Water Regional Screening Level (RSL) in resident tapwater for boron.

Note 2: The current compliance boundary is the compliance boundary found in the figure "Waste and Compliance Boundaries" provided to NCDEQ on 2/15/18

Environmental Groundwater Sub-scoring Worksheet
Closure Options Evaluation
Duke Energy

Roxboro East Ash Basin Groundwater Sub-Scoring Document Justification

Justification Notes	(Option 1) Closure-in-Place	(Option 2) Closure by Removal (off-site disposal)	(Option 3) Close-in-Place Hybrid	(Option 4) Closure by Removal (on-site new landfill)
Criteria 1. Modeled Plume Intersecting Surface Water	**10** Based on the predictive model for the year 2017, found in the January 2019 version of the Preliminary Updated Revised Groundwater Flow and Transport Modeling Report for Roxboro Steam Electric Plant, East Ash Basin, simulated boron concentrations for the Closure-in-Place scenario with natural attenuation does not show boron of 4,000 ppb or greater intercepting surface water bodies.	**10** Based on the predictive model for the year 2017, found in the January 2019 version of the Preliminary Updated Revised Groundwater Flow and Transport Modeling Report for Roxboro Steam Electric Plant, East Ash Basin, simulated boron concentrations for the Closure-in-Place scenario with natural attenuation does not show boron of 4,000 ppb or greater intercepting surface water bodies.	**10** Based on the predictive model for the year 2017, found in the January 2019 version of the Preliminary Updated Revised Groundwater Flow and Transport Modeling Report for Roxboro Steam Electric Plant, East Ash Basin, simulated boron concentrations for the Closure-in-Place scenario with natural attenuation does not show boron of 4,000 ppb or greater intercepting surface water bodies.	**10** Based on the predictive model for the year 2017, found in the January 2019 version of the Preliminary Updated Revised Groundwater Flow and Transport Modeling Report for Roxboro Steam Electric Plant, East Ash Basin, simulated boron concentrations for the Closure-in-Place scenario with natural attenuation does not show boron of 4,000 ppb or greater intercepting surface water bodies.
Criteria 2. Groundwater Impact Beyond the Current Compliance Boundary	**0** Based on the predictive model for the year 2017, found in the January 2019 version of the Preliminary Updated Revised Groundwater Flow and Transport Modeling Report for Roxboro Steam Electric Plant, East Ash Basin, simulated boron concentrations for the Closure-in-Place scenario with natural attenuation show boron of 4,000 ppb at the current (2018) compliance boundary in the vicinity of (a, Point 1) east of the east ash basin in the transition zone. (>200 years from 2017)	**0** Based on the predictive model for the year 2017, found in the January 2019 version of the Preliminary Updated Revised Groundwater Flow and Transport Modeling Report for Roxboro Steam Electric Plant, East Ash Basin, simulated boron concentrations for the Closure- by Removal scenario with natural attenuation show boron of 4,000 ppb at the current (2018) compliance boundary northeast of the ash basin (c, Point 3) in the transition zone. (>100 years from 2017)	**0** Based on the predictive model for the year 2017, found in the January 2019 version of the Preliminary Updated Revised Groundwater Flow and Transport Modeling Report for Roxboro Steam Electric Plant, East Ash Basin, simulated boron concentrations for the Close-in-Place Hybrid scenario with natural attenuation show boron of 4,000 ppb at the current (2018) compliance boundary northeast of the ash basin (c, Point 3) in the transition zone. (>100 years from 2017)	**0** Based on the predictive model for the year 2017, found in the January 2019 version of the Preliminary Updated Revised Groundwater Flow and Transport Modeling Report for Roxboro Steam Electric Plant, East Ash Basin, simulated boron concentrations for the Closure- by Removal scenario with natural attenuation show boron of 4,000 ppb at the current (2018) compliance boundary northeast of the ash basin (c, Point 3) in the transition zone. (>100 years from 2017)
Criteria 3. Modeled Off-site Impact	**10** Based on the predictive model for the year 2017, found in the January 2019 version of the Preliminary Updated Revised Groundwater Flow and Transport Modeling Report for Roxboro Steam Electric Plant, East Ash Basin, simulated boron concentrations for the Closure-in-Place scenario with natural attenuation does not show boron of 4,000 ppb or greater off of Duke Energy property.	**10** Based on the predictive model for the year 2017, found in the January 2019 version of the Preliminary Updated Revised Groundwater Flow and Transport Modeling Report for Roxboro Steam Electric Plant, East Ash Basin, simulated boron concentrations for the Closure by Removal scenario with natural attenuation does not show boron of 4,000 ppb or greater off of Duke Energy property.	**10** Based on the predictive model for the year 2017, found in the January 2019 version of the Preliminary Updated Revised Groundwater Flow and Transport Modeling Report for Roxboro Steam Electric Plant, East Ash Basin, simulated boron concentrations for the Close-in-Place Hybrid scenario with natural attenuation does not show boron of 4,000 ppb or greater off of Duke Energy property.	**10** Based on the predictive model for the year 2017, found in the January 2019 version of the Preliminary Updated Revised Groundwater Flow and Transport Modeling Report for Roxboro Steam Electric Plant, East Ash Basin, simulated boron concentrations for the Closure by Removal scenario with natural attenuation does not show boron of 4,000 ppb or greater off of Duke Energy property.
Criteria 4. Relative rank based on visual interpretation of modeled boron plume	**0** Based on review of the predictive model for the year 2017, found in the January 2019 version of the Preliminary Updated Revised Groundwater Flow and Transport Modeling Report for Roxboro Steam Electric Plant, East Ash Basin, this scenario is not marginally better than Option 2/4 Closure by Removal or Options 3 Close-in-Place Hybrid.	**10** Based on a review of boron concentrations found in the January 2019 Preliminary Updated Revised Groundwater Flow and Transport Modeling Report for Roxboro Steam Electric Plant, this scenario is marginally better than Option 4 (identical except landfills on-site), Closure in Place and Options 3 Close-in-Place Hybrid.	**5** Based on a review of boron concentrations found in the January 2019 Preliminary Updated Revised Groundwater Flow and Transport Modeling Report for Roxboro Steam Electric Plant, this scenario is marginally better than Option 1 Closure-in-Place.	**9** Based on a review of boron concentrations found in the January 2019 Preliminary Updated Revised Groundwater Flow and Transport Modeling Report for Roxboro Steam Electric Plant, this scenario is marginally better than Option 4 (identical except landfills on-site), Closure in Place and Options 3 Close-in-Place Hybrid.

Notes:
1. Based on avaliable data at the time of scoring, the modeled plume considered boron at a concentration of 4,000 ug/l or greater; 4,000 µg/L does not represent a remediation goal, however this concentration does represent the EPA Tap Water Regional Screening Level (RSL) in resident tapwater for boron.
2. The current compliance boundary, as of 10/9/18, was used for all scenarios for criteria 2.

Mayo Steam Station
Person County, North Carolina

I. Site History

The Mayo Steam Station ("Mayo") is a Duke Energy Progress, LLC ("DE Progress" or the "Company") coal-fired generation facility that began generating coal-fired electricity in 1983. Mayo has one ash basin, which was constructed in 1982 to received coal combustion residuals ("CCR") from the plant's coal-fired generation unit. In response to the North Carolina Clean Smokestacks Act, the Company installed a scrubber system on the coal-fired unit at Mayo to control emissions. The process water from the scrubber, known as flue-gas desulfurization ("FGD") sludge, necessitated the construction of a flush pond and settling basin, which were completed by 2009. The flush pond and settling basin were constructed within the footprint of the Ash Basin.

In 2013, the Mayo Plant converted from a wet ash system (sluicing) to a dry ash system. During the conversion and until November 2014, CCR were transported to a lined landfill located at the Roxboro Plant. Since November 2014, CCR have been placed in an onsite coal combustion product monofill ("CCP Monofill"). The CCP Monofill was constructed with an engineered liner and is permitted to receive fly ash, bottom ash, gypsum, and other CCR.

An aerial view of the Mayo ash basin and storage areas (collectively, the "CCR Units") is provided in **Figure 1** below.

Figure 1 – Aerial showing CCR Units at Mayo

II. Regulatory History

The CCR Units at Mayo have been regulated by a combination of state agencies during the operational history of the plant. The North Carolina Department of Environmental Quality ("DEQ") regulated the wet storage of ash in ash basins through the National Pollutant Discharge Elimination System ("NPDES") permit program and the dry ash storage and beneficial reuse of CCR through the state's solid waste permitting program. Power plant dams were regulated by the North Carolina Utilities Commission (the "Commission") until January 1, 2010, when that authority was transferred to DEQ.

Following the Tennessee Valley Authority coal ash spill in 2008, EPA was prompted to assess coal ash impoundments across the country. In 2010, EPA proposed, for the first time, comprehensive regulations and federal minimum standards to address the disposal and long-term storage of CCR. The final CCR Rule was signed in December 2014 and published in April 2015. The CCR Rule applies to and requires the closure of the ash basins at Mayo.

In 2014, the North Carolina General Assembly passed the Coal Ash Management Act ("CAMA") to establish new state standards for the disposal of CCR from coal-fired electric generation facilities. CAMA, and its later amendments, complement and overlap with the federal CCR Rule. DEQ initially designated Mayo as an "intermediate risk" site. Under CAMA, "intermediate risk" sites are required to be excavated; however, "intermediate risk" sites are eligible for a downgraded risk designation – to "low-risk" – if the Company undertakes certain actions that are independently required by CAMA, including the provision of a permanent water supply to residents within a half mile and dam repair work. Receiving a "low-risk" classification, in turn, makes the site eligible for cap-in-place closure (or closure-in-place), pending DEQ's approval of the closure plan. In November 2018, DEQ approved the "low-risk" classification for Mayo.

Cap-in-place is the Company's preferred closure method for Mayo, because it is environmentally protective, unobtrusive, and economical. DE Progress prepared and submitted to DEQ a comprehensive options analysis for Mayo to compare and contrast the closure methods available for Mayo, including excavation, cap-in-place, or a combination of excavation and cap-in-place. That options analysis supports DE Progress' preference for cap-in-place closure at Mayo.

On April 1, 2019, DEQ issued an order requiring DE Carolinas to excavate the ash basin at Mayo ("DEQ Order"). DE Progress expected DEQ's closure decision to come in 2020 following the submission of the Company's closure plan for Mayo by the CAMA-imposed deadline of December 31, 2019. The Company disagrees with the DEQ Order and filed an appeal, which is pending before the North Carolina Office of Administrative Hearings. That appeal will ultimately resolve how the ash basin at Mayo will be closed.

III. Site Closure Activities – January 1, 2015 through August 31, 2017

The Company immediately began complying with its new state and federal regulatory requirements affecting its storage of CCR as they became effective. These compliance activities at Mayo included installing and monitoring groundwater wells, connecting neighbors to permanent water supplies, satisfying the CCR Rule's reporting requirements, stabilizing the ash basin dams, and constructing an alternate spillway for the impoundments. Relating to CCR Unit closure, the Company's activities have been preliminary in nature because, under CAMA, the final closure method is dependent on DEQ's approval, which was not expected until 2020. Those preliminary activities involved preparing engineering reports, performing engineering planning and design work, and obtaining environmental permits.

The activities described above and costs associated with those activities were the subject of DE Progress' 2017 rate case before the Commission (Docket No. E-2, 1142). In that docket, the Commission determined that DE Progress' coal ash basin closure costs for the Mayo were reasonable, prudent, and recoverable. (*Order Accepting Stipulation, Deciding Contested Issues, and Granting Partial Rate Increase*, Docket No. E-2, Sub 1142).

IV. Site Closure Activities – September 1, 2017 through February 29, 2020

The Company has continued to meet its obligations under state and federal law and is performing the preliminary work necessary to close the CCR Units at Mayo. Understanding that the closure method for Mayo may not be finalized until 2020, the Company deliberately avoided incurring costs that would be solely related to either cap-in-place or excavation. With limited exceptions, the activities performed since September 1, 2017 and scheduled to be performed through February 29, 2020 would have been required regardless of whether the CCR Units at Mayo were to be capped-in-place or excavated. Those activities include:

- Performing engineering design and site assessments to evaluate closure options;
- Developing and finalizing draft closure plans;
- Operating and maintaining the CCR Units;
- Obtaining environmental permits;
- Installing groundwater monitoring wells;
- Monitoring and analyzing groundwater samples;
- Planning, designing, and installing permanent water supplies to neighbors;
- Designing and constructing holding and retention basins;
- Cease flows from the ash basin;
- Constructing a water treatment system to treat the water generated from decanting and dewatering the ash basin;
- Dewatering and decanting the ash basin; and
- Constructing a new Flue Gas Desulfurization Blowdown treatment basin.

The tasks that DE Progress has performed and will perform from September 1, 2017 through February 29, 2020 are a continuation of the activities for which costs were approved in the prior DE Progress rate case. These activities and associated costs continue to be necessary, appropriate, and consistent with applicable regulatory requirements.

Roxboro Steam Station
Person County, North Carolina

I. Site History

The Roxboro Steam Station ("Roxboro") is a Duke Energy Progress, LLC ("DE Progress" or the "Company") coal-fired generation facility that began generating coal-fired electricity in 1966. Roxboro currently has four coal-fired generating units in service.

The Roxboro has two ash basins. The oldest ash basin at this site is the East Ash Basin, which was constructed in 1963, prior to the plant becoming operational. The East Ash Basin was constructed to receive sluiced coal combustion residuals ("CCR") from the plant's coal-fired units. The East Ash Basin was vertically expanded in 1973. Also in 1973, the Company constructed the West Ash Basin by damming a portion of Sargents Creek. In 1983, the East Ash Basin reached capacity and was taken out of service.

In 1988, the Company converted Roxboro to dry ash handling and brought into service an onsite, partially lined coal ash monofill known as the Roxboro Industrial Landfill. The Roxboro Industrial Landfill was constructed partially within the footprint of the inactive East Ash Basin and is permitted to receive bottom ash, fly ash, gypsum and other CCR. In 2008, the Company completed construction of the West Settling Pond and flue gas desulfurization ("FGD") Flush Pond. In 2011, the Company completed construction of the East Settling Pond. These ponds were constructed to receive scrubber wastewater from the facility's FGD technology, which was installed in the coal-fired units to reduce emissions of sulfur dioxide in response to the North Carolina Clean Smokestacks Act. An aerial view of the Roxboro ash basin and storage areas (collectively, the "CCR Units") is provided in **Figure 1** below.

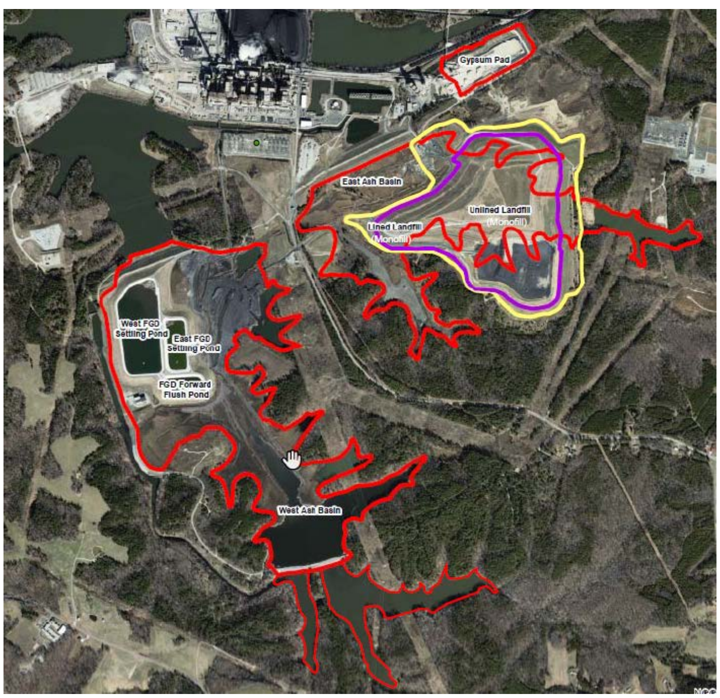


Figure 1 – Aerial showing CCR Units at Roxboro

II. Regulatory History

The CCR Units at Roxboro have been regulated by a combination of state agencies during the operational history of the plant. The North Carolina Department of Environmental Quality ("DEQ") regulated the wet storage of ash in ash basins through the National Pollutant Discharge Elimination System ("NPDES") permit program and the dry ash storage and beneficial reuse of CCR through the state's solid waste permitting program. Power plant dams were regulated by the North Carolina Utilities Commission (the "Commission") until January 1, 2010, when that authority was transferred to DEQ.

Following the Tennessee Valley Authority coal ash spill in 2008, EPA was prompted to assess coal ash impoundments across the country. In 2010, EPA proposed, for the first time, comprehensive regulations and federal minimum standards to address the disposal and long-term storage of CCR. The final CCR Rule was signed in December 2014 and published in April 2015. The CCR Rule applies to and requires the closure of the ash basins at Roxboro.

In 2014, the North Carolina General Assembly passed the Coal Ash Management Act ("CAMA") to establish new state standards for the disposal of CCR from coal-fired electric generation facilities. CAMA, and its later amendments, complement and overlap with the federal CCR Rule. DEQ initially designated Roxboro as an "intermediate risk" site. Under CAMA, "intermediate risk" sites are required to be excavated; however, "intermediate risk" sites are eligible for a downgraded risk designation – to "low-risk" – if the Company undertakes certain actions that are independently required by CAMA, including the provision of a permanent water supply to residents within a half mile and dam repair work. Receiving a "low-risk" classification, in turn, makes the site eligible for cap-in-place closure (or closure-in-place), pending DEQ's approval of the closure plan. In November 2018, DEQ approved the "low-risk" classification for Roxboro.

Cap-in-place is the Company's preferred closure method for Roxboro, because it is environmentally protective, unobtrusive, and economical. DE Progress prepared and submitted to DEQ a comprehensive options analysis for Roxboro to compare and contrast the closure methods available for Roxboro, including excavation, cap-in-place, or a combination of excavation and cap-in-place. That options analysis supports DE Progress' preference for cap-in-place closure at Roxboro.

On April 1, 2019, DEQ issued an order requiring DE Carolinas to excavate the ash basin at Roxboro ("DEQ Order"). DE Progress expected DEQ's closure decision to come in 2020 following the submission of the Company's closure plan for Roxboro by the CAMA-imposed deadline of December 31, 2019. The Company disagrees with the DEQ Order and filed an appeal, which is pending before the North Carolina Office of Administrative Hearings. That appeal will ultimately resolve how the ash basin at Roxboro will be closed.

III. Site Closure Activities – January 1, 2015 through August 31, 2017

The Company immediately began complying with its new state and federal regulatory requirements affecting its storage of CCR as they became effective. These compliance activities at Roxboro included installing and monitoring groundwater wells, connecting neighbors to permanent water supplies, satisfying the CCR Rule's reporting requirements, stabilizing the ash basin dams, and constructing an alternate spillway for the impoundments. Relating to CCR Unit closure, the Company's activities have been preliminary in nature because, under CAMA, the final closure method is dependent on DEQ's approval, which was not expected until 2020. Those preliminary activities involved preparing engineering reports, performing engineering planning and design work, and obtaining environmental permits.

The activities described above and costs associated with those activities were the subject of DE Progress' 2017 rate case before the Commission (Docket No. E-2, 1142). In that docket, the Commission determined that DE Progress' coal ash basin closure costs for the Roxboro were reasonable, prudent, and recoverable. (*Order Accepting Stipulation, Deciding Contested Issues, and Granting Partial Rate Increase*, Docket No. E-2, Sub 1142).

IV. Site Closure Activities – September 1, 2017 through February 29, 2020

The Company has continued to meet its obligations under state and federal law and is performing the preliminary work necessary to close the CCR Units at Roxboro. Understanding that the closure method for Roxboro may not be finalized until 2020, the Company deliberately avoided incurring costs that would be solely related to either cap-in-place or excavation. With limited exceptions, the activities performed since September 1, 2017 and scheduled to be performed through February 29, 2020 would have been required regardless of whether the CCR Units at Roxboro were to be capped-in-place or excavated. Those activities include:

- Performing engineering design and site assessments to evaluate closure options;
- Developing and finalizing closure plans;
- Operating and maintaining the CCR Units;
- Obtaining environmental permits;
- Installing groundwater monitoring wells;
- Monitoring and analyzing groundwater samples;
- Planning, designing, and installing permanent water supplies to neighbors;
- Designing and constructing holding and retention basins;
- Cease flows to the ash basin;
- Constructing a water treatment system to treat the water generated from decanting and dewatering the ash basin;
- Dewatering and decanting the ash basin; and
- Constructing a new Flue Gas Desulfurization Blowdown treatment facility.

The tasks that DE Progress has performed and will perform from September 1, 2017 through February 29, 2020 are a continuation of the activities for which costs were approved in the prior DE Progress rate case. These activities and associated costs continue to be necessary, appropriate, and consistent with applicable regulatory requirements.

Asheville Steam Station
Buncombe County, North Carolina

I. Site History

The Asheville Steam Station ("Asheville") is a Duke Energy Progress, LLC ("DE Progress" or the "Company") coal-fired generation facility that began commercial operations in 1964 under the ownership of Carolina Power & Light Company.

Asheville has two onsite ash basins that were constructed to receive sluiced coal combustion residuals ("CCR") from the coal-fired units at the plant. Those ash basins are referred to as the 1964 Ash Basin and the 1982 Ash Basin. The 1964 Ash Basin was the first ash basin constructed at the site to receive sluiced CCR from the plant's original coal-fired unit. The 1964 Ash Basin underwent an expansion around 1971 to increase the basin's storage capacity. The 1964 Ash Basin was taken out of service in 1982 and drained. After 1982, the 1964 Ash Basin served as additional storage space for CCR dredged from the 1982 Ash Basin and served as the location for a wetlands treatment system that was constructed in 2006 to treat flue gas emission control wastewater.

DE Progress began construction of a second ash basin in 1981 and began operating that basin in 1982 ("1982 Ash Basin"). This basin provided additional ash storage capacity for Asheville. In 2005 an interior dike was constructed in the center of the 1982 Ash Basin that divided the basin into two cells in order to facilitate settlement of bottom ash and lighter fly ash. In around 2007, DE Progress began dredging and dewatering of the 1982 Ash Basin for the purpose of beneficially reusing the ash at the Asheville Regional Airport for structural fill, and to increase storage capacity. An aerial view of the Asheville ash basins (collectively, the "CCR Units") is provided in **Figure 1** below.

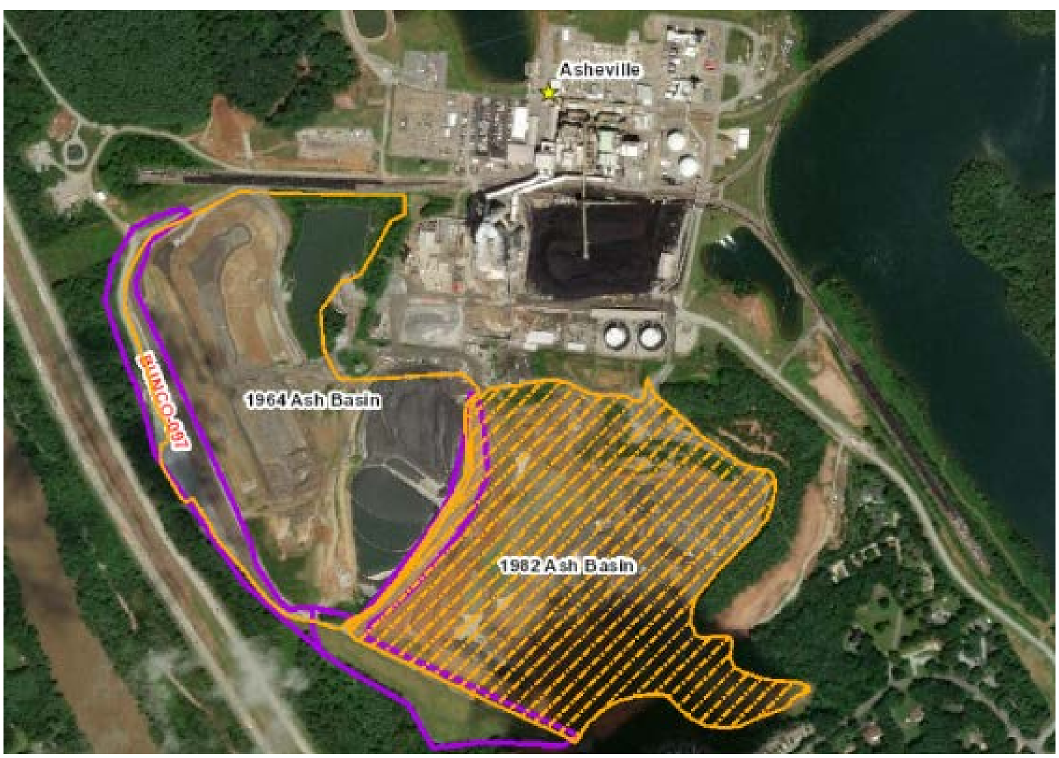


Figure 1 – Aerial showing CCR Units at Asheville

II. Regulatory History

The CCR Units at Asheville have been regulated by a combination of state agencies during the operational history of the plant. The North Carolina Department of Environmental Quality ("DEQ") regulated the wet storage of ash in ash basins through the National Pollutant Discharge Elimination System ("NPDES") permit program and the dry ash storage and beneficial reuse of CCR through the state's solid waste permitting program. Power plant dams were regulated by the North Carolina Utilities Commission (the "Commission") until January 1, 2010, when that authority was transferred to DEQ.

Following the Tennessee Valley Authority coal ash spill in 2008, EPA was prompted to assess coal ash impoundments across the country. In 2010, EPA, for the first time, proposed comprehensive regulations and federal minimum standards to address the disposal and long-term storage of CCR. The final CCR Rule was signed in December 2014 and published in April 2015. The CCR Rule applies to and requires the closure of the ash basins at Asheville.

In 2014, the North Carolina General Assembly passed the Coal Ash Management Act ("CAMA") to establish new state standards for the disposal of CCR from coal-fired electric generation facilities. CAMA, and its later amendments, complement and overlap with the federal CCR Rule. CAMA originally designated Asheville as a "high priority" site and required that its ash impoundments be closed by August 2019, but the Mountain Energy Act amendment to CAMA revised the closure date to August 1, 2022. Additionally, CAMA required the Company to construct a new combined cycle power plant and facilitate the shut-down of the existing coal fired plant by January 31, 2020.[1]

III. Site Closure Activities – January 1, 2015 through August 31, 2017

In response to new state and federal regulatory requirements, the Company began closure activities at Asheville. Those activities included:

- Selecting location(s) for disposal of excavated ash;
- Developing closure plans and other engineering reports;
- Obtaining environmental permit from State and Federal agencies necessary to begin closure;
- Installing erosion and sediment control measures;
- Installing groundwater monitoring wells;
- Dewatering the 1964 Ash Basin and the 1982 Ash Basin;
- Excavating ash from the 1964 Ash Basin and 1982 Ash Basin;
- Transporting excavated ash to offsite landfills and a structural fill;
- Complete excavation of the 1982 Ash Basin;
- Rerouting inflows away from the ash basins; and
- 1982 Ash Basin dam decommissioning.

The activities described above and costs associated with those activities were the subject of DE Progress' 2017 rate case before the Commission (Docket No. E-2, 1142). In that docket, the Commission determined that DE Progress' coal ash basin closure costs for Asheville were reasonable, prudent, and

[1] *See* Mountain Energy Act of 2015, Session Law 2015-110.

recoverable. (*Order Accepting Stipulation, Deciding Contested Issues, and Granting Partial Rate Increase*, Docket No. E-2, Sub 1142).

IV. Site Closure Activities – September 1, 2017 through February 29, 2020

As of September 1, 2017, DE Progress had already entered into extensive contracts with engineering and construction contractors to perform the necessary site assessments, develop excavation and compliance plans, and to excavate and transport the CCR for permanent disposal. Costs related to those contracts and activities performed pursuant to those contracts through August 31, 2017 have already been approved by the Commission. DE Progress has continued its efforts to execute the excavation and closure plans for Asheville and comply with state and federal regulatory requirements.

From September 1, 2017 through February 29, 2020, DE Progress has completed or is scheduled to complete the following tasks:

- Excavate ash from the 1964 Ash Basin;
- Transport ash from the 1964 Ash Basin to the R&B Landfill;
- Operate and maintaining the 1964 Ash Basin;
- Obtain environmental permits;
- Install groundwater monitoring wells;
- Monitor and analyze groundwater samples;
- Plan, design, and install permanent water supplies for neighbors;
- Complete construction of the lined retention basin for water equalization after coal station and rim ditch retirement;
- Decommission and grade ash basin dams to meet post-closure dam safety requirements;
- Initiate and complete water treatment implementation and commissioning;
- Complete design for onsite landfill and submit permit applications for new onsite landfill.

The tasks that DE Progress has performed and will perform from September 1, 2017 through February 29, 2020 are a continuation of the activities for which costs were approved in the prior DE Progress rate case. These activities and associated costs continue to be necessary, appropriate, and consistent with applicable regulatory requirements.

I/A

Asheville Steam Electric Generating Plant

Coal Ash Excavation Plan

DUKE ENERGY

2018 Update

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Exhibits

I. Statement of Purpose

Duke Energy Progress, Inc. (Duke Energy or the Company) is required by Part II, Section 3(b) of the Coal Ash Management Act of 2014 (Session Law 2014-122) (Coal Ash Act or Act) to close in accordance with Part II, Section 3(c) the coal combustion residuals (CCR) surface impoundments located at the Asheville Steam Electric Generating Plant in Buncombe County (Asheville or Plant) as soon as practicable, but not later than August 1, 2022.[1]

This Coal Ash Excavation Plan (Plan) represents activities to satisfy the requirements outlined in Part II, Sections 3(b) and 3(c), Subparagraphs 1 and 2 of the Act and the requests set forth in the North Carolina Department of Environmental Quality's (NCDEQ) August 13, 2014 letter titled "Request for Coal Ash Excavation Plans for Asheville Steam Electric Generating Plant, Dan River Combined Cycle Station, Riverbend Steam Station, L.V. Sutton Electric Plant" (NCDEQ Letter). The NCDEQ Letter specifically requests that the Plan include 1) soil and sediment erosion control measures, 2) dewatering, and 3) the proposed location(s) of the removed ash. These requirements are found in this updated Plan.

This is a revision of the Coal Ash Excavation Plan updated December 1, 2017, which covered the subsequent phase of ash basin excavation activities, including basin dewatering, site preparation, ash basin preparation, and ash removal from the basins at Asheville. The Plan will generally be updated and submitted to NCDEQ annually.

The Mountain Energy Act of 2015 (MEA 2015), which extends the removal of all ash to August 1, 2022, led to a modification of our previous strategy to address the dewatering of the rim ditch system located in the 1964 Ash Basin. Previously, the existing rim ditch system in the 1964 Ash Basin was to be removed and relocated in a temporary configuration in the 1982 Ash Basin. The Company is building a natural gas-fired plant in the footprint of the1982 Ash Basin. The existing rim ditch system will remain in service through plant retirement. The Company will have excavated a significant portion of the ash in the 1964 Ash Basin by January 31, 2020, the coal plant retirement date. Once the plant is retired and the rim ditch system is no longer operational, the rim ditch system will be removed and the ash directly beneath the rim ditch system will be excavated and placed in a lined storage facility.

The Act contains no requirement for the submittal of an excavation plan of the kind presented here. Thus, while the formulation, submittal, and review of this Plan will assist in Duke Energy's work to close the ash basins, its ultimate approval is an action not specifically required by statutory, regulatory, or other applicable authority.

[1] The Mountain Energy Act of 2015 (Session Law 2015-110) (June 24, 2015) amended the Coal Ash Management Act of 2014 closure date from August 1, 2019 to August 1, 2022.

The scope of work in excavating the ash basins has been determined by applicable laws, rules, permits, and approvals that control the activities to be performed under the Plan. There are several external and internal factors that could potentially affect the precise scope of the work to be performed under the Plan. As a consequence, neither the submittal of this Plan, nor its acknowledgement by NCDEQ, should be taken as requiring actions different from such applicable requirements. Duke Energy submits this Plan to NCDEQ based on the understanding that it may be necessary to take actions that deviate from the Plan in the future, and the Company reserves the right to make such changes.

II. General Facility Description

The Plant is in Arden, NC, approximately eight miles south of Asheville, NC. The Plant's Unit 1 was constructed in 1964 with a second coal burning unit (Unit 2) added in 1971. Current generation capacity of the Plant is 376 megawatts (MW) from two coal-fired units. In 1999 and 2000, two natural gas and oil combustion turbines with an additional output of 324 MW were added (Figure 1).

UNIT	TYPE	COMMERCIAL YEAR	RATING (net MW)	COMBINED
1	Coal-Fired Steam	1964	191	376
2		1971	185	
3	Natural Gas and Oil Combustion	1999	162	324
4		1999	162	
			Total	**700**

Figure 1: Asheville Steam Electric Generating Plant Generation Profile

The Plant had two ash basins. The first basin was created in 1964 when the plant began operations and is currently being excavated (1964 Ash Basin). In 1982, a second basin (1982 Ash Basin) was constructed directly adjacent to the 1964 Ash Basin's south retention dam. The 1982 Ash Basin was excavated and turned over for construction of the natural gas combined-cycle plant in September 2016. Decommissioning of the 1982 Ash Basin Dam (BUNCO-89) was completed in January 2018.

Duke Energy's Coal Combustion Residuals Removal Verification Procedure (Removal Verification Procedure) was used to verify that primary source ash was removed from the 1982 Ash Basin. Subsequent to removal of the ash pursuant to the Removal Verification Procedure, Duke Energy implemented its Excavation Soil Sampling Plan (ESSP), which was developed for the purpose of meeting the applicable performance standard. Although not required under CAMA, in November 2016, NCDEQ sent Coal Combustion Residuals Surface Impoundment Closure Guidelines for Protection of Groundwater to Duke Energy instructing the Company to submit the ESSP to NCDEQ as part of the site's excavation plan. In accordance with this directive, a copy of the ESSP is attached as Exhibit "A" to this Plan.

The 1964 Ash Basin Dam (BUNCO-097) was constructed in 1964 to serve as a wastewater treatment facility for the treatment of ash sluice water. The surface area of the basin is approximately 45 acres. The basin does not retain a permanent pool with the exception of a three-acre unlined retention pond known as the "Duck Pond."

Production ash is sluiced to a concrete rim ditch system that is located within the footprint of the 1964 Ash Basin. The rim ditch system also receives plant stormwater drainage and low volume wastewater from the Duck Pond. CCR is dredged from the rim ditch, dewatered, and transported off-site.

The wastewater from the rim ditch process is treated in the rim ditch system and then pumped through the center pond filters (constructed at the end of the rim ditch) to a settling pond outside of the 1964 Ash Basin. The settling pond serves as the monitoring point for Outfall 001 of the Plant's National Pollutant Discharge Elimination System (NPDES) permit (NC0000396). Treated wastewater discharged from this settling pond is routed to the French Broad River in accordance with the terms and conditions of the NPDES permit.

III. Project Charter

Dewatering of the ash basins and the removal of ash from the site will be performed in project phases. As of November 1, 2018, approximately 6.13 million tons of ash have been excavated and transported off-site. The project has completed Phase I and has been planning and implementing Phase II.

The following items in Phase I have been completed:

1. Excavation and closure of the 1982 Ash Basin.
2. Design and construction of alternate treatment methods for FGD process water to replace engineered wetlands process.
3. Decommissioning, excavation, and transportation of the FGD engineered wetlands in the 1964 Ash Basin to an approved RCRA Subtitle D landfill.
4. 1982 Ash Basin Dam decommissioning and grading material into former 1982 Ash Basin footprint to facilitate the construction of the natural gas-fired plant.
5. Initiation of the 1964 Ash Basin ash excavation and transportation.

Project Charter Objectives

Phase II Objectives

1. Submit and obtain any necessary permits for Phase II activities.
2. Excavate and transport ash from the 1964 Ash Basin.
3. Evaluate, design, and construct water treatment system and/or water retention for utilization after plant retirement.
4. Complete decommissioning of the 1982 Ash Basin dam (completed).
5. Gain knowledge and opportunities for program improvement that can be applied to the subsequent phase(s).
6. Plan activities for Phase III.

Phase III Objectives

1. Submit and obtain any necessary permits for Phase III activities.
2. Decommission and remove 1964 Ash Basin rim ditch system.
3. Excavate remaining ash from the 1964 Ash Basin.
4. Initiate 1964 Ash Basin Dam decommissioning.
5. Perform 1964 Ash Basin closure activities.

Project Charter Scope

Phase II Scope

1. Submit and obtain permits for Phase II activities.
2. Excavate and transport approximately 2 million tons of ash from the 1964 Ash Basin, including newly generated ash.
3. Evaluate, design, and construct wastewater treatment system and water equalization basin for utilization after plant and rim ditch retirement.
4. Maintain lowered water state of the Duck Pond and implement 1964 Ash Basin dewatering plan.
5. Complete decommissioning of the 1982 Ash Basin dam and grade for construction of the natural gas combined-cycle plant (completed).
6. Continue to validate production rates to meet project requirements and increase efficiency.

Phase III Scope

1. Prepare remaining required permit applications for subsequent phase(s) of ash removal activities (if applicable).
2. Decommission and remove the 1964 Ash Basin rim ditch.
3. Continue to manage wastewater with the on-site wastewater treatment system.
4. Excavate and transport the remaining approximate 1.3 million tons of ash from the 1964 Ash Basin to an approved landfill or structural fill location.
5. Initiate 1964 Ash Basin dam decommissioning to retain dam stability factors of safety and to support completion of ash excavation.
6. Complete closure activities for the 1964 Ash Basin.

IV. Critical Milestone Dates

Critical Milestones within the Plan are summarized in the table below.

MILESTONES	NO LATER THAN DATE	STATUS
Submit Excavation Plan to NCDEQ	November 15, 2014	Completed November 13, 2014
Complete Comprehensive Engineering Review	November 30, 2014	Completed November 30, 2014
Receive Dam Safety Permit to excavate 1982 Ash Basin dam face	December 12, 2014	Received approval on June 25, 2015

MILESTONES	NO LATER THAN DATE	STATUS
Excavation Plan acknowledgment	February 17, 2015	Received February 2, 2015
Receive updated Distribution of Residual Solids Permit	February 28, 2015	Received Final Permit September 2, 2015
Decommission engineered wetlands and commission alternate FGD wastewater treatment system	November 3, 2015	Completed FGD wastewater conveyance to sewer on October 28, 2015
Submit Updated Excavation Plan to NCDEQ	November 15, 2015	Completed November 13, 2015
Dewater and remove engineered wetlands	March 2, 2016	Completed May 13, 2016 with no impact on final completion schedule
Complete removal of ash from 1982 Ash Basin (except interim storage of production ash)	July 31, 2016	Completed September 30, 2016
Submit Updated Excavation Plan to NCDEQ	December 31, 2016	Completed December 21, 2016
Submit Updated Excavation Plan to NCDEQ	December 31, 2017	Completed December 1, 2017
Cease Operation of coal-fired units at the Asheville Plant	January 31, 2020*	On Track
Impoundments closed pursuant to Part II, Sections 3(b) and 3(c) of the Act	August 1, 2022*	On Track
Submit Updated Excavation Plan	December 31, Annually	On Track

*Pursuant to MEA 2015

V. Erosion and Sediment Control Plan

Asheville Plant permits allow for the excavation and transportation of ash on existing paved roads and within the ash basins during excavation. Any new construction supporting ash basin closure will be in compliance with applicable erosion and sediment control permits.

VI. Dewatering Plan

The 1964 Ash Basin is currently void of free-standing water, except for the Duck Pond. Stormwater and process water flows into the Duck Pond are captured and pumped to the head of the rim ditch wastewater treatment system within the footprint of the 1964 Ash Basin. The treated wastewater continues to flow to the permitted NPDES Outfall 001. In July 2018, the site commenced interstitial dewatering of the 1964 Ash Basin. At the time, the site was operating under an administratively extended NPDES Wastewater Permit and, at the direction of NCDEQ, was required to pretreat interstitial wastewater prior to discharging it into the rim ditch system. This additional pretreatment will not be required under the new NPDES Wastewater Permit. Subsequent to the coal plant and rim ditch retirement, a water equalization basin and a new wastewater treatment system will be required to complete dewatering of the 1964 Ash Basin.

VII. Location(s) for Removed Ash

Ash removed from the site will be transported by the contractor to permitted facilities. The ash disposal location(s) will be managed and maintained to ensure environmental compliance with all applicable rules and regulations.

Disposal Sites

Ash from the 1964 Ash Basin is currently being transported to a permitted ash monofill at the R&B Landfill in Homer, GA. The on-site landfill at Duke Energy's Rogers Energy Complex remains an option for the Company if events warrant transition to another site. The Company continues to develop and evaluate contingency storage locations.

Plans for ash disposal during Phase III are currently being evaluated and will be finalized in 2019. The on-site landfill at Duke Energy's Rogers Energy Complex remains an option, and the construction of an on-site landfill at the Asheville Plant is being evaluated as well.

The project team will utilize lessons learned from Phase II to develop an off-site disposal strategy and/or alternative beneficial use site(s) that will provide the improvements below:

- Provide a reliable, long-term, cost-effective solution for ash designated for removal
- Support development of a diverse supplier program to drive innovation and competition
- Establish performance baselines and a system to optimize excavation, transportation, and disposal of ash

VIII. Transportation Plan

Ash is currently being transported from the site via highway trucks to an off-site facility. Truck loading operations are conducted with a crew typically working 12 hours per day, five days per week. Transportation is conducted by approved transporters and meets Department of Transportation (DOT) and other applicable federal, state, and local regulations.

IX. Environmental and Dam Safety Permitting Plan

Excavation of ash creates potential for stormwater impacts. The site is operating under an NPDES Industrial Stormwater Permit (ISW) issued on May 24, 2016. As required by the ISW, the site has an active Stormwater Pollution Prevention Plan (SPPP) implemented November 2016 and updated August 2017. Throughout most of 2018, the facility operated under an administratively extended NPDES Wastewater Permit. The facility was issued a new NPDES Wastewater Permit in Q4 2018, which included modifications to facilitate the closure of the 1964 Ash Basin. The new NPDES Wastewater Permit went into effect on December 1, 2018.

If the Company constructs any treatment basins or conducts grading related to construction activities within the 1964 Ash Basin footprint, an approved Erosion and Sediment Control Plan and a Buncombe County Post-Construction Stormwater Permit may be required.

There are no jurisdictional wetlands/streams associated with the removal of ash in the 1964 Ash Basin in Phase II. Asheville ash is a non-hazardous material.

All necessary Dam Safety approvals have been or will be obtained to cover activities on or around jurisdictional dikes. Any impacted monitoring wells or piezometers will be abandoned in accordance with NCDEQ requirements. Fugitive dust will be managed to mitigate impacts to neighboring areas. Additional site-specific or local requirements will be secured, as needed.

Permit Matrix

MEDIA	PERMIT	RECEIVED DATE (R) TARGET DATE (T)	COMMENTS
Water	NPDES Industrial Stormwater Permit	May 24, 2016 (R)	The site has two active SPPP.
	NPDES Wastewater Permit – Renewal	Q4 2018 (R)	Became effective on December 1, 2018.
	Jurisdictional Wetlands and Stream Impacts / 404 Permitting and 401 WQC	N/A	No impacts to jurisdictional wetlands and streams have been identified at this time.
	Erosion and Sediment Control Plan	April 1, 2020 (T), if needed	Permit may be required for grading activities.
	Buncombe County Post-Construction Stormwater Permit	April 1, 2020 (T), if needed	Permit may be required for any basin construction or grading activities.
Dam Safety	Dam Decommissioning Request Approval	Complete June 25, 2015 (R) and July 1, 2016 (R) Q2 2019 (T) for 1964 Ash Basin dam decommissioning	Dam Safety permits to excavate ash from the interior face of the 1982 Ash Basin dam and the 1964 Separator Dike were received on June 25, 2015 and July 1, 2016, respectively. A permit for decommissioning the 1964 Ash Basin dam will be required.
Other Requirements	Site-Specific Nuisance/Noise/	Oct. 28, 2015 (R)	During Phase I, the Company received an Industrial User Permit on June 13, 2015 to discharge the FGD wastewater

MEDIA	PERMIT	RECEIVED DATE (R) TARGET DATE (T)	COMMENTS
	Odor/Other Requirements, including DOT		into the MSD system. As noted above, this activity was completed on October 28, 2015.

X. Contracting Strategy

The Ash Management Program strategy is to engage multiple contractors, drive competition, create system-wide innovation, and develop a collection of best practices. Duke Energy has engaged contractor(s) who are experienced in coal ash excavation, transportation, and disposal, and continues to evaluate other potential contractors. The Company provides in-depth oversight, coordination, and monitoring of the contractors to ensure the work is performed appropriately. Duke Energy's core values include safety, quality, and protection of the environment, which are incorporated into our contracts. The Company continues to evaluate alternate approaches, methods, and contracting solutions and will adjust its strategy, as necessary.

XI. Environmental, Health, and Safety Plan

Duke Energy is committed to the health, safety, and welfare of employees, contractors, and the public, and to protecting the environment and natural resources. During all phases of the project work, Duke Energy and its contractors will follow the Duke Energy Safe Work Practices Manual, the Environmental, Health, and Safety supplement document, and any additional requirements. Occupational health and safety expectations include oversight and continuous improvement throughout the project. The project will include comprehensive environmental, health, and safety plans encompassing all aspects of the project work. In addition to adhering to all applicable environmental, health, and safety rules and regulations, Duke Energy and its contractors will focus on ensuring the safety of the public and protection of the environment during each phase of the project.

XII. Communications Plan

The project team has coordinated with Duke Energy's Corporate Communications Department to develop a comprehensive external communications plan tailored to the specific needs of each phase of the project. Many different external stakeholders, including neighbors, government officials, and media have an interest in this project. The Company is committed to providing information by proactively communicating about the project activities to potentially affected parties and responding to inquiries in a timely manner.

XIII. Glossary

TERM	DEFINITION
Ash Basin	Synonymous with Coal Combustion Residuals Impoundment. A topographic depression, excavation, or dammed area that is primarily formed from earthen materials; without a base liner approved for use by Article 9 of Chapter 130A of the North Carolina General Statutes or rules adopted thereunder for a combustion products landfill or coal combustion residuals landfill, industrial landfill, or municipal solid waste landfill; and an area that is designed to hold accumulated coal combustion residuals in the form of liquid wastes, wastes containing free liquids, or sludge, and that is not backfilled or otherwise covered during periods of deposition.
Beneficial Use	Beneficial use of coal combustion residuals, or byproducts, removed from the site in compliance with the requirements of Section .1700 of 31 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).
Bottom Ash	The agglomerated, angular ash particles formed in pulverized coal furnaces that are too large to be carried in the flue gases and collect on the furnace walls. Bottom ash falls through open grates to an ash hopper at the bottom of the furnace.
Coal Ash Excavation Plan	Plan required by NCDEQ letter dated August 13, 2014, including a schedule for soil and sediment erosion control measures, dewatering, and the proposed location of the removed ash.
Coal Ash Management Act of 2014	North Carolina Session Law 2014-122.
Coal Combustion Residuals (CCR)	Coal Combustion Residuals. Residuals include fly ash, bottom ash, and boiler slag produced by a coal-fired generating unit.
Dewatering	The act of removing bulk and entrapped water from the ash basin.
Dewatering Plan	Engineered plan and the associated process steps necessary to dewater an ash basin.
Duke Energy Safe Work Practices Manual	Document detailing the Duke Energy safety guidelines.
Excavation Activities	Tasks and work performed related to the planning, engineering, and excavation of ash from an ash basin.

TERM	DEFINITION
Excavation Plan	Refer to Coal Ash Excavation Plan.
Fly Ash	Very fine, powdery material, composed mostly of silica with nearly all particles spherical in shape, which is a product of burning finely ground coal in a boiler to produce electricity and is removed from the plant exhaust gases by air emission control devices.
Mountain Energy Act of 2015	North Carolina Session Law 2015-110.
NPDES	National Pollutant Discharge Elimination System.
NPDES Permit	A permit that regulates the direct discharge of wastewater to surface waters.
Permit	Federal, state, county, or local government authorizing document.
1964 Ash Basin	Ash pond created in 1964 for wastewater treatment of industrial wastewater produced by coal combustion for electric steam generation (#BUNCO-097).
1982 Ash Basin	Ash pond created in 1982 for wastewater treatment of industrial wastewater produced by coal combustion for electric steam generation (#BUNCO-089).

XIV. Reference Documents

REF	DOCUMENT	DATE
1	NCDEQ letter to Duke Energy, request for excavation plans	August 13, 2014
2	Coal Ash Management Act of 2014	September 20, 2014
3	Mountain Energy Act of 2015	June 24, 2015
4	NCDEQ letter from Jeff Poupart, Water Quality Permitting Section Chief, to Duke Energy regarding decant	July 20, 2016

Sutton Steam Station
New Hanover County, North Carolina

I. Site History

The Sutton Steam Station ("Sutton") is a Duke Energy Progress, LLC ("DE Progress" or the "Company") coal-fired generation facility that began generating coal-fired electricity in 1954 under the ownership of Carolina Light & Power Company. From 1954 to 1971, the Company disposed of coal combustion residuals ("CCR") from its coal-fired unit in the Lay of Land Area ("LOLA") located onsite. In 1971, the Company constructed the first ash basin at the site to receive sluiced bottom and fly ash for storage and disposal. In 1983, the Company expanded storage capacity of the 1971 Ash Basin by raising its dikes. Since this vertical expansion, this original ash basin has been known interchangeably as the 1971 Ash Basin, the 1983 Ash Basin or the 1971/1983 Ash Basin.

In 1984, the Company constructed a clay-lined second ash basin at Sutton Plant located north of the 1971 Ash Basin, known as the 1984 Ash Basin. In 2006, an Interior Containment Area was constructed within the footprint of the 1984 Ash Basin to increase its storage capacity.

The coal-fired units at the Sutton Plant were retired in 2013 and demolished in 2017. They were replaced by a 625 MW natural gas combined-cycle plant that has been operating since 2013. An aerial view of the Sutton ash basins (collectively, the "CCR Units") is provided in **Figure 1** below.

Figure 1 – Aerial showing CCR Units at Sutton

II. Regulatory History

The CCR Units at Sutton have been regulated by a combination of state agencies during the operational history of the plant. The North Carolina Department of Environmental Quality ("DEQ") regulated the wet storage of ash in ash basins through the National Pollutant Discharge Elimination System ("NPDES") permit program and the dry ash storage and beneficial reuse of CCR through the state's solid waste permitting program. Power plant dams were regulated by the North Carolina Utilities Commission (the "Commission") until January 1, 2010, when that authority was transferred to DEQ.

Following the Tennessee Valley Authority coal ash spill in 2008, EPA was prompted to assess coal ash impoundments across the country. In 2010, EPA, for the first time, proposed comprehensive regulations and federal minimum standards to address the disposal and long-term storage of CCR. The final CCR Rule was signed in December 2014 and published in April 2015. The CCR Rule applies to and requires the closure of the ash basins at Sutton.

In 2014, the North Carolina General Assembly passed the Coal Ash Management Act ("CAMA") to establish new state standards for the disposal of CCR from coal-fired electric generation facilities. CAMA, and its later amendments, complement and overlap with the federal CCR Rule. CAMA designated Sutton as a "high priority" site and required that its ash impoundments be closed by August 1, 2019.

III. Site Closure Activities – January 1, 2015 through August 31, 2017

In response to new state and federal regulatory requirements, the Company began closure activities at Sutton. Those activities included:

- Selecting location(s) for disposal of excavated ash;
- Developing closure plans and other engineering reports;
- Obtaining environmental permit from State and Federal agencies necessary to begin closure;
- Installing erosion and sediment control measures;
- Installing groundwater monitoring wells;
- Dewatering the 1971 Ash Basin and the 1984 Ash Basin;
- Excavating the 1971 Ash Basin and the 1984 Ash Basin;
- Designing and constructing an onsite landfill;
- Transporting excavated ash to an offsite landfill then to the onsite landfill;
- Rerouting inflows away from the ash basins.

The activities described above and costs associated with those activities were the subject of DE Progress' 2017 rate case before the Commission (Docket No. E-2, 1142). In that docket, the Commission determined that DE Progress' coal ash basin closure costs for the Sutton were reasonable, prudent, and recoverable. (*Order Accepting Stipulation, Deciding Contested Issues, and Granting Partial Rate Increase*, Docket No. E-2, Sub 1142).

IV. Site Closure Activities – September 1, 2017 through February 29, 2020

As of September 1, 2017, DE Progress had already entered into extensive contracts with engineering and construction contractors to perform the necessary site assessments, develop excavation and compliance plans, and to excavate and transport the CCR for permanent disposal. Costs related to those contracts and activities performed pursuant to those contracts through August 31, 2017 have already been approved by the Commission. DE Progress has continued its efforts to execute the excavation and closure plans for Sutton and comply with state and federal regulatory requirements.

From September 1, 2017 through February 29, 2020, DE Progress has completed or is scheduled to complete the following tasks:

- Complete construction of the onsite landfill;
- Complete excavation ash from the 1971 Ash Basin and the 1984 Ash Basin;
- Transport ash to the onsite landfill;
- Close landfill cells;
- Excavate ash from the LOLA;
- Obtain environmental permits;
- Install groundwater monitoring wells;
- Monitor and analyze groundwater samples;
- Plan, design, and install permanent water supplies for neighbors;
- Decommission ash basin dams.

The tasks that DE Progress has performed and will perform from September 1, 2017 through February 29, 2020 are a continuation of the activities for which costs were approved in the prior DE Progress rate case. These activities and associated costs continue to be necessary, appropriate, and consistent with applicable regulatory requirements.

L.V. Sutton Electric Plant

Coal Ash Excavation Plan

DUKE ENERGY®

2018 Update

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Exhibits

I. Statement of Purpose

Duke Energy Progress, LLC (Duke Energy, or the Company) is required by Part II, Section 3(b) of the Coal Ash Management Act of 2014 (Session Law 2014-122) (Coal Ash Act or Act) to close, in accordance with Part II, Section 3(c), the coal combustion residuals (CCR) surface impoundments located at the L.V. Sutton Electric Plant (Sutton or Plant), National Pollutant Discharge Elimination System (NPDES) Permit No. NC0001422, in New Hanover County, as soon as practicable, but not later than August 1, 2019.

This Coal Ash Excavation Plan (Plan) represents activities to satisfy the requirements outlined in Part II, Sections 3(b) and 3(c), Subparagraphs 1 and 2 of the Act and the requests set forth in the North Carolina Department of Environmental Quality's (NCDEQ) August 13, 2014 letter titled "Request for Coal Ash Excavation Plans for Asheville Steam Electric Generating Plant, Dan River Combined Cycle Station, Riverbend Steam Station, L.V. Sutton Electric Plant" (NCDEQ Letter). The NCDEQ Letter specifically requests that the Plan include 1) soil and sediment erosion control measures, 2) dewatering, and 3) the proposed location(s) of the removed ash. These requirements are discussed in this updated Plan.

This is a revision of the Coal Ash Excavation Plan dated December 1, 2017, which covers the subsequent phase of ash basin excavation activities, including dewatering, site preparation, landfill operation, ash basin preparation, and ash removal from the basins at Sutton. The Plan has been updated and submitted to NCDEQ annually, but no further updates will be prepared upon completion of excavation of the ash basins in accordance with the applicable CAMA provisions.

The Plan covers some of the work required by Part II, Sections 3(b) and 3(c) of the Coal Ash Act. The Act requires the closure of the ash basins as soon as practicable, but no later than August 1, 2019. However, the Act contains no requirement for the submittal of an excavation plan of the kind presented here. Thus, while the formulation, submittal, and review of this Plan will assist in Duke Energy's work to close the ash basins, its ultimate approval is an action not specifically required by statutory, regulatory, or other applicable authority.

The precise scope of work in excavating the ash basins has been determined by applicable laws, rules, permits, and approvals that control the activities to be performed under the Plan. There are several external and internal factors that could potentially affect the precise scope of the work to be performed under the Plan. As a consequence, neither the submittal of this Plan nor its acknowledgement by NCDEQ should be taken as requiring actions different from such applicable requirements. Duke Energy submits this Plan to NCDEQ based on the understanding that it may be necessary to take actions that deviate from the Plan in the future, and the Company reserves the right to make such changes.

II. General Facility Description

Sutton is located in New Hanover County near Wilmington, NC, situated between the Cape Fear River to the west and the Northeast Cape Fear River to the east. Sutton was a three-unit, 575 megawatt (MW) coal-fired power plant. The Plant operated from 1954 until retirement of the coal-fired units in November 2013. Upon retirement of the coal-fired units, a new 625 MW gas-fired unit began operations.

There are two CCR basins—the 1971 and 1984 Basins—containing fly ash, bottom ash, boiler slag, stormwater, ash sluice water, coal pile runoff, and low volume wastewater. One other area that contains CCR material is the Lay of Land Area (LOLA). The LOLA consists mostly of bottom ash and soil. The Sutton facility also includes a cooling lake (also known as "Sutton Lake"), which does not contain CCR. Sutton Lake is accessible to the general public and is used for recreational purposes. Sutton Lake was classified as Waters of the State on November 5, 2014.

Duke Energy's Coal Combustion Residuals Removal Verification Procedure (Removal Verification Procedure) will be used to verify that primary source ash has been removed from the basin. Subsequent to removal of the ash pursuant to the Removal Verification Procedure, Duke Energy will implement its Excavation Soil Sampling Plan (ESSP), which was developed for the purpose of meeting the applicable performance standard. Although not required under CAMA, in November 2016, NCDEQ sent Coal Combustion Residuals Surface Impoundment Closure Guidelines for Protection of Groundwater to Duke Energy instructing the Company to submit the ESSP to NCDEQ as part of the site's excavation plan. In accordance with this directive, a copy of the ESSP for the 1984 Basin is attached as **Exhibit "A"** to this Plan.[1]

1971 Ash Basin

The 1971 Basin was operated from 1971 to 1985. It was opened again in 2011 for temporary use during repair work and ash removal activities. The 1971 Basin is unlined and was initially constructed with a crest elevation of 18 feet mean sea level (msl), which was raised in 1983 to 26 msl. The 1971 Basin initially contained approximately 3.8 million tons of CCR material. The southern basin dikes of the 1971 Basin contain ash and will be excavated as part of final closure.

[1] The ESSP for the 1971 Basin was not updated and, therefore, is not attached hereto.

1984 Ash Basin

The 1984 Basin was operated from 1984 to 2013. The 1984 Basin was constructed with a 12-inch thick clay liner at the basin bottom, which extends along the side slopes where it is protected by a 2-foot thick sand layer. The 1984 Basin crest elevation is 34 feet msl. In 2006, an Interior Containment Area (ICA) was constructed within the 1984 Basin with a crest elevation of 42 feet msl. The 1984 Ash Basin initially contained approximately 2.8 million tons of CCR material.

LOLA

The LOLA is located between the discharge canal and the coal pile. It is believed that the presence of CCR in this area may have been due to Plant operations between approximately 1954 and 1972. A small portion adjacent to the coal pile storage area was used to locate fuel oil storage tanks. This area contains approximately 686,000 tons of CCR and soil mixture at depths of 0 to 15 feet.

Current Operating Permit Details

The Cooling Basin, 1971 Basin, and 1984 Basin are operated under NPDES Permit No. NC0001422 to regulate effluent discharges to the Cape Fear River. Additionally, the dams of the Cooling Basin, 1971 Basin, and 1984 Basin are listed under the NCDEQ Dam Safety Program. The dam identification numbers for the Cooling Basin, 1971 Basin, and 1984 Basin are NEWHA-003, NEWHA-004, and NEWHA-005, respectively. The dam inventory lists the Cooling Basin and 1971 dams as exempt. The 1984 dam is listed as impounding, hence regulated. In 2014, these dams were re-rated as high hazard by NCDEQ. The 2006 Interior Containment Area (ICA) constructed within the 1984 Basin was permitted and used as a “basin within a basin,” where an interior dam was constructed on top of the CCR within the basin; sluiced CCR was excavated from rim ditches, placed within the interior basin, and compacted to heights that are above the exterior basin dams. This operation was discontinued before reaching the permitted final grades when the Plant was shut down in November 2013.

III. Project Charter

Dewatering of the ash basins and the removal of ash from the site is being performed in project phases. As of November 1, 2018, approximately 4.56 million tons of ash have been excavated. Approximately 2.0 million tons were moved to an off-site structural fill and the remainder to the on-site landfill. The project has completed Phase I and is now implementing Phase II.

The following items in Phase I have been completed or initiated:

1. Developed and installed approved erosion and sediment control measures.

2. Developed and constructed the infrastructure to remove and transport the ash.
3. Completed the installation of a wastewater treatment system to support dewatering of the ash basins.
4. Began dewatering of the ash basins.
5. Completed the work scope and bid event to support ash basin closure.
6. Initiated and completed the removal of the first 2 million tons of ash from the Sutton site.
7. Development of option(s) for proposed ash disposal or beneficial use locations.
8. Rerouted approximately two miles of the Sutton Lake public boat ramp access road.
9. Initiated development of the on-site landfill.
10. Obtained permit to construct the on-site landfill.

The Sutton NPDES wastewater permit was issued to Duke Energy in December 2015 to allow for removal of bulk free water. The removal of the bulk free water was completed on January 28, 2016. After the required wastewater treatment facility was installed and operational, removal and treatment of the basin interstitial water commenced in June 2016. Based on revisions to the NPDES permit, the stormwater from the fossil plant has been rerouted and no longer discharges into the basins. Therefore, rainwater is the only inflow into the basins. Basin dewatering is currently being implemented on an as-needed basis to maintain the basins' clear water ponds as low as reasonably possible.

Under this Plan, the Company began removing ash to an off-site location while simultaneously developing an on-site landfill in order to meet the closure requirement mandated in the Coal Ash Act. The Sutton on-site landfill construction permit was received on September 22, 2016. This date was significantly later than originally planned, resulting from delays with NCDEQ's environmental justice review.

The construction of the on-site landfill commenced early in the fourth quarter of 2016. The first permit to operate for a completed landfill cell was obtained on July 6, 2017 from the NC Division of Waste Management. Phase I CCR excavation and transport off-site completed on June 27, 2017, and the Phase II CCR excavation and placement in the on-site landfill commenced on July 7, 2017. Landfill construction was completed March 26, 2018. Currently four cells are in operation. Two of the operating cells are scheduled for closure in the first and second quarters of 2019.

The Sutton site was significantly impacted by Hurricane Florence in September 2018. Normal operation was suspended for storm preparation beginning September 10, 2018, and ash excavation and transport was not resumed until October 1, 2018. Suspended operations resulted in the loss of approximately 99,500 tons of production during that period.

Due to the late start of landfill construction, combined with the impacts of both Hurricane Matthew in 2016 and Hurricane Florence in 2018, the projected completion date has moved beyond the mandatory closure date of August 1, 2019. Schedule recovery opportunities are and will continue to be evaluated and implemented.

Pursuant to N.C.G.S. § 130A-309.215, on November 16, 2018, Duke Energy submitted to the North Carolina Department of Environmental Quality an application for a variance to extend by six months (i.e., until February 1, 2020) the CAMA closure deadline applicable to the 1971 and 1984 Ash Basins at Sutton, because, despite Duke Energy's application of best available technology found to be economically reasonable, compliance with the applicable CAMA deadline cannot be achieved.

The following items in Phase II have been completed or initiated:

1. Received NCDEQ Permits to Operate (PTO) landfill Cells 5, 6, 7, and 8. Completed construction of the on-site landfill.
2. Continued the excavation and transport of Phase II ash to the on-site landfill.
3. Began on-site treatment of landfill leachate wastewater through the on-site wastewater treatment facility.
4. Received NCDEQ permits to decommission the 1971 Basin dikes and outfall structure.
5. Received NCDEQ permits to decommission the 1984 Basin dikes and outfall structure.
6. Commenced the excavation of CCR and the removal of the 1971 Basin southern berm.
7. Commenced operation of the on-site landfill.
8. Performed pump and haul operations of landfill leachate wastewater to a local Publically Owned Treatment Works (POTW) facility
9. Completed the construction of 4,600 feet of sheet pile wall to support future dike and berm removal.
10. Relocated several thousand feet of Piedmont Natural Gas gas line that was in operation through the LOLA.
11. Completed construction of the second phase of the wastewater treatment facility to support basin dewatering and landfill leachate treatment.
12. Completed the installation of the on-site extraction well system.
13. Completed the relocation of several miles of outfall discharge piping to support operation of the extraction well system and future dike excavation.

Project Charter Objectives

Phase II Objectives

1. Continue to dewater ash basins, pumping water through the on-site wastewater treatment facility.

2. Submit and obtain any necessary permits for Phase II activities.
3. Excavate and transport ash from the 1971 and 1984 Ash Basins.
4. Construct, operate, and close cells for the on-site landfill.
5. Gain knowledge and opportunities for program improvement that can be applied to the subsequent phase(s).

Inactive Ash Areas Objectives

1. Submit and obtain any necessary permits for activities.
2. Excavate and transport ash from the LOLA to commence in 2019.
3. Operate and close cells for the on-site landfill.
4. Gain knowledge and opportunities for program improvement.

Project Charter Scope

Phase II Scope

1. Submit and obtain applicable permits.
2. Install and maintain required site haul roads.
3. Continue dewatering of the 1984 and 1971 Basins and treat landfill leachate water using the on-site wastewater treatment facility.
4. Commence landfill operations.
5. Continue to excavate and transport approximately an additional 2.1 million tons of material from the 1971 and 1984 Ash Basins to an approved on-site landfill.
6. Continue infrastructure activities that are required to support the future excavation of the basins and the LOLA.
7. Complete closure activities for the 1971 and 1984 Ash Basins.

Inactive Ash Areas Scope

1. Excavate and transport the approximately 686,000 tons of material from the LOLA to the on-site landfill.
2. Reinforce the LOLA western dike.
3. The LOLA will be closed as part of overall site closure, but is not subject to Part II, Sections 3(b) and 3(c) of the Coal Ash Act.
4. Operate and close cells for the on-site landfill.

IV. Critical Milestone Dates

Critical milestones within the Plan are summarized in the table below.

MILESTONES	NO LATER THAN DATE	STATUS
Submit Excavation Plan	November 15, 2014	Completed November 13, 2014
Complete Comprehensive Engineering Review	November 30, 2014	Completed November 30, 2014

MILESTONES	NO LATER THAN DATE	STATUS
Excavation Plan Acknowledgement	February 17, 2015	Completed February 2, 2015
Submit Updated Excavation Plan to NCDEQ	November 15, 2015	Completed November 13, 2015
Commence Work – Ash Removal	Final permit approval + 14 Days	Completed October 30, 2015
Receive NPDES Wastewater Permit	December 11, 2015	Completed December 2015
Receive Permit-to-Construct On-site Landfill	February 29, 2016	Delayed due to NCDEQ environmental justice review; completed September 22, 2016
Submit Updated Excavation Plan to NCDEQ	December 31, 2016	Completed December 21, 2016
Receive permit for basin dam decommissioning	August 1, 2017	Completed December 7, 2017
Receive Permit-to-Operate On-Site Landfill, Cell 3	August 31, 2017	Completed July 6, 2017
Submit Updated Excavation Plan to NCDEQ	December 31, 2017	Completed December 1, 2017
Eliminate Stormwater Discharge into Impoundments	December 31, 2018	Completed July 2016
1971 and 1984 Basins closed pursuant to Part II, Sections 3.(b) and 3.(c) of the Coal Ash Act	August 1, 2019	Challenged due to permitting delays and severe weather, including Hurricane Matthew in 2016 and Hurricane Florence in 2018
Excavate CCR From the Lay of the Land Area (LOLA)	June 20, 2020	On Track
Submit Updated Excavation Plan	December 31, Annually	On Track

V. Erosion and Sediment Control Plan

The project currently has one active Erosion and Sediment Control (E&SC) plan: Site Wide Clearing Activities (NEWHA -2016-025). Additional applications are expected to be submitted during this phase as the project planning develops. Modifications from E&SC plans for subsequent phase(s) will be approved by NCDEQ prior to installation and initiation of subsequent phase work. The approved contractor will install the E&SC measures indicated in the plan. All control measures will be maintained throughout the project in accordance with the E&SC plans and permits. When possible, portions of the E&SC plan will be closed out at the approval of NCDEQ as areas become stabilized.

VI. Dewatering Plan

The Sutton ash basins will be dewatered to facilitate the removal of ash and to mitigate risk. Engineering analysis has shown that lowering the water below the level of ash within each basin does not improve the factor of safety against failure of the associated dam; therefore, removal of entrapped water is not required.

An engineered Dewatering Plan for Sutton was developed, and dewatering has been in progress since October 2015. Interstitial basin dewatering will likely continue throughout the life of the project. Pumping is managed to control the water level as low as reasonably possible.

The current plan calls for the removal of ash from the 1971 Basin through different methods than from the 1984 Basin and the LOLA. Heavy equipment operation directly on top of the ash in the basin has been deemed impractical due to high groundwater recharge rates. Therefore, removal of the ash from the 1971 Basin incorporates hydraulic dredging and dewatering of the resulting dredged material. The water generated during ash removal will be directed back to the 1971 Basin.

Interstitial dewatering and landfill leachate wastewater treatment will be performed by the on-site wastewater treatment facility in accordance with the NPDES permit.

VII. Location(s) for Removed Ash

Ash removed from the site was transported by the contractor to permitted facilities. The ash storage location has been managed and maintained to ensure environmental compliance with applicable rules and regulations.

Disposal Sites

Brickhaven Structural Fill was the primary disposal location for the first two million tons of CCR material that was excavated at Sutton, and the on-site landfill located at Sutton is the primary disposal location for the remaining CCR material.

Brickhaven Structural Fill

The Brickhaven Structural Fill is located at the Brickhaven Mine near the City of Moncure in Chatham County, NC. It resides on approximately 299 acres. Ash was transported and beneficially used as fill material for a structural fill project at the reclaimed mine. The final rail shipment of ash to the Brickhaven Structural Fill from Sutton occurred on June 27, 2017.

Sutton On-Site Landfill

Ash excavated from the basins and LOLA will be disposed of in the on-site CCR landfill. The project includes the installation of a liner and leachate collection system for the landfill.

VIII. Transportation Plan

Ash is currently being transported from the basins via off-road articulated dump truck to the on-site landfill. Truck loading operations is being conducted with a crew working typically 10-12 hours per day, five to six days per week.

IX. Environmental and Dam Safety Permitting Plan

Excavation of ash creates potential for stormwater impacts. Since Sutton has no point source discharges consisting solely of industrial stormwater, NCDEQ determined that an individual industrial stormwater permit is not necessary. Instead, NCDEQ has included internal stormwater outfalls and the requirement to develop a stormwater pollution prevention plan as a requirement of the NPDES wastewater permit. Future modifications to the permit/plan will be managed as necessary.

NCDEQ has determined that removal of dry ash from the Sutton ash basins can be regulated via the Construction Stormwater General Permit. Ash removal activities were originally permitted when NC DEMLR approved erosion control plan NEWHA-2016-023. These activities are now encompassed in NEWHA-2016-025.

NCDEQ determined that dewatering activities, including free water removal, required a NPDES wastewater permit modification. Based on this requirement, the Company applied for a permit modification to specifically allow decanting of free water and dewatering of interstitial water. Application was made in January 2015. The Company received the modified NPDES permit in December 2015 for a term of one year. On October 1, 2017, the permit was re-issued and included the authorization to treat and discharge landfill leachate through the on-site wastewater treatment plant.

There are no jurisdictional wetlands/streams associated with the removal of ash from the 1984 and 1971 Ash Basins during Phase I and II. The current and future wetland/stream impacts and jurisdictional determinations will be managed through the United States Army Corps of Engineers with particular attention paid to the difference between jurisdictional wetlands/streams under Section 404 and those arising from Section 401 waters. Any Section 404 individual permitting will require Section 401 Water Quality Certification by NCDEQ. Wetlands stream impacts have been permitted for the construction of the on-site landfill. Sutton ash is a non-hazardous material.

Subsequent phase(s) will include dewatering and continued excavation and removal of ash from the 1984 and 1971 Basins and the LOLA. Subsequent phase(s) also include(s) the continued construction of the on-site landfill.

All necessary Dam Safety approvals will be or have been obtained to cover activities on or around jurisdictional dams. Breaching of the dams will require Dam Safety approval. Any impacted wells or piezometers will be properly abandoned in accordance with

NCDEQ requirements. Fugitive dust will be managed to mitigate impacts to neighboring areas.

Permit Matrix

MEDIA	PERMIT	RECEIVED DATE (R) TARGET DATE (T)	COMMENTS
Water	NPDES Wastewater Permit – Major Modification	Major Modification to allow basin dewatering: December 2015 (R)	None
		Major Modification to allow the discharge of landfill leachate: October 1, 2017 (R)	A NPDES permit revision was required to authorize the treatment and discharge of landfill leachate. The target date was originally January 2017, but was affected by shifts in Agency priorities. The draft permit was posted for public comment in June 2017 and again in August 2017. The approved NPDES modification was received and went into effect on October 1, 2017.
	Jurisdictional Wetland and Stream Impacts 404 Permitting and 401 WQC	September 2016 (R)	Four cells in the new Sutton landfill had identified jurisdictional wetland/stream impacts in Phase I. Wetland permits have been received. No impacts to jurisdictional wetlands requiring additional permitting have been identified for Phase II.
Dam Safety	Dam Decommissioning Request Approval	February 7, 2018 (R)	Original target date was March, 2017. Permit is required to support excavation plan.
Waste	Site Suitability Report	July 2, 2015 (R)	Site Suitability obtained for Sutton landfill. Previous date was March 31, 2015. Change was related to additional requirements to complete the report prior to submittal.
	Permit-to-Construct Landfill	September 2016 (R)	The original target date was February 23, 2016.

MEDIA	PERMIT	RECEIVED DATE (R) TARGET DATE (T)	COMMENTS
	Permit-to-Operate Landfill	Cell 3: July 6, 2017 (R) Cell 4: August 25, 2017 (R) Cell 5: December 7, 2017 (R) Cell 6: February 7, 2018 (R) Cells 7 & 8: March 16, 2018 (R)	The original project target date for Cell 3 was November 23, 2016. Delay was due to NCDEQ's environmental justice review process.
Other Requirements	Site Site-Specific Nuisance/Noise/Od orOther Requirements, including DOT and FERC Requirements	N/A	None identified.

X. Contracting Strategy

The Ash Management Program strategy is to engage multiple contractors, drive competition, create system-wide innovation, and develop a collection of best practices. Duke Energy has engaged contractor(s), who are experienced in coal ash excavation, transportation, and disposal, and continues to evaluate other potential contractors. The Company provides in-depth oversight, coordination, and monitoring of the contractors to ensure the work is performed appropriately. Duke Energy's core values include safety, quality, and protection of the environment, which are incorporated into our contracts. The Company continues to evaluate alternate approaches, methods, and contracting solutions and will adjust its strategy, as necessary.

XI. Environmental, Health, and Safety Plan

The Company is committed to the health, safety, and welfare of employees, contractors, and the public, and to protecting the environment and natural resources. During all phases of the project work, the Company and its contractors will follow the Duke Energy Safe Work Practices Manual, the Environmental, Health, and Safety supplement document, and any additional requirements. Occupational health and safety expectations include oversight and continuous improvement throughout the project. The project includes comprehensive environmental, health, and safety plans encompassing all aspects of the project work. In addition to adhering to all applicable environmental, health, and safety rules and regulations, Duke Energy and its contractors will focus on ensuring the safety of the public and protection of the environment during each phase of the project.

XII. Communications Plan

The project team has coordinated with Duke Energy's Corporate Communications Department to develop a comprehensive external communications plan tailored to the specific needs of each phase of the project. Many different external stakeholders, including neighbors, government officials, and media have an interest in this project. The Company is committed to providing information by proactively communicating about the project activities to potentially affected parties and responding to inquiries in a timely manner.

XIII. Glossary

TERM	DEFINITION
Ash Basin	Synonymous with Coal Combustion Residual Impoundment. A topographic depression, excavation, or dammed area that is primarily formed from earthen materials; without a base liner approved for use by Article 9 of Chapter 130A of the General Statutes or rules adopted thereunder for a combustion products landfill or coal combustion residuals landfill, industrial landfill, or municipal solid waste landfill; and an area that is designed to hold accumulated coal combustion residuals in the form of liquid wastes, wastes containing free liquids, or sludge, and that is not backfilled or otherwise covered during periods of deposition.
Ash Stack	A dry ash storage feature external to the ash basin
Beneficial and Beneficial Use	Projects promoting public health and environmental protection, offering equivalent success relative to other alternatives, and preserving natural resources
Bottom Ash	The agglomerated, angular ash particles formed in pulverized coal furnaces that are too large to be carried in the flue gases and collect on the furnace walls. Bottom Ash falls through open grates to an ash hopper at the bottom of the furnace.
Bulk Water	Water above the ash contained in the ash basin; synonymous with free water
Coal Ash Excavation Plan	Plan required by NCDEQ letter dated August 13, 2014, including a schedule for soil and sediment erosion control measures, dewatering, and the proposed location of the removed ash
Coal Ash Management Act of 2014	North Carolina Session Law 2014-122

TERM	DEFINITION
Coal Combustion Residuals (CCR)	Residuals, including fly ash, bottom ash, boiler slag, mill rejects, and flue gas desulfurization residue produced by a coal-fired generating unit
Dewatering	The act of removing bulk and entrapped water from the ash basin
Dewatering Plan	Engineered plan and the associated process steps necessary to dewater an ash basin
Duke Energy Safe Work Practices Manual	Document detailing the Duke Energy safety guidelines
Engineer of Record	Duke Energy or third-party contracted engineer responsible for final verification of specific plan actions and documents
Entrapped Water	Water below the ash surface, which creates hydrostatic pressure on the dam
Excavation Activities	Tasks and work performed related to the planning, engineering, and excavation of ash from an ash basin
Excavation Plan	Refer to Coal Ash Excavation Plan
Factor of Safety	In reference to dam safety, the ratio of the forces or moments resisting mass movement to the forces or moments tending to produce mass movement
Free Water	Water above the ash contained in the ash basin; synonymous with bulk free water
Fly Ash	Very fine, powdery material, composed mostly of silica with nearly all particles spherical in shape, which is a product of burning finely ground coal in a boiler to produce electricity and is removed from the plant exhaust gases by air emission control devices.
LOLA	Lay of Land Area
NPDES	National Pollutant Discharge Elimination System
NPDES Permit	A permit that regulates the direct discharge of wastewater to surface waters

TERM	DEFINITION
Permitting	Federal, state, county, or local government authorizing document

XIV. Reference Documents

REF	DOCUMENT	DATE
1	NCDEQ Letter to Duke Energy, Request for Excavation Plans	August 13, 2014
2	Coal Ash Management Act of 2014	September 20, 2014
3	NCDEQ Letter from Jeff Poupart, Water Quality Permitting Section Chief, to Duke Energy regarding decant	July 20, 2016

Cape Fear Steam Station
Chatham County, North Carolina

I. Site History

The Cape Fear Steam Station ("Cape Fear") is a Duke Energy Progress, LLC ("DE Progress" or the "Company") coal-fired generation facility that began generating coal-fired electricity in 1923 and ceased power production in 2012. The Company has operated a total of six coal-fired units and four oil-fueled combustion turbine units at Cape Fear. The coal-fired units were constructed between 1923 and 1969. Two of the site's six coal-fired units were retired in 1977 and two were retired in 2011. The remaining two coal-fired units, along with one of four oil-fueled combustion turbine units on site, were retired in October 2012. The remaining three oil fired units were retired in April 2013.

Coal combustion residuals ("CCR") from the plant's coal-fired units were sluiced to and stored in five onsite ash basins, which are referenced using their date of construction: 1956, 1963, 1970, 1978, and 1985. Sluicing to the 1985 Ash Basin ceased in 2012. The 1956 Ash Basin is located north of the former power production area, and the remaining ash basins are located south of the former power production area. The 1963 and 1970 Ash Basins were constructed on the west side of the site adjacent to the Cape Fear River. The 1978 Ash Basin was constructed east of and abutting the 1963 and 1970 Ash Basins. The 1985 ash basin was constructed east of the existing ash basins.

An aerial view of the Cape Fear ash basins (collectively, the "CCR Units") is provided in **Figure 1** below.

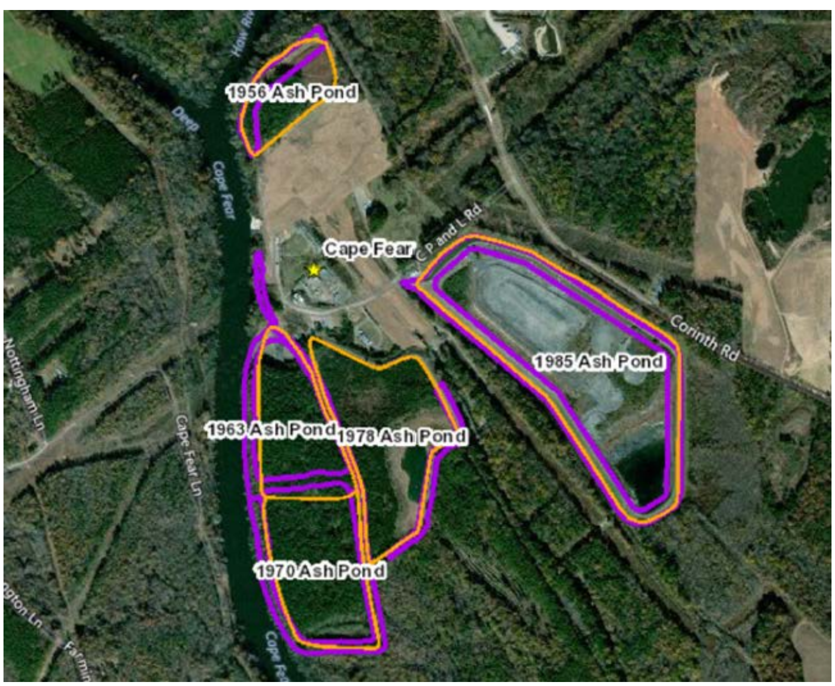

Figure 1 – Aerial showing CCR Units at Cape Fear

II. Regulatory History

The CCR Units at Cape Fear have been regulated by a combination of state agencies during the operational history of the plant. The North Carolina Department of Environmental Quality ("DEQ") regulated the wet storage of ash in ash basins through the National Pollutant Discharge Elimination System ("NPDES") permit program and the dry ash storage and beneficial reuse of CCR through the state's solid waste permitting program. Power plant dams were regulated by the North Carolina Utilities Commission (the "Commission") until January 1, 2010, when that authority was transferred to DEQ.

Following the Tennessee Valley Authority coal ash spill in 2008, EPA was prompted to assess coal ash impoundments across the country. In 2010, EPA, for the first time, proposed comprehensive regulations and federal minimum standards to address the disposal and long-term storage of CCR. The final CCR Rule was signed in December 2014 and published in April 2015. The CCR Rule applies to and requires the closure of the ash basins at Cape Fear.

In 2014, the North Carolina General Assembly passed the Coal Ash Management Act ("CAMA") to establish new state standards for the disposal of CCR from coal-fired electric generation facilities. CAMA, and its later amendments, complement and overlap with the federal CCR Rule. CAMA designated Cape Fear as an "intermediate risk" and required that its ash impoundments be excavated.

In 2016, the North Carolina General Assembly passed amendments to CAMA. *See* N.C. Gen. Stat. § 130A-309.216. Among other things, the amendments required the Company to select three sites to construct an onsite beneficiation facility capable of producing 300,000 tons of processed CCR annually. The Company evaluated technologies that were capable of meeting these requirements and selected The SEFA Group's STAR® technology. The Company then selected Cape Fear and H.F. Lee and Duke Energy Carolinas, LLC's Buck Steam Station as the three sites to comply with the CAMA amendments. These sites were selected based on several factors, including the quantity of CCR, the quality of CCR, the proximity of the sites to transportation corridors, and the proximity of the sites to markets for the processed CCR.

III. Site Closure Activities – January 1, 2015 through August 31, 2017

The Company immediately began complying with its new state and federal regulatory requirements affecting its storage of CCR at Cape Fear as they became effective. These compliance activities included installing and monitoring groundwater wells, connecting neighbors to permanent water supplies, satisfying the CCR Rule's reporting requirements, preparing engineering reports, performing engineering planning and design work, developing a closure plan, obtaining certain environmental permits.

The activities described above and costs associated with those activities were the subject of DE Progress' 2017 rate case before the Commission (Docket No. E-2, 1142). In that docket, the Commission determined that DE Progress' coal ash basin closure costs for the Cape Fear were reasonable, prudent, and recoverable. (*Order Accepting Stipulation, Deciding Contested Issues, and Granting Partial Rate Increase*, Docket No. E-2, Sub 1142).

IV. Site Closure Activities – September 1, 2017 through February 29, 2020

As of September 1, 2017, DE Progress had already entered into extensive contracts with engineering contractors to perform the necessary site assessments, construct the onsite beneficiation facility, and develop and execute excavation and closure plans. Costs related to those contracts and activities performed pursuant to those contracts through August 31, 2017 have already been approved by the Commission. DE Progress has continued its efforts to execute the excavation and closure plans for Cape Fear and to comply with state and federal regulatory requirements.

From September 1, 2017 through February 29, 2020, DE Progress has completed or is scheduled to complete the following tasks:

- Develop and finalize excavation and closure plans;
- Perform engineering analysis to support closure activities;
- Obtain environmental permits necessary to execute closure and operate the beneficiation facility;
- Construct erosion control measures and a sedimentation basin;
- Install piling and the concrete foundation for the beneficiation facility;
- Install above-grade structures for the beneficiation facility;
- Dewater the ash basins;
- Perform activities to prepare for processing CCR through the beneficiation facility;
- Install and monitor groundwater wells and analyze groundwater samples;
- Connect neighboring properties to permanent water supplies;
- Complete dam stability work;
- Construct a water treatment system to treat the water generated from decanting and dewatering the Ash Basins; and
- Continue decanting the Ash Basins.

The tasks that DE Progress has performed and will perform from September 1, 2017 through February 29, 2020 are a continuation of the activities for which costs were approved in the prior DE Progress rate case. These activities and associated costs continue to be necessary, appropriate, and consistent with applicable regulatory requirements.

H.F. Lee Steam Station
Wayne County, North Carolina

I. Site History

The H.F. Lee Steam Station ("H.F. Lee") is a Duke Energy Progress, LLC ("DE Progress" or the "Company") coal-fired generation facility that began generating coal-fired electricity in 1951. Over its life, the H.F. Lee Plant has employed various combinations of electric generation units to produce energy. From 1967 through 1971, four oil-fueled combustion turbine units were added to the facility. In 2000, five simple-cycle, duel fuel (oil and natural gas) units were built. The plant's coal-fired units were retired in September 2012, followed by the retirement of the four oil-fired combustion turbine units in October 2012. A new combined cycle unit was brought on line in 2012.

Coal combustion residuals ("CCR") from H.F. Lee's coal-fired units have been stored in the plant's three inactive ash basins ("Inactive Ash Basins 1-3"), the Active Ash Basin, a Lay of Land Area ("LOLA"), an ash fill construction road area, and a cinder waste area. Inactive Ash Basins 1-3 were built as three storage cells in approximately the late 1950s and early 1960s. Construction of the Active Ash Basin began in 1978 and was completed in April 1980. The Active Ash Basin stopped receiving sluiced CCRs in 2012 when the plant's coal-fired units were retired.

An aerial view of the H.F. Lee ash basins and storage areas (collectively, the "CCR Units") is provided in **Figure 1** below.

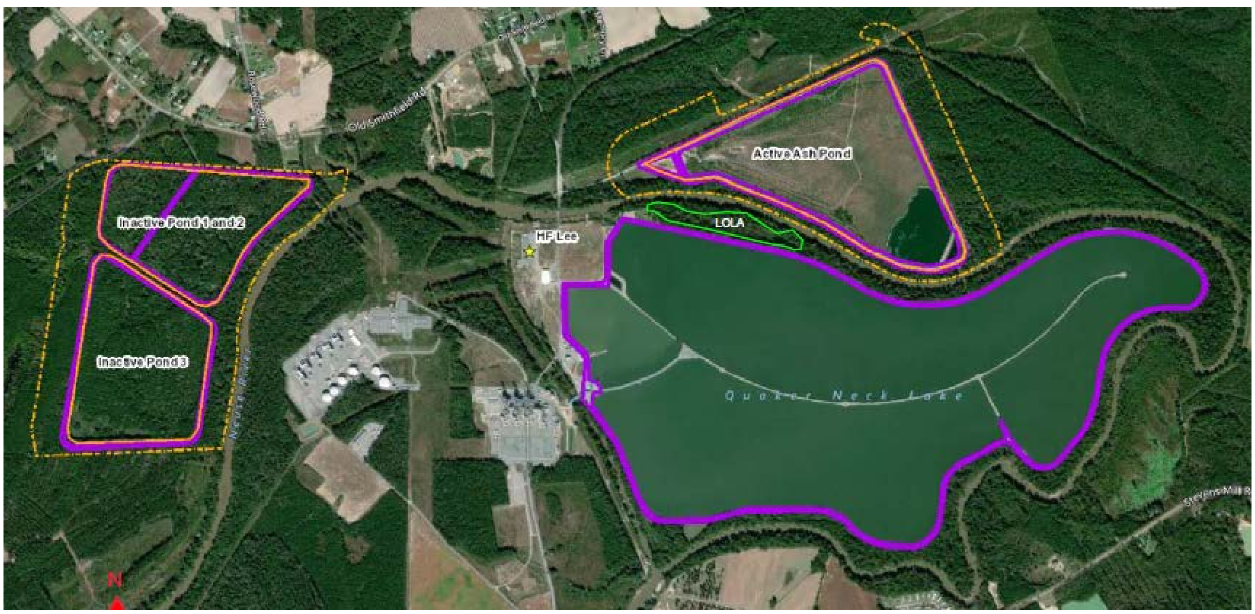

Figure 1 – Aerial showing CCR Units at H.F. Lee

II. Regulatory History

The CCR Units at H.F. Lee have been regulated by a combination of state agencies during the operational history of the plant. The North Carolina Department of Environmental Quality ("DEQ") regulated the wet storage of ash in ash basins through the National Pollutant Discharge Elimination System ("NPDES") permit program and the dry ash storage and beneficial reuse of CCR through the state's solid waste permitting program. Power plant dams were regulated by the North Carolina Utilities Commission (the "Commission") until January 1, 2010, when that authority was transferred to DEQ.

Following the Tennessee Valley Authority coal ash spill in 2008, EPA was prompted to assess coal ash impoundments across the country. In 2010, EPA, for the first time, proposed comprehensive regulations and federal minimum standards to address the disposal and long-term storage of CCR. The final CCR Rule was signed in December 2014 and published in April 2015. The CCR Rule applies to and requires the closure of the ash basins at H.F. Lee.

In 2014, the North Carolina General Assembly passed the Coal Ash Management Act ("CAMA") to establish new state standards for the disposal of CCR from coal-fired electric generation facilities. CAMA, and its later amendments, complement and overlap with the federal CCR Rule. CAMA designated H.F. Lee as an "intermediate risk" and required that its ash impoundments be excavated.

In 2016, the North Carolina General Assembly passed amendments to CAMA. *See* N.C. Gen. Stat. § 130A-309.216. Among other things, the amendments required the Company to select three sites to construct an onsite beneficiation facility capable of producing 300,000 tons of processed CCR annually. The Company evaluated technologies that were capable of meeting these requirements and selected The SEFA Group's STAR® technology. The Company then selected H.F. Lee and Cape Fear and Duke Energy Carolinas, LLC's Buck Steam Station as the three sites to comply with the CAMA amendments. These sites were selected based on several factors, including the quantity of CCR, the quality of CCR, the proximity of the sites to transportation corridors, and the proximity of the sites to markets for the processed CCR.

III. Site Closure Activities – January 1, 2015 through August 31, 2017

The Company immediately began complying with its new state and federal regulatory requirements affecting its storage of CCR at H.F. Lee as they became effective. These compliance activities included installing and monitoring groundwater wells, connecting neighbors to permanent water supplies, satisfying the CCR Rule's reporting requirements, preparing engineering reports, performing engineering planning and design work, developing a closure plan, obtaining certain environmental permits.

The activities described above and costs associated with those activities were the subject of DE Progress' 2017 rate case before the Commission (Docket No. E-2, 1142). In that docket, the Commission determined that DE Progress' coal ash basin closure costs for the H.F. Lee were reasonable, prudent, and recoverable. (*Order Accepting Stipulation, Deciding Contested Issues, and Granting Partial Rate Increase*, Docket No. E-2, Sub 1142).

IV. Site Closure Activities – September 1, 2017 through February 29, 2020

As of September 1, 2017, DE Progress had already entered into extensive contracts with engineering contractors to perform the necessary site assessments, construct the onsite beneficiation facility, and develop and execute excavation and closure plans. Costs related to those contracts and activities performed pursuant to those contracts through August 31, 2017 have already been approved by the Commission. DE Progress has continued its efforts to execute the excavation and closure plans for H.F. Lee and to comply with state and federal regulatory requirements.

From September 1, 2017 through February 29, 2020, DE Progress has completed or is scheduled to complete the following tasks:

- Develop and finalize excavation and closure plans;
- Perform engineering analysis to support closure activities;
- Obtain environmental permits necessary to execute closure and operate the beneficiation facility;
- Construct erosion control measures and a sedimentation basin;
- Install piling and the concrete foundation for the beneficiation facility;
- Install above-grade structures for the beneficiation facility;
- Dewater the ash basins;
- Perform activities to prepare for processing CCR through the beneficiation facility;
- Install and monitor groundwater wells and analyze groundwater samples;
- Connect neighboring properties to permanent water supplies;
- Complete dam stability work;
- Construct a water treatment system to treat the water generated from decanting and dewatering the ash basins; and
- Continue dewatering the active ash basins.

The tasks that DE Progress has performed and will perform from September 1, 2017 through February 29, 2020 are a continuation of the activities for which costs were approved in the prior DE Progress rate case. These activities and associated costs continue to be necessary, appropriate, and consistent with applicable regulatory requirements.

I/A

Cape Fear Plant

Coal Ash Excavation Plan

DUKE ENERGY®

2018

Contents

Exhibits

I. Statement of Purpose

Duke Energy Progress, LLC (Duke Energy or the Company) is required by Section 3.(a) of the Coal Ash Management Act of 2014, as amended by NC House Bill 630, Sess. L. 2016-95 (CAMA, Coal Ash Act, or Act), to close, in accordance with Section 3.(b) of the Act, the five coal combustion residuals (CCR) surface impoundments (Ash Basins or Basins) located at the Cape Fear Plant (Cape Fear or Plant)

Cape Fear was chosen on June 30, 2017, as an ash beneficiation site required by NC House Bill 630. Pursuant to NC House Bill 630, 300,000 tons of ash from the site must be beneficiated to specifications appropriate for cementitious products each year. NC House Bill 630 also requires that sites with ash beneficiation products shall be closed no later than December 31, 2029.

Duke Energy is further directed by the Amended Order Granting Motion for Partial Summary Judgment in *State of North Carolina ex rel. N.C. Department of Environment and Natural Resources, Division of Environmental Quality v. Duke Energy Progress, Inc.*, Wake County, Case No. 13-CVS11032, to complete excavation of the 1956, 1963, and 1970 Ash Basins within 10 years of receiving the required permits and to complete excavation of the 1978 and 1985 Ash Basins within 10 years of starting dewatering, which must start within one year following receipt of the NPDES permit.

This Coal Ash Excavation Plan (Plan) represents activities to satisfy the requirements outlined in Section 3.(a), Subparagraph (2) and 3.(b), Subparagraphs (1) and (2) of NC House Bill 630 and the direction set forth in the NC Department of Environment Quality's (NCDEQ) November 4, 2016 letter and attachment titled "CCR Surface Impoundment Closure Guidelines for Protection of Groundwater" (NCDEQ Guidelines).

The NCDEQ Guidelines specifically require the following:

> *A stand-alone Excavation Soil Sampling Plan (Plan) generated for closure of a CCR surface impoundment shall be developed to ensure the proposed excavation design is comprehensive enough in scope to meet the performance standards for closure. This Plan shall be submitted to DEQ as part of an Excavation Plan, with details to show how the sample analytical results and related modeling will incorporate the data collected as part of the final overall closure plan for approval, as dictated by §130A-309.214.*

This Plan provides the general scope of work, schedule milestones, permitting requirements, dewatering, excavation, transportation, and Beneficial Use of the ash from Cape Fear. This Plan is also being prepared and provided pursuant to NCDEQ's request in its letter dated October 31, 2017 with subject "*Clarification on Excavation Plan Submittals*". No future updates to this Plan are intended. Duke Energy will prepare and submit its proposed Coal Combustion Residuals Surface Impoundment Closure Plan (Closure Plan) for Cape Fear no later than December 31, 2019, pursuant to G.S. § 130A-309.214(a)(2).

The scope of work in excavating the Ash Basins has been determined by applicable laws, rules, permits, and approvals that control the activities to be performed under the Plan. The Act contains no requirement for the submittal of an excavation plan of the kind presented here. Thus, while the development of this Plan will assist in Duke Energy's work to close the Ash Basins, its approval is an action not specifically required by statutory, regulatory, or other applicable authority. The submittal of this Plan notwithstanding external and internal factors, including site-specific considerations, may affect the work performed under the Plan. Accordingly, Duke Energy submits this Plan to NCDEQ with the proviso that it may be necessary to take actions that deviate from the Plan, and the Company reserves the right to make such changes.

II. General Facility Description

Cape Fear is located in Moncure, North Carolina adjacent to the Cape Fear River and south of the confluence of the Haw and Deep Rivers. The Plant began commercial operation in 1923. Two of the original coal-fired generating units were retired in 1977 and two in 2011. The remaining two coal-fired units, along with the oil-fired combustion turbine units on site, were retired in October 2012.

The CCR from Cape Fear's coal combustion operations was historically processed in one of five Ash Basins located on the property. Cape Fear has been decommissioned, thus no active ash placement or sluicing is occurring within the Ash Basin system.

Duke Energy's CCR Removal Verification Procedure (Removal Verification Procedure) will be used to verify that primary source ash has been removed from the Basins. Subsequent to removal of the ash pursuant to the Removal Verification Procedure, Duke Energy will implement its Excavation Soil Sampling Plan (ESSP), which was developed for the purpose of meeting the applicable performance standards. Although not required under CAMA, NCDEQ Guidelines published in November 2016 provide that an ESSP should be submitted to NCDEQ as part of a site's excavation plan. In accordance with this request, a copy of the ESSP is attached as **Exhibit "A"** to this Plan.

<u>1956 Ash Basin</u>

The 1956 Ash Basin at Cape Fear was operated from 1956 to 1963. The 1956 Ash Basin is located at the northwest corner of the site adjacent to the Haw River, near the confluence with the Deep River that then forms the Cape Fear River. The Ash Basin has a surface area of about 12 acres, maximum dike height of about 20 feet, crest width in the range of 7-10 feet, crest level in the range of elevation 182-190 feet, and dike length of approximately 3,200 feet.

The 1956 Ash Basin is regulated and listed under the NCDEQ Dam Safety Program. The dam identification number for the Ash Basin is CHATH-075. This Ash Basin is not subject to the CCR rule, but is subject to CAMA. In 2015, with the Basin being inactive, the original discharge outlet structure was filled with grout and permanently abandoned. The Ash Basin contains approximately 422,400 tons of CCR material. The Basin does not impound water

1963 / 1970 Basins

The 1963 Ash Basin at Cape Fear was operated from 1963 to 1978. The combined 1963 and 1970 Ash Basin is located on the southwest corner of the site adjacent to the east bank of the Cape Fear River. The 1963 Ash Basin has a surface area of about 21 acres, maximum dike height of about 22 feet, crest width in the range of 12-14 feet, crest level at elevation 197 feet, and dike length of approximately 4,000 feet. The 1970 Ash Basin has a surface area of about 30 acres, maximum dike height of about 27 feet, crest width in the range of 12-14 feet, crest level at elevation 197 feet, and dike length of approximately 4,600 feet.

The original 1963 Ash Basin was constructed with a crest level at elevation 188 feet. The crest level for the 1963 Ash Basin was raised to elevation 197 feet when the perimeter enclosure dikes were extended and incorporated into the 1970 Ash Basin to form the current combined area. The crest level for the combined 1963/1970 Ash Basin is at elevation 197 feet. The common separating dike originating from the 1963 Ash Basin was cut down to the allow flow to pass into the 1970 Ash Basin.

The original discharge outlet structure consisted of an 18-inch diameter reinforced concrete riser and discharge pipe and was located on the separation dike between the 1963 Ash Basin and 1970 Ash Basin. This original discharge outlet structure for the 1963 Ash Basin was abandoned after combining the two Ash Basins. The 1970 Ash Basin had a discharge outlet structure at the south end consisting of a concrete 3.5 ft. x 3.5 ft. riser box and a 20” diameter fiberglass reinforced plastic discharge pipe. In 2015, with the Basins being inactive, this structure was removed and a new 32-inch diameter high-density polyethylene storm water outlet was added.

The interior of the Ash Basins is covered with ash, which is overgrown by trees and brush. The Ash Basins contain approximately 760,800 tons of CCR material in the 1963 Ash Basin and 837,000 tons of CCR material in the 1970 Ash Basin. The Basins do not impound water.

The Ash Basin is operated under NPDES Permit No. NC0003433 to regulate emergency discharges to the Cape Fear River. The dams of the 1963 and 1970 Ash Basins are regulated and listed under the NCDEQ Dam Safety Program. The dam identification numbers for the Basins are CHATH-076 (1963 Basin) and CHATH-077 (1970 Basin). These Ash Basins are not subject to the CCR rule, but are subject to CAMA.

1978 Basin

The 1978 Ash Basin at Cape Fear was operated from 1978 to 1985. The 1978 Ash Basin is located south of the Cape Fear Plant, on the east side of the 1963/1970 Ash Basins, and adjacent to the plant’s discharge canal. The 1978 Ash Basin has a surface area of about 35 acres, maximum dike height of about 27 feet, crest width of 15 feet, crest level at elevation 197 feet, and dike length of approximately 5,600 feet. The 1978 Ash Basin was formed by incorporating a portion of the

1963/1973 Ash Basin dike on the west side, and constructing new dikes on the north, south, and east sides.

The original discharge outlet structure consisted of an 18-inch diameter reinforced concrete drop inlet riser and an 18-inch diameter reinforced concrete outlet pipe. In 2016, this discharge structure was grouted and permanently abandoned.

Decanting of the 1978 Ash Basin was initially completed in November 2017. Duke Energy continues to monitor the bulk water level within the Basin and will perform maintenance decanting as needed to maintain the Basin in a decanted state. The Ash Basin contains approximately 896,400 tons of CCR material.

The Ash Basin is operated under NPDES Permit No. NC0003433 to regulate effluent discharges to the Cape Fear River. Additionally, the dam of the Basin is regulated and listed under the NCDEQ Dam Safety Program. The dam identification number for the Ash Basin is CHATH-078. This Basin is not subject to the CCR rule, but is subject to CAMA.

1985 Basin

The 1985 Ash Basin at Cape Fear was operated from 1985 to 2012. It has a maximum embankment height of 28 feet, a crest width of 15-feet, a crest elevation of 194 feet, and a dike length of approximately 7,400 feet. In 2007, an ash stack was added within the limits of the 1985 Ash Basin. The 1985 Ash Basin decant structure consists of a 48-inch diameter precast concrete riser connected to a 30-inch diameter reinforced concrete pipe penetrating the embankment. In 2016, a valve was added to the 30-inch outfall pipe to mitigate against seismic risk of the riser. This valve is locked in the closed position and can be opened pursuant to the DEQ-approved pumping plan.

The Ash Basin encompasses approximately 60 acres and contains approximately 2.82 million tons of CCR material. Decanting of the 1985 Ash Basin was completed in December 2017. Duke Energy continues to monitor the bulk water level within the Basin and will perform maintenance decanting as needed to maintain the Basin in a decanted state.

The 1985 Ash Basin is operated under NPDES Permit No. NC0003433 to regulate effluent discharges to the Cape Fear River. Additionally, the dam for the Basin is regulated and listed under the NCDEQ Dam Safety Program. The dam identification number for the Ash Basin is CHATH-079. This Basin is not subject to the CCR rule, but is subject to CAMA.

III. Project Scope

Cape Fear was selected in June 2017 as an ash beneficiation site required by NC House Bill 630. Excavation of ash from the Cape Fear site for beneficial use will occur over multiple project phases. Activities started in April 2017 and will continue until approximately July 2031, including final site restoration. The proposed ash excavation for beneficial use is planned in multiple phases and the estimated scope of work under each phase is presented below. Phase I primarily consists of obtaining required permits, development of site infrastructure, and equipment mobilization. During the subsequent phase(s), ash will be safely excavated from the Basins concurrently with dewatering and maintaining the infrastructure. Approximately 430,000 tons of ash per year will be excavated from the Basins and hauled to the ash processing unit. The final phase of the project will include dam breach and decommissioning, as well as site restoration and closeout.

Phase I Scope

1. Submit and obtain necessary permits for Phase I activities
2. Install Erosion and Sediment Control (E&SC) measures
3. Construct haul roads within and outside of the Ash Basins
4. Construct truck staging areas
5. Construct pump station for water trucks to control dusting
6. Clear vegetation from within the Ash Basins
7. Install drainage features and detention sumps within the Ash Basins
8. Relocate existing transmission structures and a capacitor bank located in the northern portion of the 1963 Ash Basin
9. Obtain power to the Ash Basins
10. Install a wheel wash station
11. Install ash screening equipment within the Ash Basins
12. Construct stockpile and load out areas within the Ash Basin
13. Mobilize ash excavation and processing equipment

Subsequent Phase(s) Scope

1. Submit and obtain any additional permits
2. Excavate and transport ash from Ash Basins for beneficial use
3. Maintain E&SC measures
4. Relocate haul roads, working pads, screening locations, etc. within the Ash Basins as work progresses
5. Install and operate interstitial water treatment (if required)
6. Following ash beneficiation, excavate and haul any remaining ash to a permitted CCR landfill
7. Gain knowledge and opportunities for continuous program improvement
8. Complete the ESSP and confirm closure by removal
9. Complete closure activities for the Ash Basins as outlined in Sections 3.(a) and 3.(b) of the Coal Ash Act, as amended by NC House Bill 630
10. Complete dam breach and dam decommissioning
11. Complete site restoration and project closeout

IV. Critical Milestone Dates

Critical milestones within the Plan are summarized in the table below.

MILESTONE	TARGET DATE	STATUS
Site Selected for Beneficial Reuse pursuant to NC House Bill 630	06/30/2017 (A)	Complete
Mobilization for Beneficiation Plant Construction	Q1 2019	On Track
Ash Basin Decanting Complete	Q1 2019	On Track
Submit CAMA Closure Plans	Q4 2019	On Track
Begin Ash Basin Excavation and Stockpiling for Beneficiation Plant Feed	Q1 2020	On Track
Complete Beneficiation Plant Construction and Commissioning	Q3 2020	On Track
Beneficiation Plant Placed In-Service	Q4 2020	On Track
Begin hauling to a Permitted CCR Landfill (In Parallel due to CAMA Time Constraints)	Q1 2023	On Track
Complete Hauling to Permitted CCR Landfill	Q3 2028	On Track
Complete Ash Basin Excavation Pursuant to Court Order	Q4 2029	On Track
Complete Beneficiation Plant Operations	Q4 2029	On Track
Complete Closure per CAMA/NC House Bill 630	Q4 2029	On Track
Complete Final Site Restoration	Q3 2031	On Track

V. Erosion and Sediment Control Plan

The Erosion and Sediment Control plans for the excavation of the Ash Basins will be developed and submitted to NCDEQ at a later date. Modifications to E&SC plans for subsequent phase(s) will be approved by NCDEQ prior to installation and initiation of subsequent phase work. The approved contractor installed the E&SC measures indicated in the plans. All control measures will be maintained through the project in accordance with the E&SC plans. When possible, portions of the E&SC plans will be closed out with the approval of NCDEQ, as areas become stabilized.

VI. Dewatering Plan

Bulk decanting of the 1978 Ash Basin was completed in November 2017. Bulk decanting of the 1985 Ash Basin was completed in December 2017. Additional maintenance decanting will be performed as needed to maintain the Basins in a decanted state. The 1956, 1963, and 1970 Ash Basins contain no bulk water.

Management of contact and interstitial water during the initial phase(s) will be performed, to the extent possible, within the Ash Basins and through diversion and the conditioning of the ash. Moisture conditioning will be achieved through windrowing and tilling to facilitate evaporation, infiltration, and gravity drainage of water. Basin water will be re-used for dust control within the Ash Basins. Dewatering and interstitial water treatment (if required) will be managed in accordance with the NPDES permit.

VII. Location(s) for Removed Ash

The Plan includes the excavation of approximately 5.7 million tons of ash from the Ash Basins. Ash removed from the site is being beneficiated by SEFA, with whom Duke Energy has entered into an agreement to process and sell ash from the Cape Fear Ash Basins for use in the concrete industry. It is currently estimated that approximately 4.3 million tons of ash will be beneficiated, with the remaining 1.4 million tons placed into a permitted CCR landfill. Pursuant to NC House Bill 630, 300,000 tons of ash from the site must be beneficiated to specifications appropriate for cementitious products each year. NC House Bill 630 also requires that sites with ash beneficiation projects be closed no later than December 31, 2029.

VIII. Transportation Plan

Beneficiated ash becomes the property of SEFA when SEFA's trucks are loaded at the sale silo after processing. Output from the sale silo will average 40-60 truckloads daily. For ash that is not processed through the reprocessing unit, ash will be loaded onto trucks and sent to a permitted CCR landfill. Ownership of the ash will transfer to a third-party vendor when the trucks are loaded at the site. A more detailed transportation plan will be developed in the future.

IX. Environmental and Dam Safety Permitting Plan

NCDEQ has indicated that an NPDES Industrial Stormwater Permit is required to transport ash. The Company will pursue an Individual or General Industrial Stormwater Permit to support ash removal and beneficiation at the site. Pursuant to the requirements of the Industrial Stormwater Permit, a Stormwater Pollution Prevention Plan (SPPP) incorporating best management practices will be created and implemented. Future modifications to the permit/plan will be managed as necessary. Cape Fear will hold applicable Construction Stormwater Permits for ash removal, if required.

Contact and/or interstitial water that is encountered will be managed in accordance with NPDES Permit NC0003433. An updated NPDES Wastewater Permit application was submitted on July 31, 2014 (amendments submitted March 13, 2015, August 31, 2016 and March 1, 2018) to facilitate the closure of the Ash Basins. The Cape Fear site received a NPDES Wastewater Permit on August 30, 2018, effective on October 1, 2018. Decanting, dewatering, and ash beneficiation are included in the NPDES Wastewater Permit.

There could be impacts to jurisdictional wetlands/streams associated with the removal of the ash from within the Ash Basins. During the final phase, dam breach and dam decommissioning, further evaluation will be required to determine if there will be any wetlands impacts. Cape Fear ash is a non-hazardous material.

All necessary Dam Safety approvals will be or have been obtained to cover activities on or around jurisdictional dams. Breaching of the dam will require Dam Safety approval. Any impacted wells or piezometers will be abandoned in accordance with NCDEQ requirements. Fugitive dust will be managed to mitigate impacts to neighboring areas. Additional site-specific or local requirements will be secured, as needed.

Permit Matrix

MEDIA	PERMIT	RECEIVED DATE (R) TARGET DATE (T)	COMMENTS
Water	NPDES Wastewater Permit	October 1, 2018 (R) (effective date)	Required for Decanting/Dewatering
	Well Abandonment	TBD	To be determined following Closure Plan approval
	Industrial Stormwater	May 27, 2016 (R) (effective date)	To be modified in Q3 2019 to include ash hauling
Dam Safety	Ash Basin Dam Decommissioning Request Approval	Q3 2027 (T)	None
Land Quality	Erosion & Sediment Control	Q4 2018 (T)	Phase I of beneficiation facility
Other Requirements	Site-specific Nuisance/Noise/ Odor/Other Requirements, including DOT Requirements	TBD	

X. Contracting Strategy

The Ash Management Program strategy is to engage multiple contractors, drive competition, create systemwide innovation, and develop a collection of best practices. Duke Energy has engaged contractor(s) who are experienced in coal ash excavation, transportation and disposal, and continues to evaluate other potential contractors. The Company provides in-depth oversight, coordination, and monitoring of the contractors to ensure the work is performed appropriately. Duke Energy's core values include safety, quality, and protection of the environment, which are incorporated into our contracts. The Company continues to evaluate alternate approaches, methods, and contracting solutions and will adjust its strategy, as necessary.

XI. Environmental, Health, and Safety Plan

The Company is committed to the health, safety, and welfare of employees, contractors, and the public, and to protecting the environment and natural resources. During all phases of the project work, the Company and its contractors will follow the Duke Energy Safe Work Practices Manual, the Environmental, Health, and Safety supplement document, and any additional requirements. Occupational health and safety expectations include oversight and continuous improvement throughout the project. The project includes comprehensive environmental, health, and safety plans encompassing all aspects of the project work. In addition to adhering to all applicable environmental, health, and safety rules and regulations, Duke Energy and its contractors will focus on ensuring the safety of the public and protection of the environment during each phase of the project.

XII. Communications Plan

The project team will continue to coordinate with Duke Energy's Corporate Communications Department to develop a comprehensive external communications plan tailored to the specific needs of each phase of the project. Many different external stakeholders, including neighbors, government officials, and media have an interest in this project. The Company is committed to providing information by proactively communicating about the project activities to potentially affected parties and responding to inquiries in a timely manner.

XIII. Glossary

TERM	DEFINITION
Ash Basin	Synonymous with Coal Combustion Residual Impoundment. A topographic depression, excavation, or dammed area that is primarily formed from earthen materials; without a base liner approved for use by Article 9 of Chapter 130A of the North Carolina General Statutes or rules adopted thereunder for a combustion products landfill or coal combustion residuals landfill, industrial landfill, or municipal solid waste landfill; and an area that is designed to hold accumulated coal combustion residuals in the form of liquid wastes, wastes containing free liquids, or sludge, and that is not backfilled or otherwise covered during periods of deposition.
Beneficial Use	Projects promoting public health and environmental protection, offering equivalent success relative to other alternatives, and preserving natural resources
Bottom Ash	The agglomerated, angular ash particles formed in pulverized coal furnaces that are too large to be carried in the flue gases and collect on the furnace walls. Bottom ash falls through open grates to an ash hopper at the bottom of the furnace.
Coal Ash Excavation Plan	Plan requested by NCDEQ pursuant to its issuance of CCR Surface Impoundment Closure Guidelines for Protection of Groundwater on November 4, 2016.
Coal Ash Management Act	North Carolina Session Law 2014-122 (as amended by NC House Bill 630, Sess. L. 2016-95)
Coal Combustion Residuals (CCR)	Residuals, including fly ash, bottom ash, boiler slag, mill rejects, and flue gas desulfurization residue produced by a coal-fired generating unit
Decanting	The act of removing bulk / free water from the Ash Basin
Dewatering	The act of removing entrapped/interstitial water from the ash
Duke Energy Safe Work Practices Manual	Document detailing the Duke Energy safety guidelines
Entrapped Water	Flowable water below the ash surface, which creates hydrostatic pressure on the dam
Excavation Plan	Refer to Coal Ash Excavation Plan

Fly Ash	Very fine, powdery material, composed mostly of silica with nearly all particles spherical in shape, which is a product of burning finely ground coal in a boiler to produce electricity and is removed from the plant exhaust gases by air emission control devices.
NPDES	National Pollutant Discharge Elimination System
NPDES Permit	A permit that regulates the direct discharge of wastewater to surface waters
Permit	Federal, state, county, or local government authorizing document

XIV. Reference Documents

REF	DOCUMENT	DATE
1	Coal Ash Management Act, as amended by NC House Bill 630, Sess. L. 2016-95	July 14, 2016
2	Amended Order Granting Motion for Partial Summary Judgment in *State of North Carolina ex rel. NC Department of Environment and Natural Resources, Division of Environmental Quality v. Duke Energy Progress, Inc.*, Wake County, Case No. 13-CVS-11032	June 9, 2017
3	CCR Surface Impoundment Closure Guidelines for Protection of Groundwater	November 4, 2016
4	NCDEQ Letter with subject Clarification on Excavation Plan Submittals	October 31, 2017

HF Lee Plant

Coal Ash Excavation Plan

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2018

Contents

Exhibits

I. Statement of Purpose

Duke Energy Progress, LLC (Duke Energy or the Company) is required by Section 3.(a) of the Coal Ash Management Act of 2014, as amended by NC House Bill 630, Sess. L. 2016-95 (CAMA, Coal Ash Act, or Act), to close, in accordance with Section 3.(b) of the Act, the four coal combustion residuals (CCR) surface impoundments (Ash Basins or Basins) located at the HF Lee Power Plant (HF Lee or Plant).

HF Lee was chosen on December 13, 2016, as an ash beneficiation site required by NC House Bill 630. Pursuant to NC House Bill 630, 300,000 tons of ash from the site must be beneficiated to specifications appropriate for cementitious products each year. NC House Bill 630 also requires that sites with ash beneficiation products shall be closed no later than December 31, 2029.

Duke Energy is further directed by the Amended Order Granting Motion for Partial Summary Judgment in *State of North Carolina ex rel. N.C. Department of Environment and Natural Resources, Division of Environmental Quality v. Duke Energy Progress, Inc.*, Wake County, Case No. 13-CVS11032, to complete excavation of the HF Lee Inactive Ash Area by April 4, 2028, and complete excavation of the Ash Basins within 12 years from the start of dewatering, which must start within one year following receipt of the NPDES permit.

This Coal Ash Excavation Plan (Plan) represents activities to satisfy the requirements outlined in Section 3.(a), Subparagraph (1) and Section 3.(b), Subparagraphs (1) and (2) of NC House Bill 630 and the direction set forth in the NC Department of Environment Quality's (NCDEQ) November 4, 2016 letter and attachment titled "CCR Surface Impoundment Closure Guidelines for Protection of Groundwater" (NCDEQ Guidelines).

The NCDEQ Guidelines specifically require the following:

> *A stand-alone Excavation Soil Sampling Plan (Plan) generated for closure of a CCR surface impoundment shall be developed to ensure the proposed excavation design is comprehensive enough in scope to meet the performance standards for closure. This Plan shall be submitted to DEQ as part of an Excavation Plan, with details to show how the sample analytical results and related modeling will incorporate the data collected as part of the final overall closure plan for approval, as dictated by §130A-309.214.*

This Plan provides the general scope of work, schedule milestones, permitting requirements, dewatering, excavation, transportation, and beneficial use of the ash from HF Lee. This Plan is also being prepared and provided pursuant to NCDEQ request in its letter dated October 31, 2017 with subject "*Clarification on Excavation Plan Submittals.*" No future updates to this Plan are intended. Duke Energy will prepare and submit its proposed Coal Combustion Residuals Surface Impoundment Closure Plan (Closure Plan) for HF Lee no later than December 31, 2019, pursuant to G.S. § 130A-309.214(a)(2).

The scope of work in excavating the Ash Basins has been determined by applicable laws, rules, permits, and approvals that control the activities to be performed under the Plan. The Act contains no requirement for the submittal of an excavation plan of the kind presented here. Thus, while the development of this Plan will assist in Duke Energy's work to close the Ash Basins, its approval is an action not specifically required by statutory, regulatory, or other applicable authority. The submittal of this Plan notwithstanding external and internal factors, including site-specific considerations, may affect the work performed under the Plan. Accordingly, Duke Energy submits this Plan to NCDEQ with the proviso that it may be necessary to take actions that deviate from the Plan, and the Company reserves the right to make such changes.

II. General Facility Description

HF Lee is located in Goldsboro, North Carolina on the Neuse River. The three-unit plant began commercial operation in 1951 with one unit, added another unit in 1952, and then expanded to three units in 1962. At its peak, the generating facility had a capacity of 382 megawatts. In September 2012, all of the coal-fired units were retired.

The CCR from HF Lee's coal combustion operations was historically processed in one of four Ash Basins located on the property. HF Lee has been decommissioned, thus no active ash placement or sluicing is occurring within the Ash Basin system.

Duke Energy's Coal Combustion Residuals Removal Verification Procedure (Removal Verification Procedure) will be used to verify that primary source ash has been removed from the Basins. Subsequent to removal of the ash pursuant to the Removal Verification Procedure, Duke Energy will implement its Excavation Soil Sampling Plan (ESSP), which was developed for the purpose of meeting the applicable performance standards. Although not required under CAMA, NCDEQ Guidelines published in November 2016 provide that an ESSP should be submitted to NCDEQ as part of a site's excavation plan. In accordance with this request, a copy of the ESSP is attached as **Exhibit "A"** to this Plan.

<u>1950 and 1955 Ash Basins (Inactive Ash Basins 1 and 2)</u>

The 1950 Ash Basin at HF Lee was operated from 1950 to 1969, and the 1955 Ash Basin was operated from 1955 to 1969. The 1950/1955 Ash Basins area is located in the northwest corner of the site, adjacent to the Neuse River on the east side of the Basins and adjacent to a tributary stream to the Neuse River on the south side of the Basins. The 1955 Ash Basin was constructed as an addition to the east side of the 1950 Ash Basin.

These two Ash Basins have a combined available surface area of about 76 acres, estimated maximum dike height that ranges from 5 to 15 feet, and crest width in the range of 14 to 20 feet. The crest level is approximately elevation 78.5 to 82 feet. The approximate total combined dike length is 11,900 feet (7,700 feet for the exterior dike crest). There is a common dike separating the two Basin areas, but the 1950 Basin has no outlet structure and the two work as a combined Basin. The 1950 and 1955 Ash Basins have been inactive since the late 1960s and are currently dry. These Basins are not under an NPDES permit nor are they regulated under the NC Dam Safety program (non-jurisdictional), but are on the NCDEQ inventory list as WAYNE-031 and WAYNE-032, respectively.

The 1950 Ash Basin contains approximately 268,800 tons of CCR material, and the 1955 Ash Basin contains approximately 529,200 tons of CCR material. These Ash Basins are not subject to the CCR rule, but are subject to CAMA.

1962 Ash Basin (Inactive Ash Basin 3)

The 1962 Ash Basin at HF Lee was operated from 1962 to 1980. This Ash Basin has a surface area of about 87 acres, estimated maximum dike height in the range of 8 to 10 feet, and average crest width of approximately 12 feet. The estimated crest level is approximately elevation 78.5 to 81 feet. The dike length is approximately 8,000 feet. The Ash Basin encompasses approximately 87 acres, does not contain any free water, and contains approximately 910,800 tons of CCR material. The Basin is not under an NPDES permit, nor is it regulated under the NC Dam Safety program (non-jurisdictional), but it is listed on the NCDEQ inventory list as WAYNE-033. This Ash Basin is not subject to the CCR rule, but is subject to CAMA.

Active Basin (1982 Ash Basin)

The 1982 Ash Basin at HF Lee was operated from 1980 to 2012. Construction of the Active Basin began in September 1978 and was completed in April 1980. The Basin was constructed with a crest elevation of approximately 90 ft. and a dike length of approximately 10,200 ft. The width of the dike crest is approximately 12 to 20 ft. The original outlet structure in the Basin was a 15-inch reinforced concrete riser pipe located near the southeast corner of the Basin, which discharged into a secondary settling basin, then through a second 15-inch reinforced concrete pipe into the Neuse River. In 2016, this discharge structure was grouted and permanently abandoned and a new high-density polyethylene alternative outlet structure was installed to mitigate seismic risk.

The ash Basin encompasses approximately 132 acres and contains approximately 4.52 million tons of CCR material. Decanting of the Basin is scheduled to complete in December 2018. Upon completion, Duke Energy will continue to monitor the bulk water level within the Basin and will perform maintenance decanting as needed to maintain the Basin in a decanted state.

The 1982 Ash Basin is operated under NPDES Permit No. NC0003417 to regulate effluent discharges to the Neuse River. Additionally, the dam for the Ash Basin is regulated and listed under the NCDEQ Dam Safety Program. The dam identification number for the Ash Basin is WAYNE-022. This Ash Basin is subject to both the CCR rule and CAMA.

III. Project Scope

HF Lee was selected in December 2016 as an ash beneficiation site required by NC House Bill 630. Excavation of ash from the site for beneficial use will occur over multiple years. Activities began in April 2017 and will continue until approximately July 2031, including final site restoration. The proposed ash excavation for beneficial use is planned in multiple phases, and the estimated scope of work under each phase is presented below. Phase I primarily consists of obtaining required permits, development of site infrastructure, and equipment mobilization. During the subsequent phase(s), ash will be safely excavated from the Basins concurrently with dewatering and maintaining the infrastructure. Approximately 430,000 tons of ash per year will be excavated from the Basins and hauled to the ash processing unit. The final phase of the project will include dam breach and decommissioning, as well as site restoration and closeout.

Phase I Scope

1. Submit and obtain necessary permits for Phase I activities
2. Install Erosion and Sediment Control (E&SC) measures
3. Construct haul roads within and outside of the Ash Basins
4. Construct truck staging areas
5. Construct pump station for water trucks to control dusting
6. Clear vegetation from within the Ash Basins
7. Install drainage features and detention sumps within the Ash Basins
8. Obtain power to the Ash Basins
9. Install a wheel wash station
10. Install ash screening equipment within the Ash Basins
11. Construct stockpile and load out areas within the Ash Basins
12. Mobilize ash excavation and processing equipment

Subsequent Phase(s) Scope

1. Submit and obtain any additional permits
2. Excavate and transport ash from the Ash Basins for beneficial use
3. Maintain E&SC measures
4. Relocate haul roads, working pads, screening locations, etc. within the Ash Basins as work progresses
5. Install and operate interstitial water treatment (if required)
6. Following ash beneficiation, excavate and haul any remaining ash to a permitted CCR landfill
7. Gain knowledge and opportunities for continuous program improvement
8. Complete the ESSP and confirm closure by removal
9. Complete closure activities for the Ash Basins as outlined in Sections 3.(a) and 3.(b) of the Coal Ash Act, as amended by NC House Bill 630
10. Complete dam breach and dam decommissioning

11. Complete site restoration and project closeout

IV. Critical Milestone Dates

Critical milestones within the Plan are summarized in the table below.

MILESTONE	TARGET DATE	STATUS
Site Selected for Beneficial Re-use Pursuant to NC House Bill 630	12/13/2016 (A)	Complete
Ash Basin Decanting Complete	Q4 2018	On Track
Mobilization for Beneficiation Plant Construction	Q1 2019	On Track
Submit CAMA Closure Plans	Q4 2019	On Track
Begin Ash Basin Excavation and Stockpiling for Beneficiation Plant Feed	Q3 2019	On Track
Complete Beneficiation Plant Construction and Commissioning	Q2 2020	On Track
Beneficiation Plant Placed In-Service	Q2 2020	On Track
Begin hauling to a permitted CCR Landfill (In Parallel due to CAMA Time Constraints)	Q1 2025	On Track
Complete Hauling to Permitted CCR Landfill	Q2 2028	On Track
Complete Ash Basin Excavation	Q3 2029	On Track
Complete Beneficiation Plant Operations	Q4 2029	On Track
Complete Closure per CAMA/ NC House Bill 630	Q4 2029	On Track
Complete Final Site Restoration	Q3 2031	On Track

V. Erosion and Sediment Control Plan

The E&SC plans for the excavation of the Ash Basins will be developed and submitted to NCDEQ at a later date. Modifications to E&SC plans for subsequent phase(s) will be approved by NCDEQ prior to installation and initiation of subsequent phase work. The approved contractor will install the E&SC measures indicated in the plans. All control measures will be maintained through the project in accordance with the E&SC plans. When possible, portions of the E&SC plans will be closed out with the approval of NCDEQ, as areas become stabilized.

VI. Dewatering Plan

Bulk decanting of the 1982 Ash Basin began on November 27, 2017 and is targeted to complete in Q4 2018. Upon completion, additional maintenance decanting will be performed as needed to maintain the Basin in a decanted state. The 1950, 1955, and 1962 Ash Basins are dry.

Management of contact and interstitial water during the initial phase will be performed, to the extent possible, within the Ash Basins and through diversion and the conditioning of ash. Moisture conditioning will be achieved through windrowing and tilling to facilitate evaporation, infiltration, and gravity drainage of water. Basin water will be re-used for dust control within the Ash Basins. Dewatering and interstitial water treatment (if required) will be managed in accordance with the NPDES permit.

VII. Location(s) for Removed Ash

The Plan includes the excavation of approximately 6.2 million tons of ash from the Ash Basins. Ash removed from the site is being beneficiated by SEFA, with whom Duke Energy has entered into an agreement to process and sell ash from the HF Lee Ash Basins for use in the concrete industry. It is currently estimated that approximately 4.2 million tons of ash will be beneficiated, with the remaining 2.0 million tons placed into a permitted CCR landfill. Pursuant to NC House Bill 630, 300,000 tons of ash from the site must be beneficiated to specifications appropriate for cementitious products each year. NC House Bill 630 also requires that sites with ash beneficiation projects be closed no later than December 31, 2029.

VIII. Transportation Plan

Beneficiated ash becomes the property of SEFA when SEFA's trucks are loaded at the sale silo after processing. Output from the sale silo will average 40-60 truckloads daily. For ash that is not processed through the reprocessing unit, ash will be loaded onto trucks and sent to a permitted CCR landfill. Ownership of the ash will transfer to a third-party vendor when the trucks are loaded at the site. A more detailed transportation plan will be developed in the future.

IX. Environmental and Dam Safety Permitting Plan

NCDEQ has indicated that an NPDES Industrial Stormwater Permit is required to transport ash. The Company will pursue an Individual or General Industrial Stormwater Permit to support ash removal and beneficiation at the site. Pursuant to the requirements of the Industrial Stormwater Permit, a Stormwater Pollution Prevention Plan (SPPP) incorporating best management practices will be created and implemented. Future modifications to the permit/plan will be managed as necessary. HF Lee will hold applicable Construction Stormwater Permits for ash removal, if required.

Contact and/or interstitial water that is encountered will be managed in accordance with NPDES Permit NC0003417. An updated NPDES Wastewater Permit application was submitted on November 19, 2012 (amendments submitted October 31, 2014, March 11, 2015, August 31, 2016, and October 27, 2016) to facilitate the closure of the Ash Basins. The facility continues to operate under an administratively extended NPDES Wastewater Permit. Decanting, dewatering, and ash beneficiation will be included in the revised NPDES Wastewater Permit.

There could be impacts to jurisdictional wetlands/streams associated with construction of haul roads to facilitate the removal of the ash from within the Ash Basins. During the final phase, dam breach and dam decommissioning, further evaluation will be required to determine if there will be any wetland impacts. HF Lee ash is a non-hazardous material.

All necessary Dam Safety approvals will be or have been obtained to cover activities on or around jurisdictional dams. Breaching of the dam will require Dam Safety approval. Any impacted wells or piezometers will be abandoned in accordance with NCDEQ requirements. Fugitive dust will be managed to mitigate impacts to neighboring areas. Additional site-specific or local requirements will be secured, as needed.

Permit Matrix

MEDIA	PERMIT	RECEIVED DATE (R) TARGET DATE (T)	COMMENTS
Water	NPDES Wastewater Permit	Q4 2018 (T)	Required for Dewatering
	Well Abandonment	TBD	To be determined following Closure Plan approval
	Industrial Stormwater	Q3 2019 (T)	Required for ash hauling
Dam Safety	Ash Basin Dam Decommissioning Request Approval	Q1 2030 (T)	None
Land Quality	Erosion & Sediment Control	July 6, 2018 (R)	Phase I of beneficiation facility
Other Requirements	Site-specific Nuisance/Noise/ Odor/Other Requirements, including DOT Requirements	TBD	

X. Contracting Strategy

The Ash Management Program strategy is to engage multiple contractors, drive competition, create systemwide innovation, and develop a collection of best practices. Duke Energy has engaged contractor(s) who are experienced in coal ash excavation, transportation and disposal, and continues to evaluate other potential contractors. The Company provides in-depth oversight, coordination, and monitoring of the contractors to ensure the work is performed appropriately. Duke Energy's core values include safety, quality, and protection of the environment, which are incorporated into our contracts. The Company continues to evaluate alternate approaches, methods, and contracting solutions and will adjust its strategy, as necessary.

XI. Environmental, Health, and Safety Plan

The Company is committed to the health, safety, and welfare of employees, contractors, and the public, and to protecting the environment and natural resources. During all phases of the project work, the Company and its contractors will follow the Duke Energy Safe Work Practices Manual, the Environmental, Health, and Safety supplement document, and any additional requirements. Occupational health and safety expectations include oversight and continuous improvement throughout the project. The project includes comprehensive environmental, health, and safety plans encompassing all aspects of the project work. In addition to adhering to all applicable environmental, health, and safety rules and regulations, Duke Energy and its contractors will focus on ensuring the safety of the public and protection of the environment during each phase of the project.

XII. Communications Plan

The project team will continue to coordinate with Duke Energy's Corporate Communications Department to develop a comprehensive external communications plan tailored to the specific needs of each phase of the project. Many different external stakeholders, including neighbors, government officials, and media have an interest in this project. The Company is committed to providing information by proactively communicating about the project activities to potentially affected parties and responding to inquiries in a timely manner.

XIII. Glossary

TERM	DEFINITION
Ash Basin	Synonymous with Coal Combustion Residual Impoundment. A topographic depression, excavation, or dammed area that is primarily formed from earthen materials; without a base liner approved for use by Article 9 of Chapter 130A of the North Carolina General Statutes or rules adopted thereunder for a combustion products landfill or coal combustion residuals landfill, industrial landfill, or municipal solid waste landfill; and an area that is designed to hold accumulated coal combustion residuals in the form of liquid wastes, wastes containing free liquids, or sludge, and that is not backfilled or otherwise covered during periods of deposition
Beneficial Use	Projects promoting public health and environmental protection, offering equivalent success relative to other alternatives, and preserving natural resources
Bottom Ash	The agglomerated, angular ash particles formed in pulverized coal furnaces that are too large to be carried in the flue gases and collect on the furnace walls. Bottom ash falls through open grates to an ash hopper at the bottom of the furnace
Coal Ash Excavation Plan	Plan requested by NCDEQ pursuant to its issuance of CCR Surface Impoundment Closure Guidelines for Protection of Groundwater on November 4, 2016
Coal Ash Management Act	North Carolina Session Law 2014-122 (as amended by NC House Bill 630, Sess. L. 2016-95)
Coal Combustion Residuals (CCR)	Residuals, including fly ash, bottom ash, boiler slag, mill rejects, and flue gas desulfurization residue produced by a coal-fired generating unit
Decanting	The act of removing bulk / free water from the Ash Basin
Dewatering	The act of removing entrapped/interstitial water from the ash
Duke Energy Safe Work Practices Manual	Document detailing the Duke Energy safety guidelines
Entrapped Water	Flowable water below the ash surface, which creates hydrostatic pressure on the dam
Excavation Plan	Refer to Coal Ash Excavation Plan

Fly Ash	Very fine, powdery material, composed mostly of silica with nearly all particles spherical in shape, which is a product of burning finely ground coal in a boiler to produce electricity and is removed from the plant exhaust gases by air emission control devices
NPDES	National Pollutant Discharge Elimination System
NPDES Permit	A permit that regulates the direct discharge of wastewater to surface waters
Permit	Federal, state, county, or local government authorizing document

XIV. Reference Documents

REF	DOCUMENT	DATE
1	Coal Ash Management Act, as amended by NC House Bill 630, Sess. L. 2016-95	July 14, 2016
2	Amended Order Granting Motion for Partial Summary Judgment in *State of North Carolina ex rel. NC Department of Environment and Natural Resources, Division of Environmental Quality v. Duke Energy Progress, Inc.*, Wake County, Case No. 13-CVS-11032	June 9, 2017
3	CCR Surface Impoundment Closure Guidelines for Protection of Groundwater	November 4, 2016
4	NCDEQ Letter with subject Clarification on Excavation Plan Submittals	October 31, 2017

Weatherspoon Steam Station
Robeson County, North Carolina

I. Site History

The Weatherspoon Steam Station ("Weatherspoon") is a Duke Energy Progress, LLC ("DE Progress" or the "Company") coal-fired generation facility that began generating coal-fired electricity in 1949 when the first of three coal-fired units came on line. The original ash basin at the site was constructed in 1955 to receive sluiced coal combustion residuals ("CCR") from the plant's coal unit. The ash basin underwent two expansions in 1963 and 1979. The 1979 expansion brought the basin to its modern-day size, and the basin is now referred to as the 1979 Ash Basin. In 2002, a dry stack disposal area was constructed in the north end of the ash basin. In 2007, a vertical expansion was constructed southeast of the dry stack area within the 1979 Ash Basin. The Weatherspoon Plant ceased use of coal-fired electric generation units and stopped sluicing CCRs to the 1979 Ash Basin in October 2011. The site still has four oil-fired (fast-start and black-start) combustion turbine that are active.

An aerial view of the Weatherspoon ash basin is provided in **Figure 1** below.

Figure 1 – Aerial showing CCR Units at Weatherspoon

II. Regulatory History

The ash basin at Weatherspoon have been regulated by a combination of state agencies during the operational history of the plant. The North Carolina Department of Environmental Quality ("DEQ") regulated the wet storage of ash in ash basins through the National Pollutant Discharge Elimination System ("NPDES") permit program and the dry ash storage and beneficial reuse of CCR through the state's solid waste permitting program. Power plant dams were regulated by the North Carolina Utilities Commission (the "Commission") until January 1, 2010, when that authority was transferred to DEQ.

Following the Tennessee Valley Authority coal ash spill in 2008, EPA was prompted to assess coal ash impoundments across the country. In 2010, EPA, for the first time, proposed comprehensive regulations and federal minimum standards to address the disposal and long-term storage of CCR. The final CCR Rule was signed in December 2014 and published in April 2015. The CCR Rule applies to and requires the closure of the ash basins at Weatherspoon.

In 2014, the North Carolina General Assembly passed the Coal Ash Management Act ("CAMA") to establish new state standards for the disposal of CCR from coal-fired electric generation facilities. CAMA, and its later amendments, complement and overlap with the federal CCR Rule. CAMA designated Weatherspoon as an "intermediate" priority site and required that its ash impoundment to be closed by August 1, 2028.

III. Site Closure Activities – January 1, 2015 through August 31, 2017

In response to new state and federal regulatory requirements, the Company began closure activities at Weatherspoon. Those activities included:

- Selecting location(s) for disposal of excavated ash;
- Developing closure plans and other engineering reports;
- Obtaining environmental permit from State and Federal agencies necessary to begin closure;
- Installing erosion and sediment control measures;
- Installing groundwater monitoring wells;
- Dewatering the 1979 Ash Basin;
- Excavating the 1979 Ash Basin; and
- Transporting excavated and processed ash to two cement kilns in South Carolina for reuse;

The activities described above and costs associated with those activities were the subject of DE Progress' 2017 rate case before the Commission (Docket No. E-2, 1142). In that docket, the Commission determined that DE Progress' coal ash basin closure costs for the Weatherspoon were reasonable, prudent, and recoverable. (*Order Accepting Stipulation, Deciding Contested Issues, and Granting Partial Rate Increase*, Docket No. E-2, Sub 1142).

IV. Site Closure Activities – September 1, 2017 through February 29, 2020

As of September 1, 2017, DE Progress had already entered into extensive contracts with engineering and construction contractors to perform the necessary site assessments, develop excavation and compliance plans, and to excavate and transport the CCR. Costs related to those contracts and activities performed pursuant to those contracts through August 31, 2017 have already been approved by the Commission. DE Progress has continued its efforts to execute the excavation and closure plans for Weatherspoon and comply with state and federal regulatory requirements.

From September 1, 2017 through February 29, 2020, DE Progress has completed or is scheduled to complete the following tasks:

- Excavate and process ash from the 1979 Ash Basin;
- Transport ash to two cement kilns in South Carolina for reuse;
- Install groundwater monitoring wells;
- Monitor and analyze groundwater samples; and
- Plan, design, and install permanent water supplies for neighbors.

The tasks that DE Progress has performed and will perform from September 1, 2017 through February 29, 2020 are a continuation of the activities for which costs were approved in the prior DE Progress rate case. These activities and associated costs continue to be necessary, appropriate, and consistent with applicable regulatory requirements.

I/A

W.H. Weatherspoon Power Plant

Coal Ash Excavation Plan

2017

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Exhibits

I. Statement of Purpose

Duke Energy Progress, LLC (Duke Energy or the Company) is required by Section 3.(a) of the Coal Ash Management Act of 2014, as amended by House Bill 630, Sess. L. 2016-95 (Coal Ash Act or Act), to close, in accordance with Section 3.(b) of the Act, the 1979 coal combustion residuals (CCR) surface impoundment (Ash Basin or Basin) located at the W.H. Weatherspoon Power Plant (Weatherspoon or Plant), as soon as practicable, but not later than August 1, 2028. Duke Energy is further directed by the Amended Order Granting Motion for Partial Summary Judgment in *State of North Carolina ex rel. N.C. Department of Environment and Natural Resources, Division of Environmental Quality v. Duke Energy Progress, Inc.*, Wake County, Case No. 13-CVS-11032, to complete excavation of the Weatherspoon impoundment by April 4, 2028.

This Coal Ash Excavation Plan (Plan) represents activities to satisfy the requirements outlined in Sections 3.(a) and 3.(b), Subparagraphs 1 and 2 of the Act and the direction set forth in the North Carolina Department of Environment Quality's (NC DEQ) November 4, 2016 letter and attachment titled "CCR Surface Impoundment Closure Guidelines for Protection of Groundwater" (NC DEQ Guidelines).

The NC DEQ Guidelines specifically requires the following:

> *A stand-alone Excavation Soil Sampling Plan (Plan) generated for closure of a CCR surface impoundment shall be developed to ensure the proposed excavation design is comprehensive enough in scope to meet the performance standards for closure. This Plan shall be submitted to DEQ as part of an Excavation Plan, with details to show how the sample analytical results and related modeling will incorporate the data collected as part of the final overall closure plan for approval, as dictated by §130A-309.214.*

This Plan provides the general scope of work, schedule milestones, permitting requirements, dewatering, excavation, transportation, and Beneficial Use of the ash from Weatherspoon. This Plan is also being prepared and provided pursuant to NC DEQ request in its letter dated October 31, 2017 with subject *Clarification on Excavation Plan Submittals.* No future updates to this Plan are intended. Duke Energy will prepare and submit its proposed Coal Combustion Residuals Surface Impoundment Closure Plan (Closure Plan) for Weatherspoon no later than December 31, 2019, pursuant to G.S. § 130A-309.214(a)(2).

The scope of work in excavating the Ash Basin has been determined by applicable laws, rules, permits, and approvals that control the activities to be performed under the Plan. The Act contains no requirement for the submittal of an excavation plan of the kind presented here. Thus, while the development of this Plan will assist in Duke Energy's work to close the Ash Basin, its approval is an action not specifically required by statutory, regulatory, or other applicable authority. The submittal of this Plan notwithstanding, external and internal factors, including site-specific considerations, may affect the work performed under the Plan. Accordingly, Duke Energy submits this Plan to NC DEQ with the proviso that it may be necessary to take actions that deviate from the Plan, and the Company reserves the right to make such changes.

II. General Facility Description

Weatherspoon is located off S. Roberts Avenue near the town of Lumberton in Robeson County, North Carolina on the north side of the Lumber River. The three-unit plant began commercial operation in 1949 with one unit and then expanded to three units by 1952. At its peak, the generating facility had a capacity of 171 megawatts. As of September 2011, all three of the coal-fired units were retired. Additionally, the site contains four oil-fired combustion turbine units that began commercial operation between 1970 and 1971 and have a combined capacity of 131 megawatts.

The CCR from Weatherspoon's coal combustion operations was historically processed in the Ash Basin system located on the northeast side of the property. Weatherspoon has been decommissioned, thus no active ash placement or sluicing is occurring within the Ash Basin system.

Duke Energy's Coal Combustion Residuals Removal Verification Procedure (Removal Verification Procedure) will be used to verify that primary source ash has been removed from the Basin. Subsequent to removal of the ash pursuant to the Removal Verification Procedure, Duke Energy will implement its Excavation Soil Sampling Plan (ESSP), which was developed for the purpose of meeting the applicable performance standards. Although not required under CAMA, NC DEQ Guidelines published in November 2016 provide that an ESSP should be submitted to NC DEQ as part of a site's excavation plan. In accordance with this request, a copy of the ESSP is attached as **Exhibit "A"** to this Plan.

1979 Ash Basin

The Ash Basin system at Weatherspoon was operated from 1955 to 2011. The Basin was constructed in phases with the initial sections built during 1955 in the northeast corner. The Basin was expanded further south in 1963 and then again in 1979. The 1979 expansion completed the overall footprint of the basin.

The Ash Basin encompasses approximately 58 acres. The 360-degree perimeter dike is approximately 6,600 feet in length with a maximum dike height of 28 feet. It was constructed entirely of structural fill. The crest of the dike is approximately 12 feet wide and has an elevation of approximately 143 feet above mean sea level.

During initial operations, discharge flows were directed towards a channel on the east side of the Basin. Following the 1979 expansion, decant water and stormwater were directed to a clarifier cell in the southeast corner of the Basin and discharged into the cooling pond. Two vertical expansions were added within the Ash Basin footprint during 2001-2002 and 2006-2007. Following retirement of the coal units at Weatherspoon, cessation of ash sluicing occurred in late 2011. The Ash Basin contains approximately 2.5 million tons of CCR material.

The Cooling Pond and Ash Basin are operated under NPDES Permit No. NC0005363 to regulate effluent discharges to the Lumber River. Additionally, the dams of the Cooling Pond and the Ash Basin are regulated and listed under the NC DEQ Dam Safety Program. The dam identification numbers for the Cooling Pond and the Ash Basin are ROBES-004 and ROBES-009, respectively. In 2014, these dams were re-rated as high-hazard by NC DEQ.

III. Project Scope

Excavation of ash from the Weatherspoon site for Beneficial Use will occur over multiple project phases. Activities started in August 2017 and will continue until approximately April 2028. During the initial phase, work will include the installation of site infrastructure, mobilization, as well as the excavation and the shipment for Beneficial Use of approximately 156,000 tons of ash. No bulk-water decanting is required during the initial phase. Subsequent phases will include continued water management and ash conditioning, dewatering, and the excavation and shipment for Beneficial Use of the remaining 2.34 million tons of ash. The final phase of the project will include dam breach and decommissioning, as well as site restoration and closeout.

Phase I Scope

1. Submit and obtain necessary permits for Phase I activities
2. Install Erosion and Sediment Control (E&SC) measures
3. Construct haul roads within and outside of the Ash Basin
4. Construct truck staging areas
5. Construct pump station for water trucks to control dusting
6. Clear vegetation and geotubes from within the Ash Basin
7. Install drainage features and detention sumps within the Ash Basin
8. Install a wheel wash station and truck scales
9. Install ash screening equipment within the Ash Basin
10. Construct stockpile areas within the Ash Basin
11. Mobilize ash excavation and processing equipment
12. Excavate and transport ash from the Ash Basin for Beneficial Use
13. Gain knowledge and opportunities for continuous program improvement

Subsequent Phase(s) Scope

1. Submit and obtain any additional permits
2. Maintain Erosion and Sediment Control measures
3. Relocate haul roads, working pads, screening locations, etc. within the Ash Basin as work progresses
4. Relocation transmission structure
5. Install and operate interstitial water treatment (if required)
6. Excavate and transport remaining ash from the Ash Basin for Beneficial Use
7. Complete the Excavation Soil Sampling Plan and confirm closure by removal
8. Complete closure activities for the Ash Basin as outlined in Sections 3.(a) and 3.(b) of the Coal Ash Act, as amended by House Bill 630
9. Complete dam breach and dam decommissioning
10. Complete site restoration and project closeout

IV. Critical Milestone Dates

Critical milestones within the Plan are summarized in the table below.

MILESTONE	NO LATER THAN DATE	STATUS
Execute Contract for Ash Haul and Beneficial Use	N/A	Completed May 26, 2017
Complete Phase I Engineering plan	August 15, 2017	Completed August 1, 2017
Submit E&SC Plan & Permit request to NC DEQ	July 15, 2017	Completed July 10, 2017
Receive E&SC Permit approval	N/A	Completed July 21, 2017
Submit Ash Transportation Informational Plan to NC DEQ - Solid Waste	N/A	Completed August 21, 2017
Complete installation of site infrastructure	September 15, 2017	Completed September 6, 2017
Commence work – Ash excavation, transport and Beneficial Use	N/A	Completed September 11, 2017
Submit Ash Excavation Plan and Soil Sampling Plan to NC DEQ	December 31, 2017	On track
Complete ash excavation of the Ash Basin	April 4, 2028	On track
Impoundment closed	August 1, 2028	On track

V. Erosion and Sediment Control Plan

The Erosion and Sediment Control plans for the excavation of the Ash Basin were developed, submitted to NC DEQ, and approved. Modifications from E&SC plans for subsequent phase(s) will be approved by NC DEQ prior to installation and initiation of subsequent phase work.

The approved contractor installed the E&SC measures indicated in the plan. All control measures will be maintained through the project in accordance with the E&SC plans. When possible, portions of the E&SC plan will be closed out at the approval of NC DEQ as areas become stabilized.

VI. Dewatering Plan

The Ash Basin contains no bulk free water. Management of contact and interstitial water during the initial phase(s) will be performed, to the extent possible, within the Ash Basin and through diversion and the conditioning of the ash. Moisture conditioning will be achieved through windrowing and tilling to facilitate evaporation, infiltration, and gravity drainage of water. Basin water will be re-used for dust control within the Ash Basin. Dewatering and interstitial water treatment (if required) will be managed in accordance with the NPDES permit.

VII. Location(s) for Removed Ash

The Plan includes the excavation and removal of approximately 2.5 million tons of ash from the Ash Basin. Ash removed from the site is being transported by contractor to Beneficial Use facilities in South Carolina.

Duke Energy has entered into an agreement with Converse & Company to transport and sell ash from the Weatherspoon Ash Basin to two cement mills for raw kiln feed, a recognized encapsulated Beneficial Use of coal ash. Similarly, Converse & Company has agreements in place with Argos Cement in Holly Hill, SC and with Holcim Cement in Harleyville, SC to purchase the coal ash.

The commitment provides for approximately 230,000 - 250,000 tons per year of Beneficial Use over the next 10 years.

VIII. Transportation Plan

Ash transportation from the site will be performed utilizing highway trucks to off-site facilities in Holly Hill, SC and Harleysville, SC. Truck loading operations will be conducted with a crew working typically 10 hours per day, five to six days per week. Transportation will be conducted by approved transporters and will meet Department of Transportation (DOT) and other applicable federal, state, and local regulations. Duke previously submitted an Ash Transportation Informational Plan to NC DEQ - Waste Management on August 21, 2017.

IX. Environmental and Dam Safety Permitting Plan

Excavation of ash creates potential for stormwater impacts. The facility holds approved erosion and sediment control plans and associated Construction Stormwater Permits for ash removal. Also, NC DEQ has indicated that an NPDES Industrial Stormwater Permit is required to transport ash. The Company received the Industrial Stormwater Permit to support ash removal at the site. Pursuant to the requirements of the Industrial Stormwater Permit, a Stormwater Pollution Prevention Plan (SPPP) incorporating best management practices has been created and is currently being implemented. Future modifications to the permit/plan will be managed as necessary.

The Ash Basin contains no bulk free water, thus decanting is not necessary during the initial phase(s) of excavation. Contact and/or interstitial water that is encountered will be managed in accordance with the NPDES Permit. An updated NPDES Wastewater Permit application was submitted on January 28, 2014 (amendment submitted October 10, 2014) to facilitate the closure of the Ash Basin. The facility continues to operate under an administratively extended NPDES Wastewater Permit.

There are no jurisdictional wetlands/streams associated with the removal of the ash from within the Ash Basin. During the final phase, dam breach and dam decommissioning, further evaluation will be required to determine if there will be any wetland impacts.

Weatherspoon ash is a non-hazardous material.

All necessary Dam Safety approvals will be or have been obtained to cover activities on or around jurisdictional dams. Breaching of the dam will require Dam Safety approval. Any impacted wells or piezometers will be abandoned in accordance with NC DEQ requirements. Fugitive dust will be managed to mitigate impacts to neighboring areas. Additional site-specific or local requirements will be secured, as needed.

Permit Matrix

MEDIA	PERMIT	RECEIVED DATE (R) / TARGET DATE (T)	COMMENTS
Water	NPDES Industrial Stormwater Permit	February 1, 2017 (R)	None
	NPDES Wastewater Permit	March 15, 2018 (T)	Not required for Phase I
	Well Abandonment	N/A	Abandonment records submitted to DEQ on August 18, 2017
Dam Safety	Ash Basin Dam Decommissioning Request Approval	July 1, 2027 (T)	None

MEDIA	PERMIT	RECEIVED DATE (R) / TARGET DATE (T)	COMMENTS
Land Quality	Erosion & Sediment Control	July 21, 2017 (R)	None
Other Requirements	Site-specific Nuisance/Noise/ Odor/Other Requirements, including DOT Requirements	August 18, 2017 (R)	USDA Noxious Weeds Approval - Clemson University

X. Contracting Strategy

The Ash Management Program strategy is to engage multiple contractors, drive competition, create system-wide innovation, and develop a collection of best practices. Duke Energy has engaged contractor(s), who are experienced in coal ash excavation, transportation, and disposal, and continues to evaluate other potential contractors. The Company provides in-depth oversight, coordination, and monitoring of the contractors to ensure the work is performed appropriately. Duke Energy's core values include safety, quality, and protection of the environment, which are incorporated into our contracts. The Company continues to evaluate alternate approaches, methods, and contracting solutions and will adjust its strategy, as necessary.

XI. Environmental, Health, and Safety Plan

Protecting workers, the public, the community, and the environment

The Company is committed to the health, safety, and welfare of employees, contractors, and the public, and to protecting the environment and natural resources. During all phases of the project work, the Company and its contractors will follow the Duke Energy Safe Work Practices Manual, the Environmental, Health, and Safety supplement document, and any additional requirements. Occupational health and safety expectations include oversight and continuous improvement throughout the project.

The project includes comprehensive environmental, health, and safety plans encompassing all aspects of the project work.

In addition to adhering to all applicable environmental, health, and safety rules and regulations, Duke Energy and its contractors will focus on ensuring the safety of the public and protection of the environment during each phase of the project.

XII. Communications Plan

The project team is coordinating with Duke Energy's Corporate Communications Department to develop a comprehensive external communications plan tailored to the specific needs of each phase of the project. Many different external stakeholders, including neighbors, government officials, and media have an interest in this project. The Company is committed to providing information by proactively communicating about the project activities to potentially affected parties and responding to inquiries in a timely manner.

XIII. Glossary

TERM	DEFINITION
Ash Basin	Synonymous with Coal Combustion Residual Impoundment. A topographic depression, excavation, or dammed area that is primarily formed from earthen materials; without a base liner approved for use by Article 9 of Chapter 130A of the North Carolina General Statutes or rules adopted thereunder for a combustion products landfill or coal combustion residuals landfill, industrial landfill, or municipal solid waste landfill; and an area that is designed to hold accumulated coal combustion residuals in the form of liquid wastes, wastes containing free liquids, or sludge, and that is not backfilled or otherwise covered during periods of deposition.
Beneficial Use	Projects promoting public health and environmental protection, offering equivalent success relative to other alternatives, and preserving natural resources
Bottom Ash	The agglomerated, angular ash particles formed in pulverized coal furnaces that are too large to be carried in the flue gases and collect on the furnace walls. Bottom ash falls through open grates to an ash hopper at the bottom of the furnace.
Coal Ash Excavation Plan	Plan requested by NC DEQ pursuant to its issuance of CCR Surface Impoundment Closure Guidelines for Protection of Groundwater on November 4, 2016.
Coal Ash Management Act of 2014	North Carolina Session Law 2014-122 (as amended by House Bill 630, Sess. L. 2016-95)
Coal Combustion Residuals (CCR)	Residuals, including fly ash, bottom ash, boiler slag, mill rejects, and flue gas desulfurization residue produced by a coal-fired generating unit
Decanting	The act of removing bulk / free water from the ash basin

TERM	DEFINITION
Dewatering	The act of removing entrapped/interstitial water from the ash
Duke Energy Safe Work Practices Manual	Document detailing the Duke Energy safety guidelines
Entrapped Water	Flowable water below the ash surface, which creates hydrostatic pressure on the dam
Excavation Activities	Tasks and work performed related to the planning, engineering, and excavation of ash from an ash basin
Excavation Plan	Refer to Coal Ash Excavation Plan
Fly Ash	Very fine, powdery material, composed mostly of silica with nearly all particles spherical in shape, which is a product of burning finely ground coal in a boiler to produce electricity and is removed from the plant exhaust gases by air emission control devices.
NPDES	National Pollutant Discharge Elimination System
NPDES Permit	A permit that regulates the direct discharge of wastewater to surface waters
Permit	Federal, state, county, or local government authorizing document

XIV. Reference Documents

REF	DOCUMENT	DATE
1	Coal Ash Management Act , as amended by House Bill 630, Sess. L. 2016-95	July 14, 2016
2	Amended Order Granting Motion for Partial Summary Judgment in State of North Carolina ex rel. N.C. Department of Environment and Natural Resources, Division of Environmental Quality v. Duke Energy Progress, Inc., Wake County, Case No. 13-CVS-11032	June 9, 2017
3	CCR Surface Impoundment Closure Guidelines for Protection of Groundwater	November 4, 2016
4	NC DEQ Letter with subject Clarification on Excavation Plan Submittals	October 31, 2017

Robinson Steam Station
Darlington County, South Carolina

I. Site History

The Robinson Steam Station ("Robinson") is a Duke Energy Progress, LLC ("DE Progress" or the "Company") coal-fired generation facility that began generating coal-fired electricity in 1960. The Robinson Plant began commercial operations in 1960 when its coal-fired unit ("Unit 1") came online. In 1971, the Company added a 724 MW nuclear unit to the site. DE Progress also owns and operates the Darlington Electric Power Plant, which is located just north of the Robinson Plant and consists of thirteen natural gas units. The Robinson Plant's lone coal-fired unit was retired in 2012.

Over the life of the Robinson Plant, coal combustion residuals ("CCR") from Unit 1 were stored in either the 1960 Fill Area or the onsite ash basin ("Unit 1 Ash Basin"). From 1960 to the mid-1970s, CCR from Unit 1 were placed in the 1960 Fill Area. The 1960 Fill Area received CCR from Unit 1 until the Unit 1 Ash Basin was constructed in the mid-1970s by damming an unnamed tributary to Black Creek. The Unit 1 Ash Basin received sluiced CCR until Unit 1 was retired in 2012.

An aerial view of the Robinson ash basin and storage areas (collectively, the "CCR Units") is provided in **Figure 1** below.

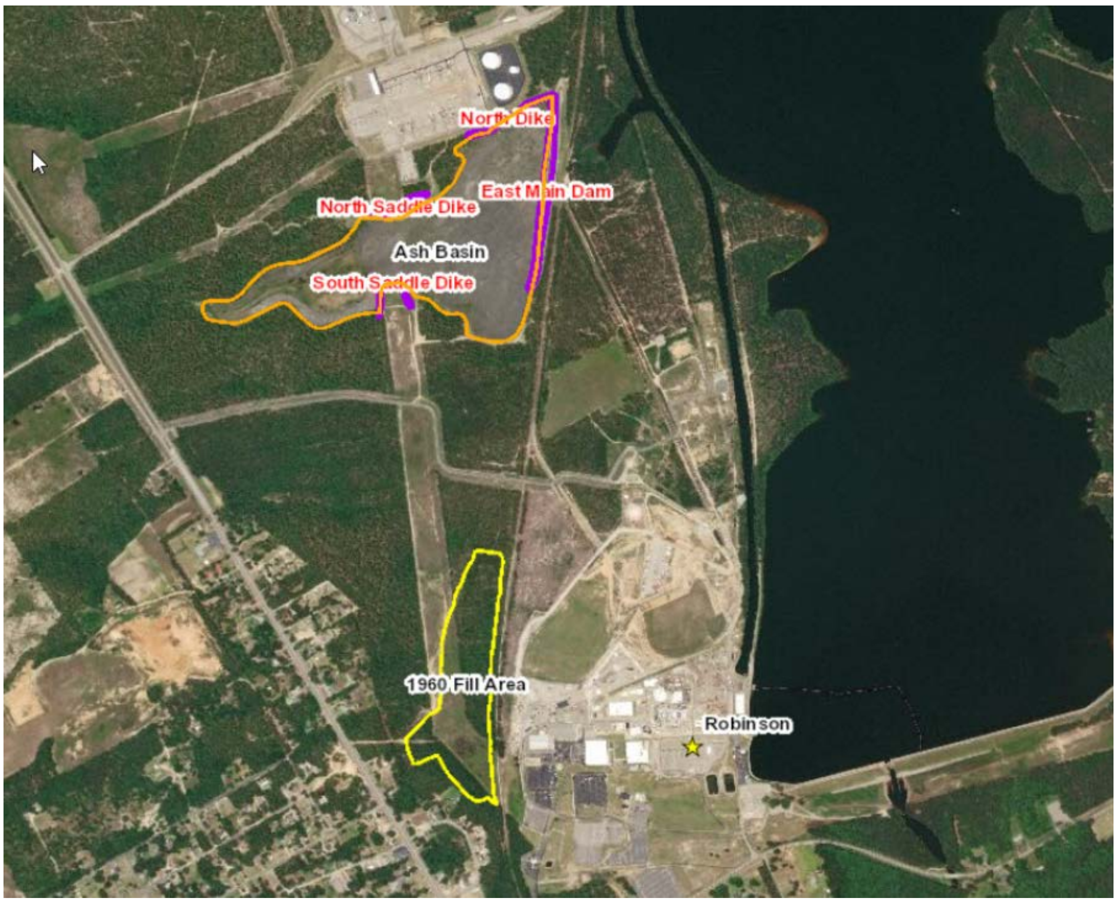

Figure 1 – Aerial showing CCR Units at Robinson

II. Regulatory History

The CCR Units at Robinson have been regulated by a combination of state agencies over the operational history of the plant. The South Carolina Department of Health and Environmental Control ("DHEC") regulated the wet storage of ash in impoundments through the National Pollutant Discharge Elimination System ("NPDES") permit program and the landfilling and beneficial reuse of CCR through the state's solid waste management program. Dams were also regulated by DHEC under the S.C. Dams and Reservoirs Safety Act.

Following the Tennessee Valley Authority coal ash spill in 2008, EPA was prompted to assess coal ash impoundments across the country. In 2010, EPA proposed, for the first time, comprehensive regulations and federal minimum standards to address the disposal and permanent storage of CCR. The final CCR Rule was signed in December 2014 and published in April 2015.

In July 1, 2015, DE Progress entered into the Consent Agreement (15-23-HW) with DHEC relating to the permanent storage of CCR at Robinson. DHEC entered the Consent Agreement pursuant to its authority under the South Carolina Hazardous Waste Management Act, S.C. Code Ann. §44-56-10, et. seq. (Rev. 2002 and Supp. 2013), the Pollution Control Act, S.C. Code Ann. §48-1-10 et seq. (Rev. 2008 and Supp. 2013) and the South Carolina Solid Waste Policy and Management Act, S.C. Code Ann. §44-96-10, et. seq. (Rev. 2002 and Supp. 2013). Under the Consent Agreement and CCR Rule, DE Progress is required to close the 1960 Fill Area and Unit 1 Ash Basin at Robinson. Pursuant to the Consent Agreement and the CCR Rule, DE Carolinas will be excavating all CCR at Robinson. Excavated CCR will be placed in an onsite landfill that is being constructed to meet federal and state landfill standards. DE Progress decision to excavate CCR at Robinson is consistent with closure plans approved by DHEC for other utilities operating in South Carolina that have stored CCR in impoundments.

III. Site Closure Activities – January 1, 2015 through August 31, 2017

The Company immediately began complying with its new state and federal regulatory requirements affecting its storage of CCR as they became effective. The closure activities that were performed during this time period include:

- Revised Closure Plan Submitted;
- Developed and submitted the Landfill Permit Application;
- Received Approval for Closure Plan;
- Completed Well Abandonment;
- Received Landfill Permit;
- Developed and submitted Ash Removal Plan for the 1960 Ash Fill Area; and
- Commenced landfill construction.

The activities described above and costs associated with those activities were the subject of DE Progress' 2017 rate case before the Commission (Docket No. E-2, 1142). In that docket, the Commission determined that DE Progress' coal ash basin closure costs for the Robinson were reasonable, prudent, and recoverable. (*Order Accepting Stipulation, Deciding Contested Issues, and Granting Partial Rate Increase*, Docket No. E-2, Sub 1142).

IV. Site Closure Activities – September 1, 2017 through February 29, 2020

The Company has continued to meet its obligations under state and federal law and is performing the preliminary work necessary to close the CCR Units at Robinson. Those activities include:

- Performing engineering design and site assessments to facilitate closure;
- Obtaining environmental permits to construct the onsite landfill and install groundwater monitoring wells;
- Enter into agreements with localities in order to proceed with closure;
- Installing groundwater monitoring wells;
- Monitoring and analyzing groundwater samples;
- Designing and constructing sedimentation basins;
- Constructing landfill cells and install liner system;
- Installing leachate detection and pumping system;
- Constructing haul roads to transport excavated ash onsite; and
- Developing ash excavation and landfill operation/fill plans.

The tasks that DE Progress has performed and will perform from September 1, 2017 through February 29, 2020 are a continuation of the activities for which costs were approved in the prior DE Progress rate case. These activities and associated costs continue to be necessary, appropriate, and consistent with applicable regulatory requirements.

SITE ANALYSIS AND REMOVAL PLAN

ASHEVILLE STEAM ELECTRIC GENERATING PLANT

REVISION 1

Prepared for

DUKE ENERGY

Duke Energy
550 South Tryon Street
Charlotte, North Carolina 28202

April 2017

Prepared by

amec foster wheeler

Amec Foster Wheeler Environment & Infrastructure, Inc.
Project No. 7810160620

NORTH CAROLINA
PROFESSIONAL
SEAL
043443
ENGINEER
DANIEL R. SMITH

4/6/17

EXECUTIVE SUMMARY

Amec Foster Wheeler Environment & Infrastructure, Inc. (Amec Foster Wheeler) has prepared this Site Analysis and Removal Plan (Removal Plan) in support of the proposed closure of the Coal Combustion Residuals (CCR) Basins (Ash Basins) at the Asheville Steam Electric Generating Plant (Asheville Plant) located near Arden, North Carolina. The purpose of this Removal Plan is to seek the North Carolina Department of Environmental Quality's (NCDEQ) concurrence with the Duke Energy Progress, LLC (Duke) plan for closure of the Ash Basins located at the Asheville Plant. This Removal Plan is submitted to NCDEQ on behalf of Duke. The work to be performed in support of the closure of the Ash Basins is summarized in this document, which is consistent with the requirements of the Hazardous and Solid Waste Management System: Disposal of Coal Combustion Residuals from Electric Utilities Rule (CCR Rule) [EPA, 2015] and the NC Coal Ash Management Act (CAMA). This Removal Plan is based on engineering and environmental factors minimizing the impacts to communities and managing cost. The drawings presented herein are accurate at the time of preparing this Removal Plan and are subject to change pending further discussion with Duke. The closure option entails excavation of CCR within the Ash Basins and transport for beneficial use or placement in an off-site permitted landfill.

The two Ash Basins located at the Asheville Plant include: (i) the 1982 Ash Basin; and (ii) the 1964 Ash Basin. Excavation of the 1982 Ash Basin was completed on September 30, 2016, and the basin was turned over for dam decommissioning and the construction of a natural gas combined cycle plant after an independent qualified professional engineer concluded that primary source ash had been removed from the basin. Duke estimates the tonnage of ash in the 1964 Ash Basin to be approximately 2.9 million tons as of December 31, 2016. Subsequent to removal of the ash pursuant to the Coal Combustion Residual Removal Verification Procedure, Duke will implement its Excavation Soil Sampling Plan, as referenced in the Construction Quality Assurance Plan, in a manner that meets the closure performance standards set out in Part II, Section 3.(c) of CAMA and Section 257.102(c) of the CCR Rule.

Assessment activities for the Asheville Plant were performed by SynTerra, Corp. (SynTerra) and were reported in a Comprehensive Site Assessment (CSA) report dated August 23, 2015, a CSA Supplement 1 dated August 31, 2016, a Corrective Action Plan (CAP) Part 1 dated November 20, 2015, and a CAP Part 2 dated February 19, 2016. Groundwater receptor surveys were conducted for the site. In addition to identification of receptors, the compiled data was used to develop a description of the site, surrounding area, geology, and hydrogeology, including a Site Hydrogeologic Conceptual Model (SCM). The Constituents of Interest (COI) identified from the Asheville Plant ash material and pore water sample analyses include antimony, arsenic, boron, chromium, cobalt, iron, manganese, sulfate, thallium, TDS, vanadium, and pH. These COIs are identified as exceeding either the 2L or Interim Maximum Allowable Concentrations (IMAC) in at least one ash pore water monitoring well. Groundwater trend analysis modeling showed that COIs with exceedances of the 2L or IMAC are identified in all compliance boundary wells at statistically elevated values over concentrations observed in designated background wells.

A preliminary geotechnical evaluation was performed and is presented in this Removal Plan. The results of the investigations indicate that the subsurface materials primarily consist of, from top to bottom, CCR (within the 1964 Ash Basin) or Dike Fill (at the perimeters of the basins) and residual soils (sitting on bedrock). A partially weathered rock zone was encountered at the transition between the residual soils and the bedrock (gray to dark gray, fine to medium-grained gneiss).

The closure of the Ash Basins will entail the following activities: CCR will be excavated and transported from the site for beneficial use or placement in an off-site permitted landfill. Per the current plan, after establishing the final design grades, the footprints of the 1982 Ash Basin will become the site for a planned combined cycle plant, and the 1964 Ash Basin footprint will be graded to drain. The potential future use of the 1964 Ash Basin is undetermined at this time. This Removal Plan also presents a summary of the engineering evaluation and analyses performed, as well as a Construction Quality Assurance (CQA) Plan.

A description of the existing stormwater and wastewater management facilities, as well as provisions for stormwater and wastewater management during and after ash basin closure are provided in this Removal Plan.

A Post-Closure Care Plan is provided, including the groundwater monitoring program currently under evaluation by NCDEQ. This Removal Plan presents the estimated milestones related to basin closure and post-closure activities.

LIST OF ACRONYMS AND ABBREVIATIONS

Acronym/ Abbreviation	Definition
µg/L	Microgram per liter
2B	NCAC Title 15A, Subchapter 2B. Surface Water and Wetland Standards
2L	NCAC Title 15A, Subchapter 2L. Groundwater Classification and Standards
ASTM	American Society for Testing Materials
CAMA	Coal Ash Management Act
CAP	Corrective Action Plan
CCP	Coal Combustion Products
CCR	Coal Combustion Residual
CCR Rule	Coal Combustion Residuals Rule
CFR	Code of Federal Regulations
CMS	Closure Model Scenario
cm/sec	centimeters per second
CMP	Corrugated Metal Pipe
COI	Constituent of Interest
CQA	Construction Quality Assurance
CSA	Comprehensive Site Assessment
CY	Cubic Yards
DWQ	Division of Water Quality
DWR	Division of Water Resources (formerly DWQ)
EDXRF	Energy Dispersive X-Ray Fluorescence
EMP	Effectiveness Monitoring Plan
EPSC	Erosion Prevention and Sediment Control
FGD	Flue Gas Desulfurization
gal/min	gallons per minute
GAP	Groundwater Assessment Work Plan
GIS	Geographic Information System
HDPE	High Density Polyethylene
IMAC	Interim Maximum Allowable Concentrations
IMP	Interim Monitoring Plan
MDE	Maximum Design Earthquake
mL/g	milliliters per gram
MPD	Master Programmatic Document
MSD	Metropolitan Sewerage District
MW	Megawatt
NAVD 88	North American Vertical Datum of 1988
NCDENR	North Carolina Department of Environment and Natural Resources
NCDEQ	North Carolina Department of Environmental Quality (formerly NCDENR)
NOI	Notice of Inspection
NPDES	National Pollutant Discharge Elimination System
O&M	Operations and Maintenance
OM&M	Operations Maintenance and Monitoring
pcf	Pounds per Cubic Foot

Acronym/ Abbreviation	Definition
Plant	Asheville Steam Electric Generating Plant
PMP	Probable Maximum Precipitation
psf	Pounds per Square Foot
PWR	Partially Weathered Rock
RCP	Reinforced Concrete Pipe
RSL	USEPA Regional Screening Level
S.B.	Senate Bill
SCM	Site Conceptual Model
SPLP	Synthetic Precipitation Leaching
SPT	Standard Penetration Test
TBD	To be determined
TDS	Total Dissolved Solids
TOC	Total Organic Carbon
Tsf	Tons per square foot
UNCC	University of North Carolina, Charlotte
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
XRD	X-Ray Diffraction

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Appendix C	Corrective Action Plan (CAP) Part 1, November 20, 2015 (SynTerra 2015b), and CAP Part 2 February 19, 2016 (SynTerra, 2016a); Updated Flow and Transport Modeling Report, March 17, 2017 (Falta et al, 2017)
Appendix D	Engineering Evaluations and Analyses of Closure Design Grading Plans for the 1982 Ash Basin
Appendix E	Dam Decommissioning and Ash Removal Closure Plan Drawings for the 1982 Ash Basin
Appendix F	Construction Quality Assurance Plan
Appendix G	Post-Closure Operations Maintenance and Monitoring (OM&M) Plan
Appendix H	Closure and Post-Closure Care Cost Estimates
Appendix I	NPDES Permit No. NC0000396 2016 Permit Renewal Supplemental Information Package

RECORD OF REVISION

Revision Number	Revision Date	Section Revised	Reason for Revision	Description of Revision
0	12/2016	N/A	N/A	Initial Issue
1	04/2017	8,12	Response to NCDEQ	Revised Executive Summary, Sections 8.1 and 8.2 to address NCDEQ comments; Included schedule milestone dates in Section 12.1, and included cost estimate information in Section 12.2 and Appendix H; and added Appendix I
2				

1. INTRODUCTION

Duke intends to close the 1982 and 1964 Ash Basins at the Asheville Steam Electric Generating Plant (Plant). Both basins will be closed by removal of the coal ash for transport for beneficial use or an off-site fully lined landfill. The purpose of this document is to outline and present the plan and objectives to achieve closure for the ash basins and meet the requirements of the North Carolina Coal Ash Management Act (CAMA) and the Coal Combustion Residuals (CCR) Rule (CCR Rule).

1.1 Site Analysis and Removal Plan Objectives

The objective of this Site Analysis and Removal Plan (Removal Plan) is to set out the process for closing the 1982 and 1964 Ash Basins at the Plant in accordance with applicable regulations, including the Hazardous and Solid Waste Management System: Disposal of Coal Combustion Residuals from Electric Utilities Rule (CCR Rule) (EPA, 2015) and the North Carolina Coal Ash Management Act (CAMA) for closure of CCR surface impoundments.

1.2 Document Organization

Although closure of the CCR surface impoundments at the Asheville facility is solely controlled by Part II, Sections 3.(b) and 3.(c) of CAMA (and not N.C.G.S. § 130A-309.214), for purposes of consistency with the closure plans for those non-high-priority Duke facilities to which N.C.G.S. § 130A-309.214 applies, this Removal Plan is structured to follow generally the closure plan elements set forth in N.C.G.S § 130A-309.214(a)(4).

2. GOVERNING REGULATIONS

2.1 Federal CCR Rules

The CCR Rule was published in the Federal Register on April 17, 2015. This rule regulates CCR as a nonhazardous waste under Subtitle D of the Resource Conservation and Recovery Act. The effective date of the rule is October 19, 2015.

Written closure plan requirements are set forth in 40 CFR § 257.102(b)(1) of the CCR Rule and are summarized in **Table 2-1** of this document. **Table 2-1** provides a cross reference between each regulatory closure plan requirement and the corresponding Removal Plan section(s) where that requirement is addressed.

The CCR Rule requires that a history of construction be developed for each CCR unit as described in 40 CFR § 257.73(c)(1), and 40 CFR §257.105(f)(9) requires that this history of construction be maintained in the facility's written operating record. In addition, §§ 257.106(f)(8) and 257.107(f)(8) require notification of the availability of the history of construction to the State Director and posting of this information on the publicly accessible CCR Website, respectively. The History of Construction Report (Amec Foster Wheeler 2016a) has been developed as a primary source of information reported in the Removal Plan and to satisfy these record keeping requirements.

2.2 North Carolina

In August 2014, the North Carolina General Assembly passed Senate Bill (S.B.) 729 (known as CAMA), which lists specific regulatory requirements for CCR surface impoundment closure. For the Plant, "surface impoundment," as defined in N.C.G.S. § 130A-309.201(6), is interpreted to include the 1982 Ash Basin and 1964 Ash Basin. Part II, Section 3(b) of CAMA deems the Plant a "high-priority" site and specifically requires closure by August 1, 2019, which entails dewatering the ash basins to the maximum extent practicable and removing and transferring CCR from basins to a lined landfill or structural fill. However, the North Carolina Mountain Energy Act of 2015 extended the closure date to August 1, 2022. Note that ash removal is required to be complete by August 1, 2022; however, dam decommissioning and final grading of the former ash basin areas and completion of corrective actions to restore groundwater quality, if needed, as provided in N.C.G.S. § 130A-309.204, may extend beyond this date. CAMA's closure plan requirements applicable to non-high-priority sites were codified at N.C.G.S. § 130A-309.214(a)(4), which requires plans for such sites to include the elements listed below. Although, as noted in Section 1.2 above, N.C.G.S. § 130A-309.214 is not specifically applicable to the Plant, which is a high-priority site required to close pursuant to Part II, Sections 3.(b) and 3.(c) of CAMA, this Removal Plan relies on N.C.G.S. § 130A-309.214(a)(4) solely to inform its organization.

A closure plan will be required for each CCR surface impoundment subject to N.C.G.S. § 130A-309.214(a)(4) regardless of its risk classification. CAMA defines the requirements for these closure plans in N.C.G.S. §130A-309.214(a)(4). The CAMA closure plan regulations are summarized in **Table 2-2** for reference. The Closure Plan shall include the following:

- Facility description;
- Site maps;
- Hydrogeologic, geologic, geotechnical characterization results;
- Groundwater potentiometric maps and extent of contaminants of concern;
- Groundwater modeling;
- Description of beneficial reuse plans;
- Removal Plan drawings, design documents, and specifications;
- Description of the construction quality assurance and quality control program;
- Description of wastewater disposal and stormwater management provisions;
- Description of how the final disposition of CCR will be provided;
- List of applicable permits to complete closure;
- Description of post-closure monitoring and care plans;
- Estimated closure and post-closure milestone dates;
- Estimated costs of assessment, corrective action, closure and post-closure care; and
- Future site use description.

In addition to the closure pathway and closure plan requirements, CAMA outlines groundwater assessment and corrective action requirements summarized as follows:

- Submit Groundwater Assessment Plans by December 31, 2014;
- Within 180 days of Groundwater Assessment Plan approval, complete a groundwater assessment and submit a Groundwater Assessment Report; and
- Provide a Corrective Action Plan (if required) within 90 days (and no later than 180 days) of Groundwater Assessment Report completion.

The groundwater assessment and corrective action activities for the Plant are currently being developed by SynTerra Corp. (SynTerra). The *Comprehensive Site Assessment (CSA) Report* for the Plant was completed on August 23, 2015 (SynTerra 2015a). Duke has been in correspondence with the NCDEQ and has received permission to submit a Corrective Action Plan (CAP) in two parts. The first part of the CAP was submitted on November 20, 2015, and includes background information; a brief summary of the CSA findings; a brief description of site geology and hydrogeology; a summary of the previously completed receptor survey; a description of NCAC Title 15A Subchapter 2L. Groundwater Standards (2L Standards) and NCAC Title 15A NCAC Subchapter 2B. Surface Water Standards (2B Standards) exceedances;

proposed site-specific groundwater background concentrations; a description of the site conceptual model; and groundwater flow, and transport modeling (SynTerra 2015b). The second part of the CAP was submitted on February 19, 2016, and includes risk assessment, alternative methods for achieving restoration, conceptual plans for recommended corrective actions, implementation schedule, and a plan for future monitoring and reporting (SynTerra 2016a).

The CSA Supplement 1 was also issued on August 31, 2016, and addresses the following (SynTerra 2016b):

- Summary of groundwater monitoring data through July 2016;
- Reponses to NCDEQ review comments pertaining to the CSA;
- Update on the development of provisional background groundwater concentrations (through April 2016 data);
- Findings from assessment activities conducted since the submittal of the CSA report, including data gaps previously identified in the CSA; and
- Description of planned additional assessment activities.

On March 17, 2017, an updated groundwater modeling report was prepared for SynTerra (Falta, et al 2017). This study updated the groundwater flow and constituent transport model that was previously developed for the site in 2015.

3. FACILITY DESCRIPTION AND EXISTING SITE FEATURES

3.1 Surface Impoundment Description

3.1.1 Site History and Operations

The Plant is a coal-combustion generating facility that began commercial operation in 1964. Ash basins, which support operations at the Plant, were expanded or otherwise modified in 1971, 1999, and 2000. As shown on **Figure 1**, the facility is located in Buncombe County in Western North Carolina, approximately 8 miles south of the City of Asheville, and is within the U.S. Geological Survey (USGS) Skyland Quadrangle. The center of the facility is at the approximate coordinates: latitude 35°28'N, longitude 82°32'W. The Plant is situated on approximately 786 acres, including areas on both sides of Interstate 26 (I-26).

The Plant consists of two coal-fired generating units with a combined power generating capacity of 376 megawatts (MW), two combustion turbine units with a combined 324 MW capacity, two CCR units known as the 1982 Ash Basin and the 1964 Ash Basin, and obtains makeup water from Lake Julian. **Figure 2** includes an aerial photo of the Plant that also shows the associated and surrounding features.

The two ash basin dams fall under the jurisdiction of the NCDEQ Division of Energy, Mineral and Land Resources, Land Quality Section, Dams Program and are listed under State ID Number BUNCO-089 (1982 Ash Basin) and BUNCO-097 (1964 Ash Basin). According to the current NCDEQ hazard-rating criteria, the dams are considered to be large, high-hazard structures, falling under Class C dam classification based on potential breach impacts to potential loss of life and/or economic damage.

Fly ash and bottom ash have been deposited within the facility's two ash basins by hydraulic sluicing. Ash is currently sluiced to the Rim Ditch system, where it is dewatered and temporarily stored within the 1964 Ash Basin. Ash is later removed and transported off-site for beneficial reuse or proper disposal. Decant water from the Rim Ditch is pumped through a center pond filter system to the stilling basin located to the north of the 1964 Ash Basin, and then out through NPDES Outfall 001. Some stormwater and wastewater from portions of the Plant site is routed into the Duck Pond and then pumped into to the head of the Rim Ditch for treatment.

Following is a brief summary from the History of Construction report (Amec Foster Wheeler 2016a) of each of the Ash Basins.

<u>1964 Ash Basin and Equalization Basin</u>

The 1964 Ash Basin Dam was part of the original steam plant construction designed by Ebasco in 1962. The dam was constructed as a compacted, random earth fill embankment with a design crest elevation of approximately 2125 feet. The 1964 Ash Basin has a drainage area of approximately 75 acres according to the NCDEQ dam database.

In 1970–71, the dam was extended and raised approximately 30 feet to a planned crest elevation of 2157.5 feet to provide additional ash storage. This raising necessitated a separator dike east of the main dam. Recent survey information shows a spot crest low point elevation of approximately 2157.3 feet (North American Vertical Datum of 1988 [NAVD 88]). Sluicing of ash to the 1964 Ash Basin ceased in 1982 with the construction of the 1982 Ash Basin.

In 2005, an engineered wetlands treatment system for flue gas desulfurization (FGD) process wastewater was constructed within the northwestern portion of the 1964 Ash Basin. The system consisted of two equalization basins that routed wastewater from the FGD process to a series of lined ponds that contained vegetation to treat the wastewater. The constructed wetlands and equalization basins were designed by Parsons E&C (now known as Worley Parsons).

In 2012, a 1964 Dam improvement project was initiated to improve the stability of the dam. This improvement project included:

- Extension of the core of the dam along the crest;
- Installation of a toe drain along the base of the downstream slope of the dam that routes collected water into an existing concrete structure;
- Abandonment of the 30-inch-diameter concrete spillway pipe and riser by grouting in-place;
- Construction of a riprap buttress along the toe of the dam; and
- Modification of the path for discharge from the wetlands system and 1982 Ash Basin.

In parallel with the dam improvements, a drainage improvement project designed by MACTEC (now Amec Foster Wheeler) was completed to redirect the outflow from the 1982 Ash Basin riser structure into buried piping (high density polyethylene [HDPE] encased in flowable fill) installed within the 1964 Ash Basin area to the interior of the Duck Pond, and from the Duck Pond to a new outlet structure at the French Broad River. With this project, the spillway for the 1964 Ash Basin is located within the Duck Pond in the northeast corner of the basin and connected to the drainage pipe system installed in 2012. For more detailed information and area capacity curves for the basin, refer to the History of Construction report (Amec Foster Wheeler 2016a).

The equalization basins and engineered wetlands were removed to provide an area to temporarily place ash excavated from the 1982 Ash Basin. During 2016, wastewater flows and treatment were adjusted to facilitate the excavation of the 1982 Basin. The center pond filters were constructed at the end of the Rim Ditch and commissioned to replace the treatment provided by the Duck Pond. Infrastructure was developed to dewater the Duck Pond to the head of the Rim Ditch, and subsequently, the low volume waste and stormwater that flowed into the 1982 Basin and pumped to the Rim Ditch was re-routed to the Duck Pond. All treated effluent is discharged to Outfall 001.

<u>1982 Ash Basin and Separator Dike</u>

The 1982 Ash Basin Dam was designed by CP&L Engineers and W.L. Wells in 1981. The ash basin dam was constructed of compacted random earth fill in 1981–82 and ash storage began in 1982 (when the 1964 Ash Basin was removed from service).

The dam is approximately 1500 feet long with a design crest elevation at 2165 feet. Recent survey information before dam decommissioning activities began showed spot elevations ranging from 2164.5 feet to 2165.7 feet (NAVD 88). The west end of the dam joins the abutment of the 1964 Ash Basin Dam and the east end ties into a natural knoll. An internal drainage blanket connected to toe-drainage piping provides seepage control. The 1982 Ash Basin has a drainage area of approximately 70 acres, according to the NCDEQ dam database.

When the 1964 Ash Basin dam was raised in 1970–71, a Separator Dike was constructed across a topographic low area on the east side of the 1964 Ash Basin. The 1982 Ash Basin design included raising the Separator Dike due to the planned higher crest elevation of the 1982 Ash Basin Dam. The Separator Dike was built on a native soil base; fill for the dike was not placed on ash.

The outfall skimmer was near the southwest corner of the 1982 Ash Basin. It connected to a drainage pipe that was installed in 2012 that runs below the constructed wetlands (now removed) and the northern portion of the 1964 Ash Basin, before connecting to a stilling basin and concrete outfall structure at the French Broad River. For more detailed information and area capacity curves for the basin, refer to the History of Construction report (Amec Foster Wheeler 2016a).

The 1982 Ash Basin began to reach capacity in 2007. To facilitate continued Plant operations, an ash excavation plan was developed to increase ash storage capacity. As part of this plan, ash was transported to the Asheville Regional Airport (Airport) and beneficially used as structural fill. The structural fill project areas 1, 4, and 3 were completed in 2015. In October 2015, operations began to transport ash to an off-site fully lined landfill near Homer, Georgia. As ash removal operations were conducted within the 1982 Ash Basin, the outfall skimmer was disconnected from the drainage pipe, because sufficient volume existed in the 1982 Ash Basin to store the PMP storm event. Ash removal within the 1982 Ash Basin was completed on September 30, 2016, and decommissioning of the dam is currently underway.

3.1.2 Estimated Volume of CCR Materials in Impoundments

The volume of CCR material contained in the ash basins is presented below. Throughout this document, ash volumes are expressed as tons using the conversion of 1.2 tons per cubic yard (tons/yd^3). Excavation of the 1982 Ash Basin was completed on September 30, 2016, and the Basin was turned over for dam decommissioning and the construction of a natural gas combined cycle plant.

The volume of ash currently in the 1964 Ash Basin is estimated to be approximately 2,900,000 tons as of December 31, 2016 (Duke Energy 2016). A Waste Inventory Analysis, dated January 2015 (Amec Foster Wheeler 2015c), was performed for the 1964 Ash Basin. Since that date some ash from the 1982 Ash Basin was temporarily placed in the 1964 Ash Basin ash stack in 2016. The plant also continues to generate ash resulting from the operation of the coal-fired units, until they are retired from operation. The Waste Inventory Analysis is an estimation of the volume of ash present at the time, but does not include the subsequent ash placed within the basin due to ash stacking operations or generation ash production.

The Waste Inventory Analysis calculations were performed using historical ground surface topographic information from historical design drawings or USGS mapping, and used AutoCAD Civil 3D software to compare the historical ground surface elevation contours with current conditions. In these calculations, an approximate pre-fill ground surface was generated, and pre-fill grades were compared to current North Carolina Flood Plain Mapping LIDAR topography. The Waste Inventory Analysis for the 1964 Ash Basin (including report and calculations) is included with this document as **Appendix A**. All of the ash will be removed from the 1964 Ash Basin prior to dam decommissioning and ash basin closure.

3.1.3 Description of Surface Impoundment Structural Integrity

A Reconstitution of Ash Basin Design (Amec Foster Wheeler 2015e) was performed for the 1982 and 1964 Ash Basins that compiled and analyzed pertinent information regarding the integrity of the embankments. As summarized below, this report examined the geotechnical properties, structural elements (spillways), and hydrology and hydraulics of the basins. The report compiled and analyzed existing reports and evaluations for the ash basins, and addressed data gaps with additional analyses and conclusions for the site. Additional information is presented in the History of Construction Report (Amec Foster Wheeler 2016a) in reference to the hydrologic and hydraulic studies performed after the issuance of the Reconstitution of Ash Basin Design report.

In addition, an additional geotechnical stability analysis was performed by AECOM (AECOM 2016) for the 1964 Ash Basin dam. This analysis analyzed the potential for liquefaction and seismic stability of the embankment to determine if stability improvements to the dam were needed. Based on a review of the historical documents and additional data gathered, the following conclusions were reached for the ash basins and related structures:

<u>Geotechnical analyses show:</u>

- The minimum factors of safety for the 1964 Ash Basin Dam, 1982 Ash Basin Dam, the Separator Dike and the Equalization Basin dike were greater than the target factor of safety requirements for applicable loading conditions at all locations analyzed.
- Seismic Site Class C and D were determined to be appropriate for the 1982 Dam/Separator Dike and Equalization Basin/1964 Dam area, respectively, prior to analysis of liquefaction.
- Based on the Standard Penetration Test (SPT) analyses, widespread liquefaction of the foundation soils of the embankments is not anticipated for the design seismic event. The dams and dikes are not susceptible to liquefaction, and post-earthquake shearing failures of the impoundments are not anticipated. Displacements of the dam/dike crests are not expected.

<u>Structural analyses show:</u>

- The riser structure at the former Duck Pond within the 1964 Ash Basin could not be evaluated due to lack of information regarding the timber pile foundation system. By inspection, it was concluded that this structure was not designed for seismic events and it would likely fail under seismic loading conditions.
- The 1982 Ash Basin riser and outfall pipe were determined to be in poor condition. However, those structures have been abandoned as of the date of this Removal Plan.

<u>Hydrologic and Hydraulic:</u>

- All ash has been removed from the 1982 Ash Basin, and dam decommissioning activities are currently underway. The drawings for the dam decommissioning (**Appendix E**) address the sequencing of grading for removal of the embankment and backfilling to prohibit impounding water, and management of stormwater during this process.
- The total storm volume in the 1964 Ash Basin for the full PMP event is approximately 183.7 acre feet, and the available storage volume is approximately 192.9 acre feet (Amec Foster Wheeler 2016a).

3.1.4 Sources of Discharges into Surface Impoundments

The 1964 Ash Basin currently receives low volume stormwater, sluice water, and stormwater from the switchyards and gypsum pad. Both ash basins receive stormwater from their associated drainage areas. The sluicing operations and effluent discharges from the Plant have historically been routed to the ash basins. However, only the 1964 Ash Basin currently supports ongoing operations with the Duck Pond and the Rim Ditch. Ash is directed to the Rim Ditch, where generation ash is sluiced, recovered, and temporarily placed in the 1964 Ash Basin.

The discharge of effluent from the Plant's operation is permitted under NPDES Permit NC0000396 authorized by the NCDEQ Division of Water Resources (DWR).

3.1.5 Existing Liner System

Based on historical documents, the 1982 and 1964 Ash Basins are not lined.

3.1.6 Inspection and Monitoring Summary

Weekly, monthly, and annual inspections of the ash management facilities are conducted at the Plant consistent with the North Carolina CAMA and CCR Rule and in accordance with the Operations & Maintenance (O&M) Manual (Amec Foster Wheeler 2015d). The findings presented in this section are tracked and resolved in the pertinent work management system.

Independent third-party inspections are performed once every year to promote the design, operation, and maintenance of the surface impoundment in accordance with generally accepted engineering standards.

Annual inspections are performed to gather information on the current condition of the dams and appurtenant works. This information is then used to establish needed repairs and repair schedules, to assess the safety and operational adequacy of the dam, and to assess compliance activities with respect to applicable permits, environmental and dam regulations. Annual inspections are also performed to evaluate previous repairs.

In May 2016, an annual inspection of the Plant ash basin dams was performed (Amec Foster Wheeler 2016b). This inspection included observations of the ash basin dams, discharge towers, and drainage pipes. In addition to the field observations of the physical features of the impoundments, this annual inspection included a review of available design documents and inspection records. This report included findings from previous inspections including, but not limited to, the following documents:

- AMEC Environment & Infrastructure, Inc., “2014 Annual Ash Basin Dam Inspection, Asheville Steam Electric Station,” January 14, 2015;
- Amec Foster Wheeler, “2015 Annual Ash Basin Dam Inspection, Asheville Plant,” May 9, 2016;
- AMEC Environment & Infrastructure, Inc., “2012 Five-Year Independent Consultant Inspection, Cooling Lake Dam and Ash Pond Dams, Asheville Steam Electric Plant,” February 19, 2013;
- S&ME Inc., “Construction Repair Certification Report, 1964 Ash Basin Dam Improvements (Phase II), Progress Energy Asheville Plant,” December 18, 2012;
- NCDENR Notice of Inspection Reports for 1964 Ash Pond Dam (BUNCO-097) dated April 30, 2010; May 6, 2011; February 22, 2012; April 19, 2013; and April 1, 2014;
- AMEC Environment & Infrastructure, Inc., “2013 Report of Limited Field Inspection, Cooling Lake Dam and Ash Pond Dams, Duke Energy Progress – Asheville Steam Electric Plant,” August 5, 2013;
- AMEC Environment & Infrastructure, Inc., “2014 Report of Limited Field Inspection, Cooling Lake Dam and Ash Pond Dams, Duke Energy Progress – Asheville Steam Electric Plant,” August 28, 2014;
- AMEC Environment & Infrastructure, Inc., “Asheville Plant, BUNCO-089-H, BUNCO-097-H Observations, 8/27/2014 through 10/2/2014, Buncombe County, North Carolina,” September 8, 2014, through October 6, 2014;
- NCDENR Notice of Inspection Reports for 1982 Ash Pond Dam (BUNCO-089) dated May 5, 2010; May 6, 2011; February 22, 2012; April 19, 2013; and April 1, 2014;
- Dewberry & Davis, Inc., “Final Coal Combustion Waste Impoundment Dam Assessment Report, Site 7, 1982 Pond & 1964 Pond, Progress Energy Carolinas, Asheville, North Carolina,” Revised Final September 11, 2009;
- Stantec, “Asheville Plant – Field Reconnaissance,” 2014.

The 2016 annual inspection, dated September 12, 2016, states that the “inspection did not identify features or conditions in the inspected ash basin dams, their outlet structures or their spillways that indicate an imminent threat of impending failure hazard. Review of critical analyses suggests 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 being practiced.”

Summary recommendations were developed for both the 1982 and 1964 Ash Basin Dams. The recommendations are summarized in **Table 3-1** and **Table 3-2** for the 1982 and 1964 Ash Basin Dams, respectively.

Table 3-1: 1982 Ash Basin Dam Summary Recommendations (Amec Foster Wheeler 2016b)

Ref. No.	Recommendations	2016 Annual Inspection Status
1982 AP-2009-1 (EPA)	Take precautions to not mow slope when wet or take necessary measures to not create ruts up and down slope.	No ruts observed along slope of embankment.
1982 AP-2009-2 (EPA)	Vegetative cover needs to be established in bare areas.	Bare areas noted during weekly inspections are seeded as required to establish vegetation. Bare areas were not observed during the annual inspection.
1982 AP-2009-3 (EPA)	Small animal burrows found on downstream slope should be filled with appropriate material.	Animal burrows observed and filled with appropriate material as necessary. Continue monitoring
1982 AP-2010 (NCDENR)	Animals should be removed from dam and burrows repaired.	Animal burrows observed and filled with appropriate material as necessary. Continue monitoring.
1982 AP-2010-2013 (NCDENR)	Monitor wet area noted about halfway up downstream slope near left abutment.	No wet area noted on downstream slope. Monitoring of this area continues with weekly inspections.
1982 AP-2012-2014 (NCDENR)	Monitor wetness noted at toe on right abutment and near toe drains.	No wet area noted at the toe on right abutment and near the toe drains. Monitoring of this area continues.
1982 AP-2012-1	Plant personnel should continue to perform their monthly inspections and measurements at the weir and piezometers. The measurements at the weir should not be performed during or within about 12 hours after rainfall events.	Inspections and monthly measurements are continuing.
1982 AP-2012-2	Cut trees and bushes growing within the riprap lined upstream slope. The grass and weeds growing in this area do not need to be cut or killed.	Ash excavation continues. Upper portion of upstream face has established vegetation. Vegetation should be established in lower portion of upstream face. (Note: As of December 2016, ash excavation is complete and dam decommissioning activities are in progress.)
1982 AP-2014-1a (NCDENR)	Repair rutted area along left abutment toe road.	Continue to monitor and repair erosion areas as necessary.

Ref. No.	Recommendations	2016 Annual Inspection Status
1982 AP – 2014-1b (NCDENR)	Monitor mole holes noted on downstream slope.	No evidence of mole activity during inspection.
1982 AP-2014-2	Slope protection should be implemented on the upstream face of the dam during the ash removal process.	Ash excavation continues. Upper portion of upstream face has established vegetation. Vegetation should be established in lower portion of upstream face. (Note: As of December 2016, ash excavation is complete and dam decommissioning activities are in progress.)
1982 AP-2014-4 (Stantec ASH-5)	Establish grass vegetation or other erosion control measures on external slope of separator dike.	Continue to monitor and establish vegetation and other erosion control measures as necessary. (Note: As of December 2016, Riprap has been added to this slope in lieu of vegetation repairs.)
1982 AP 2014-8	Monthly inspection of the dam and measurements of water elevations at the piezometers and seepage flow at the weirs should continue	Inspections and measurements are continuing.

Table 3-2: 1964 Ash Basin Dam Summary Recommendations (Amec Foster Wheeler 2016b)

Ref. No.	Recommendations	2016 Annual Inspection Status
1964 AP-2009-2 (EPA)	Establish a program to have rip-rapped slope cleared of vegetation at least once every year.	Riprap slope is sprayed with herbicide as necessary to kill vegetation.
1964 AP-2010&2011-1 (NCDENR) & 2014-1	Monitor seepage at toe of dam on right abutment where 1971 section over 1964 section begins.	This area of seepage is monitored for change during monthly and weekly inspections. Observed to be similar to previous inspections.
1964 AP-2012-1	Recommended that safety inspection of the 1964 Ash Pond Dam should continue annually.	Annual inspections performed by Amec Foster Wheeler.
1964 AP-2012-2	Regularly remove trees and bushes from the face of the dam.	D/S Slope of dam is sprayed with herbicide as necessary to kill young trees and bushes.
1964 AP-2012-4	Consider installing a flow monitoring weir at the outfall from the concrete structure that collects flow from the toe drains.	Flow meters that were previously installed at toe drain outlets and flow rates are recorded monthly by Duke personnel.
1964 AP-2014-2	Consider installing a flow monitoring device at the outfall of the corrugated HDPE culvert beneath the toe road along the right abutment to monitor seepage from the upstream area where 1971 section over 1964 section begins. In the interim, measure flow with pan and stopwatch.	Flow monitoring device installed in October 2015. Flow is visually monitored and recorded during weekly inspections. Flow is collected into a two inch diameter PVC pipe and discharges into the toe drain outlet structure.
1964 AP-2014-4 (Stantec ASH-6)	Future inspections of the pipe should be performed without water flowing. (Note: this refers to Stantec's Video inspection of the HDPE pipe installed in 2012 between MH#1 in 1964 pond and the new stilling basin outside the 1964 pond.)	Future inspection videos should be performed at a 5-year interval with no flow in the pipe.

Ref. No.	Recommendations	2016 Annual Inspection Status
1964 AP-2014-5	Stability analyses should be performed to improve the adequacy of supporting technical documentation.	Additional analysis performed by AECOM. Based on report dated March 31, 2016, the 1964 Ash Pond Dam is stable for the static and seismic loading conditions outlined in the Duke programmatic guidelines and CCR Rules.
2015-1 Structural (Amec Foster Wheeler)	The riser structure at the Duck Pond within the 1964 Ash Pond could not be evaluated due to lack of information regarding the timber pile foundation system. By inspection, we conclude that this structure was not designed for seismic events and it would likely fail under seismic loading conditions.	Duke evaluating condition to determine appropriate action.
2015-2 Geotechnical (Amec Foster Wheeler)	Slope Stability Analyses: The pseudo seismic acceleration must be updated to meet the requirements of the MPD. Slope stability analyses should be performed for the section at stations 10+00 (where an alluvial layer was indicated) and 13+50 for the downstream section under static and pseudo static load cases.	Additional analysis performed by AECOM. Based on report dated March 31, 2016, the 1964 Ash Pond Dam is stable for the static and seismic loading conditions outlined in the Duke programmatic guidelines and CCR Rules.
2016-1 (Duke Energy weekly inspections)	Small section of riprap on southern downstream slope near abutment road has bare soil. Bare soil should be covered with additional riprap.	Area should be repaired in near future (Duke Work Order # 9583222-3).
2016-2 (Duke Energy weekly inspections)	Northern upstream slope has areas of bare soil and erosion rills in where grading has occurred from the temporary ash stacking project. These areas shall be revegetated.	Bare areas on the northern upstream slope will be revegetated in near future.
2016-3 (Duke Energy weekly inspections)	Erosion along south abutment road.	Erosion shall be continued to be monitored and repaired as necessary.
2016-3 (Duke Energy weekly inspections)	Seepage noted on divider dike on downstream slope into the 1982 basin.	The seep will continue to be monitored during weekly inspections. No flow was observed during the annual inspection.

3.2 Site Maps

3.2.1 Summary of Existing CCR Impoundment Related Structures

A site map that includes a summary of the CCR impoundment-related structures is included as **Figure 3**. This map illustrates the following features that are associated with the CCR units:

- Property boundary (determined from Buncombe County GIS);
- Location of main steam Plant;
- Identification of the CCR surface impoundments and their approximate boundaries;
- 500-foot compliance boundary for the basins (developed from SynTerra information);
- Location of the existing Primary Spillway System and associated features;
- Locations of the Rim Ditch and Decant Basin operations;

- Location of center pond filter system and associated features;
- Drainage culverts downstream of the Ash Basins and under Interstate I-26.

3.2.2 Receptor Survey

SynTerra completed a report, *Drinking Water Well and Receptor Survey for Asheville Steam Electric Plant*, September 2014 (SynTerra 2014a), and later updated it with the *Supplement to Drinking Water Well and Receptor Survey for Asheville Steam Electric Plant*, November 2014 (SynTerra 2014b). The receptor surveys were further updated in the CSA under Section 4.0 (SynTerra 2015a) and in the CSA Supplement 1 (SynTerra 2016b), and Receptor Information with human and ecological receptors, pathways, and their risks associated with exposure to coal ash-derived constituents that maybe present in soil, sediments, surface water, and groundwater are described in Section 5.0 of the CAP part 2 (SynTerra 2016a). Results of the two receptor surveys, and risk assessment updates from the CSA, CAP parts 1 and 2 are herein referred to collectively as receptor surveys, are summarized as follows.

Completion of the receptor surveys included the collection, compilation, and assessment of electronic and field data. Publicly available electronic data used in receptor surveys includes the following sources:

- NCDEQ Division of Environmental Health;
- NC OneMap GeoSpatial Portal;
- DWR Source Water Assessment Program online database;
- County geographic information system;
- Environmental Data Resources, Inc.;
- USGS National Hydrography Dataset.

In addition to the collection and assessment of electronic data, SynTerra completed a visual reconnaissance by driving along public roadways and obtaining information from local property owners using questionnaires. These activities were completed within an approximate 0.5-mile radius of the facility compliance boundary. The goals of these surveys were to identify land development and use, and additional potential water supply wells, including detailed well completion information when possible.

The entire dataset for the receptor surveys was collected to satisfy requirements stipulated by the following:

- CAMA 2014 – North Carolina S.B. 729;
- Notice of Regulatory Requirements received by Duke on August 13, 2014.

In addition to identification of receptors, the compiled data was used to develop a description of the site, surrounding area, geology, and hydrogeology, including a Site Hydrogeologic Conceptual Model (SCM) which are documented in Sections 4.0 and 5.0 of this document.

The results of the receptor surveys conclude the following:

- No public municipal water supply wells exist within the 0.5-mile radius of the compliance boundary. The closest public municipal water supply wells are more than 2 miles from the Site, and produce water from bedrock at depths between 320 to 500 feet below ground surface in areas separated from groundwater near the Asheville Plant by topographic and groundwater divides including the French Broad River;
- Forty private water supply wells and 3 springs were identified within the 0.5-mile radius of the compliance boundary (**Figure B-1, Appendix B**). However, most of the residences receive potable water from municipal water lines, and not all private water wells have been field verified. Additionally, most of these wells are potentially isolated by topographic and groundwater divides, including being west of the French Broad River, or are upgradient of the groundwater flow direction (**Figure B-1, Appendix B**);
- Four of the water supply wells had iron, manganese, sulfate, and TDS above 2L, and NCDEQ recommended that the associated residents use an alternate drinking water supply;
- Five of the 40 private water supply wells within the 0.5-mile radius of the compliance boundary are on the east side of the French Broad River, south of the ash basin along the residential road Bear Leah Trail. A municipal water supply line was completed in 2016 (**Figure B-1, Appendix B**), and the existing private wells along Bear Leah Trail were abandoned in 2016 (SynTerra 2016b);
- Human health exposure media includes potentially impacted groundwater, soil, surface water and sediments with exposure pathways including ingestion, inhalation and dermal contact of the exposure media;
- Potential ecological receptors include aquatic (e.g., fish, benthic invertebrates), semi-aquatic (e.g., piscivorous birds and mammals), and terrestrial (e.g., terrestrial invertebrates, plants, mammals, passerine birds, raptors) receptors;
- While some constituents are found in various media at greater concentrations in the source areas relative to background, many constituents that exceed screening criteria occur at naturally elevated levels.

The identified public and private water supply wells are listed in **Table B-3 of Appendix B**. The table summarizes the following information:

- Map well ID (for figures referenced within the report);
- Property address;
- Property owner;
- Parcel ID number;
- Source of drinking water;

- Well use;
- Approximate distance from compliance boundary (feet);
- Well depth (feet);
- Well casing or open hole depth (feet).

Six of the private water supply wells (DW-3, DW-14, DW-19, DW-27, DW-32, and DW-34) identified within the 0.5-mile radius of the compliance boundary were sampled by NCDEQ for water quality parameters and constituents, including drinking water constituents and parameters, presented in **Table B-1, Appendix B**, between February and July 2015. Two of the sampled wells (DW-3 and DW-19) are on the east side of the French Broad River and south of the Plant. The other four sampled wells (DW-14, DW-27, DW-32, and DW-34) are west of the French Broad River, and south and west of the Plant (**Figure B-1, Appendix B**). Analytical results are further discussed in the CSA.

In 2016, Duke began assessing the water supply wells to understand if the concentrations reflect natural conditions or other potential source areas west of the French Broad River (such as agricultural run-off, use of pesticides, or detergents in septic tank systems). Groundwater underflow across the French Broad River would not be anticipated under natural conditions. Therefore, the assessment is focused on understanding the reason for the constituent concentrations observed (SynTerra 2016b).

Duke collected additional groundwater samples from the former water supply wells on Bear Leah Trail prior to well abandonment and from water supply wells located on the west side of the French Broad River (AS-9, AS-11, AS-13, AS-14, and AS-20) using the available well pumps. Analytical results are further discussed in the CSA Supplement 1, and results are depicted on **Figures 1-14, 1-20, 1-23, 1-47, and 1-50 (Appendix B)**.

The risk assessment synopsis in Section 5.0 of part 2 of the CAP also states that media exposure estimates were less than their respective risk-based concentrations (RBCs) for current use exposure to groundwater with respect to construction and commercial worker exposure via dermal and incidental ingestion pathways. Additionally, Haley and Aldrich (2015) performed an analysis of the groundwater data collected by NCDEQ from 8 private drinking water wells located less than 0.5 miles of the Asheville facility, and 13 private drinking water wells located within a 2 to 10 mile radius of the Asheville facility that concluded the testing provided no evidence for a coal ash management unit release related impact. However, based on lowest observed adverse effect level-derived toxicity reference values, the baseline ecological risk assessment identified potential risk to wildlife from barium, manganese, molybdenum, selenium, and vanadium in seeps and seep soils within the immediate ash basin area (SynTerra 2016a). The settling pond was also identified as a potential risk to wildlife associated with selenium exposure, and in the French Broad River the selenium lowest observed adverse effect level-based HQ was 1 for the meadow vole receptor. However, SynTerra states that the food chain model for risk is an over estimate and selenium is not expected to pose unacceptable risks to ecological receptors in the French Broad River floodplain.

Part 2 of the CAP, Section 2.6, also states numerous wells have been abandoned since completion of the CSA and are provided in Appendix A of Part 2 of the CAP.

3.2.3 Existing On-Site Landfills

No existing on-site landfills are present at the Asheville Plant.

3.3 Monitoring and Sampling Location Plan

SynTerra provided a groundwater monitoring and sampling location plan in the CSA for future monitoring. The monitoring well locations of both historical and planned sampling are shown on **Figure 2-1 and Figure 16-1 of Appendix B**.

3.3.1 Interim Groundwater Monitoring Plan

The groundwater monitoring and sampling location plan is a longer-term, future sampling plan described under Section 16.0 of the CSA. The goals of this plan are to collect sufficient data to determine site-specific background water quality concentrations, support current interpretations of Site data, and to monitor for temporal trends.

The Interim Groundwater Monitoring Plan recommends a total of 46 monitoring well locations within 5 different geologic units including (**Table 16-2 and Figure 16-1, Appendix B**):

- Alluvium – 9 monitoring wells;
- Transition Zone – 17 monitoring wells;
- Saprolite – 8 monitoring wells;
- Bedrock – 12 monitoring wells.

The groundwater monitoring wells were also selected to include a combination of the above geologic units for groundwater monitoring in areas based on the following rationales:

- Determine background concentrations upland of basins – 9 monitoring wells;
- Downslope of the ash basin, both next to the French Broad River (13 monitoring wells) and southwest (8 monitoring wells) of the Site – 21 monitoring wells;
- Monitor contaminant migration south (2 monitoring wells), east (2 monitoring wells), and northwest (5 monitoring wells) of the basins – 9 monitoring wells;
- Next to 1964 basin, to monitor intersecting flow path to French Broad River – 7 monitoring wells.

The recommended parameter and constituent list includes a set of 6 field parameters, a suite of 21 inorganic constituents, major cations and anions, nitrate, total dissolved solids (TDS), total organic carbon (TOC), and total suspended solids (**Table 16-1, Appendix B**). Analytical methods and associated reporting limits are also provided for each parameter and constituent (**Table 16-1, Appendix B**).

The Interim Groundwater Monitoring Plan recommends a triannual groundwater sampling frequency intended to provide insight into potential seasonal trends, if any.

The Interim Groundwater Monitoring Plan presented in Section 16.0 of the CSA described above will be superseded by the updated Interim Monitoring Plan (IMP), and a post-closure Effectiveness Monitoring Program (EMP) described in Section 9.0 of Part 2 of the CAP, if and when the proposed remedial actions are accepted as proposed in Part 2 of the CAP. The IMP and EMP proposed in Part 2 of the CAP are described in further detail under **Section 11** of this document.

Additional characterization of the bedrock flow system beneath the ash basins and at a background location was requested by NCDEQ (SynTerra 2016b). Monitoring well ABMW-11BR was installed at a central location within the 1964 and 1982 Ash Basin waste boundary **(Figure 1-2, Appendix B)**. ABMW-11BR has been sampled twice since installation. Monitoring well CB-1BRL was also installed at a background location **(Figure 1-2, Appendix B)**.

4. RESULTS OF HYDROGEOLOGIC, GEOLOGIC, AND GEOTECHNICAL INVESTIGATIONS

The information in this section is a summary based on the Phase 2 Reconstitution Report (Amec Foster Wheeler 2015e), CSA report (SynTerra 2015a), and CSA Supplement 1 (SynTerra 2016b). More detailed descriptions can be found in the original reports.

4.1 Hydrogeology and Geologic Descriptions

4.1.1 Regional Geology

The Plant is within the Blue Ridge Physiographic Province of North Carolina. This province is characterized by a mountainous vegetated terrain with elevations ranging from 1,500 feet above mean sea level at the base of the escarpment to summit altitudes of over 6,000 feet.

The formations that underlie the Blue Ridge Physiographic Province primarily consist of complexly folded and faulted metamorphic and igneous rock with some sedimentary rock that make up the Blue Ridge geologic belt. The Blue Ridge geologic belt complexity is a result of extensive sheet thrusting, and is bounded to the southeast by the Brevard zone, a zone of major southwest–northeast faulting, and to the northwest by the Valley and Ridge Physiographic province in eastern Tennessee that are composed of low angle thrust faults. Within the Brevard zone, there are two major thrust faults approximately 1.3 miles southeast of the site (**Figure 6-1, Appendix B**). Since their deformation and Cenozoic uplift, this assemblage of metasedimentary and metavolcanic rock has been exposed and subjected to an extended period of erosion, and the erosion has produced a rugged terrain, consisting of steep mountains, intermittent basins, and trench valleys.

4.1.2 Regional Hydrogeology

Due to the geologic complexity of the Blue Ridge Physiographic Province, numerous studies have been conducted, including the USGS Regional Aquifer-System Analysis, which refers to hydrogeologic terranes instead of identifying specific aquifers and confining units for the province. Groundwater occurrence in the Blue Ridge Physiographic Province has been grouped into two hydrogeologic terranes identified by rock types and median well yields:

1. Gneiss-granite terrane having an interquartile well yield of approximately 8 to 32 gallons per minute (gal/min);
2. Schist-sandstone terrane having an interquartile well yield of approximately 10 to 61 gal/min.

Groundwater resides within the soil/saprolite regolith and is hydrologically connected with the underlying fractured bedrock forming a composite water-table aquifer system. Local groundwater flow is primarily influenced by 1) the soil/saprolite regolith thickness, and its existence, and 2) the nature of the parent bedrock. Typically, topographic highs exhibit thinner soil/saprolite zones, and topographic lows exhibit thicker soil/saprolite zones, with gneiss and schist rock sources having thicker soils and relatively higher fracture densities compared to unaltered igneous rocks, including granite. The higher fracture density and thicker soil zones of the gneiss and schist bedrock provide efficient transition zones with less clay, and may facilitate both rapid lateral groundwater movement along unweathered bedrock and vertical groundwater movement to underlying fractured rock.

Groundwater flow is also influenced in the area by precipitation serving as recharge, seasonal water table fluctuations with highs in the winter and lows in the fall, flow boundaries such as rivers, and topography where ridges can serve as groundwater divides. In general, groundwater flow in the area can be classified as a slope-aquifer system.

4.2 Stratigraphy of the Geologic Units Underlying Surface Impoundments

The stratigraphy of geologic units underlying the surface impoundments is similar in characteristics described for the local and regional geology. A comparison of preconstruction topography before installation of the ash basin to current elevations is consistent with measured ash thickness in core samples and indicates ash depth generally mimics the historical land surface. Borings drilled within the ash basins indicated a distinct contact between the ash and underlying soils without visible evidence of ash staining into underlying soils (Section 7 of CSA report).

In particular, the ash basins directly overly the local residual soils (Section 7 of CSA report). Toward the Lake Julian dam, ash overlies saprolite with increasing thickness (**Figure 6-3 and Figure 6-4, Appendix B**). The saprolite within the ash basin is underlain by transition zone media and a bedrock of mica gneiss, a member of the late Precambrian Ashe Metamorphic Suite. The Geologic Map of the Skyland Quadrangle (Dabbagh 1981) describes the underlying bedrock as being mainly composed of gray to dark gray, fine- to medium-grained gneiss. Of note is a shear zone trending northeast-southwest, which is mapped to underlie the approximate northwestern side of the 1982 Ash Basin.

4.3 Hydraulic Conductivity Information

The horizontal hydraulic conductivities of the site hydrogeologic zones were determined from in-situ field slug testing of wells in accordance with the Groundwater Assessment Work Plan (GAP) Section 7.1.4 (**Table 6-5, Appendix B**). The slug tests were performed in accordance with the documented standard ASTM D4044-96 (Appendix C of CSA report [SynTerra 2015a]). A total of 143 slug tests was performed at 47 well locations (**Table 4-1**). The tests were analyzed primarily by the Hvorslev analytical solution, with some well tests analyzed by the Bouwer-Rice analytical solution for wells that were not fully penetrating (Appendix G of CSA report [SynTerra 2015a]) according to the methodology described in Appendix C of the CSA report. Locations of tested wells are shown on **Figure 2-1 of Appendix B**.

The slug testing results listed in **Table 6-5 of Appendix B** includes individual well test hydraulic conductivity results, calculated geometric means for repeated testing of individual wells and for each hydrogeologic zone having multiple well results, and minimum and maximum values for individual wells and for each hydrogeologic zone. Testing results include testing of wells completed in hydrogeologic zones below the ash basins and in the surrounding area (**Figure 2-1, Appendix B**).

Table 4-1: Summary of Hydraulic Conductivity Geometric Mean Monitoring Well Slug Testing Results for Each Hydrogeologic Zone

Hydrogeologic Zone	Number of Wells Tested	Number of Slug Tests	Hydraulic Conductivity Geometric Mean (cm/sec)	Hydraulic Conductivity Geometric Mean (ft/day)
Ash Basins	3	7	1.52E-04	4.32E-01
Alluvium	2	15	3.21E-03	9.09E+00
Saprolite	7	25	2.83E-04	8.01E-01
Transition Zone	18	57	3.09E-04	8.76E-01
Bedrock	17	39	4.77E-04	1.35E+00

The results of slug testing indicate spatial variability throughout the site and between different hydrogeologic zones. Slug testing of alluvial deposits indicated approximately an order of magnitude higher hydraulic conductivity than other hydrogeologic zones (**Table 4-1**).

The hydraulic conductivity values for wells screened in the transition zone spanned three orders of magnitude from 1.1 × 10E-5 to 1.3 × 10E-2 centimeters per second (cm/sec), with a mean of 3.1 × 10E-4 cm/sec (**Table 6-5, Appendix B**). The large range in results reflects the degree of weathering which can be highly variable within the transition zone and related to the degree of infilling of fractures, varying amounts of clays, and other weathering products.

In addition to in-situ, horizontal hydraulic conductivity slug testing, three laboratory vertical hydraulic conductivity tests were performed on cores collected in Shelby tubes. These laboratory tests are reflective of site conditions because the ash basin is not lined (**Table 6-6, Appendix B**). A 2.5-foot core was collected from bore hole ABMW-02SB, and 2-foot cores were collected from both ABMW-07 and MW-16SB (**Table 6-6, Appendix B**). The intervals selected for testing the core represent three distinct zones: saprolite, ash, and alluvium, with values of 2.60E-06, 8.60E-06, and 4.80E-07 cm/sec, respectively. The vertical conductivity testing results are one to two orders of magnitude lower than horizontal conductivity values from in-situ slug testing, supporting a predominantly lateral groundwater flow in the Site area. In addition, the results support a predominantly lateral migration of COIs relative to vertical migration.

4.4 Geotechnical Properties

Subsurface investigations were performed as part of previous design and reconstitution projects at the Asheville Steam Electric Generating Plant. A summary of available boring, monitoring well, and piezometer locations involving the ash basins is shown on **Figure 4**. In these investigations, geotechnical properties were developed to characterize the soils and ash present at the site. As previously discussed, there is no liner underneath the ash basins. For this Removal Plan, the geotechnical properties listed below were gathered from the following previous reports:

- Amec Foster Wheeler, "Subsurface Exploration and Laboratory Testing Data Report, Landfill Development and Ash Basin Closure," August 2015;
- Amec Foster Wheeler, "Phase 2 Reconstitution of Ash Pond Designs, Final Report Submittal, Revision B, Asheville Steam Station," July 17, 2015;
- S&ME, Inc., "Subsurface Investigation and Slope Stability Analysis of 1964 Ash Basin Dike," December 28, 2009;
- S&ME, Inc. "1964 Ash Basin Dam Improvement Design – Appendix I – Slope Stability Analysis Discussion and Summary," December 28, 2009;
- MACTEC Engineering and Consulting, Inc., "Geotechnical Exploration Data Report, Asheville FGD Project, Constructed Wetlands System," October 18, 2004;
- MACTEC Engineering and Consulting, Inc., "Report of Geotechnical Exploration, 1982/1964 Ash Pond Drainage Modification Project," January 19, 2011;
- MACTEC Engineering and Consulting, Inc., "Final Report for Task ASH-1 Issue," August 2014;
- Law Engineering, Inc., "Stability Analysis of Downstream Slope, 1982 Ash Pond Dike," September 30, 1992;
- AMEC, "Asheville Steam Plant, Final Report for Task ASH-2 Issue," August 26, 2014.

<u>1982 Ash Basin Dam</u>

Design parameters for the 1982 Ash Basin Dam were developed from the analysis completed by Law Engineering (1992) and from the Phase 2 Reconstitution of Design report (Amec Foster Wheeler 2015e). The following material properties were developed from these analyses:

Table 4-2: Unit Weight and Shear Strength Parameters for the 1982 Ash Basin Dam

Material Description	Unit Weight	Shear Strength			
		Effective		R-Envelope	
	(pcf)	c' (psf)	Φ' (degree)	c' (psf)	Φ' (degree)
Embankment	120	400	33.9	0	32.8
Sand Drain	120	0	36	0	36
Foundation Soil	130	400	32	650	30
Partially Weathered Rock	135	10,000	45	10,000	45

*Note: Material Description information is included in the Phase 2 Reconstitution Report (Amec Foster Wheeler 2015e).

1964 Ash Basin Dam

The subsurface stratigraphy for the dam has been based on the stability analysis completed for the 1964 Ash Pond Dam (S&ME 2009) and on the Phase 2 Reconstitution of Design report (Amec Foster Wheeler 2015e). The following material properties were developed from this analysis:

Table 4-3: Unit Weight and Shear Strength Parameters for the 1964 Ash Basin Dam

Material Description	Unit Weight	Shear Strength			
		Effective		R-Envelope	
	(pcf)	c' (psf)	Φ' (degree)	c' (psf)	Φ' (degree)
Zone 1 - Core	120	200	32	600	17
Zone 2 - Rock Shell	120	0	47	0	47
Zone 3 – Mixed Fill	120	0	40	440	24
Zone 4 – Drainage Zone	120	0	36	0	36
Upstream Rockfill	120	0	40	0	40
Ash Fill	120	0	30	0	30
Ash (Above Water)	85	0	30	0	30
Ash (Below Water)	85	0	30	0	20
Ash Stack	85	0	30	0	30
Original 1964 Dike Fill	120	0	40	420	21
1971 Cofferdam Fill	120	0	30	300	20
Stilling Pond Embankment	120	140	33	400	20
Alluvium	120	50	28	50	24
Residual Soil	120	115	35	330	25
Partially Weathered Rock	120	1000	40	1000	40

*Note: Zone and Material Description information is included in the Phase 2 Reconstitution Report (Amec Foster Wheeler 2015e)

Separator Dike

The design parameters for the Separator Dike were developed from the Final Report for Task ASH-2 Issue (AMEC 2014b) and from the Phase 2 Reconstitution of Design report (Amec Foster Wheeler 2015e). The following material properties were developed from these analyses:

Table 4-4: Unit Weight and Shear Strength Parameters for the Separator Dike

Material Description	Unit Weight	Shear Strength			
		Effective		R-Envelope	
	(pcf)	c' (psf)	Φ' (degree)	c' (psf)	Φ' (degree)
Embankment	120	400	33.9	0	32.8
Zone 3	120	0	40	435	24.4
Ash	85	210	28.8	40	19.4
Zone 1	120	200	32	1000	16.9
Foundation Soil	130	400	32	650	30
Partially Weathered Rock	135	10,000	45	10,000	45

*Note: Zone and Material Description information is included in the Phase 2 Reconstitution Report (Amec Foster Wheeler 2015e).

Residual Materials in 1982 Ash Basin

Amec Foster Wheeler drilled an additional 30 borings within the limits of the 1982 Ash Basin. Laboratory tests were performed on samples collected from these borings. The samples generally consisted of ash fill within the basin, and residual materials from the original ground underlying the basin. Since ash removal was completed on September 30, 2016, **Table 4-5** only lists the material properties that were developed for the residual materials from these analyses.

TABLE 4-5
Index Property Test Results of Materials in 1982 Ash Basin

Boring	Sample Type	Sample Depth (Feet bgs)	Visual Identification	Natural Moisture Content, %	Dry Unit Weight, pcf	Atterberg Limits			Percent Finer Than No. 200 Sieve	Other Test
						Liquid Limit	Plastic Limit	Plasticity Index		
BL-1A	UD-1	15-17	Yellowish Brown Silt with Sand (ML)-RESIDUUM	74.8* 81.6*		NP	NP	NP	82.8	S.G. = 3.00 k
BL-8	Bulk-1	0-10	Brown Silty Sand (SM) - RESIDUUM	22.7*		NP	NP	NP	41.1	S.G. = 2.72 P
BL-14	Bulk-1	0-8.9	Brown Silty Sand (SM) - RESIDUUM	12.9 12.7*		NP	NP	NP	27.7	S.G. = 2.78 P
BL-19	Bulk-1	0-10	Brown Silty Sand (SM) - RESIDUUM	17.8		NP	NP	NP	36.2	S.G. = 2.73 P

SPT-Standard Penetration Test/Split-Spoon; UD-Undisturbed Sample;
P - Moisture-Density Relationship Test; NP-Non Plastic;
k – Hydraulic Conductivity Test; S.G.-Specific Gravity Test
*Result obtained from a different laboratory test method (i.e., Hydraulic Conductivity, Atterberg limit test, etc.)

Prepared/Date: H. Benkhayal/7-29-2015
Checked/Date: C. Tockstein/7-29-2015

CCR and Residual Materials in 1964 Ash Basin

A subsurface investigation was performed by Amec Foster Wheeler in 2015 with the intent of providing additional information for the development of closure and/or landfill options for the ash basins. As part of this investigation, 10 borings were drilled within the limits of the 1964 Ash Basin. Laboratory tests were performed on samples collected from these borings. The samples generally consisted of ash fill within the basin, and residual materials from the original ground underlying the basin. The following material properties were developed from these analyses:

I/A

TABLE 4-6
Index Property Test Results of Materials in 1964 Ash Basin

Boring	Sample Type	Sample Depth (Feet bgs)	Visual Identification	Natural Moisture Content, %	Dry Unit Weight, pcf	Atterberg Limits			Percent Finer Than No. 200 Sieve	Other Test
						Liquid Limit	Plastic Limit	Plasticity Index		
BC-2	UD-1	21-23	Dark Gray Sandy Silt (ML) - Fly Ash - FILL	26.7*		NP	NP	NP	55.4	S.G. = 2.15
BC-2	UD-2	51-53	Brown Micaceous Silty Sand (SM) - RESIDUUM	18.5* 20.5*		NP	NP	NP	13.7	S.G. = 2.81 k
BC-4	SPT-1	3.5-5	Light to Dark Gray Sandy Silt - Fly Ash - FILL	35.5						
BC-4	SPT-2	8.5-10	Light to Dark Gray Sandy Silt - Fly Ash - FILL	35.4						
BC-4	SPT-3	13.5-15	Dark Gray Sandy Silt - Fly Ash - FILL	34.3						
BC-4	SPT-4	18.5-20	Dark Gray Sandy Silt - Fly Ash - FILL	40.9						
BC-4	SPT-6	28.5-30	Dark Gray Sandy Silt - Fly Ash - FILL	47.0						
BC-4	SPT-8	40-41.5	Dark Gray Sandy Silt - Fly Ash - FILL	46.8						
BC-4	SPT-10	48.5-50	Dark Gray Sandy Silt - Fly Ash - FILL	45.5						
BC-4	SPT-12	58.5-60	Dark Gray Silty Sand with Gravel - Fly Ash - FILL	38.4						
BC-4	SPT-14A	68.5-69.2	Light to Dark Gray Sandy Silt - Fly Ash - FILL	37.7						
BC-4	SPT-14A	69.2-70	Reddish Brown Sandy Lean Clay - RESIDUUM	24.8						
BC-4	SPT-16	78.5-79	Dark Gray and Brown Silty Sand - RESIDUUM	29.8						

SPT-Standard Penetration Test/Split-Spoon; UD-Undisturbed Sample;
P – Moisture-Density Relationship Test; NP-Non Plastic; k – Hydraulic Conductivity Test;
S.G.-Specific Gravity Test *Result obtained from a different laboratory test method (i.e. Hydraulic Conductivity, Atterberg limit test, etc.)

Prepared/Date: H. Benkhayal/7-29-2015
Checked/Date: C. Tockstein/7-29-2015

TABLE 4-6 (Continued)
Index Property Test Results of Materials in 1964 Ash Basin

Boring	Sample Type	Sample Depth (Feet bgs)	Visual Identification	Natural Moisture Content, %	Dry Unit Weight, pcf	Atterberg Limits			Percent Finer Than No. 200 Sieve	Other Test
						Liquid Limit	Plastic Limit	Plasticity Index		
BC-4	UD-1	20-22	Dark Gray Silty Sand (SM) - Fly Ash - FILL	18.0*		NP	NP	NP	43.8	S.G. = 2.34
BC-5	Bulk-1	28.5-38.5	Dark Gray Silt with Sand (ML) -Fly Ash - FILL	31.3*		NP	NP	NP	80.5	S.G. = 2.26 P
BC-7	Bulk-1	5-15	Dark Gray Silt (ML) - Fly Ash - FILL	25.6*		NP	NP	NP	84.8	S.G. = 2.34 P
BC-8	UD-1	26-28	Reddish Brown Silty Sand (SM) - RESIDUUM	14.8*		NP	NP	NP	30.1	S.G. = 2.73 k
BC-8	UD-2	55.5-57.5	Gray Micaceous Silty Sand (SM) - RESIDUUM	27.5* 32.5*		NP	NP	NP	25.3	S.G. = 2.80 k
BC-9	SPT-1	5-6.5	Very Dark Gray Sandy Silt – Fly Ash - FILL	32.4						
BC-9	SPT-2	8.5-10	Very Dark Gray Sandy Silt – Fly Ash - FILL	42.2						
BC-9	SPT-3	13.5-15	Very Dark Gray Sandy Silt – Fly Ash - FILL	39.3						
BC-9	SPT-4	18.5-20	Very Dark Gray Sandy Silt – Fly Ash - FILL	32.5						
BC-9	SPT-5	23.5-25	Very Dark Gray Sandy Silt – Fly Ash - FILL	51.9						
BC-9	SPT-6	28.5-30	Very Dark Gray Sandy Silt – Fly Ash - FILL	43.6						
BC-9	SPT-7	33.5-35	Very Dark Gray Sandy Silt – Fly Ash - FILL	58.1						

SPT-Standard Penetration Test/Split-Spoon; UD-Undisturbed Sample;
P - Moisture-Density Relationship Test; NP-Non Plastic; k – Hydraulic Conductivity Test;
S.G.-Specific Gravity Test *Result obtained from a different laboratory test method (i.e. Hydraulic Conductivity, Atterberg limit test, etc.

Prepared/Date: H. Benkhayal/7-29-2015
Checked/Date: C. Tockstein/7-29-2015

I/A

TABLE 4-6 (Continued)
Index Property Test Results of Materials in 1964 Ash Basin

Boring	Sample Type	Sample Depth (Feet bgs)	Visual Identification	Natural Moisture Content, %	Dry Unit Weight, pcf	Atterberg Limits			Percent Finer Than No. 200 Sieve	Other Test
BC-9	SPT-9	43.5-45	Very Dark Gray Sandy Silt – Fly Ash - FILL	78.5						
BC-9	SPT-11	53.5-55	Strong Brown, Yellow, and Dark Reddish Brown Sandy Silt - RESIDUUM	23.4						
BC-9	SPT-13	63.5-65	White, Strong Brown, and Very Dark Gray Sandy Silt - RESIDUUM	40.7						
BC-10	Bulk-1	13.5-23.5	Dark Gray Silt (ML) - Fly Ash - FILL	27.9*		NP	NP	NP	86.1	S.G. = 2.30 P
BC-10	UD-1	35-37	Gray Silt (ML) - Fly Ash - FILL	26.8*		NP	NP	NP	97.8	S.G. = 2.31

SPT-Standard Penetration Test/Split-Spoon; UD-Undisturbed Sample;
P - Moisture-Density Relationship Test; NP-Non Plastic; k – Hydraulic Conductivity Test;
S.G.-Specific Gravity Test *Result obtained from a different laboratory test method (i.e. Hydraulic Conductivity, Atterberg limit test, etc.)

Prepared/Date: H. Benkhayal/7-29-2015
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4.5 Chemical Analysis of Impoundment Water, CCR Materials and CCR Affected Soil

Source area characterization of the site is described in the CSA (SynTerra 2015a) and supplemented by the CAP Part 1 (SynTerra 2015b). The characterization includes the collection and analysis of soil, groundwater, surface water, and sediment samples from the ash basins and surrounding area to identify provisional background concentrations and the extent of impacts. Sample locations are identified on **Figure 2-1, Appendix B**. Development of groundwater provisional background concentrations for key constituents is an ongoing process that primarily entails collection of sufficient groundwater samples to provide statistically meaningful results. The long-term goal is to calculate upper prediction limits for the pool of background data to be used for comparison to samples collected from monitoring wells located hydraulically downgradient of the ash basins. EPA guidance documents indicate that eight to 10 rounds of background sample data are necessary to develop meaningful provisional background concentrations. Six rounds of background sample data are included in the CSA Supplement 1 (SynTerra 2016b), and results are tabulated in **Tables 4-1 through 4-8 (Appendix B)**.The analysis of CCR ash and pore water from the ash basins resulted in the identification of Site-specific constituents of interest (COIs). The COIs are constituents that are associated with the ash basin and are elevated above background values. Some COIs are also identified in water quality samples collected from background monitoring wells, and they require careful examination to determine their origin and source. The COIs identified from the Asheville Plant ash material and pore water sample analyses include antimony, arsenic, boron, chromium, cobalt, iron, manganese, sulfate, thallium, TDS, vanadium, and pH. These COIs are identified as exceeding either the 2L or Interim Maximum Allowable Concentrations (IMAC) in at least one ash pore water monitoring well (CSA report [SynTerra 2015a]).

4.5.1 Source Area(s) Characterization

Included in this section are the results of the ash basin and seep source area characterization, as presented in the CSA Report (SynTerra 2015a). Media sampled by SynTerra included ash matrix, ash porewater, settling basin surface water, and seep water.

<u>CCR Ash Materials Chemical Analyses Results</u>

A total of 10 borings and 13 monitoring wells were drilled and installed using rotary sonic drilling with continuous sample recovery (Section 7 of CSA report [SynTerra 2015a]). The drilling locations were divided between the 1964 (borings AB-01 and AB-03 and monitoring wells ABMW-02, ABMW-02S, ABMW-04, ABMW-04D, and ABMW-04BR) and the 1982 (borings AB-09 and AB-10 and monitoring wells ABMW-05S, ABMW-05D, ABMW-05BR, ABMW-06BR, ABMW-07, ABMW-07S, ABMW-07BR and ABMW-08) ash basins (Appendix E of the CSA report). During this drilling program, ash samples were collected from the basin in accordance with GAP Section 7.1.1 for analysis of total metals, U.S. Environmental Protection Agency (USEPA) Synthetic Precipitation Leaching Procedure (SPLP), and Energy Dispersive X-Ray

Fluorescence (EDXRF) with documented methodologies in Appendix C of the CSA report (SynTerra 2015a).

Results from 16 ash samples were analyzed for total metals, and results identified 14 constituents (aluminum, antimony, arsenic, barium, beryllium, cobalt, copper, iron, lead, manganese, mercury, molybdenum, selenium, and vanadium) at levels exceeding one or more of the USEPA Soil Regional Screening Level (**Table 7-4, Appendix B**). Ash samples from the basin were also analyzed for TOC content and resulted in values from 9,630 to 87,800 milligrams per kilogram.

Results from eight ash samples tested using the SPLP method were compared to the 2L for informational purposes and values of antimony, arsenic, chromium, cobalt, iron, manganese, nitrate, selenium, thallium, and vanadium were typically in exceedance of the 2L reference values. However, boron in ash SPLP leachate was not in exceedance of the 2L value. These results were also compared to background soil values. The comparison of ash SPLP leachate results to background soil values indicates the following:

- Antimony, arsenic, selenium, and vanadium values in SPLP leachate from ash are higher than background soils. However, these metals are typically not detected in background soils, with the exception of vanadium and sporadic selenium.
- Boron, chromium, cobalt, iron, lead, manganese, nitrate, and thallium leachate results indicate similar ranges of concentrations from soils and ash.

While the above metals are identified as being elevated in the SPLP leachate of ash samples, SPLP concentrations in soil samples collected from below the ash basins do not suggest migration of these metals from the source material.

Results from three ash samples analyzed by EDXRF indicate whole rock metal oxide (**Table 7-6, Appendix B**) and elemental content (**Table 7-7, Appendix B**). The results indicate the ash primarily consists of oxides of silicon (SiO_2), aluminum (Al_2O_3), and iron (Fe_2O_3) (**Figure 7-1, Appendix B**).

Results from chemical analyses of ash samples collected throughout the ash basins indicate aluminum, arsenic, barium, cobalt, iron, lead, manganese, mercury, selenium, and vanadium are above either the USEPA Regional Screening Level (RSL) for Protection of Groundwater or Residential Health.

<u>CCR Ash Impoundment Pore Water Chemical Analyses Results</u>

Ash pore water quality samples were collected for analysis of the expanded analyte list, metals speciation, and radiological parameters. The samples were collected from ash basin monitoring wells ABMW-02 and ABMW-04 in the 1964 Ash Basin (**Table 7-8, Appendix B**), and from monitoring wells ABMW-08, P-100, P-101, and P-103 in the 1982 Ash Basin. The results indicate that antimony, arsenic, boron, chromium, cobalt, iron, manganese, sulfate, thallium, TDS, vanadium, and pH are above the 2L or IMAC in ash pore water (**Table 7-9, Appendix B**).

Analysis of the analytical results using published methods referenced in the CSA also indicate that the redox state of pore water within both the ash basins is anoxic, with some mixed anoxic processes identified at well ABMW-04 in the 1964 basin (**Table 7-8, Appendix B**).

Speciation results of arsenic, chromium, iron, manganese, and selenium are provided for wells ABMW-02 and ABMW-04 (**Table 7-10, Appendix B**). The results indicate that trivalent iron is the predominant species of iron in both well pore water samples, and hexavalent chromium is below the USEPA tapwater screening level of 0.035 microgram per liter (µg/L) in ash pore water.

Settling Basin Surface Water Characteristics

One surface water sample was collected from the settling basin located within the 1964 Ash Basin, SW-05 (**Table 9-3, Appendix B**) [SynTerra 2015a]. Most of the constituent detections above the 2L or 2B values were from this sample. SynTerra noted no corrective action is necessary because the wastewater from this basin is under a NPDES permit.

Summary of CCR Waste Boundary Seep Water Sediment Characteristics

Seeps have been documented and sampled by SynTerra (**Figure 2-1, Appendix B**). Seep data includes results from the June 2014 Asheville Seep Monitoring Report (SynTerra 2014c) with samples from 17 representative seeps below (downgradient of) the ash basins, NCDENR seep sampling in 2014 (**Table 9-4, Appendix B**), and seep results from 11 seeps that confirm the extent of impacted groundwater with COI values above the 2L or IMAC (**Table 9-2, Appendix B**). Concentrations from seep P-01 are consistent with background surface waters (**Figures 9-1 and 9-2, Appendix B**). SynTerra also compared the results of the 11 seep samples in **Table 9-2, Appendix B**, to North Carolina Administrative Code (NCAC) Surface Water (2B) values.

4.5.2 Surface Water and Sediment Assessment

Summary of Surface Water Characteristics

Samples of sediment, surface water, and seeps were collected in August 2015 and analyzed for water quality (**Figure 2-1, Appendix B**). Sediment samples were collected from the same locations of surface water and seep sample water quality collection (**Figure 2-1, Appendix B**).

Sediment sample results from background locations exceed one or more RSLs for a few COIs including aluminum, cobalt, iron, and manganese (**Table 9-1, Appendix B**). The sediment samples collected from seeps below (downgradient of) the ash basins exceeded the RSL for COIs including aluminum, antimony, arsenic, barium, cobalt, copper, iron, manganese, mercury, molybdenum, nickel, selenium, and thallium in at least one sample. The side-gradient sediment sample results from SW-01 are generally similar to background values except for elevated aluminum and barium.

SynTerra provided results for surface water samples collected from the French Broad River (upstream and downstream from the Site), Lake Julian, and areas within the French Broad River floodplain. Two samples, one from upstream of the French Broad River (FB-01) and the other from Lake Julian (SW-06), serve as background locations for comparison. Surface water sample results to seep sample results are compared in Piper diagrams (**Figures 9-1 and 9-2, Appendix**

B). The upstream and downstream French Broad River samples did not vary. However, thallium was detected only at the upstream site (0.202 µg/L), which may indicate other potential sources of thallium outside the ash basins. The surface water samples that have concentrations greater than 2B values are listed in **Table 9-5, Appendix B**. Surface water sample results for constituents that are elevated compared to background and lack a 2B value include boron, iron, manganese, sulfate, TDS, and vanadium.

In part 2 of the CAP, Section 2.5, SynTerra reports that additional seep, surface water, and sediment data was collected in November 2015 with a seep inspection performed on November 19, 2015. The results of an initial screening of the data indicates no substantial variation from August 2015 with no newly identified seeps.

To further refine knowledge of hydrogeologic conditions, ten stream gauges were installed in March 2016. Gauges were co-located with CSA surface water sample locations A-01, A-02, B-01, C-01, and D-01, spanning the eastern side of the French Broad River along the western stretch of the property boundary. Gauges were also co-located at SD-01 and N-01, representing the western portion of Powell Creek below the Lake Julian dam. A gauge was placed in the outfall area of the 1964 dam, correlating to surface water sample location C-02. Stream gauge survey information is provided in **Table 1-1 (Appendix B)**. Four surface water features (two springs and two surface water drainages) were sampled as part of the additional assessment west of the French Broad River (SynTerra 2016b). The purpose of collecting surface water samples is to evaluate the contribution of agricultural and domestic activities to observed concentrations of boron in water supply wells. The primary area targeted for investigation is located on the same parcel as AS-14 (115 Justin Trail). In May 2016, four surface water samples were collected in upgradient, sidegradient, and downgradient areas to agricultural fields. Data is presented in **Table 3-1 (Appendix B)**.

4.6 Historical Groundwater Sampling Results

A detailed description of groundwater characterization from the installation and sampling of 47 new monitoring wells and 36 existing monitoring wells is provided in Section 10 of CSA report (SynTerra 2015a). A summary of those findings is provided in this section.

The sampling locations and dates are listed in **Table 10-1 of Appendix B**, and the full parameter list with analytical methods and reporting limits are listed in **Table 10-2 of Appendix B**. Analytical results are listed in **Table 10-3 of Appendix B**.

The results of groundwater sampling indicate that 18 analytes exceed the 2L or IMAC in groundwater at the Site (**Table 10-4, Appendix B**). The area of groundwater concentrations exceeding 2L is identified under the ash basins and to the west along groundwater flow lines up to the French Broad River (**Figure ES-1, Appendix B**). Five of the 18 parameters (pH, cobalt, iron, manganese, and vanadium) exceed the 2L or IMAC in one or more background wells. In 2013, chromium was sporadically detected above the 2L limit at background monitoring well CB-01. While concentrations for 18 parameters are in exceedance of 2L or IMAC values, no private or public wells are within the impacted area (**Figures ES-1, and 10-5 to 10-56, Appendix B**).

The speciation data results are presented in **Table 10-3 of Appendix B** and indicate the following:

- Background groundwater is oxic, with oxic and mixed conditions in groundwater upgradient of the ash basins.
- Groundwater beneath the ash basins is anoxic and mixed anoxic.
- Downgradient and side gradient groundwater is variable.

Part 2 of the CAP, Section 2.6, discusses additional characterization of the bedrock flow system beneath the ash basins at a background location is included within data gap activities as requested by NCDEQ. The information collected during the data gap activities is not expected to substantially alter the groundwater corrective action plans proposed in Part 2 of the CAP. The data gap activities include confirmation sampling on a private water supply well located on the west side of the French Broad River, and confirmed initial results of iron, manganese, and TDS at levels greater than the 2L standard, and boron elevated above background but below the 2L standard. Additionally, a third and fourth set of CSA groundwater data was collected in December 2015 and January 2016 for comparison to the initial two sets of data and to supplement background data. Six rounds of monitoring for CSA parameters have been completed through July 2016 and **Tables 1-2 through 1-5 (Appendix B)** provide a summary of groundwater from all sampling events completed to date (*e.g.*, CSA and NPDES programs) that exceed 2L or IMAC for each of the primary hydrogeologic flow zones (surficial transition zone, and bedrock). Additional sampling is scheduled in September and November of 2016 from select Asheville wells (**Table 1-8, Appendix B**). Additional data from sampling results and results of analysis are included in the CSA Supplement 1 (SynTerra, 2016b). CAMA sampling locations are summarized in **Table 1-8 (Appendix B)** with locations and rationale for inclusion. Background wells CB-09 (saprolite), CB-09SL (lower saprolite), CB-09BR (bedrock), CB-01 (surficial), CB-01D (transition zone), AMW-03B (bedrock), and MW-10 (alluvial) are planned to be monitored to provide a more robust data set for provisional background concentration evaluation. Groundwater data reported from previous rounds of monitoring from the majority of wells across the site is consistent and confirms the current understanding of site conditions, specifically the extent of impact to groundwater from ash basin-sourced constituents (*e.g.*, boron). However, monitoring of select wells along the east side of the French Broad River and west of the ash basins is anticipated to be ongoing in 2016. Data gap wells installed in 2016 (ABMW-11BR, MW-18BRL) are also included in the 2016 sampling program.

4.6.1 Summary of Surficial Aquifer Results

Surficial aquifer samples were collected from 27 saprolite monitoring wells and 9 alluvial monitoring wells. The results indicate that impacts downgradient of the ash basins and wastewater treatment constructed wetlands from leaching of the source areas are migrating toward the French Broad River resulting in 17 parameters in the saprolite, and 11 parameters in the alluvium that exceed 2L or IMAC (**Table 10-4, Appendix B**). SynTerra reports that the wells completed within the surficial zone downgradient of the ash basin and the wastewater treatment constructed wetlands are the most impacted by leaching from the source areas. The CSA Supplement 1 reports the following results for background data. Surficial groundwater is represented by alluvial well MW-10 and saprolite wells CB-1, CB-09, CB-9SL, and MW-24S, and provisional background concentrations were calculated for those wells. Exceedances above 2L and IMAC values were noted for pH (all wells), hexavalent chromium (MW-10, CB-9, CB-9SL, and MW-24S); chromium (CB-1), cobalt (MW-10, CB-1, CB-9. MW-24S), iron (all wells), manganese (MW-10, CB-1, CB-9, MW-24S), and vanadium (CB-9).

The CSA Supplement 1 reports the following results for downgradient wells. Concentrations of boron, cadmium, chloride, cobalt, iron, manganese, hexavalent chromium, selenium, strontium, sulfate, thallium, TDS, and vanadium have been detected in alluvial monitoring wells in excess of the 2L, IMAC values. In general, concentrations within the floodplain area of the French Broad River have remained relatively stable, with one exception at CB-6. Concentrations of cobalt, manganese, sulfate and TDS increased substantially between July and November 2015, January 2016, and April 2016. These increases can be correlated to a decrease in pH from 5.9 to 3.4. The pH at CB-6 was 4.7 in July 2016. Concentrations of antimony, boron, cobalt, hexavalent chromium, iron, manganese, nitrate, sulfate, TDS, thallium, and vanadium have been detected in saprolite monitoring wells in excess of the 2L and IMAC values; however, none of these constituents exceeded corresponding provisional background concentrations beyond the compliance boundary. In general, concentrations within saprolite wells have remained stable with slight increases of boron noted in wells MW-8S and MW-9S and slight increases of boron, sulfate, and TDS in GW-3. **Figure 1-81 (Appendix B)** presents a piper diagram that indicates samples from the alluvial and saprolite flow zones appear to be divided into two sub-groups, sulfate and chloride type. Samples collected downgradient of the 1964 Ash Basin are dominated by chloride, while those collected downgradient from the 1982 Ash Basin are more associated with sulfate type water. This difference is attributed to the former wetland treatment areas recently removed from the 1964 Ash Basin.

4.6.2 Summary of Transitional Zone Aquifer Results

In general, the distribution of parameters in exceedance of the 2L or IMAC in the transition zone samples mimics those identified in the surficial aquifer, but at reduced concentrations. Twenty-four wells within the transition zone were sampled, and boron, chromium, cobalt, iron, manganese, nickel, nitrate, selenium, sulfate, thallium, TDS, and vanadium were detected at concentrations greater than the 2L or IMAC. One well, MW-09D, showed concentrations of chloride and selenium greater than the 2L.

The CSA Supplement 1 reports transition zone groundwater is represented by one monitoring well, CB-1, and provisional background concentrations were determined for this well. Exceedances above 2L or IMAC are noted for pH, cobalt, iron, manganese, and vanadium. Downgradient results indicate concentrations of boron, chloride, chromium, cobalt, hexavalent chromium, iron, manganese, nitrate, nickel, selenium, sulfate, TDS, thallium, and vanadium have been detected in transition zone monitoring wells in excess of 2L and IMAC values. Of these constituents, cobalt, iron, manganese, and vanadium are detected greater than provisional background concentrations (which are greater that the 2L or IMAC values) downgradient of the 1964 and 1982 Ash Basins beyond the compliance boundary in transition zone wells. Concentrations of boron, chloride, sulfate, and TDS beyond the compliance boundary are greater than provisional background concentrations, but less than 2L. In general, concentrations within transition zone wells have remained stable. **Figure 1-82 (Appendix B)** presents a piper diagram that indicates samples from the transitional flow zone associated with the 1982 Ash Basin tend to show sulfate type characteristics, while those associated with the 1964 Ash Basin tend to be associated with chloride type water. Groundwater from background locations and unaffected areas near each ash basin are characterized by calcium bicarbonate type groundwater, typical of shallow fresh groundwater.

4.6.3 Summary of Bedrock Aquifer Results

Bedrock groundwater samples were collected from 20 wells and indicated exceedances of 2L or IMAC for 9 parameters, and most have exceedances of cobalt, iron, manganese, and vanadium (**Table 10-4, Appendix B**). Boron was only detected in a quarter of the bedrock wells sampled, and sulfate was detected above the 2L at MW-18BR.

The CSA Supplement 1 presents data from two background monitoring wells, CB-9BR and AMW-3B, and provisional background concentrations were determined for these wells. Exceedances above 2L and IMAC values were noted for pH (both wells); hexavalent chromium (both wells), iron (both wells); manganese (both wells); and vanadium (both wells).

Concentrations of boron, chloride, chromium, cobalt, hexavalent chromium, iron, manganese, selenium, sulfate, TDS, thallium, and vanadium have been detected in bedrock monitoring wells in excess of 2L or IMAC values. Iron and manganese have been detected in exceedance of 2L and provisional background concentrations beyond the compliance boundary to the south of the 1982 Ash Basin. Chloride, strontium, and TDS are found at levels greater than the provisional background concentration beyond the compliance boundary west of the 1964 Ash Basin and south of the 1982 Ash Basin. In general, concentrations within bedrock wells have remained stable with a few exceptions. Initial monitoring indicates increasing concentrations are noted in downgradient monitoring wells of the 1964 Ash Basin: MW-9BR (boron, chloride, iron, manganese, sulfate, strontium, and TDS) and GW-2 (boron chromium, iron, manganese, sulfate, and strontium). However, these data sets are limited, and further monitoring will determine if these increases are trends. Similar to the transition zone, bedrock groundwater is consistent with calcium-bicarbonate type water. The distinction of the 1964 Ash Basin groundwater (chloride-type) and the 1982 Ash Basin groundwater (sulfate type) is evident and most clearly defined in this flow zone. Groundwater downgradient of the ash basins is characteristic of calcium – sulfate type water (**Figure 1-83, Appendix B**).

4.7 Groundwater Potentiometric Contour Maps

Existing site wells and piezometers have been used to monitor groundwater levels in and around the 1982 and 1964 Ash Basins. During monthly site visits, the wells and piezometers are gauged using a water-level meter to measure the depth to water to the nearest 0.01 foot. All measurements are referenced to the top of riser casing and recorded on a well gauging form. Groundwater gauging data from June 2015 were used to develop surficial (alluvium, saprolite, and transition zone) and bedrock water-level maps (**Figure 6-10 and Figure 6-11, respectively, Appendix B**). And groundwater gauging data from December 2015 were used to develop an updated surficial (alluvium, saprolite, and transition zone) and bedrock water-level maps provided in Part 2 of the CAP (**Figure 2-1 and Figure 2-2, respectively, Appendix C**). The surficial potentiometric data was combined with the transition zone data because the aquifers do not appear to be isolated.

Groundwater flow remains consistently to the west and southwest toward the French Broad River. During the April to July 2015 data collection period, the groundwater hydraulic gradient calculated from the northeast edge of the 1982 Ash Basin to the dam wall along the southwest edge of the basin averaged 0.03 foot/foot. During this same four-month period, the hydraulic gradient calculated from the dam wall along the southwest edge of the 1982 Ash Basin to the wells along the French Broad River averaged 0.06 foot/foot.

For the June 2015 contour figures, water levels in a combined 107 wells and piezometers were gauged within a 24-hour period on June 29, 2015. This provided a snapshot in time of the groundwater elevation data for the multiple flow systems observed at the Site (**Table 6-2, Appendix B**).

The potentiometric surfaces developed from the June 2015 water level measurements for the combined surficial/transition zone and bedrock hydrogeologic zones indicate a substantial variability in the Site horizontal gradients (**Table 6-2, Figures 6-10 and 6-11, and Appendix B**). The horizontal gradients were used with Site-specific slug test hydraulic conductivity values and average porosities to calculate groundwater flow velocities at the Site (Appendix G of CSA report). The resulting groundwater flow velocities range from 0.61 foot to 3,266 feet per year. The highest values are observed near the ash basins due to the increased hydraulic gradients that are related to the location of the basins at topographic highs.

Vertical groundwater gradients were also calculated using select well pairs (**Table 6-4, Appendix B**). The wells in upland areas indicate downward vertical gradients of 0.9 foot, and the remaining well clusters show vertical gradients near equilibrium (Section 6, CSA report [SynTerra 2015a]).

The CSA Supplement 1 presents the following additional information. A comprehensive, site-wide round of water level measurements from all site monitoring wells was collected during a 24-hour period on December 17, 2015 for comparison to previous measurements collected during June 2015 for the CSA. The water level data are presented in **Table 1-6 (Appendix B)**. No significant changes in water levels or groundwater flow directions were noted in December 2015 as compared to the June 2015 water level map included in the CSA Report (SynTerra, 2015a). However, it was also noted that the recent ash excavation and dewatering of the 1982 Ash Basin has effectively lowered the potentiometric surface in adjacent downgradient compliance wells (CB-2, CB-3R) that have had significant decreases in water elevation since the basin dewatering began in 2012. Hydrograph data is shown on **Figure 1-80 (Appendix B)**, and is summarized in the CSA Supplement 1.

4.8 Figures: Cross Sections Vertical and Horizontal Extent of CCR within the Impoundments

As previously discussed, groundwater at the site generally flows from east to west, from the ash basins toward the French Broad River, following topography. Similarly, the COIs are expected to be highest near the ash basins with transport toward the west. The area of groundwater concentrations exceeding 2L are identified under the ash basins and to the west along groundwater flow lines up to the French Broad River (**Figure ES-1, Appendix B**).

The vertical and horizontal extent of ash at the Site is illustrated in relation to local hydrogeologic zones underlying and surrounding the ash basins, including the vertical extent of areas where groundwater quality standards exceed the 2L or IMAC standards in plan layout view and in cross-sections developed form the drilling and monitoring program (CSA report [SynTerra 2015a]). Relevant available figures from the CSA report (**Appendix B**) are listed below.

- Plan Layout Figures (**Appendix B**):
    - General Site map with cross-section lines, well locations, and boundaries, **Figure 2-1;**
    - Geologic map with ash basin delineations, **Figure 6-1;**
    - Surficial soil exceedances of COIs, **Figure 8-3;**
    - Groundwater 2L exceedances for ash pore water, surficial, transition zone, and bedrock wells, **Figures 10-1 to 10-4;**
    - Ash pore water well isoconcentration maps of antimony, arsenic, boron, chloride, chromium, cobalt, iron, manganese, pH, sulfate, thallium, TDS, and vanadium, **Figures 10-5 to 10-17;**
    - Surficial groundwater well isoconcentration maps of antimony, arsenic, boron, chloride, chromium, cobalt, iron, manganese, pH, sulfate, thallium, TDS, and vanadium, **Figures 10-18 to 10-30;**
    - Transition zone groundwater well isoconcentration maps of antimony, arsenic, boron, chloride, chromium, cobalt, iron, manganese, pH, sulfate, thallium, TDS, and vanadium, **Figures 10-31 to 10-43;**
    - Bedrock groundwater well isoconcentration maps of antimony, arsenic, boron, chloride, chromium, cobalt, iron, manganese, pH, sulfate, thallium, TDS, and vanadium, **Figures 10-44 to 10-56;**
    - Detection monitoring results for ash, surficial, transition zone, and bedrock wells, **Figures 10-57 to 10-60;**
    - Assessment monitoring results for ash, surficial, transition zone, and bedrock wells, **Figures 10-61 to 10-64.**

- Cross-section Figures (Section line locations depicted in **Figure 2-1, Appendix B**):
  - Geology and water level, **Figures 6-3 and 6-4;**
  - Geology and water level with photographs of core, **Figures 6-5 to 6-9;**
  - Conceptual Site model with area of COIs greater than 2L and IMAC, **Figure 6-12;**
  - Geology and water level with groundwater and soil analytical results for sampled monitoring wells and borings, **Figures 8-1 and 8-2;**
  - Geology and water level with individual COIs (antimony, arsenic, boron, chromium, chloride, cobalt, iron, manganese, sulfate, TDS, thallium, vanadium, **Figures 11-1 to 11-12.**

The CSA Supplement 1 contains updated geologic cross sections for various COI's.

5. GROUNDWATER MODELING ANALYSIS

As previously discussed in **Section 2.2**, NCDEQ granted permission for Duke to submit the CAP in two phases. Part 1 of the CAP was submitted on November 20, 2015. Part 1 includes background information, a brief summary of the CSA findings, a brief description of site geology and hydrogeology, a summary of the previously completed receptor survey, a description of 2L and 2B exceedances, proposed site-specific groundwater background concentrations, a detailed description of the site conceptual model, geochemical assessment and modeling, and numerical groundwater flow and transport modeling used to evaluate the effects of various potential closure options on groundwater and surface water quality.

The second part of the CAP was submitted on February 19, 2016, and identifies updated numerical modeling results, alternative corrective actions, the proposed corrective action, conceptual plans for recommended corrective actions, implementation schedule, and a plan for future monitoring and reporting.

The groundwater modeling analysis prepared by SynTerra is presented as a combination of assessments including the following:

- SCM development;
- Geochemical assessment and modeling;
- Numerical flow and transport modeling.

The information from each of the above assessments was successively used to develop the next in order to develop a complete model of the system.

Modeling in Part 1 of the CAP was used to assess source handling and control options with the following scenarios:

- Existing Conditions;
- Capping Ash Basins;
- Removal of Ash.

Ash removal by excavation with lowering of the dams, and installation of drains was proposed as the recommended source control option and modeling in Part 2 of the CAP addresses alternative remedial alternatives to restore groundwater after ash removal including:

- Monitored Natural Attenuation;
- Groundwater Extraction;
- In-Situ Chemical Immobilization;
- Permeable Reactive Barrier.

The modeling results were then used to select the final combined recommended remedial approach following specific alternative evaluation criteria described in detail in Section 6.0 of the CAP Part 2:

- Effectiveness;
- Implementability/Feasibility;
- Environmental Sustainability;
- Cost; and
- Community Acceptance.

Modeling applied with the above alternative evaluation criteria, resulted in selection of monitored natural attenuation as the proposed groundwater restoration alternative. After initial selection of Monitored Natural Attenuation, the modeling results were used to assess the effectiveness against the EPA guidance methods for monitored natural attenuation using a tiered approach. The four tiered objectives from EPA cited by SynTerra are:

I. Demonstration that the ground-water plume is not expanding and that sorption of the contaminant onto aquifer solids is occurring where immobilization is the predominant attenuation process;

II. Determination of the mechanism and rate of the attenuation process;

III. Determination of the capacity of the aquifer to attenuate the mass of the contaminant within the plume and the stability of the immobilized contaminant to resist re-mobilization, and;

IV. Design performance monitoring program based on the mechanistic understanding developed for the attenuation process, and establish a contingency plan tailored to the site-specific characteristics.

The final result of the modeling efforts by SynTerra is the recommendation for ash removal, dam lowering, and installation of drains, followed by monitored natural attenuation.

The following section presents the SCM. Predictions for post-closure groundwater elevations are included in the figure, "**Predicted Post-Closure Groundwater Elevation, Asheville Steam Electric Plant, Arden, North Carolina**," included in **Appendix B**.

Each assessment detailed in Part 1 and 2 of the CAP is summarized in the following sections.

5.1 Site Conceptual Model

SynTerra developed and summarized the components of a SCM for the Asheville Plant area in Section 11 of the CSA report, and Section 3 of the CAP Part 1 (SynTerra 2015b), and used it as the basis for the development of the numerical groundwater transport model presented in Part 1 of the CAP. The SCM was developed from data (discussed in Section 4) generated during previous assessments and existing groundwater monitoring data. The SCM was modified based on the results of the 2015 groundwater assessment activities and included geochemical testing and analysis described in Part 1 of the CAP and further refined in Part 2 of the CAP.

The SCM identifies the following key aspects for model development and predictions of potential impacts:

- The two ash basins, designated as the 1964 and 1982 ash basins, and a constructed wetlands used for FGD treatment within a portion of the 1964 ash basin, are identified as the source of potential COIs;
- Groundwater wells immediately downgradient of the constructed wetlands indicate potential impact from FGD blowdown wastewater;
- The subsurface geology at the Asheville Plant is composed of alluvium in the French Broad River valley, saprolite, a transition zone, and fractured shallow bedrock;
- Groundwater flow is unconfined and generally follows topography;
- Groundwater flow is from the east and dominated by Lake Julian at higher elevation (2160.7 feet mean sea level [MSL]), and discharges to the French Broad River in the west at lower elevation (2030 feet MSL), that then flows north;
- The primary factor in constituent transport across the site is hydraulic control, with the hydraulic head at Lake Julian and significant topographic relief driving groundwater flow through the system from the ash basin to the French Broad River;
- Groundwater flow from the Lake Julian area to the French Broad River occurs over less than half a mile;
- Groundwater is significantly influenced by the unlined, secondary settling basin at the northeastern corner of the 1964 ash basin with an average water level of 2137 feet MSL;
- Groundwater is recharged by Lake Julian and aerial precipitation that also occurs within the ash basins;
- Coal ash is primarily above the existing water table, but historically would have been below the water table during sluicing operations;
- The ash basin source areas discharge pore water to the subsurface beneath the basins and via seeps through the embankments;
- Forty-one private water wells have been identified within one-half mile of the site, with more than half on the west side of the French Broad River, and a large number south of the site;
- The primary site-specific COIs identified as being above 2L or IMAC standards in ash pore water are: antimony, arsenic, boron, chromium, cobalt, iron, manganese, sulfate, thallium, TDS, vanadium, and pH;

- Boron and cobalt are the most prevalent COIs in downgradient groundwater. The identified boron plume extends to saprolite, the transition zone and bedrock groundwater, and to wells west of the French Broad River;
- Boron concentrations are elevated in a localized area downgradient from the northwest corner of the constructed wetlands, but are typically significantly below 2L standards and generally less than the detection limit in background wells;
- Cobalt is identified in groundwater throughout the site at concentrations above the IMAC without a distinct plume, having similar values identified in background wells and ash pore water, and transition concentrations that often exceed ash pore water values;
- Boron, chloride, cobalt, sulfate, and TDS were selected as a subset of site-specific COIs to represent the extent of contamination for further modeling because values of other COIs either do not significantly exceed background levels, and/or no discernable existing associated plume is downgradient from the ash basins.

5.2 Geochemical Modeling

The geochemical modeling detailed in Part 1 of the CAP (SynTerra 2015b) provides qualitative and quantitative estimations of key COIs behavior in the Site environment. The geochemical modeling and assessment results were performed to address site-specific processes and characteristics identified in the SCM. Part 1 of the CAP presents a detailed discussion of the geochemical properties of the COIs in relation to site-specific materials and how these properties relate to the retention and mobility of these constituents. The mobility of the COIs is addressed in a detailed soil sorption evaluation provided in Part 1 of the CAP, (Appendix B) that had the objective of providing site-specific sorption coefficients (K_d) for each COI for use in numerical modeling and incorporates effects related to oxidation/reduction potential (E_H) and pH. In Part 2 of the CAP, geochemical modeling was used to assess alternative groundwater restoration scenarios and to assess site specific monitored natural attenuation against the EPA tiered approach for monitored natural attenuation.

5.2.1 Soil Sorption Evaluation

SynTerra contracted the University of North Carolina at Charlotte (UNCC) to perform and analyze soil sorption characteristics. UNCC developed K_d values for COIs using 12 soil samples collected during the geotechnical and environmental exploration program at the site between March 13 and January 2, 2015 (**Table 1 of Appendix C**). The 12 soil samples were selected to represent the saturated zone beneath and downgradient of the ash basin. The solutions used in both the batch and column sorption testing were generated in the laboratory as synthetic groundwater with targeted COI concentrations (**Table 2 of Appendix C**). The leachates of the batch and column testing were analyzed for 13 analytes (arsenic, beryllium, boron, cadmium, chromium, cobalt, antimony, iron, manganese, nickel, selenium, thallium, and vanadium). Desorption assessment was subsequently performed on column tests by application of six pore volumes of laboratory-grade water to assess the potential for COI mobilization after sorption.

Leaching analysis of two ash samples from each basin, 1982 and 1964, was also conducted using standard Methods 1313 and 1316 to assess the source of COIs.

The soil sorption evaluation by UNCC assumed that metal oxy-hydroxide phases of iron, manganese, and aluminum in the soil samples are the most important phases in terms of sorption of COIs, and provided quantitative analysis of these phases in the soil samples.

UNCC identified general concerns with applying batch and column testing results to the field results, and key findings of the soil sorption evaluation.

Soil Sorption Evaluation General Comments:

- The synthetic groundwater used differs from in-situ groundwater chemistry, and the soil samples were originally exposed to different geochemical conditions before testing;
- The geochemical interaction of COIs with the soils in the same testing solution may result in different sorption characteristics;
- Tests were performed at atmospheric conditions, and redox conditions were not adjusted to represent field conditions. The sorption results are reflective of the redox conditions in the lab and may not be representative of other redox conditions;
- The soil samples were sieved to less than 0.30 millimeter before testing, which could affect the laboratory-determined K_d value.

Soil Sorption Evaluation Key Findings:

- The batch and column testing for most COIs yielded results that were typically within one order of magnitude difference for each COI, with the exception of cadmium, chromium, cobalt, nickel and vanadium, which spanned two orders of magnitude;
- The batch test for boron was inconclusive. A K_d value could not be determined due to non-linear behavior, negligible sorption, and/or leaching of boron from the soil sample. The column experiment for boron produced a K_d range from less than 10 to 75 milliliters per gram (mL/g);
- Iron and manganese were not included in the synthetic groundwater solution, but their presence in leachates provide insight into their potential for leaching;
- Ash leaching tests indicated negligible (close to the detection limit of 1 part per billion) leaching of beryllium, cadmium, cobalt, copper, nickel, lead, thallium and zinc;
- Ash leaching tests indicated increased concentrations of arsenic, boron, chromium, iron, molybdenum, selenium, and vanadium in the leachate solution, and the leachate concentrations of these COIs were higher for the 1982 basin test compared to the 1964 basin test.

An addendum to the initial UNCC soil sorption evaluation study was provided in Part 2 of the CAP to include calculation of three sorption isotherm equations for the batch testing data provided in Part 1 of the CAP. Isotherm equations are presented in Appendix D of Part 2 of the

CAP. Linear, linear with irreversible sorption fraction, and Freundlich sorption isotherms equations for antimony, arsenic, beryllium, boron, cadmium, chromium, cobalt, nickel, selenium, thallium, and vanadium are included in tabular and graphical format.

5.2.2 Geochemical Numerical Modeling Analysis

In addition to the geochemical sorption testing and analysis performed by UNCC, SynTerra contracted Brian Powell, Ph.D., to perform a geochemical assessment and modeling of the overall mobility of COIs at the site. The results of this testing and analysis are presented in detail in Appendix C of Part 1 of the CAP and updated with modeling results using additional site specific data in Appendix C of Part 2 of the CAP. The geochemical assessment and modeling includes the sorption processes performed by UNCC and precipitation/coprecipitation reactions involving COIs and mineral phases. This assessment also accounted for geochemical reactions and COI speciation influenced by the pH and E_H of the pore water at the site. The geochemical modeling was performed using the USGS program PHREEQC and the results were compared to the UNCC Soil sorption evaluation study results (**Table 5.1 of Appendix C**). In Part 1 of the CAP sorption was modeled as being associated only with hydrous ferric oxide (HFO) using values based on the measured extractable iron content of the aquifer solids in site samples. In Part 2 of the CAP additional data, including extractable iron and aluminum concentrations, was used in the numerical modeling of COIs to account for HFO, gibbsite (HAO), and potential variations in site specific pH and E_H, using averages, minimums and maximums to bracket values, that could occur due to system changes associated with remediation. The CAP Part 2 assessment compares K_d values obtained from PHREEQC simulations of sorption with sorption identified in Part 1 of the CAP from UNCC laboratory batch testing.

In summary, the geochemical modeling identified the following results:

- Boron as borate, barium, and zinc were identified as being relatively mobile with low K_d values;
- Boron has the lowest experimentally and simulated K_d, and therefore is assumed to be a conservative representation of known areas of groundwater impact;
- Arsenic, iron, manganese, selenium, and vanadium also were identified as having low K_d values, but were predicted for the “worst case” scenario. The modeled E_H and pH conditions similar to those during the UNCC laboratory testing produced generally similar results as the UNCC tests for these COIs;
- The modeled and the experimental boron sorption were significantly different (1000x), where boron sorption was underpredicted by the modeling. In either case, boron is considered highly mobile under site conditions;
- Sorption processes were identified as a dominant removal mechanism, and the number of sorption sites required for complete removal of the total of all constituents in solution is calculated as less than 1% of the available sorption sites. It is concluded that sufficient

sorption capacity exists for removal of high concentrations of all COIs (**Table 6.2 Appendix C**).

Recommendations and limitations of the geochemical modeling from Part 1 of the CAP include:

- Consideration of aluminum oxide surface for sorption should be included to improve predictions, and may in part be related to the observed differences between experimental and modeled K_d values for boron;
- Additional studies to identify sorption site density of solid phases for soils are needed to verify assumptions on site densities used in modeling;
- Additional speciation data is needed to verify predicted oxidation states of arsenic, selenium, vanadium, and other redox-sensitive COIs under site conditions;
- Predictive geochemical modeling using fixed E_H and pH site-specific conditions could be used to verify observed field data for model verification;
- A statistical analysis of the correlation between dissolved COIs and dissolved organic carbon in pore waters is recommended to identify potentially associated sorption relationship to COI mobility.

Part 2 of the CAP addressed some of the above recommendations and limitations including:

- Assessment of aluminum oxide surface sorption;
- Incorporation of additional data to support sorption site density;
- Incorporation of pH and E_H data to support predicted oxidation states for redox-sensitive COIs under site conditions.

5.3 Numerical Groundwater and Transport Modeling

SynTerra provided a detailed numerical groundwater flow and transport model report in Appendix D of Part 1 of the CAP (SynTerra 2015b) and updated modeling results in Part 2 of the CAP (SynTerra 2016a). The model was based on the SCM and geochemical modeling and assessment using MODFLOW to simulate hydrologic flow, and MT3DMS to simulate COI transport. The numerical flow and transport models were developed such that the key site-specific geological and hydrogeological features identified in the SCM and geochemical assessment influencing the migration, chemical, and physical characteristics of contaminants are represented.

The described numerical groundwater model is a three-dimensional groundwater flow and contaminant fate and transport model having the objective of predicting the following in support of the CAP:

- Predict concentrations of the COIs at the compliance boundary or other locations of interest over time;
- Estimate the groundwater flow and constituent loading to surface water discharge areas;

- Predict approximate groundwater elevations in the ash for the proposed corrective action;
- Predict fate and transport of COIs for the different remedial alternatives for groundwater restoration.

The model and model report were developed in general accordance with the guidelines found in the memorandum Groundwater Modeling Policy, issued by NCDEQ DWQ on May 31, 2007 (DEQ modeling guidelines).

5.3.1 Numerical Groundwater Flow Model Description

The MODFLOW model includes the following features:

- The model covers an area of approximately 802.5 acres centered on the site, and includes Lake Julian and the French Broad River as constant-head boundary conditions to the east and west, respectively;
- Surface topography was interpolated from NCDOT LIDAR data;
- Ash basin top elevations, for both the 1964 and 1982 ash basins, came from site-specific survey data;
- Geologic grids developed from interpolation between well boring logs and represented by 16 model layers were discretized horizontally at a 40-foot by 40-foot spacing, resulting in 240,202 active cells;
- Hydraulic conductivities were determined through calibration;
- Recharge was set as 6 inches per year for upland areas, and 1 inch per year historically at the Plant site for the dams of Lake Julian and the two ash basins to represent the impervious nature of the facility and compacted soils. The ash basins during current conditions had infiltration rates of 6 and 12 inches per year for the 1982 and 1964 basins, respectively. Final basin recharge rates ranged from 12 to 24 inches per year;
- The settling pond in the 1964 basin and dewatering basin in the 1982 basin were also set as constant-head boundaries within the model;
- Creeks and drains determined from LIDAR elevations were assigned in the model using the MODFLOW DRAIN feature;
- Steady-state flow calibration targets included 97 water level measurements taken in June 2015.

Sensitivity analysis of the flow model was performed after calibration. The results indicated that the numeric flow model is insensitive to small changes in the main hydraulic conductivity parameters, the model is more sensitive to changes in the bedrock hydraulic conductivity value compared to shallow layers, and the uncertainty is likely a factor of 2 or more, but less than an order of magnitude.

5.3.2 Numerical Groundwater Transport Model Description

Transport was assessed using MT3DMS with the MODFLOW-generated transient flow velocity fields representing the time from January 1964 to July 2015. The transient flow field began with steady-state conditions, followed by development history of the 1964 and 1982 ash basins broken into three successive periods:

1. High infiltration rate in the 1964 basin representing ash sluicing from 1964 to 1982;
2. Increased infiltration rate in the 1982 basin from 1982 to 2013;
3. Current basin infiltration rates from 2013 to 2015.

The combined CAP Part 1 and 2 transport modeling took into account the following characteristics:

- Boron, chloride, cobalt, manganese, sulfate, and TDS selected as a subset of site-specific COIs to represent the extent of contamination for modeling;
- Source concentrations in the ash basins identified in ash pore water samples;
- Soil-water distribution coefficients (K_d) for the lowest UNCC cobalt value (2.5 mL/g), and a default low value of 0.1 mL/g to represent boron and sulfate retardation consistent with other sites;
- Longitudinal, transverse and vertical dispersivity of 20 feet, 2 feet, and 0.2 feet, respectively;
- Effective porosity of 0.2 in unconsolidated layers and 0.001 in bedrock layers;
- Soil dry bulk density of 1.6 g/mL.

Initial background COI concentrations were set as zero concentration to represent no impacts in 1964. The saturated cells within layers 3–7 underlying the ash basins were assigned constant concentrations to represent the source of COIs. The report notes that the placement of constant concentrations several feet deeper than the ash basins potentially results in an overestimate of the COIs in groundwater below the basins. The transport of COIs was then calibrated to concentrations measured in samples from 98 monitoring wells in June 2015.

The calibrated model comparison of simulated to measured boron, chloride, cobalt, sulfate, and TDS concentrations is listed in **Tables 6, 7, 8, 9, and 10 of Appendix C**, respectively.

5.4 Groundwater Chemistry Effects

Predictions of groundwater chemistry effects were modeled for three possible source control scenarios presented in Part 1 of the CAP:

1. Closure Model Scenario #1 (CMS1) – no further action;

2. Closure Model Scenario #2 (CMS2) – complete ash removal from the 1982 and 1964 Ash Basins, installation of drains along the bottom of the former ash basins, and backfilling and regrading of the former ash basins with clean fill to 2110 feet and 2120 feet MSL based on the Amec Foster Wheeler Environment & Infrastructure (Amec Foster Wheeler) ash basin closure design (2015) (**Figure 29 of Appendix C**);
3. Closure Model Scenario #3 (CMS3) – adds an impermeable surface cap to CMS1.

All source control scenario predictions were used to provide simulated results through year 2045, and results in Appendix D of the CAP Part 1 are presented at 5 years (2020), 15 years (2030), and 30 years (2045). Results provided in the CAP Part 1 are only presented for boron under the assumption that it provides the most conservative estimate of widespread transport. Boron is considered the most conservative COI based on laboratory sorption evaluation and geochemical modeling. However, updated modeling results are provided in the CAP Part 2 to address potential source contribution of manganese, sulfate and TDS concentrations by applying observed concentrations to model simulations for these constituents. A manganese concentrations of 7000 µg/L in the western parts of the 1964 and 1982 basins, and a manganese concentration of 1000 µg/L for the eastern parts of the basins.

The model report results for the CMS1 scenario indicate that the boron plume is stabilized after 30 years, and little change occurs. This is because the boron plume has already reached the French Broad River from the 1964 ash basin, while the boron plume from the 1984 basin recedes due to reduced infiltration through the ash basin.

The model results for the CMS2 scenario indicate little effect on the boron plume within the first 2 years, but by 2030 the simulation predicts that the boron plume in the shallower part of the system will be significantly reduced (**Figure 39 of Appendix C**), as will the southern area of the deeper part of the system (**Figure 40 of Appendix C**). By year 2045, the simulation predicts that the extent of boron will be greatly reduced, both horizontally and vertically (**Figures 41 and 42 of Appendix C**). The dominant concentration reduction mechanism is dilution by flushing of groundwater from upgradient toward the French Broad River. The remaining boron is identified in lower conductivity zones which receive less flushing.

The model results for CMS3 are relatively similar to those identified for CMS1 with the exception that the boron plume is slightly reduced for CMS3 compared to CMS1.

While predictions are based on the conservative nature of boron, Part 1 of the CAP identified that the pH and oxidation/reduction potential has a fundamental influence on the extent of contaminant mobility for redox sensitive COIs.

Part 2 of the CAP addressed alternative corrective action measures for groundwater restoration which required additional numerical transport modeling of fate and transport of COPCs to evaluate the effectiveness of the different remedial alternatives.

The alternative corrective action measures evaluated are:

- Monitored Natural Attenuation (MNA);

- Groundwater Extraction (recovery wells or trenches) with fracture enhancement option;
- In-Situ Chemical Immobilization;
- Permeable Reactive Barrier.

Each alternative was evaluated and discussed in Section 6.0 of Part 2 of the CAP including model simulations to support the final recommended approach.

The groundwater extraction simulation included a line of 10 bedrock pumping wells covering 800 feet located beyond the northwest corner of the 1964 ash basin along the access road near the toe of the 1964 dam, and eighty feet into the saturated bedrock. The simulation indicated that each of the 10 wells was able to sustain a pumping rate of 0.3 gpm for a combined total of 3 gpm resulting in drawdown of 10 to 20 feet in each well. The boron transport simulation with source excavation. MNA, and groundwater extraction indicates that the bulk of the boron plume mass is removed by the year 2030 with some smaller areas of boron mass remaining through 2045. A comparison of simulated boron concentrations over time resulting from source excavation with monitored natural attenuation (MNA), and with groundwater extraction is provided in Figure 3-1 in Part 2 of the CAP.

Section 7.0 of Part 2 of the CAP provides the final proposed corrective actions based on data and numerical modeling assessment from both Parts 1 and 2 of the CAP, with subsequent evaluation of each piece to assure compliance in a timely manner, and includes the following:

- Source Control – ash basin closure and source removal. Soils left on site after ash removal will be sampled and analyzed, and results will be incorporated into fate and transport modeling to assess the potential for modification to the corrective actions;
- Elimination of Potential Receptors – installation of the Bear Leah Trail public water supply line has resulted in replacing five private water wells that are planned for subsequent geophysical survey and abandonment;
- Monitored Natural Attenuation – SynTerra identified that the groundwater impacted by the ash basin does not pose unacceptable risks to either human health or ecological receptors further discussed in Section 5 of Part 2 of the CAP. And as supported by groundwater flow and geochemical modeling, attenuation of COPCs will be achieved by a combination of dilution, dispersion, and limited sorption.

Simulated manganese concentrations, and updated simulations of sulfate and TDS are provided in Appendix B of Part 2 of the CAP.

The results of modeling the monitored natural attenuation alternative are presented in Figure 3-1 of Part 2 of the CAP for predictions at years 2020, 2030, and 2045.

5.5 Groundwater Trend Analysis Methods

The CSA Report indicates that historical analytical results from compliance and voluntary groundwater monitoring wells were used to assess background groundwater quality and assess results against existing IMAC and 2L values. Compliance groundwater monitoring wells were sampled as part of the CSA Report to supplement the expanded groundwater assessment. Time series plots of existing data comparing compliance, background wells, and 2L standards, where applicable, were shown on **Figures H1 through H21 of Appendix B**.

Groundwater monitoring data collected from the four compliance monitoring wells were evaluated by SynTerra using interwell prediction limits (parametric, nonparametric, and Poisson) to compare background well data (CB-01 and CB-09) to the results for the most recently available sample data from compliance wells collected in April 2015. The detailed description is in Section 10.0 of the CSA (SynTerra 2015a).

Before statistical assessment, the dataset was assessed and treated using guidance from ASTM D6312-98 and USEPA 2007. COIs with exceedances of the 2L or IMAC are identified in all compliance boundary wells at statistically elevated values over concentrations observed in designated background wells CB-01 and CB-09 (**Table 2-2, Appendix B**).

6. BENEFICIAL REUSE AND FUTURE USE

6.1 CCR Material Reuse

From 2007 through summer 2015, a portion of the CCR materials from the 1982 Ash Basin was excavated and transported to the Asheville Regional Airport for beneficial use. The airport extended its runway/taxiway network by using the CCR as permitted structural fill in compliance with existing permits. Ash transport to the Asheville Regional Airport ended in summer 2015.

Duke considers CCR beneficial use in an environmentally responsible manner for ash that is produced at its plants or is removed from existing ash basins. Ash basin closure by removal presents the opportunity for CCR beneficial use. Duke has a team dedicated to identifying beneficial use opportunities and evaluating their feasibility. Consistent with North Carolina CAMA requirements, Part III, Section 4(e), Duke issued a request for proposals to conduct a beneficial use market analysis, study the feasibility and advisability of installing existing beneficiation technologies, and examine innovative technologies.

At this time, no CCR beneficial use opportunities have been identified for the remaining CCR materials. Findings indicate that large-scale beneficiation technologies are not feasible to install at this time.

6.2 Site Future Use

The anticipated future use of the 1964 Ash Basin is undetermined at this time. Possibilities for this Ash Basin include but are not limited to a permitted structural fill, a solar farm, or simply being reseeded with grass. The closure design of the 1964 Ash Basin is planned to include a balanced breach, in which the impoundment will be excavated to a design elevation. The basin will be backfilled to promote drainage, resulting in a non-impounding structure. The backfill will also be graded in a way to allow stormwater flows from the basin to pass through an existing culvert under I-26.

In contrast to the 1964 Ash Basin, the closure plans for the 1982 Ash Basin were developed to facilitate the construction of the proposed Combined Cycle Plant. This Plant will be located within the footprint of the 1982 Ash Basin. The closure design of the 1982 Ash Basin includes a dam breach to an elevation of 2106 feet, with an engineered fill to this same minimum elevation within the existing Ash Basin. After completion of the balanced breach, additional fill will be placed to facilitate construction of the Combined Cycle Plant to design grades.

After the completion of the Combined Cycle Plant, the existing coal-fired generating plant will be decommissioned. Duke intends to cease operation of the coal-fired units in accordance with CAMA, but specific details of future decommissioning and demolition have not been developed at this time. The property deed will be recorded to document the site conditions at the time of closure.

7. CLOSURE DESIGN DOCUMENTS

7.1 Engineering Evaluations and Analyses

As part of the closure design process, engineering evaluations and analyses (calculations) were developed for the 1982 Ash Basin and are included in **Appendix D**. Engineering evaluations and analyses will be developed in the future for the 1964 Ash Basin. The basins are required to be closed by 2022, and each basin must be closed such that it will not impound water. Ash has been removed from the 1982 Ash Basin, and dam decommissioning is currently underway.

Excavation of the 1982 Ash Basin was completed on September 30, 2016. The ash basin was then turned over for dam decommissioning and construction of the natural gas combined cycle plant. The proposed decommissioning of this ash basin dam is shown on the drawings referenced in Section 7.2. Additional fill will be placed to support a combined cycle plant. To construct the fill, the existing embankment will be breached to create a non-impounding structure, and this material will be placed in the existing ash basin. Borrow material will also be obtained from onsite borrow areas to support the combined cycle plant construction. This borrow material will be placed and compacted in accordance with the CQA Plan referenced in Section 7.3. Drainage ditches are also incorporated into the final configuration to route the 100 year – 24 hour flow to an existing culvert under I-26.

7.2 Site Analysis and Removal Plan Drawings

The design drawings associated with the dam decommissioning of the 1982 Ash Basin are included in **Appendix E**. These drawings were developed for three separate submittals and resulting approvals from NCDEQ: 1) Decommissioning and Ash Removal Closure Plan drawings, 2) Erosion and Sediment Control Plan drawings, and 3) Stormwater Management Plan drawings.

Design drawings for the dam decommissioning of the 1964 Ash Basin will be prepared and submitted to NCDEQ at a later date.

7.3 Construction Quality Assurance Plan

The purpose of the CQA Plan is to identify the quality assurance procedures, standards, and methods that will be employed during the project to provide assurance that the requirements of the drawings, specifications, and regulatory permits are met. The CQA Plan is specific to the Asheville 1982 and 1964 Ash Basins Closure Design, and is prepared in compliance with CAMA. The CQA Plan is included and attached to this document in **Appendix F**.

8. MANAGEMENT OF WASTEWATER AND STORMWATER

8.1 Stormwater Management

Ash removal within the 1982 Ash Basin is complete, and dam decommissioning activities are currently underway to prepare the site for construction of a natural gas combined cycle plant. At the conclusion of dam decommissioning activities, stormwater flows will exit the basin through permitted stormwater channels along the toe of the dam breach. Stormwater management for the 1982 Ash Basin is detailed on the drawings in **Appendix E**.

Duke Energy is authorized to discharge stormwater and industrial effluent to the French Broad River through Outfall 001 in accordance with NPDES Permit NC0000396. Stormwater from the 1964 Ash Basin currently drains to the Duck Pond within the ash basin, and is conveyed to the lined Rim Ditch system. Stormwater runoff from the plant area, parking lots, existing combustion turbine area, oil storage and handling facility, and the plant's substations is also routed to the lined Rim Ditch for treatment. During maintenance activities, sludge removed from catch basins, sumps, etc., may be transported to the 1964 Ash Basin, and/or lined Rim Ditch for treatment and further handling. Runoff from the coal, limestone, and gypsum piles are collected in their respective drainage ditches. The drainage ditches are routed to the 1964 Ash Basin or lined Rim Ditch for treatment. Additional information is contained in the 2016 Permit Renewal Supplemental Information Package (Duke Energy 2016a, **Appendix I**). Characteristics of discharges are included in **Table 8-1** in the following section.

The goal of the 1964 Ash Basin decommissioning is to return the former ash basin to a natural state where stormwater is discharged via sheet flow to the receiving water(s), such as the French Broad River, and eliminate the requirement for an NPDES stormwater permit, concurrent with ash removal activities. To accomplish this, multiple phases of decommissioning work are required. Subsequent work activities will include the following:

- Evaluate, design, and construct water treatment system(s) and/or water retention for utilization after plant and rim ditch retirement;
- Maintain the lowered water state of the Duck Pond;
- Decommission and demolish the 1964 Ash Basin Rim Ditch system.

8.2 Wastewater Management

The Rim Ditch system receives the sluiced ash and water from the Plant. Water from the Rim Ditch is pumped through a center pond filter system to the stilling basin located to the north of the 1964 Ash Basin, and then out through NPDES Outfall 001. Characteristics of wastewater discharges to the 1964 Ash Basin are listed in **Table 8-1** and are described as follows. Ash sluice water consists of fly and bottom ash from both units, is hydraulically conveyed via pipeline to the lined Rim Ditch system, and is treated with sulfuric acid for pH adjustment. As needed, chemical flocculants may be added to aid settling. The Plant operates a Selective Catalytic Reduction system, which may introduce ammonia into the combustion process. Various wastewater boiler sediments and ash accumulations from wastewater processes collected during maintenance activities may also be physically transported the lined Rim Ditch. The 1964 Ash Basin and lined Rim Ditch discharge into the secondary settling pond prior to discharging to the French Broad River through Outfall 001.

Low volume waste sources discharged to the lined Rim Ditch system include: boiler water treated with ammonia, hydrazine, and sodium hydroxide; boiler blowdown and drainage; thus, the waste streams may contain small quantities of these chemicals. Effluent from other sources and treatment systems include the following: reject stream from reverse osmosis, molybdate waste from the closed cooling water system, overflow from the hopper seal treated with sodium hydroxide solution for pH adjustment, chemicals used for coal dust suppression, small amounts of urea from bulk area unloading operations, plant floor drains and equipment drainage and wash down. In many cases, added chemicals are consumed or chemically altered during the plant processes. Only trace amounts might be recoverable in water entering the lined Rim Ditch. Detectable levels of these chemicals would not be expected to occur in Rim Ditch discharges.

Operation of the combustion turbine generating facility may produce turbine blade wash water, inlet filter cooling water, various condensate waters, and water from equipment and tank drains. These wastewaters are collected in the stormwater collection system of the combustion turbine site and are routed to the lined Rim Ditch system.

The boilers are chemically cleaned every five-to-eight years using tetraammonia ethylate diamine tetraaccetic acid solution. The cleaning solution is stored on-site for disposal by evaporation in an operating system's furnace. Should evaporation not be used, the wastewater can be treated by neutralization and precipitation prior to being conveyed to the lined Rim Ditch system, or other means of disposal. Dam seepage is addressed in Appendix F of the 2016 Permit Renewal Supplemental Information Package (Duke Energy 2016a, **Appendix I**).

The wastewater treatment system will continue to be operated in this manner until such time that the coal fired plant is retired, and ash and effluent discharges from the plant to the 1964 Ash Basin cease.

Subsequent to plant and Rim Ditch retirement, additional water management and treatment systems will be required in accordance with the DEQ letter from Jeff Poupart, Water Quality Permitting Section Chief, to Duke Energy on July 20, 2016 regarding decanting of coal ash impoundments. Management of wastewater will also be addressed as the coal operations become inactive.

Table 8-1: Flow Characteristics of Discharges into the 1964 Ash Basin[1]

Stream	Name	Average Flow	Comments
E	Low Volume Wastes • Ash Hopper Seals • Sandbed Filter Backwash • Boiler Blowdown • Truck Wash • Water purification process waste streams	 0.05 MGD 2600 Gal/event 0.006 MGD Variable variable	 Rare Usage Startup - Estimated
G	Ash Sluice Water	3.03 MGD	Estimated
H	Dam Seepage	~ 0.09 MGD	Calculated
J	Coal Pile Runoff	0.01 MGD	Based on Average Annual Rainfall of 47" and 50 % Runoff
K	Storm Water	0.07 MGD	Estimated
L	Chemical Metal Cleaning Wastes	0 - 90,000 Gallons (0 gallons anticipated)	Normal Practice is Evaporation
M	Water From Combustion Turbine Facility Operation (Blade wash activities)	0 - 0.02 MGD	Intermittent
Q	Fire Protection Water	0.010 MGD	Estimated
R	Air Preheater Cleaning	10,000 gallons/event	Estimated

[1]Information taken from Duke Energy, July 30, 2014

9. DESCRIPTION OF FINAL DISPOSITION OF CCR MATERIALS

From early 2007 through summer 2015, the CCR materials from the 1982 Ash Basin were excavated and transported by truck to the Asheville Regional Airport and beneficially reused as structural fill. The airport used the ash for projects aimed at extending the runway/taxiway network. The off-site removal details for the Asheville Regional Airport are presented below:

- Facility location and name: Asheville Regional Airport, 61 Terminal Drive, Fletcher, NC 28732;
- Facility permit number: Structural Fill Permit # WQ0000020;
- Facility type: Permitted structural fill for runway/taxiway construction.

Beginning in fall 2015, Duke started transporting the remaining CCR in the 1982 Ash Basin to an off-site fully lined landfill near Homer, Georgia. From February 2016 through October 2016, ash was transported to an additional landfill located in Mooresboro, North Carolina. Currently, ash from the 1964 Ash Basin is being transported to the landfill near Homer, Georgia. The off-site removal details for the Georgia landfill are presented below:

- Facility location and name: R&B Landfill, 610 Bennett Road, Homer, GA 30547;
- Facility permit number: Permit 006-009D(MSWL);
- Facility type: Solid Waste Handling - Permitted landfill.

The off-site removal details for the North Carolina landfill are presented below:

- Facility location and name: Duke Energy Rogers CCP Landfill, 573 Duke Power Rd, Mooresboro, NC 28114;
- Facility permit number: Solid Waste Management Facility Permit No. 8106;
- Facility type: Solid Waste Management Facility.

Duke continues to consider future disposal and/or beneficial reuse opportunities.

10. APPLICABLE PERMITS FOR CLOSURE

Implementation of the Ash Basin closure at the Asheville Steam Electric Generating Plant will require permits issued by regulatory authorities. A list of the anticipated permits required for closure is below:

- Dam Breach Certificate of Approval to Repair/Modify for Decommissioning Dam Structures;
- Discharge Permits for Wastewater and Stormwater;
- Solid Waste Permits for Landfills and Structural Fills (by others); and
- Erosion and Sedimentation Control Permits.

11. POST CLOSURE MONITORING AND CARE

The Post-Closure Operations Maintenance and Monitoring (OM&M) Plan is provided as **Appendix G**. The default post-closure period is 30 years; however, opportunities to modify and reduce the post-closure period for various requirements including groundwater and surface water monitoring are possible. The Post-Closure OM&M Plan addresses the following:

- Description of the closure components;
- Regular inspections and maintenance of the stormwater and erosion control measures;
- Post-closure inspection checklist to guide post-closure inspections;
- Continuation of the groundwater and surface water monitoring and assessment program;
- Provide means and methods of managing affected groundwater and stormwater;
- Maintaining the groundwater monitoring system;
- Facility contact information;
- Description of planned post-closure uses.

11.1 Groundwater Monitoring Program

The (CSA report [SynTerra 2015a]) provides an interim groundwater monitoring plan to bridge the gap between completion of CSA Report activities and implementation of the pending Groundwater Monitoring Plan and CAP. The interim groundwater monitoring plan provided in the CSA is also summarized in **Section 3.3.2** of this document. The proposed constituents, parameters, and sampling locations for the interim groundwater monitoring plan were presented in Section 16.0 of the CSA report (SynTerra 2015a) and is updated in Part 2 of the CAP in relation to proposed remedial actions.

With the submittal of part 2 of the CAP SynTerra has provided a proposed updated Interim Monitoring Plan (IMP), and a post-closure Effectiveness Monitoring Program (EMP) as required by CAMA in Section 9.0 of Part 2 of the CAP. The EMP is to begin after implementation of the basin closure groundwater Corrective Action Plan, with the IMP being implemented within 30 days of CAP approval by CAMA.

The proposed updated IMP consists of sampling groundwater and surface water for the constituents listed in Part 2 of the CAP (**Table 9-1 of Appendix C**) on a semi-annual basis, with the sampling frequency of background wells being modified to achieve a minimum of eight sets of data prior to implementation of the EMP. Reporting will be annually. The IMP will also be periodically evaluated and modified as needed. The proposed IMP sampling locations for groundwater are provided in **Table 9-2 of Appendix C**, and surface water and seep sampling locations are provided in **Table 9-3 of Appendix C**. Groundwater, surface water, and seep sample locations are presented spatially in **Figure 9-1 of Appendix C**.

The proposed EMP program also consists of sampling groundwater and surface water for the constituents listed in **Table 9-1 of Appendix C** on a semi-annual basis, and is intended to support triannual NPDES compliance monitoring with a reduced frequency if monitoring results are consistent with modeling results provided in Section 6.0 of Part 2 of the CAP. Reporting will be annually. The EMP will also be evaluated periodically and modified as needed. The proposed EMP sampling locations for groundwater are provided in **Table 9-2 of Appendix C**, and surface water and seep sampling locations are provided in **Table 9-3 of Appendix C**. Groundwater, surface water, and seep sample locations are presented spatially in **Figure 9-1 of Appendix C**. Additional monitoring locations may be required once the final corrective action plan is selected and implemented. Additionally, the EMP is designed to meet the requirements of the Tier 4 monitoring and the USEPA established eight objectives for performance. However, additional analysis is required to achieve all the objectives and the EMP reports will include two phases to address these.

A Sampling and Analysis Plan (SAP) will be developed and adhered to once approved and prior to implementation of both the IMP and EMP. Currently, groundwater samples are planned to be collected using low-flow sampling techniques in accordance with the NCDEQ conditionally approved June 10, 2015, low flow sampling program provided in Appendix G of Part 2 of the CAP.

Implementation of the IMP or EMP is scheduled to begin in the month April or November following the CAP approval. Subsequent sampling events will then follow on subsequent April and November months. The data will be reviewed annually to confirm the corrective actions are effective at protecting human health and the environment.

12. PROJECT MILESTONES AND COST ESTIMATES

12.1 Project Schedule

CAMA deems the Asheville Plant a "high-priority" site, which specifically requires closure of the ash basins pursuant to Part II, Section 3(c). The CAMA closure definition of dewatering to the maximum extent practicable and removing and transferring CCR to a landfill or structural fill is demonstrated in the proposed schedule. Groundwater assessment and corrective action is ongoing, and the requirements and time for restoring groundwater quality are currently unknown.

The anticipated milestones are defined and shown below. The Dam Decommissioning Plan for the1982 Ash Basin has been approved by NCDEQ, and ash removal is complete. Note that the milestones are subject to change when not required by regulations.

The Anticipated Activities and milestone dates are listed in **Table 12-1**.

Table 12-1: Project Schedule

Milestones	Dates	
	1982 Ash Basin	1964 Ash Basin
Removal Plan Submittal	December 21, 2016 (Actual)	December 21, 2016 (Actual)
Start Date of Ash Removal	2007 (Actual)	August 26, 2016 (Actual)
Completion of Ash Removal	September 30, 2016 (Actual)	August 2022
Cease operation of coal-fired units at the Plant	January 2020	January 2020
Impoundments Closed Pursuant to PART II, Section 3.(c) of CAMA and Section 2.(a) of the Mountain Energy Act	August 2022	August 2022
Beginning of Post-Closure Care Period	March 2023	March 2023

12.2 Closure and Post-Closure Cost Estimate

The estimated cost associated with the assessment, corrective action, closure and post-closure care, and water line connection of the site was prepared internally by Duke Energy to support the Duke Energy Carolinas and Duke Energy Progress December 31, 2016 CCR asset retirement obligations within balance sheets of the audited financial statements on Form 10-K submitted to the Securities and Exchange Commission. The cost estimate is provided in **Appendix H**.

13. REFERENCED DOCUMENTS

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NCDENR Notice of Inspection Reports for 1982 Ash Pond Dam (BUNCO-089) dated May 5, 2010; May 6, 2011; February 22, 2012; April 19, 2013; and, April1, 2014.

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TABLES

Table 2-1: Federal CCR Rule Closure Plan Requirements
Summary and Cross Reference Table
Ash Basin Site Analysis and Removal Plan - Asheville Steam Electric Generating Plant
Duke Energy

No.	Description	Corresponding Closure Plan Section
Federal Register Vol. 80 No. 74 Part 2 (April 17, 2015)/40 CFR Part 257: Environmental Protection, Beneficial Use, Coal Combustion Products, CCRs, Coal Combustion Waste, Disposal, Hazardous Waste, Landfill, Surface Impoundments		
40 CFR §257.102 (b)(1) (i. - vi) Closure Plans for all impoundments shall include all of the following:		
i.	**Narrative description of how CCR unit will be closed (in accordance with this section)**	**All Chapters**
ii.	**If closure is through the removal of CCR from the unit, description of procedures to remove CCR and decontaminate CCR unit (in accordance with (c))**	**7**
iii.	**If closure by leaving CCR in place, description of final cover system (in accordance with (d)), methods & procedures used to install final cover, and also discussion of how final cover will achieve performance standards (in accordance with (d))**	**NA**
iv.	**Estimate of maximum inventory of CCR ever on site over active life of CCR unit**	**3.1.2**
v.	**Estimate of largest area of CCR unit ever requiring a final cover (in accordance with (d)) at any time during active life of CCR unit**	**NA**
vi.	**Schedule for completion of all activities necessary to satisfy closure, including estimate of year in which all closure activities will be completed. Sufficient information to describe sequential steps of closure, including:**	**12.1**
a.	Obtaining approvals and permits	10
b.	Dewatering and stabilization phases	7
c.	Installation of final cover system	7
d.	Estimated timeframes to complete each step/phase	10
Note:	If closure exceeds timeframes in (f)(1), closure plan must include site specific info./factors/considerations to support time extension.	

Table 2-2: NC CAMA Closure Plan Requirements
Summary and Cross Reference Table
Ash Basin Site Analysis and Removal Plan - Asheville Steam Electric Generating Plant
Duke Energy

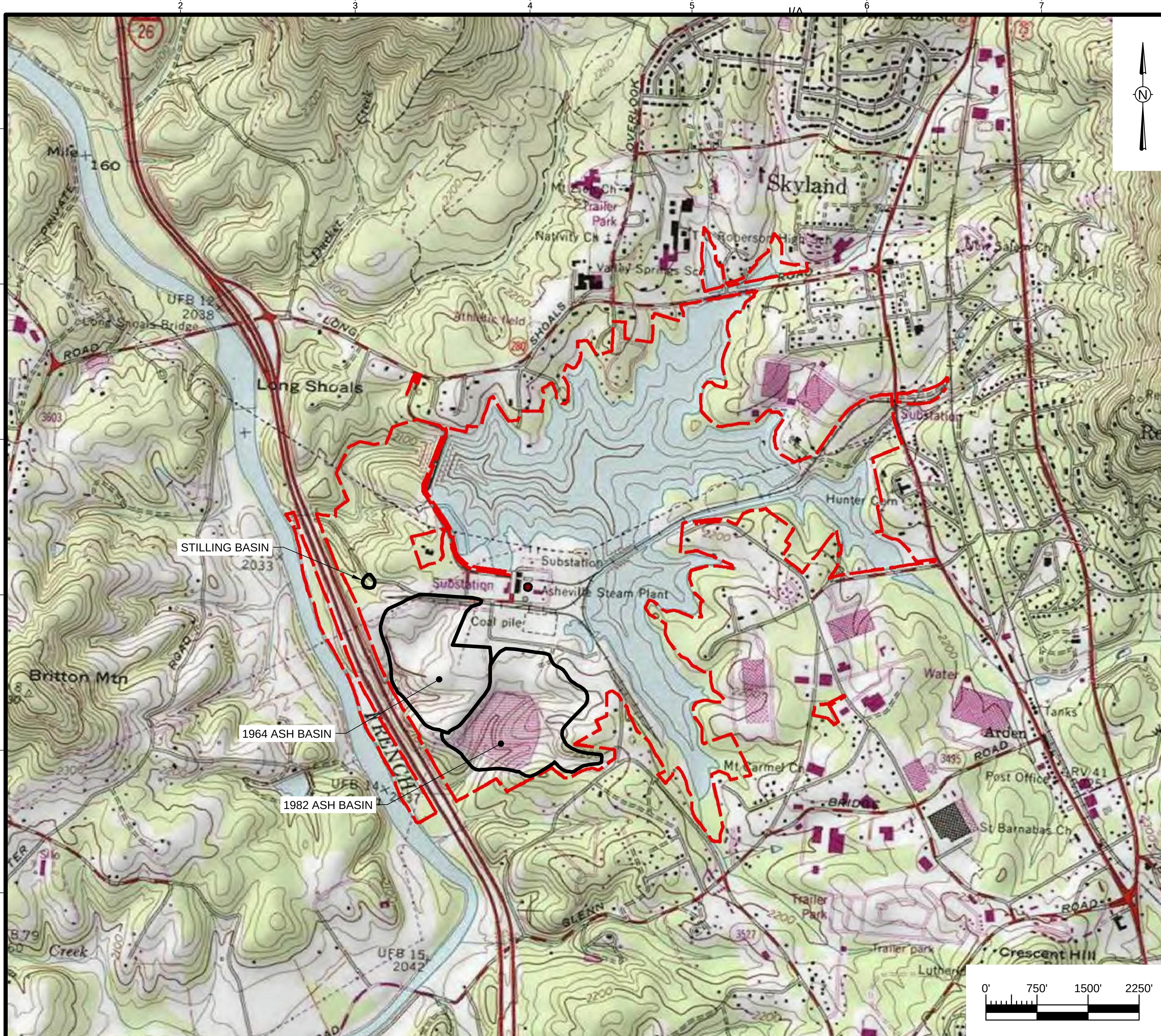
No.	Description	Corresponding Closure Plan Section
Part II. Provisions for Comprehensive Management of Coal Combustion Residuals		
§ 130A-309.214(a)(4) Closure Plans for all impoundments shall include all of the following:		
a. Facility and coal combustion residuals surface impoundment description. – 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.	3.1.5
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.	3.2.1
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
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

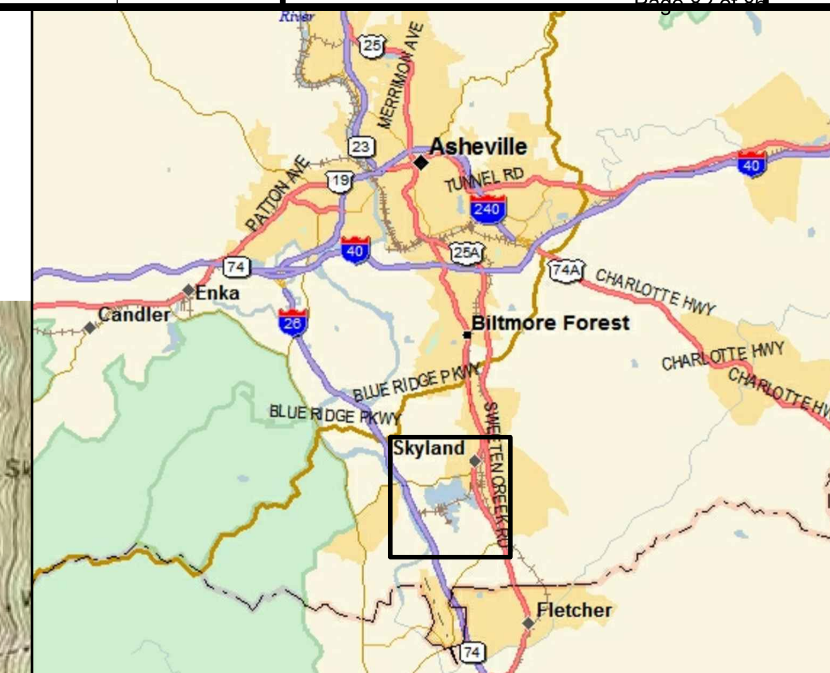
Table 2-2: NC CAMA Closure Plan Requirements
Summary and Cross Reference Table
Ash Basin Site Analysis and Removal Plan - Asheville Steam Electric Generating Plant
Duke Energy

No.	Description	Corresponding Closure Plan Section
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
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.	11.1
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
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-309.212(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.		
§ 130A-309.212(d) Within 30 days of its approval of a Coal Combustion Residuals Surface Impoundment Closure Plan, the Department shall submit the Closure Plan to the Coal Ash Management Commission.		

Note: Although it is not mandated by CAMA, Duke Energy is submitting this Closure Plan to the North Carolina Department of Environmental Quality (formerly NCDENR) to assist the department with identifying areas where its permitting actions will be crucial in allowing Duke Energy to meet its statutory deadlines. Securing the required permit approvals by March 31, 2016, will allow Duke Energy to achieve closure of the 1982 Ash Basin and meet the requirements of the Mountain Energy Act of 2015 (Session Law 2015-110, Signed June 24, 2015), which requires that the ash basins be closed by August 1, 2022.

FIGURES





SERVICE LAYER: CREDITS: DELORME STREET ATLAS, ESRI ARCMAP, © : 2013 NATIONAL GEOGRAPHIC SOCIETY.

LEGEND

APPROXIMATE DUKE ENERGY PROPERTY BOUNDARY

APPROXIMATE BASIN BOUNDARIES

Environment & Infrastructure
2030 FALLING WATERS SUITE 300
KNOXVILLE, TN 37922
TEL: (865) 671-6774
FAX: (865) 671-6254
LICENSURE:
NC ENG: F-1253
NC GEOLOGY: C-247

amec foster wheeler

SEAL

TITLE
SITE LOCATION MAP
DUKE ENERGY ASHEVILLE PLANT
SKYLAND, NORTH CAROLINA

FOR
ASHEVILLE PLANT

DUKE ENERGY

SCALE:	AS SHOWN	DES:	APT
DWG TYPE:	DWG	DFTR:	APT
JOB NO:	7810160620	CHKD:	MB
DATE:	12-12-2016	ENGR:	DS
FILENAME:	Figure 1 Site Location Map.dwg	APPD:	

DWG SIZE	DRAWING NO.	REVISION
ANSI C 11"x17"	FIGURE 1	01

FIGURE 1
REV. 01

Plotted By: Troxel, Paul Sheet Set: New Sheet Set (3) Layout: 01 December 13, 2016 08:31:38am P:\CADD\Projects\7810\7810160620 Asheville\Site Analysis & Removal Plan\Plansheets\Figure 1 Site Location Map.dwg

LEGEND

— — —	ASH POND LIMITS
—·—·—	PROPERTY BOUNDARY
———	FORMER WETLAND AREA

NOTE:

1. AERIAL PHOTO DATED 10-2015 SOURCE BY GOOGLE EARTH PRO.
2. PROPERTY BOUNDARY OBTAINED FROM BUNCOMBE COUNTY GIS DATA AT http://BUNCOMBECOUNTY.ORG/MAP_ALL.HTML.

REV	D	M	Y	ISSUE/REVISION DESCRIPTION	ENG.	APPR.

CLIENT LOGO: DUKE ENERGY

CLIENT: DUKE ENERGY PROGRESS
BUNCOMBE COUNTY, NORTH CAROLINA

Amec Foster Wheeler Environment & Infrastructure, Inc.
2801 YORKMONT ROAD, SUITE 100
CHARLOTTE, NC 28208
TEL: (704) 357-8600 FAX: (704) 357-8638
LICENSURE: NC ENG: F-1253 NC GEOLOGY: C-247

amec foster wheeler

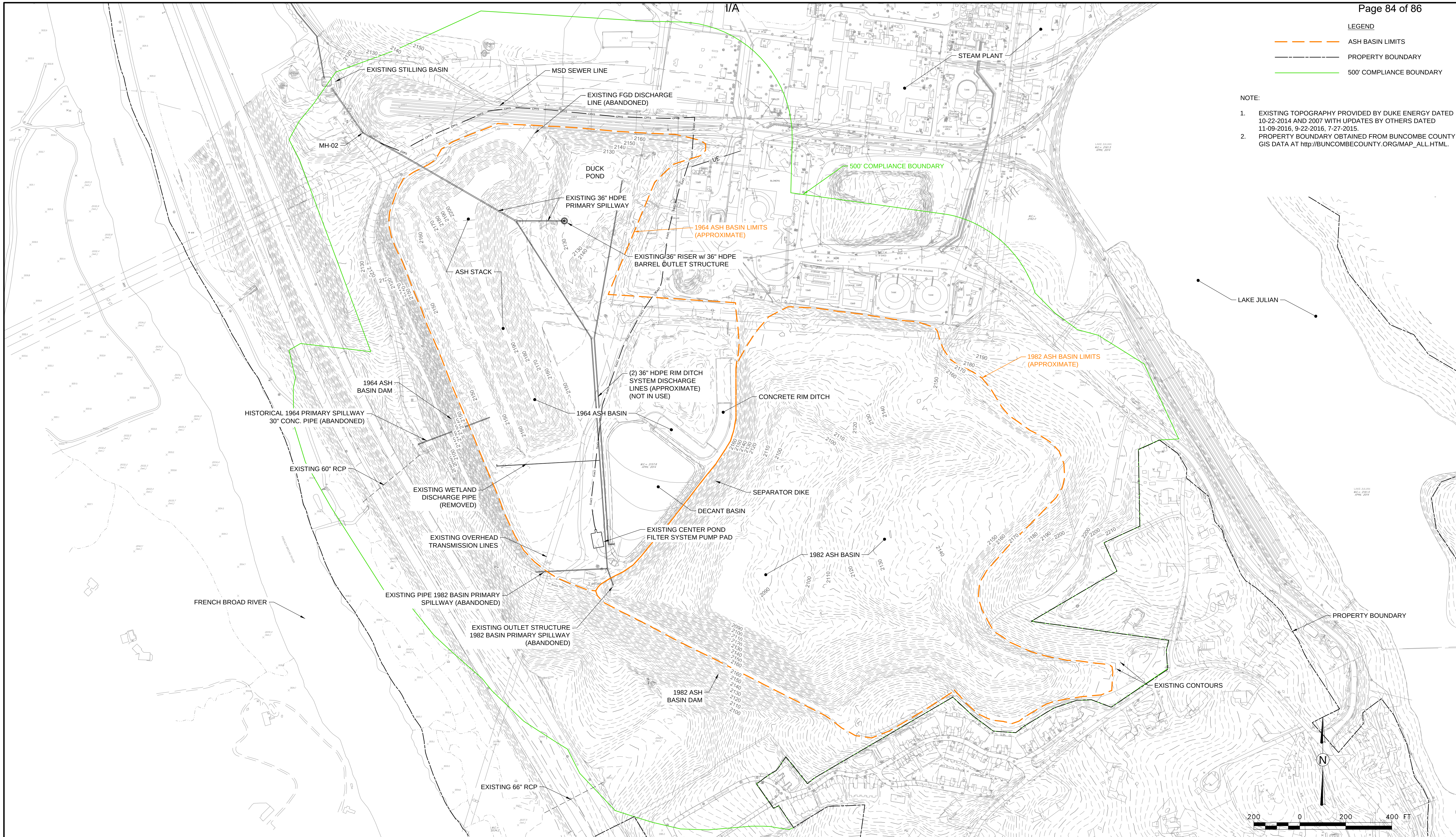
DATUM: WGS84
PROJECTION: STATE PLANE 83
DRAWN BY: APT
REVIEWED BY: MB
SCALE: AS NOTED

PROJECT: SITE ANALYSIS AND REMOVAL PLAN
DUKE ENERGY - ASHEVILLE STEAM ELECTRIC GENERATING PLANT
BUNCOMBE COUNTY, NORTH CAROLINA

TITLE: SITE OVERVIEW AERIAL PLAN

PROJECT NO.: 7810160620
REVISION NO. NA
DATE: 12/12/2016
FIGURE NO. 2

Plotted By: Troxel, Paul Sheet Set: N/A Layout: 01 December 13, 2016 08:28:46am P:\CADD\Projects\7810\7810160620 Asheville\Site Analysis & Removal Plan\Plansheets\Figure 2 Site Overview Aerial.dwg



REV	D	M	Y	ISSUE/REVISION DESCRIPTION	ENG.	APPR.

CLIENT LOGO: DUKE ENERGY

CLIENT:
DUKE ENERGY PROGRESS
BUNCOMBE COUNTY, NORTH CAROLINA

Amec Foster Wheeler Environment & Infrastructure, Inc.
2801 YORKMONT ROAD, SUITE 100
CHARLOTTE, NC 28208
TEL: (704) 357-8600 FAX: (704) 357-8638
LICENSURE: NC ENG: F-1253 NC GEOLOGY: C-247

amec foster wheeler

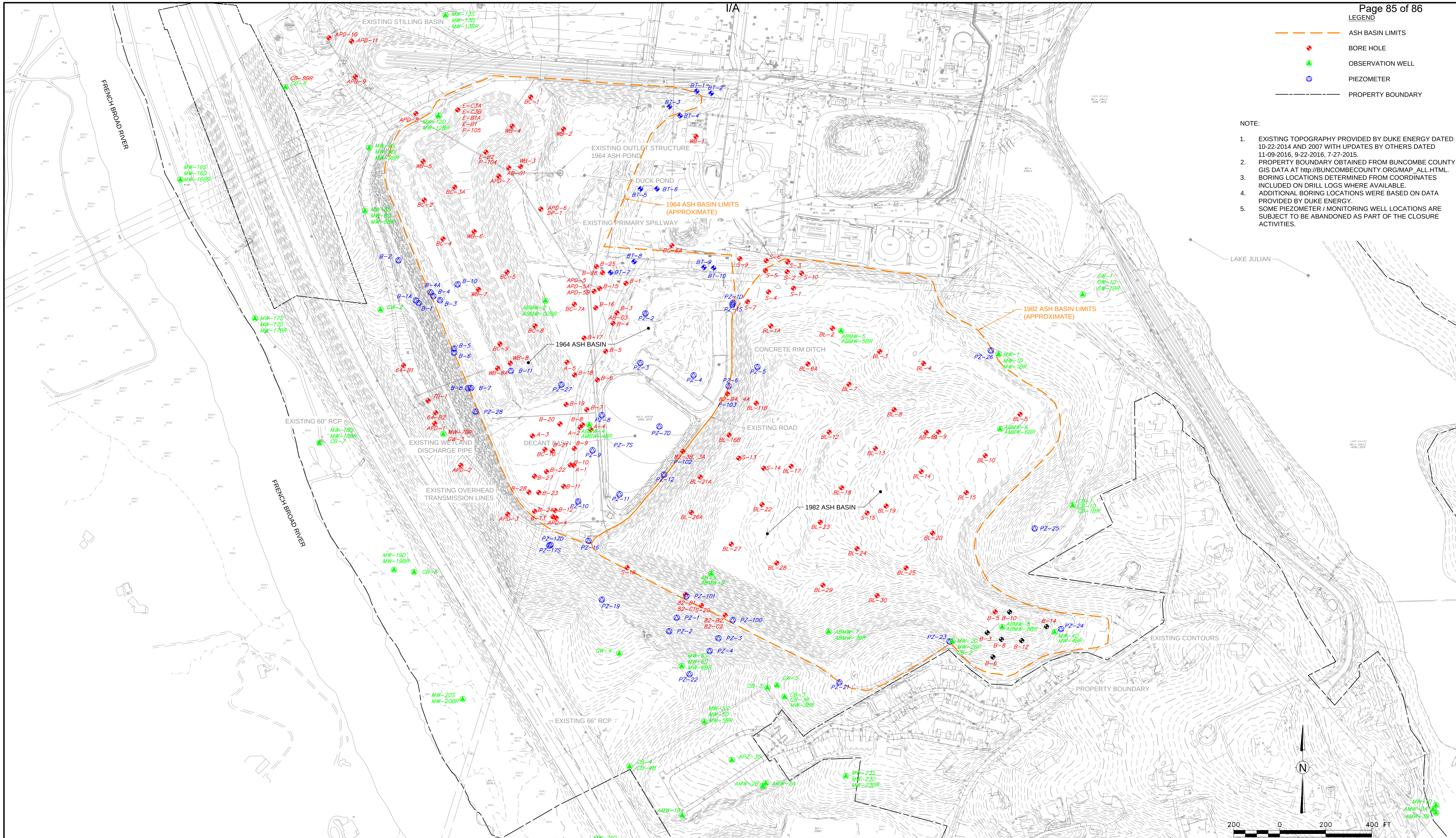
DATUM:	WGS84
PROJECTION:	STATE PLANE 83
DRAWN BY:	APT
REVIEWED BY:	MB
SCALE:	AS NOTED

PROJECT:
SITE ANALYSIS AND REMOVAL PLAN
DUKE ENERGY - ASHEVILLE STEAM ELECTRIC GENERATING PLANT
BUNCOMBE COUNTY, NORTH CAROLINA

TITLE:
CCR IMPOUNDMENT RELATED STRUCTURES

PROJECT NO.:	7810160620
REVISION NO.:	NA
DATE:	12/12/2016
FIGURE NO.:	3

Plotted By: Troxel, Paul Sheet Set: N/A Layout: 01 December 13, 2016 08:33:14am P:\CADD\Projects\7810\7810160620 Asheville\Site Analysis & Removal Plan\Plansheets\Figure 3 CCR Impoundment Related Structures.dwg



LEGEND

- ASH BASIN LIMITS
- BORE HOLE
- OBSERVATION WELL
- PIEZOMETER
- PROPERTY BOUNDARY

NOTE:

1. EXISTING TOPOGRAPHY PROVIDED BY DUKE ENERGY DATED 10-22-2014 AND 2007 WITH UPDATES BY OTHERS DATED 11-09-2016, 9-22-2016, 7-27-2015.
2. PROPERTY BOUNDARY OBTAINED FROM BUNCOMBE COUNTY GIS DATA AT http://BUNCOMBECOUNTY.ORG/MAP_ALL.HTML.
3. BORING LOCATIONS DETERMINED FROM COORDINATES INCLUDED ON DRILL LOGS WHERE AVAILABLE.
4. ADDITIONAL BORING LOCATIONS WERE BASED ON DATA PROVIDED BY DUKE ENERGY.
5. SOME PIEZOMETER / MONITORING WELL LOCATIONS ARE SUBJECT TO BE ABANDONED AS PART OF THE CLOSURE ACTIVITIES.

REV	D	M	Y	ISSUE/REVISION DESCRIPTION	ENG.	APPR.

CLIENT LOGO: DUKE ENERGY

CLIENT:
DUKE ENERGY PROGRESS
BUNCOMBE COUNTY, NORTH CAROLINA

Amec Foster Wheeler Environment & Infrastructure, Inc.
2801 YORKMONT ROAD, SUITE 100
CHARLOTTE, NC 28208
TEL: (704) 357-8600 FAX: (704) 357-8638
LICENSURE: NC ENG: F-1253 NC GEOLOGY: C-247

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DATUM:	WGS84
PROJECTION:	STATE PLANE 83
DRAWN BY:	APT
REVIEWED BY:	MB
SCALE:	AS NOTED

PROJECT:
SITE ANALYSIS AND REMOVAL PLAN
DUKE ENERGY - ASHEVILLE STEAM ELECTRIC GENERATING PLANT
BUNCOMBE COUNTY, NORTH CAROLINA

TITLE:
BORING LOCATION MAP 1982 & 1964
ASH BASINS

PROJECT NO.:	7810160620
REVISION NO.:	NA
DATE:	12/12/2016
FIGURE NO.:	4

Plotted By: Troxel, Paul Sheet Set: N/A Layout: 01 December 13, 2016 08:34:50am P:\CADD\Projects\7810\7810160620 Asheville\Site Analysis & Removal Plan\Planssheets\Figure 4 Boring Location Map.dwg

APPENDICES

APPENDIX A: WASTE INVENTORY ANALYSIS (1964 ASH BASIN)

CALCULATION COVER SHEET

Project Asheville Steam Station – Waste Strategy Analysis	**Calc/Analysis No.** WBS 2	**AMEC Project No.** 7810-14-0162.02
Title Estimate of Coal Combustion Residuals (CCR) Quantity	**Client Contract** NA **Discipline** Civil	**Sheet No. 1 of 5**
Computer Program AutoDesk Civil 3D 2013	**Version / Release No.** N/A	
Purpose and Objective Estimate the quantity of CCR located on Asheville Steam Station property (excluding material that is currently being removed).	**Quality Assurance Conditions (e.g. safety classification)** NA	

Summary of Conclusion
Based on the assumptions described in this calculation, the quantity of CCR on the Asheville Steam Station site (excluding material that is currently being removed) was estimated to be approximately 2,113,000 cubic yards (2.1 million dry tons).

Revision Log

Rev. No.	**Revision Description**
00	Initial issue.
1A	Refined volume calculations. Separated from landfill size calculations.

Sign Off

Rev. No.	**Originator (Print)** **Sign / Date**	**Verification Method**	**Verifier (Print)** **Sign / Date**	**Technical Lead (Print)** **Sign / Date**
00	Chris Jordan	**Design Review**	Thomas B. Maier	Kenneth R. Daly
	Chris Jordan, EI		**Thomas B. Maier, PE**	**Ken Daly, PE**
1A	**1/12/2015**		**1/12/2015**	**1/14/2015**

Additional Reviewer (Print)	**Signature**	**Date**
NA		

RECORD OF REVISION

Revision No.	Date	Revisions Made
00	11/05/2014	Initial issue
1A	1/12/2015	Refined volume calculations. Separated from landfill size calculations.

TABLE OF CONTENTS

LIST OF TABLES

1.0 OBJECTIVE

The objective of this calculation is to estimate the quantity of coal combustion residuals (CCR) located on Asheville Steam Station property (excluding material that is currently being removed). The areas containing CCR are shown on the attached **Figure 1**.

2.0 ASSUMPTIONS

The following assumptions and limitations are noted.

- Based on data gathered from several coal burning plants, the following typical CCR properties are assumed:

Material	Dry Unit Weight (tons/cy)	Moisture Content (%)	Moist Unit Weight (%)
CCR in Wet Ponds	0.8	50%	1.2
CCR in Ash Fills	1.0	20%	1.2

- Since the 1964 Ash Pond has not impounded water for many years and there has been significant dry stacking/filling on the pond, it is assumed to have properties closer to those in the second row of the above table.

3.0 APPROACH

Material quantities were estimated using a method that consists of utilizing historical ground surface topographic information from historic design drawings or USGS mapping, and using AutoCAD Civil 3D software to compare the historic ground surface with current conditions.

<u>Quantity of Material Within the 1964 Ash Basin</u>
(see attached Figures 2.1 through 2.5)

The area of the 1964 Ash Basin is approximately 41 acres (**See Table 1**). The quantity of material within the 1964 Ash Basin was estimated using AutoCAD Civil 3D software. An approximate pre-fill ground surface was generated based on the approximate topographic information shown in Brown and Root Drawing G-221-B Rev. B dated 7/29/1971 (topography dated 12/30/1969). The pre-fill grades were compared to 4/3/2012 topography obtained from the North Carolina Flood Plain Mapping LIDAR geodatabase. In addition, a surface was generated to approximate the 2013 settling basin excavation by Charah based on the drawing entitled, " '64 Rim Ditch & Settling Basin Improvements – Layout/Grading Plan" revised 1/29/13. The estimated quantity of material within the 1964 Ash Basin is provided in **Table 1**.

<u>Data Limitations</u>
The following data limitations, which are potential sources of inaccuracies in the calculated volumes, have been identified: Drawing G-221-B used for the 1964 basin bottom topography shows standing water which decreases the calculated pond volume, and the volume of FGD wastewater pond material that may need to be disposed separately is not known.

4.0 CONCLUSIONS

Based on the assumptions described in this calculation, the quantity of CCR in the Asheville Steam Station 1964 Ash Basin was estimated to be approximately 2,113,000 cubic yards (2,113,000 dry tons). The estimated moist weight of CCR is also reported in **Table 1** because it is a more realistic representation of the weight of material to be handled during removal and construction activities. Moist unit weight is calculated based on the assumed dry unit weight and moisture content noted herein.

Table 1: Summary of Areas Containing Ash Included in this Analysis

Description	Surface Area (ac)	Volume (cy)	Estimated Dry Unit Weight (ton/cy)	Estimated Dry Weight (tons)	Estimated Moisture Content (%)	Estimated Moist Unit Weight (ton/cy)	Estimated Moist Weight* (tons)
1964 Ash Basin	41.4	2,113,000	1.0	2,113,000	20%	1.2	2,535,600
TOTAL	41.4	2,113,000		2,113,000			2,536,000

*Moist unit weight is used for construction cost estimating purposes.

I/A

NOTES:
1. ASH BOUNDARIES ARE APPROXIMATE.
2. THE 1982 ASH BASIN IS NOT INCLUDED IN THIS INVENTORY. ASH IS CURRENTLY BEING REMOVED FROM THIS BASIN FOR BENEFICIAL USE.

REFERENCES
1. HIGH RESOLUTION 2010 AERIAL IMAGERY WAS OBTAINED FROM WWW.ESRI.COM.

CLIENT: DUKE ENERGY

AMEC Environment & Infrastructure, Inc.
2801 YORKMONT ROAD, SUITE 100
CHARLOTTE, NC 28208
TEL: (704) 357-8600 FAX: (704) 357-8638
LICENSURE: NC ENG: F-1253 NC GEOLOGY: C-247

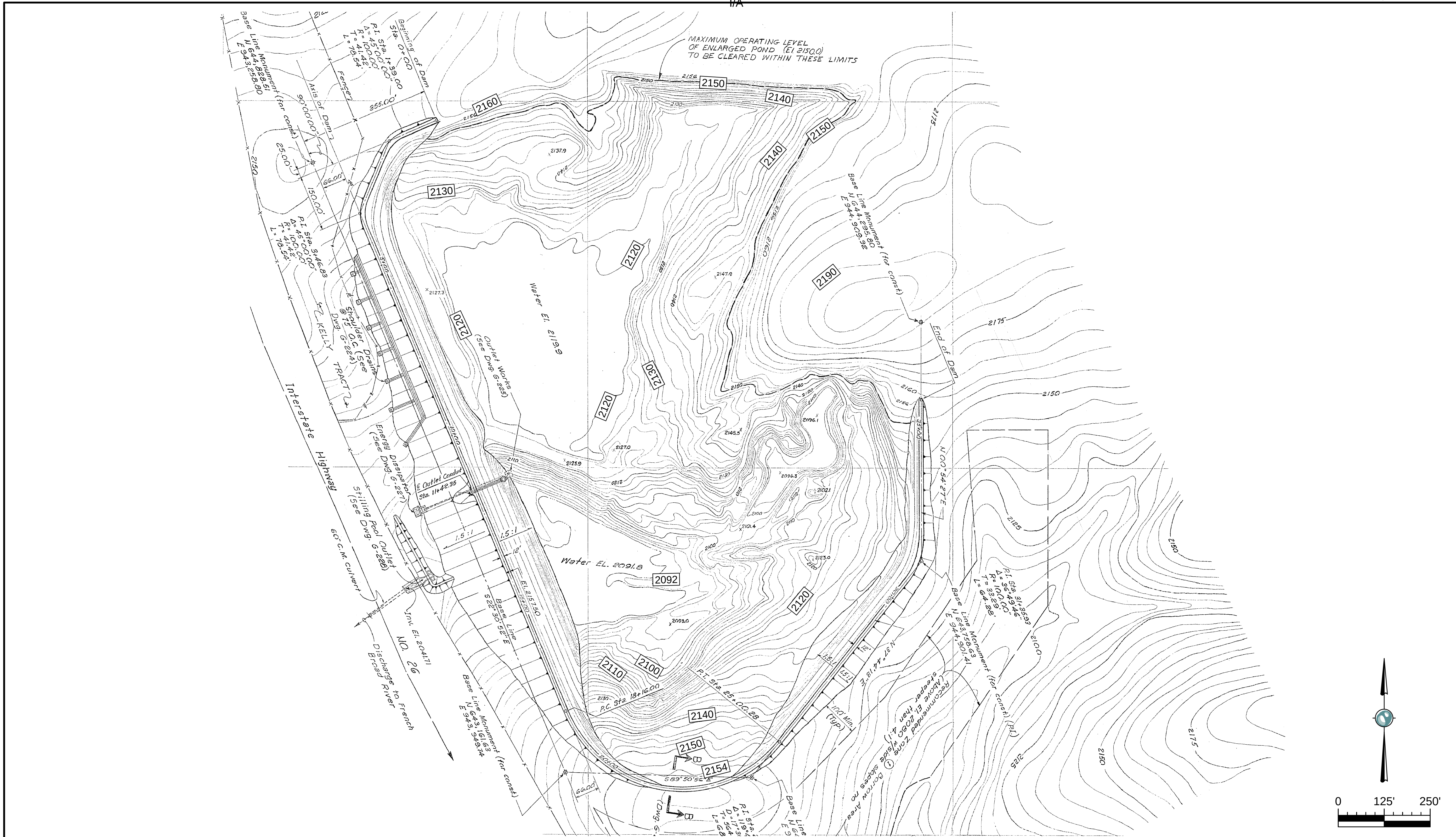
DATUM (HOR - VER):	NAD83 - NAVD88
PROJECTION:	NC83F
DRAWN BY:	MA
REVIEWED BY:	TM
SCALE:	AS NOTED

PROJECT: WASTE STRATEGY ANALYSIS
ASHEVILLE - ASH INVENTORY

TITLE: ASH AREAS
AERIAL IMAGERY
ASHEVILLE STEAM STATION, BUNCOMBE CO., NC

PROJECT NO.:	7810140162.02
REVISION NO.	0
DATE:	DEC. 2014
FIGURE NO.	1

Q:\Ash Inventory\Asheville\Asheville 2.x Set.dwg



NOTES:
1. BOXED CONTOUR LABELS HAVE BEEN ADDED FOR CLARITY.
2. CONTOUR ELEVATIONS ARE ASSUMED TO REFERENCE NGVD29 VERTICAL DATUM.

REFERENCES
1. DRAWING NO. G-221-B ENTITLED, "ASH DISPOSAL POND & DAM, GENERAL LAYOUT" PREPARED BY CAROLINA POWER & LIGHT COMPANY, REV. B, DATED 7/29/71. VERTICAL DATUM NOT INDICATED.

CLIENT: DUKE ENERGY	DATUM (HOR - VER): NAD83 - NGVD29	PROJECT: WASTE STRATEGY ANALYSIS ASHEVILLE - ASH INVENTORY	PROJECT NO.: 7810140162.02
	PROJECTION: NC83F		REVISION NO. 0
AMEC Environment & Infrastructure, Inc. 2801 YORKMONT ROAD, SUITE 100 CHARLOTTE, NC 28208 TEL: (704) 357-8600 FAX: (704) 357-8638 LICENSURE: NC ENG: F-1253 NC GEOLOGY: C-247	DRAWN BY: MA	TITLE: 1964 ASH BASIN ORIGINAL TOPOGRAPHY ASHEVILLE STEAM STATION, BUNCOMBE CO., NC	DATE: DEC. 2014
amec	REVIEWED BY: TM		FIGURE NO. 2.1
	SCALE: AS NOTED		

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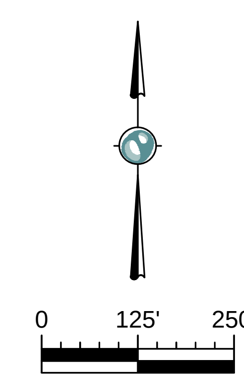
I/A



NOTES:
1. (2FT) CONTOURS WERE DIGITIZED FROM HISTORICAL TOPO SHOWN IN FIGURE 2.1 (REFERENCE 1). INTERPOLATED (5FT) CONTOURS ARE SHOWN HERE FOR CLARITY PURPOSE.
2. A DATUM SHIFT OF -0.13 FT WAS APPLIED TO CONVERT ELEVATIONS FROM NGVD29 TO NAVD88.
3. THIS IS AN ACCURATE REPRESENTATION OF THE CONTOURS SHOWN IN REFERENCE 1 AND IS AN APPROXIMATION OF THE BOTTOM OF ASH BASIN CONTOURS BASED ON THE BEST INFORMATION AVAILABLE TO AMEC IN DECEMBER 2014.

REFERENCES
1. DRAWING NO. G-221-B ENTITLED, "ASH DISPOSAL POND & DAM, GENERAL LAYOUT" PREPARED BY CAROLINA POWER & LIGHT COMPANY, REV. B, DATED 7/29/71. VERTICAL DATUM CONVERTED FROM NGVD29 TO NAVD88.

CLIENT: DUKE ENERGY

AMEC Environment & Infrastructure, Inc.
2801 YORKMONT ROAD, SUITE 100
CHARLOTTE, NC 28208
TEL: (704) 357-8600 FAX: (704) 357-8638
LICENSURE: NC ENG: F-1253 NC GEOLOGY: C-247

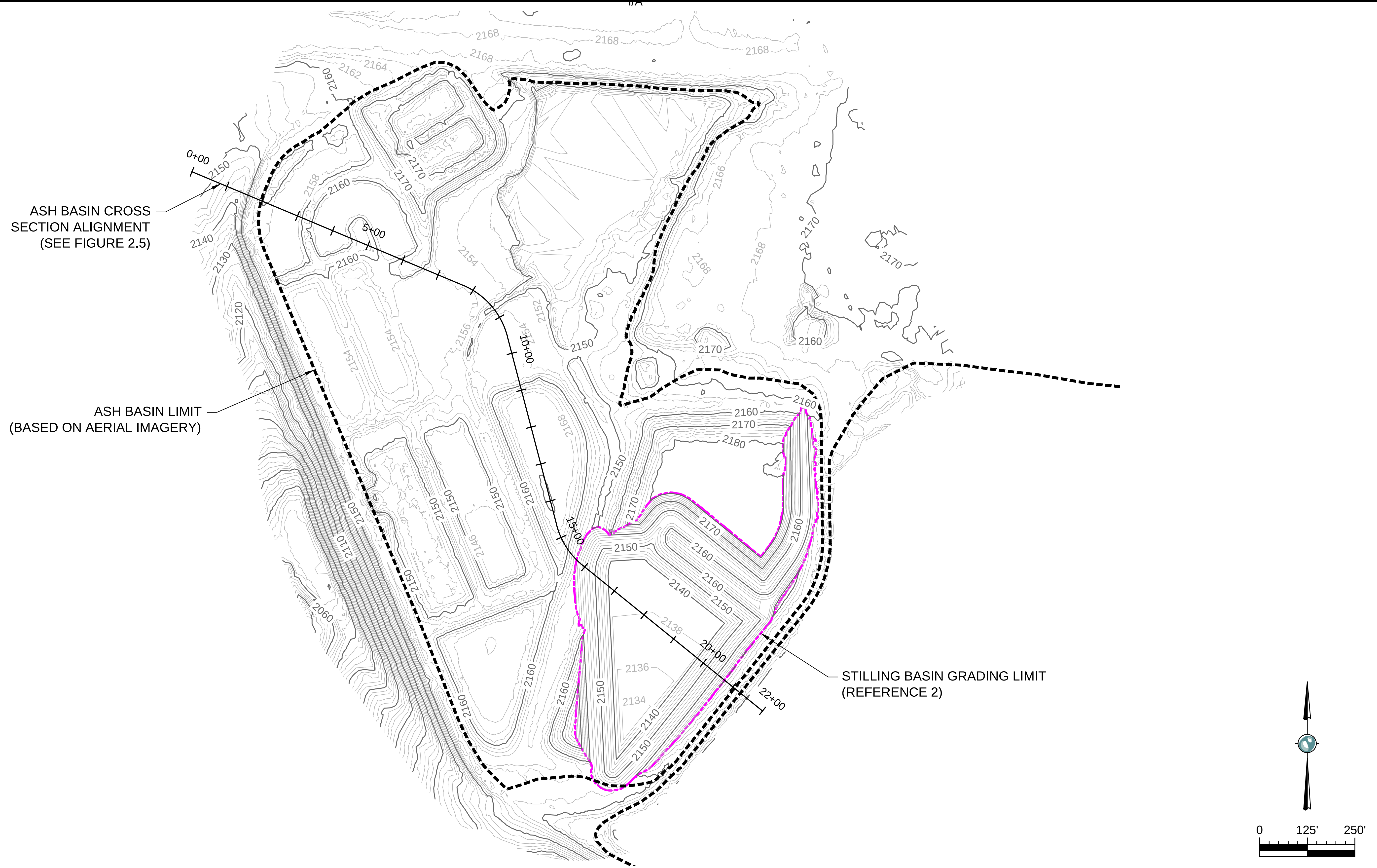
DATUM (HOR - VER):	NAD83 - NAVD88
PROJECTION:	NC83F
DRAWN BY:	MA
REVIEWED BY:	TM
SCALE:	AS NOTED

PROJECT: WASTE STRATEGY ANALYSIS
ASHEVILLE - ASH INVENTORY

TITLE: 1964 ASH BASIN
DIGITIZED BASE CONTOURS
ASHEVILLE STEAM STATION, BUNCOMBE CO., NC

PROJECT NO.:	7810140162.02
REVISION NO.	0
DATE:	DEC. 2014
FIGURE NO.	2.2

Q:\Ash Inventory\Asheville\Asheville 2.x Set.dwg



NOTES

1. ASH BOUNDARIES ARE APPROXIMATE.

REFERENCES

1. NORTH CAROLINA FLOODPLAIN MAPPING PROGRAM (NCFMP) LIDAR BARE EARTH MASS POINTS PUBLISHED IN APRIL 2006. VERTICAL DATUM NAVD88.
2. DRAWING NO. 1.0 ENTITLED, " '64 RIM DITCH & STILLING BASIN IMPROVEMENTS LAYOUT/GRADING PLAN" REV. 2 PREPARED BY FRANKLIN S. CRAIG, PE, DATED 1/29/13.VERTICAL DATUM NAVD88.

CLIENT: DUKE ENERGY

AMEC Environment & Infrastructure, Inc.
2801 YORKMONT ROAD, SUITE 100
CHARLOTTE, NC 28208
TEL: (704) 357-8600 FAX: (704) 357-8638
LICENSURE: NC ENG: F-1253 NC GEOLOGY: C-247

DATUM (HOR - VER):	NAD83 - NAVD88
PROJECTION:	NC83F
DRAWN BY:	MA
REVIEWED BY:	TM
SCALE:	AS NOTED

PROJECT: WASTE STRATEGY ANALYSIS
ASHEVILLE - ASH INVENTORY

TITLE: 1964 ASH BASIN
RECENT TOPOGRAPHY
ASHEVILLE STEAM STATION, BUNCOMBE CO., NC

PROJECT NO.:	7810140162.02
REVISION NO.	0
DATE:	DEC. 2014
FIGURE NO.	2.3

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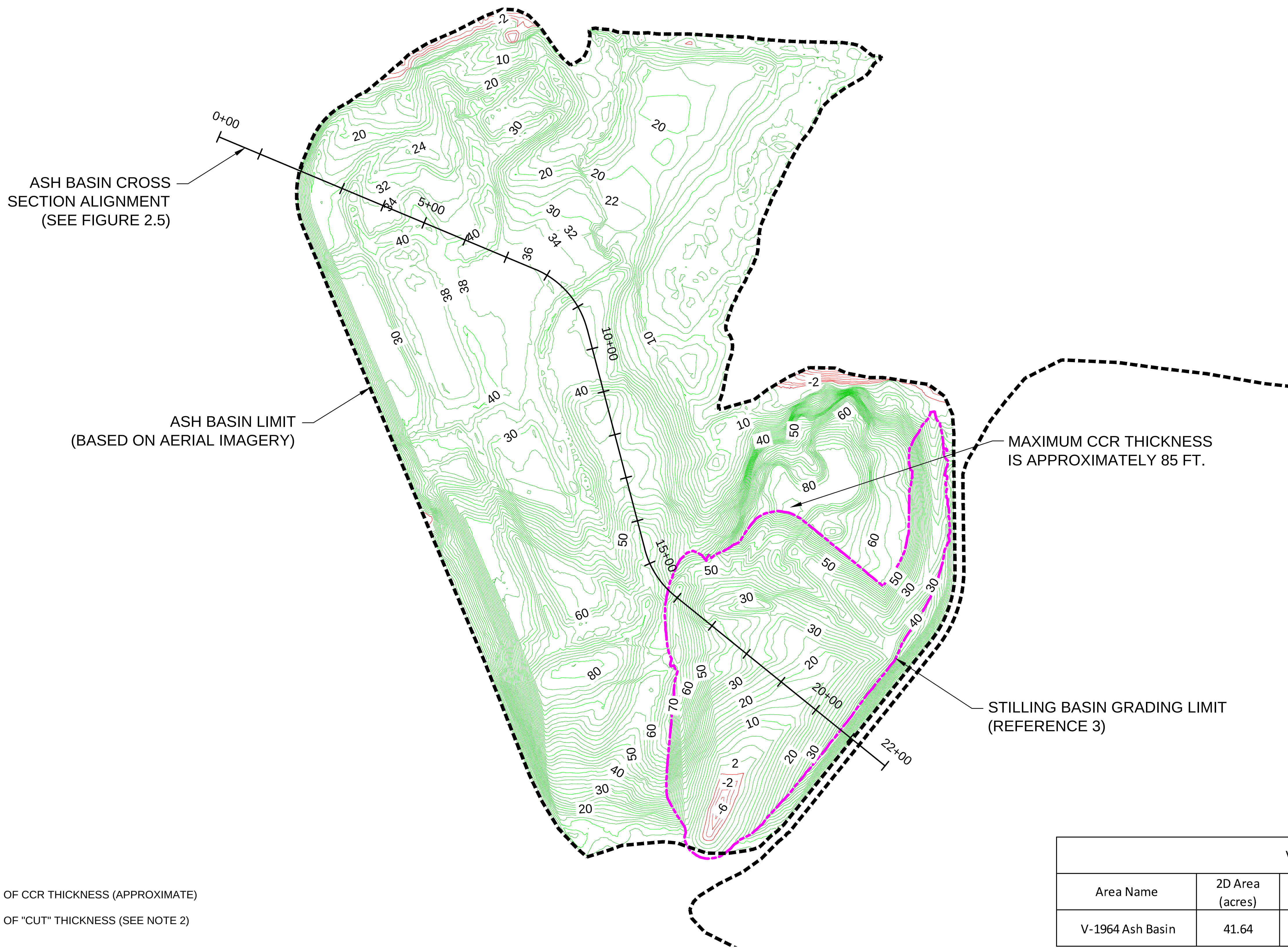
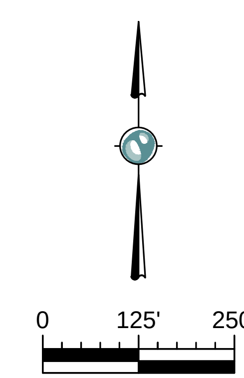
I/A





Volume Summary					
Area Name	2D Area (acres)	Cut (Cu. Yd.)	Fill (Cu. Yd.)	Base	Comparison
V-1964 Ash Basin	41.64	2,991	2,112,603	Reference 1	Reference 2

LEGEND

CONTOUR OF CCR THICKNESS (APPROXIMATE)

CONTOUR OF "CUT" THICKNESS (SEE NOTE 2)

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NOTES:
1. COAL COMBUSTION RESIDUALS (CCR) VOLUME WAS CALCULATED USING AUTOCAD CIVIL 3D SOFTWARE.
2. RED CONTOURS, IF PRESENT, INDICATE THAT THE BASE SURFACE IS AT HIGHER ELEVATION THAN THE COMPARISON SURFACE. THIS MAY BE DUE TO REGRADING AND/OR LIMITATIONS OF DATA QUALITY.

REFERENCES:
1. DRAWING NO. G-221-B ENTITLED, "ASH DISPOSAL POND & DAM, GENERAL LAYOUT" PREPARED BY CAROLINA POWER & LIGHT COMPANY, REV. B, DATED 7/29/71. VERTICAL DATUM CONVERTED FROM NGVD29 TO NAVD88.
2. NORTH CAROLINA FLOODPLAIN MAPPING PROGRAM (NCFMP) LIDAR BARE EARTH MASS POINTS PUBLISHED IN APRIL 2006. VERTICAL DATUM NAVD88.
3. DRAWING NO. 1.0 ENTITLED, " '64 RIM DITCH & STILLING BASIN IMPROVEMENTS LAYOUT/GRADING PLAN" REV. 2 PREPARED BY FRANKLIN S. CRAIG, PE, DATED 1/29/13.VERTICAL DATUM NAVD88.

CLIENT: DUKE ENERGY

AMEC Environment & Infrastructure, Inc.
2801 YORKMONT ROAD, SUITE 100
CHARLOTTE, NC 28208
TEL: (704) 357-8600 FAX: (704) 357-8638
LICENSURE: NC ENG: F-1253 NC GEOLOGY: C-247

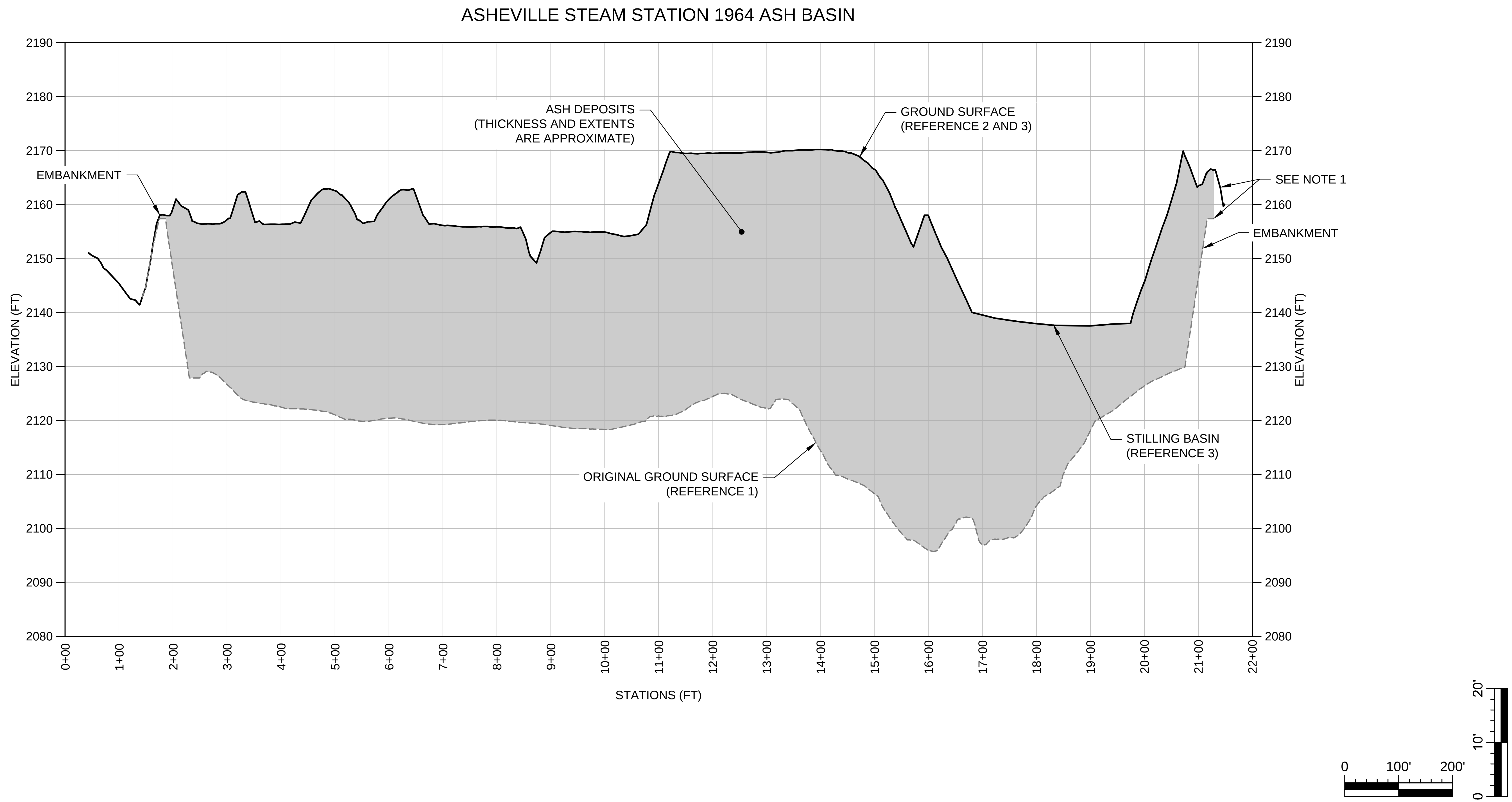
DATUM (HOR - VER): NAD83 - NAVD88
PROJECTION: NC83F
DRAWN BY: MA
REVIEWED BY: TM
SCALE: AS NOTED

PROJECT: WASTE STRATEGY ANALYSIS
ASHEVILLE - ASH INVENTORY

TITLE: 1964 ASH BASIN
ISOPACH
ASHEVILLE STEAM STATION, BUNCOMBE CO., NC

PROJECT NO.: 7810140162.02
REVISION NO.: 0
DATE: DEC. 2014
FIGURE NO. 2.4

I/A



NOTES:
1. AT THE DESIGNATED LIMIT OF ASH BASIN, THE ORIGINAL GROUND SURFACE ELEVATION MAY NOT EQUAL THE "EXISTING" GROUND SURFACE ELEVATION DUE TO REGRADING AND/OR LIMITATIONS OF DATA QUALITY.

REFERENCES:
1. DRAWING NO. G-221-B ENTITLED, "ASH DISPOSAL POND & DAM, GENERAL LAYOUT" PREPARED BY CAROLINA POWER & LIGHT COMPANY, REV. B, DATED 7/29/71. VERTICAL DATUM CONVERTED FROM NGVD29 TO NAVD88.
2. NORTH CAROLINA FLOODPLAIN MAPPING PROGRAM (NCFMP) LIDAR BARE EARTH MASS POINTS PUBLISHED IN APRIL 2006. VERTICAL DATUM NAVD88.
3. DRAWING NO. 1.0 ENTITLED, " '64 RIM DITCH & STILLING BASIN IMPROVEMENTS LAYOUT/GRADING PLAN" REV. 2 PREPARED BY FRANKLIN S. CRAIG, PE, DATED 1/29/13.VERTICAL DATUM NAVD88.

CLIENT:	DUKE ENERGY
	AMEC Environment & Infrastructure, Inc. 2801 YORKMONT ROAD, SUITE 100 CHARLOTTE, NC 28208 TEL: (704) 357-8600 FAX: (704) 357-8638 LICENSURE: NC ENG: F-1253 NC GEOLOGY: C-247
DATUM (HOR - VER):	NAD83 - NAVD88
PROJECTION:	NC83F
DRAWN BY:	MA
REVIEWED BY:	TM
SCALE:	AS NOTED
PROJECT:	WASTE STRATEGY ANALYSIS ASHEVILLE - ASH INVENTORY
TITLE:	1964 ASH BASIN CROSS SECTION ASHEVILLE STEAM STATION, BUNCOMBE CO., NC
PROJECT NO.:	7810140162.02
REVISION NO.:	0
DATE:	DEC. 2014
FIGURE NO.:	2.5

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APPENDIX B: COMPREHENSIVE SITE ASSESSMENT (CSA) REPORT, AUGUST 23, 2015 (SYNTERRA 2015a); CSA REPORT SUPPLEMENT 1, AUGUST 31, 2016 (SYNTERRA 2016b)

amec
foster
wheeler

Reports are presented herein in electronic format on the enclosed CD.

APPENDIX C: CORRECTIVE ACTION PLAN (CAP) PART 1, NOVEMBER 20, 2016 (SYNTERRA 2015b); CAP PART 2, FEBRUARY 19, 2016 (SYNTERRA, 2016a); UPDATED GROUNDWATER FLOW AND TRANSPORT MODELING REPORT, MARCH 17, 2017 (Falta, et al 2017)

amec foster wheeler

Reports are presented herein in electronic format on the enclosed CD.

APPENDIX D: ENGINEERING EVALUATIONS AND ANALYSES OF CLOSURE DESIGN GRADING PLANS FOR THE 1982 ASH BASIN

Decommissioning Plan Calculations

Calculation Title:
PMP Containment Calculations

Summary:
This calculation determines the minimum crest elevation required for the existing 1982 Ash Basin Dam to contain the design PMP storm event. Stage-storage curves were developed during the decommissioning design for the ash basin dam and the storage volumes within the existing ash basin. Those stage-storage curves were compared with the PMP stormwater volume, and an elevation of 2126' was determined as the minimum required crest elevation for the dam to contain the storm.

Once this elevation is reached the dam will be breached along the left abutment to the active fill area (or lower to facilitate underdrain construction) so that the dam will no longer impound significant volumes of water.

Notes:

Revision Log:

No.	Description	Originator / Date	Technical Reviewer / Date
0	Initial Submittal	Luke C. Williams, PE NORTH CAROLINA PROFESSIONAL SEAL 041903 ENGINEER LUKE C. WILLIAMS Luke C. Williams 1-14-16	Daniel R. Smith DRS 1/14/16

OBJECTIVE:

The objective of this calculation is to determine the minimum crest elevation of the 1982 Ash Basin dam that is required to store the PMP design storm event without overtopping. The results of this calculation will be used in the construction sequencing design to determine the point in which the dam should be breached.

METHOD:

Calculations for the PMP storm event are based on stage-storage information associated with the balanced breach design presented in the drawings. Two stage-storage curves were developed for the balanced breach: 1. Volume of dam material generated during excavation, and 2. Impoundment volume present within the existing ash basin after ash removal. The design storm volume was compared to the stage-storage curves to determine the minimum crest elevation required.

CALCULATIONS:

1.0 Volume of Dam Material Generated During Excavation

A stage-volume curve was developed for the material in the current 1982 Ash Basin Dam that will be used as fill material. The volumes were determined using the computer program AutoCAD Civil 3D. AutoCAD calculates these volumes based on triangulation methods. The volumes were calculated between the crest elevation of approximately 2166' to an elevation of 2090'. As shown on **Figure 1**, the cumulative volume present within the 1982 Ash Basin Dam between these elevations is approximately 208 acre-feet. The AutoCAD output of these volumes is included with this calculation as **Attachment 1**.

2.0 Impoundment Volume within the Existing Ash Basin

Storage volumes that will be present within the existing 1982 Ash Basin were also calculated. As part of the decommissioning process, ash that is currently present within the basin will be removed and transported offsite. Therefore, post ash excavation grades were developed for the 1982 Ash Basin, which will represent the configuration of the basin before dam decommissioning activities commence. Using the post ash excavation grades, a stage-storage curve was developed for the storage volume available.

The stage-storage curve was calculated using AutoCAD Civil 3D's triangulation methods. The storage volumes were calculated between the basin elevations of 2074' and 2130'. As shown on **Figure 1**, the cumulative storage volume present within the 1982 Ash Basin between these elevations is approximately 492 acre-feet. The AutoCAD output of these volumes is included with this calculation as **Attachment 2**.

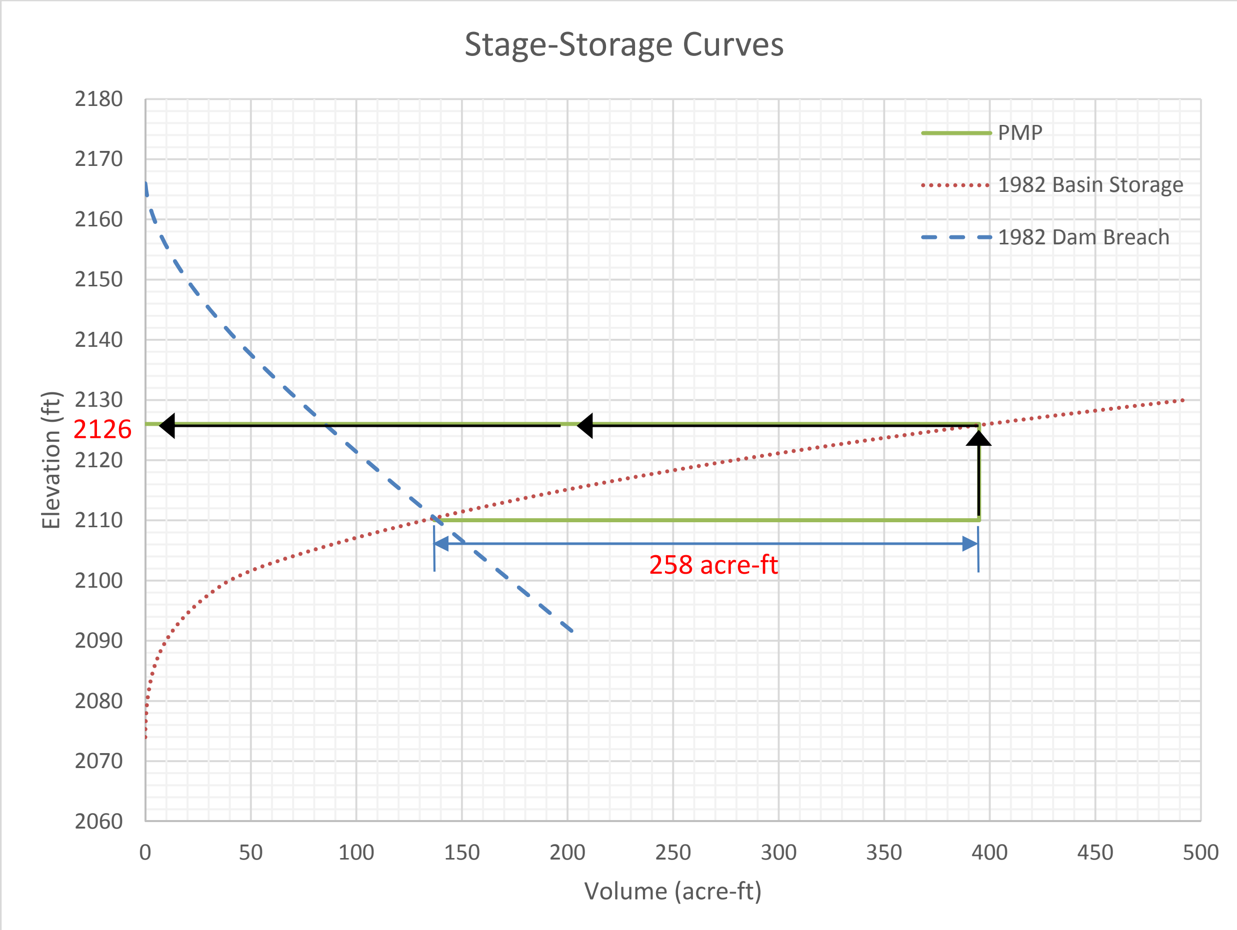

Figure 1: Stage-Storage Curves for the 1982 Ash Basin

3.0 PMP Storage Volume Calculations

The design storm volumes for the 1982 Ash Basin was modeled using a Full PMP storm event. These calculations were performed as part of the Phase 2 Reconstitution for the site. As determined from the "Asheville 1964 and 1982 Ash Ponds – Hydrologic and Hydraulic (H&H) Analysis," the design storm volume under a Full PMP storm event is 258 acre-feet.

To calculate the minimum required crest elevation to contain the design storm event, the design storm volume of 258 acre-feet was also plotted with the stage-storage curves presented on **Figure 1**. As part of the balanced breach activities, excavated materials from the dam will be used as fill materials within the basin. The intersection of the two curves is at 2110' and 138 acre-feet, thus representing the idealized balanced breach elevation and volume, respectively.

It should be noted that the design drawings [Ref. 4] show a balanced breach at elevation 2106'. The final design reflects a lower breach elevation, as more material is necessary to slope the proposed backfill to allow for stormwater drainage. However, the calculation herein presents the idealized balanced breach, which is applicable for interim construction conditions.

The design storm volume of 258 acre-feet was drawn at the idealized intersection at elevation 2110', and new line intersects were drawn to determine the required dam crest elevation to contain the storm volume. As shown on **Figure 1**, a minimum dam elevation of 2126' is required during balanced breach activities to contain the design storm event.

DISCUSSION:

During the decommissioning activities, the PMP design storm volume will initially be contained within the existing 1982 Ash Basin at the site. However, as construction of the dam breach progresses, storage volume within the existing basin will be decreased as the dam is lowered and backfill is placed within the basin. Once the basin is no longer able to contain the PMP storm event, a breach through the dam is necessary to safely convey the stormwater runoff away from the basin and prevent overtopping of the dam. Using stage-storage curves for both the dam excavation and the storage volume within the basin, it was determined that the PMP storm event could be contained with a minimum dam elevation of 2126'.

REFERENCES:

1. "Asheville 1964 and 1982 Ash Ponds – Hydrologic and Hydraulic (H&H) Analysis," Phase 2 Reconstitution of Design, December 30, 2014.
2. Microsoft Excel 2013, Microsoft Corporation.
3. AutoCAD Civil 3D 2015, AutoDesk Inc.
4. Amec Foster Wheeler, "Decommissioning and Ash Removal Plan, 1982 Ash Basin," January 14, 2016.

ATTACHMENTS:

Attachment 1 – 1982 Ash Basin Dam Breach Volumes AutoCAD Output

Attachment 2 – 1982 Ash Basin Storage Volumes AutoCAD Output

Attachment 1

1982 Ash Basin Dam Breach Volumes AutoCAD Output

1982 Dam Breech-Volumes by Triangulation (Prisms).txt

Volumes by Triangulation (Prisms) Wed Jan 06 12:03:24 2016
Existing Surface: P:\CADD\Projects\7810\7810150250 Asheville Pond\100% Design Package Pond 1982 & 1964 Closure\Work\APT\1982 Dam Breech Base.tin
Final Surface: P:\CADD\Projects\7810\7810150250 Asheville Pond\100% Design Package Pond 1982 & 1964 Closure\Work\APT\1982 Dam Breech.tin

Cut volume: 9,042,998.3 C.F., 334,925.86 C.Y.
Fill volume: 565.7 C.F., 20.95 C.Y.

Area in Cut : 285,518.5 S.F., 6.55 Acres
Area in Fill: 477.4 S.F., 0.01 Acres
Total inclusion area: 286,004.9 S.F., 6.57 Acres

Average Cut Depth: 31.67 feet
Cut to Fill ratio: 15984.50
Export Volume: 334,904.9 C.Y.
Elevation Change To Reach Balance: 31.616
Volume Change Per .1 ft: 1,059.3 C.Y.

Cut (C.Y.) / Area (acres): 51010.91
Fill (C.Y.) / Area (acres): 3.19

Max Cut: 76.000 at 944892.414,642851.901
Max Fill: 2.915 at 944500.922,643111.262

Elevation Zone Volumes

Zone: 2166.000 to 2168.000
Cut Volume : 314.49 C.F., 11.65 C.Y.
Fill Volume : 0.00 C.F., 0.00 C.Y.

Zone: 2164.000 to 2166.000
Cut Volume : 35,794.31 C.F., 1,325.72 C.Y.
Fill Volume : 1.47 C.F., 0.05 C.Y.
Running Totals:
Cut Volume : 36,108.80 C.F., 1,337.36 C.Y.
Fill Volume : 1.47 C.F., 0.05 C.Y.

Zone: 2162.000 to 2164.000
Cut Volume : 64,747.36 C.F., 2,398.05 C.Y.
Fill Volume : 0.32 C.F., 0.01 C.Y.
Running Totals:
Cut Volume : 100,856.16 C.F., 3,735.41 C.Y.
Fill Volume : 1.79 C.F., 0.07 C.Y.

Zone: 2160.000 to 2162.000
Cut Volume : 83,739.29 C.F., 3,101.46 C.Y.
Fill Volume : 0.07 C.F., 0.00 C.Y.
Running Totals:
Cut Volume : 184,595.45 C.F., 6,836.87 C.Y.
Fill Volume : 1.86 C.F., 0.07 C.Y.

Zone: 2158.000 to 2160.000
Cut Volume : 102,073.34 C.F., 3,780.49 C.Y.
Fill Volume : 0.10 C.F., 0.00 C.Y.
Running Totals:
Cut Volume : 286,668.79 C.F., 10,617.36 C.Y.
Fill Volume : 1.95 C.F., 0.07 C.Y.

Zone: 2156.000 to 2158.000
Cut Volume : 119,667.30 C.F., 4,432.12 C.Y.
Fill Volume : 0.02 C.F., 0.00 C.Y.
Running Totals:

Cut Volume : 406,336.10 C.F., 15,049.49 C.Y.
Fill Volume : 1.97 C.F., 0.07 C.Y.

Zone: 2154.000 to 2156.000
Cut Volume : 136,460.10 C.F., 5,054.08 C.Y.
Fill Volume : 0.01 C.F., 0.00 C.Y.
Running Totals:
Cut Volume : 542,796.20 C.F., 20,103.56 C.Y.
Fill Volume : 1.98 C.F., 0.07 C.Y.

Zone: 2152.000 to 2154.000
Cut Volume : 152,439.02 C.F., 5,645.89 C.Y.
Fill Volume : 0.07 C.F., 0.00 C.Y.
Running Totals:
Cut Volume : 695,235.23 C.F., 25,749.45 C.Y.
Fill Volume : 2.05 C.F., 0.08 C.Y.

Zone: 2150.000 to 2152.000
Cut Volume : 167,634.39 C.F., 6,208.68 C.Y.
Fill Volume : 7.53 C.F., 0.28 C.Y.
Running Totals:
Cut Volume : 862,869.61 C.F., 31,958.13 C.Y.
Fill Volume : 9.58 C.F., 0.35 C.Y.

Zone: 2148.000 to 2150.000
Cut Volume : 181,338.47 C.F., 6,716.24 C.Y.
Fill Volume : 366.78 C.F., 13.58 C.Y.
Running Totals:
Cut Volume : 1,044,208.08 C.F., 38,674.37 C.Y.
Fill Volume : 376.36 C.F., 13.94 C.Y.

Zone: 2146.000 to 2148.000
Cut Volume : 193,633.69 C.F., 7,171.62 C.Y.
Fill Volume : 187.75 C.F., 6.95 C.Y.
Running Totals:
Cut Volume : 1,237,841.77 C.F., 45,845.99 C.Y.
Fill Volume : 564.11 C.F., 20.89 C.Y.

Zone: 2144.000 to 2146.000
Cut Volume : 205,482.72 C.F., 7,610.47 C.Y.
Fill Volume : 0.00 C.F., 0.00 C.Y.
Running Totals:
Cut Volume : 1,443,324.49 C.F., 53,456.46 C.Y.
Fill Volume : 564.11 C.F., 20.89 C.Y.

Zone: 2142.000 to 2144.000
Cut Volume : 216,571.67 C.F., 8,021.17 C.Y.
Fill Volume : 0.10 C.F., 0.00 C.Y.
Running Totals:
Cut Volume : 1,659,896.16 C.F., 61,477.64 C.Y.
Fill Volume : 564.21 C.F., 20.90 C.Y.

Zone: 2140.000 to 2142.000
Cut Volume : 227,265.20 C.F., 8,417.23 C.Y.
Fill Volume : 0.00 C.F., 0.00 C.Y.
Running Totals:
Cut Volume : 1,887,161.36 C.F., 69,894.87 C.Y.
Fill Volume : 564.21 C.F., 20.90 C.Y.

Zone: 2138.000 to 2140.000
Cut Volume : 237,438.41 C.F., 8,794.02 C.Y.
Fill Volume : 0.22 C.F., 0.01 C.Y.
Running Totals:

Cut Volume : 2,124,599.77 C.F., 78,688.88 C.Y.
Fill Volume : 564.43 C.F., 20.90 C.Y.

Zone: 2136.000 to 2138.000
Cut Volume : 246,970.04 C.F., 9,147.04 C.Y.
Fill Volume : 0.08 C.F., 0.00 C.Y.
Running Totals:
Cut Volume : 2,371,569.82 C.F., 87,835.92 C.Y.
Fill Volume : 564.51 C.F., 20.91 C.Y.

Zone: 2134.000 to 2136.000
Cut Volume : 255,418.40 C.F., 9,459.94 C.Y.
Fill Volume : 0.00 C.F., 0.00 C.Y.
Running Totals:
Cut Volume : 2,626,988.22 C.F., 97,295.86 C.Y.
Fill Volume : 564.51 C.F., 20.91 C.Y.

Zone: 2132.000 to 2134.000
Cut Volume : 262,753.18 C.F., 9,731.60 C.Y.
Fill Volume : 0.00 C.F., 0.00 C.Y.
Running Totals:
Cut Volume : 2,889,741.40 C.F., 107,027.46 C.Y.
Fill Volume : 564.51 C.F., 20.91 C.Y.

Zone: 2130.000 to 2132.000
Cut Volume : 267,889.22 C.F., 9,921.82 C.Y.
Fill Volume : 0.00 C.F., 0.00 C.Y.
Running Totals:
Cut Volume : 3,157,630.62 C.F., 116,949.28 C.Y.
Fill Volume : 564.51 C.F., 20.91 C.Y.

Zone: 2128.000 to 2130.000
Cut Volume : 271,568.38 C.F., 10,058.09 C.Y.
Fill Volume : 0.00 C.F., 0.00 C.Y.
Running Totals:
Cut Volume : 3,429,199.00 C.F., 127,007.37 C.Y.
Fill Volume : 564.51 C.F., 20.91 C.Y.

Zone: 2126.000 to 2128.000
Cut Volume : 275,646.87 C.F., 10,209.14 C.Y.
Fill Volume : 0.00 C.F., 0.00 C.Y.
Running Totals:
Cut Volume : 3,704,845.87 C.F., 137,216.51 C.Y.
Fill Volume : 564.51 C.F., 20.91 C.Y.

Zone: 2124.000 to 2126.000
Cut Volume : 279,366.71 C.F., 10,346.92 C.Y.
Fill Volume : 0.00 C.F., 0.00 C.Y.
Running Totals:
Cut Volume : 3,984,212.58 C.F., 147,563.43 C.Y.
Fill Volume : 564.51 C.F., 20.91 C.Y.

Zone: 2122.000 to 2124.000
Cut Volume : 282,625.92 C.F., 10,467.63 C.Y.
Fill Volume : 0.09 C.F., 0.00 C.Y.
Running Totals:
Cut Volume : 4,266,838.50 C.F., 158,031.06 C.Y.
Fill Volume : 564.60 C.F., 20.91 C.Y.

Zone: 2120.000 to 2122.000
Cut Volume : 285,514.94 C.F., 10,574.63 C.Y.
Fill Volume : 0.00 C.F., 0.00 C.Y.
Running Totals:

```
Cut Volume : 4,552,353.43 C.F., 168,605.68 C.Y.
Fill Volume : 564.60 C.F., 20.91 C.Y.

Zone: 2118.000 to 2120.000
Cut Volume : 289,722.86 C.F., 10,730.48 C.Y.
Fill Volume : 0.06 C.F., 0.00 C.Y.
Running Totals:
Cut Volume : 4,842,076.30 C.F., 179,336.16 C.Y.
Fill Volume : 564.66 C.F., 20.91 C.Y.

Zone: 2116.000 to 2118.000
Cut Volume : 294,265.15 C.F., 10,898.71 C.Y.
Fill Volume : 0.21 C.F., 0.01 C.Y.
Running Totals:
Cut Volume : 5,136,341.44 C.F., 190,234.87 C.Y.
Fill Volume : 564.87 C.F., 20.92 C.Y.

Zone: 2114.000 to 2116.000
Cut Volume : 297,227.92 C.F., 11,008.44 C.Y.
Fill Volume : 0.23 C.F., 0.01 C.Y.
Running Totals:
Cut Volume : 5,433,569.36 C.F., 201,243.31 C.Y.
Fill Volume : 565.10 C.F., 20.93 C.Y.

Zone: 2112.000 to 2114.000
Cut Volume : 298,522.04 C.F., 11,056.37 C.Y.
Fill Volume : 0.13 C.F., 0.00 C.Y.
Running Totals:
Cut Volume : 5,732,091.41 C.F., 212,299.68 C.Y.
Fill Volume : 565.23 C.F., 20.93 C.Y.

Zone: 2110.000 to 2112.000
Cut Volume : 298,002.05 C.F., 11,037.11 C.Y.
Fill Volume : 0.04 C.F., 0.00 C.Y.
Running Totals:
Cut Volume : 6,030,093.46 C.F., 223,336.79 C.Y.
Fill Volume : 565.27 C.F., 20.94 C.Y.

Zone: 2108.000 to 2110.000
Cut Volume : 297,974.54 C.F., 11,036.09 C.Y.
Fill Volume : 0.00 C.F., 0.00 C.Y.
Running Totals:
Cut Volume : 6,328,068.00 C.F., 234,372.89 C.Y.
Fill Volume : 565.27 C.F., 20.94 C.Y.

Zone: 2106.000 to 2108.000
Cut Volume : 299,642.95 C.F., 11,097.89 C.Y.
Fill Volume : 0.17 C.F., 0.01 C.Y.
Running Totals:
Cut Volume : 6,627,710.95 C.F., 245,470.78 C.Y.
Fill Volume : 565.44 C.F., 20.94 C.Y.

Zone: 2104.000 to 2106.000
Cut Volume : 301,147.46 C.F., 11,153.61 C.Y.
Fill Volume : 0.00 C.F., 0.00 C.Y.
Running Totals:
Cut Volume : 6,928,858.41 C.F., 256,624.39 C.Y.
Fill Volume : 565.44 C.F., 20.94 C.Y.

Zone: 2102.000 to 2104.000
Cut Volume : 302,469.88 C.F., 11,202.59 C.Y.
Fill Volume : 0.00 C.F., 0.00 C.Y.
Running Totals:
```

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Cut Volume : 7,231,328.28 C.F., 267,826.97 C.Y.
Fill Volume : 565.44 C.F., 20.94 C.Y.

Zone: 2100.000 to 2102.000
Cut Volume : 303,159.42 C.F., 11,228.13 C.Y.
Fill Volume : 0.00 C.F., 0.00 C.Y.
Running Totals:
Cut Volume : 7,534,487.70 C.F., 279,055.10 C.Y.
Fill Volume : 565.44 C.F., 20.94 C.Y.

Zone: 2098.000 to 2100.000
Cut Volume : 302,756.31 C.F., 11,213.20 C.Y.
Fill Volume : 0.31 C.F., 0.01 C.Y.
Running Totals:
Cut Volume : 7,837,244.01 C.F., 290,268.30 C.Y.
Fill Volume : 565.74 C.F., 20.95 C.Y.

Zone: 2096.000 to 2098.000
Cut Volume : 301,936.72 C.F., 11,182.84 C.Y.
Fill Volume : 0.00 C.F., 0.00 C.Y.
Running Totals:
Cut Volume : 8,139,180.72 C.F., 301,451.14 C.Y.
Fill Volume : 565.75 C.F., 20.95 C.Y.

Zone: 2094.000 to 2096.000
Cut Volume : 301,296.97 C.F., 11,159.15 C.Y.
Fill Volume : 0.00 C.F., 0.00 C.Y.
Running Totals:
Cut Volume : 8,440,477.70 C.F., 312,610.29 C.Y.
Fill Volume : 565.75 C.F., 20.95 C.Y.

Zone: 2092.000 to 2094.000
Cut Volume : 301,078.88 C.F., 11,151.07 C.Y.
Fill Volume : 0.00 C.F., 0.00 C.Y.
Running Totals:
Cut Volume : 8,741,556.58 C.F., 323,761.35 C.Y.
Fill Volume : 565.75 C.F., 20.95 C.Y.

Zone: 2090.000 to 2092.000
Cut Volume : 301,433.49 C.F., 11,164.20 C.Y.
Fill Volume : 0.00 C.F., 0.00 C.Y.
Running Totals:
Cut Volume : 9,042,990.07 C.F., 334,925.56 C.Y.
Fill Volume : 565.75 C.F., 20.95 C.Y.
```

Attachment 2

1982 Ash Basin Storage Volumes AutoCAD Output

I/A

1982 Ash Removal-Pond Storage Volumes.txt

Pond Storage Volumes Wed Jan 06 10:05:48 2016

Water Elev	Storage(AcreFt)	(C.Y.)	(C.F.)	Area(Acre)
2074.00	0.00122	2.0	53.0	0.005
2076.00	0.09708	156.6	4228.7	0.108
2078.00	0.43280	698.3	18852.9	0.203
2080.00	0.96722	1560.4	42131.9	0.319
2082.00	1.78284	2876.3	77660.3	0.463
2084.00	2.93112	4728.9	127679.4	0.662
2086.00	4.57653	7383.5	199353.6	0.960
2088.00	6.82646	11013.4	297360.6	1.270
2090.00	9.78460	15785.8	426217.2	1.664
2092.00	13.63750	22001.8	594049.5	2.140
2094.00	18.41436	29708.5	802129.5	2.632
2096.00	24.23012	39091.3	1055464.1	3.167
2098.00	31.25953	50432.0	1361665.0	3.797
2100.00	39.79823	64207.8	1733611.1	4.741
2102.00	52.63097	84911.3	2292605.0	7.809
2104.00	69.45406	112052.5	3025418.8	8.982
2106.00	88.42905	142665.5	3851969.6	9.956
2108.00	109.27234	176292.7	4759902.9	10.880
2110.00	132.05249	213044.7	5752206.3	11.872
2112.00	156.86645	253077.9	6833102.5	12.925
2114.00	183.69336	296358.6	8001682.7	13.918
2116.00	212.95642	343569.7	9276381.6	15.183
2118.00	244.59829	394618.6	10654701.7	16.421
2120.00	278.85199	449881.2	12146792.5	17.770
2122.00	315.93646	509710.8	13762192.0	19.286
2124.00	355.91596	574211.1	15503699.3	20.646
2126.00	398.63035	643123.6	17364338.2	22.027
2128.00	444.17086	716595.7	19348082.7	23.446
2130.00	492.47209	794521.6	21452084.1	24.826

Calculation Title:
Slope Stability of Dam Breach Calculations

Summary:
This calculation determines the stability of the existing 1982 Ash Basin Dam after dam decommissioning and final grading activities are completed. In this analysis, seepage modeling was performed using SEEP/W, and slope stability modeling was performed using SLOPE/W. Both steady-state and pseudo-static scenarios were analyzed using both circular and block failure surfaces. The slope stability modeling resulted in factors of safety greater than the minimum required values accepted under current geotechnical engineering standards of practice.

Notes:

Revision Log:

No.	Description	Originator / Date	Technical Reviewer / Date
0	Initial Submittal	Luke Williams, PE NORTH CAROLINA PROFESSIONAL SEAL 041903 ENGINEER LUKE C. WILLIAMS 1-14-16	Carl Tockstein, PE 1-14-16

OBJECTIVE:

The objective of this calculation is to evaluate the stability of the existing 1982 Ash Basin Dam after dam decommissioning and final grading activities are completed. Seepage and slope stability modeling were performed through the section of the embankment with the highest existing embankment height using the proposed final grading as shown on the project drawings.

METHOD:

Seepage and slope stability modeling were performed using GeoStudio 2012 computer software. The seepage analysis was performed using SEEP/W to calculate the pore water pressures through the profile under possible upstream water level scenarios. The stability analysis was performed using 2-dimensional limit equilibrium analysis based on the method of slices according to the Spencer Method using SLOPE/W. This method satisfies both force and moment equilibrium and incorporates the effects of interslice forces. Search methods built into the software were used to determine the minimum (critical) factors of safety for circular and block failure geometries.

The analyses performed consider the impoundment under conditions that will exist a sufficient length of time after construction to reach equilibrium both within and underneath the impoundment. In this scenario, the embankment is no longer acting as a dam that is impounding water, steady-state seepage and/or hydrostatic conditions have developed, and drained (effective stress) shear strengths were used for all materials. In addition, a pseudo-static analysis was performed to model the effects of earthquake loading on the cross-section. In this scenario, undrained (total stress) parameters were also used for materials with low permeability.

CALCULATIONS:

1.0 Geometry and Material Properties

The geometry of the modeled section was first developed based upon the final grading configuration as shown on the design drawings. Profile 1 from Sheet C-1.5 was used to develop the final grades in the SLOPE/W and SEEP/W models.

After the final grades were established, the subsurface geometries were also incorporated into the model. These geometries were developed based upon previous sections from the Phase 2 Reconstitution of Design report (Reference 1). Section 17+50 for the 1982 Ash Basin Dam was used to determine the subsurface geometries, as it closely matched the intersection of Profile 1 through the embankment.

Material properties for this analysis were established from the previously developed values from the Phase 2 Reconstitution of Design report. The materials previously used in the Phase 2 Reconstitution of Design report consist of “Embankment Fill”, “Sand Drain”, “Foundation Soil (Residuum)”, and “Weathered Rock”. As part of this analysis, an additional material named “Backfill” was also developed to represent the backfill soils used in the final grading design. Since the backfill will consist of embankment soils as part of the balanced breach design, the material properties of these two materials were modeled as the same. See **Table 1** for a summary of material properties used in the analysis.

Table 1 – Material Properties used in the Analysis

Unit	Material Description	Unit Weight (psf)	Shear Strength: Effective c' (psf)	Shear Strength: Effective Φ' (degrees)	Shear Strength: Total c (psf)	Shear Strength: Total Φ (degrees)	Coefficient of Permeability k (ft/sec)
(yellow)	Embankment Fill	120	400	33.9	0	32.8	3.77×10^{-8}
(salmon)	Sand Drain	120	0	36	0	36	3.28×10^{-5}
(green)	Foundation Soil (Residuum)	130	400	32	650	30	4.63×10^{-7}
(light green)	Weathered Rock	135	10000	45	10000	45	4.63×10^{-7}
(orange)	Backfill	120	400	33.9	0	32.8	3.77×10^{-8}

2.0 Seepage Modeling

The seepage modeling was performed with SEEP/W using the permeability values and functions previously developed as part of the Phase 2 Reconstitution of Design report. For the current model, the upstream boundary conditions was modeled using a total head of 2110'. This elevation corresponds with the emergence of Wet Area 1 as shown on the design drawings. Thus, the phreatic surface for this model was analyzed by using the observed wet area as the primary source of flow upstream of the balanced breach. SEEP/W was used to predict the phreatic surface through the remainder of the cross-section, with the results showing a consistent drop down to the "Sand Drain" layer shown in the model at the exit of the existing embankment. The results from the seepage modeling are included as **Attachment 1**.

3.0 Slope Stability Modeling

As mentioned previously, slope stability results were generated for two scenarios: steady-state conditions and pseudo-static conditions. In both scenarios, the phreatic surface generated from the seepage modeling was used, and both circular and block failures were considered. In the steady-state models, the effective stresses of the materials were used for each region as shown in **Table 1**. These models result in a circular failure factor of safety of 2.54 and a block failure factor of safety of 5.02.

In the pseudo-static models, the total stresses of the materials were used for each region as shown in **Table 1**. In addition, a horizontal seismic coefficient of 0.20g was also applied to the model, as was performed previously in the Phase 2 Reconstitution of Design report. This horizontal seismic coefficient represents the anticipated earthquake accelerations predicted for the Asheville site under the design earthquake. These models result in a circular failure factor of safety of 1.08 and a block failure factor of safety of 1.85.

DISCUSSION:

The seepage and slope stability modeling performed for this analysis resulted in slope stability factors of safety above 2.5 for steady-state conditions and above 1.0 for pseudo-static conditions. According to geotechnical engineering standards of practice, minimum acceptable values for each of these scenarios are regarded as 1.5 for steady-state conditions and 1.0 for pseudo-static conditions. Therefore, the slope stability results in these models predict acceptable factors of safety for the final grades proposed for the 1982 Ash Basin Dam.

REFERENCES:

1. "Calculation No. G-004: Slope Stability Analysis of Embankments," Phase 2 Reconstitution of Design, December 31, 2014.

2. SEEP/W, GeoStudio 2012, GEO-SLOPE International Ltd.

3. SLOPE/W, GeoStudio 2012, GEO-SLOPE International Ltd.

ATTACHMENTS:

Attachment 1 – SEEP/W Output File

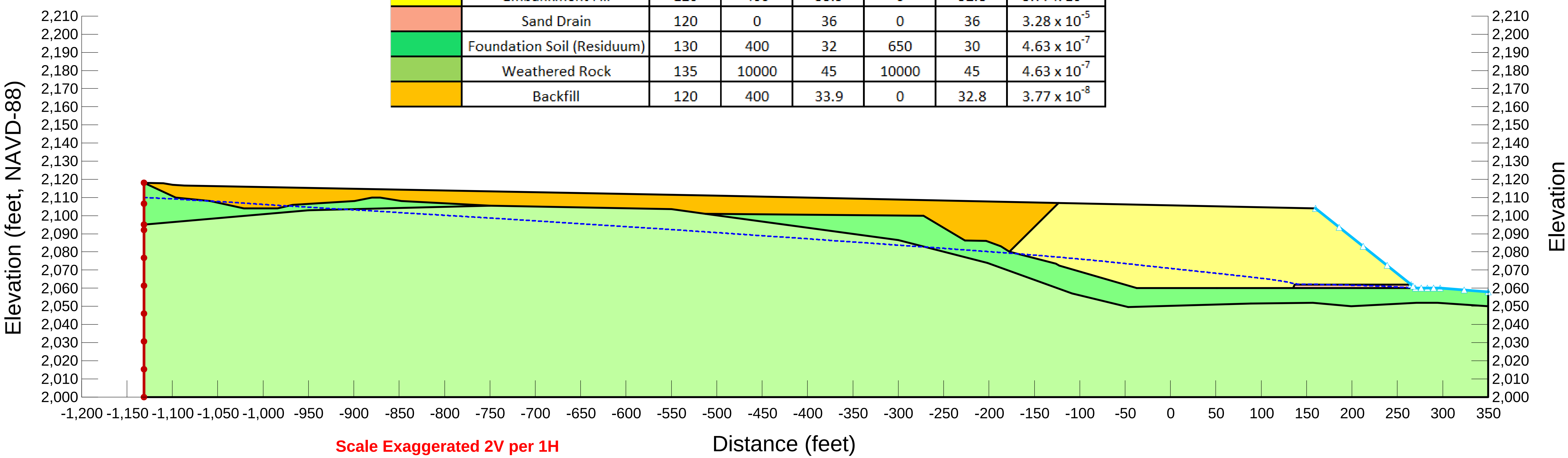
Attachment 2 – SLOPE/W Output Files

Attachment 1

SEEP/W Output File

Seepage Analysis

Unit	Material Description	Unit Weight (psf)	Shear Strength: Effective c' (psf)	Effective Φ' (degrees)	Total c (psf)	Total Φ (degrees)	Coefficient of Permeability k (ft/sec)
	Embankment Fill	120	400	33.9	0	32.8	3.77×10^{-8}
	Sand Drain	120	0	36	0	36	3.28×10^{-5}
	Foundation Soil (Residuum)	130	400	32	650	30	4.63×10^{-7}
	Weathered Rock	135	10000	45	10000	45	4.63×10^{-7}
	Backfill	120	400	33.9	0	32.8	3.77×10^{-8}



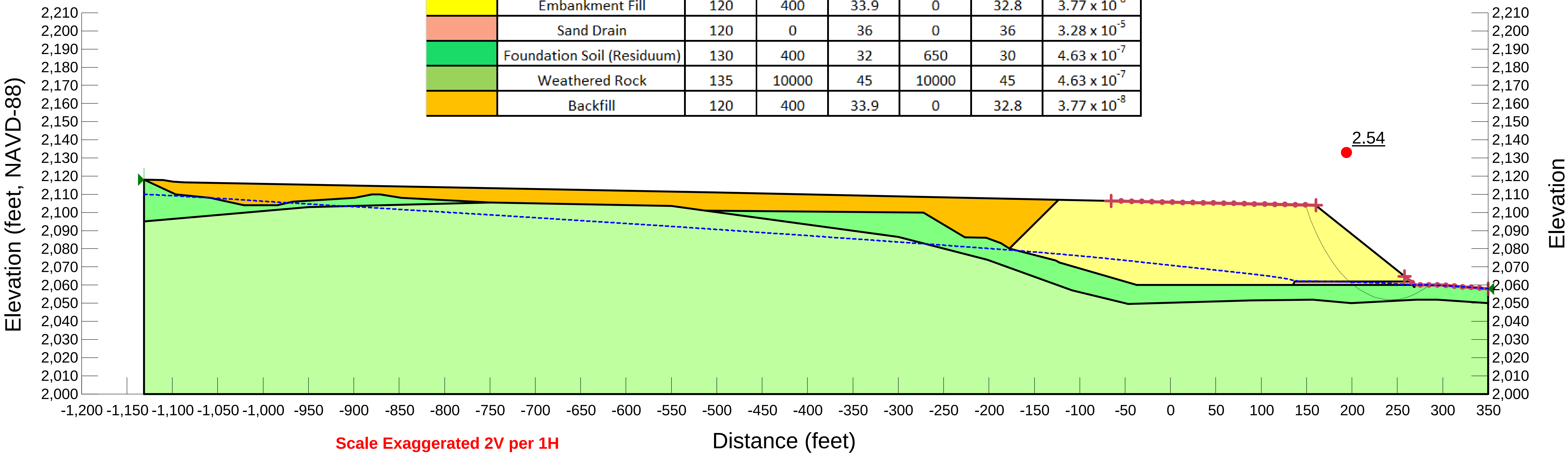
Attachment 2

SLOPE/W Output Files

I/A

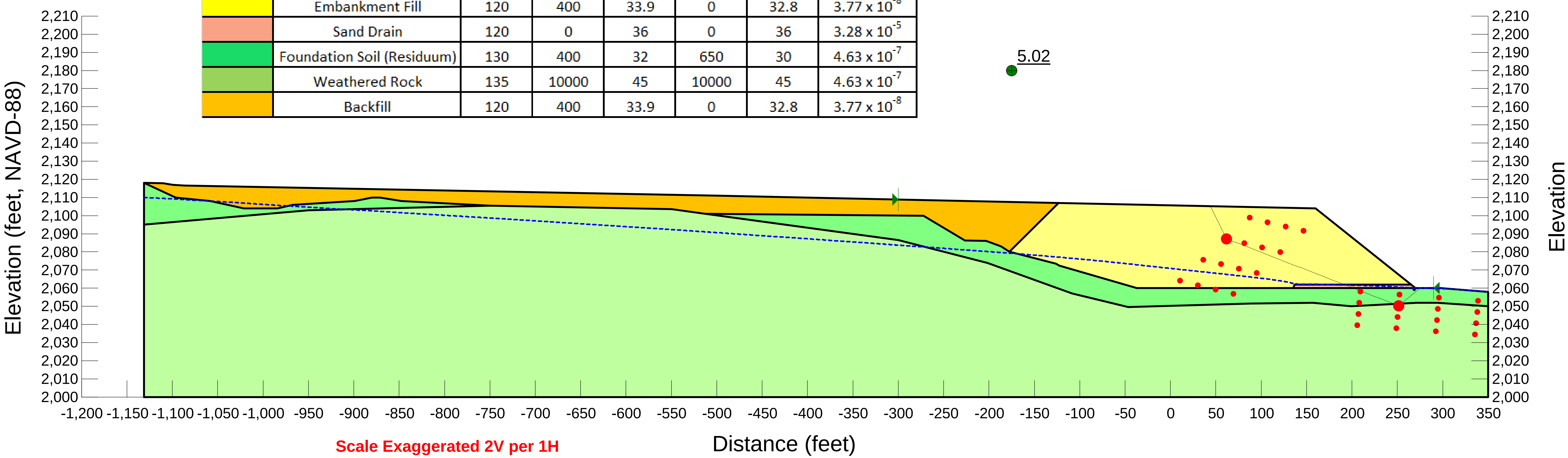
Steady-State Analysis
Circular Failure

Unit	Material Description	Unit Weight (psf)	Shear Strength: Effective c' (psf)	Effective Φ' (degrees)	Total c (psf)	Total Φ (degrees)	Coefficient of Permeability k (ft/sec)
	Embankment Fill	120	400	33.9	0	32.8	3.77×10^{-8}
	Sand Drain	120	0	36	0	36	3.28×10^{-5}
	Foundation Soil (Residuum)	130	400	32	650	30	4.63×10^{-7}
	Weathered Rock	135	10000	45	10000	45	4.63×10^{-7}
	Backfill	120	400	33.9	0	32.8	3.77×10^{-8}



Steady-State Analysis
Block Failure

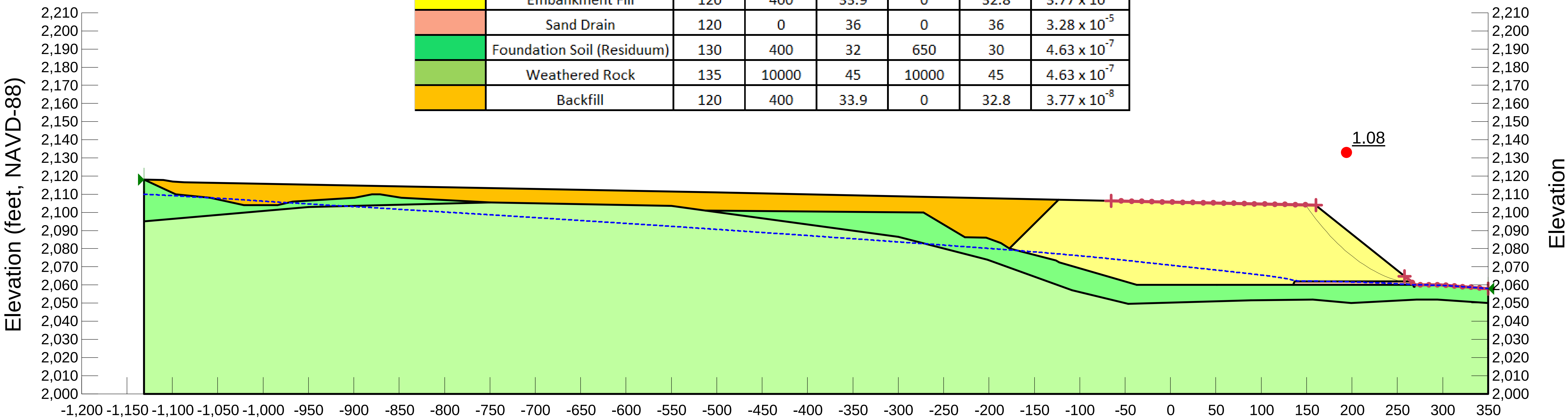
Unit	Material Description	Unit Weight (psf)	Shear Strength: Effective c' (psf)	Effective Φ' (degrees)	Total c (psf)	Total Φ (degrees)	Coefficient of Permeability k (ft/sec)
(yellow)	Embankment Fill	120	400	33.9	0	32.8	3.77×10^{-8}
(salmon)	Sand Drain	120	0	36	0	36	3.28×10^{-5}
(green)	Foundation Soil (Residuum)	130	400	32	650	30	4.63×10^{-7}
(light green)	Weathered Rock	135	10000	45	10000	45	4.63×10^{-7}
(orange)	Backfill	120	400	33.9	0	32.8	3.77×10^{-8}



I/A

Pseudo-Static Analysis
Circular Failure

Unit	Material Description	Unit Weight (psf)	Shear Strength: Effective c' (psf)	Effective Φ' (degrees)	Total c (psf)	Total Φ (degrees)	Coefficient of Permeability k (ft/sec)
(yellow)	Embankment Fill	120	400	33.9	0	32.8	3.77×10^{-8}
(salmon)	Sand Drain	120	0	36	0	36	3.28×10^{-5}
(green)	Foundation Soil (Residuum)	130	400	32	650	30	4.63×10^{-7}
(light green)	Weathered Rock	135	10000	45	10000	45	4.63×10^{-7}
(orange)	Backfill	120	400	33.9	0	32.8	3.77×10^{-8}

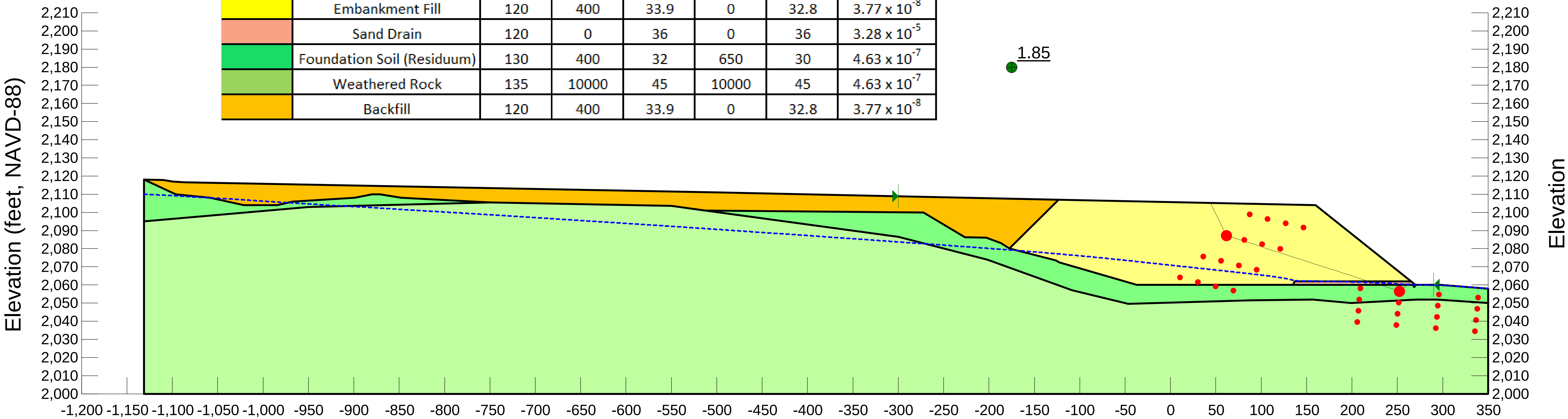


Scale Exaggerated 2V per 1H

Horz Seismic Coef.: 0.2

Pseudo-Static Analysis
Block Failure

Unit	Material Description	Unit Weight (psf)	Shear Strength: Effective c' (psf)	Shear Strength: Effective Φ' (degrees)	Shear Strength: Total c (psf)	Shear Strength: Total Φ (degrees)	Coefficient of Permeability k (ft/sec)
(yellow)	Embankment Fill	120	400	33.9	0	32.8	3.77×10^{-8}
(salmon)	Sand Drain	120	0	36	0	36	3.28×10^{-5}
(green)	Foundation Soil (Residuum)	130	400	32	650	30	4.63×10^{-7}
(light green)	Weathered Rock	135	10000	45	10000	45	4.63×10^{-7}
(orange)	Backfill	120	400	33.9	0	32.8	3.77×10^{-8}



Scale Exaggerated 2V per 1H

Horz Seismic Coef.: 0.2

Calculation Title:
Final Conditions Stormwater Calculation

Summary:
Stormwater channels and culverts were designed to convey stormwater for the 100 year, 24-hour design storm event (1% annual) from the 1982 and Ash Basin considering final closure conditions.

The Interstate 26 culvert crossing downstream of the 1982 basin was also evaluated for the 100-year 6-hr event.

Notes:

Revision Log:

No.	Description	Originator / Date	Technical Reviewer / Date
0		Luke C. Williams, PE Luke C Williams 1-14-16 NORTH CAROLINA PROFESSIONAL SEAL 041903 ENGINEER LUKE C. WILLIAMS	Daniel R. Smith 1/14/16

OBJECTIVE:

The objective of this calculation is to design the stormwater conveyance measures based on proposed conditions after decommissioning of the 1982 Ash Basin.

METHOD:

Stormwater flow rates were calculated using the SCS runoff method. The hydraulic capacity of proposed stormwater channels was evaluated using Manning's equation. Channel lining was determined using the permissible shear stress approach specified in FHWA HEC-15. The Interstate 26 culvert was evaluated using standard procedures specified in FHWA HDS-5.

CALCULATIONS:

1.0 Hydrology

Drainage areas were developed from the final grading plan drawings and represent final condition after closure of the 1982 Ash Basin. The drainage areas are shown in Figure 1. Runoff coefficients (SCS curve number) and flow travel times (time concentration) were determined using standard methods documented in the National Engineering Hand Book Part 630 Hydrology for each of the drainage areas.

The runoff coefficients for the 1982 basin considered the ground surface to be vegetated and have a minimum of 75 percent grass cover. The soils for the ash basin and existing plant footprints were considered to have moderately high runoff potential (HSG C classification) because of the disturbed nature of these soils. Area outside the 1982 ash basin and existing plant footprints were considered to have moderately low runoff potential (HSG B classification) as determined from NRCS soil mapping data.

The hydrologic input parameters for the 1982 basin are summarized in the Table 1.

Table 1: Summary of Drainage Areas 1982 Basin

Drainage Area	Area (acres)	Area (mi^2)	Curve Number CN	Tc (hr)	Lag Time (min)
1982 East1	31.3	0.0489	68	0.44	16
1982 East2	28.5	0.0445	71	0.468	17
1982 East Lower	5.9	0.0092	74	0.186	7
1982 West	40.9	0.0638	79	0.564	20
1982 Lower	15.5	0.0242	58	0.329	12

Proposed stormwater channels were designed for the 100-year 24-hour storm event. Temporary sediment control structures were designed for the 10-year 24-hour storm event. Table 2 below shows the precipitation depth for these three storm events. Precipitation depths were retrieved from NOAA Precipitation Frequency Data Server (Atlas 14) (Attachment 1).

Table 2: Summary of Precipitation Depths

Design Event	Precipitation Depth (in)	Precipitation Distribution
10-year (24-hr)	4.28	SCS Type II
100-year (24-hr)	6.31	SCS Type II

Peak runoff rates for the drainage areas were determined using the SCS runoff approach within the USACE HEC-HMS hydrology model. Peak runoff rates for the 1982 basin are shown in Table 3.

Table 3: Summary 1982 Basin Peak Flowrates

Drainage Area	Peak 10-year Flow (cfs)	Peak 100-year Flow (cfs)	Peak 500-year Flow (cfs)
1982 East1	40	87	126
1982 East2	41	85	120
1982 East Lower	15	29	40
1982 West	76	138	187
1982 Lower	11	33	52

2.0 Hydraulics

2.1 Proposed Stormwater Channels

Stormwater channels were designed to convey runoff from the 1982 basin for the 100-year flood event in a safe and non-erosive manner. The Manning formula was used to determine the 100-year flow depth in the channels.

The shear stress along the channel bottom and sides was calculated to determine appropriate channel lining following the HEC-15 approach for design of riprap lined channels.

The stormwater channels located within the basins generally have slopes near 1 percent and were lined with North Carolina Department of Transportation (NCDOT) Class B riprap having a median diameter of 8 inches. The stormwater channels that convey stormwater from the dam breach location to the toe of the abutment, called “outlet” channels on the design drawings, have relatively steep slopes and were lined with NCDOT Class 2 riprap having a median diameter of 14 inches.

The proposed stormwater channel dimensions are presented in Table 4. Table 5 shows the riprap sizes for the NCDOT Class B and Class 2 riprap.

Table 4: Summary of Stormwater Channels 1982 Basin

1982 Basin Channel Summary								
Channel ID	Q100 (cfs)	Average Velocity (ft/s)	Slope (ft/ft)	Channel Type	Side Slope (H:V)	Bottom Width (ft)	Flow Depth (ft)	Lining Type
1982 West	138	3.7	0.01	Trapezoidal	2	5	3.2	Class B
1982 West Outlet	138	8.9	0.15	Trapezoidal	3	15	0.9	Class 2
1982 East 2	85	3.1	0.01	Trapezoidal	2	5	2.6	Class B
1982 East 1	87	3.2	0.01	Trapezoidal	2	5	2.7	Class B
1982 East	171	3.9	0.01	Trapezoidal	2	8	3.1	Class B
1982 East Outlet	186	9.5	0.15	Trapezoidal	3	20	0.9	Class 2

Table 5: NCDOT Riprap Sizes

Acceptance Criteria for Rip Rap and Stone for Erosion Control			
Class	Required Stone Sizes (inches)		
	Minimum	Midrange	Maximum
A	2	4	6
B	5	8	12
1	5	10	17
2	9	14	23

3.0 Interstate 26 Culvert

Interstate 26 is located below the 1982 basin. Stormwater runoff from the 1982 basin will be directed to existing culvert running underneath I-26. The culvert underneath I-26 is a 66-in diameter RCP culvert with a concrete headwall. A summary of I-26 culvert is shown in Table 6 below.

Table 6: Summary of I-26 Culvert

I-26 Culvert	Structure	Inlet Invert (ft)	Outlet Invert (ft)	Length (ft)	Slope (ft/ft)	Top Road Elevation (ft)
Below 1982 Basin	66" RCP	2043.5	2040	273	0.013	2052.6

Table 7 and Figure 1 show the headwater elevations versus culvert discharge for the 66" CMP I-26 culvert below the 1982 basin. Note the tailwater condition (elevation) for the I-26 culvert was considered to be the water elevation for the 10-year flood elevation of the French Broad or the normal flow depth of the downstream channel whichever was greater. The French Broad River has a 10-year flood elevation near 2039' (culvert outlet not submerged) at the culvert location which is lower than the normal flow depth of the downstream channel. Therefore, for the I-26 culvert analysis the culvert tailwater condition was set to normal depth of the downstream channel.

Headwater elevations for the I-26 culverts were estimated to determine the impact of the proposed 1982 basin closure and stormwater plan. The 100-year headwater elevation was evaluated. Flood storage behind the I-26 road embankment was considered and a storage routing model was developed in HEC-HMS.

Topography data from USGS digital elevation model (1 meter) was utilized in estimating available flood storage volumes behind the I-26 embankment. Figure 2 shows the rating curve for the storage area between the toe of the 1982 basin and upstream the I-26 embankment.

Table 7: Discharge Curve for I-26 Culvert (1982)

I-26 Culvert (1982)	
Headwater Elevation (ft)	Flow (cfs)
2043.5	0
2045.71	36
2046.8	72
2047.74	108
2048.59	144
2049.47	180
2050.45	216
2051.6	252
*Top Pavement Elevation = 2052.6'	
**Inlet Invert Elevation = 2043.5'	

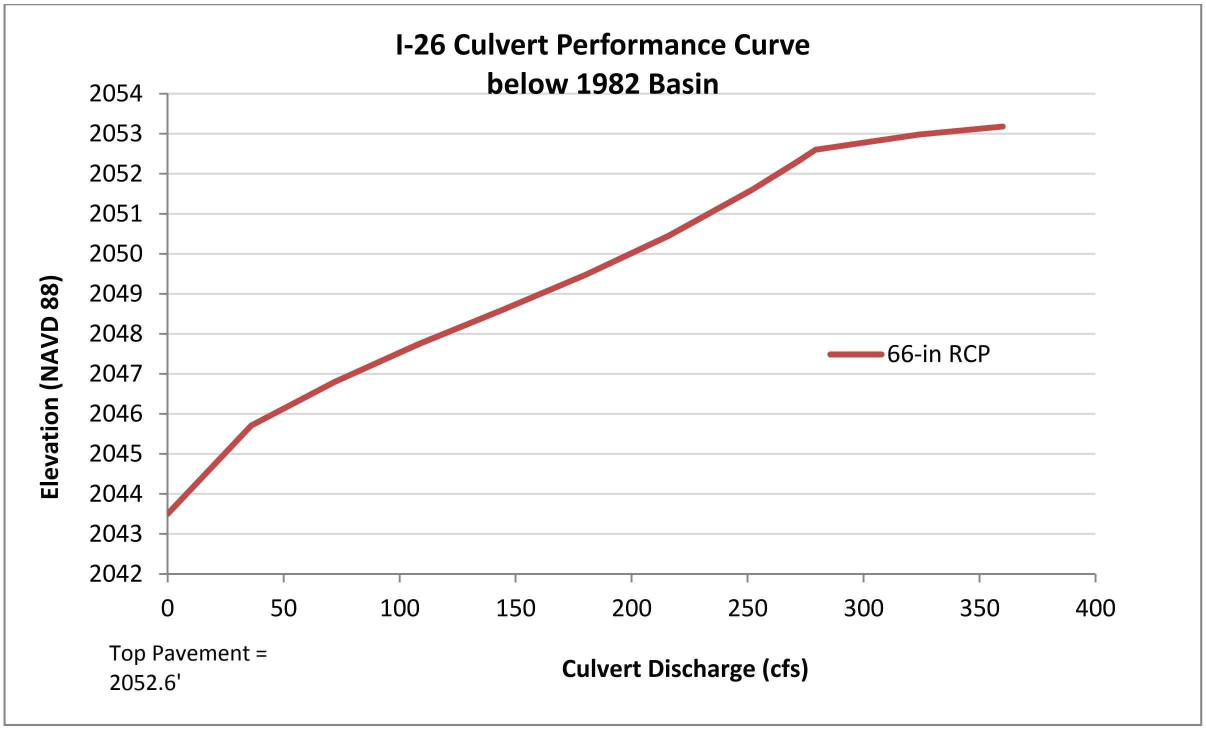


Figure 1: Discharge Curve for I-26 Culvert (1982)

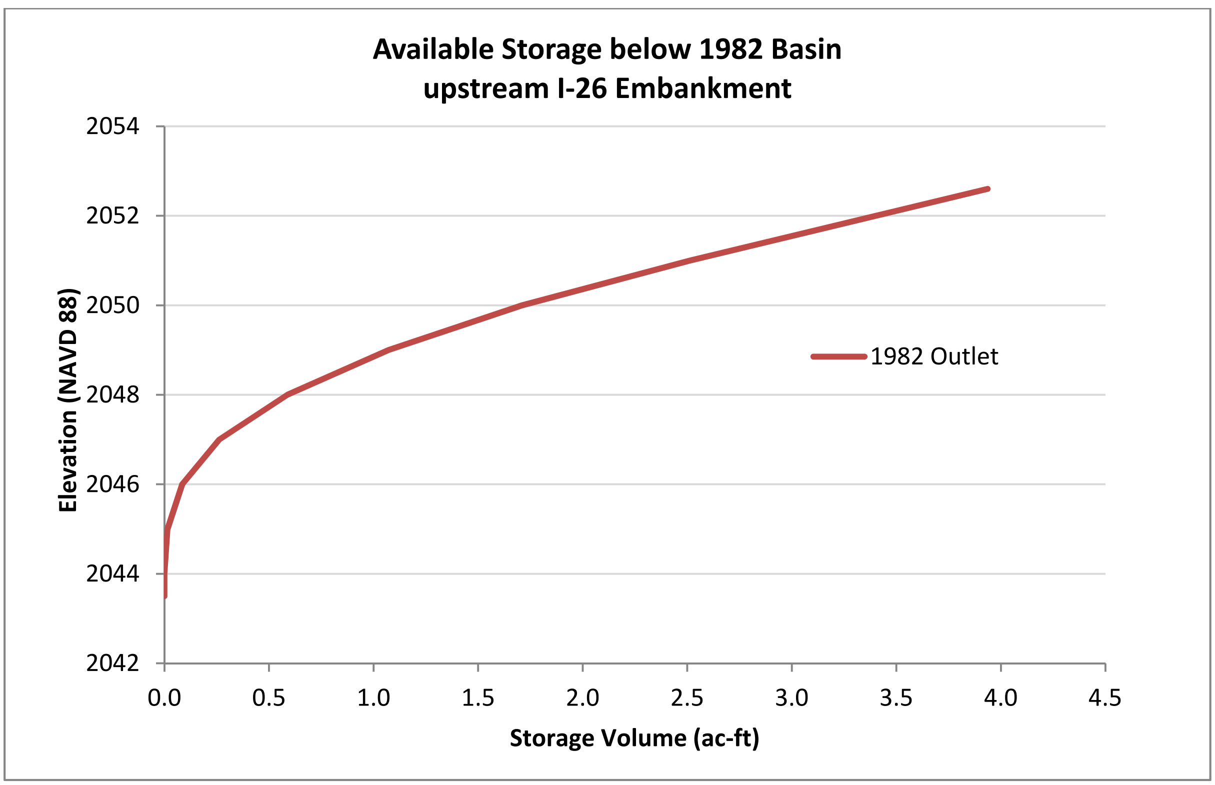


Figure 2: Storage Curve for I-26 Culvert (1982)

The headwater elevation behind the I-26 embankment for the 100-year 6-hr flood is shown in Table 8. The headwater elevation below the 1982 basin for the 100-year event is 2050.7' which is approximately 1.9 feet below the road embankment.

Coordination with NCDOT will be required to determine if additional flow capacity is needed below the 1982 basin to lower the headwater depths upstream of I-26.

Table 8: Headwater Elevations at I-26 Embankment

I-26 Culverts	Inlet Invert (ft)	100-year 6-hour Flood		
		Headwater Elevation (ft)	Freeboard from Top Pavement (ft)	HW/D
Below 1982 Basin	2043.5	2050.7	1.9	1.3

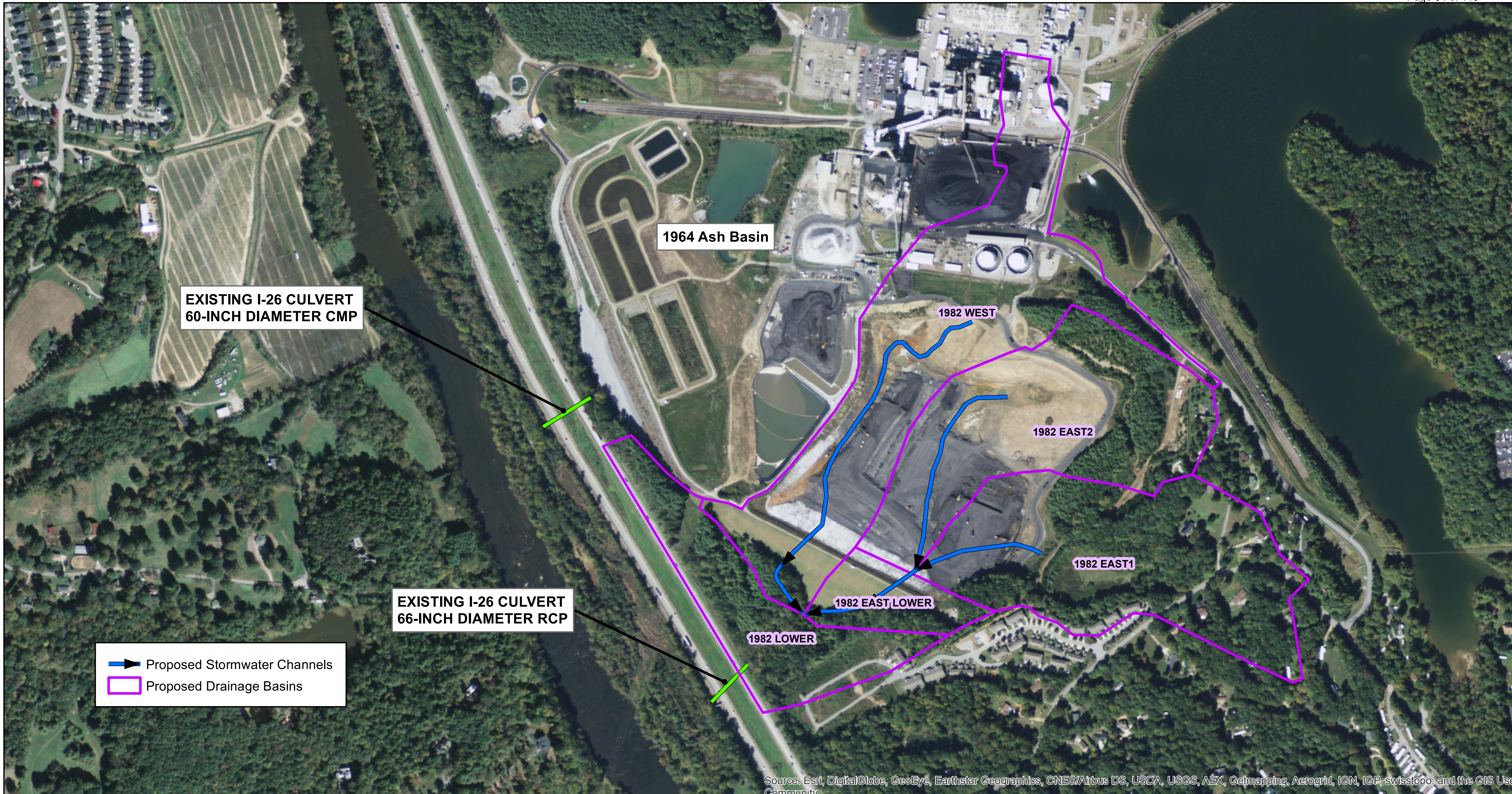
FIGURES:

1. General Site Drainage Map

REFERENCES:

1. NOAA Atlas 14, Point Precipitation Frequency Estimates", NOAA National Weather Service.
2. HEC-15, Hydraulic Engineering Circular No. 15, Third Edition. "Design of Roadside Channels with Flexible Linings". September 2005.
3. HDS-5, Hydraulic Design Series Number 5. Hydraulic Design of Highway Culverts, Third Edition. January 2012.
4. North Carolina Department of Environment and Natural Resources, "Erosion and Sediment Control Planning and Design Manual", Revised May 2013.
5. "Standard Specification for Roads and Structures", North Carolina Department of Transportation, Raleigh, January 2012.

I/A



NOTES:

N

0 0.05 0.1 0.2 Miles

amec foster wheeler

Environment & Infrastructure, Inc.
3020 Falling Waters, Rd., Suite 300
Knoxville, TN 37922

CLIENT:

DUKE ENERGY.

PROJECT:

DAM DECOMMISSIONING PLAN
ASHEVILLE STEAM STATION

TITLE:

DRAINAGE AREAS AND PROPOSED STORMWATER CHANNELS

DATE: 11/04/2015

PROJECT: 7810150250

DRAWN BY: JMP

CHECKED BY: LCW

Figure No.

1

Calculation Title:
Temporary Silt Basin Calculations

Summary:
The temporary silt basins were designed in accordance with the North Carolina Department of Transportation (NCDOT) "Erosion and Sediment Control, Field Guide." Using this guide, appropriately-sized silt basins were designed with storage capacities of approximately 84,600 ft^3 each, which is greater than the minimum required capacities of 82,800 ft^3 each.

Notes:

Revision Log:

No.	Description	Originator / Date	Technical Reviewer / Date
0	Initial Submittal	Luke C. Williams, PE NORTH CAROLINA PROFESSIONAL SEAL 041963 ENGINEER LUKE C. WILLIAMS Luke 1/14/16	Daniel R. Smith 1/14/16

amec foster wheeler

OBJECTIVE:

The objective of this calculation is to design the temporary silt basins for the interim closure conditions of the 1982 Ash Basin.

METHOD:

The temporary silt basins were designed in accordance with the North Carolina Department of Transportation (NCDOT) "Erosion and Sediment Control, Field Guide" [Ref. 1]. Areas used in the calculation were generated from the project drawings using AutoCAD Civil 3D [Ref. 2].

CALCULATIONS:

1.0 Determination of Disturbed Area

The limits of disturbance for the dam decommissioning and closure activities at the 1982 Ash Basin are shown on Sheet C-1.3 of the project drawings. The disturbed area is noted as "Limits of Ash Excavation" and represents the area in which ash will be excavated from the basin. Using AutoCAD Civil 3D, this area was calculated as approximately 46 acres.

The stormwater flows within this area will be routed through the basin with two separate stormwater channels, noted as "1982 West" and "1982 East" as shown on Sheet C-1.4 of the project drawings. Each channel will convey flows from approximately half of the disturbed areas within the basin.

2.0 Silt Basin Design

Silt Basins were designed to intercept flows from the stormwater channels along the excavation limits adjacent to the existing 1982 Ash Basin Dam. The Silt Basins were designed in accordance with the NCDOT "Erosion and Sediment Control, Field Guide" for Silt Basin, Type B recommendations. According to the design guide, each silt basin shall be designed with a storage capacity of 3,600 cubic feet per disturbed acre.

Each silt basin will intercept the proposed stormwater channels, and each channel conveys the flows from approximately half of the existing ash basin area. Therefore, each silt basin was designed for half of the total disturbed area (23 acres). As a result, the required storage capacity for each silt basin is 82,800 ft^3 (23 acres x 3600 ft^3/acre).

The silt basin design also incorporated the sizing requirements for Silt Basin, Type B recommendations. The requirements included a minimum of 2' depth, maximum of 1.5:1 side slopes, and a minimum length of 2 times the width. The silt basin design is shown on Detail 4 of Sheet E-1.2. The design consists of surface dimensions of 100' x 225' and a depth of 4'. The calculated volume for this design is approximately 84,600 ft^3, which is greater than the minimum required 82,800 ft^3 of storage capacity.

DISCUSSION:

The temporary silt basins were designed in accordance with the North Carolina Department of Transportation (NCDOT) "Erosion and Sediment Control, Field Guide." Using this guide, appropriately-sized silt basins were designed with storage capacities of approximately 84,600 ft^3 each, which is greater than the minimum required capacities of 82,800 ft^3 each.

REFERENCES:

1. North Carolina Department of Transportation, "Erosion and Sediment Control, Field Guide", 2013.
2. AutoCAD Civil 3D 2015, AutoDesk Inc.

Calculation Title:
Underdrain Sizing Calculations

Summary:
This document provides a summary of the design and calculations performed for the proposed underdrain to be installed in the 1982 Ash Basin as part of the Dam Decommissioning Plan. This underdrain will intercept Wet Area 1 and convey flows to the downstream face of the existing dam. Calculations were performed to determine the flow capacities of the proposed HDPE drainage pipes and No. 57 Stone that form the underdrain.

Notes:

Revision Log:

No.	Description	Originator / Date	Technical Reviewer / Date
0	Initial Submittal	Luke C. Williams, PE NORTH CAROLINA PROFESSIONAL SEAL 041903 ENGINEER LUKE C. WILLIAMS 1-14-16	Daniel R. Smith 1/14/16

OBJECTIVE:

The objective of this calculation is to design the underdrain for the 1982 Ash Basin based on long-term conditions after decommissioning of the Ash Basin dam and also achieving final grades as shown on the plans.

METHOD:

Design for the underdrain consists of a combination of geotextile fabric, HDPE drainage pipes and No. 57 Stone backfill. Flow rates through the HDPE drainage pipes were calculated using Manning's equation and FlowMaster modeling software. Flow rates through the No. 57 Stone backfill were estimated using Darcy's Law.

DEFINITION OF VARIABLES:

τ = shear;
A = area perpendicular to the flow direction;
b = bottom width;
CN = curve number;
d = flow depth;
D = channel depth;
i = hydraulic gradient;
k = hydraulic conductivity;
L = length;
n = Manning's n;
P = wetted perimeter;
Q = flow;
R = hydraulic radius;
S = longitudinal slope;
t = time
T = top width;
T_c = time of concentration;
V = velocity; and
Z = channel side slope.

CALCULATIONS:

1.0 Design of the Underdrain

The underdrain is designed to intercept the existing Wet Area 1 as shown on the Project Drawings. The current flows from this wet area are estimated to be at 15-25 gpm (gallons per minute). The actual ground water exit point feeding the wet areas is covered with fill and actual flow rates to size the drain may be revised as additional flow measurements are obtained. Additionally, if field conditions allow a spring box configuration may be used to capture the flow closer to the source eliminating the need for pipe perforations described below.

The underdrain is proposed to begin to the north of Wet Area 1 at approximately Elevation 2116', and continue southward at an approximately 1.0% grade to intercept the wet area at approximately Elevation 2114'. After intercepting the wet area, the underdrain is proposed to continue southward through the existing 1982 Ash Basin Dam at a slope of 1.0%. The underdrain will daylight on the downstream face of the dam at approximately Elevation 2102' and intercept the proposed stormwater ditch to be conveyed to the proposed outfall location.

In cross-sectional view, the underdrain is proposed to be constructed to a channel depth (D) of 4', a bottom width (b) of 12', and a top width (T) of 20'. A total of two 6" HDPE DR 26 perforated drainage pipes will be placed along the bottom of the underdrain to convey flows. The remainder of the underdrain area will be backfilled with No. 57 Stone to the dimensions referenced above. The underdrain will be wrapped with 12-oz Geotextile filter fabric overlapped a minimum of 2' across the top of the underdrain.

2.0 HDPE Flow Rate Calculations

Flow rates for the HDPE drainage pipes were calculated using the program FlowMaster. As part of these calculations, the following variables were required to calculate the full flow capacity of each pipe: Manning's n (n), channel slope (S), and diameter of the pipe. The Manning's n was estimated as 0.012 from Mays, 2005. The critical channel slope was defined as 1.0% per the Project Drawings, and the diameter of each HDPE pipe is known as 6". This calculation resulted in a maximum flow through each pipe of 0.61 ft^3/sec, or a total flow through both pipes of 1.22 ft^3/sec (548 gpm). Thus, the HDPE drainage pipes are able to convey approximately 548 gpm of flow from the wet area. See Figure 1 below for the output from FlowMaster.

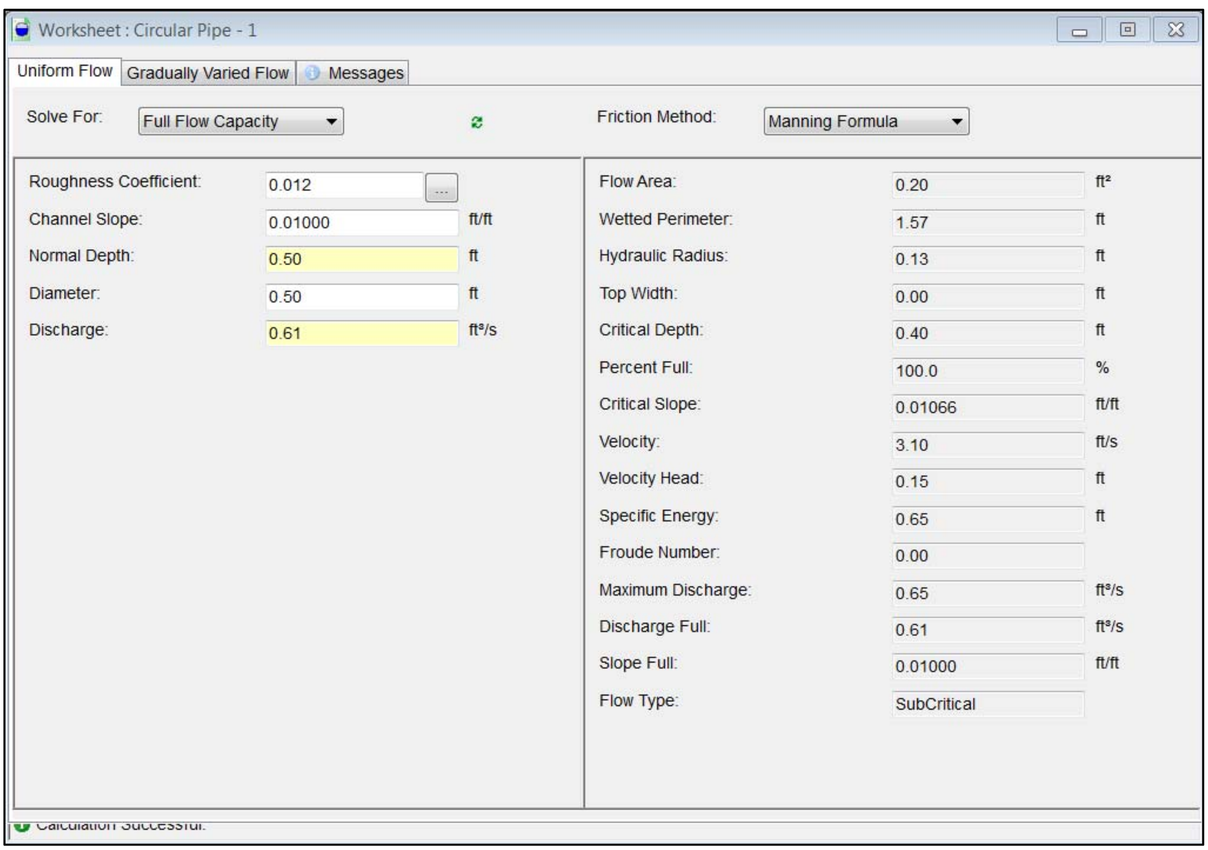


Figure 1: HDPE drainage pipe calculations from FlowMaster

However, the pipe can only convey flows that enter the pipe through the orifices of the perforations. The orifice calculations are shown below.

Orifice Flow Equation

Q= 25 x A x k x $h^{0.5}$

where:

25 is a conversion for square inches and gpm

A = area

k = constant based on inlet configuration k= 0.82 for thick wall pipe

h = head

constant	diameter	area	k	h	$h^{0.5}$	q (gpm)
25	0.25	**0.05**	**0.82**	1	**1**	**1.01**

There will be four (4) perforations placed around the pipe circumference on 1 foot intervals.

4 x 1.01 4.03 gpm/foot

For a Factor of Safety of 10 for underdrains the capacity should be:

10 x 25 250 gpm

The wet area flow will be contained in the pipe within:

250 ÷ 4.03 62.11 feet

3.0 No. 57 Stone Flow Rate Calculations

Flow rates for the #57 stone backfill were estimated using Darcy's Law, shown in the following equation:

$$Q = kiA$$ [Ref. 2]

Where *Q* is the flow rate, *k* is the hydraulic conductivity, *i* is the hydraulic gradient, and *A* is the area perpendicular to the flow direction. The equation was solved for the flow rate (Q) of the 4' by 12' cross-sectional area of the underdrain. The hydraulic gradient was set as the critical slope of the underdrain of 1.0%. The hydraulic conductivity of the No. 57 Stone was estimated as 0.3 ft/sec based upon values provided in Coduto, 1999. These calculations resulted in a flow rate of approximately 65 gpm.

Flow through rock to 6" diameter pipe

q = kia

k = 0.3

I = gradient top of under drain (4 feet)/ orifice spacing (1 foot)

a = flow area, use orifice area x 4

k	i	a	q (cfs)	gpm/ 1 cfs	gpm	
0.3	0.50	0.20	0.03	448.83	13.22	> 4.03 gpm

DISCUSSION:

The underdrain flow rates are controlled by the orifices in the HDPE drainage pipes. As a result, a factor of safety of 10 is achieved through this design.

REFERENCES:

1. Mays, L.W., “Water Resources Engineering, 2005 Edition”, John Wiley & Sons, Inc., 2005.

2. Coduto, D.P., “Geotechnical Engineering, Principles and Practice,” Prentice-Hall, Inc. 1999.

3. Bentley FlowMaster, V8i, Bentley Systems, Inc, 2009.

Erosion & Sediment Control Plan Calculations

Calculation Title:
Final Conditions Stormwater Calculation

Summary:
Stormwater channels and culverts were designed to convey stormwater for the 100 year, 24-hour design storm event (1% annual) from the 1982 and Ash Basin considering final closure conditions.

The Interstate 26 culvert crossing downstream of the 1982 basin was also evaluated for the 100-year 6-hr event.

Notes:

Revision Log:

No.	Description	Originator / Date	Technical Reviewer / Date
0		**Matt Bishop** Matt Bishop 2/23/16	**Luke C. Williams, PE** Luke C Williams 2/23/16

OBJECTIVE:

The objective of this calculation is to design the stormwater conveyance measures based on proposed conditions after decommissioning of the 1982 Ash Basin.

METHOD:

Stormwater flow rates were calculated using the SCS runoff method. The hydraulic capacity of proposed stormwater channels was evaluated using Manning's equation. Channel lining was determined using the permissible shear stress approach specified in FHWA HEC-15. The Interstate 26 culvert was evaluated using standard procedures specified in FHWA HDS-5.

CALCULATIONS:

1.0 Hydrology

Drainage areas were developed from the final grading plan drawings and represent final condition after closure of the 1982 Ash Basin. The drainage areas are shown in Figure 1. Runoff coefficients (SCS curve number) and flow travel times (time concentration) were determined using standard methods documented in the National Engineering Hand Book Part 630 Hydrology for each of the drainage areas.

The runoff coefficients for the 1982 basin considered the ground surface to be vegetated and have a minimum of 75 percent grass cover. The soils for the ash basin and existing plant footprints were considered to have moderately high runoff potential (HSG C classification) because of the disturbed nature of these soils. Area outside the 1982 ash basin and existing plant footprints were considered to have moderately low runoff potential (HSG B classification) as determined from NRCS soil mapping data.

The hydrologic input parameters for the 1982 basin are summarized in the Table 1.

Table 1: Summary of Drainage Areas 1982 Basin

Drainage Area	Area (acres)	Area (mi^2)	Curve Number CN	Tc (hr)	Lag Time (min)
1982 East1	31.3	0.0489	68	0.44	16
1982 East2	28.5	0.0445	71	0.468	17
1982 East Lower	5.9	0.0092	74	0.186	7
1982 West	40.9	0.0638	79	0.564	20
1982 Lower	15.5	0.0242	58	0.329	12

Proposed stormwater channels were designed for the 100-year 24-hour storm event. Temporary sediment control structures were designed for the 10-year 24-hour storm event. Table 2 below shows the precipitation depth for these three storm events. Precipitation depths were retrieved from NOAA Precipitation Frequency Data Server (Atlas 14) (Attachment 1).

Table 2: Summary of Precipitation Depths

Design Event	Precipitation Depth (in)	Precipitation Distribution
10-year (24-hr)	4.28	SCS Type II
100-year (24-hr)	6.31	SCS Type II

Peak runoff rates for the drainage areas were determined using the SCS runoff approach within the USACE HEC-HMS hydrology model. Peak runoff rates for the 1982 basin are shown in Table 3.

Table 3: Summary 1982 Basin Peak Flowrates

Drainage Area	Peak 10-year Flow (cfs)	Peak 100-year Flow (cfs)	Peak 500-year Flow (cfs)
1982 East1	40	87	126
1982 East2	41	85	120
1982 East Lower	15	29	40
1982 West	76	138	187
1982 Lower	11	33	52

2.0 Hydraulics

2.1 Proposed Stormwater Channels

Stormwater channels were designed to convey runoff from the 1982 basin for the 100-year flood event in a safe and non-erosive manner. The Manning formula was used to determine the 100-year flow depth in the channels.

The shear stress along the channel bottom and sides was calculated to determine appropriate channel lining following the HEC-15 approach for design of riprap lined channels.

The stormwater channels located within the basins generally have slopes near 1 percent and were lined with North Carolina Department of Transportation (NCDOT) Class B riprap having a median diameter of 8 inches. The stormwater channels that convey stormwater from the dam breach location to the toe of the abutment, called “outlet” channels on the design drawings, have relatively steep slopes and were lined with NCDOT Class 2 riprap having a median diameter of 14 inches.

The proposed stormwater channel dimensions are presented in Table 4. Table 5 shows the riprap sizes for the NCDOT Class B and Class 2 riprap.

Table 4: Summary of Stormwater Channels 1982 Basin

1982 Basin Channel Summary								
Channel ID	Q100 (cfs)	Average Velocity (ft/s)	Slope (ft/ft)	Channel Type	Side Slope (H:V)	Bottom Width (ft)	Flow Depth (ft)	Lining Type
1982 West	138	3.7	0.01	Trapezoidal	2	5	3.2	Class B
1982 West Outlet	138	8.9	0.15	Trapezoidal	3	15	0.9	Class 2
1982 East 2	85	3.1	0.01	Trapezoidal	2	5	2.6	Class B
1982 East 1	87	3.2	0.01	Trapezoidal	2	5	2.7	Class B
1982 East	171	3.9	0.01	Trapezoidal	2	8	3.1	Class B
1982 East Outlet	186	9.5	0.15	Trapezoidal	3	20	0.9	Class 2

Table 5: NCDOT Riprap Sizes

Acceptance Criteria for Rip Rap and Stone for Erosion Control			
Class	Required Stone Sizes (inches)		
	Minimum	Midrange	Maximum
A	2	4	6
B	5	8	12
1	5	10	17
2	9	14	23

3.0 Interstate 26 Culvert

Interstate 26 is located below the 1982 basin. Stormwater runoff from the 1982 basin will be directed to existing culvert running underneath I-26. The culvert underneath I-26 is a 66-in diameter RCP culvert with a concrete headwall. A summary of I-26 culvert is shown in Table 6 below.

Table 6: Summary of I-26 Culvert

I-26 Culvert	Structure	Inlet Invert (ft)	Outlet Invert (ft)	Length (ft)	Slope (ft/ft)	Top Road Elevation (ft)
Below 1982 Basin	66" RCP	2043.5	2040	273	0.013	2052.6

Table 7 and Figure 1 show the headwater elevations versus culvert discharge for the 66" CMP I-26 culvert below the 1982 basin. Note the tailwater condition (elevation) for the I-26 culvert was considered to be the water elevation for the 10-year flood elevation of the French Broad or the normal flow depth of the downstream channel whichever was greater. The French Broad River has a 10-year flood elevation near 2039' (culvert outlet not submerged) at the culvert location which is lower than the normal flow depth of the downstream channel. Therefore, for the I-26 culvert analysis the culvert tailwater condition was set to normal depth of the downstream channel.

Headwater elevations for the I-26 culverts were estimated to determine the impact of the proposed 1982 basin closure and stormwater plan. The 100-year headwater elevation was evaluated. Flood storage behind the I-26 road embankment was considered and a storage routing model was developed in HEC-HMS.

Topography data from USGS digital elevation model (1 meter) was utilized in estimating available flood storage volumes behind the I-26 embankment. Figure 2 shows the rating curve for the storage area between the toe of the 1982 basin and upstream the I-26 embankment.

Table 7: Discharge Curve for I-26 Culvert (1982)

I-26 Culvert (1982)	
Headwater Elevation (ft)	Flow (cfs)
2043.5	0
2045.71	36
2046.8	72
2047.74	108
2048.59	144
2049.47	180
2050.45	216
2051.6	252
*Top Pavement Elevation = 2052.6'	
**Inlet Invert Elevation = 2043.5'	

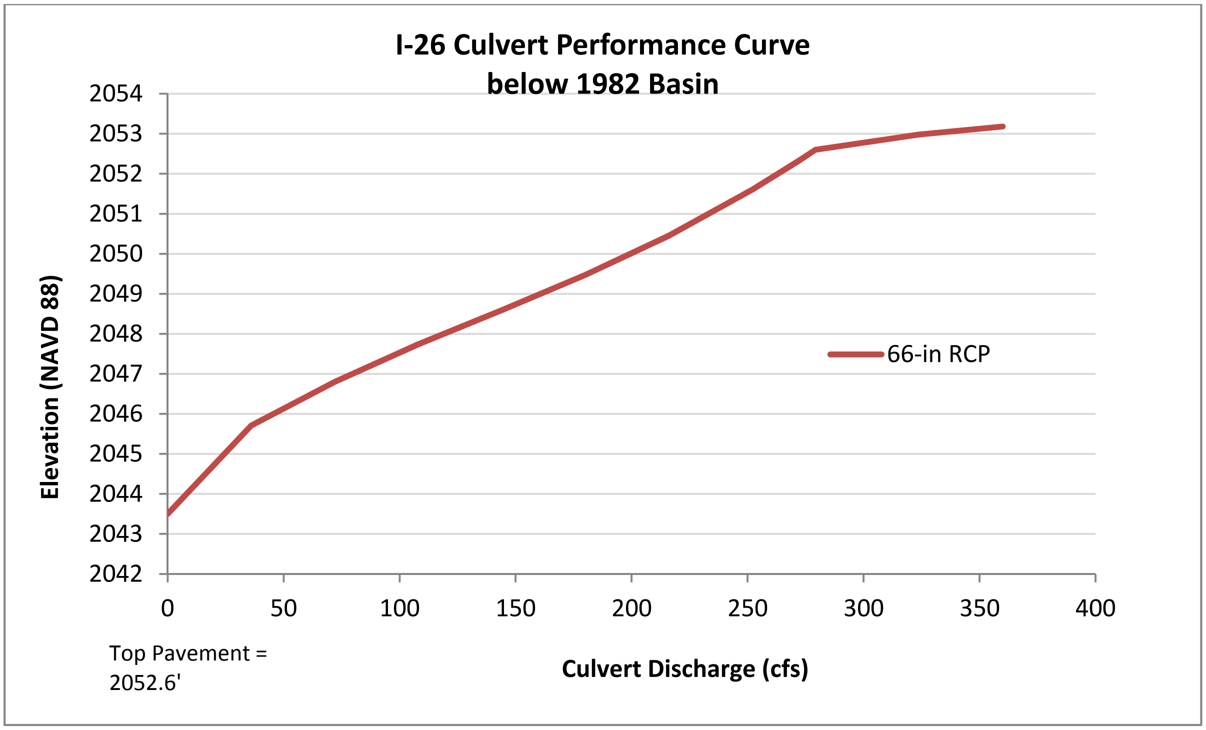


Figure 1: Discharge Curve for I-26 Culvert (1982)

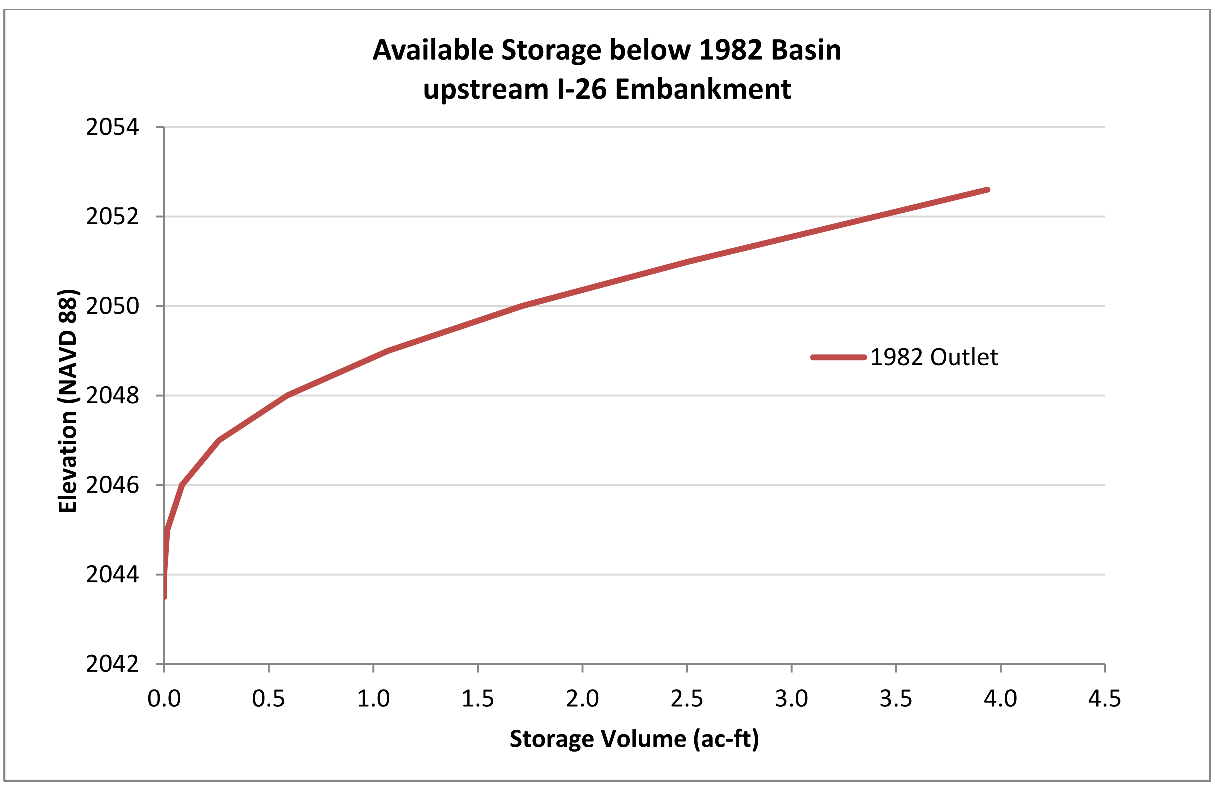


Figure 2: Storage Curve for I-26 Culvert (1982)

The headwater elevation behind the I-26 embankment for the 100-year 6-hr flood is shown in Table 8. The headwater elevation below the 1982 basin for the 100-year event is 2050.7' which is approximately 1.9 feet below the road embankment.

Coordination with NCDOT will be required to determine if additional flow capacity is needed below the 1982 basin to lower the headwater depths upstream of I-26.

Table 8: Headwater Elevations at I-26 Embankment

I-26 Culverts	Inlet Invert (ft)	100-year 6-hour Flood		
		Headwater Elevation (ft)	Freeboard from Top Pavement (ft)	HW/D
Below 1982 Basin	2043.5	2050.7	1.9	1.3

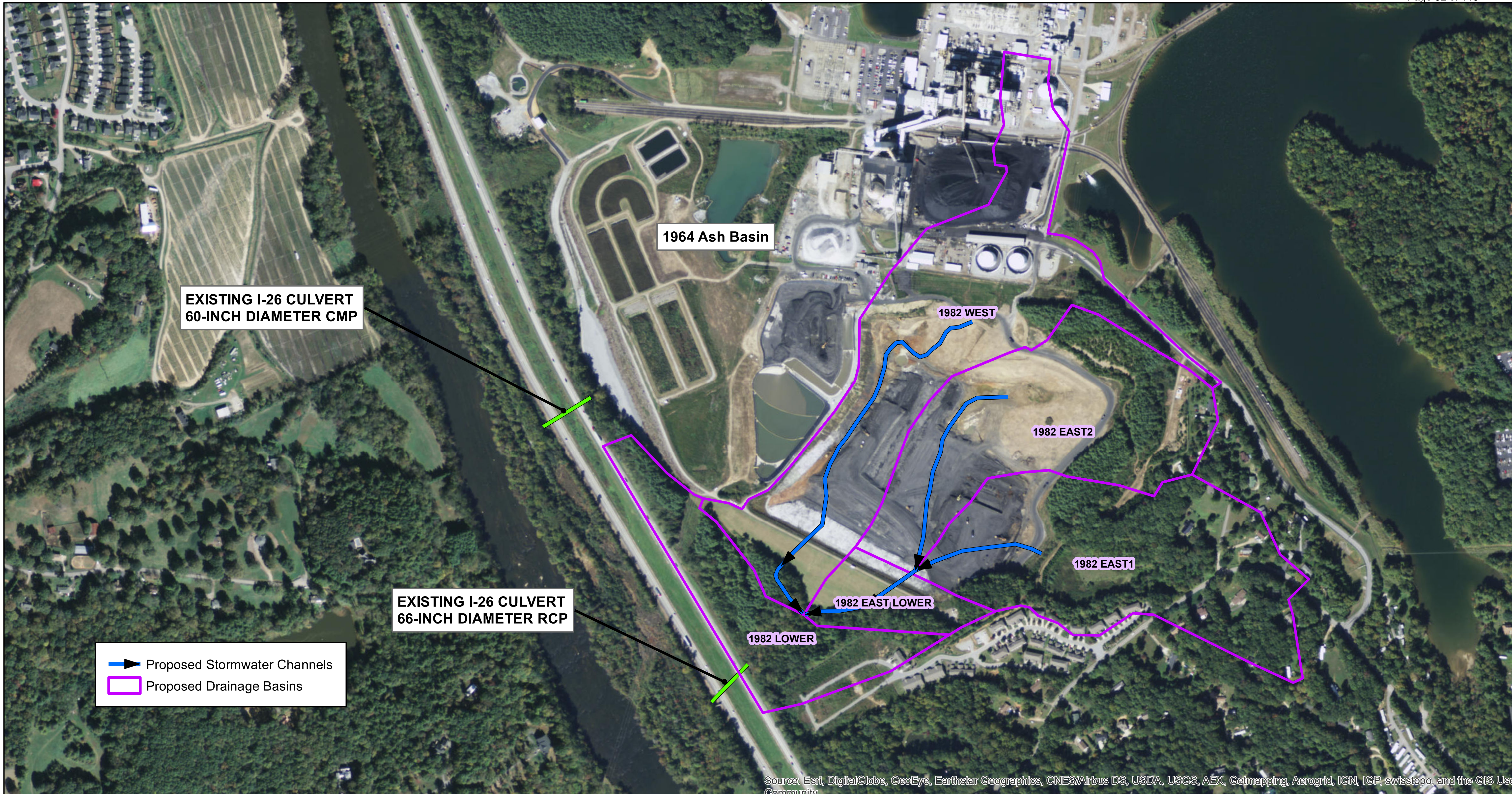
FIGURES:

1. General Site Drainage Map

REFERENCES:

1. NOAA Atlas 14, Point Precipitation Frequency Estimates", NOAA National Weather Service.
2. HEC-15, Hydraulic Engineering Circular No. 15, Third Edition. "Design of Roadside Channels with Flexible Linings". September 2005.
3. HDS-5, Hydraulic Design Series Number 5. Hydraulic Design of Highway Culverts, Third Edition. January 2012.
4. North Carolina Department of Environment and Natural Resources, "Erosion and Sediment Control Planning and Design Manual", Revised May 2013.
5. "Standard Specification for Roads and Structures", North Carolina Department of Transportation, Raleigh, January 2012.

I/A



NOTES:

N

0 0.05 0.1 0.2 Miles

amec foster wheeler

Environment & Infrastructure, Inc.
3020 Falling Waters, Rd., Suite 300
Knoxville, TN 37922

CLIENT:

DUKE ENERGY.

PROJECT:

DAM DECOMMISSIONING PLAN
ASHEVILLE STEAM STATION

TITLE:

DRAINAGE AREAS AND PROPOSED
STORMWATER CHANNELS

DATE: 11/04/2015

PROJECT: 7810150250

DRAWN BY: JMP

CHECKED BY: LCW

Figure No.

1

Attachment 1

Precipitation depths from NOAA Precipitation Frequency Data Server

I/A

NOAA Atlas 14, Volume 2, Version 3
Location name: Asheville, North Carolina, US*
Latitude: 35.5321°, Longitude: -82.5545°
Elevation: 2023 ft*
* source: Google Maps

POINT PRECIPITATION FREQUENCY ESTIMATES

G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M.Yekta, and D. Riley

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.347 (0.315–0.381)	0.412 (0.376–0.454)	0.495 (0.450–0.545)	0.558 (0.506–0.614)	0.641 (0.578–0.705)	0.704 (0.630–0.773)	0.767 (0.683–0.844)	0.829 (0.733–0.916)	0.911 (0.796–1.01)	0.975 (0.844–1.09)
10-min	0.554 (0.503–0.609)	0.659 (0.601–0.726)	0.793 (0.721–0.873)	0.893 (0.810–0.982)	1.02 (0.921–1.12)	1.12 (1.00–1.23)	1.22 (1.09–1.34)	1.31 (1.16–1.45)	1.44 (1.26–1.60)	1.54 (1.33–1.72)
15-min	0.692 (0.629–0.761)	0.828 (0.755–0.912)	1.00 (0.912–1.11)	1.13 (1.02–1.24)	1.30 (1.17–1.42)	1.42 (1.27–1.56)	1.54 (1.37–1.70)	1.66 (1.47–1.83)	1.81 (1.58–2.02)	1.93 (1.67–2.16)
30-min	0.949 (0.862–1.04)	1.14 (1.04–1.26)	1.43 (1.30–1.57)	1.64 (1.49–1.80)	1.92 (1.73–2.11)	2.14 (1.91–2.35)	2.36 (2.10–2.60)	2.58 (2.28–2.85)	2.89 (2.52–3.21)	3.12 (2.70–3.49)
60-min	1.18 (1.08–1.30)	1.44 (1.31–1.58)	1.83 (1.66–2.01)	2.13 (1.93–2.34)	2.56 (2.30–2.81)	2.90 (2.59–3.18)	3.25 (2.89–3.58)	3.62 (3.20–4.00)	4.14 (3.62–4.60)	4.56 (3.94–5.10)
2-hr	1.37 (1.24–1.50)	1.65 (1.51–1.82)	2.10 (1.90–2.30)	2.45 (2.22–2.69)	2.95 (2.65–3.24)	3.36 (2.99–3.69)	3.78 (3.34–4.16)	4.23 (3.71–4.66)	4.85 (4.20–5.38)	5.35 (4.59–5.98)
3-hr	1.44 (1.32–1.59)	1.73 (1.58–1.91)	2.18 (1.99–2.40)	2.55 (2.31–2.81)	3.09 (2.78–3.39)	3.54 (3.15–3.89)	4.01 (3.54–4.42)	4.52 (3.95–4.99)	5.25 (4.52–5.84)	5.84 (4.96–6.54)
6-hr	1.75 (1.61–1.91)	2.07 (1.90–2.26)	2.56 (2.35–2.79)	2.98 (2.72–3.24)	3.59 (3.25–3.91)	4.11 (3.69–4.47)	4.67 (4.15–5.09)	5.26 (4.63–5.76)	6.13 (5.29–6.75)	6.84 (5.82–7.56)
12-hr	2.17 (2.01–2.35)	2.57 (2.38–2.79)	3.16 (2.91–3.43)	3.63 (3.35–3.94)	4.29 (3.94–4.65)	4.83 (4.41–5.24)	5.37 (4.88–5.84)	5.93 (5.34–6.48)	6.70 (5.98–7.37)	7.29 (6.45–8.06)
24-hr	2.50 (2.33–2.70)	3.00 (2.80–3.24)	3.71 (3.45–4.00)	4.28 (3.97–4.60)	5.05 (4.68–5.43)	5.67 (5.24–6.10)	6.31 (5.81–6.78)	6.96 (6.39–7.47)	7.85 (7.16–8.43)	8.54 (7.74–9.18)
2-day	2.96 (2.77–3.18)	3.54 (3.31–3.80)	4.34 (4.05–4.65)	4.96 (4.63–5.32)	5.83 (5.42–6.24)	6.51 (6.04–6.97)	7.20 (6.66–7.72)	7.91 (7.29–8.48)	8.87 (8.12–9.51)	9.60 (8.75–10.3)
3-day	3.16 (2.96–3.38)	3.77 (3.53–4.04)	4.58 (4.28–4.90)	5.22 (4.87–5.58)	6.08 (5.66–6.50)	6.76 (6.28–7.22)	7.45 (6.90–7.96)	8.14 (7.51–8.70)	9.06 (8.32–9.70)	9.77 (8.94–10.5)
4-day	3.36 (3.15–3.58)	4.00 (3.75–4.27)	4.82 (4.51–5.15)	5.47 (5.11–5.83)	6.34 (5.91–6.75)	7.01 (6.52–7.48)	7.69 (7.13–8.20)	8.36 (7.74–8.93)	9.26 (8.52–9.89)	9.94 (9.12–10.6)
7-day	3.93 (3.69–4.20)	4.67 (4.39–5.00)	5.61 (5.26–5.99)	6.35 (5.95–6.78)	7.35 (6.86–7.83)	8.13 (7.57–8.67)	8.92 (8.27–9.51)	9.71 (8.98–10.4)	10.8 (9.89–11.5)	11.6 (10.6–12.4)
10-day	4.51 (4.25–4.78)	5.34 (5.03–5.67)	6.34 (5.98–6.74)	7.12 (6.72–7.56)	8.18 (7.69–8.68)	9.00 (8.44–9.55)	9.83 (9.19–10.4)	10.7 (9.92–11.3)	11.7 (10.9–12.5)	12.6 (11.6–13.4)
20-day	6.16 (5.84–6.51)	7.25 (6.87–7.66)	8.44 (7.99–8.92)	9.37 (8.86–9.89)	10.6 (9.98–11.2)	11.5 (10.8–12.1)	12.4 (11.6–13.1)	13.2 (12.4–14.0)	14.3 (13.4–15.2)	15.2 (14.1–16.1)
30-day	7.61 (7.25–8.00)	8.92 (8.49–9.38)	10.2 (9.72–10.7)	11.2 (10.6–11.7)	12.4 (11.8–13.0)	13.3 (12.6–14.0)	14.1 (13.4–14.9)	14.9 (14.1–15.7)	15.9 (15.0–16.8)	16.6 (15.6–17.6)
45-day	9.70 (9.25–10.2)	11.3 (10.8–11.9)	12.8 (12.2–13.4)	13.8 (13.2–14.4)	15.1 (14.4–15.8)	16.0 (15.2–16.7)	16.8 (16.0–17.6)	17.5 (16.7–18.4)	18.4 (17.5–19.3)	19.0 (18.0–20.0)
60-day	11.6 (11.1–12.2)	13.6 (13.0–14.2)	15.1 (14.5–15.9)	16.3 (15.6–17.1)	17.7 (16.9–18.5)	18.6 (17.8–19.5)	19.5 (18.6–20.5)	20.3 (19.3–21.3)	21.2 (20.2–22.3)	21.8 (20.7–22.9)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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PF graphical

Bednarcik Exhibit 8
Docket No. E-2 Sub 1219
Asheville SARP Appendix D
Page 55 of 118

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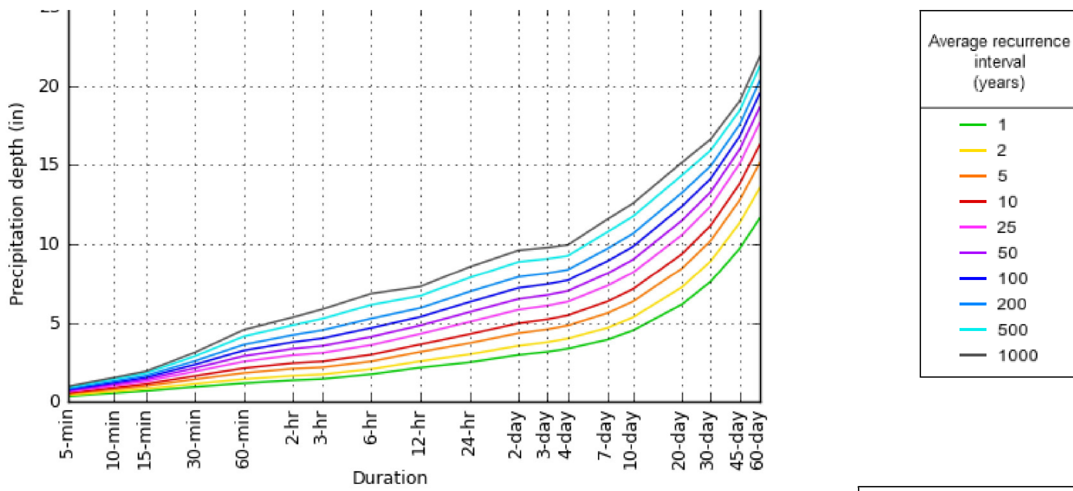

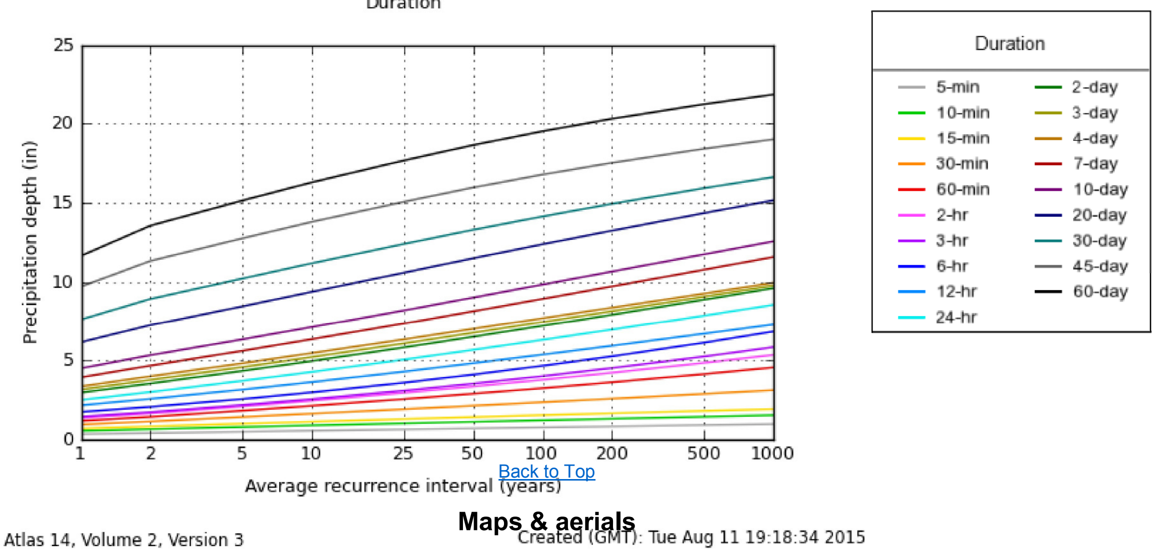

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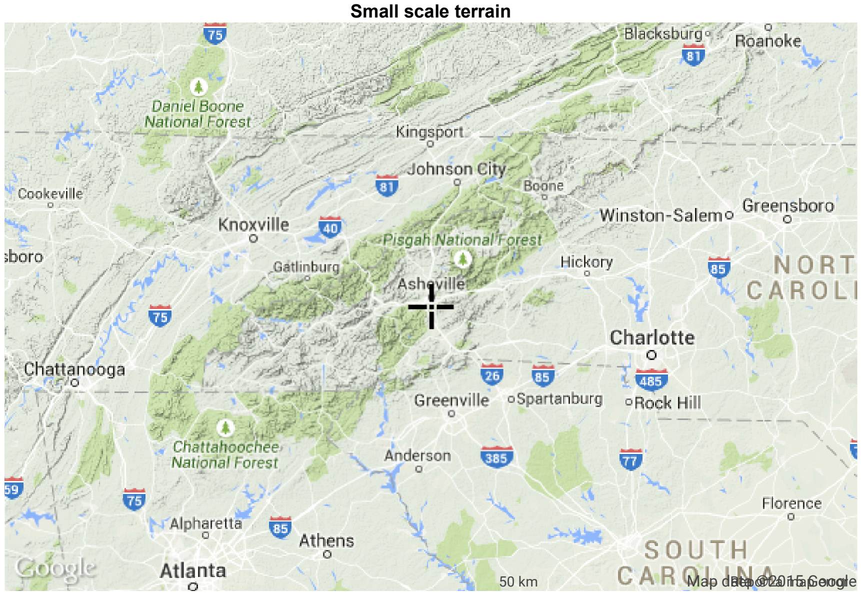
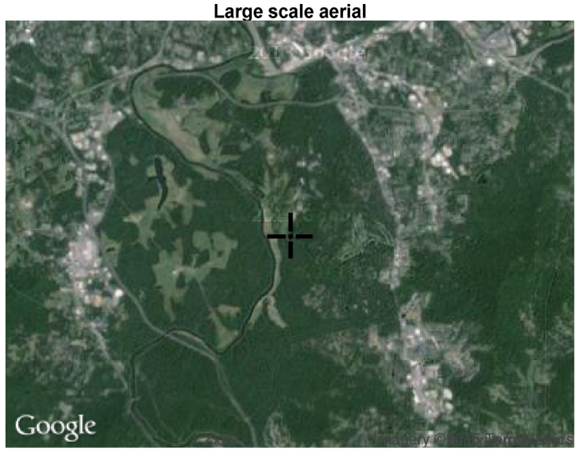
Maps & aerials

Small scale terrain



Large scale terrain

Large scale aerial



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US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
Office of Hydrologic Development
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

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Calculation Title:
Temporary Silt Basin Calculations

Summary:
The temporary silt basins were designed in accordance with the North Carolina Department of Transportation (NCDOT) "Erosion and Sediment Control, Field Guide." Using this guide, appropriately-sized silt basins were designed with storage capacities of approximately 84,600 ft^3 each, which is greater than the minimum required capacities of 82,800 ft^3 each.

Notes:

Revision Log:

No.	Description	Originator / Date		Technical Reviewer / Date
0	Initial Submittal	**Matt Bishop** Matt Bishop 2/23/16		**Luke C. Williams, PE** Luke C Williams 2/23/16

amec foster wheeler

OBJECTIVE:

The objective of this calculation is to design the temporary silt basins for the interim closure conditions of the 1982 Ash Basin.

METHOD:

The temporary silt basins were designed in accordance with the North Carolina Department of Transportation (NCDOT) "Erosion and Sediment Control, Field Guide" [Ref. 1]. Areas used in the calculation were generated from the project drawings using AutoCAD Civil 3D [Ref. 2].

CALCULATIONS:

1.0 Determination of Disturbed Area

The limits of disturbance for the dam decommissioning and closure activities at the 1982 Ash Basin are shown on Sheet C-1.3 of the project drawings. The disturbed areas are noted on the drawings as the following:

- Limits of Dam Breach Excavation (5.8 acres),
- Approximate Limits of Impoundment Backfill (13.5 acres), and
- Limits of Disturbance for Channel Construction (0.9 acres), *note that this area is a result of all channels shown on the plan (0.35 + 0.20 + 0.05 + 0.30 acres)*.

Thus, the total estimated disturbed area is approximately 20.2 acres. In addition, current ash excavation operations are underway and encompass a total area of approximately 46 acres (including the proposed 20.2 acres). There will be some overlap between the current ash excavation work and the proposed disturbance included in this submittal. Therefore, the silt basins included in this calculation were sized to be able to handle the total disturbance area within the ash basin of 46 acres, instead of the disturbed area of 20.2 acres as shown on the E&SC Permit Drawings.

The stormwater flows within the disturbed areas will be routed through the basin with two separate stormwater channels: one network of channels along the west limits of the fill, and one network of channels along the east limits of the fill. Each channel will convey flows from approximately half of the disturbed area within the basin. Therefore, each silt basin will be designed to handle half of the total disturbance area within the basin of 23 acres (46 acres / 2).

2.0 Silt Basin Design

Silt Basins were designed to intercept flows from the stormwater channels along the excavation limits adjacent to the existing 1982 Ash Basin Dam. The Silt Basins were designed in accordance with the NCDOT "Erosion and Sediment Control, Field Guide" for Silt Basin, Type B recommendations. According to the design guide, each silt basin shall be designed with a storage capacity of 3,600 cubic feet per disturbed acre.

As mentioned previously, each silt basin was designed to handle half of the total disturbance area within the basin of 23 acres. As a result, the required storage capacity for each silt basin is 82,800 ft^3 (23 acres x 3600 ft^3/acre).

The silt basin design also incorporated the sizing requirements for Silt Basin, Type B recommendations. The requirements included a minimum of 2' depth, maximum of 1.5:1 side slopes, and a minimum length of 2 times the width. The silt basin design is shown on Detail 4 of Sheet E-1.2. The design consists of surface dimensions of 100' x 225' and a depth of 4'. The calculated volume for this design is approximately 84,600 ft^3, which is greater than the minimum required 82,800 ft^3 of storage capacity.

DISCUSSION:

The temporary silt basins were designed in accordance with the North Carolina Department of Transportation (NCDOT) "Erosion and Sediment Control, Field Guide." Using this guide, appropriately-sized silt basins were designed with storage capacities of approximately 84,600 ft^3 each, which is greater than the minimum required capacities of 82,800 ft^3 each.

REFERENCES:

1. North Carolina Department of Transportation, "Erosion and Sediment Control, Field Guide", 2013.
2. AutoCAD Civil 3D 2015, AutoDesk Inc.

Calculation Title:
Temporary Stormwater Containment Berm Calculations

Summary:
The objective of this calculation is to design the temporary stormwater containment berms for the interim closure conditions of the 1982 Ash Basin. The temporary stormwater containment basins were designed to adequately contain the 25-year stormwater runoff volumes for each of their respective tributary areas. Each Berm has sufficient capacity to contain the rainfall event with adequate freeboard without overtopping.

Notes:

Revision Log:

No.	Description	Originator / Date		Technical Reviewer / Date
0	Initial Submittal	**Matt Bishop** Matt Bishop 2/23/16		**Luke C. Williams, PE** Luke C Williams 2/23/16

OBJECTIVE:

The objective of this calculation is to design the temporary stormwater containment berms for the interim closure conditions of the 1982 Ash Basin.

METHOD:

The temporary stormwater containment berms were designed to store the 25-year storm event. Stormwater flow rates were calculated using the SCS runoff method. Stage-storage curves were developed for the Upper and Lower Berms using AutoCAD Civil 3D and Microsoft Excel.

CALCULATIONS:

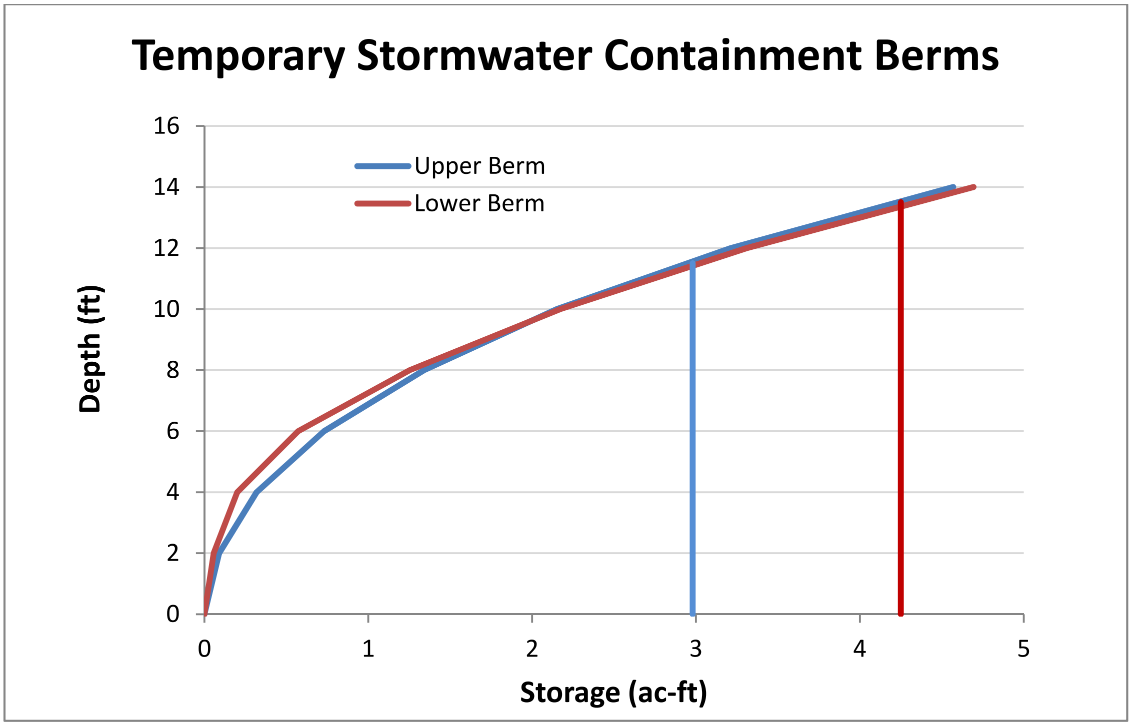
1.0 Determination of Stormwater Runoff Volume

The stormwater runoff volume for the drainage areas upstream of each berm were calculated according to the SCS runoff method as presented in the “Final Conditions Stormwater Calculation,” included with this submittal. The following runoff volumes and peak pool elevations were determined for each Berm:

	Drainage Area (ac)	25-yr Runoff Volume (ac-ft)	Peak Pool (ft)
Upper Berm	16.6	2.98	2131.6
Lower Berm	26.6	4.245	2125.4

2.0 Berm Design

Each Berm was designed using AutoCAD Civil 3D software with a maximum height of 14 feet. Using the 25-yr Runoff Volume as shown in the table above, stage-storage curves were generated to calculate the peak pool elevations and their associated depths. The figure below shows the stage-storage curves for the Berms.



DISCUSSION:

The temporary stormwater containment basins were designed to adequately contain the 25-year stormwater runoff volumes for each of their respective tributary areas. As shown on the previous figure, each Berm has sufficient capacity to contain the rainfall event with adequate freeboard without overtopping.

REFERENCES:

1. NOAA Atlas 14, Point Precipitation Frequency Estimates", NOAA National Weather Service.
2. HEC-15, Hydraulic Engineering Circular No. 15, Third Edition. "Design of Roadside Channels with Flexible Linings". September 2005.
3. HDS-5, Hydraulic Design Series Number 5. Hydraulic Design of Highway Culverts, Third Edition. January 2012.
4. North Carolina Department of Environment and Natural Resources, "Erosion and Sediment Control Planning and Design Manual", Revised May 2013.
5. "Standard Specification for Roads and Structures", North Carolina Department of Transportation, Raleigh, January 2012.

Calculation Title:
Compost Sock Calculations

Summary:
The below calculations are for the compost socks for the interim closure conditions of the 1982 Ash Basin. The compost socks were designed to handle the 10-year runoff volume.

Notes:

Revision Log:

No.	Description	Originator / Date	Technical Reviewer / Date
0	Initial Submittal	**Joe Parker** J Parker 7/18/2016	**Luke C. Williams, PE** Luke Williams by Matt Bt… w/ permission 07/18/2016

amec foster wheeler

OBJECTIVE:

The objective of this calculation is to design the compost socks for the interim closure conditions of the 1982 Ash Basin.

METHOD:

The compost socks located on the west and east excavated dam abutments were designed to filter the 10-year runoff volume without overtopping. The compost socks located on the main backfill area were not specifically designed to handle the 10-year runoff volume because the runoff from this area drains to the west and east sediment ponds, which were sized to handle sediment washoff from the main backfill area. Stormwater runoff volumes were calculated using the SCS runoff method considering a conservative runoff curve number of 88 (disturbed soil).

CALCULATIONS:

Composts socks were designed using the recommended criteria documented in the Chapter 6 Section 6.66 “Compost Sock” in the NCDEQ Erosion and Sediment Control Planning and Design Manual (NCDEQ, 2013). The compost socks will be installed on the west and east excavated dam abutments to handle the 10-year runoff volumes. Compost socks will be placed at every 10 foot change in elevation and will have 12-inch diameter as shown in the design drawings. The abutment cut has a slope of approximately 10H:1V or 10 percent. Table 1 shows the recommended design flow rate per length of compost sock. Table 2 shows that the compost sock for the west and east excavated dam abutments have adequate capacity in handling the 10-year runoff volume. Specially, the 10-year runoff volume per length of compost sock is less than the maximum recommend flow rate specified in Table 1.

Table 1: Recommended Sock Flow Rate (NCDEQ, 2013)

Compost Sock Design Diameter (in)	Flow per foot of sock (gpm/ft)
8	7.5
12	11.3
18	15
24	22.5
32	30

Table 2: Sock Flow Rate Calculations Summary

Sock Slope Elevation (ft)	Length of sock (ft)	Cumulative Drainage Area (ac)	Peak runoff (cfs)	Flow per foot of sock (gpm/ft)
West Abutment				
2160	61	0.028	0.14	1.0
2150	113	0.116	0.56	2.2
2140	155	0.35	1.69	4.9
2130	195	0.612	2.95	6.8
2120	237	0.936	4.51	8.5
2110	284	1.149	5.53	8.7
2104	309	1.287	6.2	9.0
East Abutment				
2160	52	0.025	0.12	1.0
2150	87	0.12	0.58	3.0
2140	141	0.234	1.13	3.6
2130	203	0.423	2.04	4.5
2120	250	0.642	3.09	5.5
2110	301	0.727	3.5	5.2
2106	326	1.037	5	6.9

DISCUSSION:

The temporary compost socks were designed to adequately filter the 10-year stormwater runoff volumes for each of their drainage areas to allow for proper sediment control.

REFERENCES:

1. North Carolina Department of Environment and Natural Resources, (NCDEQ) "Erosion and Sediment Control Planning and Design Manual", Revised May 2013.

Calculation Title:
Riprap Energy Dissipaters Calculations

Summary:
The following calculations are for the riprap basin energy dissipaters for the interim closure conditions of the 1982 Ash Basin. Riprap basins will be located at the outlets of the west and east outlet channels. The riprap basins will serve as a transition from the outlet channels to the downstream wetland area. The riprap basins were designed for the 100-year stormwater runoff volumes for each of their respective tributary areas.

Notes:

Revision Log:

No.	Description	Originator / Date	Technical Reviewer / Date
0	Initial Submittal	**Joe Parker** [signature] 7/18/2016	**Luke C. Williams, PE** Luke Williams by Matt [signature] w/permission 07/18/2016

amec foster wheeler

OBJECTIVE:

The objective of this calculation is to design the riprap basin energy dissipaters for the interim closure conditions of the 1982 Ash Basin.

METHOD:

The riprap basin energy dissipaters were designed using guidelines found in Chapter 10: *Riprap Basins and Aprons* from HEC-14 "Hydraulic Design of Energy Dissipaters" (FHWA, 2006). Stormwater runoff volumes were calculated using the SCS runoff method. Further calculation on the inflow volumes for the riprap basins can be found in the H&H calculation package for the channels. The riprap basins were sized for the 100-year runoff event.

CALCULATIONS:

Riprap basin energy dissipaters will be located at the outlet of the both the west and east outlet channel to transition flow from the channel to the wetland areas. The following guidelines from FHWA were used to size the riprap basins:

- The basin is pre-shaped and lined with riprap that is a least $2D_{50}$ thick;
- The riprap floor is constructed at the approximate depth of scour, h_s, that would occur in a thick pad of riprap. The h_s/D_{50} of the material should be greater than 2;
- The length of the energy dissipating pool, L_s, is 10hs, but no less than $3W_o$; the length of the apron, L_A, is $5h_s$, but no less than W_o. The overall length of the basin (pool plus apron), L_B, is $15h_s$, but no less than $4W_o$.

Tables 1 and 2 show the dimensions of the west and east dissipater basins, respectively.
Tables 3 and 4 shows the calculation steps for the west and east dissipater basins, respectively.

Table 1: Riprap Basin Energy Dissipater West Basin Summary

Riprap Basin Energy Dissipater (West Outlet Channel)	
Entrance Channel Width, W_O (ft)	7.5
Entrance Channel Flow Depth, Y_e (ft)	0.9
Pool Depth, h_S (ft)	1.5
Exit Channel Tailwater Depth, TW (ft)	0.7
Dissipater Pool Length, L_S (ft)	22.5
Apron Length, L_A (ft)	7.5
Total Basin Length, L_B (ft)	30.0
Apron Width, W_B (ft)	27.5

Table 2: Riprap Basin Energy Dissipater East Basin

Riprap Basin Energy Dissipater (East Outlet Channel)	
Entrance Channel Width, W_O (ft)	10.0
Entrance Channel Flow Depth, Y_e (ft)	1.0
Pool Depth, h_S (ft)	1.6
Exit Channel Tailwater Depth, TW (ft)	0.7
Dissipater Pool Length, L_S (ft)	30.0
Apron Length, L_A (ft)	10.0
Total Basin Length, L_B (ft)	40.0
Apron Width, W_B (ft)	36.7

Table 3: Riprap Basin Energy Dissipater West Basin Calculations

FHWA HEC-14				
Input				
West Channel				
Step 1	Parameter	Unit	Value	Comment
Design Flow	Q	(cfs)	138	
Flow Width	Wo	(ft)	7.5	
Flow Depth	ye	(ft)	0.932	
Manning (n)			0.03	
Outlet velocity	Vo	(ft)	15.812545	
Froude number	Fr		2.89	
Step 2				
Rock median diameter	D50	(ft)	0.67	
D50/ye			0.72	(>= 0.1 OK)
Tailwater	TW	(ft)	0.71	
TW/ye			0.76	
Tailwater parameter	Co		1.40	
Pool Depth	hs	(ft)	1.47	
hs/D50			2.19	(>= 2 recommended)
Step 3				
Pool Length	Ls	(ft)	14.69	
Pool Length(min)	Lsmin	(ft)	22.50	
Apron length	La	(ft)	7.35	
Apron length(min)	Lamin	(ft)	7.50	
Total Length (pool + apron)	Lb		22.04	
Min total length	Lbmin	(ft)	30.00	
Apron width	Wb	(ft)	27.50	
Step 4				
Flow	Q	(ft3/s)	138	
gravity	g	(ft2/s)	32.2	
Critical depth	yc	(ft)	0.9	iterate
Basin side slope	z1		2	
Apron width	Wb	(ft)	27.50	
Q^2/g			591.42857	
Ac^3/Tc			589.617	
Wetted Area	Ac	(ft2)	26.37	
Wetted Perimeter	Tc	(ft)	31.1	
Exit Velocity	Vc	(ft/s)	5.2332196	(OK)
Step 5				
TW/yo			0.7639485	(OK)

Table 4: Riprap Basin Energy Dissipater East Basin Calculations

FHWA HEC-14				
Input				
East Channel				
Step 1	Parameter	Unit	Value	Comment
Design Flow	Q	(cfs)	186	
Flow Width	Wo	(ft)	10	
Flow Depth	ye	(ft)	0.95	
Manning (n)			0.03	
Outlet velocity	Vo	(ft)	16.45289695	
Froude number	Fr		2.97	
Step 2				
Rock median diameter	D50	(ft)	0.67	
D50/ye			0.71	(>= 0.1 OK)
Tailwater	TW	(ft)	0.73	
TW/ye			0.77	
Tailwater parameter	Co		1.40	
Pool Depth	hs	(ft)	1.61	
hs/D50			2.41	(>= 2 recommended)
Step 3				
Pool Length	Ls	(ft)	16.15	
Pool Length(min)	Lsmin	(ft)	30.00	
Apron length	La	(ft)	8.07	
Apron length(min)	Lamin	(ft)	10.00	
Total Length (pool + apron)	Lb		24.22	
Min total length	Lbmin	(ft)	40.00	
Apron width	Wb	(ft)	36.67	
Step 4				
Flow	Q	(ft3/s)	186	
gravity	g	(ft2/s)	32.2	
Critical depth	yc	(ft)	0.9	iterate
Basin side slope	z1		2	
Apron width	Wb	(ft)	36.67	
Q^2/g			1074.409938	
Ac^3/Tc			1030.470376	
Wetted Area	Ac	(ft2)	34.62	
Wetted Perimeter	Tc	(ft)	40.26666667	
Exit Velocity	Vc	(ft/s)	5.372616984	(OK)
Step 5				
TW/yo			0.772631579	(OK)

DISCUSSION:

Both the east and west riprap basin energy dissipaters are adequately sized to handle the 100-yr peak flow for their respective tributary areas. The design drawings further show the locations and construction details for each of the riprap basin energy dissipaters.

REFERENCES:

1. Federal Highway Administration (FHWA). Hydraulic Engineering Circular No. 14, Third Edition, "Hydraulic Design of Energy Dissipaters for Culverts and Channels", July 2006.
2. North Carolina Department of Environment and Natural Resources, "Erosion and Sediment Control Planning and Design Manual", Revised May 2013.

Stormwater Management Plan Calculations

Calculation Title:
Attachment 3a
Stormwater Management Plan

Summary:
This document presents calculations from both Amec Foster Wheeler as well as Burns and McDonnell as preparers of Phase 1 (Tasks 1 and 2) of the 1982 basin construction.

Amec Foster Wheeler is the preparer of the Phase 1, Task 1 stormwater management calculations related to the 1982 dam breach and dam decommissioning.

Burns and McDonnell is the preparer of the Phase 1, Task 2 stormwater management calculations related to the structural fill placement and grading in preparation for the combined cycle power plant construction.

Notes:

Revision Log:

No.	Description	Originator / Date		Technical Reviewer / Date
0	Initial Submittal	**Section 1 – 4** **Joe Parker (Amec Foster Wheeler)** **Section 5** **Andy Fries (Burns and McDonnell)**		**Section 1 – 4** **Luke C. Williams, PE (Amec Foster Wheeler)** **Section 5** **Andy Fries (Burns and McDonnell)**

OBJECTIVE:

The objective of this calculation package is to present the pre-construction and post-construction runoff calculations and stormwater management practices for Phase 1 (1982 basin decommissioning and structural fill placement).

METHOD:

Runoff volume calculations were performed using the SCS Curve Number method. Runoff hydrographs were developed using the SCS unit hydrograph method.

CALCULATIONS:

1.0 Determination of Pre-Construction Stormwater Runoff

The pre-construction condition was considered to be the land condition prior to the building of the 1982 dam at the Asheville Steam Electric Generating Plant. The runoff volumes for the pre-construction condition were determined using historic aerial imagery and topography from the United States Geological Survey (USGS). The outlet of the project drainage area is located at the inlet of the I-26 culvert crossing. The total drainage area was delineated using the 1965 USGS Skyland, NC quad and was determined to be 119.1 acres. **Figure 1** shows this drainage area.

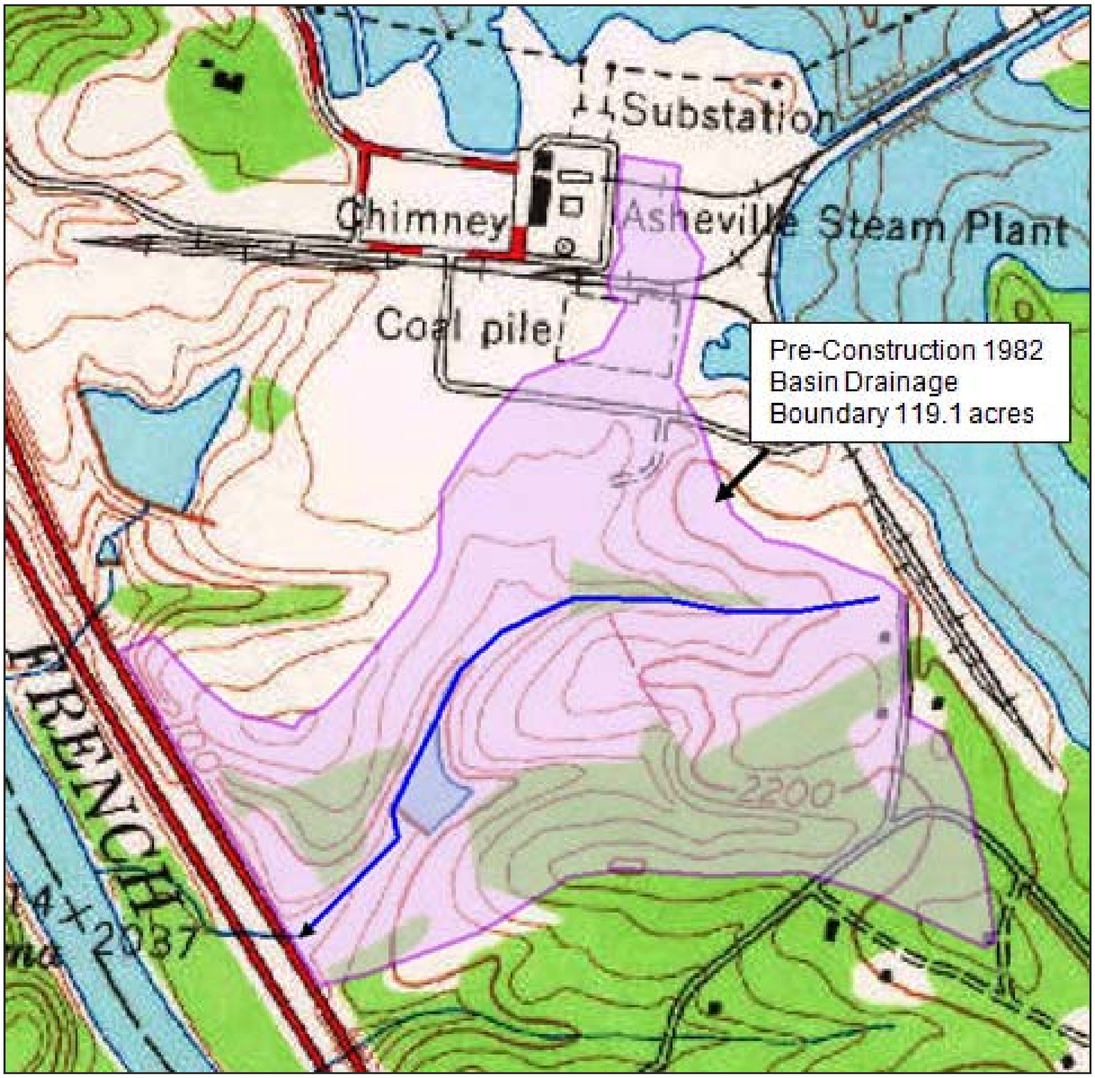


Figure 1: Pre-Construction Topography and Drainage Area (USGS Skyland, NC Quad 1965)

Figure 2 shows the 1964 aerial imagery for the 1982 basin. Prior to the building of the 1982 dam the majority of the 1982 drainage area was pasture. **Table 1** provides a summary of the land cover, hydrologic soil group, and runoff curve for the 1982 basin prior to the construction of the 1982 dam. The hydrologic soil groups were determined from Buncombe County Soil Survey. Please note the currently available Buncombe County Soil Survey was published in 2013 and the soils shown in the survey do not reflect pre-construction (i.e. pre-1982 dam) condition. Therefore to accurately estimate the pre-construction runoff the soils within the 1982 basin were estimated using the soil data for the surrounding undistributed or native soils shown in the survey. The native soils surrounding the site generally are type B soils. Developed areas associated with the plant were considered to be type C soils because of their disturbed nature. The weighted runoff curve number for the pre-construction drainage area is 68.

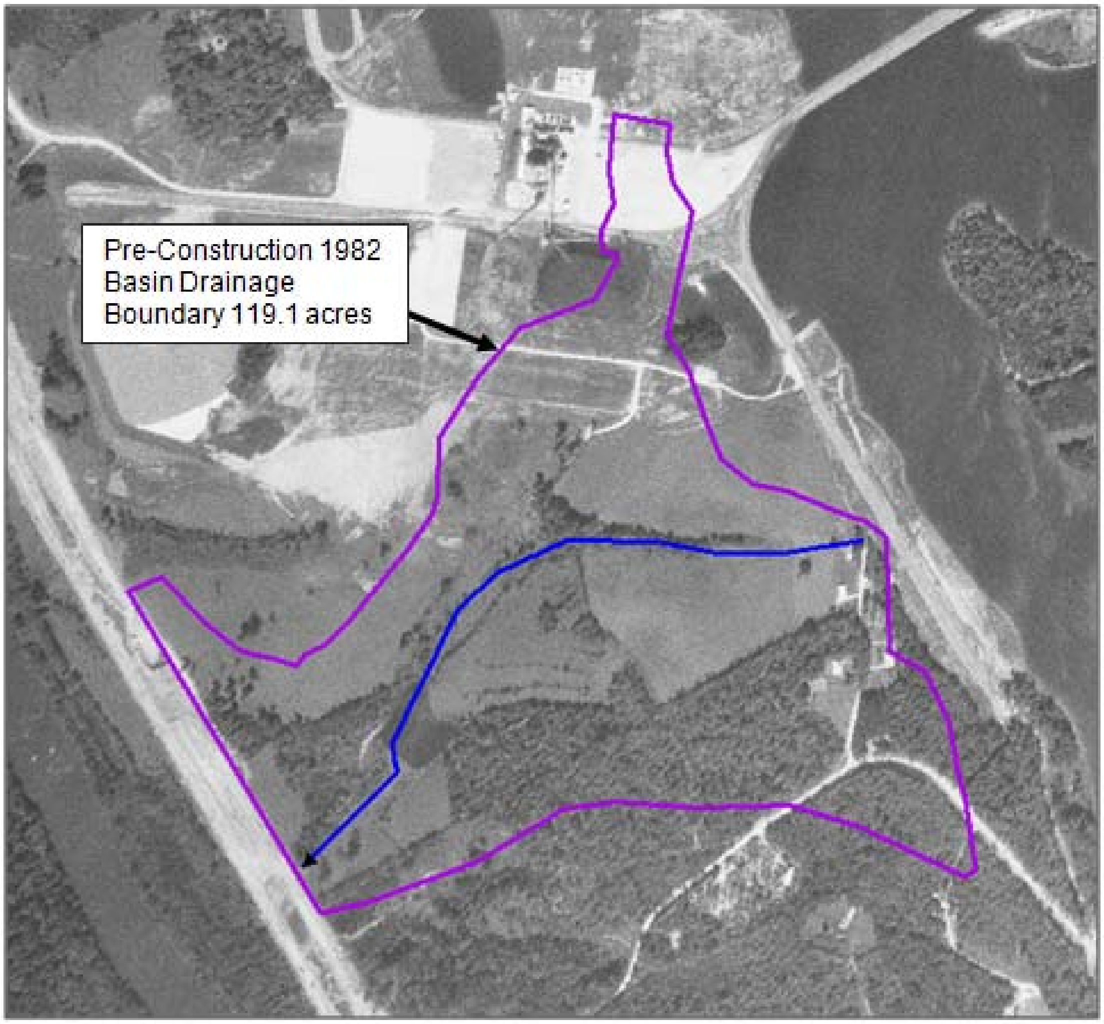


Figure 2: Pre-Construction Land Cover (USGS 09/24/1964)

Table 1: Pre-Construction 1982 Basin Runoff Curve Number Summary

Pre 1982 Dam Land Cover Summary	Area (acres)	Hydro Soil Group	CN
Industrial (72% Impervious)	8.8	C	91
Residential	5.4	B	70
Pasture	56	B	69
Pasture Tree Combination	16.3	B	65
Forest	32.6	B	60
Total	119.1	Weighted CN	68

Peak runoff flow rates were estimated using the SCS unit hydrograph method. Drainage parameters used to estimate the runoff hydrograph are shown in **Table 2** below. The peak runoff rate for the 1-year, 24-hour storm event was calculated to be 30.4 cfs (**Table 3**). The 1-

year, 24-hour rainfall depth is 2.5 inches as determined from NOAA Atlas 14. A SCS Type II storm distribution was used for the 1-year, 24-hour rainfall event.

Attachment 3b "Pre-1982 Dam Runoff Calculations" provides the supporting runoff calculations for the Pre-1982 dam condition.

Table 2: Pre-Construction 1982 Basin Drainage Area Summary

Drainage Area	Area (acres)	Area (mi2)	Curve Number CN	Tc (min)
Pre-1982 Dam Conditions				
Drainage Area upstream I-26	119.1	0.1861	68	25

Table 3: Pre-Construction 1982 Basin Runoff Summary

Storm Event	Runoff Volume (ac-ft)	Peak Runoff (cfs)
Pre-1982 Dam Conditions		
1-year, 24-hour	3.7	30.4

2.0 Determination of Post-Construction Stormwater Runoff

The Post-construction condition was considered to be the land condition after the breach and decommissioning of the 1982 dam and placement of Structural Fill as shown on the "Final Grading and Drainage" sheet in the drawing package.

The runoff volumes for the post-construction condition were determined considering the interior of the 1982 basin will be vegetated with grass. The soils within the 1982 basin footprint were considered disturbed and the hydrologic soil group was set to C to account for compaction of heavy equipment and general ground disturbance. The total drainage area was delineated using recent survey data of the site and was determined to be 107.5 acres. The drainage area was subdivided into multiple subbasins to allow for analysis of the East and West Stormwater Basins. The reduction in drainage area from the pre-construction conditions is a result of the low volume stormwater system (LVSW) which captures runoff from the plant area and diverts runoff away from the 1982 basin to an NPDES discharge point. **Figure 3** shows the drainage area and the area of the LVSW system. **Table 4** provides a summary of the land cover, hydrologic soil group, and runoff curve for the 1982 basin post breach of the 1982 dam. The weighted runoff curve number for the post-construction drainage area is 71.

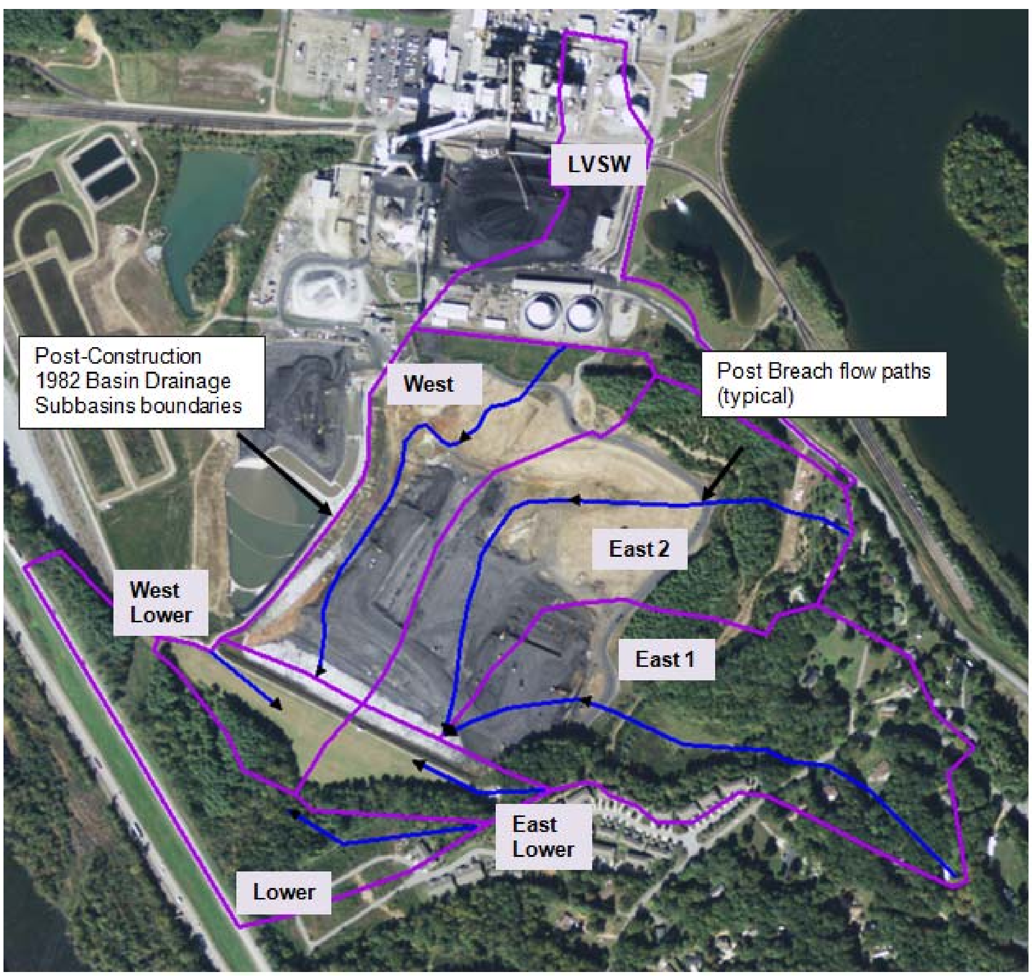


Figure 3: Post Construction Drainage Areas

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Table 4: Post-Construction 1982 Basin Runoff Curve Number Summary

Subbasin	Land Cover Type	Area (acres)	Hydro Soil Group	CN
LVSW	Grass developed area	3.1	C	74
	Industrial (72% Impervious)	12.0	C	91
West	Grass developed area	20.4	C	74
West Lower	Grass developed area	5.4	C	74
East 1	Grass developed area	11.2	C	74
	Grass woods Combination	20.1	B	68
East 2	Grass developed area	19.0	C	74
	Grass woods Combination	10.1	B	70
East Lower	Grass developed area	5.9	C	74
Lower	Grass woods Combination	15.5	B	65
	Total without LVSW	107.5	Weigthed CN	71

Peak runoff flow rates were estimated using the SCS unit hydrograph method. Drainage parameters used to estimate the runoff hydrograph for each of the subbasins are shown in **Table 5** below. **Attachment 3c** "Post-1982 Dam Runoff Calculations" provide the supporting subbasin runoff calculations for the Post-1982 dam condition. Two Stormwater basins will be constructed within the 1982 basin and will reduce peak flows leaving the project area. The Stormwater Basins details are discussed in Section 3.0. **Table 6** shows the peak runoff rate for the 1-year, 24-hour from the project site considering the stormwater basins.

Table 5: Post-Construction 1982 Basin Runoff Summary

Drainage Area	Area (acres)	Area (mi2)	Curve Number CN	Tc (min)
Post-1982 Dam Breach Conditions				
West	20.4	0.0318	74	22.8
West Lower	5.4	0.0085	74	7.1
East 1	31.3	0.0489	70	26.4
East 2	29.1	0.0454	73	28.1
East Lower	5.9	0.0092	74	11.2
Lower	15.5	0.0242	65	19.7

Table 6: Post-Construction 1982 Basin Runoff Summary

Storm Event	Runoff Volume (ac-ft)	Peak Runoff (cfs)
Post-1982 Dam Conditions		
1-year, 24-hour	4.4	12.1

3.0 Stormwater Basins

During the breaching activities of the 1982 dam two sediment ponds will be constructed at the toe of the interior face of the dam. The sediment ponds will provide erosion and sediment control during construction and were sized using guidelines from Section 6.61 NCDEQ *Erosion and Sediment Control Planning Design Manual*.

These two sediment ponds will be modified once construction is complete to function as permanent stormwater basins to control peak runoff flow from the project site. These modifications to the sediment ponds include: 1) removal of the skimmer, 2) cleanout of deposited sediment, and 3) reduction in the principal spillway riser height to 4 feet. A 4" diameter orifice will also be put in the riser pipe to keep the stormwater basins dry.

The two stormwater basins identified as "East" and "West" stormwater basins on the project drawings are located near the dam breach and will be below final grade to allow for runoff to be collected into the basins. Further details on the permanent stormwater basins are provided below.

East Stormwater Basin

The principal spillway for the East Stormwater Basin is a riser barrel type spillway. The riser pipe is 3 feet in diameter and has a height of 4 feet from the bottom of the pond. The top of the riser is open and serves as the principal spillway for the basin. The basin is dewatered by a 4-in diameter orifice located at the bottom of the riser. The horizontal barrel section of the principal spillway is a corrugated metal pipe 2 feet in diameter. The emergency spillway for the West Stormwater Basin is a trapezoidal channel with a 5' bottom width and 3H:1V side slopes. The spillway is set 7 feet off the bottom of the pond. The stage storage information for the East Stormwater Basin is provided in **Table 7** and **Figure 4**. **Table 8 – 11 and Figure 5** provide the spillway discharge information for the East Stormwater Basin.

Table 7: East Stormwater Basin Stage Storage

Stage (ft)	Surface (ft2)	Surface Area (ac)	Cumulative Storage Volume (ac-ft)
2098	0	0.000	0.0000
2099	2063	0.047	0.0237
2100	6464	0.148	0.1216
2101	11227	0.258	0.3246
2102	13886	0.319	0.6129
2103	15230	0.350	0.9471
2104	16599	0.381	1.3124
2105	17994	0.413	1.7095
2106	19424	0.446	2.1390
2107	20772	0.477	2.6004
2108	22119	0.508	3.0927

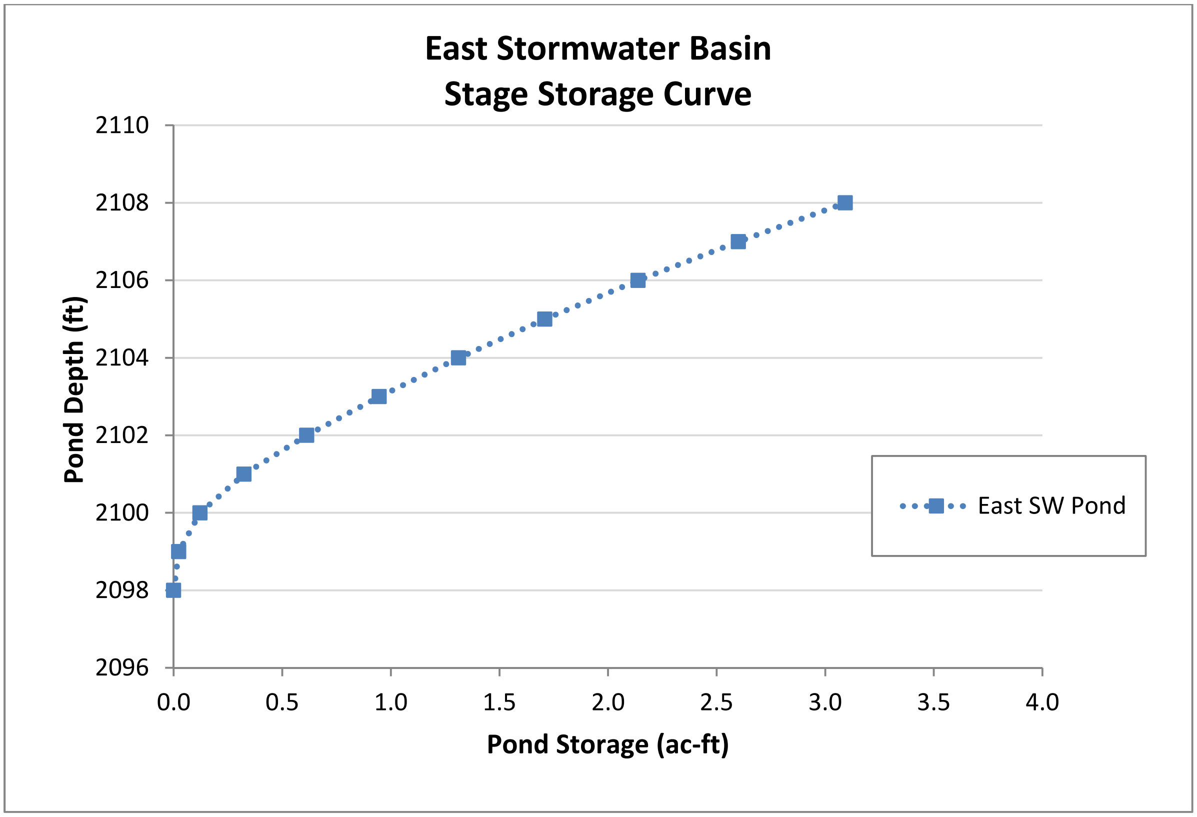

Figure 4: East Stormwater Basin Stage Storage

Table 8: East Stormwater Basin Outlet Riser Calculations

Principal Spillway Riser Equations	
Riser Weir	
Q = CLH^1.5	
C	3.3
Crest length (ft)	9.4
Riser Orifice	
Q = CA(2gH)^0.5	
C	0.8
Riser orifice diameter (in)	36
Area (ft2)	7.1
Dewatering Orifice	
Q = CA(2gH)^0.5	
C	0.4
Dewatering orifice diameter (in)	4
Area (ft2)	0.1

Table 9: East Stormwater Basin Outlet Barrel Calculations

Principal Spillway Outlet Pipe Flow Equations	
Q = A(2gH)^0.5/(1+ke+kb+f(L/D))^0.5	
f = 185*n^2/(D)^(1/3)	
Entrance Loss coefficient (ke)	0.5
Bend Loss coefficient (kb)	0.1
Friction Loss coefficient (f)	0.084576728
z	3
Outlet Pipe length, L (ft)	300
Outlet Pipe diameter, D (ft)	2
Manning's Roughness (n)	0.024

Table 10: East Stormwater Basin Emergency Spillway Calculations

Emergency Spillway Equations		
Q = CLH^1.5		
Weir Coefficient		3.1
Trapezoidal (side slope)		3
Bottom Width of Spillway (ft)		5
Elevation	**H1**	**Q**
2105	0	0
2105.5	0.5	7
2106	1	25
2106.5	1.5	54
2107	2	96
2107.5	2.5	153
2108	3	226

Table 11: East Stormwater Basin Stage Discharge Information

Elevation (ft)	Riser Weir Flow (cfs)	Riser Orifice Flow (cfs)	Dewatering orifice Flow (cfs)	Outlet pipe Flow (cfs)	Principal Spillway Control** (cfs)	Emergency Spillway (cfs)	Combined East Stormwater Basin Discharge (cfs)
2098	0	0	0.0	0	0		0
2098.5	0	0	0.2	6.8	0.2		0.2
2099	0	0	0.3	9.6	0.3		0.3
2099.5	0	0	0.3	11.7	0.3		0.3
2100	0	0	0.4	13.5	0.4		0.4
2100.5	0	0	0.4	15.1	0.4		0.4
2101	0	0	0.5	16.6	0.5		0.5
2101.5	0	0	0.5	17.9	0.5		0.5
2102	0	0	0.6	19.1	0.6		0.6
2102.5	11	32.1	0.6	20.3	11.6		11.6
2103	31	45.4	0.6	21.4	21.4		21.4
2103.5	57	55.6	0.7	22.4	22.4		22.4
2104	88	64.2	0.7	23.4	23.4		23.4
2104.5	123	71.8	0.7	24.4	24.4		24.4
2105	162	78.6	0.7	25.3	25.3	0	25.3
2105.5	204	84.9	0.8	26.2	26.2	7	33.3
2106	249	90.8	0.8	27.1	27.1	25	51.9
2106.5	297	96.3	0.8	27.9	27.9	54	82
2107	348	101.5	0.8	28.7	28.7	96	125.1
2107.5	401	106.4	0.9	29.5	29.5	153	182.7
2108	457	111.2	0.9	30.2	30.2	226	255.8

*Top Principal Spillway Riser = 2102'; Invert Emergency Spillway = 2105'

**Principal Spillway Control Flow includes flow from the dewatering orifice.

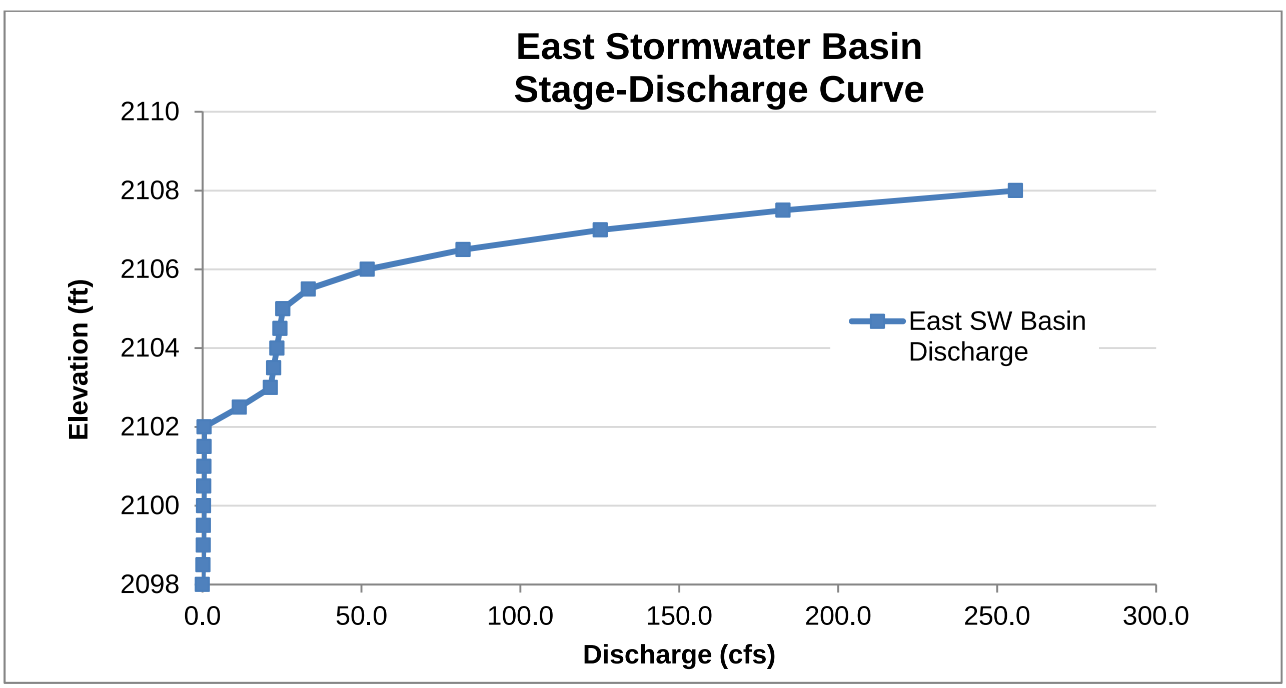

Figure 5: East Stormwater Basin Stage Discharge Curve

West Stormwater Basin

The principal spillway for the West Stormwater Basin is a riser barrel type spillway. The riser pipe is 3 feet in diameter and has a height of 4 feet from the bottom of the pond. The top of the riser is open and serves as the principal spillway for the basin. The basin is dewatered by a 4-in diameter orifice located at the bottom of the riser. The horizontal barrel section of the principal is spillway is a corrugated metal pipe 2 feet in diameter. The emergency spillway for the West Stormwater Basin is a trapezoidal channel with a 5' bottom width and 3H:1V side slopes. The spillway is set 8 feet off the bottom of the pond. The stage storage information for the West Stormwater Basin is provided in **Table 12** and **Figure 6**. **Table 13 – 16 and Figure 7** provide the spillway discharge information for the West Stormwater Basin.

Table 12: West Stormwater Basin Stage Storage

Stage (ft)	Surface Area (ft2)	Surface Area (ac)	Incremental Storage Volume(ac-ft)	Cumulative Storage Volume (ac-ft)
2097	0	0.000	0.000	0.000
2098	1773	0.041	0.020	0.020
2099	5229	0.120	0.080	0.101
2100	9396	0.216	0.168	0.269
2101	13330	0.306	0.261	0.529
2102	14691	0.337	0.322	0.851
2103	16068	0.369	0.353	1.204
2104	17469	0.401	0.385	1.589
2105	18897	0.434	0.417	2.007
2106	20352	0.467	0.451	2.457
2107	21992	0.505	0.486	2.943
2108	23631	0.542	0.524	3.467

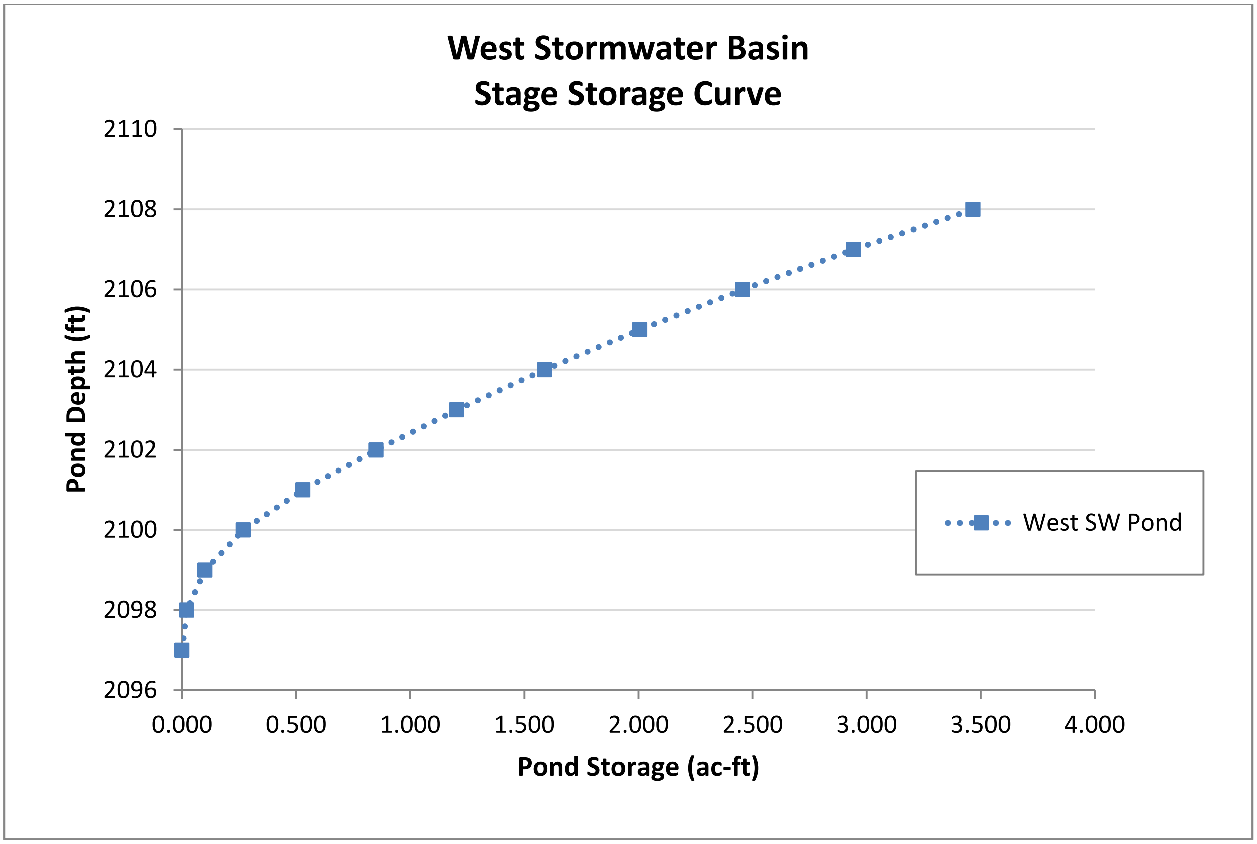

Figure 6: West Stormwater Basin Stage Storage

Table 13: West Stormwater Basin Outlet Riser Calculations

Principal Spillway Riser Equations	
Riser Weir	
Q = CLH^1.5	
C	3.3
Crest length (ft)	9.4
Riser Orifice	
Q = CA(2gH)^0.5	
C	0.8
Riser orifice diameter (in)	36
Area (ft2)	7.1
Dewatering Orifice	
Q = CA(2gH)^0.5	
C	0.4
Dewatering orifice diameter (in)	4
Area (ft2)	0.1

Table 14: West Stormwater Basin Outlet Barrel Calculations

Principal Spillway Outlet Pipe Flow Equations	
Q = A(2gH)^0.5/(1+ke+kb+f(L/D))^0.5	
f = 185*n^2/(D)^(1/3)	
Entrance Loss coefficient (ke)	0.5
Bend Loss coefficient (kb)	0.1
Friction Loss coefficient (f)	0.084576728
z	3
Outlet Pipe length, L (ft)	300
Outlet Pipe diameter, D (ft)	2
Manning's Roughness (n)	0.024

Table 15: West Stormwater Basin Emergency Calculations

Emergency Spillway		
Q = CLH^1.5		
Weir Coefficient		3.1
Trapezoidal (side slope)		3
Bottom Width of Spillway (ft)		5
Elevation	**H1**	**Q**
2105	0	0
2105.5	0.5	7
2106	1	25
2106.5	1.5	54
2107	2	96
2107.5	2.5	153
2108	3	226

Table 16: West Stormwater Basin Stage Discharge Information

Elevation (ft)	Riser Weir Flow (cfs)	Riser Orifice Flow (cfs)	Dewatering orifice Flow (cfs)	Outlet pipe Flow (cfs)	Principal Spillway Control** (cfs)	Emergency Spillway (cfs)	Combined East Stormwater Basin Discharge (cfs)
2097	0	0.0	0.00	0.0	0.0		0.0
2097.5	0	0.0	0.20	6.8	0.2		0.2
2098	0	0.0	0.28	9.6	0.3		0.3
2098.5	0	0.0	0.34	11.7	0.3		0.3
2099	0	0.0	0.40	13.5	0.4		0.4
2099.5	0	0.0	0.44	15.1	0.4		0.4
2100	0	0.0	0.49	16.6	0.5		0.5
2100.5	0	0.0	0.52	17.9	0.5		0.5
2101	0	0.0	0.56	19.1	0.6		0.6
2101.5	11	32.1	0.59	20.3	11.6		11.6
2102	31	45.4	0.63	21.4	21.4		21.4
2102.5	57	55.6	0.66	22.4	22.4		22.4
2103	88	64.2	0.69	23.4	23.4		23.4
2103.5	123	71.8	0.71	24.4	24.4		24.4
2104	162	78.6	0.74	25.3	25.3		25.3
2104.5	204	84.9	0.77	26.2	26.2		26.2
2105	249	90.8	0.79	27.1	27.1	0	27.1
2105.5	297	96.3	0.82	27.9	27.9	7	35.0
2106	348	101.5	0.84	28.7	28.7	25	53.5
2106.5	401	106.4	0.86	29.5	29.5	54	83.6
2107	457	111.2	0.89	30.2	30.2	96	126.7

*Top Principal Spillway Riser = 2101'; Invert Emergency Spillway = 2105'

**Principal Spillway Control Flow includes flow from the dewatering orifice.

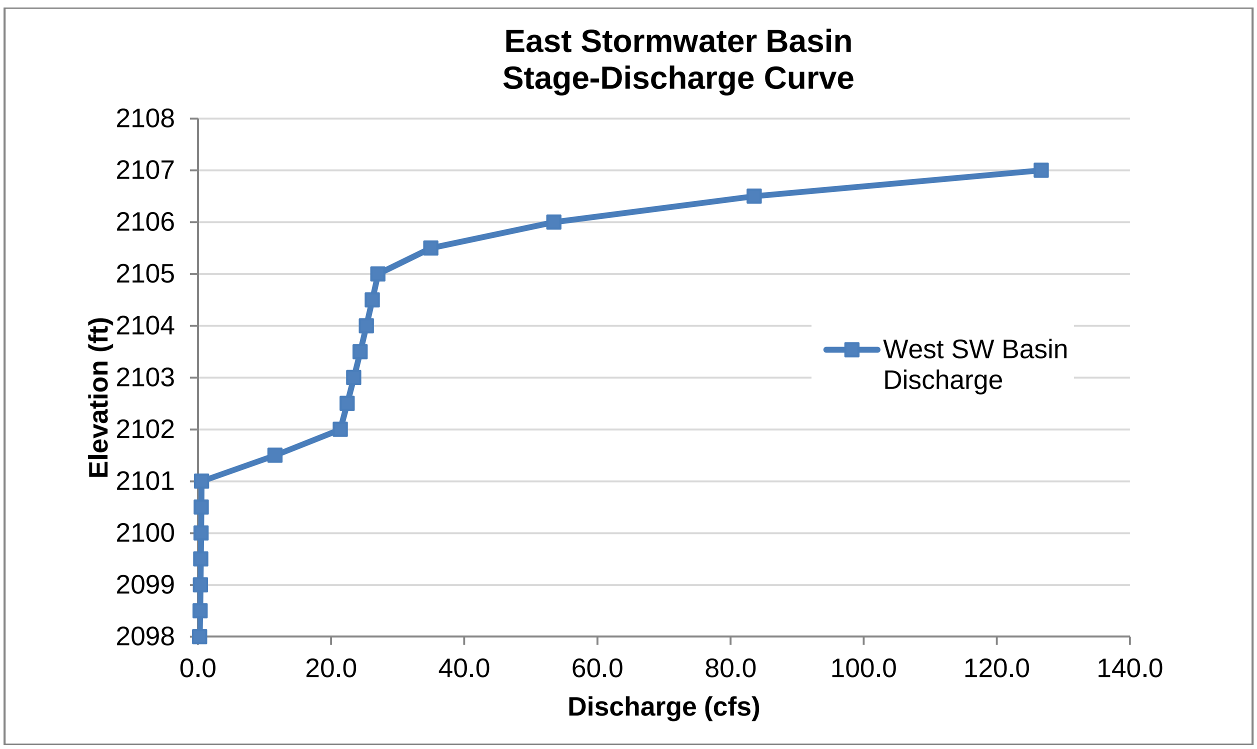

Figure 7: West Stormwater Basin Stage Discharge Curve

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4.0 Outlet Hydrograph

The USACE HMS hydrology model was used to model the storage routing within the East and West Stormwater Basins. **Figure 8** shows the inflow and outflow hydrographs for the East Stormwater Basin. **Figure 9** shows the inflow and outflow hydrographs for the West Stormwater Basin. **Figure 10** shows the outflow hydrograph at the outfall of the project site. The peak flow from the project site for post-construction conditions is 12.1 cfs.

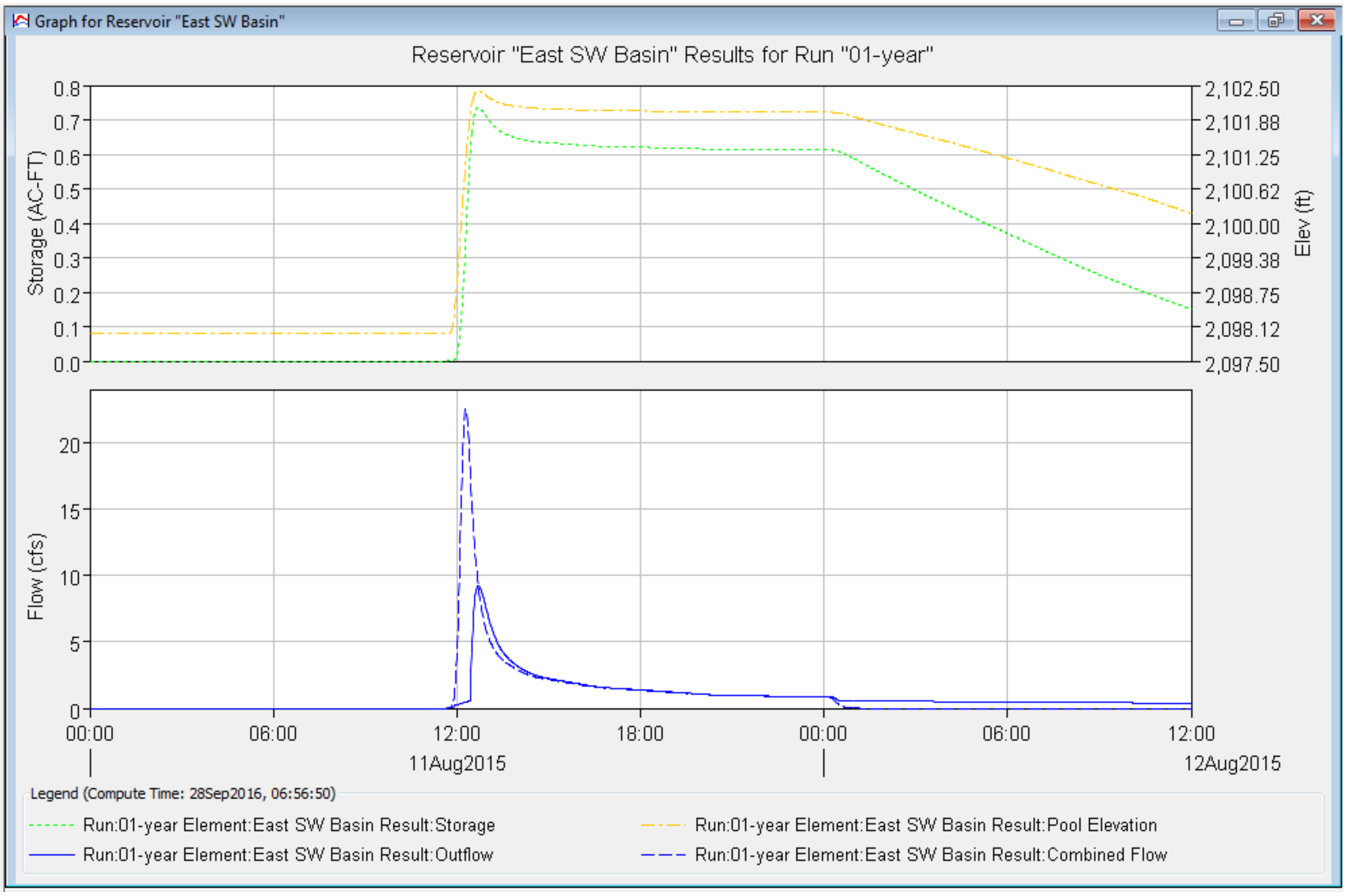


Figure 8: East Stormwater Basin Discharge Hydrograph

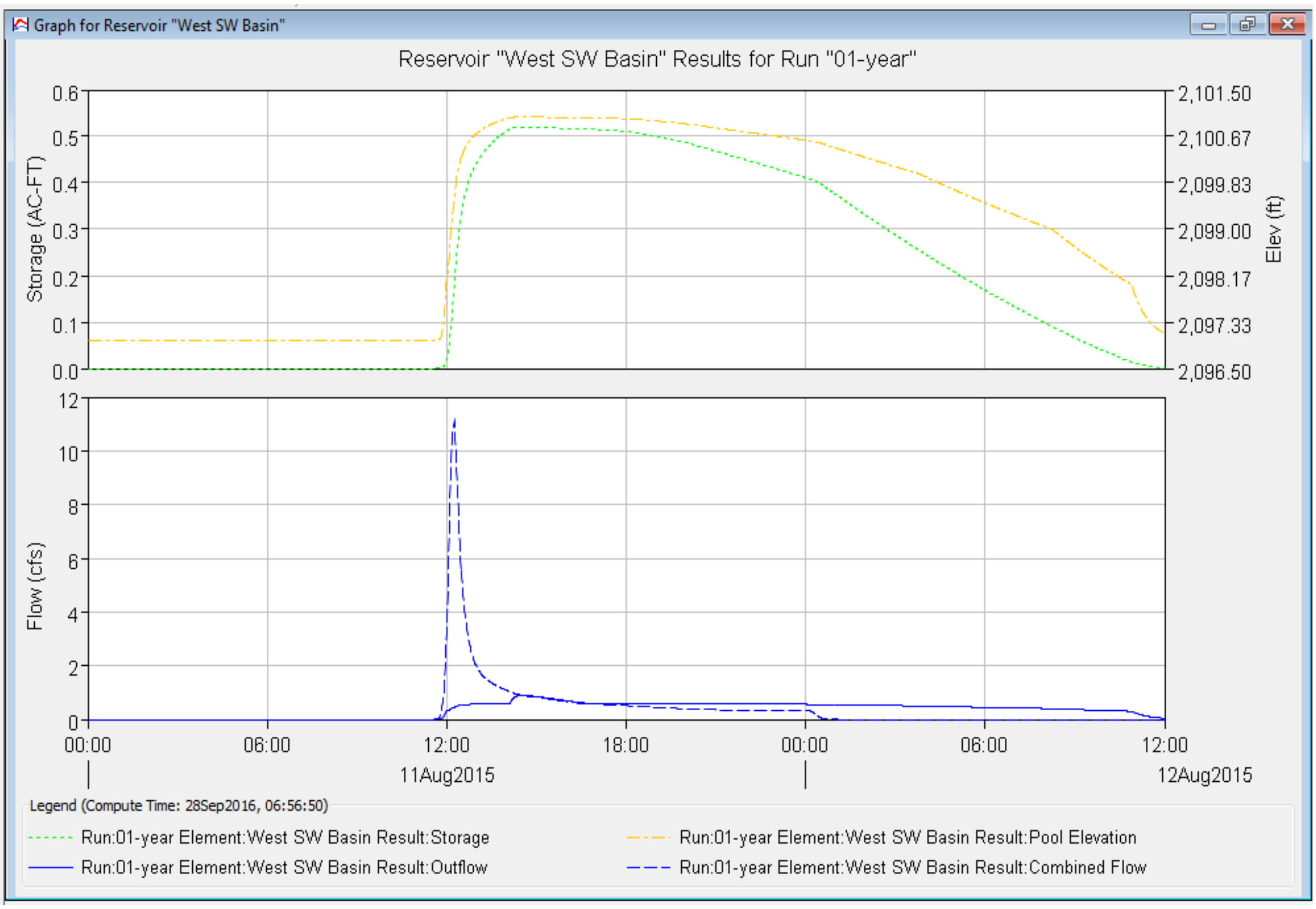


Figure 9: West Stormwater Basin Discharge Hydrograph

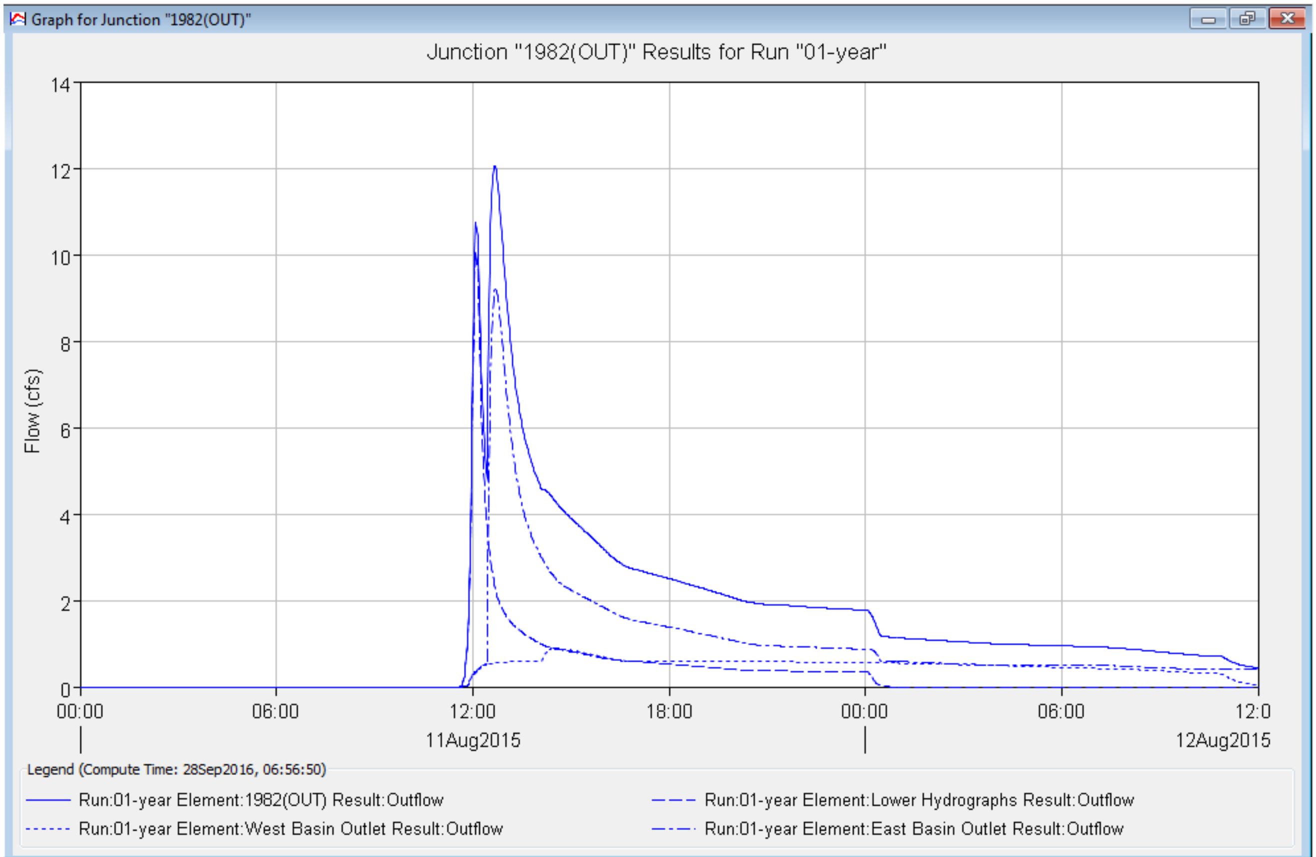


Figure 10: Project Outfall Hydrograph

5.0 Culverts

This section was developed by individuals from Burns & McDonnell in conjunction with Amec Foster Wheeler. Burns & McDonnell is the sole responsible party for information provided in this section.

Two proposed culverts will be placed within the site to convey drainage across the main site pad, as well as under the proposed access road. These culverts will be maintained by Duke Energy. The first culvert is a 48" HDPE pipe located under the aggregate road between the main site pad at elevation 2138' and the portion of the site at elevation 2150'. The second culvert is a 60" HDPE pipe located under the proposed asphalt access road and affiliated turnaround area.

Table 14: Post-Construction 1982 Basin with New Plant Grading - Culvert Calculation Summary

1982 Basin - Plant Grading Culvert Summary									
Pipe ID	Area (Ac)	Q100 (cfs)	Inlet HW (ft)	Slope (ft/ft)	Pipe Type	Critical Depth (ft)	Outlet Velocity (ft/s)	Flow Depth (ft)	Outlet Type
48"	12.9	28.38	2.4	0.005	HDPE	1.58	8.37	1.26	Class 1
60"	47.1	103.62	4.5	0.0075	HDPE	2.90	13.64	2.05	Class 2

Attachment 3b
Pre-1982 Dam
Runoff Calculations

Project Description

File Name Pre-1982dam.SPF

Project Options

Flow Units .... CFS
Elevation Type .... Elevation
Hydrology Method .... SCS TR-55
Time of Concentration (TOC) Method .... SCS TR-55
Link Routing Method .... Hydrodynamic
Enable Overflow Ponding at Nodes .... YES
Skip Steady State Analysis Time Periods .... NO

Analysis Options

Start Analysis On	Sep 27, 2016	00:00:00
End Analysis On	Sep 29, 2016	00:00:00
Start Reporting On	Sep 27, 2016	00:00:00
Antecedent Dry Days	0	days
Runoff (Dry Weather) Time Step	0 01:00:00	days hh:mm:ss
Runoff (Wet Weather) Time Step	0 00:05:00	days hh:mm:ss
Reporting Time Step	0 00:01:00	days hh:mm:ss
Routing Time Step	1	seconds

Number of Elements

	Qty
Rain Gages	1
Subbasins..	1
Nodes...	1
Junctions	0
Outfalls	1
Flow Diversions	0
Inlets	0
Storage Nodes	0
Links..	0
Channels	0
Pipes	0
Pumps	0
Orifices	0
Weirs	0
Outlets	0
Pollutants	0
Land Uses	0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
1	01-year	Time Series	01-year, 24-hour	Cumulative	inches					User Defined

Subbasin Summary

SN	Subbasin ID	Area (ac)	Weighted Curve Number	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	Pre-1982dam	119.10	67.66	2.50	0.38	44.90	30.40	0 00:25:24

Node Summary

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft^2)	Peak Inflow (cfs)	Max HGL Elevation Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	Pre-outfall	Outfall	2043.50					0.00	0.00					

Subbasin Hydrology

Subbasin : Pre-1982dam

Input Data

Area (ac) 119.10
Weighted Curve Number 67.66
Rain Gage ID 01-year

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Urban industrial, 72% imp	8.80	C	91.00
1/2 acre lots, 25% impervious	5.40	B	70.00
Pasture, grassland, or range, Fair	56.00	B	69.00
Woods & grass combination, Fair	16.30	B	65.00
Woods, Fair	32.60	B	60.00
Composite Area & Weighted CN	119.10		67.66

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

$Tc = (0.007 * ((n * Lf)^{0.8})) / ((P^{0.5}) * (Sf^{0.4}))$

Where :

Tc = Time of Concentration (hr)
n = Manning's roughness
Lf = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (Sf^0.5) (unpaved surface)
V = 20.3282 * (Sf^0.5) (paved surface)
V = 15.0 * (Sf^0.5) (grassed waterway surface)
V = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
V = 9.0 * (Sf^0.5) (cultivated straight rows surface)
V = 7.0 * (Sf^0.5) (short grass pasture surface)
V = 5.0 * (Sf^0.5) (woodland surface)
V = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
R = Aq / Wp
Tc = (Lf / V) / (3600 sec/hr)

Where :

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
R = Hydraulic Radius (ft)
Aq = Flow Area (ft²)
Wp = Wetted Perimeter (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)
n = Manning's roughness

I/A

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.4	0.00	0.00
Flow Length (ft) :	100	0.00	0.00
Slope (%) :	5.3	0.00	0.00
2 yr, 24 hr Rainfall (in) :	3	0.00	0.00
Velocity (ft/sec) :	0.11	0.00	0.00
Computed Flow Time (min) :	15.02	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	1200	0.00	0.00
Slope (%) :	5.3	0.00	0.00
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	3.71	0.00	0.00
Computed Flow Time (min) :	5.39	0.00	0.00

Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.045	0.00	0.00
Flow Length (ft) :	1922	0.00	0.00
Channel Slope (%) :	5.3	0.00	0.00
Cross Section Area (ft²) :	7.506	0.00	0.00
Wetted Perimeter (ft) :	9.721	0.00	0.00
Velocity (ft/sec) :	6.42	0.00	0.00
Computed Flow Time (min) :	4.99	0.00	0.00

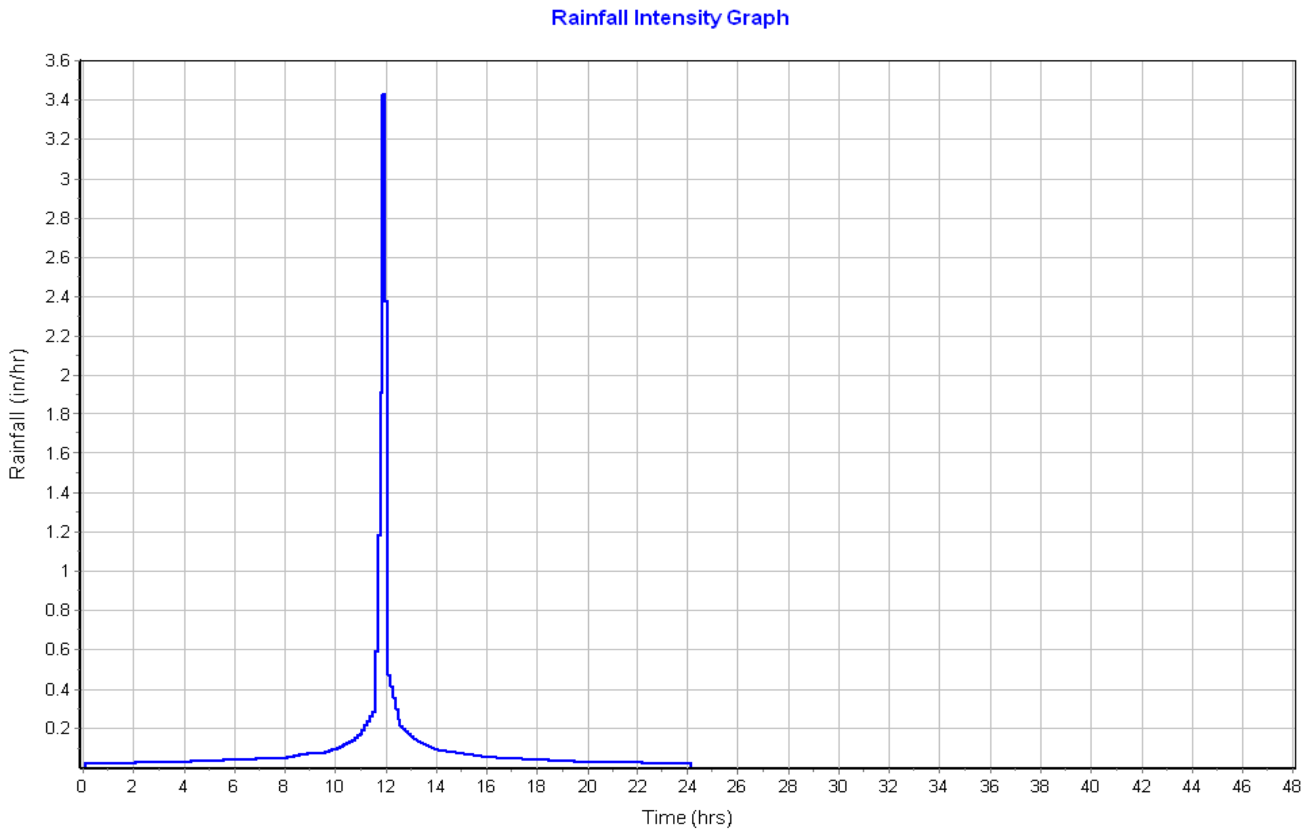
Total TOC (min) 25.40

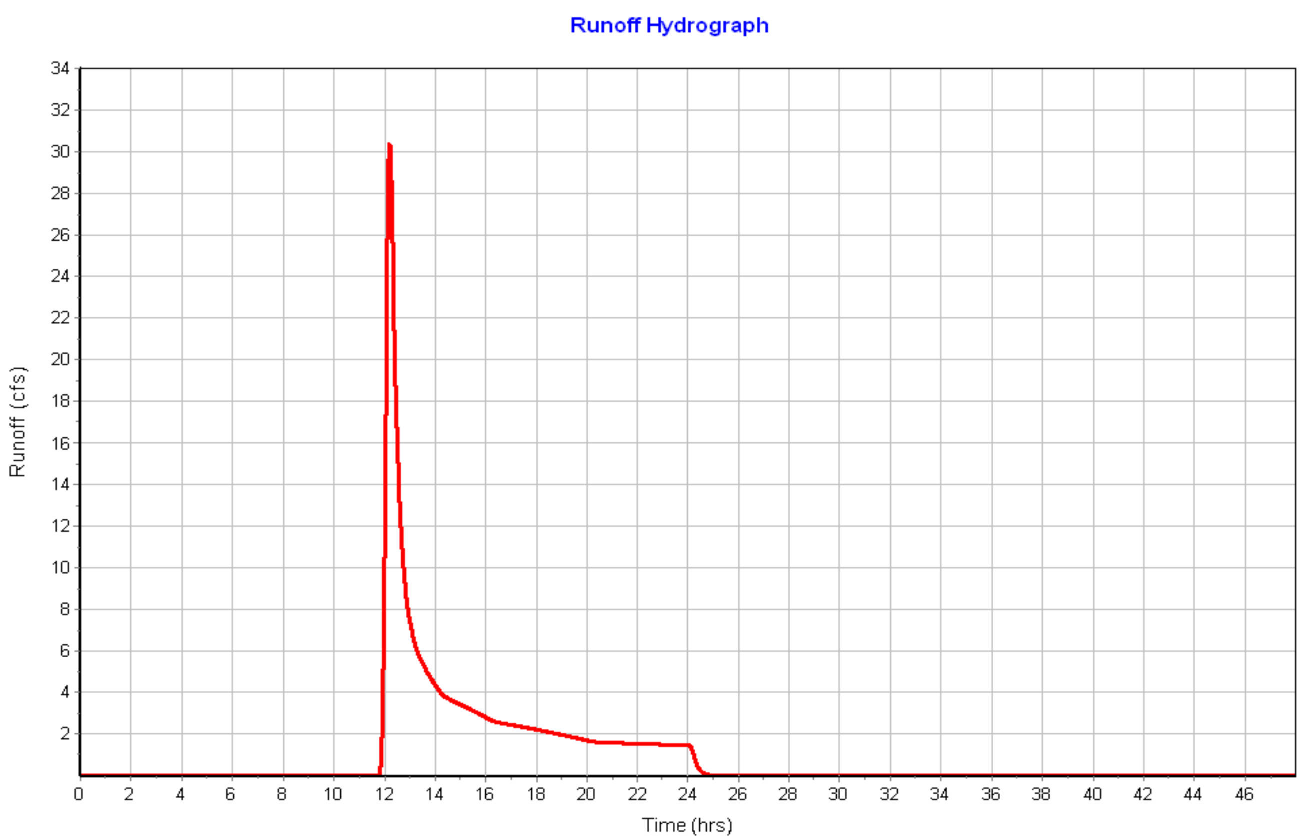
Subbasin Runoff Results

Total Rainfall (in) 2.50
Total Runoff (in) 0.38
Peak Runoff (cfs) 30.40
Weighted Curve Number 67.66
Time of Concentration (days hh:mm:ss) 0 00:25:24

I/A

Subbasin : Pre-1982dam





Attachment 3c
Post-1982 Dam
Runoff Calculations

I/A

Project Description

File Name Post-1982dam.SPF

Project Options

Flow Units .... CFS
Elevation Type .... Elevation
Hydrology Method .... SCS TR-55
Time of Concentration (TOC) Method .... SCS TR-55
Link Routing Method .... Hydrodynamic
Enable Overflow Ponding at Nodes .... YES
Skip Steady State Analysis Time Periods .... NO

Analysis Options

Start Analysis On	Sep 27, 2016	00:00:00
End Analysis On	Sep 29, 2016	00:00:00
Start Reporting On	Sep 27, 2016	00:00:00
Antecedent Dry Days	0	days
Runoff (Dry Weather) Time Step	0 01:00:00	days hh:mm:ss
Runoff (Wet Weather) Time Step	0 00:05:00	days hh:mm:ss
Reporting Time Step	0 00:05:00	days hh:mm:ss
Routing Time Step	1	seconds

Number of Elements

	Qty
Rain Gages	1
Subbasins..	6
Nodes..	4
Junctions	3
Outfalls	1
Flow Diversions	0
Inlets	0
Storage Nodes	0
Links...	0
Channels	0
Pipes	0
Pumps	0
Orifices	0
Weirs	0
Outlets	0
Pollutants	0
Land Uses	0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
1	01-year	Time Series	01-year, 24-hour	Cumulative	inches				0.00	

I/A

Subbasin Summary

SN	Subbasin ID	Area (ac)	Weighted Curve Number	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	East_1	31.30	70.15	2.50	0.46	14.43	10.64	0 00:26:24
2	East_2	29.10	72.61	2.50	0.55	16.06	12.32	0 00:28:06
3	East_lower	5.90	74.00	2.50	0.61	3.59	4.52	0 00:11:10
4	Lower	15.51	65.00	2.50	0.30	4.61	3.13	0 00:19:43
5	West	20.40	74.00	2.50	0.61	12.40	11.24	0 00:22:48
6	West_lower	5.40	74.00	2.50	0.61	3.28	4.48	0 00:07:06

Node Summary

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft²)	Peak Inflow (cfs)	Max HGL Elevation Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
4	I26	Outfall	2043.50	2108.00	0.00	0.00	0.00	0.00	0.00					
2	Lower_out	Junction	2043.50	2052.60	0.00	0.00	0.00							
3	West_SWb	Junction	2097.00	2108.00	0.00	0.00	0.00							

Subbasin Hydrology

Subbasin : East_1

Input Data

Area (ac) 31.30
Weighted Curve Number 70.15
Rain Gage ID 01-year

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
> 75% grass cover, Good	11.20	C	74.00
Woods & grass combination, Fair	20.10	B	68.00
Composite Area & Weighted CN	31.30		70.15

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

Where :

Tc = Time of Concentration (hr)
n = Manning's roughness
Lf = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (Sf^0.5) (unpaved surface)
V = 20.3282 * (Sf^0.5) (paved surface)
V = 15.0 * (Sf^0.5) (grassed waterway surface)
V = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
V = 9.0 * (Sf^0.5) (cultivated straight rows surface)
V = 7.0 * (Sf^0.5) (short grass pasture surface)
V = 5.0 * (Sf^0.5) (woodland surface)
V = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
R = Aq / Wp
Tc = (Lf / V) / (3600 sec/hr)

Where :

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
R = Hydraulic Radius (ft)
Aq = Flow Area (ft^2)
Wp = Wetted Perimeter (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)
n = Manning's roughness

I/A

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.4	0.00	0.00
Flow Length (ft) :	100	0.00	0.00
Slope (%) :	7	0.00	0.00
2 yr, 24 hr Rainfall (in) :	3	0.00	0.00
Velocity (ft/sec) :	0.12	0.00	0.00
Computed Flow Time (min) :	13.44	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	1588	548	0.00
Slope (%) :	7	0.7	0.00
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	4.27	1.35	0.00
Computed Flow Time (min) :	6.20	6.77	0.00

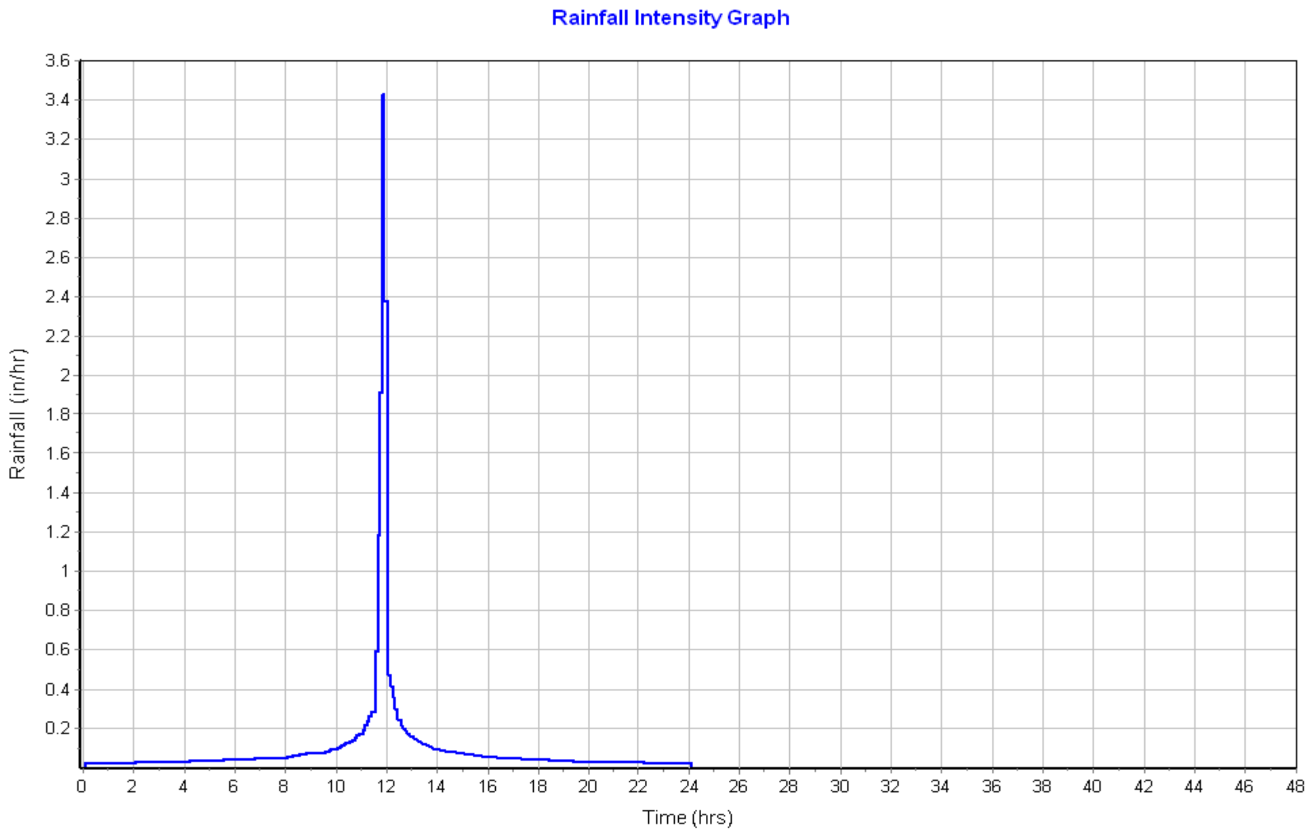
Total TOC (min) 26.40

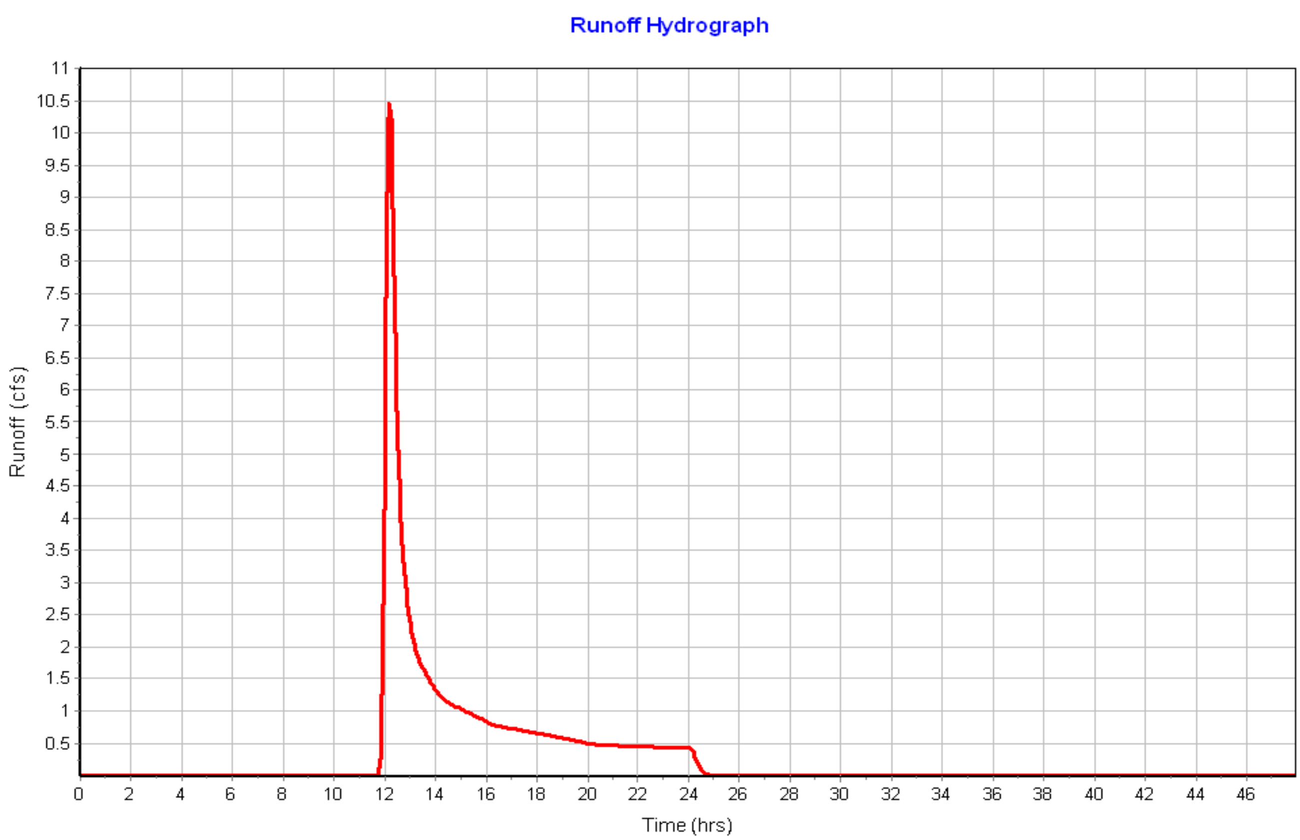
Subbasin Runoff Results

Total Rainfall (in) 2.50
Total Runoff (in) 0.46
Peak Runoff (cfs) 10.64
Weighted Curve Number 70.15
Time of Concentration (days hh:mm:ss) 0 00:26:24

I/A

Subbasin : East_1





Subbasin : East_2

Input Data

Area (ac) 29.10
Weighted Curve Number 72.61
Rain Gage ID 01-year

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
> 75% grass cover, Good	19.00	C	74.00
Woods & grass combination, Fair	10.10	B	70.00
Composite Area & Weighted CN	29.10		72.61

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.40	0.00	0.00
Flow Length (ft) :	100	0.00	0.00
Slope (%) :	7.2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	3	0.00	0.00
Velocity (ft/sec) :	0.13	0.00	0.00
Computed Flow Time (min) :	13.29	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	1018	1158	0.00
Slope (%) :	7.2	1.2	0.00
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	4.33	1.77	0.00
Computed Flow Time (min) :	3.92	10.90	0.00

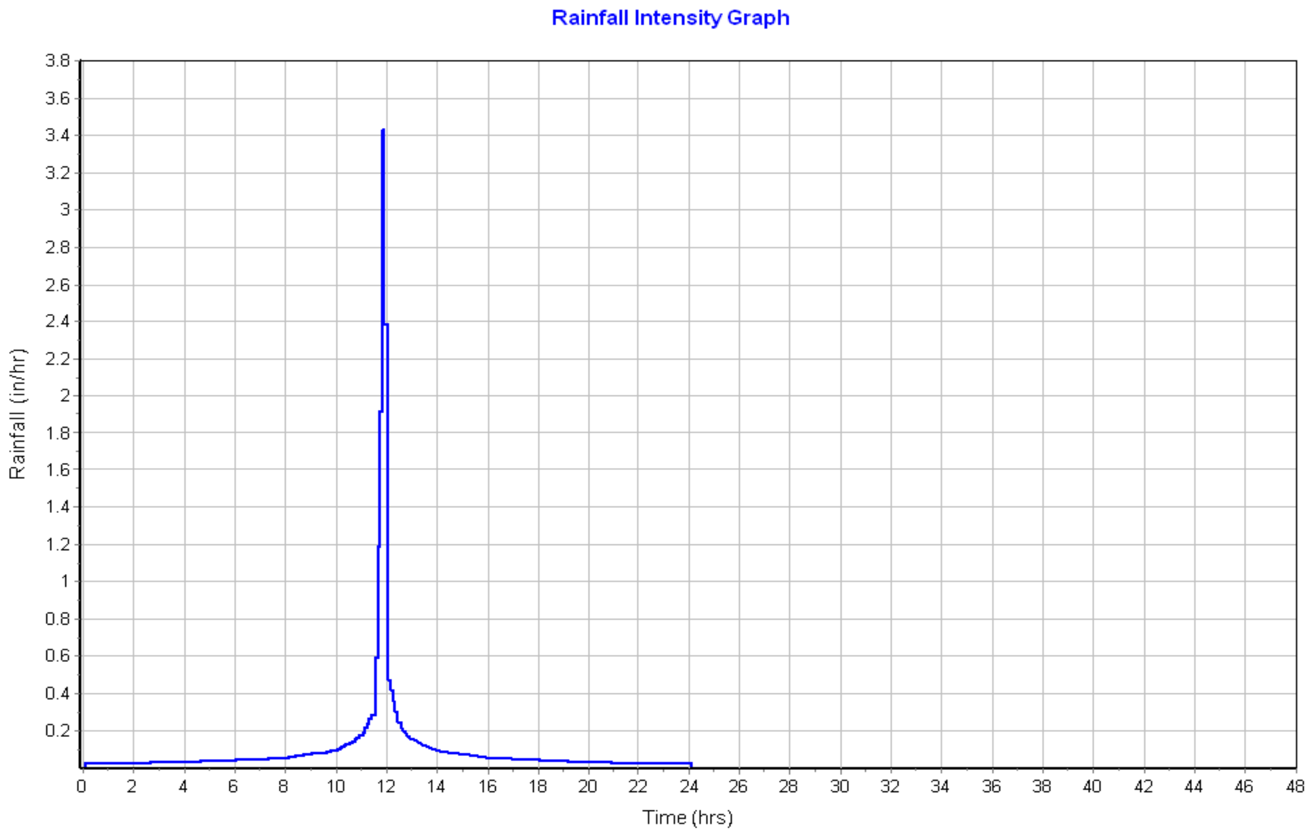
Total TOC (min) 28.11

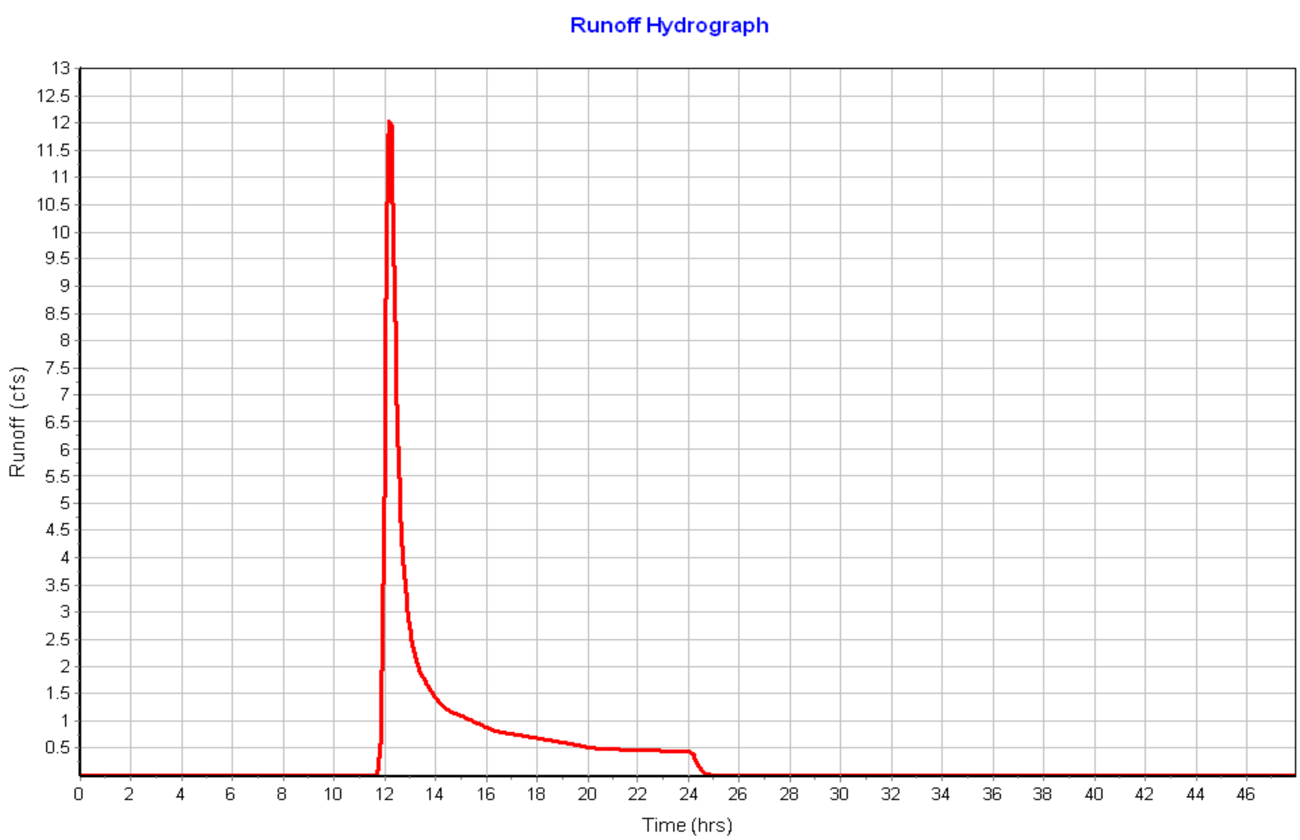
Subbasin Runoff Results

Total Rainfall (in) 2.50
Total Runoff (in) 0.55
Peak Runoff (cfs) 12.32
Weighted Curve Number 72.61
Time of Concentration (days hh:mm:ss) 0 00:28:07

I/A

Subbasin : East_2





Subbasin : East_lower

Input Data

Area (ac) 5.90
Weighted Curve Number 74.00
Rain Gage ID 01-year

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
> 75% grass cover, Good	5.90	C	74.00
Composite Area & Weighted CN	5.90		74.00

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.4	0.00	0.00
Flow Length (ft) :	100	0.00	0.00
Slope (%) :	14.7	0.00	0.00
2 yr, 24 hr Rainfall (in) :	3	0.00	0.00
Velocity (ft/sec) :	0.17	0.00	0.00
Computed Flow Time (min) :	9.99	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	444	0.00	0.00
Slope (%) :	14.7	0.00	0.00
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	6.19	0.00	0.00
Computed Flow Time (min) :	1.20	0.00	0.00

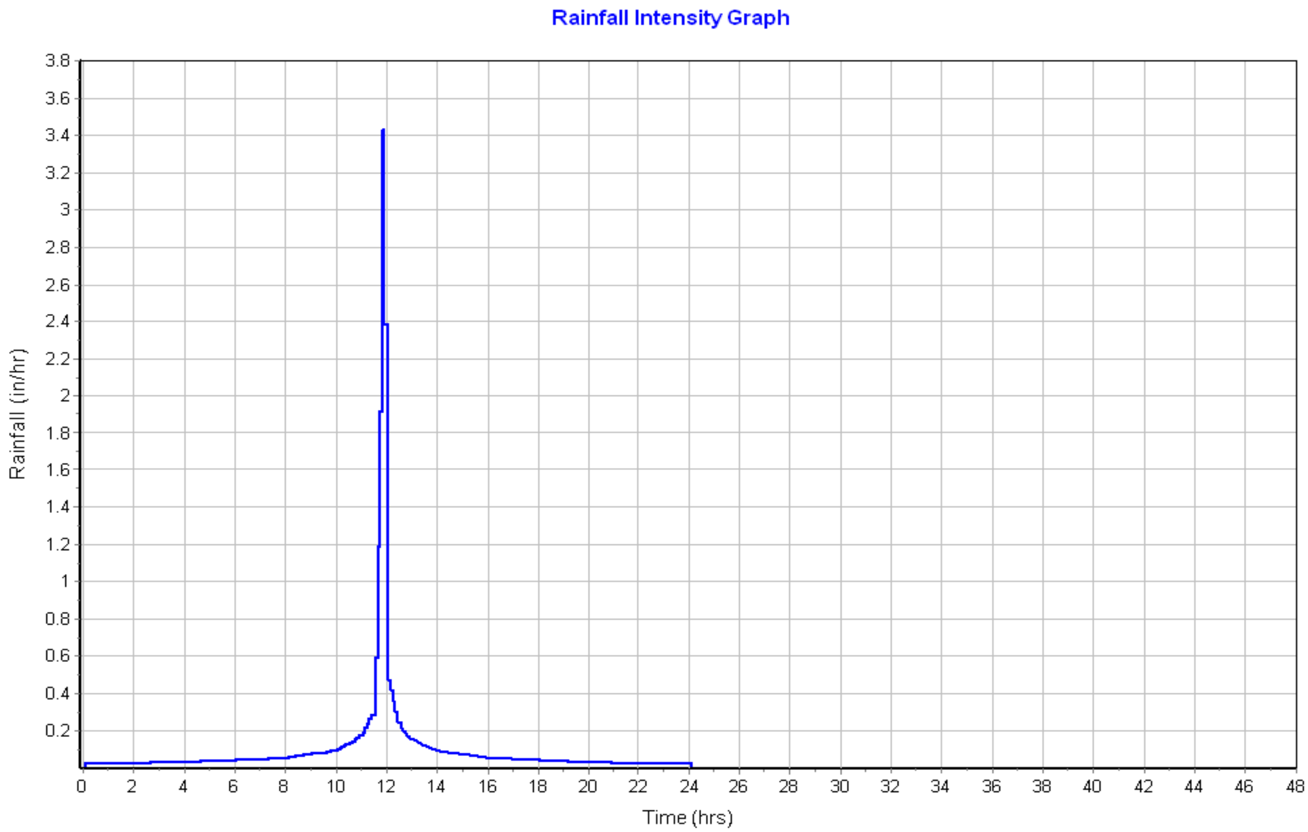
Total TOC (min) 11.18

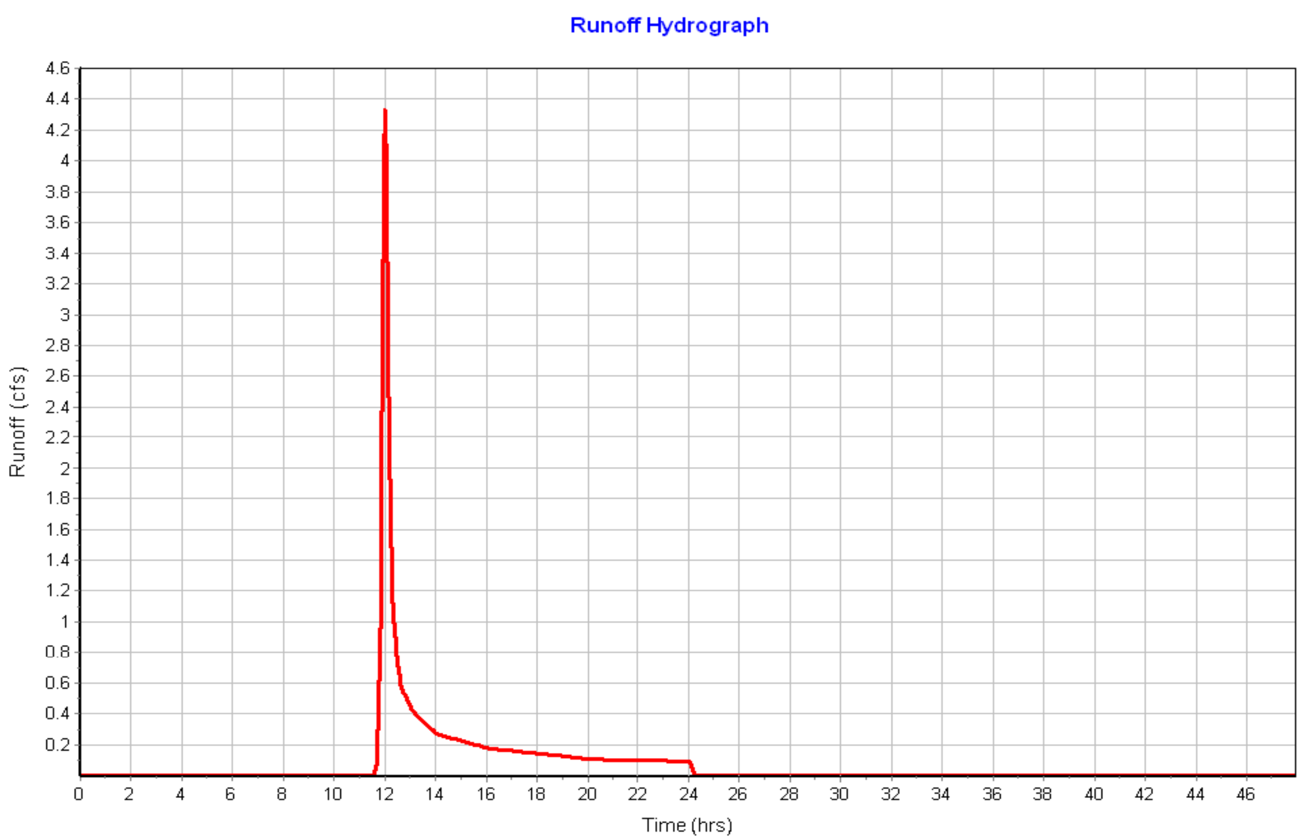
Subbasin Runoff Results

Total Rainfall (in) 2.50
Total Runoff (in) 0.61
Peak Runoff (cfs) 4.52
Weighted Curve Number 74.00
Time of Concentration (days hh:mm:ss) 0 00:11:11

I/A

Subbasin : East_lower





Subbasin : Lower

Input Data

Area (ac) 15.51
Weighted Curve Number 65.00
Rain Gage ID 01-year

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Woods & grass combination, Fair	15.51	B	65.00
Composite Area & Weighted CN	15.51		65.00

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.8	0.00	0.00
Flow Length (ft) :	100	0.00	0.00
Slope (%) :	13.8	0.00	0.00
2 yr, 24 hr Rainfall (in) :	3	0.00	0.00
Velocity (ft/sec) :	0.09	0.00	0.00
Computed Flow Time (min) :	17.83	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	680	0.00	0.00
Slope (%) :	13.8	0.00	0.00
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	5.99	0.00	0.00
Computed Flow Time (min) :	1.89	0.00	0.00

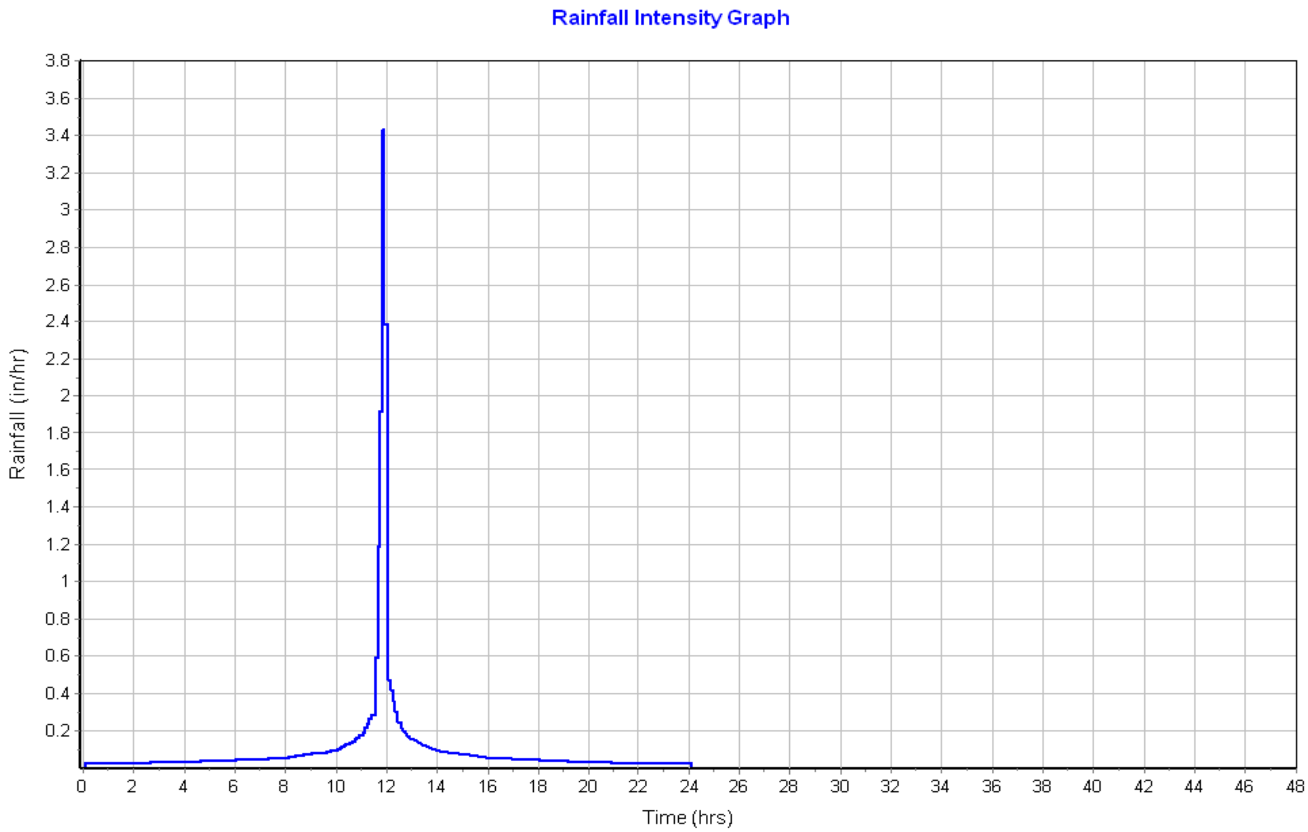
Total TOC (min) 19.72

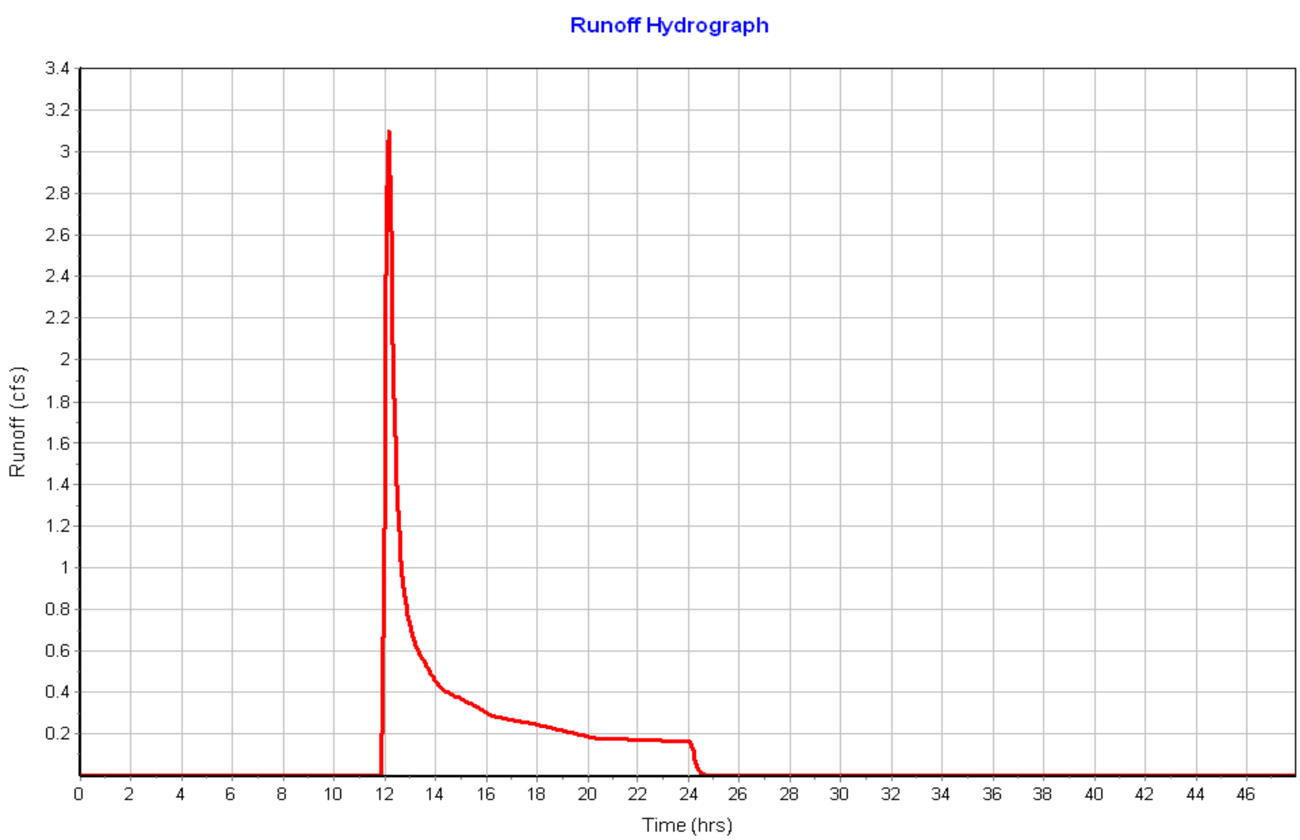
Subbasin Runoff Results

Total Rainfall (in) 2.50
Total Runoff (in) 0.30
Peak Runoff (cfs) 3.13
Weighted Curve Number 65.00
Time of Concentration (days hh:mm:ss) 0 00:19:43

I/A

Subbasin : Lower





Subbasin : West

Input Data

Area (ac) 20.40
Weighted Curve Number 74.00
Rain Gage ID 01-year

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
> 75% grass cover, Good	20.40	C	74.00
Composite Area & Weighted CN	20.40		74.00

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.24	0.00	0.00
Flow Length (ft) :	100	0.00	0.00
Slope (%) :	9.2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	3	0.00	0.00
Velocity (ft/sec) :	0.21	0.00	0.00
Computed Flow Time (min) :	8.00	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	481	1271	0.00
Slope (%) :	9.2	1	0.00
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	4.89	1.61	0.00
Computed Flow Time (min) :	1.64	13.16	0.00

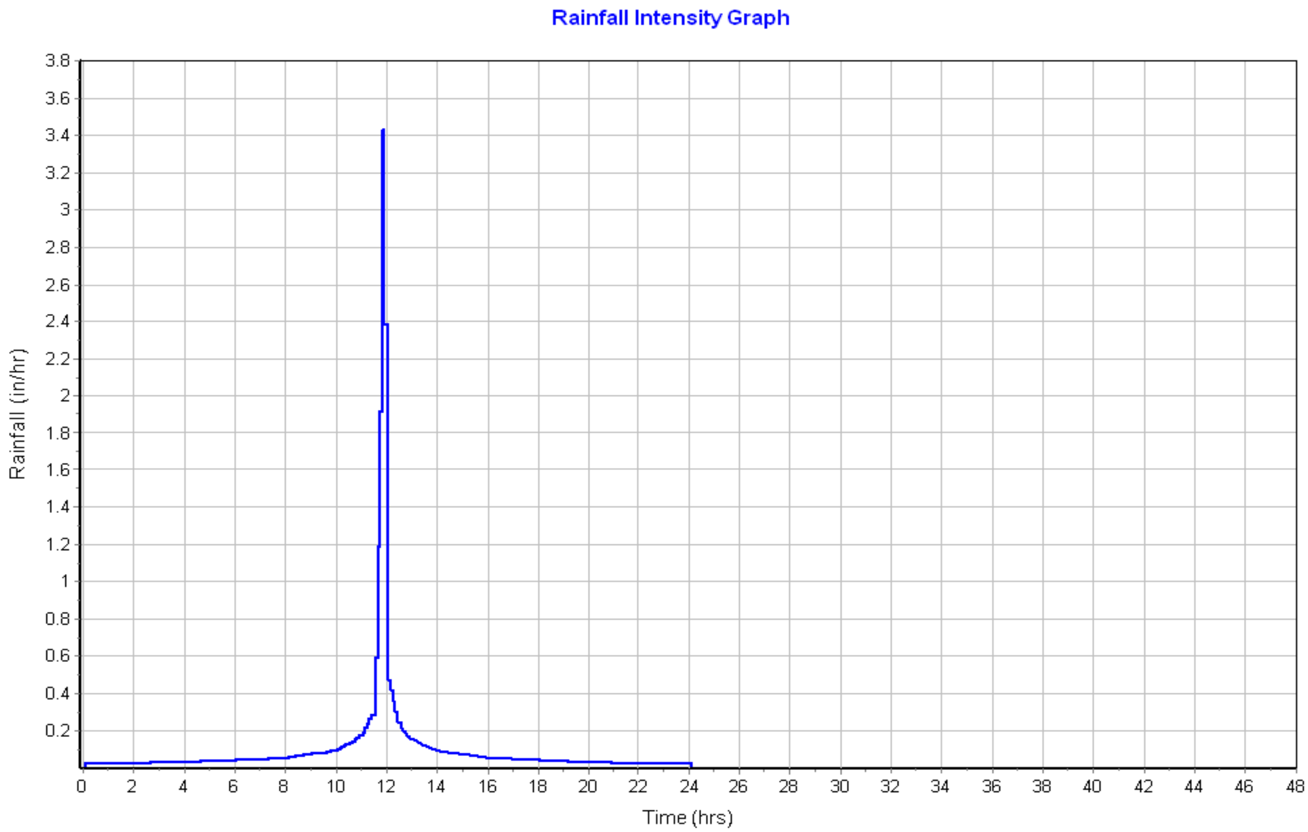
Total TOC (min) 22.80

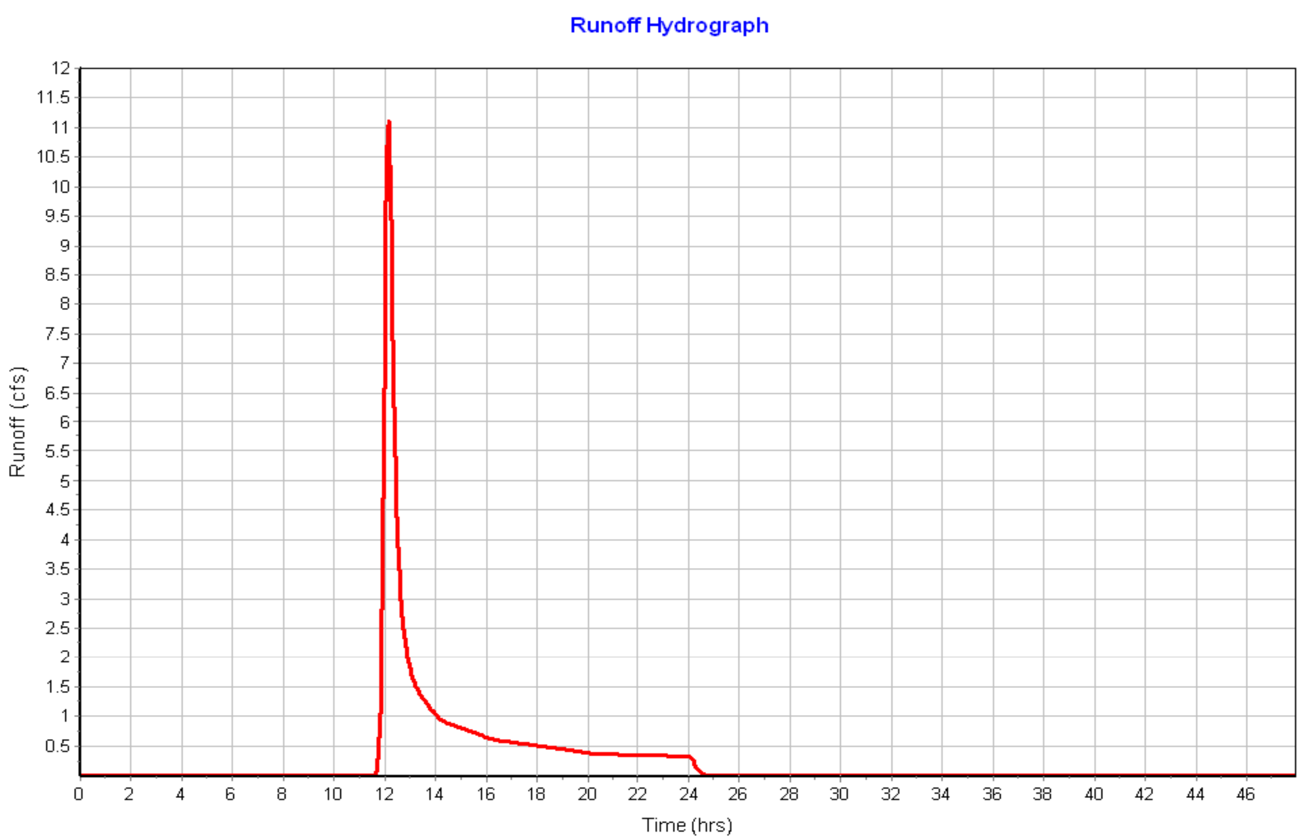
Subbasin Runoff Results

Total Rainfall (in) 2.50
Total Runoff (in) 0.61
Peak Runoff (cfs) 11.24
Weighted Curve Number 74.00
Time of Concentration (days hh:mm:ss) 0 00:22:48

I/A

Subbasin : West





Subbasin : West_lower

Input Data

Area (ac) 5.40
Weighted Curve Number 74.00
Rain Gage ID 01-year

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
> 75% grass cover, Good	5.40	C	74.00
Composite Area & Weighted CN	5.40		74.00

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.24	0.00	0.00
Flow Length (ft) :	100	0.00	0.00
Slope (%) :	15.8	0.00	0.00
2 yr, 24 hr Rainfall (in) :	3	0.00	0.00
Velocity (ft/sec) :	0.26	0.00	0.00
Computed Flow Time (min) :	6.45	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	254	0.00	0.00
Slope (%) :	15.8	0.00	0.00
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	6.41	0.00	0.00
Computed Flow Time (min) :	0.66	0.00	0.00

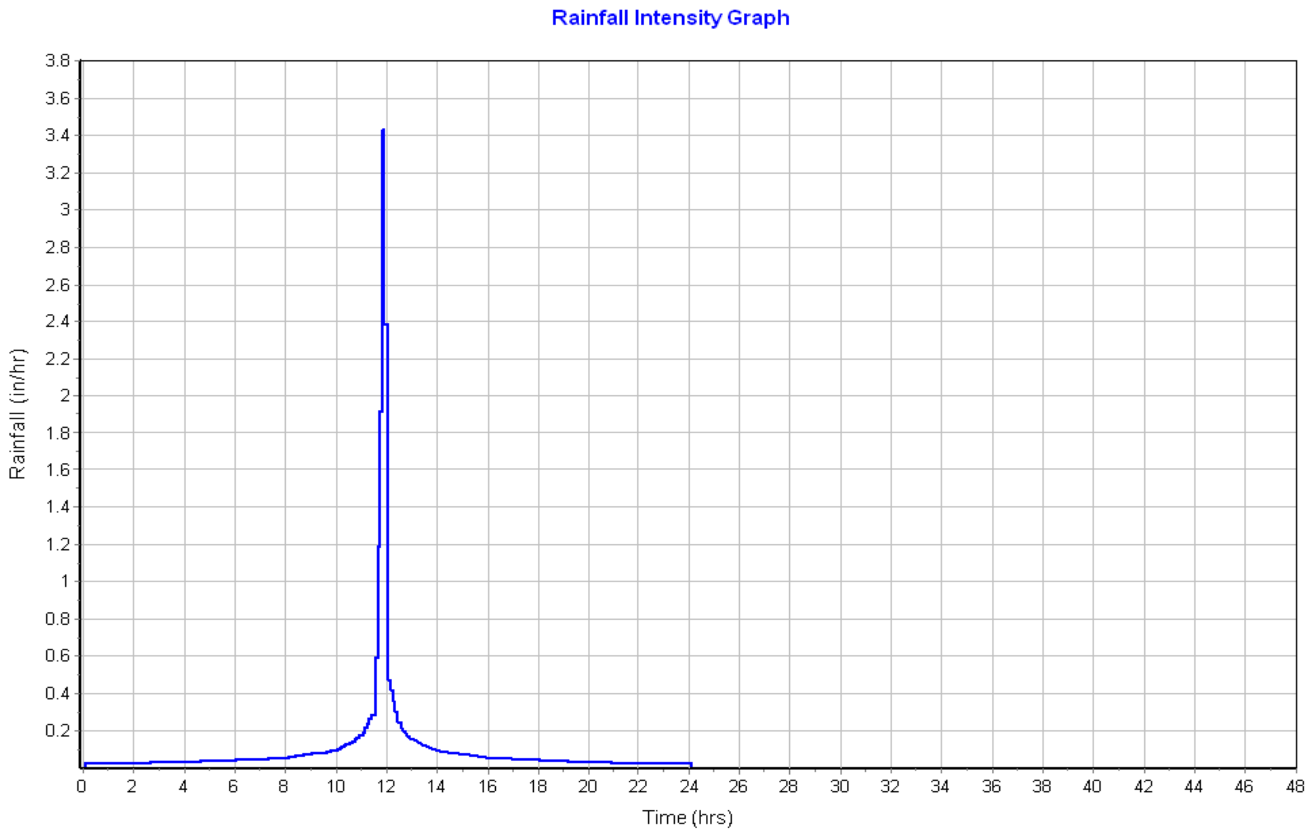
Total TOC (min) 7.11

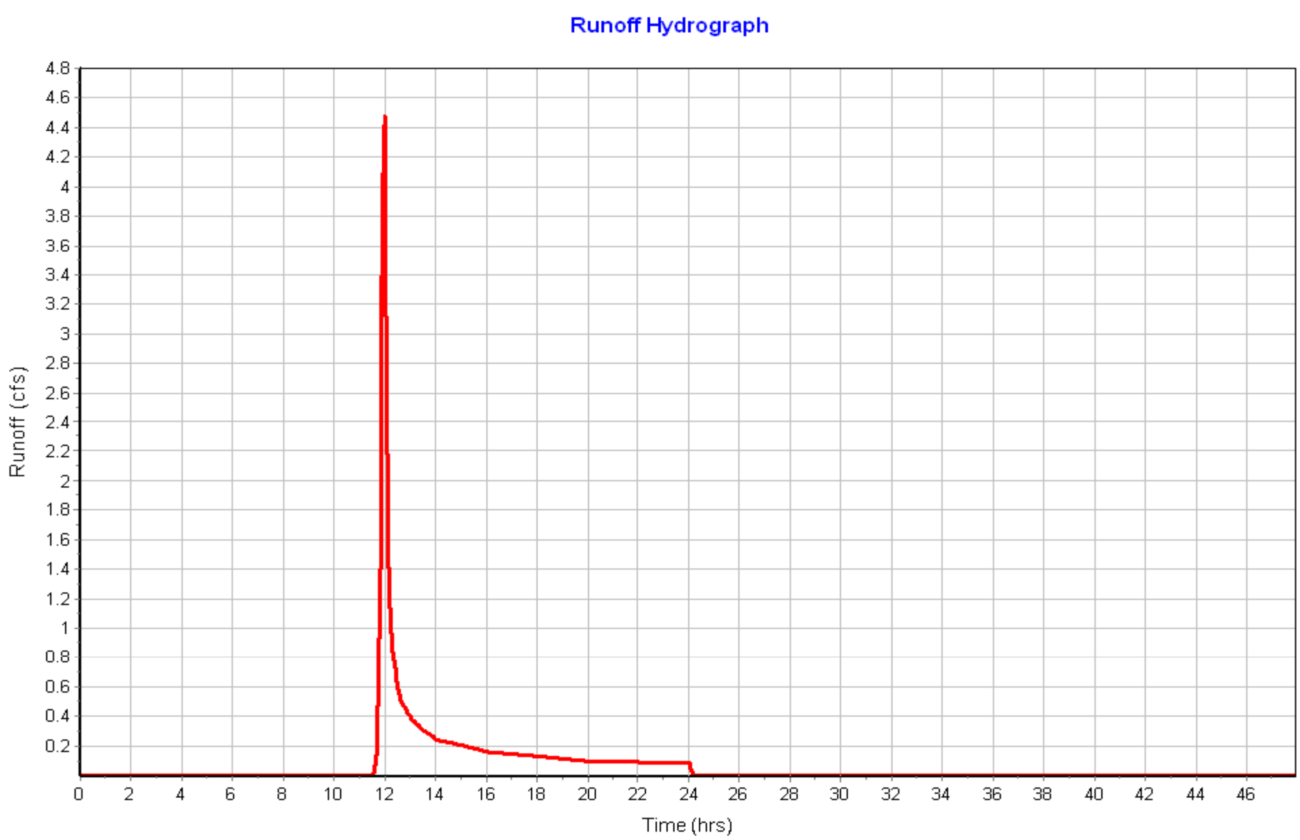
Subbasin Runoff Results

Total Rainfall (in) 2.50
Total Runoff (in) 0.61
Peak Runoff (cfs) 4.48
Weighted Curve Number 74.00
Time of Concentration (days hh:mm:ss) 0 00:07:07

I/A

Subbasin : West_lower





Junction Input

SN	Element ID	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Ground/Rim (Max) Offset (ft)	Initial Water Elevation (ft)	Initial Water Depth (ft)	Surcharge Elevation (ft)	Surcharge Depth (ft)	Ponded Area (ft²)	Minimum Pipe Cover (in)
1	East_SWbasin2	2098.00	2108.00	10.00	0.00	-2098.00	0.00	-2108.00	0.00	0.00
2	Lower_out	2043.50	2052.60	9.10	0.00	-2043.50	0.00	-2052.60	0.00	0.00
3	West_SWbasin	2097.00	2108.00	11.00	0.00	-2097.00	0.00	-2108.00	0.00	0.00

I/A

Junction Results

SN	Element ID	Peak Inflow (cfs)	Peak Lateral Inflow (cfs)	Max HGL Elevation Attained (ft)	Max HGL Depth Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Average HGL Elevation Attained (ft)	Average HGL Depth Attained (ft)	Time of Max HGL Occurrence (days hh:mm)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	East_SWbasin2												
2	Lower_out												
3	West_SWbasin												