

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

Roxboro 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. Pursuant to N.C. Gen. Stat. § 130A-309.213(d)(1), the CCR surface impoundments located at Duke Energy's Roxboro Steam Station (Roxboro) in Person County, NC received a low-risk classification. Therefore, according to N.C. Gen. Stat. § 130A-309.214(a)(3), the closure option for CCR surface impoundments is at the election of the North Carolina Department of Environmental Quality (DEQ or Department). 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 impoundments. DEQ held a public information session on January 24, 2019 in Roxboro, NC where the community had the opportunity to learn about options for closing 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 CCR surface impoundments at Roxboro 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 unlined impoundments at Roxboro 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 impoundments at Roxboro 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 two CCR surface impoundments at Roxboro 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 impoundments at the Roxboro site, and the election by DEQ for the final closure option.

II. Site History

Duke Energy Progress, LLC (Duke Energy) owns and operates Roxboro Steam Station (Roxboro or Site), which is located at 1700 Dunnaway Road in Semora, Person County, North Carolina. The Site consists of approximately 6,095 acres situated between McGhees Mill Road to the east, Concord-Ceffo Road to the south, Semora Road to the west, and Hyco Lake to the north. Roxboro began operations in 1966 as a coal-fired electrical generating station with additional generating units added in 1968, 1973, and 1980. Roxboro has a combined electric generating capacity of 2,422 megawatts.

Roxboro has two CCR surface impoundments: the East Ash Basin (EAB), which was constructed in 1964, and the West Ash Basin (WAB), which was constructed in 1973. Duke Energy sluiced CCR into the EAB until the 1980s, at which time, Roxboro transitioned to dry fly ash handling. Duke Energy constructed an industrial landfill partially within the waste boundary of the EAB, which isolated part of the EAB and created the “EAB Eastern Extension Impoundment.” To add storage capacity, Duke Energy modified the WAB in 1986 by installing a filter dike, which created the “WAB Southern Extension Impoundment. In 2008, Duke Energy installed Flue gas desulfurization (FGD) technology to reduce SO₂ emissions for all the steam units. Duke Energy continues to sluice bottom ash into the WAB.

Collectively, the EAB and WAB at Roxboro contain approximately 20,045,000 tons of CCR. The two CCR surface impoundments at Roxboro are subject to the requirements of N.C. Gen. Stat. § 130A-309.214(a)(3) with the exception of CCR in the landfills above the East Ash Basin.

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 otherwise 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 impoundments at Roxboro 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) 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]. 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* 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 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 24, 2019 – DEQ public meeting near Roxboro Steam Station
- 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 Roxboro that are either CCR surface impoundments or hydrologically connected to CCR surface 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 Roxboro 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 East Ash Basin. All of these references are part of the record supporting DEQ’s determination.

DEQ conducted a public meeting in Roxboro, NC on January 24, 2019. Approximately 40 members of the public attended the meeting. Approximately 950 comments were received during the comment period, which closed on February 15, 2019. The majority of commenters requested that the coal ash be removed from the CCR surface impoundments and moved to dry lined storage away from waterways and groundwater. Only two commenters specifically requested closure-in-place. No commenters requested the hybrid option. A summary of and response to public 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 impoundments at Roxboro. 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 East Ash Basin and the West Ash Basin at Roxboro in accord with N.C. Gen. Stat. § 130A-309.214(a)(3). For purposes of DEQ's closure determination, the term "East Ash Basin" includes the so called "EAB Eastern Extension Impoundment" and the term "West Ash Basin" includes the so called "WAB Southern Extension Impoundment." 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 unlined impoundments at Roxboro 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.

For the East Ash Basin at Roxboro, DEQ does not elect CAMA Option B. 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 the East Ash Basin.

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 East Ash Basin.

For the West Ash Basin at Roxboro, DEQ does not elect CAMA Option B. The footprint of the West Ash Basin at Roxboro is in Sargent's Creek, a natural drainage way. The NC floodplain map depicts a 100-year flood elevation to occur within the West Ash Basin. The basin is located in the arm of a reservoir, and currently holds approximately 7,310,000 tons of coal ash. The impoundment is directly adjacent to waters of the state. From a dam safety perspective, the embankment is 70 feet tall and has a volume of 5,567 acre feet; therefore, it is large in size with downstream hazards being environmental concerns. The off-site drainage area for the West Ash Basin is 345.6 acres. While there are limited exceedances of the 2L standard beyond the compliance boundary for this impoundment, DEQ believe CAMA Option A is the most appropriate closure method for this impoundment. Excavation of impoundments located in or near 100-year flood plains would be the consistent closure method. There are six other facilities in North Carolina with CCR surface impoundments that are in or immediately adjacent to the 100-year flood plain. Four of those sites are already excavating the coal ash from the impoundments. The remaining two sites are Roxboro and Marshall. DEQ is electing CAMA Option A for these two sites because it represents the more protective closure method.

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 impoundments at Roxboro. 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 CAMA 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 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. Conclusion

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 West Ash Basin and the East Ash Basin at Roxboro 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 Results

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 those closure options would prevent any post-closure exceedances of groundwater standards beyond the compliance boundary upon full implementation of the closure plan. 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 Roxboro October 2017 CSA Update Report (available on the DEQ website).

There are two CCR surface impoundments at Roxboro: the East Ash Basin (EAB) and the West Ash Basin (WAB). The vertical extent of constituents of interest (COIs) has been reasonably defined for both surface impoundments. However, each impoundment has unique groundwater conditions which are addressed below.

East Ash Basin (EAB)

Prior to the construction of the EAB, groundwater and surface water discharge from the area flowed into the Hyco River. The EAB was created by damming a stream segment in that area. Surficial flow for the EAB has been diverted where a portion of the discharge travels through the eastern discharge canal to the intake canal. Boron concentrations above 2L Standards approximates the leading edge of the CCR plume at the site. Almost all COIs are present in the shallow flow layer. The horizontal extent of those COIs is generally within the footprint of the boron plume.

Based on review of data submitted to date, both soil and groundwater have been impacted by CCR handling activities at the site. Groundwater within the area of the EAB generally flows north toward the cooling water intake canal and pond which eventually flow to Hyco Lake. Boron, sulfate, strontium and total dissolved solids (TDS) have been detected above the 2L Standards downgradient beyond the compliance boundary in the both transition zone and bedrock monitoring wells.

DEQ concludes that the contaminated groundwater plume above 2L standards has extended beyond the compliance boundary along the northern edge of the impoundment. Based on Figure ES-1, this plume extends along the majority of the length of the EAB.

West Ash Basin (WAB)

The West Ash Basin (WAB) was created by damming the flow path for Sargents Creek that discharged to Hyco River. The surficial flow now travels around the WAB by way of the western discharge canal which discharges to the heated water pond on the north side of the WAB. The CSA groundwater investigation appears to demonstrate that a portion of groundwater flow continues to migrate into Hyco Lake. Groundwater within the area of the WAB generally flows northeast toward the heating water discharge pond which eventually flows to Hyco Lake.

Boron, sulfate and TDS have been detected greater than the 2L Standards in bedrock monitoring wells underlying the WAB and downgradient in the transition zone. However, there have been limited exceedances of the 2L standards beyond the compliance boundary.

II. Groundwater Cross Section Modeling

DEQ evaluated cross-sections of the groundwater modeling results provided by Duke Energy to determine whether Duke Energy's final closure *Option 1: Closure-in-Place* and *Option 3: Hybrid* for the EAB would meet the criteria of CAMA Option B. DEQ considered whether the proposed closure option would prevent any post closure exceedances of the 2L groundwater quality standards at the compliance boundary upon full closure implementation. Cross sections A-A' and B-B' were evaluated and can be seen in the figures below. These cross sections represent 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=100 years
- upon completion of the hybrid option at t=0 years
- hybrid option at t=100 years

The tables below summarize 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.

Roxboro 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	105	660
Completion of Final Cover (t=0 yrs)	700-4,000	100	670
Final Cover (t=100 yrs)	700-4,000	105	300
Completion of Hybrid (t=0 yrs)	700-4,000	85	670
Hybrid (t=100 yrs)	700-4,000	105	400

bgs – below ground surface

Roxboro Modeling Results for Cross-Section B-B'			
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	4,000-10,000	250	2260
Completion of Final Cover (t=0 yrs)	4,000-10,000	280	2290
Final Cover (t=100 yrs)	700-4,000	360	1200
Completion of Hybrid (t=0 yrs)	10,000-40,000	280	2260
Hybrid (t=100 yrs)	4,000-10,000	380	1270

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 100 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 for the EAB can meet the requirements of CAMA Option B.

Figure ES-1: Roxboro Steam Station October 2017 CSA Update Report

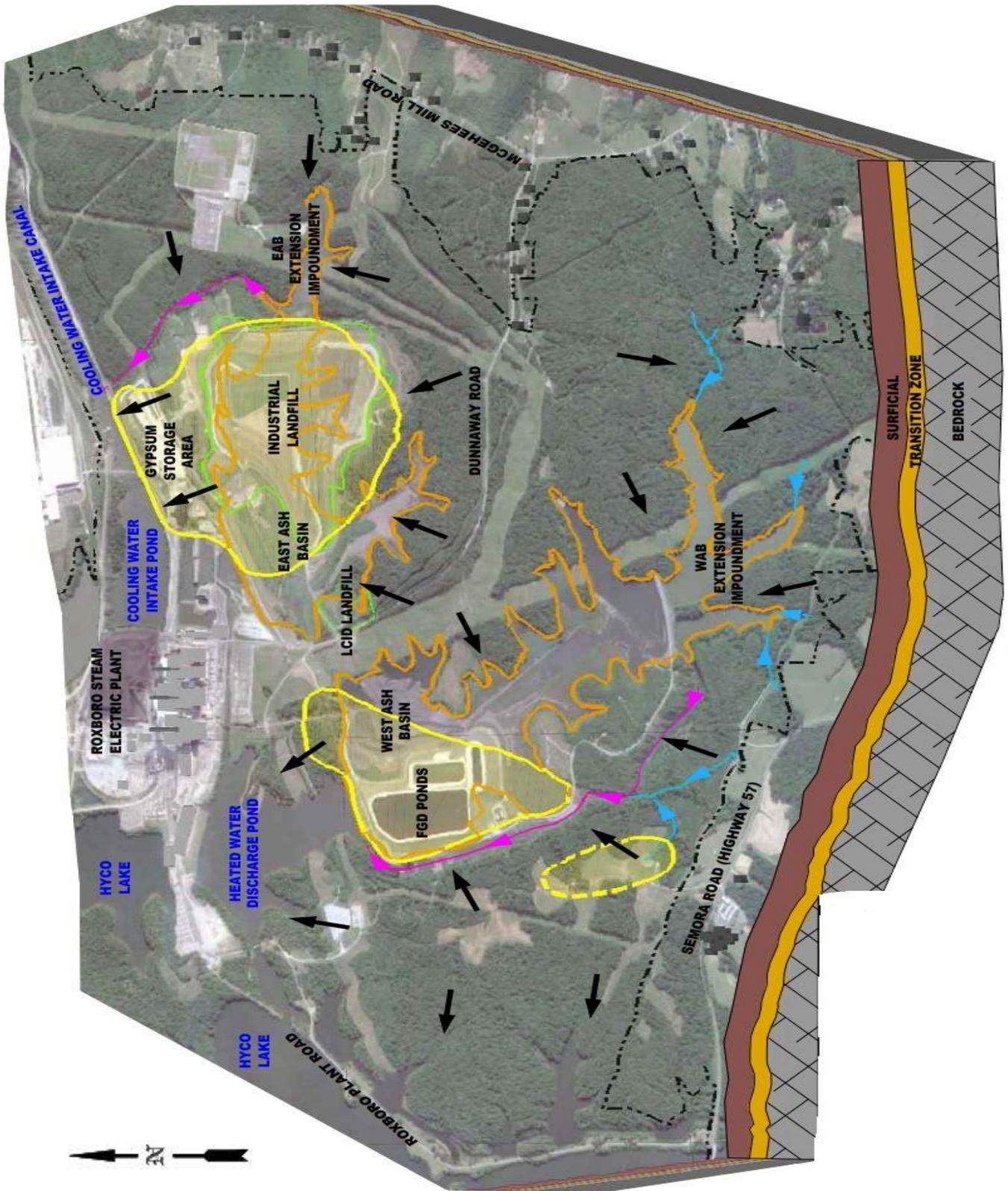
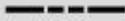


Figure ES-1 Legend: Roxboro Steam Station October 2017 CSA Update Report

LEGEND

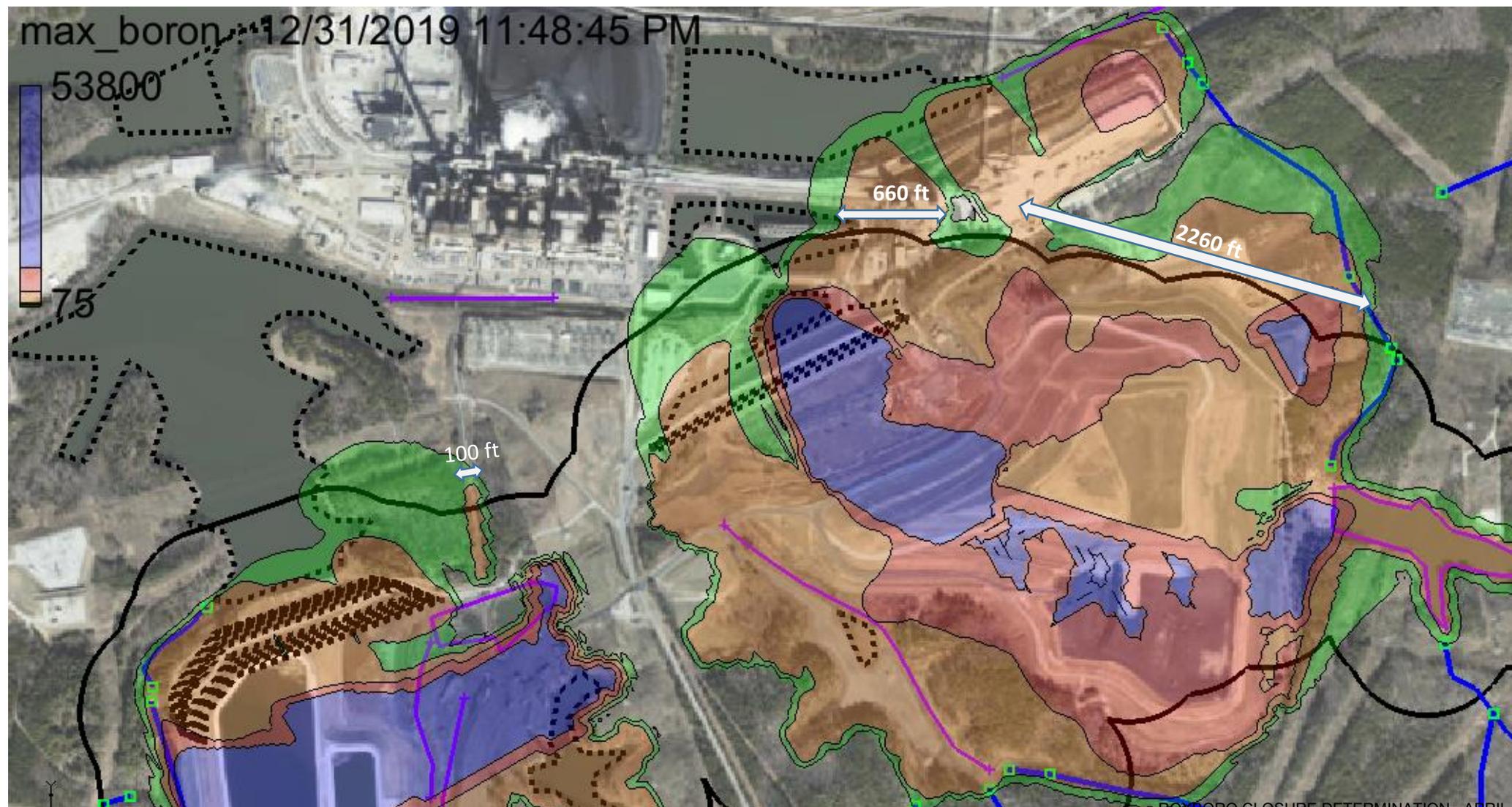
-  AREA OF CONCENTRATION IN GROUNDWATER ABOVE NC2L (SEE NOTE 5)
-  INFERRED AREA OF CONCENTRATION IN GROUNDWATER ABOVE NC2L (SEE NOTE 5)
-  ASH BASIN WASTE BOUNDARY
-  APPROXIMATE LANDFILL WASTE BOUNDARY
-  GENERALIZED GROUNDWATER FLOW DIRECTION
-  RESIDENTIAL UNIT
-  DESIGNATED EFFLUENT CHANNEL WITH FLOW DIRECTION
-  STREAM WITH FLOW DIRECTION
-  DUKE ENERGY PROPERTY BOUNDARY

NOTE:

1. OCTOBER, 2016 AERIAL PHOTOGRAPHY OBTAINED FROM GOOGLE EARTH PRO ON SEPTEMBER 27, 2017, DATED JUNE 13, 2016.
2. STREAM FROM WSP SURVEY, 2014.
3. GENERALIZED GROUNDWATER FLOW DIRECTION BASED ON APRIL 10, 2017 WATER LEVEL DATA.
4. PROPERTY BOUNDARY PROVIDED BY DUKE ENERGY.
5. GENERALIZED AREAL EXTENT OF MIGRATION REPRESENTED BY NCAC 02L EXCEEDANCES OF BORON, SULFATE, OR TOTAL DISSOLVED SOLIDS (TDS).

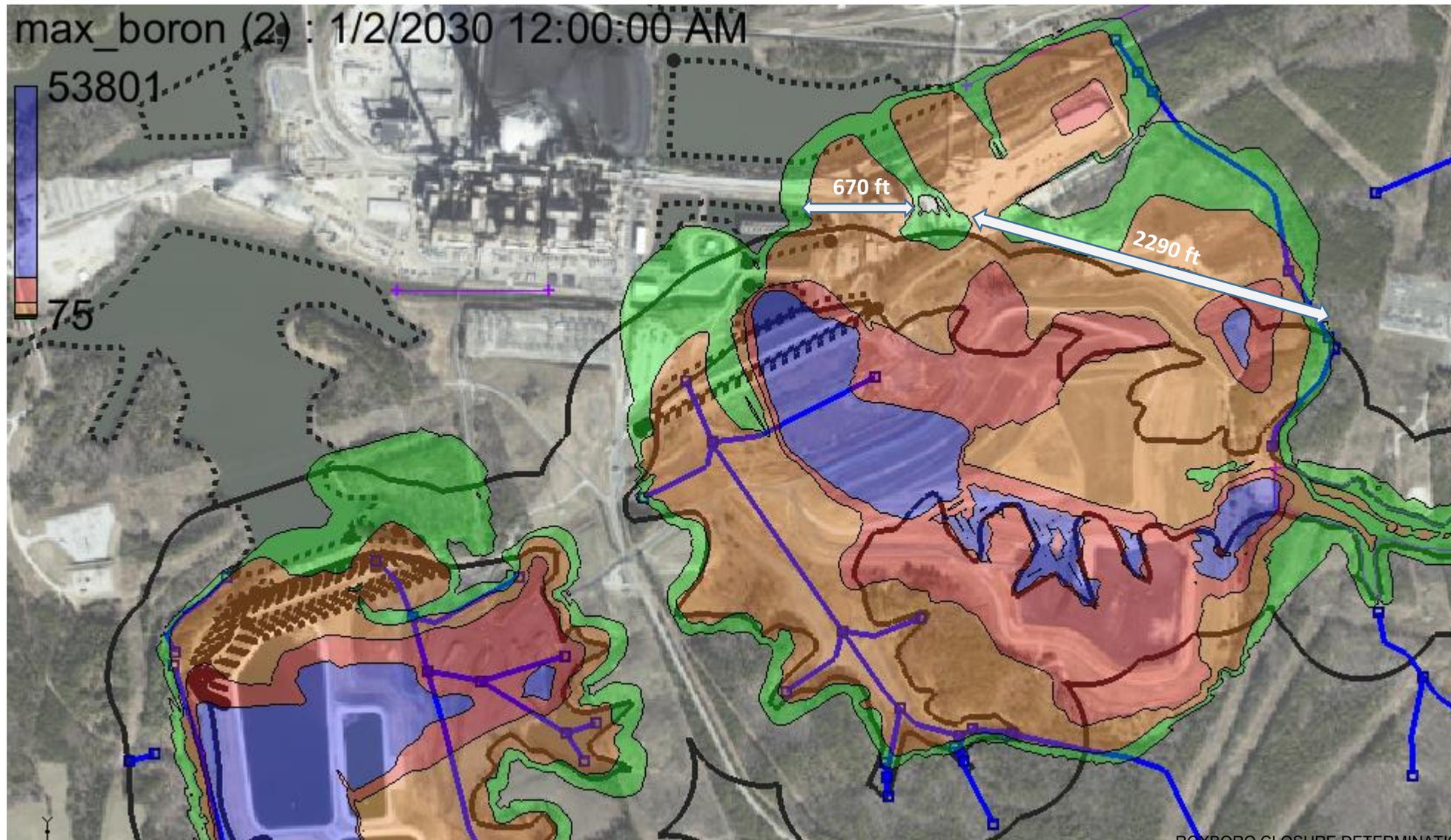
ROXBORO CURRENT CONDITIONS IN 2019

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



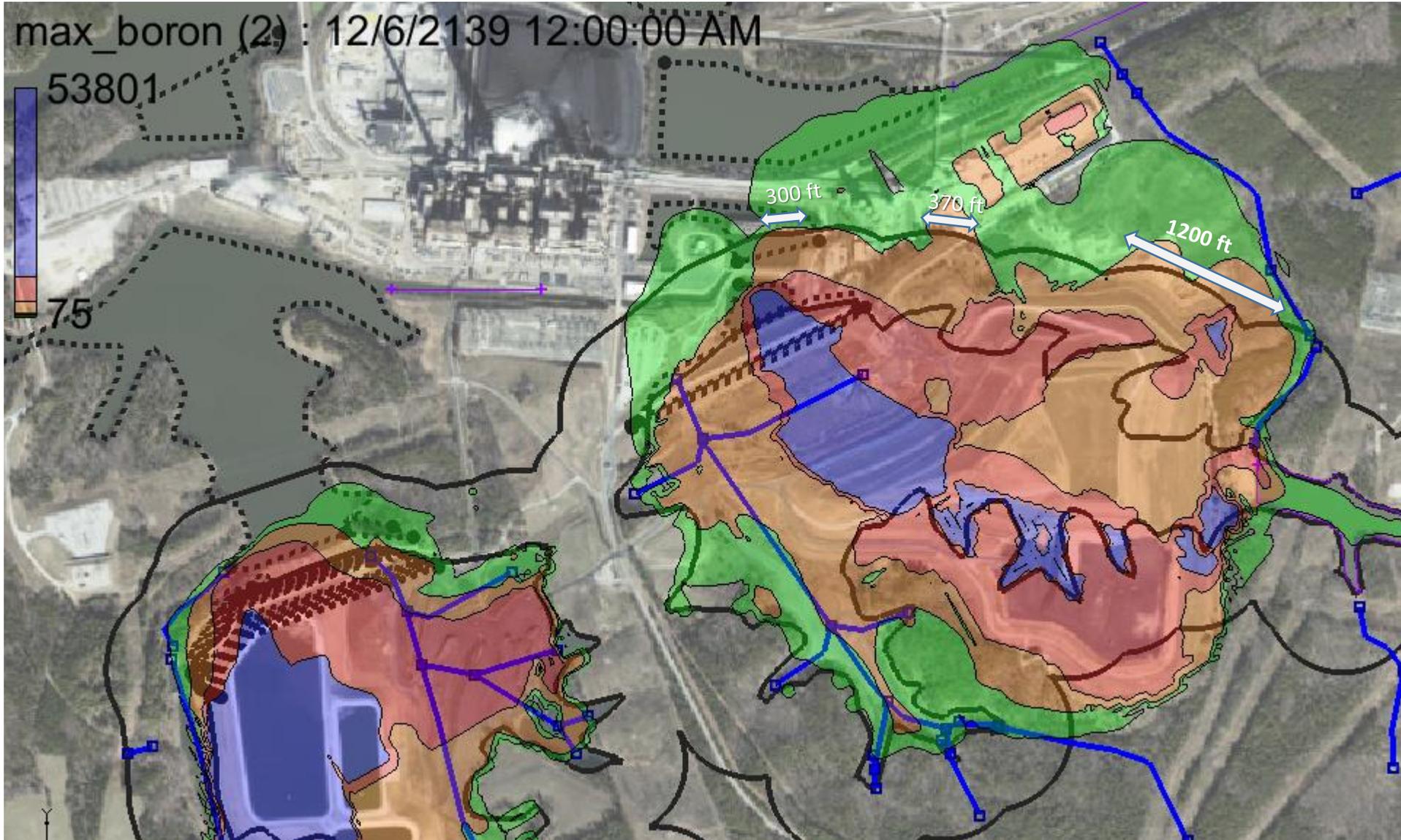
ROXBORO **UPON COMPLETION OF FINAL COVER IN 2030, t = 0**

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



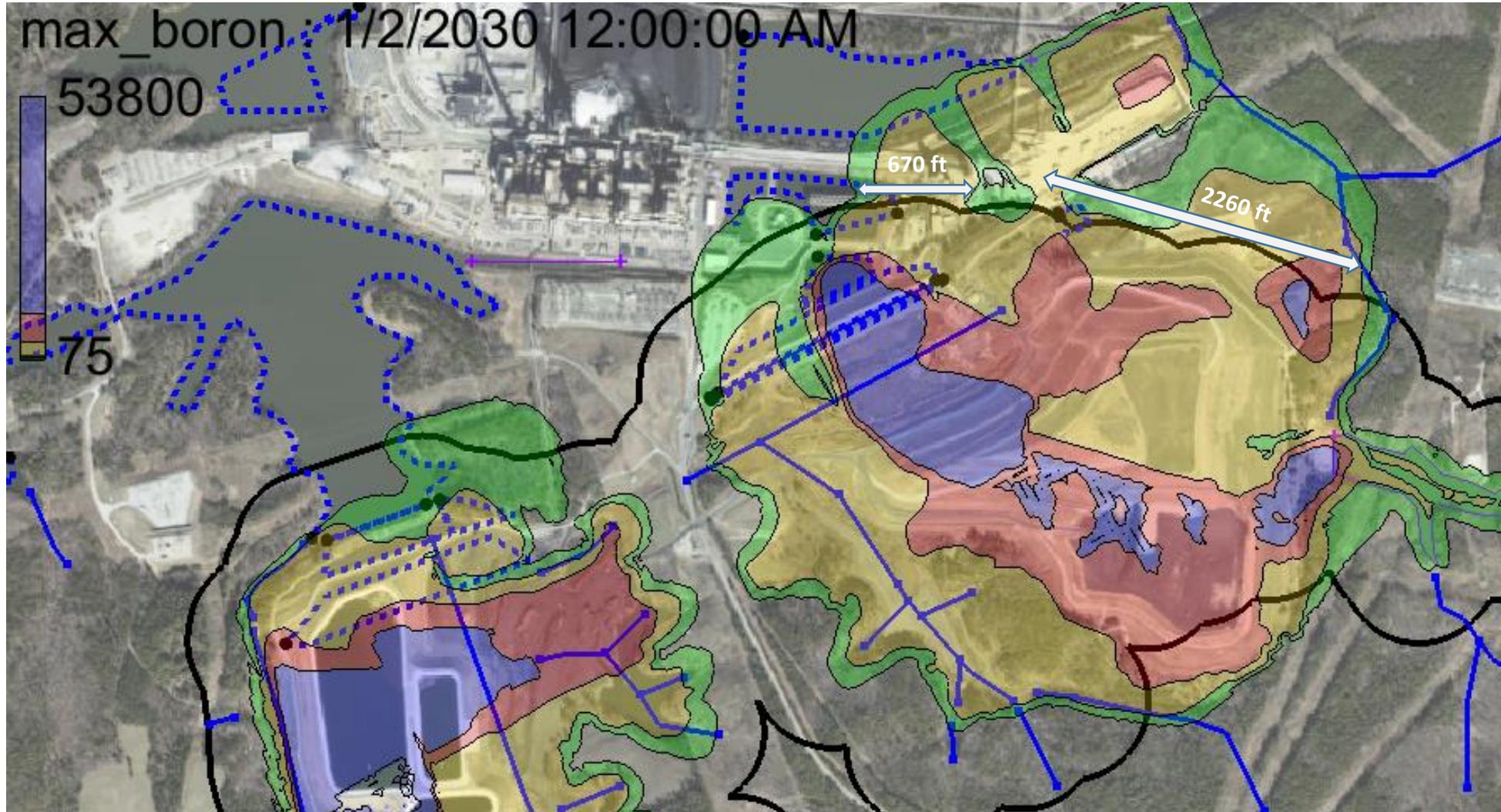
ROXBORO **FINAL COVER IN 2130, t = 100 years**

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



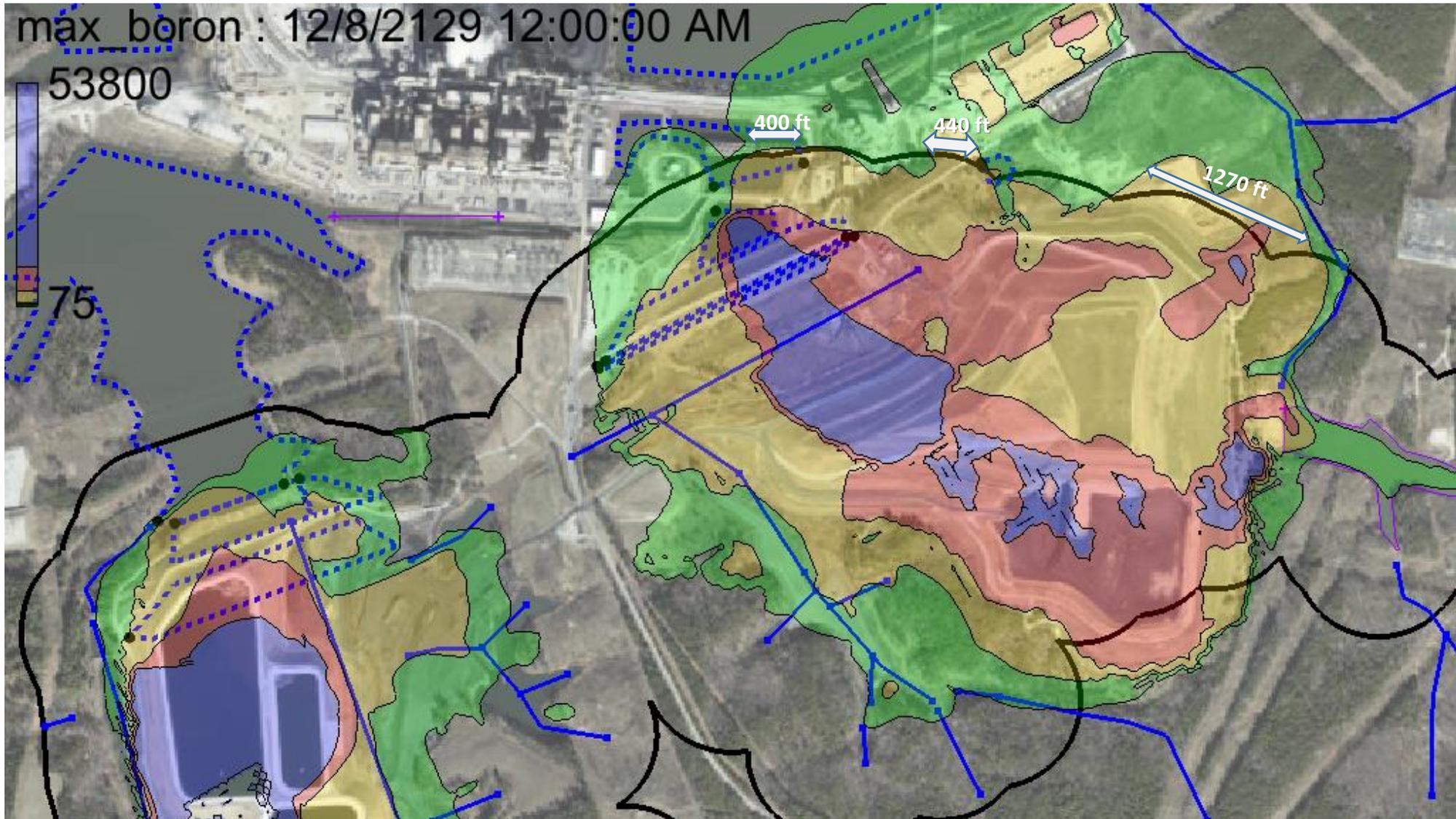
ROXBORO **UPON COMPLETION OF HYBRID IN 2030, t = 0**

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



ROXBORO **HYBRID IN 2130, t = 100 years**

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



ROXBORO CURRENT CONDITIONS, 2019

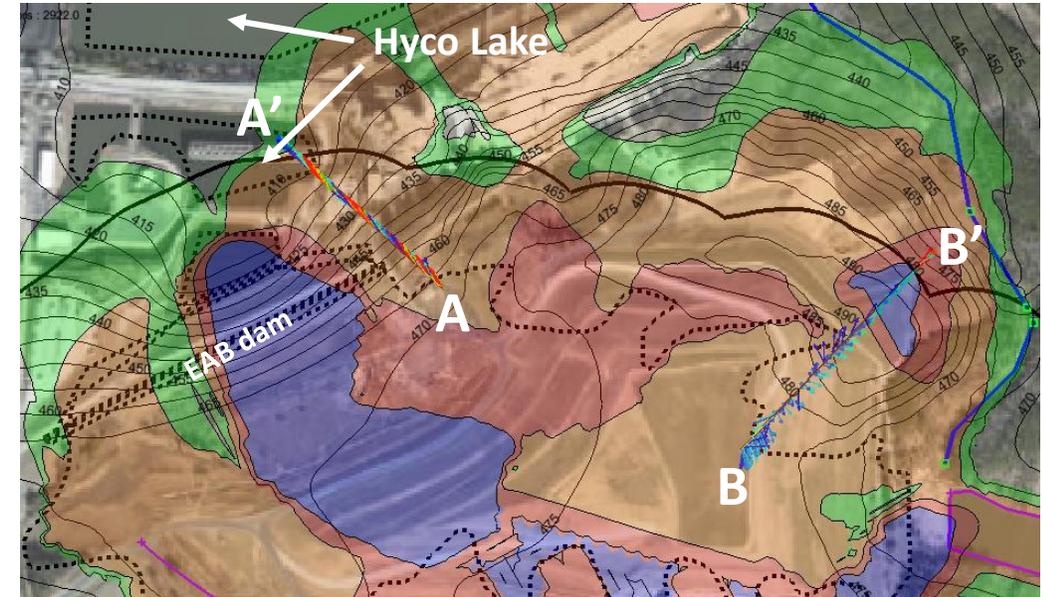
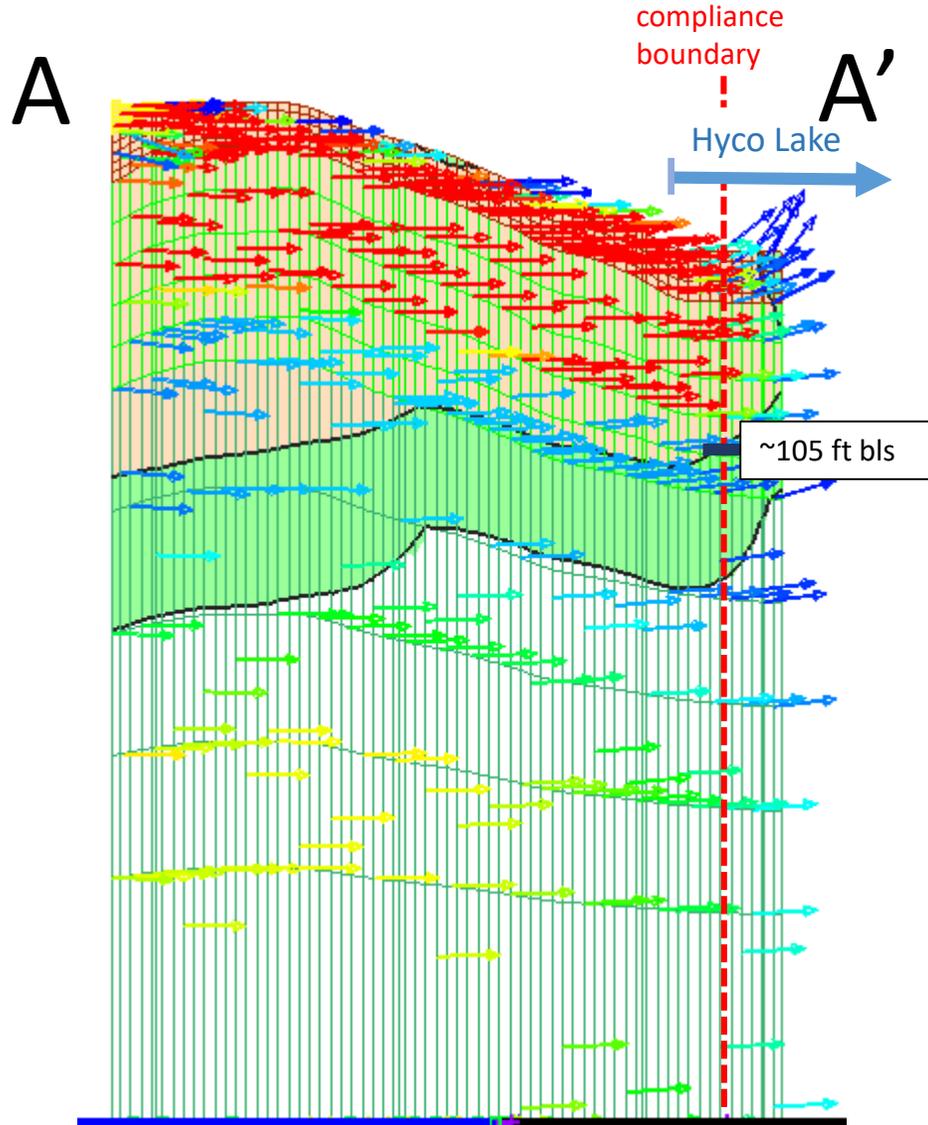
CROSS SECTION A-A' (VIEWED FROM NE SIDE OF CROSS SECTION LOOKING TO SW)

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

Roxboro model layers:

- Ash 1-8
- Saprolite 9-11
- TZ 12-13
- Bedrock 14-23

Vertical
exaggeration X 3



A-A' ~950 ft
B-B' ~1200 ft

ROXBORO UPON COMPLETION OF FINAL COVER, 2030, t = 0

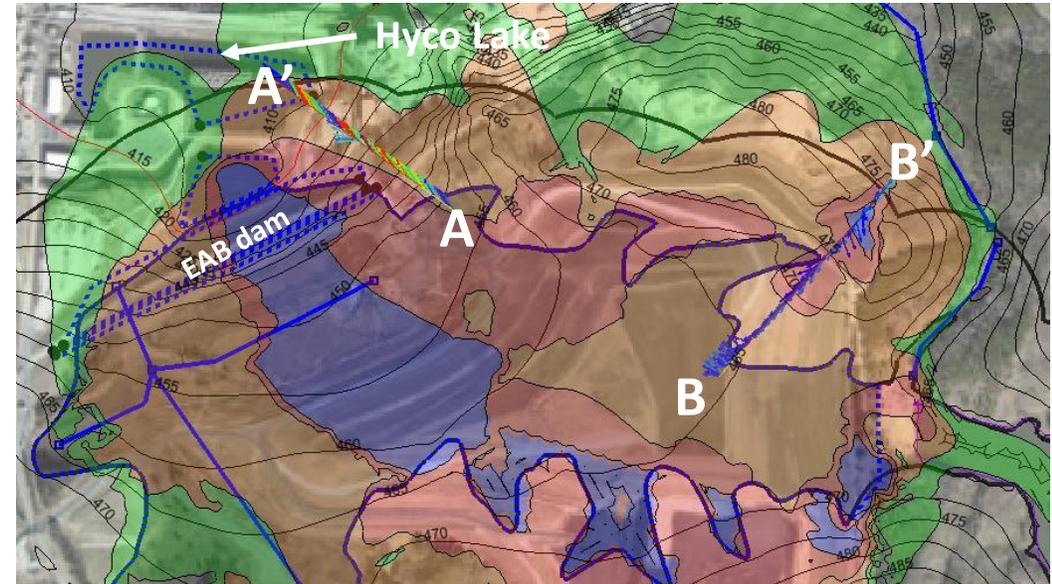
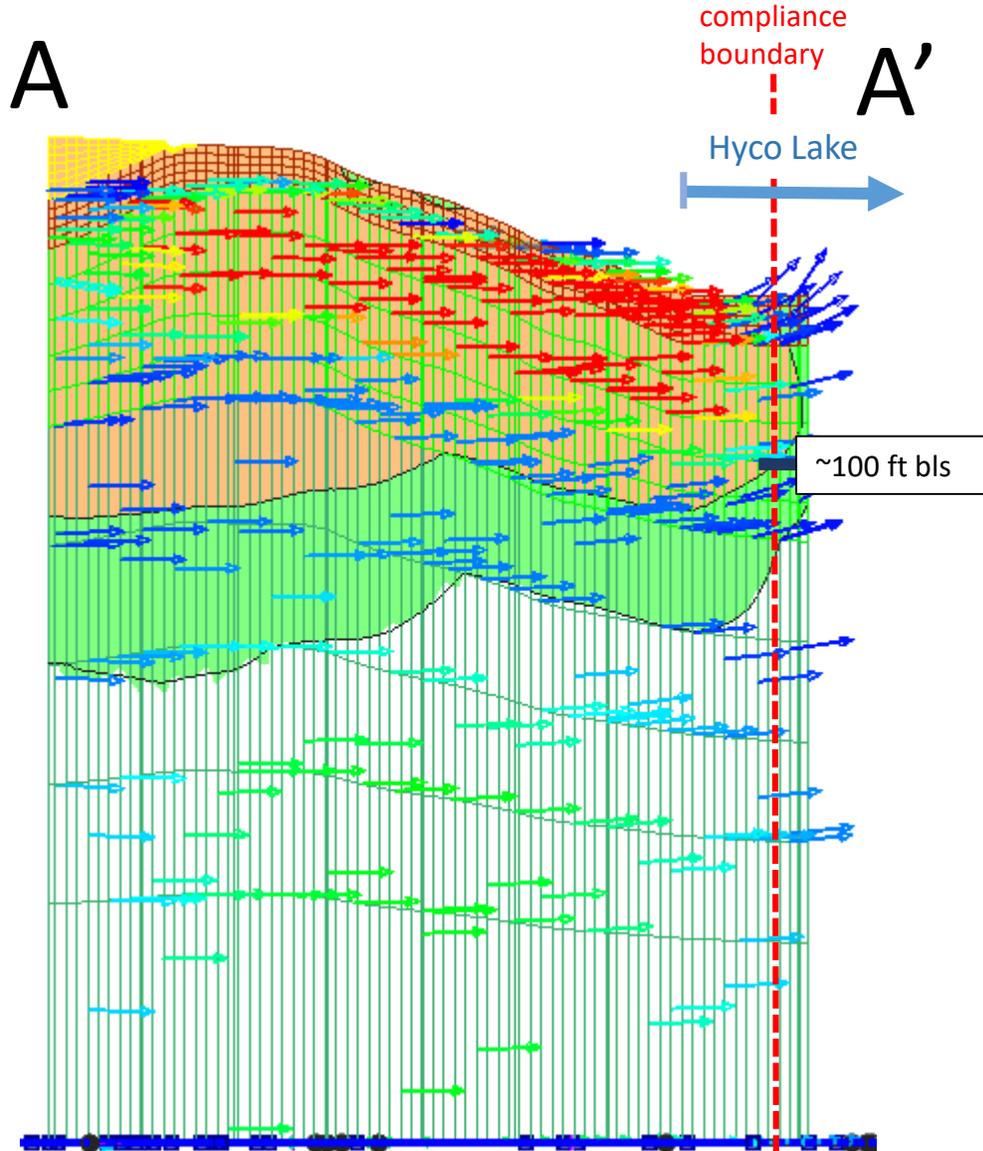
CROSS SECTION A-A' (VIEWED FROM NE SIDE OF CROSS SECTION LOOKING TO SW)

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Vertical exaggeration X 3



A-A' ~950 ft
B-B' ~1200 ft

ROXBORO FINAL COVER, 2130, t = 100 years

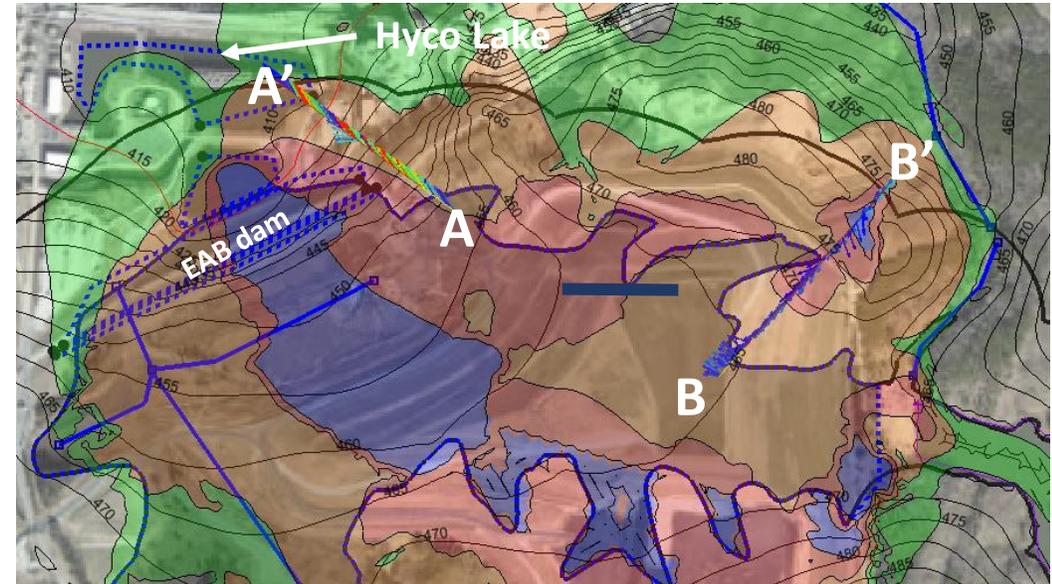
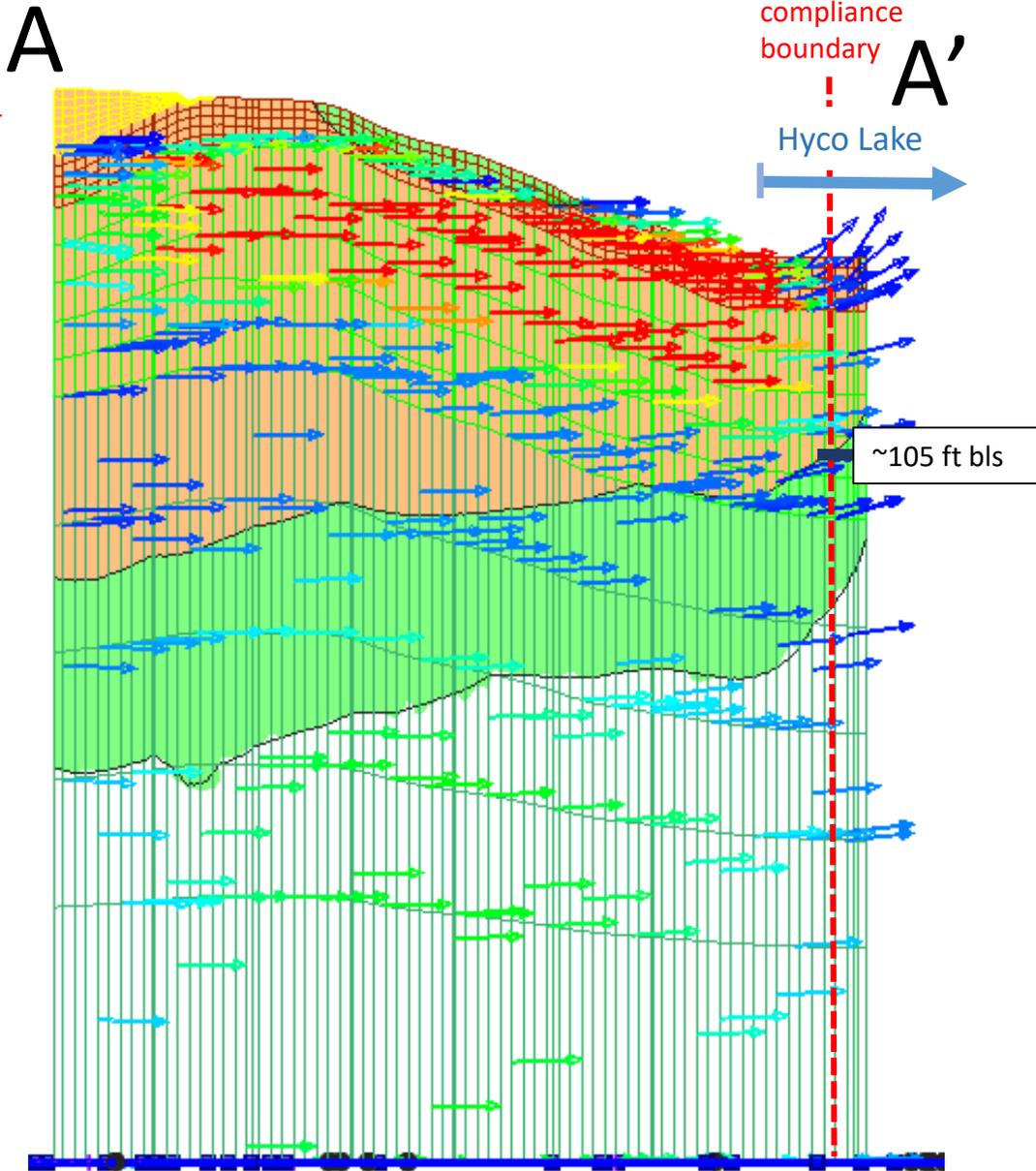
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- TZ 12-13
- Bedrock 14-23

Vertical
exaggeration X 3



A-A' ~1000 ft
B-B' ~1200 ft

ROXBORO **UPON COMPLETION OF HYBRID, 2030, t = 0**

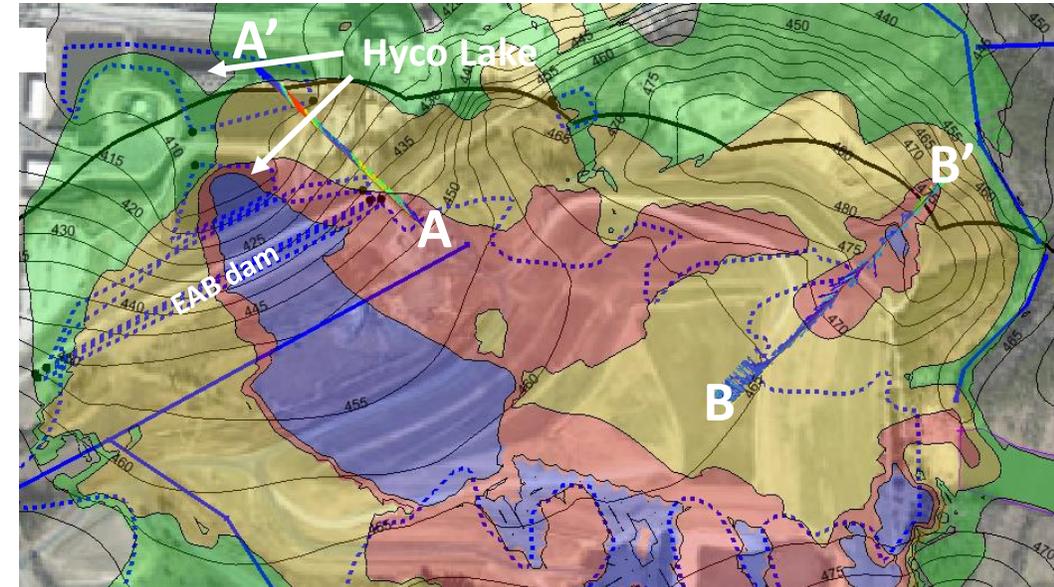
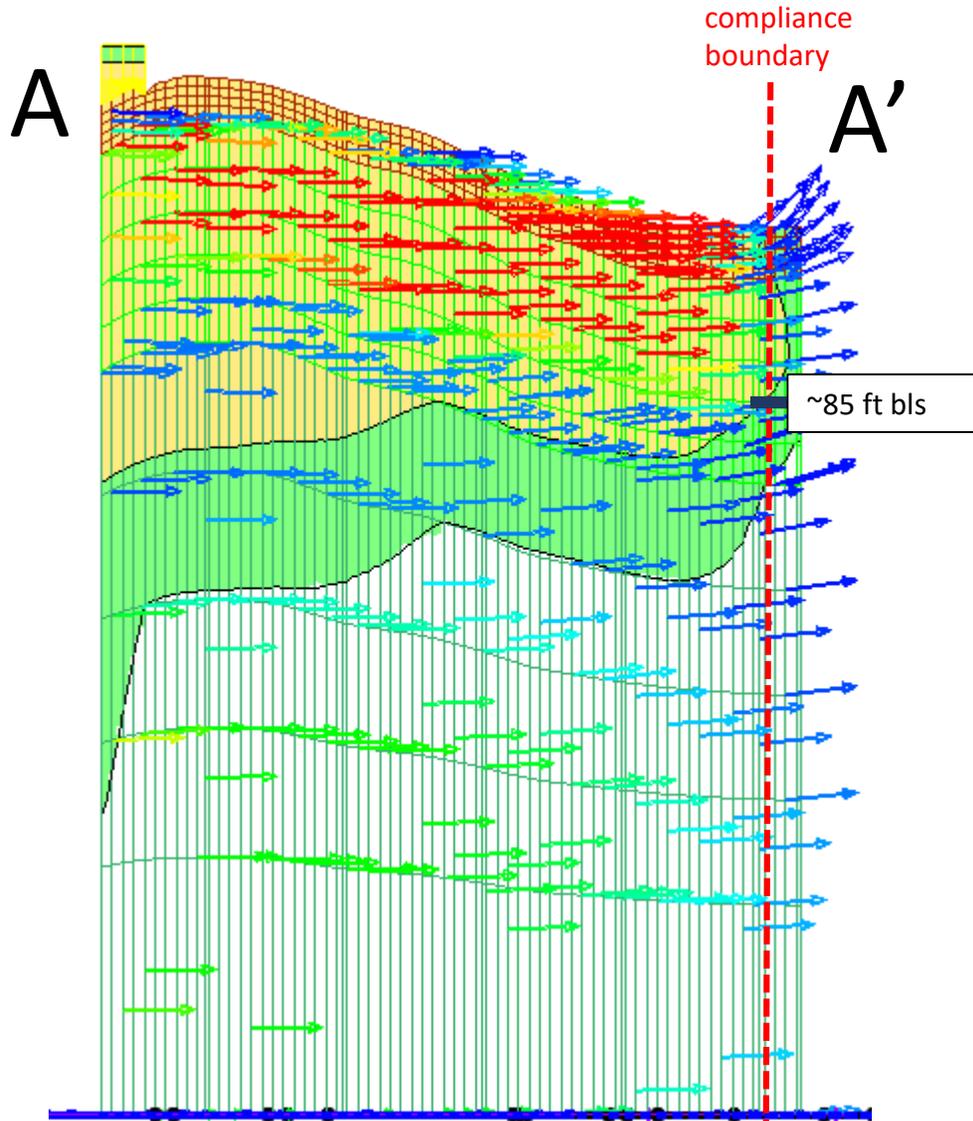
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- TZ 12-13
- Bedrock 14-23

Vertical
exaggeration X 3



A-A' ~950 ft
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ROXBORO **HYBRID, 2130, t = 100 years**

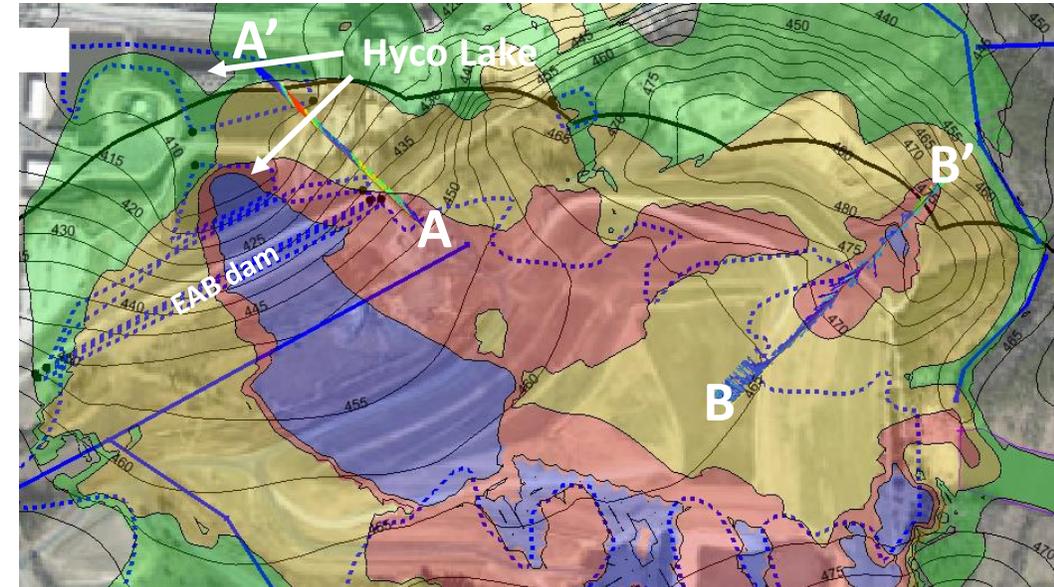
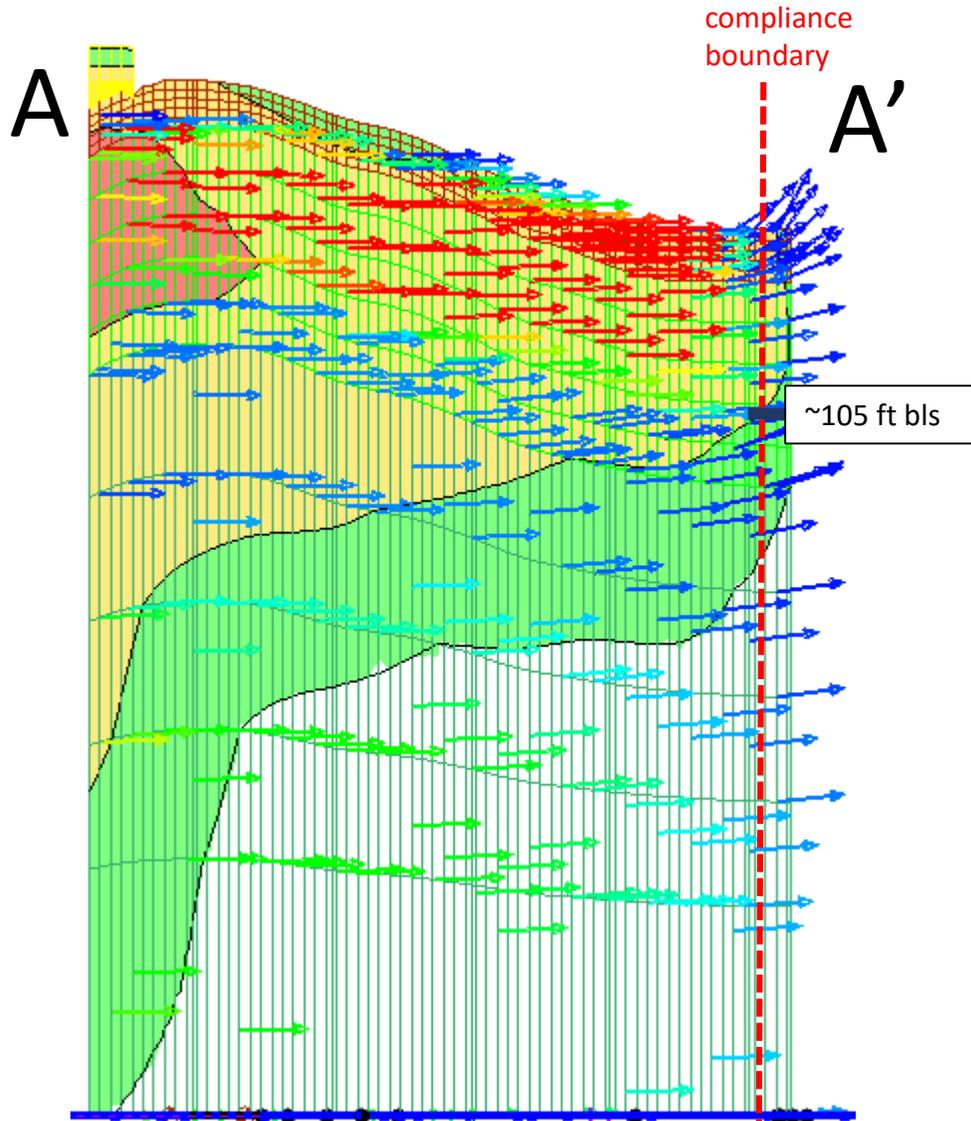
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Vertical
exaggeration X 3



A-A' ~950 ft
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ROXBORO CURRENT CONDITIONS, 2019

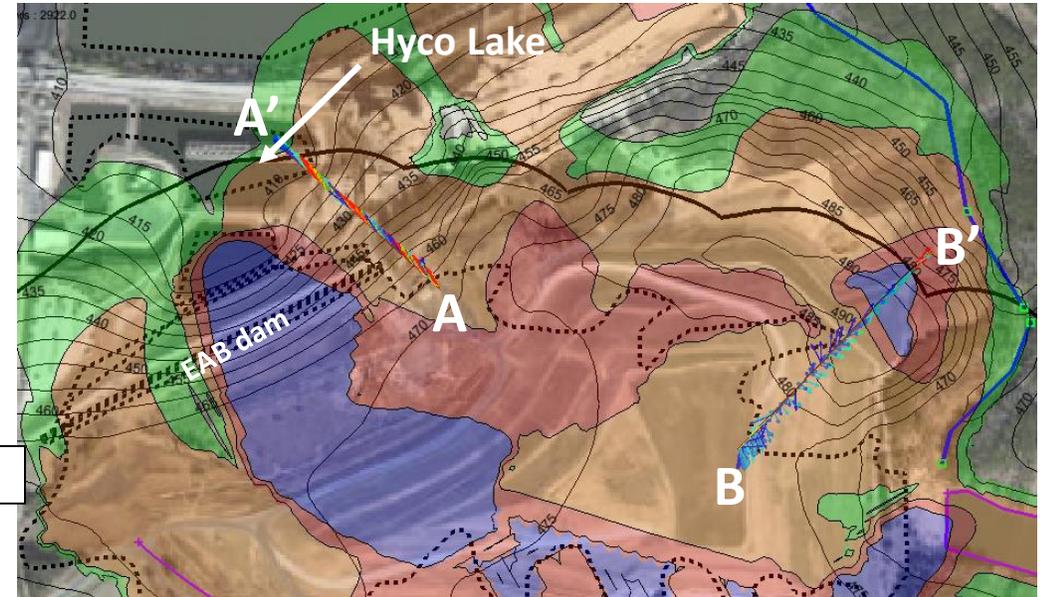
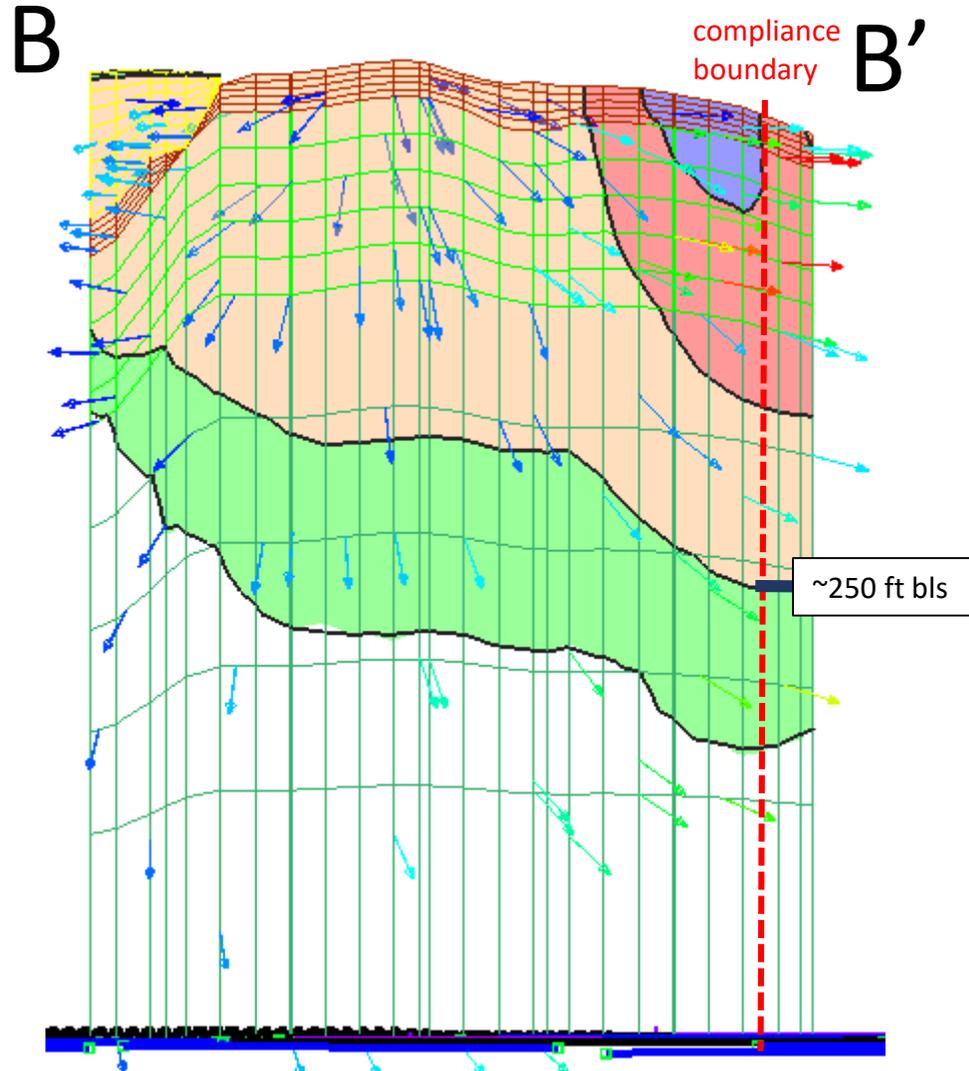
CROSS SECTION B-B' (VIEWED FROM SE SIDE OF CROSS SECTION LOOKING TO NW)

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Roxboro model layers:

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- TZ 12-13
- Bedrock 14-23

Vertical
exaggeration X 3



A-A' ~950 ft
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ROXBORO **UPON COMPLETION OF FINAL COVER, 2030, t = 0**

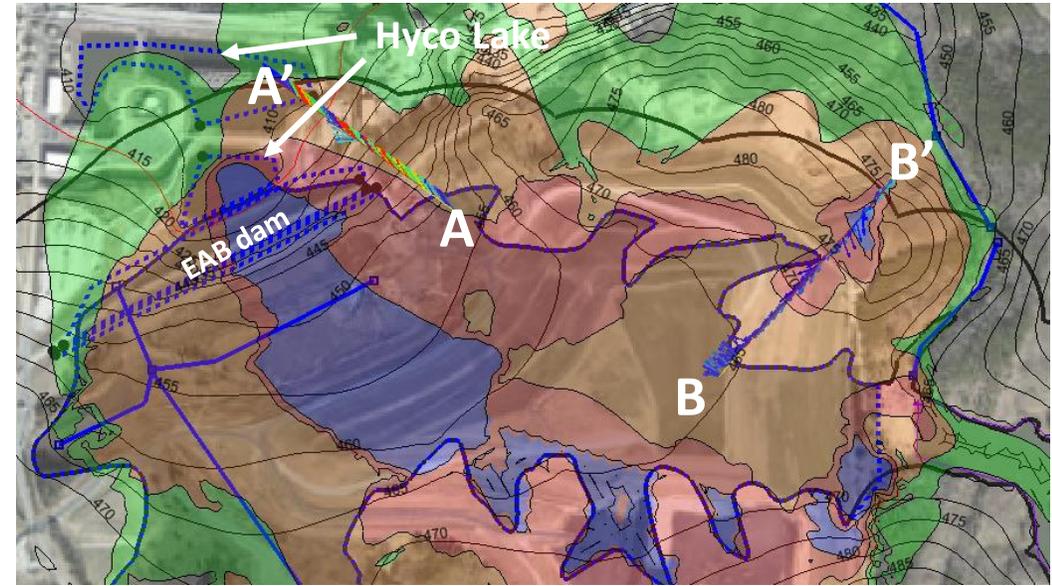
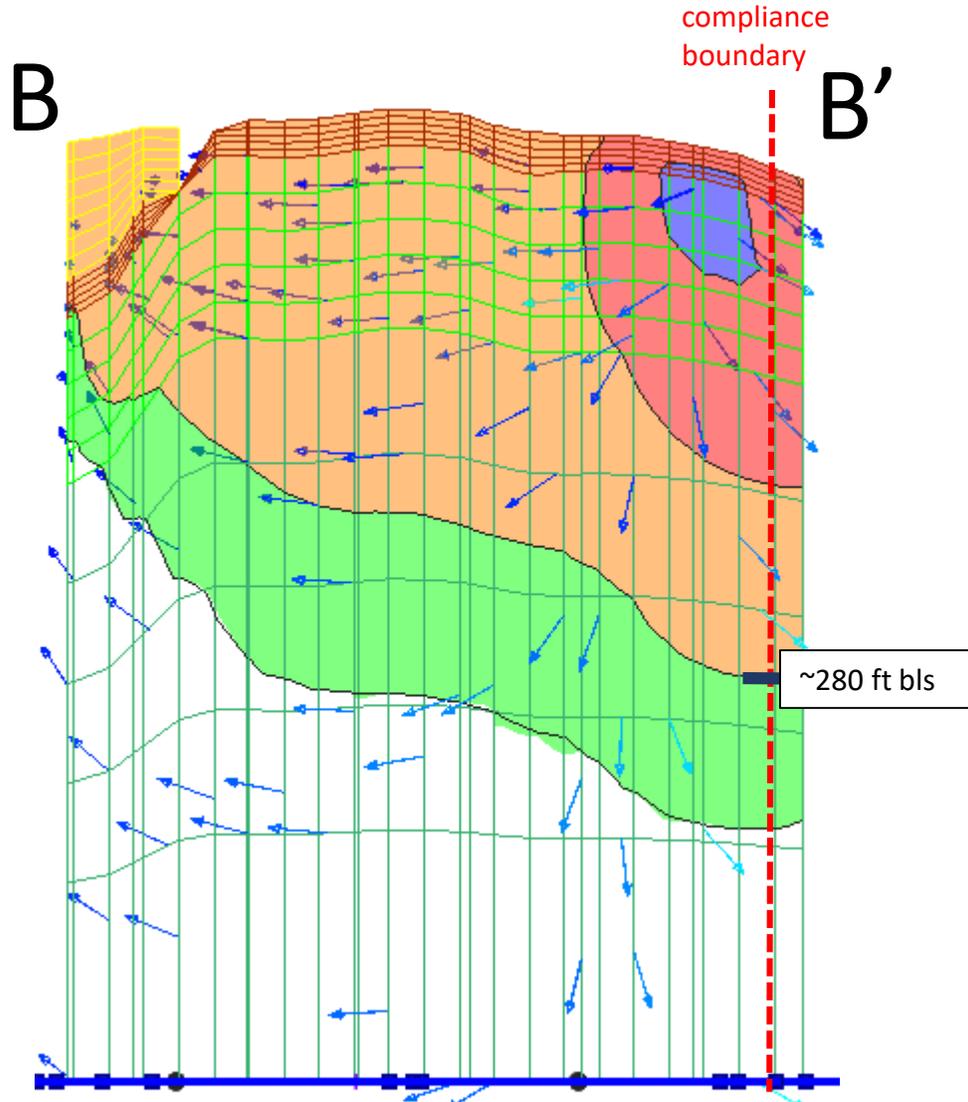
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Vertical
exaggeration X 3



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ROXBORO **FINAL COVER, 2130, t = 100 years**

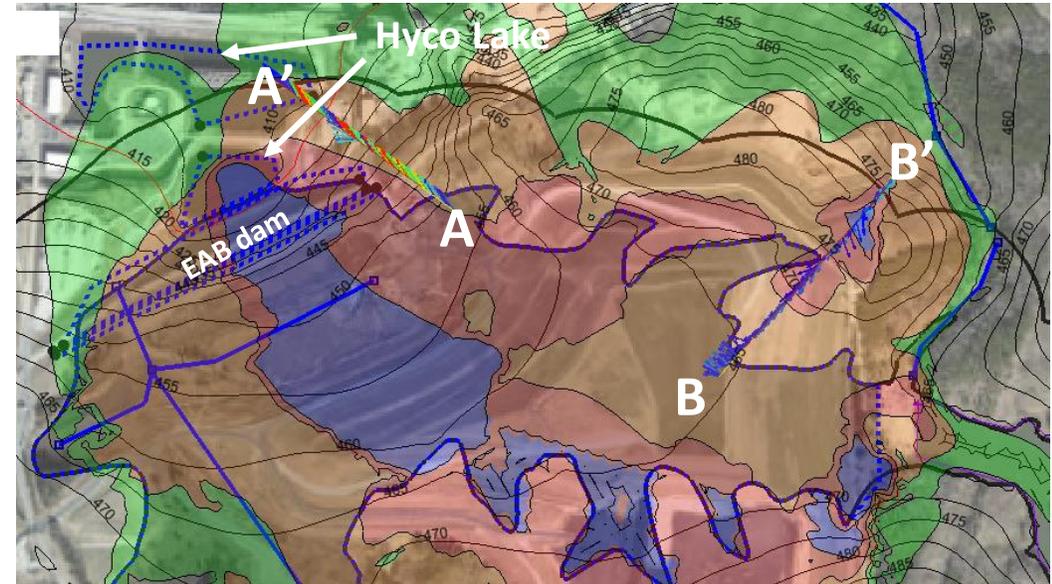
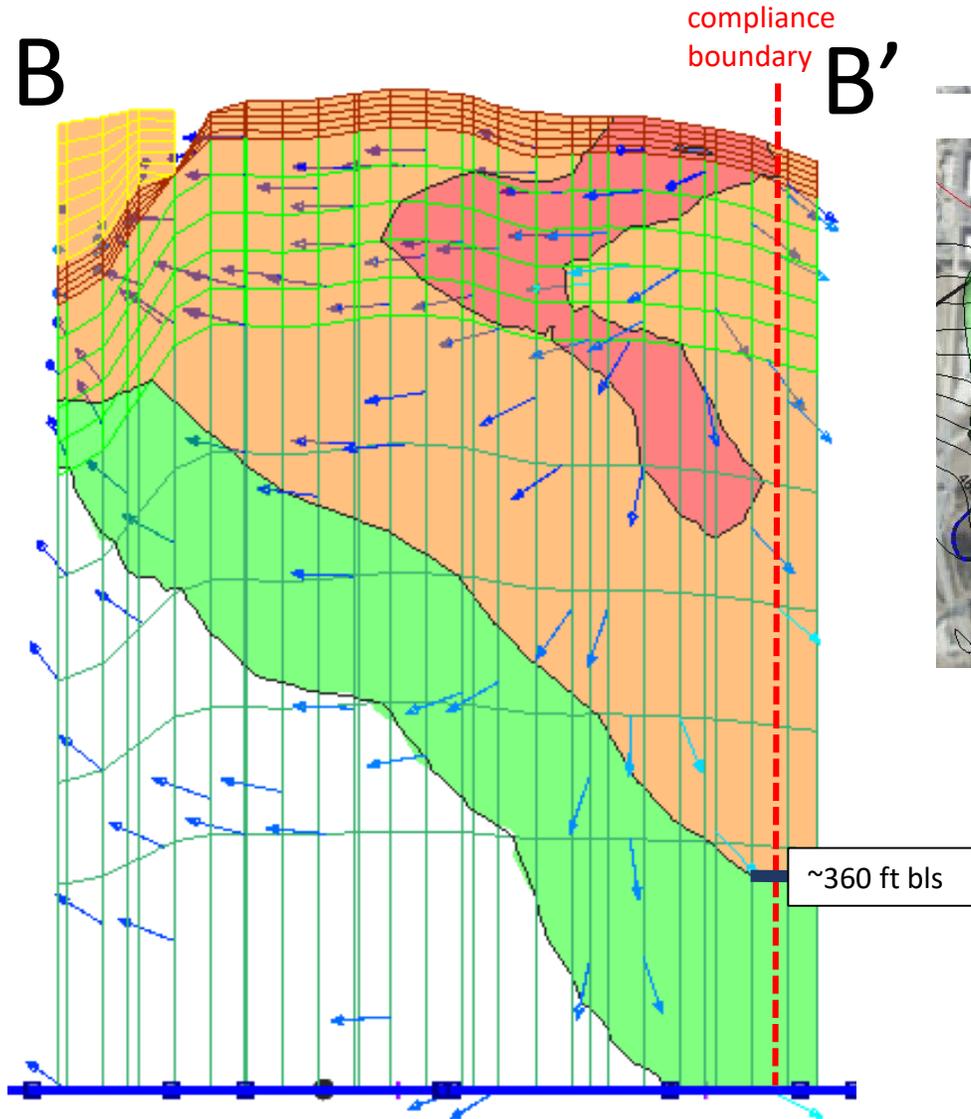
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Vertical
exaggeration X 3



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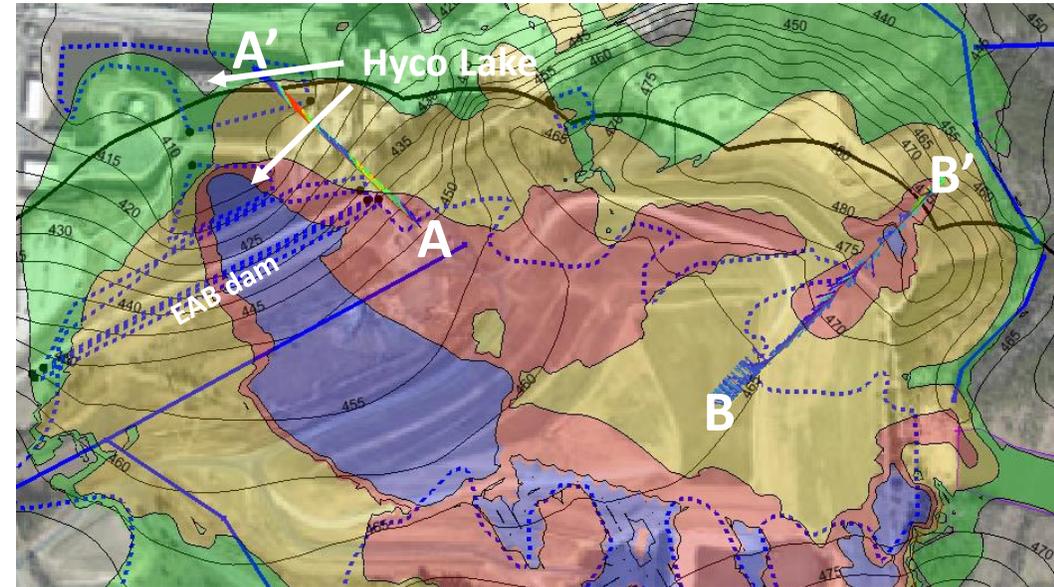
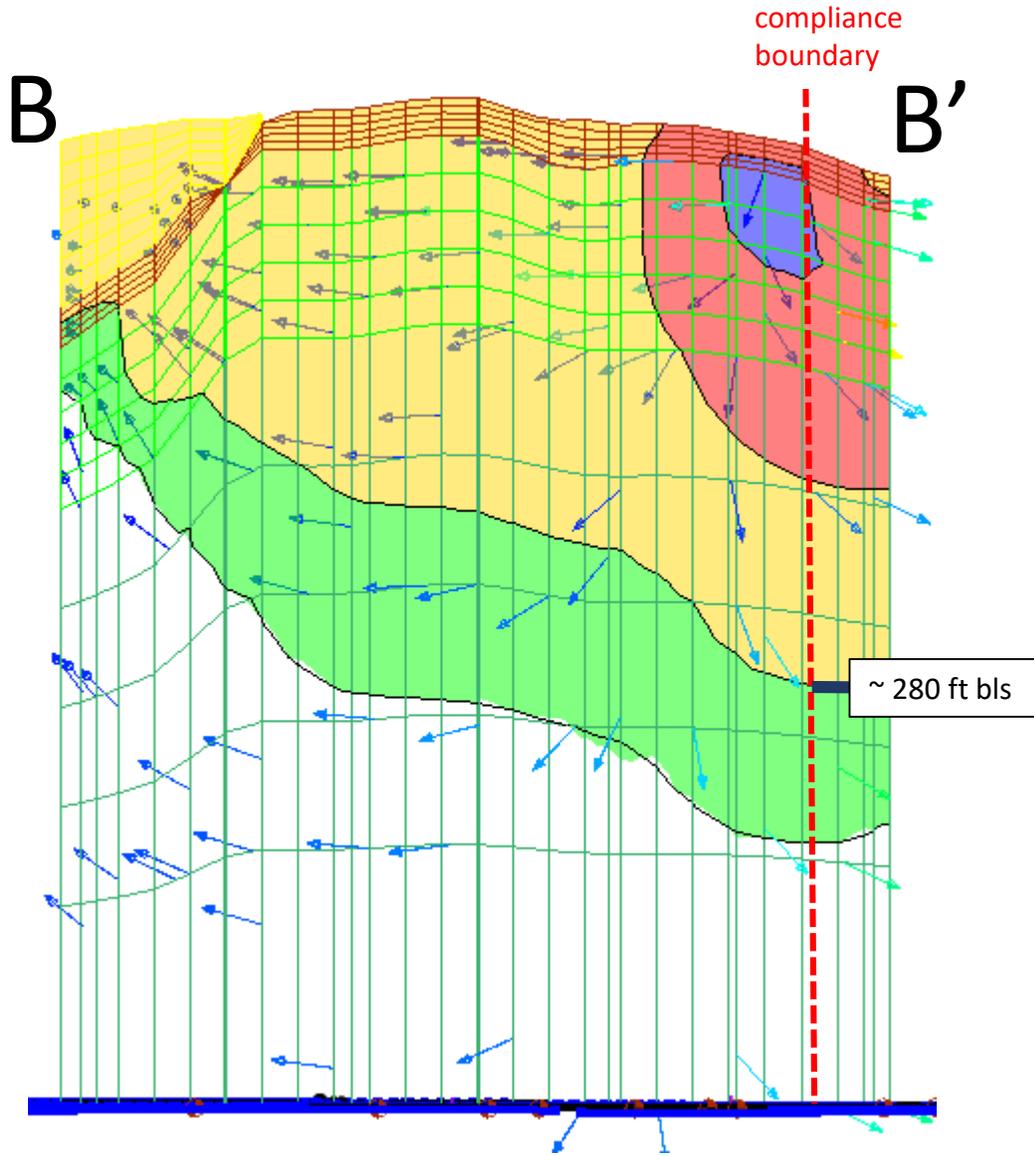
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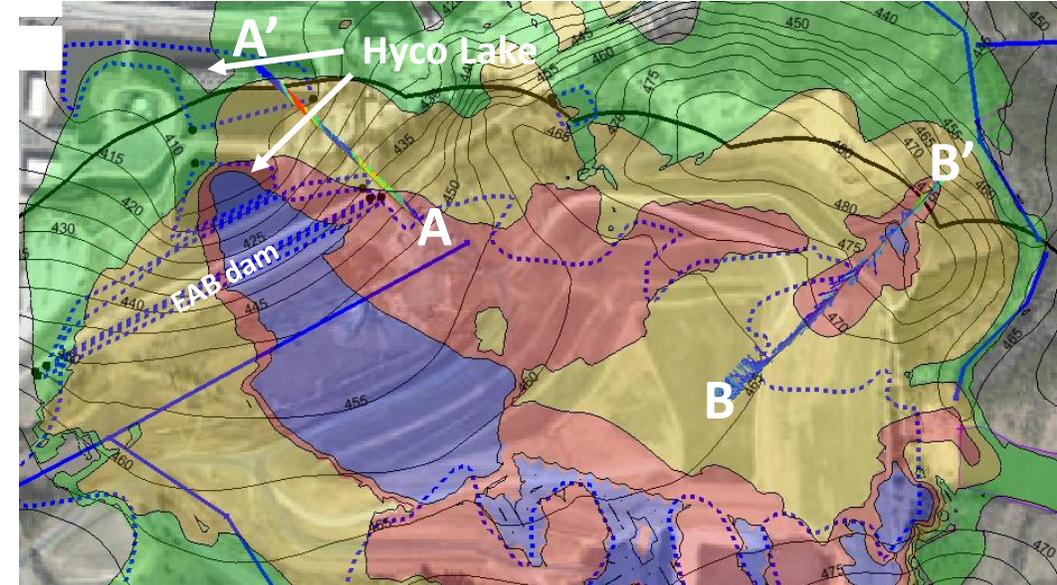
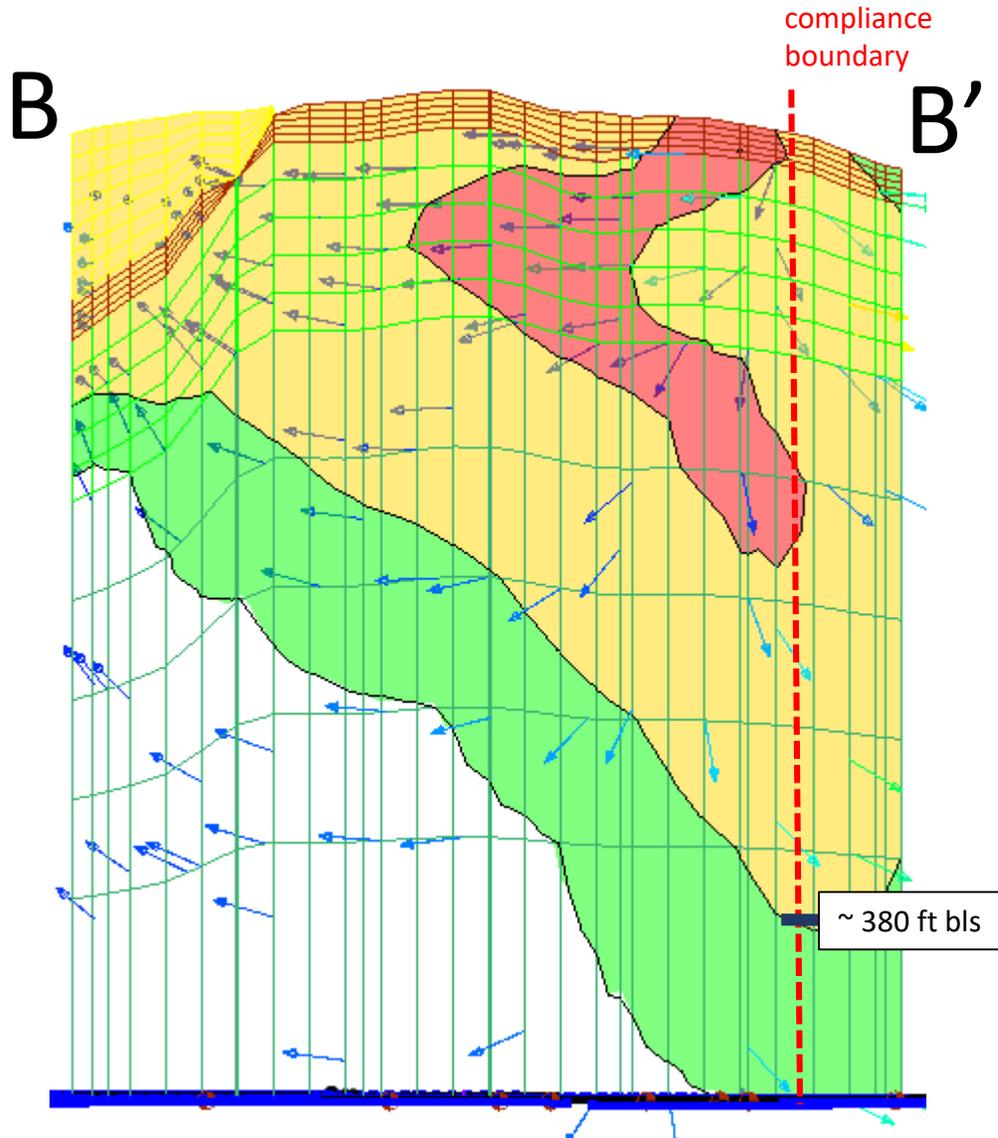
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Vertical
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ATTACHMENT B
RESPONSE TO COMMENTS

RESPONSE TO COMMENTS

I. Summary of Responses to Comments

The North Carolina Department of Environmental Quality (Department) received approximately 950 public comments regarding closure options for coal combustion residuals (CCR) surface impoundments at Duke Energy's Roxboro Steam Station (Roxboro), which is located in Person County, North Carolina. Almost all comments expressed concerns about coal ash's impact on groundwater and surface water and about leaving coal ash in unlined CCR surface impoundments where saturated ash remains in groundwater.

Almost all comments supported excavation of ash from the CCR surface impoundments at Roxboro. Approximately 850 comments were submitted using the following form email:

"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."

Like the form email above, many comments supported excavation without indicating a preference for where the ash should ultimately be disposed. Of those comments expressing a preference, most favored excavation to an onsite landfill.

A few comments encouraged beneficial reuse of excavated coal ash. Two comments supported capping in place. No comments indicated a preference for a hybrid closure option. The Department has determined that both CCR surface impoundments at Roxboro must be excavated. The Department appreciates the public's input and notes that public comments were near unanimous in supporting excavation of coal ash from the CCR surface impoundments at Roxboro.

The Department conducted an extensive technical review of Duke Energy's closure option submittal. In general, the Department shares concerns that capping in place, as proposed by Duke Energy, leaves coal ash saturated in groundwater to provide an ongoing source of groundwater and surface water pollution. For the East Ash Basin, the Department has elected excavation for several reasons, including the fact that Duke Energy's own groundwater modeling

shows that capping in place would not prevent post closure exceedances of groundwater quality standards beyond the compliance boundary. For the West Ash Basin, the Department has elected excavation for several reasons, including the fact that a significant portion of the West Ash Basin sits within the 100-year floodplain.

As required by the Coal Ash Management Act (CAMA), Duke Energy must submit a closure plan. At that time, the public will have another opportunity to provide input on Duke Energy's closure plan for CCR surface impoundments at Roxboro.

II. Detailed Responses to Comments

A. Comments Supporting Excavation

Comment: As indicated above, almost all comments expressed a preference for excavating ash from the CCR surface impoundments to a lined landfill. For example, several comments stated: "DEQ should require Duke Energy to remove its coal ash from its leaking, unlined pits and move it to dry, lined storage — out of our groundwater and away from Hyco Lake, Sargents River, and the rivers and streams in the Dan River Basin and Roanoke River Basin."

Response: The Department determined that the CCR surface impoundments at Roxboro must be excavated.

Comment: Many comments expressed a preference for excavation to remove coal ash from floodplains. Some comments indicated that excavating ash from floodplains was especially important in light of recent flooding events, like Hurricane Florence, and global warming. Some comments suggested that ash should be excavated to a landfill that is outside of the 100 year floodplain and others suggested that the landfill should be at an elevation that would be above lake levels during the one day Potential Maximum Precipitation event.

Response: The Department will take these comments into consideration when it reviews Duke Energy's closure plans.

Comment: Several comments supported excavation due to a concern that capping in place leaves coal ash saturated in groundwater, where it will continue to be a source of groundwater pollution. Some comments stated that a cap may cut off vertical infiltration but fails to prevent coal ash constituents from migrating via horizontal groundwater flows.

Response: The Department shares this concern and has determined that the CCR surface impoundments at Roxboro must be excavated.

Comment: Several comments supported excavation because of concerns regarding the structural stability of capping in place. Several comments expressed concern that capping in place without eliminating pore water may lead to structural instability. Another comment indicated that capping in place has already failed at other locations and at Roxboro.

Response: The Department has determined that the CCR surface impoundments at Roxboro must be excavated.

Comment: Several comments indicated that the costs associated with closure options should not be a factor for the Department's consideration. Other comments expressed concern that Duke Energy overestimated the cost of excavation and underestimated the cost of capping in place. For example, some stated that prior excavations in South Carolina indicate that Duke Energy's cost estimates for excavation are too high. Another comment stated that Duke Energy underestimated the cost of capping in place because Duke Energy assumes they do not have to dewater pore water.

Response: The Department has determined that the CCR surface impoundments at Roxboro must be excavated. To the extent that this comment applies to the ultimate disposition of excavated ash, the Department will take these comments into consideration when it reviews Duke Energy's closure plan.

Comment: Several comments took issue with Duke Energy's groundwater modeling. Specific concerns included: modeling a cap in place scenario with a Kd approach; using boundary conditions that create unrealistic groundwater gradients, software compatibility issues, and using a different compliance boundary for each closure option.

Response: The Department conducted a thorough review of Duke Energy's groundwater modeling and agrees with some of the concerns raised. The Department expects its concerns to be addressed in Duke Energy's closure plans.

Comment: Many comments encouraged the Department to impose stricter requirements for landfills receiving excavated coal ash. Some encouraged the Department to require more separation between the bottom of ash and the groundwater table—one commenter suggested five feet of separation and another suggested ten to twelve feet of separation. Another comment encouraged the Department to require ground water and surface water monitoring for a minimum of 50 years. Other comments encouraged the Department to require redundant liners with leak detection systems.

Response: The Department will take these comments into consideration when it reviews Duke Energy's closure plans.

Comment: Several comments supported excavation because it is already required at eight other Duke Energy sites in North Carolina or is already required in South Carolina and Virginia.

Response: The Department has determined that the CCR surface impoundments at Roxboro must be excavated.

B. Comments Supporting Excavation to an Onsite Landfill

Comment: Several comments expressed a preference for excavation to an onsite landfill instead of excavating ash fifteen miles to an offsite landfill at the Mayo Plant because onsite disposal minimizes the impact of truck traffic and air pollution on neighboring communities.

Response: The Department will take these comments into consideration when it reviews Duke Energy's closure plans.

Comment: Several comments expressed a preference for excavation to an onsite landfill because it would be less expensive than excavating to an offsite landfill.

Response: The Department will take these comments into consideration when it reviews Duke Energy's closure plans.

C. Comment Supporting Excavation and Encouraging Beneficial Use

Comment: Several comments encouraged beneficial use of excavated coal ash. One comment encouraged Duke Energy to partner with North Carolina A & T State University to look at creative ways to reuse coal ash. Another comment suggested Duke Energy provide a million dollar prize incentive to engineering students for developing an environmentally safe way to recycle coal ash. Another comment suggested recycling and encasing coal ash into cement bricks and concrete.

Response: The Department will take these comments into consideration when it reviews Duke Energy's closure plans for Roxboro. CAMA requires Duke Energy to include in its closure plan any plans for beneficial use of coal ash. Duke Energy is already required to beneficiate (for cementitious products) coal ash from its Buck (Rowan County), Lee (Wayne County), and Cape Fear (Chatham County) facilities.

D. Comment Supporting Excavation to an Offsite Landfill

Comment: Two comments supported excavation of coal ash to a rural area outside of North Carolina.

Response: The Department does not have the legal authority to require Duke Energy to dispose of coal ash in a "rural area outside of North Carolina."

E. Comment Supporting Cap in Place

Comment: Two comments supported capping in place. One comment expressed support for capping in place because it is the least costly and the quickest way to address groundwater and other environmental issues. Another comment expressed doubt that coal ash was negatively impacting neighboring water supply wells and stated that excavation (to an offsite landfill) would be detrimental due to road damage, noise, congestion, and air pollution when there is no evidence that wells near ash ponds are any worse than other wells in the State.

Response: The Department disagrees with these comments. Duke Energy's own groundwater modeling for capping in place at the East Ash Basin shows post-closure exceedances of groundwater quality standards beyond the compliance boundary.

F. Other Comments

Comment: A couple of comments indicated that the federal CCR rule prohibits capping in place as proposed by Duke Energy.

Response: The Department has determined that the CCR surface impoundments at Roxboro must be excavated.

Comment: One comment stated that coal ash used as structural fill should be excavated to a lined landfill.

Response: CAMA requires closure of all CCR surface impoundments—not closure of coal ash structural fills.

Comment: Several comments encouraged the Department to perform independent analysis of the closure options.

Response: The Department has performed extensive technical analysis of Duke Energy's closure options submittal.

Comment: Several comments stated that Duke Energy should be held financially responsible for coal ash cleanup and should not be allowed to pass the cost to ratepayers.

Response: This issue is not within the purview of the Department. This issue rests with the North Carolina Utilities Commission.

Comment: Several comments stated that the Department should fine or penalize Duke Energy.

Response: CAMA requires the Department to elect the closure option for CCR surface impoundments at six Duke Energy sites, including Roxboro. Fining or penalizing Duke is not relevant to that statutory requirement or the Department's closure determination. In other contexts, the Department has taken enforcement actions against Duke Energy related to coal ash pollution.

Comment: One comment stated that Duke Energy should provide new water lines to all the homeowners and landowners impacted by coal ash.

Response: As required by CAMA, Duke Energy provided permanent replacement water supplies for each household that has a drinking water supply well located within a one-half mile radius from the established compliance boundary of the CCR surface impoundments at Roxboro.

Comment: Several comments expressed concern regarding worker safety in implementing closure. Specifically, a comment stated that protections should be in place to avoid the health issues faced by workers handling the Kingston, TN coal ash spill in 2008.

Response: The Department will take these comments into consideration when it reviews Duke Energy's closure plans.

Comment: One comment stated that the Department's reclassification of coal ash ponds as low risk indicated preferential treatment and improper application of administrative rules and procedures.

Response: Duke Energy satisfied the two statutory criteria set forth in NCGS §130A-309.213(d)(1); therefore, the Department was *required* to classify the CCR surface impoundments at Roxboro as "low risk." However, the Department has determined that the CCR surface impoundments at Roxboro must be excavated.