

**DEQ Coal Combustion Residuals
Surface Impoundment
Closure Determination**

Marshall Steam Station

April 1, 2019



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Executive Summary

The Coal Ash Management Act (CAMA) establishes criteria for the closure of coal combustion residuals (CCR) surface impoundments. The CCR surface impoundment located at Duke Energy Carolinas, LLC's (Duke Energy) Marshall Steam Station (Marshall) in Catawba County, NC has received a low-risk classification. Therefore, according to N.C. Gen. Stat. § 130A-309.214(a)(3), the closure option for the CCR surface impoundment is at the election of the North Carolina Department of Environmental Quality (DEQ). CAMA provides three principal closure pathways: (a) closure in a manner allowed for a high-risk site, such as excavation and disposal in a lined landfill [CAMA Option A]; (b) closure with a cap-in-place system similar to the requirements for a municipal solid waste landfill [CAMA Option B]; or (c) closure in accordance with the federal CCR rule adopted by EPA [CAMA Option C].

In preparing to make its election, DEQ requested information from Duke Energy related to closure options. By November 15, 2018, Duke Energy provided the following options for consideration: closure in place, full excavation, and a hybrid option that included some excavation with an engineered cap on a smaller footprint of the existing CCR surface impoundment. DEQ held a public information session on January 17, 2019 in Sherrills Ford, NC where the community near Marshall had the opportunity to learn about options for closing coal ash CCR surface impoundments and to express their views about proposed criteria to guide DEQ's coal ash closure decision making process. To evaluate the closure options, the Department considered environmental data gathered as part of the site investigation, permit requirements, ambient monitoring, groundwater modeling provided by Duke Energy and other data relevant to the CAMA requirements.

DEQ elects the provisions of CAMA Option A that require movement of coal ash to an existing or new CCR, industrial or municipal solid waste landfill located on-site or off-site for closure of the Active Ash Basin at the Marshall facility in accord with N.C. Gen. Stat. § 130A-309-214(a)(3). In addition, DEQ is open to considering beneficiation projects where coal ash is used as an ingredient in an industrial process to make a product as an approvable closure option under CAMA Option A.

DEQ elects CAMA Option A because removing the coal ash from the unlined CCR surface impoundment at Marshall is more protective than leaving the material in place. DEQ determines that CAMA Option A is the most appropriate closure method because removing the primary source of groundwater contamination will reduce uncertainty and allow for flexibility in the deployment of future remedial measures.

Duke Energy will be required to submit a final Closure Plan for the CCR surface impoundment at Marshall by August 1, 2019. The Closure Plan must conform to this election by DEQ.

I. Introduction

DEQ has evaluated the closure options submitted by Duke Energy for the CCR surface impoundment at the Marshall Steam Station. This document describes the CAMA requirements for closure of CCR surface impoundments, the DEQ evaluation process to make an election under CAMA for the subject CCR surface impoundment at the Marshall site, and the election by DEQ for the final closure option.

II. Site History

Duke Energy owns and operates the Marshall Steam Station which is located at 8320 NC Highway 150 East in Terrell, Catawba County, North Carolina. Marshall, including the station and supporting facilities, is approximately 1,446 acres in area. Marshall began operation in 1965 as a coal-fired generating station and currently operates four coal-fired units with 2,090 megawatts of total capacity. Coal combustion residuals consisting of bottom and fly ash material from Marshall have historically been managed in the Marshall ash basin, located north of the station adjacent to Lake Norman. Dry ash has been disposed of in other areas at Marshall, including the dry ash landfill units (Phases I and II) and Industrial Landfill No. 1.

There is one CCR surface impoundment at the site, called the Active Ash Basin. According to the Duke Energy website and data current as of September 30, 2018, the Active Ash Basin is approximately 394 acres in size and contains approximately 16,836,000 tons of CCR. The Active Ash Basin is subject to the requirements of N.C. Gen. Stat. § 130A-309.214(a)(3).

III. CAMA Closure Requirements

CAMA establishes closure requirements for CCR surface impoundments. The General Assembly has mandated that DEQ “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.” N.C. Gen. Stat. § 130A-309.214(b). Similarly, the General Assembly has required that DEQ “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 other complies with the requirements of this Part.” N.C. Gen. Stat. § 130A-309.214(c).

CAMA requires DEQ to review any proposed Closure Plan for consistency with the requirements of N.C. Gen. Stat. § 130A-309.214(a). See N.C. Gen. Stat. § 130A-309.214(b). DEQ must disapprove any proposed Closure Plan that DEQ finds does not meet these requirements. See N.C. Gen. Stat. § 130A-309.214(c). Therefore, an approvable Closure Plan must, at a minimum, meet the requirements of N.C. Gen. Stat. § 130A-309.214(a).

Pursuant to N.C. Gen. Stat. § 130A-309.213(d)(1), DEQ has classified the CCR surface impoundment at Marshall as low-risk. The relevant closure requirements for low-risk

impoundments are in N.C. Gen. Stat. § 130A-309.214(a)(3), which states the following:

- Low-risk impoundments shall be closed as soon as practicable, but no later than December 31, 2029;
- A proposed closure plan for a low-risk impoundment must be submitted as soon as practicable, but no later than December 31, 2019; and
- At a minimum, impoundments located in whole above the seasonal high groundwater table shall be dewatered and impoundments located in whole or in part beneath the seasonal high groundwater table shall be dewatered to the maximum extent practicable.

In addition, N.C. Gen. Stat. § 130A-309.214(a)(3) requires compliance with specific closure criteria set forth verbatim below in Table 1. The statute provides three principal closure pathways: (a) [CAMA Option A] closure in a manner allowed for a high-risk site, such as excavation and disposal in a lined landfill; (b) [CAMA Option B] closure with a cap-in-place system similar to the requirements for a municipal solid waste landfill; or (c) [CAMA Option C] closure in accordance with the federal CCR rule adopted by EPA. For each low-risk impoundment, the choice of the closure pathway in CAMA is at the “election of the Department.”

Table 1: CAMA Closure Options for Low-Risk CCR Surface Impoundments
N.C. Gen. Stat. § 130A-309.214(a)(3)

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; [CAMA Option A]
- 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 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; [CAMA Option B]
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." [CAMA Option C]

By referencing the closure options for *high-risk* CCR surface impoundments in “subdivision (1)” or N.C. Gen. Stat. § 130A-309.214(a)(1), CAMA allows for closure of a *low-risk* CCR surface impoundment in N.C. Gen. Stat. § 130A-309.214(a)(3) through the same removal scenarios:

- “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.” N.C. Gen. Stat. § 130A-309.214(a)(1)a.; or
- “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.” N.C. Gen. Stat. § 130A-309.214(a)(1)b.

IV. DEQ Election Process

Beginning with a letter to Duke Energy on October 8, 2018, DEQ began planning for a thorough evaluation of the closure options for low-risk CCR surface impoundments before making an election as outlined in Table 1 above. DEQ’s objectives were to receive input on closure options from Duke Energy and to engage with community members near low-risk sites. DEQ outlined the following schedule in the October 8, 2018 letter:

- November 15, 2018 – Duke Energy submittal of revised option analyses and related information
- January 17, 2019 – DEQ public meeting near Marshall
- April 1, 2019 – DEQ evaluation of closure options
- August 1, 2019 – Duke Energy submittal of closure plan
- December 1, 2019 – Duke Energy submittal of updated corrective action plan for all sources at Marshall that are either CCR surface impoundments or hydrologically connected to CCR impoundments

DEQ received the requested information from Duke Energy by November 15, 2018: closure options analysis, groundwater modeling and net environmental benefits assessment. These materials are posted on the DEQ website. Duke Energy provided the following options for consideration: closure in place, full excavation with either an onsite or offsite landfill, and a hybrid option that included some excavation with an engineered cap on a smaller footprint of the existing CCR surface impoundment.

In preparing to make its election of the closure option, DEQ considered environmental data contained in the comprehensive site assessment, permit requirements, ambient monitoring, closure options analysis and groundwater modeling provided by Duke Energy and other data relevant to the CAMA requirements. The Marshall site has extensive amounts of data that have been collected during the site assessment process, and these data were used as part of the

evaluation of closure options. DEQ's evaluation of closure in place and hybrid option based on groundwater monitoring and modeling data is provided in Attachment A. That analysis demonstrates that the contaminated plume is already beyond the compliance boundary for the site. All of these references are part of the record supporting DEQ's determination.

DEQ conducted a public meeting in Sherrills Ford, NC near Marshall on January 17, 2019. There were 409 members of the public who attended the meeting. Approximately 1100 comments were received during the comment period, which closed on February 15, 2019. The majority of comments received expressed a preference for excavation and removal to dry-lined storage. The majority of these comments did not specify whether the storage should be on or off-site, but instead requested that it be "away from our waterways and out of our groundwater." A minority of comments expressed support for excavation and specified a preference for on-site disposal in a lined landfill, provided additional feedback on other issues related to the closure process, or expressed additional concerns related to coal ash. A review and response to comments are included in Attachment B.

V. DEQ Evaluation of Closure Options

DEQ has evaluated the closure options proposed by Duke Energy for the CCR surface impoundment at the Marshall facility. The purpose of this evaluation was to determine which closure option or options may be incorporated into an approvable Closure Plan under CAMA.

DEQ elects the provisions of CAMA Option A that require movement of coal ash to an existing or new CCR, industrial or municipal solid waste landfill located on-site or off-site for closure of the Active Ash Basin at Marshall in accord with N.C. Gen. Stat. § 130A-309-214(a)(3). In addition, DEQ is open to considering beneficiation projects where coal ash is used as an ingredient in an industrial process to make a product as an approvable closure option under CAMA Option A.

DEQ elects CAMA Option A because removing the coal ash from the unlined impoundment at Marshall is more protective than leaving the material in place. DEQ determines that CAMA Option A is the most appropriate closure method because removing the primary source of groundwater contamination will reduce uncertainty and allow for flexibility in the deployment of future remedial measures.

DEQ does not elect CAMA Option B for the CCR surface impoundment at Marshall. In N.C. Gen. Stat. § 130A-309.214(a)(3)b, the General Assembly mandated that "[t]he Department may not approve closure for an impoundment pursuant to [this] sub-subdivision . . . 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." N.C. Gen. Stat. § 130A-309.214(a)(3)b. In light of these requirements and based on DEQ's review of the information provided by Duke Energy as well as DEQ's independent analysis, DEQ does not believe that Duke Energy can incorporate CAMA Option B into an approvable Closure Plan for Marshall.

As DEQ considered the closure options presented by Duke Energy, DEQ evaluated whether the closure in place or the hybrid options met the requirement for CAMA Option B. Specifically, DEQ attempted to determine whether, upon full implementation of the closure plan, the design would prevent any post-closure exceedances of groundwater standards beyond the compliance boundary. To address this question, DEQ considered the current state of the groundwater contamination and reviewed the results of the groundwater modeling submitted by Duke Energy. The evaluation is provided in Attachment A. DEQ's overall conclusion is that based on the current geographic scope and vertical extent of the groundwater contamination plume, and the modeled extent of the plume in the future, DEQ does not believe these two closure options can meet the requirements of CAMA Option B for the CCR surface impoundment at Marshall.

DEQ does not elect CAMA Option C (i.e., closure under the federal CCR Rules found in 40 CFR Part 257) for the CCR surface impoundment at Marshall. DEQ has determined that:

- a. Under the facts and circumstances here, CAMA Option C is less stringent than CAMA Option A. Specifically, DEQ's election of Option A would also require Duke Energy to meet the requirements of the federal CCR Rule (i.e., CAMA Option C) but election of CAMA Option C would not require implementation of CAMA Option A.
- b. Because CAMA Option A adds additional requirements or performance criteria beyond Option C, it advances DEQ's duty to protect the environment (see N.C. Gen. Stat. §§ 279B-2 & 143-211) and the General Assembly's mandate under CAMA that DEQ ensure that any Closure Plan, which must incorporate an approvable closure option, is protective of public health, safety, and welfare, the environment, and natural resources (see N.C. Gen. Stat. § 130A-309.214(b) & (c)).
- c. For the CCR surface impoundments for which the closure option(s) must be determined, CAMA Option A provides a better mechanism for ensuring State regulatory oversight of the closure process than Option C, as well as greater transparency and accountability.
- d. While the federal CCR Rule was written to provide national minimum criteria for CCR surface impoundments across the country, CAMA was written specifically to address the CCR surface impoundments in North Carolina.
- e. While the federal CCR Rule allows CCR surface impoundment owners to select closure either by removal and decontamination (clean closure) or with a final cover system (cap in place), EPA anticipates that most owners will select closure through the less protective method of cap in place.
- f. There is considerable uncertainty regarding the status and proper interpretation of relevant provisions of the federal CCR Rule. For instance, EPA is reconsidering portions of the federal CCR Rule. Also, the performance standards in 40 CFR 257.102(d) for cap in place closure are the subject of conflicting interpretations (and possible litigation) among industry and state authorities.

VI. Final Closure Plan

The final closure plan is due on August 1, 2019 in accordance with this determination. Based on DEQ's evaluation of the options submitted by Duke Energy, DEQ elects the provisions of CAMA Option A that require movement of coal ash to an existing or new CCR, industrial or municipal solid waste landfill located on-site or off-site for closure of the Active Ash Basin in accord with N.C. Gen. Stat. § 130A-309.214(a)(3). In addition, DEQ is open to considering beneficiation projects where coal ash is used as an ingredient in an industrial process to make a product as an approvable closure option under CAMA Option A.

While beneficiation is not a requirement of the closure plan, DEQ encourages Duke Energy to consider opportunities for beneficiation of coal ash that would convert coal combustion residuals into a useful and safe product.

ATTACHMENT A

**DEQ EVALUATION OF CLOSURE IN PLACE AND HYBRID OPTIONS BASED ON
GROUNDWATER MONITORING AND MODELING DATA**

DEQ EVALUATION OF CLOSURE IN PLACE AND HYBRID OPTIONS BASED ON GROUNDWATER MONITORING AND MODELING DATA

I. Groundwater Monitoring Summary

As DEQ considered the closure options presented by Duke Energy, DEQ evaluated whether the closure in place or the hybrid options met the requirement for CAMA Option B. Specifically, DEQ attempted to determine whether the design would prevent any post-closure exceedances of groundwater standards beyond the compliance boundary upon full implementation of the closure plan. Significantly, the contaminated groundwater plume has already extended beyond the compliance boundary in a portion of the CCR surface impoundment. The inferred general extent of groundwater impacts above applicable Background Threshold Values or 2L Standards are shown on Figure ES-1. Additional monitoring and hydrogeological data is available in the Marshall Steam Station January 2018 CSA Update Report (available on the DEQ website).

The groundwater site assessment at the Marshall Steam Station, as required by CAMA, began in 2015 and is still on-going. Based on review of data submitted to date in various reports, both soil and groundwater has been impacted by CCR handling activities at the site. Groundwater within the area of the CCR surface impoundment generally flows from northwest to southeast and discharges to Lake Norman as depicted on Figure ES-1 (below). The inferred general extent of groundwater impacts above applicable PBTVs or 2L Standards are shown on Figure ES-1 from the January 2018 CSA Update Report below. Boron concentrations above 2L Standards approximates the leading edge of the CCR plume (area shaded yellow) at the site.

The vertical extent of most COIs is within the shallow and transition flow layers. However, data suggests the bedrock flow layer has been impacted by CCR handling activities at the site. Manganese and strontium concentrations are fairly widespread in the bedrock flow layer. There are isolated occurrences of boron, chloride, iron, molybdenum and TDS within and downgradient of the ash basin.

DEQ concludes that the contaminated groundwater plume above 2L groundwater standards has extended beyond the compliance boundary along the northern and eastern edge on the shore of Lake Norman.

II. Groundwater Cross-section Modeling

As DEQ considered the closure options presented by Duke Energy, DEQ evaluated whether the closure in place or the hybrid options met the requirement for CAMA Option B. Specifically, DEQ attempted to determine whether the design would prevent any post-closure exceedances of groundwater standards beyond the compliance boundary upon full implementation of the closure plan. To address this question, DEQ considered the current state of the groundwater contamination and reviewed the results of the groundwater modeling submitted by Duke Energy.

DEQ evaluated cross-sections of the groundwater modeling results provided by Duke Energy to determine whether Duke Energy’s final closure *Option 1: Hybrid* and *Option 5: Closure-in-Place* would meet the criteria of CAMA Option B. DEQ considered if the agency could conclude that the proposed closure option includes design measures to prevent any post closure exceedances of the 2L groundwater quality standards at the compliance boundary upon the plan’s full implementation. Cross section A-A’ was evaluated and can be seen in the figures below. This cross section represents where the boron concentration above the 2L standard of 700 µg/L has crossed the compliance boundary based on groundwater monitoring and modeling.

Next, the model results were evaluated based on the following model simulations:

- current conditions in 2017 when the model was calibrated based on raw field data
- upon completion of the final closure-in-place cover system at t=0 years
- closure-in-place option at t=120 years
- upon completion of the hybrid option at t=0 years
- hybrid option at t=120 years

The table below summarizes the results from the model simulations. The boron concentrations depicted in the table represent the maximum boron concentration in any layer (ash, saprolite, transition zone, and bedrock) of the model.

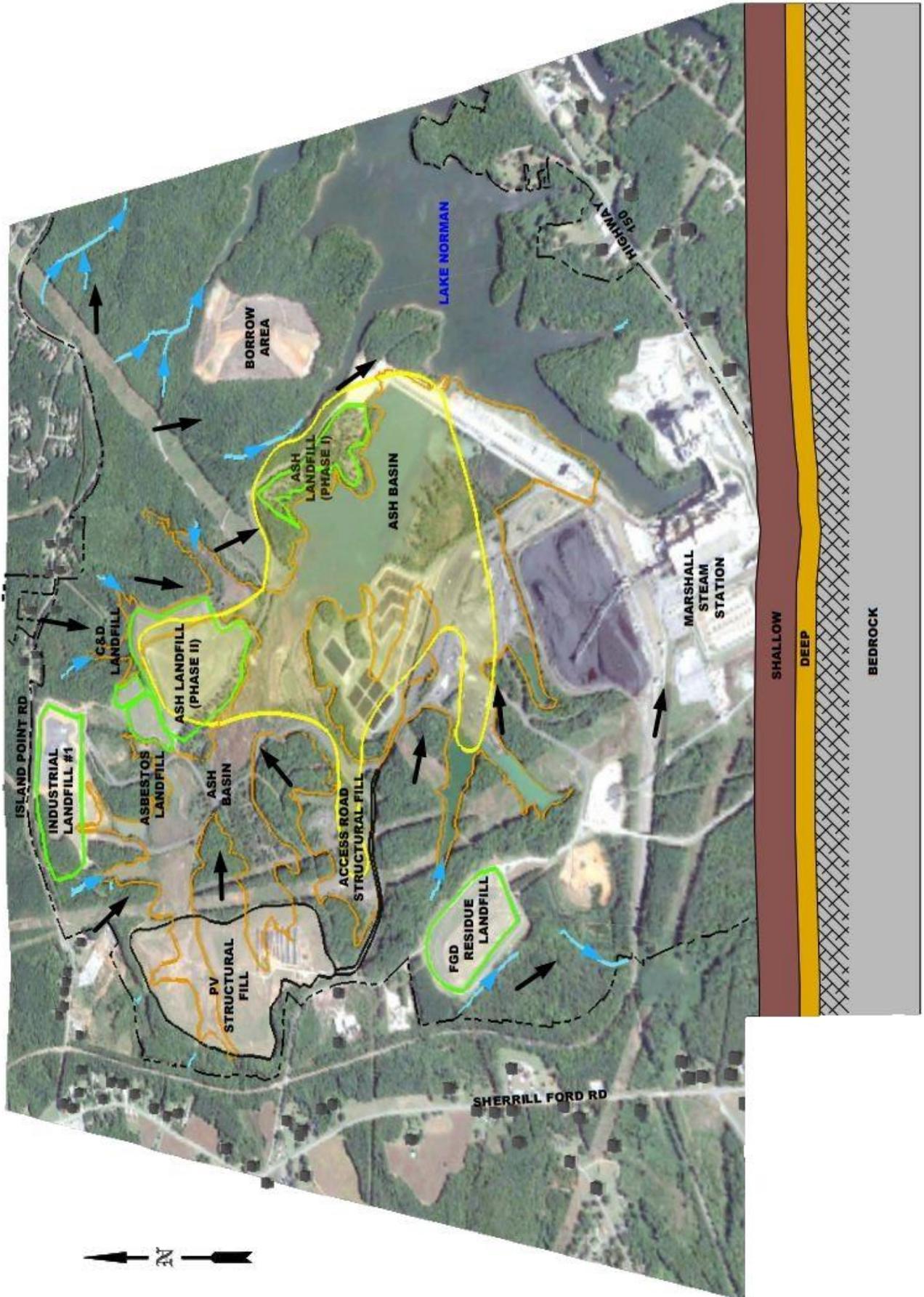
Marshall Modeling Results for Cross-Section A-A’			
Model Simulation	Maximum Concentration of Boron Above 2L Beyond Compliance Boundary (ug/L)	Depth of GW Contamination Above 2L Beyond Compliance Boundary (feet bgs)	Width of Contamination Plume Beyond Compliance Boundary (feet)
Current Conditions	700-4,000	380	1500
Completion of Final Cover (t=0 yrs)	700-4,000	390	1500
Final Cover (t=120 yrs)	700-4,000	370	1500
Completion of Hybrid (t=0 yrs)	700-4,000	310	1500
Hybrid (t=120 yrs)	700-4,000	360	1600

bgs – below ground surface

These data illustrate that after completion of closure with the final cover or hybrid option, the groundwater plume still extends beyond the compliance boundary above the 2L groundwater standard and the area of the plume requiring remediation is immense. Even 120 years beyond completion of closure, the area of the plume requiring remediation remains extensive.

DEQ recognizes that there are no groundwater remediation corrective actions included in the groundwater modeling simulations submitted to DEQ as part of Duke Energy’s closure options analysis documentation. However, based on the current geographic scope, vertical extent of the groundwater contamination plume, and future modeled extent of the plume, DEQ does not believe these two closure options can meet the requirements of CAMA Option B.

Figure ES-1: Marshall Steam Station January 2018 CSA Update Report



LEGEND

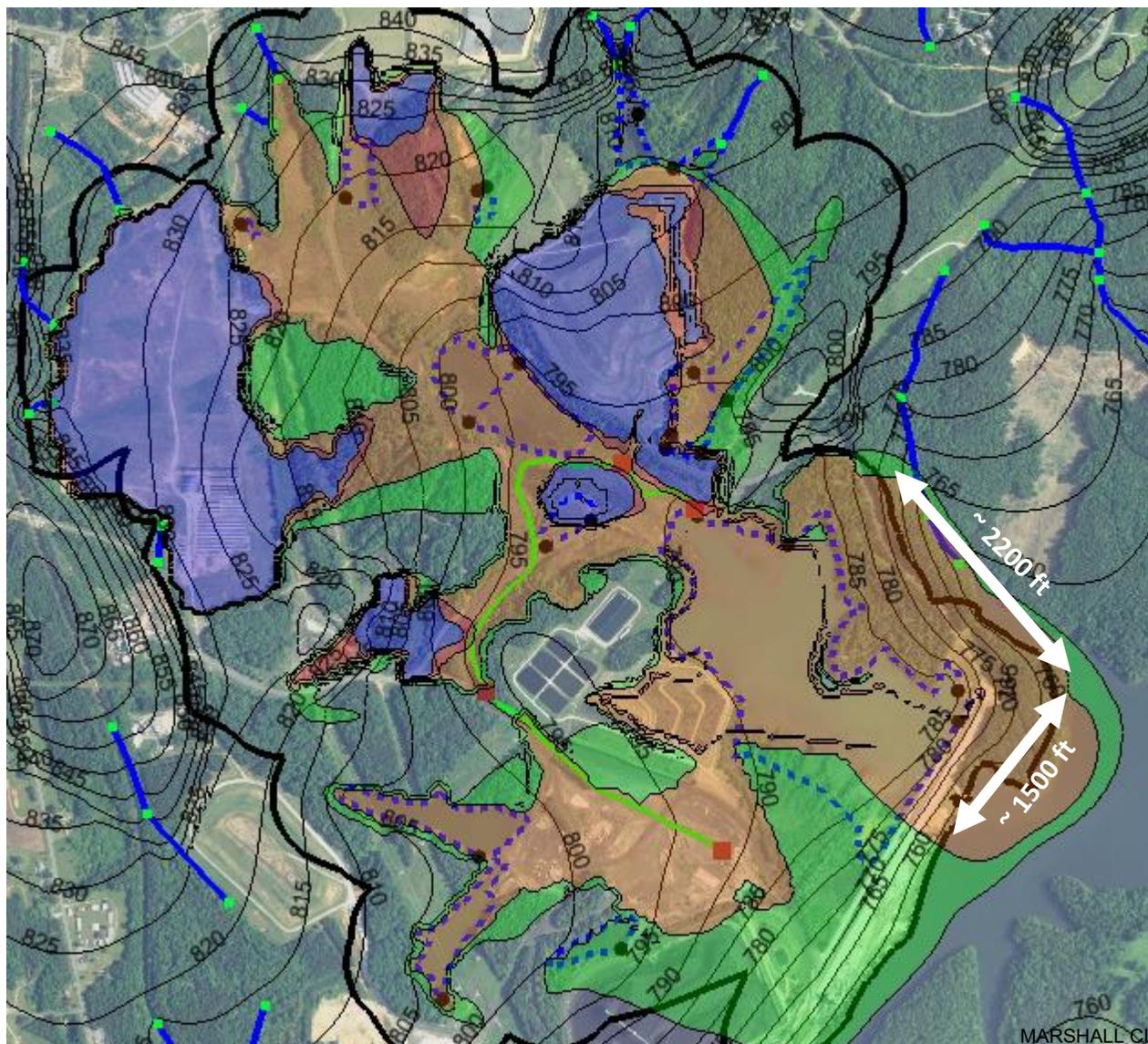
-  AREA OF CONCENTRATION IN GROUNDWATER ABOVE NC2L (SEE NOTE 5)
-  ASH BASIN WASTE BOUNDARY
-  APPROXIMATE LANDFILL WASTE BOUNDARY
-  APPROXIMATE STRUCTURAL FILL BOUNDARY
-  GENERALIZED GROUNDWATER FLOW DIRECTION
-  WATER SUPPLY WELL LOCATION
-  STREAM WITH FLOW DIRECTION
-  DUKE ENERGY PROPERTY BOUNDARY

NOTE:

1. OCTOBER, 2016 AERIAL PHOTOGRAPHY OBTAINED FROM GOOGLE EARTH PRO ON SEPTEMBER 18, 2017. AERIAL DATED OCTOBER 28, 2016.
2. STREAMS OBTAINED FROM AMEC FOSTER WHEELER NRTR, MAY 2015.
3. GENERALIZED GROUNDWATER FLOW DIRECTION BASED ON SEPTEMBER 11, 2017 WATER LEVEL DATA.
4. PROPERTY BOUNDARY PROVIDED BY DUKE ENERGY.
5. GENERALIZED AREAL EXTENT OF MIGRATION REPRESENTED BY NCAC 02L EXCEEDANCES OF MULTIPLE CONSTITUENTS IN MULTIPLE FLOW ZONES.

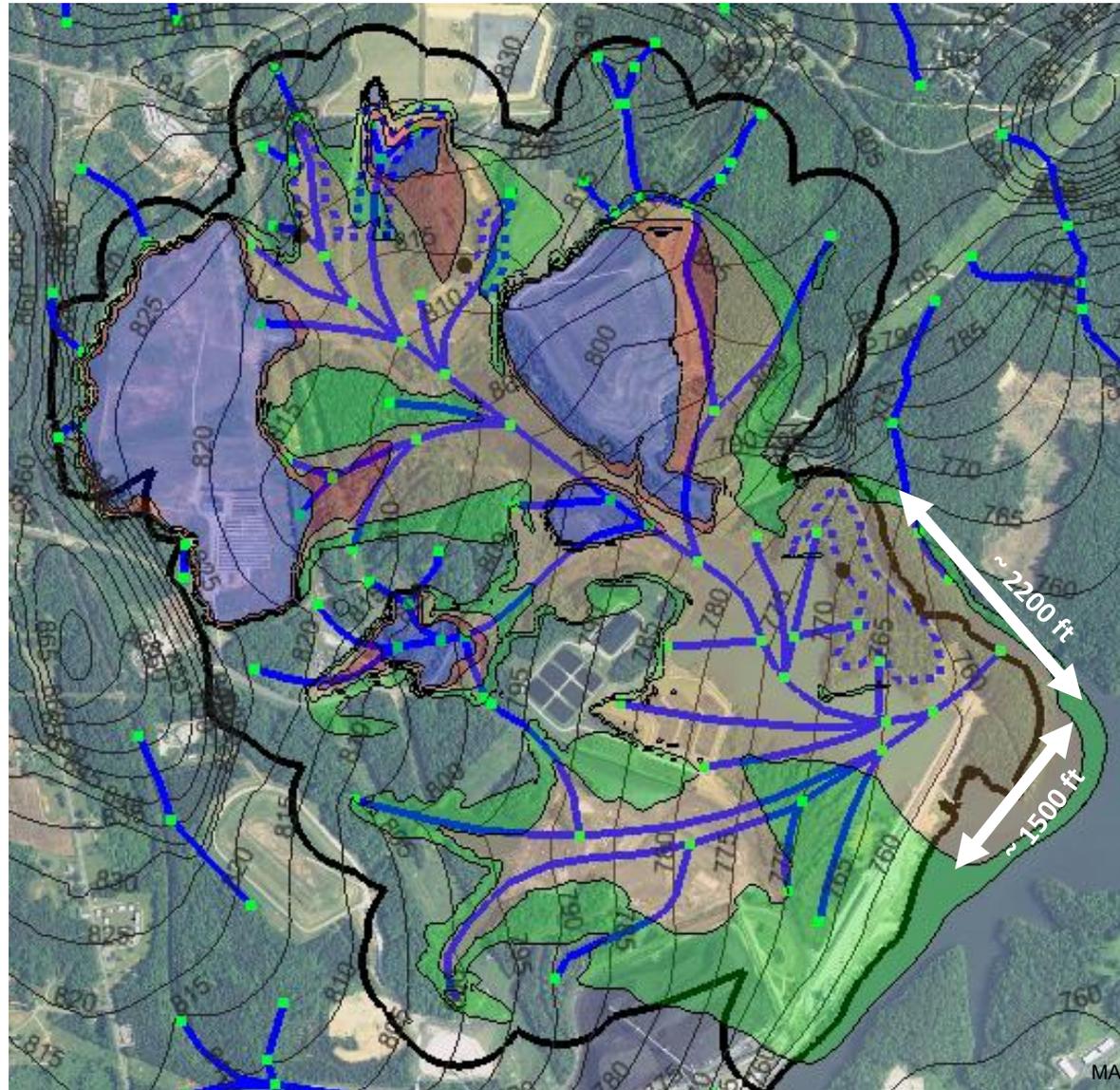
MARSHALL **CURRENT CONDITIONS IN 2018**

MAX BORON ANY LAYER (ug/L) green = 75-700, tan = 700-4000, red = 4000-10,000, blue = 10,000-40,000



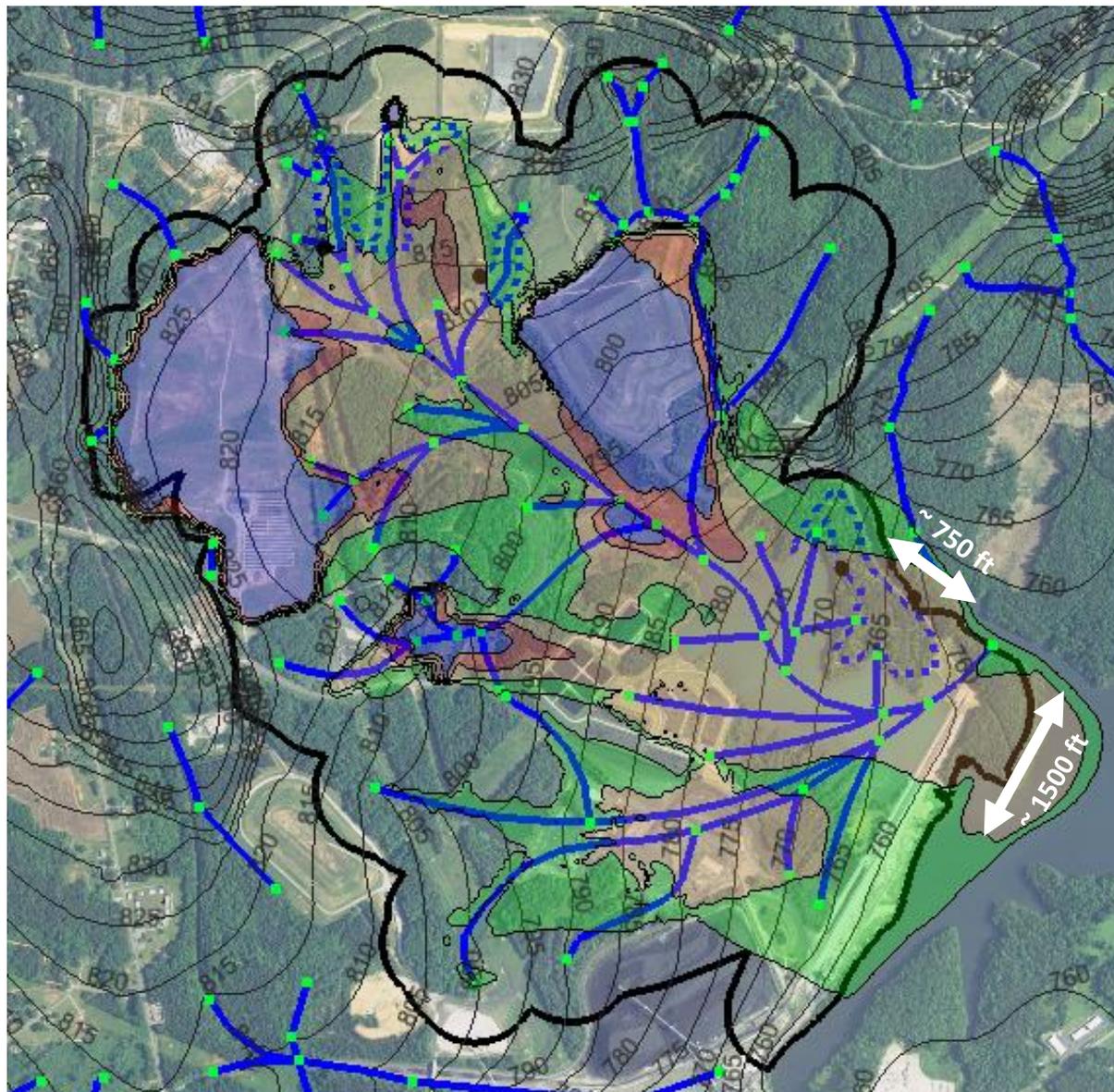
MARSHALL **UPON COMPLETION OF FINAL COVER IN 2030, t = 0**

MAX BORON ANY LAYER (ug/L) green = 75-700, tan = 700-4000, red = 4000-10,000, blue = 10,000-40,000



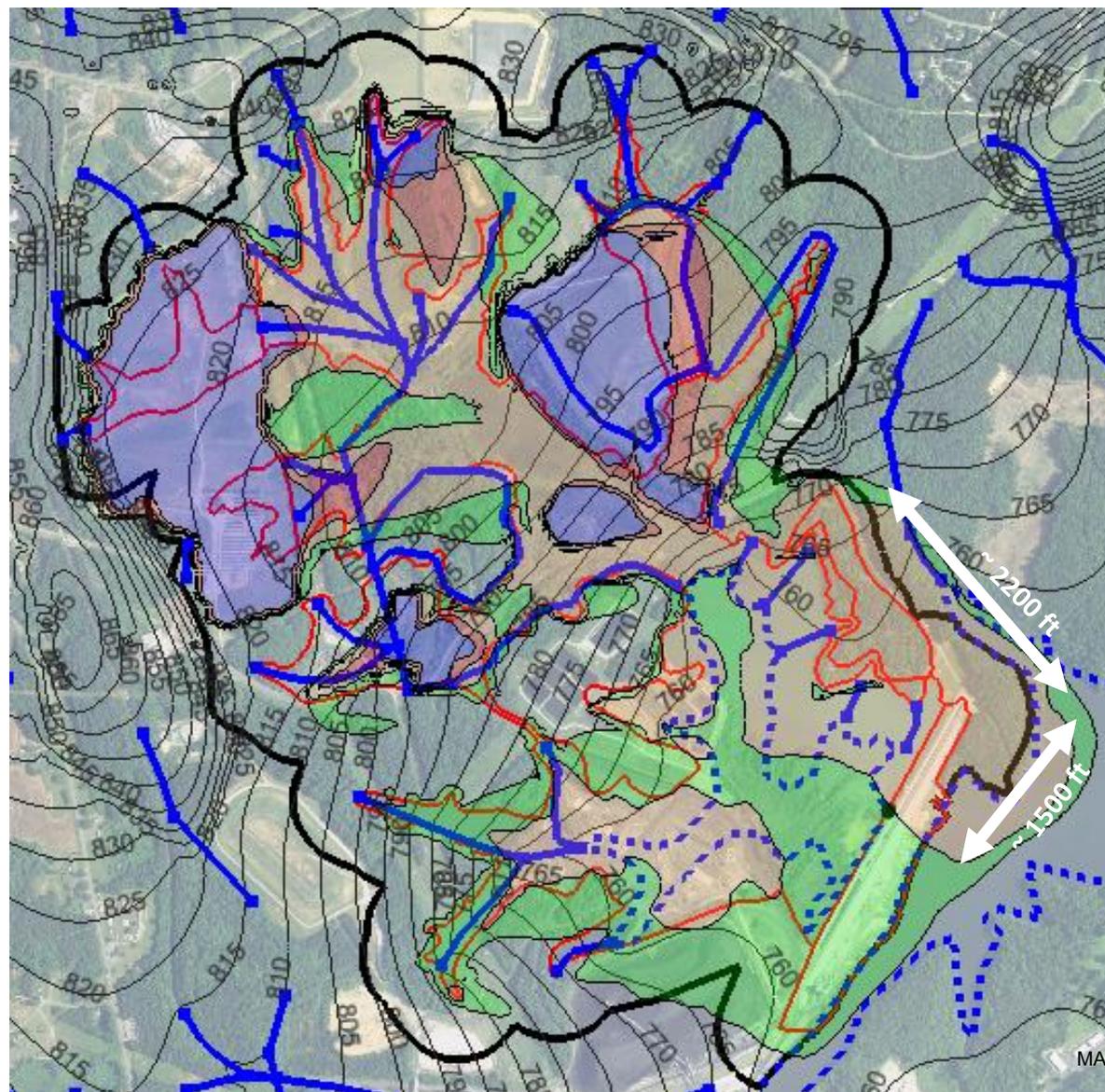
MARSHALL **FINAL COVER, 2150, t = 120 years**

MAX BORON ANY LAYER (ug/L) green = 75-700, tan = 700-4000, red = 4000-10,000, blue = 10,000-40,000



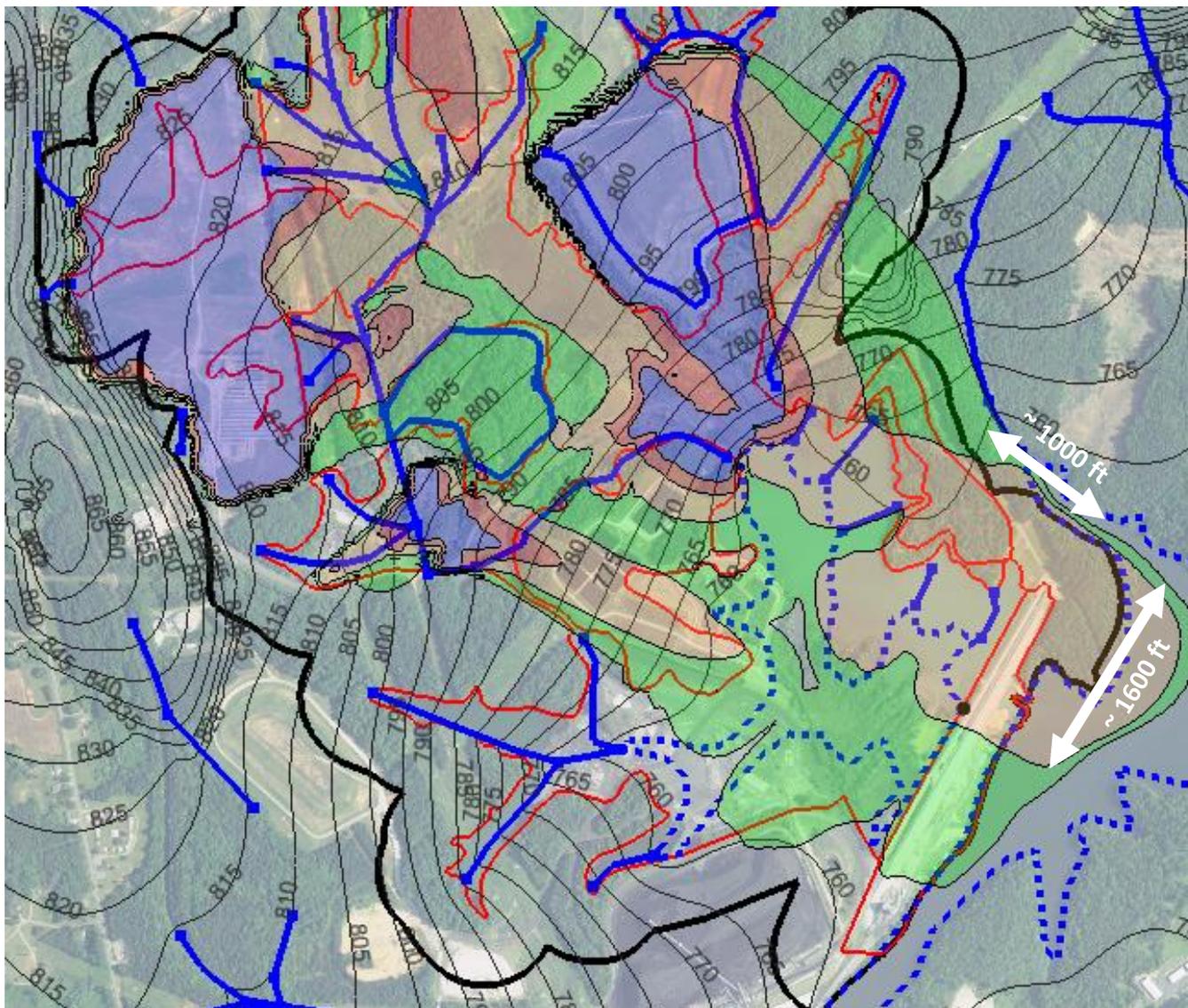
MARSHALL **UPON COMPLETION OF HYBRID IN 2030, t = 0**

MAX BORON ANY LAYER (ug/L) green = 75-700, tan = 700-4000, red = 4000-10,000, blue = 10,000-40,000



MARSHALL **UPON COMPLETION OF HYBRID IN 2150, t = 120 years**

MAX BORON ANY LAYER (ug/L) green = 75-700, tan = 700-4000, red = 4000-10,000, blue = 10,000-40,000



MARSHALL CURRENT CONDITIONS IN 2018

CROSS SECTION A-A' (VIEWED FROM SW SIDE OF DAM LOOKING NE)

MAX BORON ANY LAYER green = 75-700, tan = 700-4000, red = 4000-10,000, blue = 10,000-40,000

Marshall model layers:

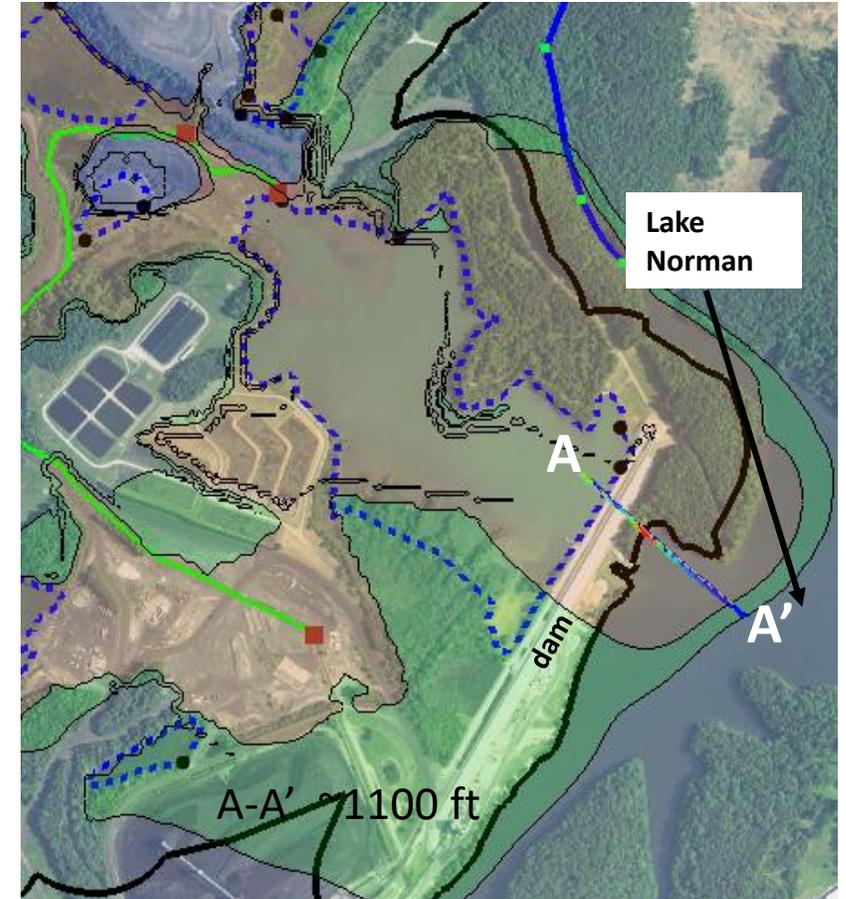
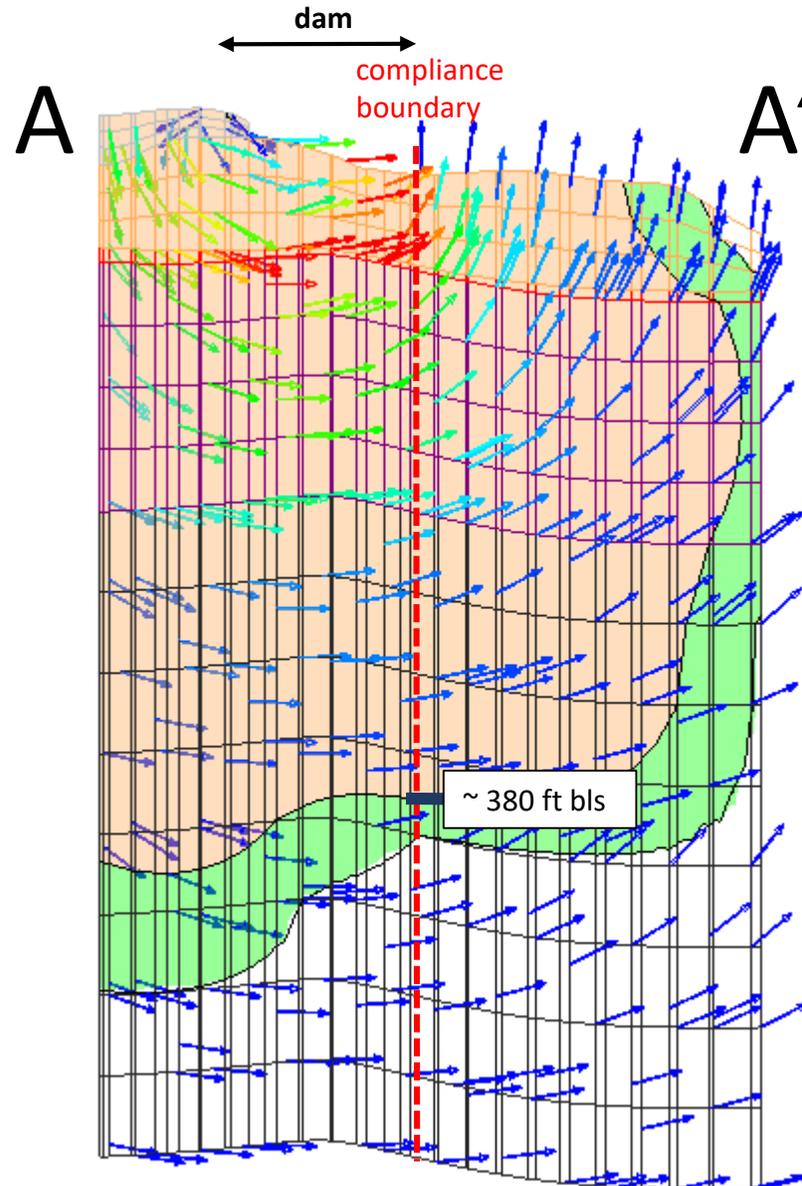
Ash 1-4

Saprolite 5-7

TZ 8

Bedrock 9-20

Vertical
exaggeration X 3



MARSHALL **UPON COMPLETION OF FINAL COVER IN 2030, t = 0**

CROSS SECTION A-A' (VIEWED FROM SW SIDE OF DAM LOOKING NE)

MAX BORON ANY LAYER green = 75-700, tan = 700-4000, red = 4000-10,000, blue = 10,000-40,000

Marshall model layers:

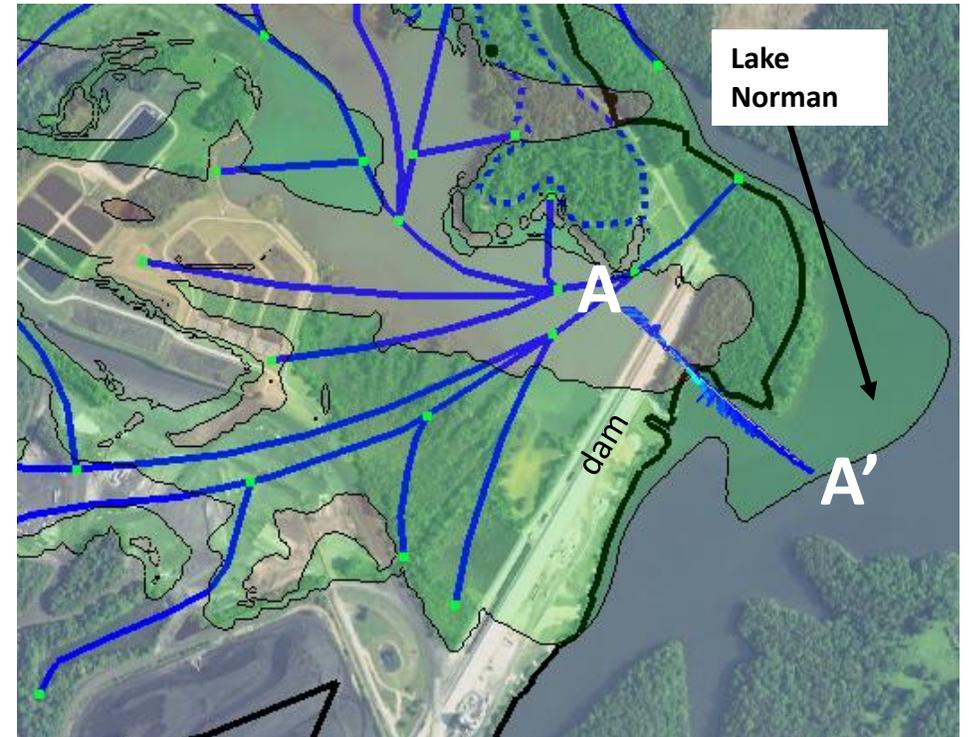
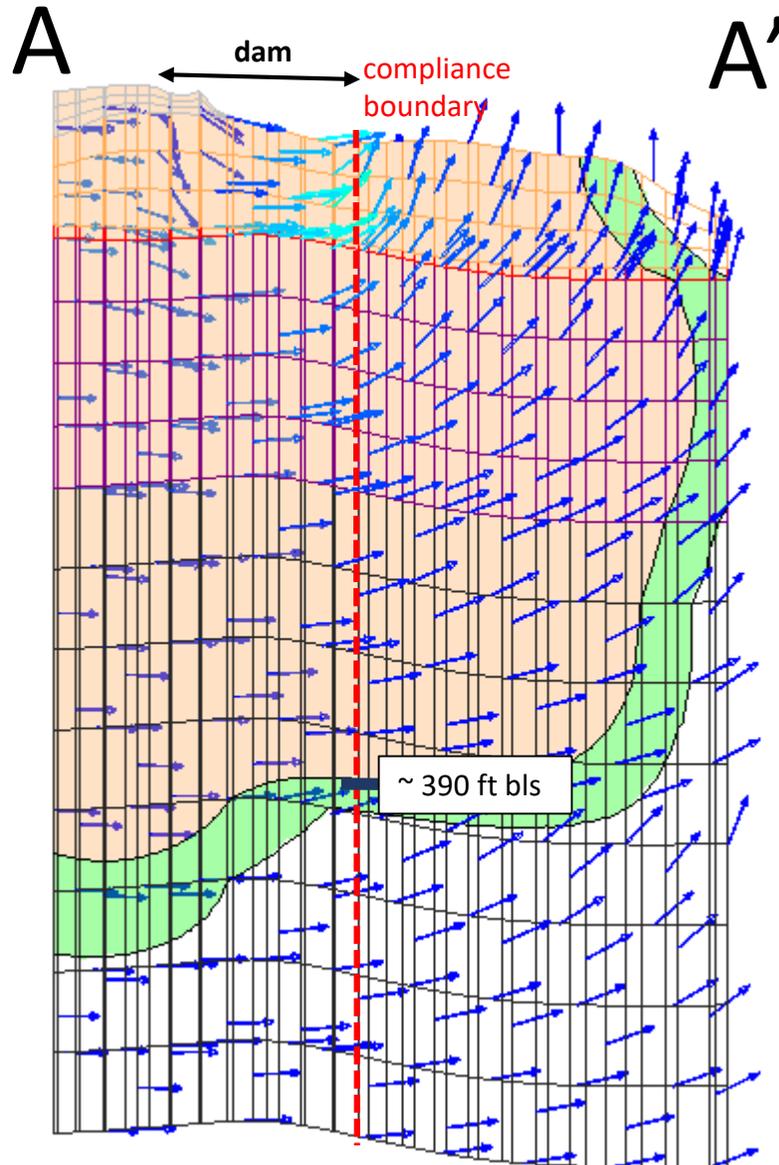
Ash 1-4

Saprolite 5-7

TZ 8

Bedrock 9-20

Vertical
exaggeration X 3



A-A' ~1200 ft

MARSHALL **UPON COMPLETION OF FINAL COVER IN 2150, t = 120 years**

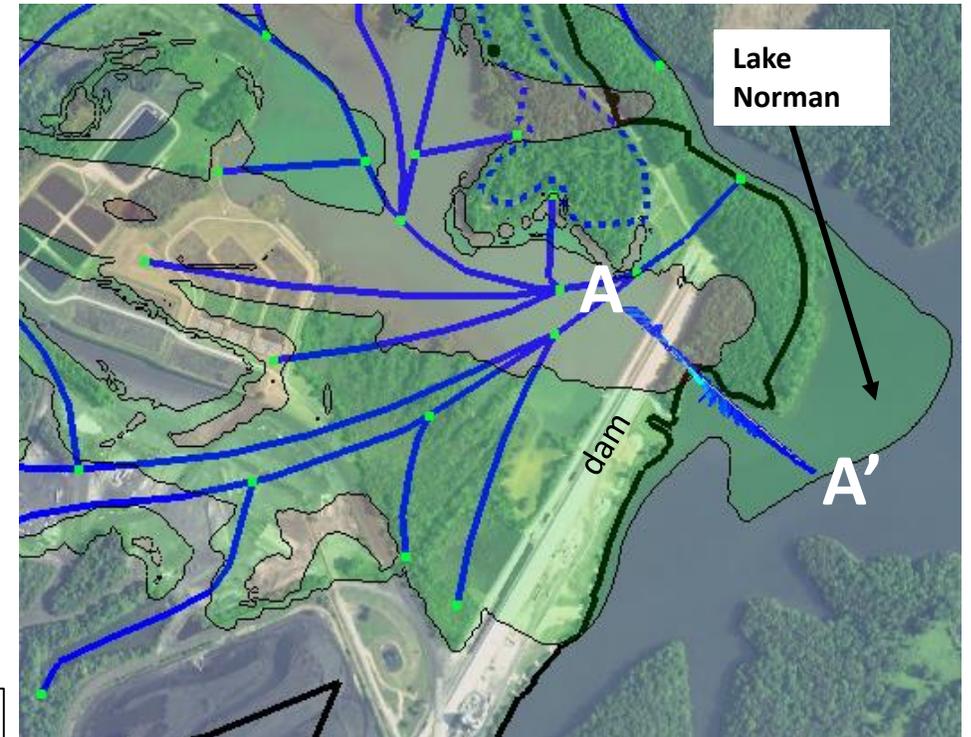
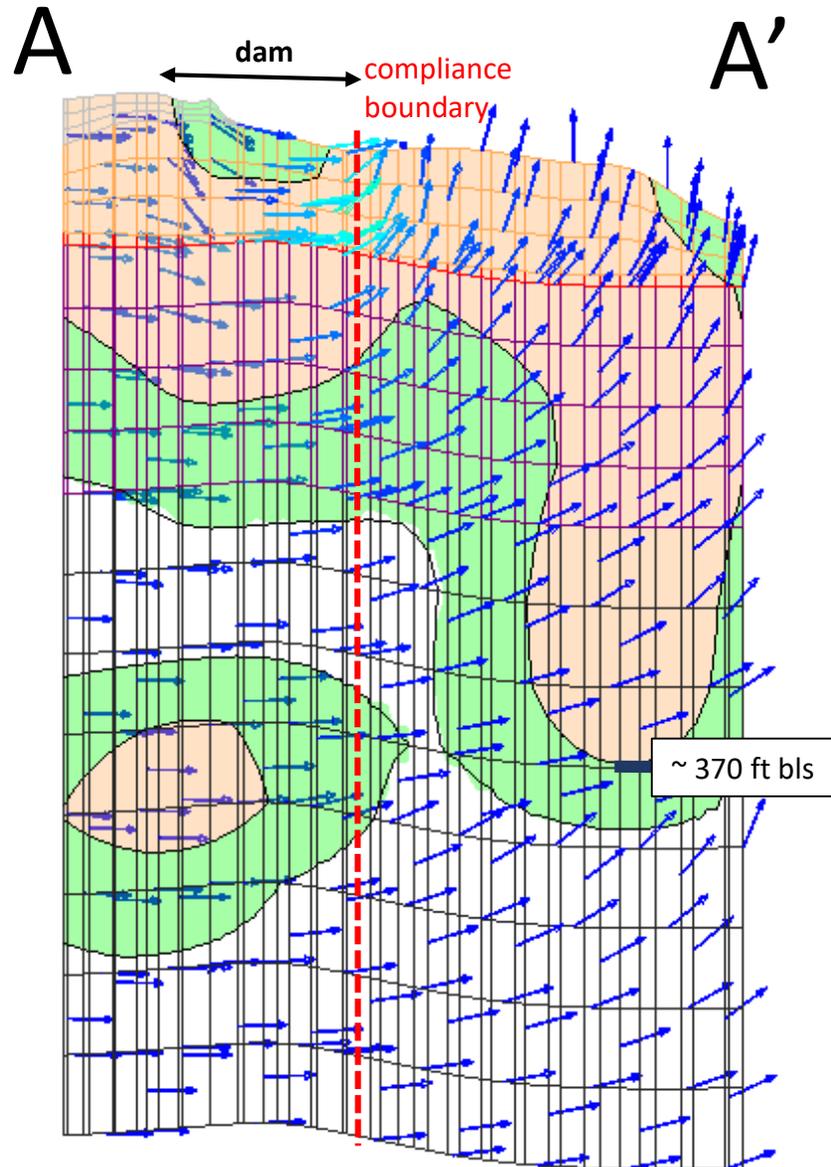
CROSS SECTION A-A' (VIEWED FROM SW SIDE OF DAM LOOKING NE)

MAX BORON ANY LAYER green = 75-700, tan = 700-4000, red = 4000-10,000, blue = 10,000-40,000

Marshall model layers:

- Ash 1-4
- Saprolite 5-7
- TZ 8
- Bedrock 9-20

Vertical
exaggeration X 3



A-A' ~1200 ft

MARSHALL UPON COMPLETION OF HYBRID IN 2030, t = 0

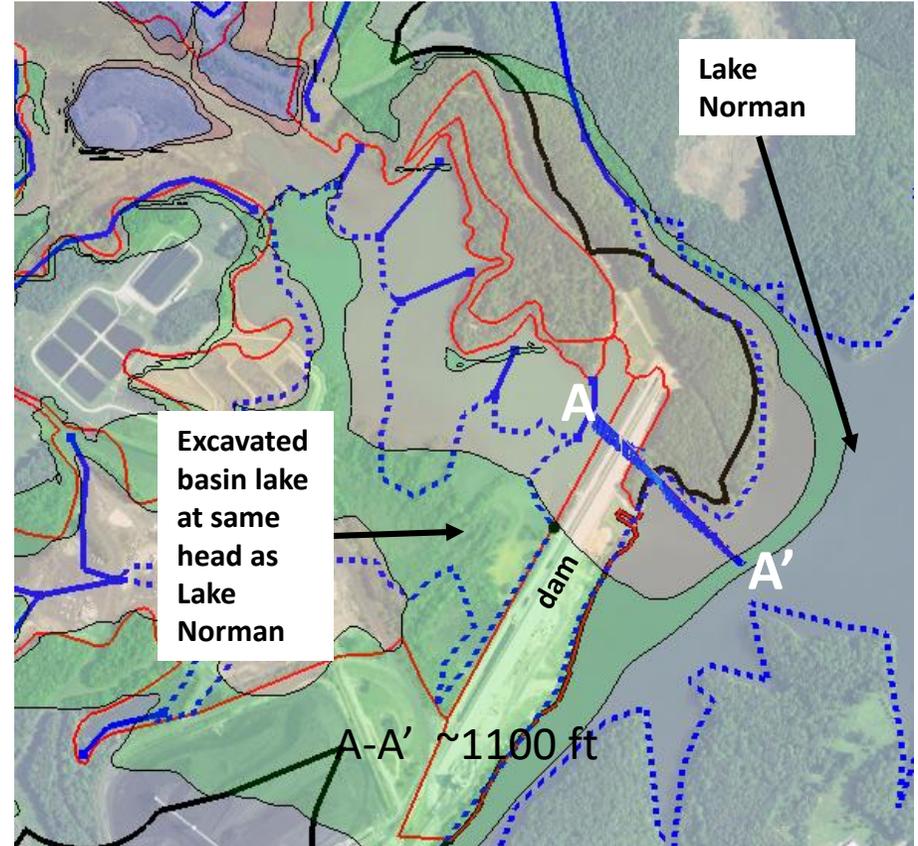
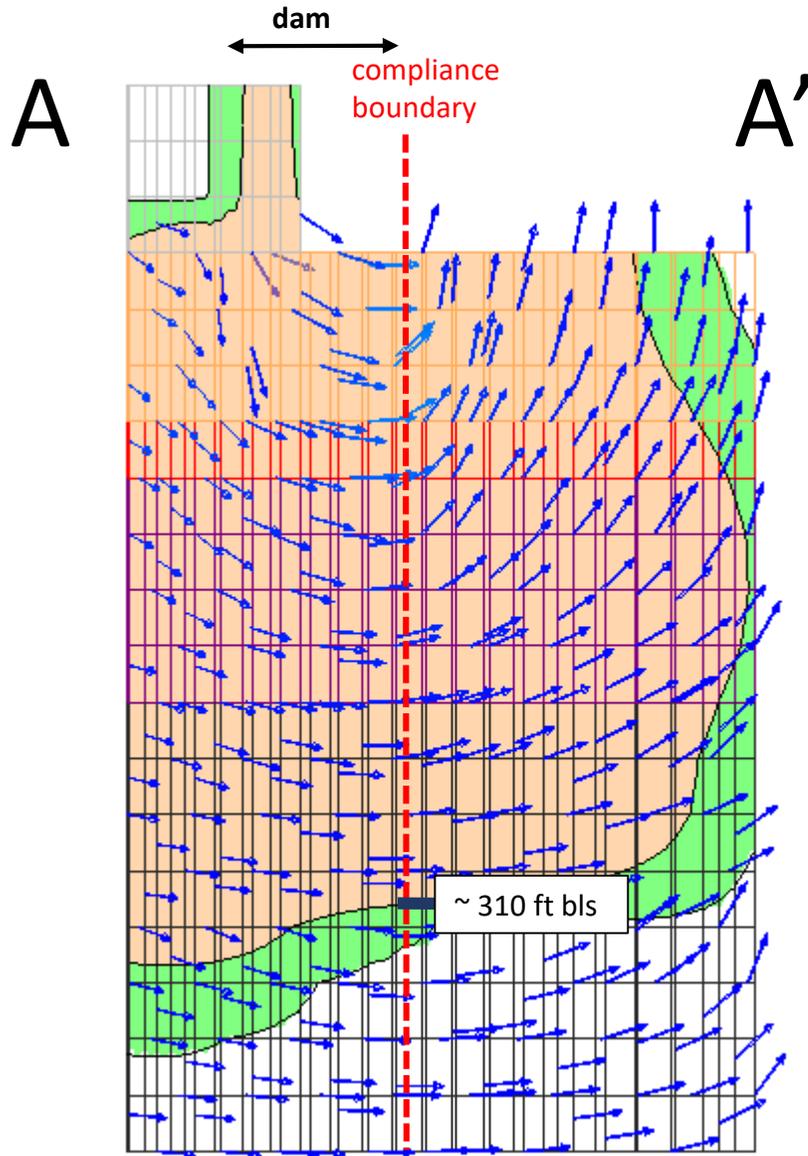
CROSS SECTION A-A' (VIEWED FROM SW SIDE OF DAM LOOKING NE)

MAX BORON ANY LAYER green = 75-700, tan = 700-4000, red = 4000-10,000, blue = 10,000-40,000

Marshall model layers:

- Ash 1-4
- Saprolite 5-7
- TZ 8
- Bedrock 9-20

Vertical exaggeration X 3



MARSHALL HYBRID IN 2150, t = 120 years

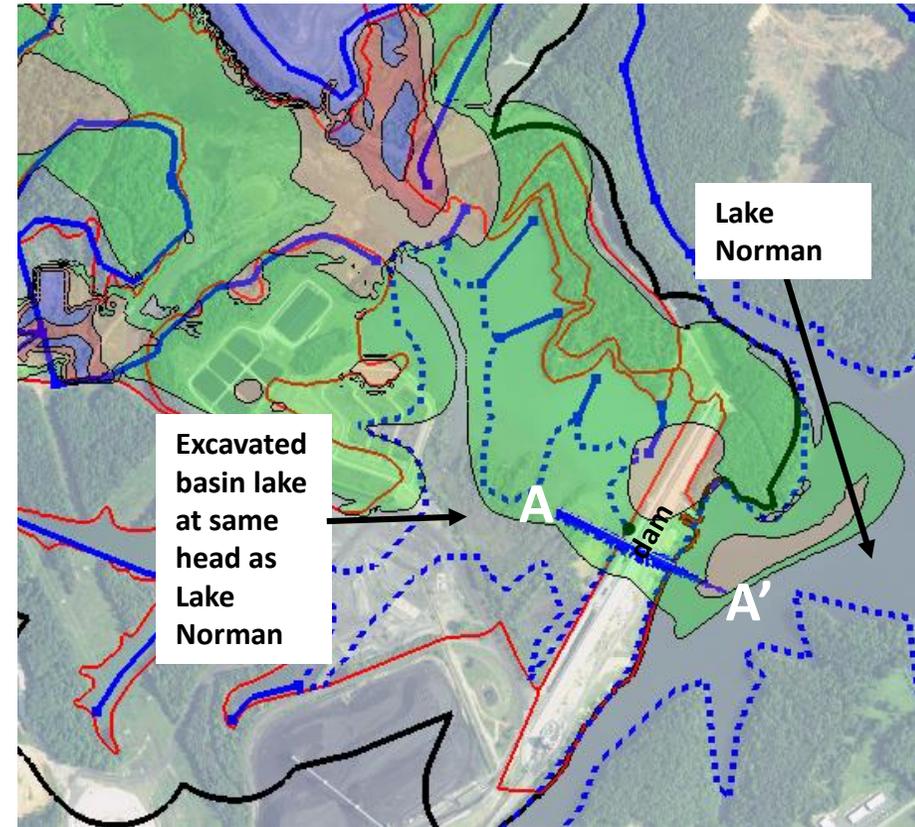
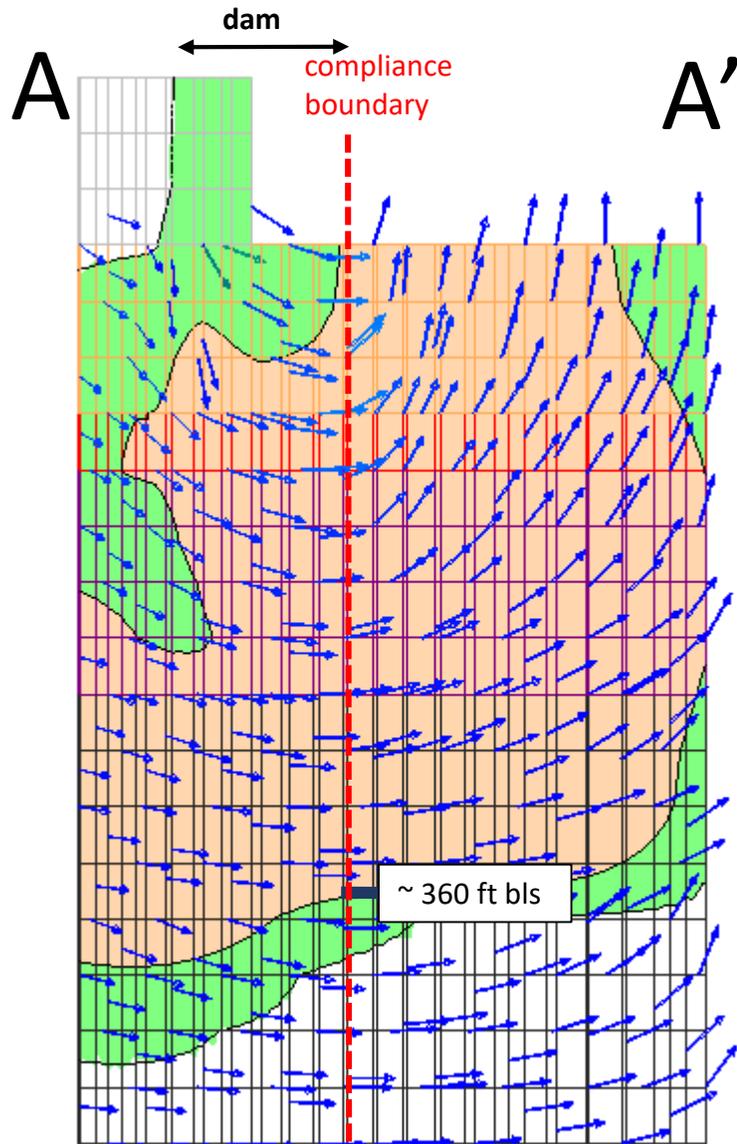
CROSS SECTION A-A' (VIEWED FROM SW SIDE OF DAM LOOKING NE)

MAX BORON ANY LAYER green = 75-700, tan = 700-4000, red = 4000-10,000, blue = 10,000-40,000

Marshall model layers:

- Ash 1-4
- Saprolite 5-7
- TZ 8
- Bedrock 9-20

Vertical
exaggeration X 3



A-A' ~1200 ft

ATTACHMENT B

RESPONSE TO COMMENTS

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I. Summary of Responses to Comments

The North Carolina Department of Environmental Quality (DEQ) received approximately 1,100 public comments regarding the closure options for coal combustion residuals (CCR) surface impoundments at Duke Energy's Marshall Steam Station. The overwhelming majority of comments received expressed a preference for excavation and removal to dry-lined storage. The majority of these comments did not specify whether the storage should be on or off-site, but instead requested that it be "away from our waterways and out of our groundwater." A minority of comments expressed support for excavation and specified a preference for on-site disposal in a lined landfill, provided additional feedback on other issues related to the closure process, or expressed additional concerns related to coal ash.

II. Detailed Responses to Comments

A. Comments Opposing Cap in Place

Comment: Many comments opposed allowing Duke Energy to cap the existing ash in its current location and supported excavation.

Response: DEQ agrees with these concerns and has determined that the CCR surface impoundments at Marshall must be excavated.

Comment: One comment opposed "cap in place" and requested that DEQ perform an independent analysis that "identifies the safest closure option for the long-term protection of water supplies."

Response: DEQ agrees with these concerns and has determined that the CCR surface impoundments at Marshall must be excavated.

Comment: One comment opposed "cap in place" and stated that professionals recommend storage in lined landfills. This comment also raised concerns about a lack of research regarding future impacts from beneficial reuse in building materials and expressed an opinion that Duke Energy should not be able to pass cleanup costs on to consumers.

Response: DEQ understands these concerns and has determined that the CCR surface impoundments at Marshall must be excavated. DEQ will continue to take this and future comments into consideration when evaluating closure plans submitted by Duke, as required by the Coal Ash Management Act. Analysis and evaluation of beneficial reuse may be included in the closure plan. The issue of cost is not within the purview of DEQ. Instead, this issue rests with the North Carolina Utilities Commission.

Comment: A commenter submitted an extensive written comment urging DEQ to require the Marshall coal ash basins to be excavated to a lined landfill to protect the environment and human health.

The commenter claimed coal ash impoundments at Marshall are not eligible for closure-in-place under CAMA. The commenter alleged that closure-in-place violates the North Carolina groundwater rule. The commenter sets out several arguments it believes support that claim: 1) Duke Energy's modelling demonstrates it will not meet groundwater standards if it chooses closure-in-place; 2) Duke Energy's modelling underestimates the extent of contamination; 3) Duke Energy tested groundwater compliance at the wrong location; 4) the groundwater rule prohibits closure-in-place because the coal ash will contribute to violations of the groundwater standard for centuries; and 5) closure-in-place is unavailable because it will not restore groundwater to the legal standard.

The commenter next claimed that coal ash impoundments at Marshall are not eligible for closure-in-place under the Coal Combustion Residuals (CCR) rule. The commenter alleged that: 1) the CCR rules' performance standards require separating ash from the groundwater and precluding its future impoundment; and 2) the CCR rules' corrective action requirements preclude closure-in-place.

The commenter continues by asserting that DEQ must base its closure determination on effectiveness and not cost to the polluter. The commenter further maintains that DEQ should reject Duke Energy's "Community Impact Analysis." The commenter claims that Duke's Energy's report downplays well-established pollution risks and exaggerates the impact on communities of excavating and trucking material to offsite landfills. Further, they claim that diesel emissions do not meaningfully distinguish between closure methods and that the report's habitat analysis is flawed. The commenter concludes by questioning the validity of Duke Energy's closure options scoring system - and offers its own analysis to demonstrate why it believes Duke Energy manipulated scores to suit a desired outcome.

Response: DEQ understands these concerns and has determined that the CCR surface impoundments at Marshall must be excavated.

B. Comments Supporting Excavation

Comment: Many comments supported excavation but did not express a preference for final disposition of the excavated materials.

Response: DEQ has determined that coal ash must be excavated and removed from CCR surface impoundments at the Marshall Steam Station.

Comment: One comment supported excavation and implementation of a requirement to publicly disclose the presence of contaminants and associated risks to current residents as well as potential new residents/buyers.

Response: DEQ has determined that coal ash must be excavated and removed from CCR surface impoundments at the Marshall Steam Station. The Department is not aware of legal authority that would enable it to require Duke Energy to provide the type of notice requested in this comment.

Comment: Several comments supported excavation and secure disposal of the excavated materials but did not express a preference for what secure disposal would entail.

Response: DEQ has determined that coal ash must be excavated and removed from CCR surface impoundments at the Marshall Steam Station.

Comment: One comment expressed support for excavation and legislative action to prevent Duke Energy from escaping liability for future problems associated with the site.

Response: DEQ has determined that coal ash must be excavated and removed from CCR surface impoundments at the Marshall Steam Station. As an executive branch agency, DEQ does not have the ability to implement legislative action.

Comment: One comment expressed support for excavation as a long term solution, while expressing the opinion that the other options would only serve as short term solutions.

Response: DEQ has determined that coal ash must be excavated and removed from CCR surface impoundments at the Marshall Steam Station.

Comment: Multiple comments expressed support for excavation, but expressed concern over the timeframe for completion or compliance.

Response: DEQ has determined that coal ash must be excavated and removed from CCR surface impoundments at the Marshall Steam Station. However, the North Carolina General Assembly has set forth the timeframe for completion of this process through the Coal Ash Management Act.

Comment: One comment expressed support for excavation, but expressed concern over pre-existing structural fills that utilized ash.

Response: DEQ has determined that coal ash must be excavated and removed from CCR surface impoundments at the Marshall Steam Station. DEQ will continue to take this and future comments into consideration when evaluating closure plans submitted by Duke, as required by the Coal Ash Management Act. Analysis and evaluation of preexisting structural fill sites will occur separate and apart from the current proceedings.

Comment: One comment expressed support for excavation and removal to an unpopulated area outside of North Carolina.

Response: DEQ has determined that coal ash must be excavated and removed from CCR surface impoundments at the Marshall Steam Station. The Department does not have the legal authority to require Duke Energy to dispose of coal ash in an “unpopulated area outside of North Carolina.”

Comment: Two comments expressed support for excavation and testing of removed material.

Response: DEQ has determined that coal ash must be excavated and removed from CCR surface impoundments at the Marshall Steam Station. DEQ will continue to take this and future comments into consideration when evaluating closure plans submitted by Duke, as required by the Coal Ash Management Act.

Comment: One comment expressed support for total excavation, including the construction of a road through the property, but requested that total deforestation be avoided.

Response: DEQ has determined that coal ash must be excavated and removed from CCR surface impoundments at the Marshall Steam Station. DEQ will continue to take this and future comments into consideration when evaluating closure plans submitted by Duke, as required by the Coal Ash Management Act.

C. Comments Supporting Excavation and Transport to Dry Lined Storage

Comment: The overwhelming majority of comments requested excavation to dry lined storage away from waterways and groundwater using the following form letter, or a derivation that was substantially similar.

“Dear Coal Ash Comment Administrator North Carolina DEQ: Marshall,

The North Carolina Department of Environmental Quality (DEQ) should require Duke Energy to remove its coal ash from its leaking, unlined pits and move it to dry lined storage away from our waterways and out of our groundwater.

Duke Energy plans to leave its coal ash sitting in the groundwater at six sites in North Carolina, where it will keep polluting our groundwater, lakes, and rivers. Recent monitoring shows Duke Energy is polluting the groundwater at its coal ash ponds in North Carolina with toxic and radioactive materials. We need cleanup—not coverup!

The communities around the coal ash ponds have come out time after time over the last several years, making clear that we’re concerned about pollution from Duke Energy’s coal ash and want Duke Energy to get its coal ash out of its unlined, leaking pits. It is long past time for DEQ and Duke Energy to listen to the communities.

Duke Energy is already required to remove its coal ash at eight other sites in North Carolina and all of its sites in South Carolina—our families and our community deserve the same protections.”

Response: DEQ has determined that coal ash must be excavated and removed from CCR surface impoundments at the Marshall Steam Station. DEQ will continue to take this and future

comments into consideration when evaluating closure plans submitted by Duke, as required by the Coal Ash Management Act.

Comment: Many (non-form letter) comments also requested excavation to dry lined storage or landfills away from waterways.

Response: DEQ has determined that coal ash must be excavated and removed from CCR surface impoundments at the Marshall Steam Station. DEQ will continue to take this and future comments into consideration when evaluating closure plans submitted by Duke, as required by the Coal Ash Management Act.

Comment: Many comments requested excavation to off-site dry lined storage. One specific comment went into significant detail about the commenters concerns regarding the usage of existing on-site storage options.

Response: DEQ has determined that coal ash must be excavated and removed from CCR surface impoundments at the Marshall Steam Station. DEQ has not yet made a decision regarding location for final disposition. DEQ will continue to take this and future comments into consideration when evaluating closure plans submitted by Duke, as required by the Coal Ash Management Act.

D. Comments Supporting Excavation and Removal to On-Site Dry Lined Storage

Comment: One comment expressed support for excavation and transport to dry lined storage on Duke Energy property but requested that the distance the ash is moved be minimized.

Response: DEQ has determined that coal ash must be excavated and removed from CCR surface impoundments at the Marshall Steam Station. DEQ has not yet made a decision regarding location for final disposition. DEQ will continue to take this and future comments into consideration when evaluating closure plans submitted by Duke, as required by the Coal Ash Management Act.

Comment: Numerous commenters submitted the following form letter requesting excavation and on-site dry lined storage, or a derivation that was substantially similar.

Marshall Steam Station Comments

N.C. Department of Environmental Quality

RE: Public Comment on the Marshall Coal Ash Cleanup

- DEQ should require Duke Energy to remove its coal ash from its leaking, unlined pit and move it to dry, lined storage on its own property — away from Lake Norman and out of our groundwater.
- Duke Energy plans to leave its coal ash sitting in the groundwater at Marshall, where it will keep polluting our groundwater, streams and rivers. Recent monitoring shows Duke Energy is polluting the groundwater surrounding Marshall with toxic and radioactive materials. We need cleanup—not coverup!

- The community has come out time after time over the last several years, making clear that we're concerned about pollution from Duke Energy's coal ash and want Duke Energy to get its coal ash out of its unlined, leaking pits. It is long past time for DEQ and Duke Energy to remove the ash.
- Duke Energy is already required to remove its coal ash from eight other communities in North Carolina and all of its sites in South Carolina, and the governor of Virginia recently called for all the coal ash to be removed from Dominion's unlined sites—our families and our community deserve the same protections.
- Duke Energy can dispose all the ash from its leaking pond onsite in safe, dry, lined storage. Ash will not travel through the community or to other communities.
- Duke cannot exaggerate traffic concerns while downplaying the community's real concern: Duke Energy's water pollution. None of these plans will have a significant increase in offsite trucking, but only excavation will remove the source of the water pollution.
- Duke Energy's own experts know that even cap-in-place will involve trucking construction materials to the site—just like any other construction project. But even under their estimates, the additional trucking impacts are minimal. Excavation would cause only a 4% increase in daily truck traffic on community roads compared to a 7% increase for the duration of the cap-in-place scenario.
- It is past time for DEQ to listen to the community—not Duke Energy's consultants—about what our community needs. We need Duke to clean up its coal ash and stop the water pollution.

Response: DEQ has determined that coal ash must be excavated and removed from CCR surface impoundments at the Marshall Steam Station. DEQ has not yet made a decision regarding location for final disposition. DEQ will continue to take this and other comments into consideration when evaluating closure plans submitted by Duke, as required by the Coal Ash Management Act.

E. Comments in Support of Beneficial Reuse

Comment: Several comments supported excavation of ash to a lined landfill or being recycled into concrete or other building materials.

Response: DEQ has determined that coal ash must be excavated and removed from CCR surface impoundments at the Marshall Steam Station. DEQ agrees that it is proper for Duke Energy to consider possible methods to beneficiate coal ash into a product.

Comment: One comment requested the ash be recycled into concrete but did not express any opinions on other closure plans.

Response: DEQ agrees that it is proper for Duke Energy to consider possible methods to beneficiate coal ash into a product.

F. Other Comments

Comment: Numerous comments cited concerns or personal experiences with thyroid cancer and other risks, stating that it was DEQ's responsibility to protect the public. Most comments citing these concerns expressed a preference for excavation.

Response: DEQ understands and appreciates the need for a remedy that addresses adverse impacts to water quality, human health, and the environment. DEQ will require Duke Energy to comply with all applicable laws and regulations during the closure process. At this time, DEQ has determined that coal ash must be excavated and removed from CCR surface impoundments at the Marshall Steam Station.

Comment: Several comments expressed concerns with Duke Energy passing on removal costs to consumers or requested that Duke Energy pay all costs of the cleanup.

Response: This issue is not within the purview of DEQ. Instead, this issue rests with the North Carolina Utilities Commission.

Comment: Several comments expressed concerns with or complaints regarding the public meeting process (preparedness, information presented, brevity of presentation, lack of answers to questions) or requested that DEQ provide additional information to the public.

Response: DEQ will take this feedback into account for future public meetings.

Comment: One comment requested additional information regarding effective filtration systems.

Response: DEQ does not typically identify or require specific filtration systems or products.

Comment: Several comments did not express a preference for a specific closure option but requested that DEQ clean up, or make sure that Duke Energy cleans up, the Marshall Steam Station site.

Response: DEQ will require Duke Energy to comply with all applicable laws and regulations during the closure process.

Comment: Several comments requested cleanup of a potential ash site near Lake Norman High School.

Response: DEQ has been made aware of this concern and will investigate.

Comment: Several comments expressed concern with Duke Energy clearcutting forest during the cleanup process.

Response: DEQ understands this concern and will continue to protect the natural resources of the State of North Carolina. DEQ will require Duke Energy to comply with all applicable laws and regulations during the closure process. DEQ will continue to take this and future comments into consideration when evaluating closure plans submitted by Duke, as required by the Coal Ash Management Act.

Comment: Several comments expressed concerns with ancillary impacts of closure, including air quality and traffic.

Response: DEQ will require Duke Energy to comply with all applicable laws and regulations during the closure process. DEQ will continue to take this and future comments into consideration when evaluating closure plans submitted by Duke, as required by the Coal Ash Management Act.

Comment: One comment provided an in-depth analysis regarding options pertaining to different types of capping in place and expressed an opinion that, if a site were capped in place, an evaluation of all technologies available for dewatering should be considered.

Response: DEQ appreciates the information presented and will continue to take this and future comments into consideration when evaluating closure plans submitted by Duke, as required by the Coal Ash Management Act.

Comment: Several comments raised concerns regarding worker safety in and around ash basins.

Response: DEQ appreciates this concern and will take these comments into consideration when it reviews Duke Energy's closure plans.

Comment: One comment requested that DEQ ignore a Duke Energy report on estimated greenhouse gas emissions associated with various closure options for the six unresolved coal ash sites. The comment claimed DEQ should disregard this submission because it was made after DEQ's deadline for Duke Energy to submit its materials and outside the public comment period, thereby denying the public an opportunity to respond to it. The comment also claimed that DEQ should disregard this submission because it is irrelevant to the decision facing DEQ, which is to select a closure method that stops the ongoing pollution and continuing threat to our water resources posed by Duke Energy's leaking coal ash basins.

Response: At this time, DEQ has determined that coal ash must be excavated and removed from CCR surface impoundments at the Marshall Steam Station. DEQ will require Duke Energy to comply with all applicable laws and regulations during the closure process.