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Sent Via KY EEC eForms Portal

Ms. Stacie Daniels
Permit Review Branch
Kentucky Division for Air Quality
300 Sower Boulevard, 2nd Floor
Frankfort, KY 40601

March 17, 2025

RE: Kentucky Utilities – E.W. Brown Generating Station (AI# 3148)
PSD Dispersion Modeling Protocol – Installation of NGCC

Dear Ms. Daniels:

Kentucky Utilities Company (KU) is submitting a dispersion modeling protocol for your review outlining the procedures proposed for the dispersion modeling analysis that will be conducted as part of a forthcoming PSD application to add a natural gas-fired combined cycle unit to the Kentucky Utilities E.W. Brown Generating Station located near Harrodsburg, Kentucky.

Please do not hesitate to contact us if you have any questions or comments on this protocol.

Sincerely,

Jason Wilkerson

Jason Wilkerson
Principal Engineer
Environmental Compliance
LG&E and KU Energy, LLC

AIR DISPERSION MODELING PROTOCOL

NGCC EGU Project / Harrodsburg, KY

a PPL company

Kentucky Utilities Company
E.W. Brown Generating Station
815 Dix Dam Rd
Harrodsburg, KY 40330

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March 2025

Project 0241801.0161

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1. INTRODUCTION

Kentucky Utilities Company (KU) in association with our air quality contractor, Trinity Consultants (Trinity), is pleased to submit this dispersion modeling protocol in support of a new electric generation unit.

KU is proposing to install and operate a one-on-one (1x1) Natural Gas Combined Cycle Turbine (NGCC) electric generating unit (EGU) with integrated NG duct burners (DB or DBs) at the E.W. Brown Generating Station (herein labeled as the NGCC EGU Project) to produce steam for the generation of electricity. The maximum gross power design rating is approximately 681 MW-g. KU will utilize and optimize the current electrical transmission system in conjunction with completing the NGCC EGU Project to the extent feasible, as well as tap into an existing natural gas pipeline on the property to serve the new NGCC EGU. The proposed NGCC EGU will be located within the existing Brown Station property near the location of the existing Unit 3 coal boiler, which will allow for considerable utilization of existing site infrastructure including transmission connectivity.

Mercer County is currently designated as an attainment or unclassified area for all criteria pollutants with respect to the National Ambient Air Quality Standards (NAAQS). The facility is currently classified as an existing major stationary source under the Prevention of Significant Deterioration (PSD) provisions at 401 KAR 51:017. Since the new NGCC EGU Unit will be constructed and operated within the existing Brown Station property, it will have the same standard industrial classification (SIC) code as existing operations and will be under the same common control and/or ownership; hence, the NGCC EGU Project will be considered a modification to an existing major stationary source. As fully described in air permit application, this NGCC EGU project is defined as a major modification to an existing major stationary source and is subject to the New Source Review (NSR) permitting program.

Pursuant to the 401 KAR 51:017, Section 1, a project at an existing major stationary source located in an area designated as attainment or unclassifiable that meets the definition of a *major modification* [refer to 401 KAR 51:001 Section 1(114)] is required to conduct a PSD permitting review, including a Best Available Control Technology (BACT) analysis (401 KAR 51:017 Section 8), a Source Impact Analysis (401 KAR 51:017 Section 9), an Air Quality Analysis (401 KAR 51:017 Section 11), and an Additional Impacts Analysis (401 KAR 51:017 Section 13). Through an application containing all required elements under Kentucky Administrative Regulations (KAR) 401 KAR 52:020 and 401 KAR 51:017, KU is seeking an initial issuance of a PSD construction permit and a significant permit revision (SPR) to the Title V permit. KU is submitting a separate SPR application (Volume 1) to obtain an amended Title V Permit authorizing the planned installation and operation of the proposed NGCC EGU Project. The subject of this submittal is to gain agreement from the Kentucky Division for Air Quality (KDAQ or Division) regarding a dispersion modeling protocol prior to submitting Volume 2, which contains the Source Impact Analysis, Air Quality Analysis, and an Additional Impacts Analysis.

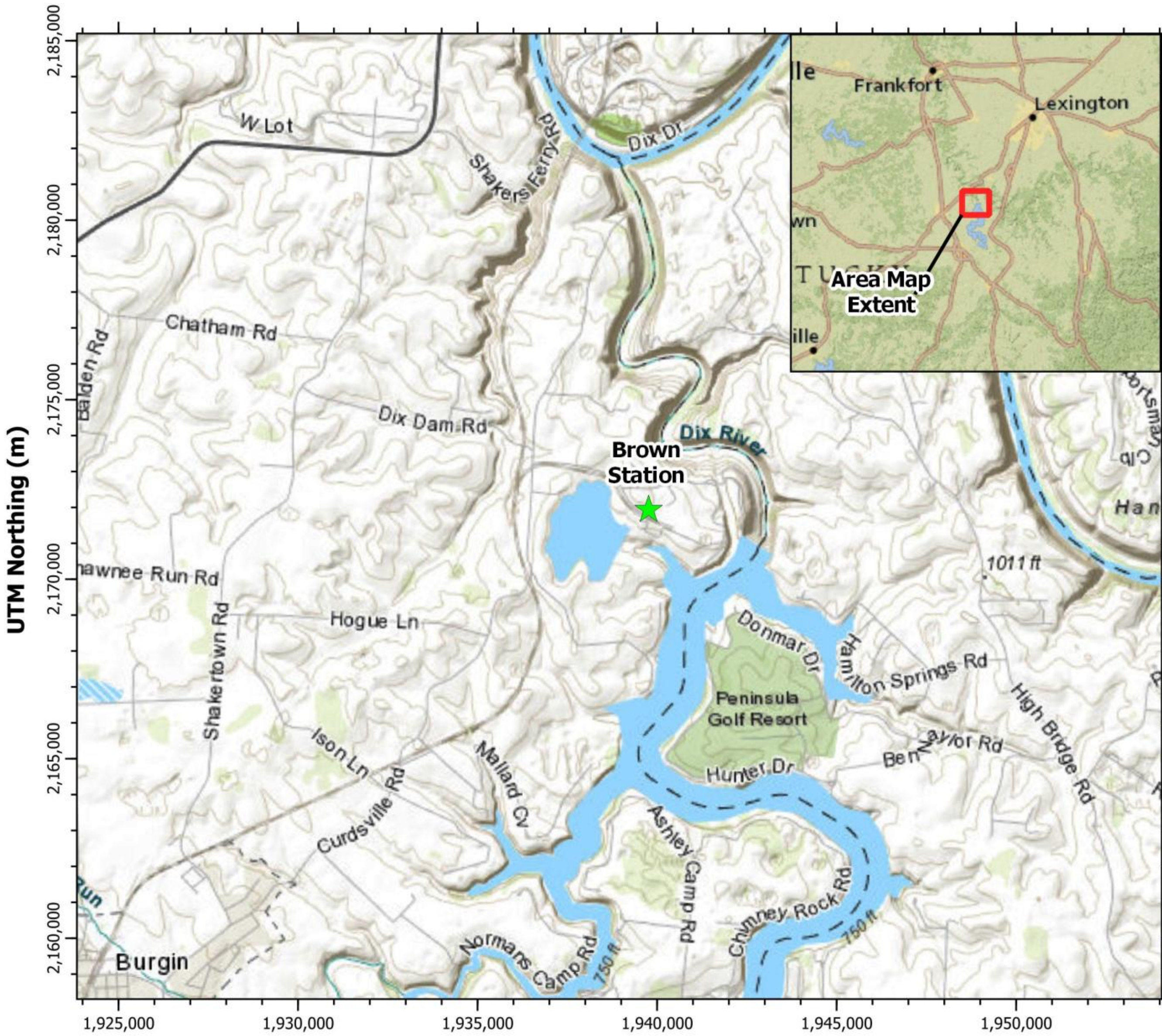
1.1 Background

KU currently operates the E.W. Brown Generation Station (Brown Station) located outside of Harrodsburg, Kentucky in Mercer County. Figure 1-1 shows a general map of the area surrounding the facility showing roads and general boundaries of towns and nearby municipalities. This facility is classified as a major source under Title V Operating Permit Program and currently operates in accordance with Title V Permit No. V-17-030 R1, issued by the Kentucky Division for Air Quality (Division) on June 8, 2019, and most recently revised on July 16, 2021. KU submitted the renewal application on December 6, 2023, within the 6-month timeframe before expiration. The permit authorizes the operation of a coal-fired utility boiler (Unit 3); seven combustion turbines; natural gas (NG)-fired heat exchanges; coal, limestone, fly ash, coal combustion residue, carbon and gypsum handling and storage operations; a cooling tower, emergency equipment; miscellaneous organic liquid tanks; general plant fugitive emissions; and numerous insignificant activities.

The new NGCC Unit proposed will consist of one natural gas-fired gas combustion turbine (GT), one steam turbine (ST), and one heat recovery steam generator (HRSG) with natural gas-fired DB arranged in a 1x1 configuration. Ancillary support equipment will also be installed to support the NGCC Unit operations, including one NG-fired boiler (Auxiliary Boiler) rated at 95.52 million British thermal units per hour (MMBtu/hr), one NG-fired fuel gas (dewpoint) heater rated at 15.65 MMBtu/hr, one 2.18 megawatt (MW) emergency generator with diesel-fired engine, one 422 horsepower (HP) emergency diesel driven fire pump engine, one 10-cell mechanical draft cooling tower, new NGCC haul roads & traffic, and equipment with potential for leaks or evaporative losses (diesel tanks, sulfuric acid tanks, circuit breakers, piping fugitives, lube oil system, etc.).

Figure 1-2 shows the NGCC project within the property owned and operated by KU. Figure 1-3 shows the NGCC Project with nearby existing emission units. Figure 1-4 represents a plot plan of the NGCC Project. Lastly, Figure 1-5 is a plot from the AERMOD modeling system showing the modeled layout for the site after modification, where the green outline represents the facility's fence line and controlled-access boundary that identifies the ambient air.

Figure 1-1. Area Map of Brown Station



UTM Easting (m)

All coordinates shown in UTM Coordinates,
UTM Zone 16, NAD 83 Datum

Figure 1-2. Brown Station Proposed NGCC Project Site Map

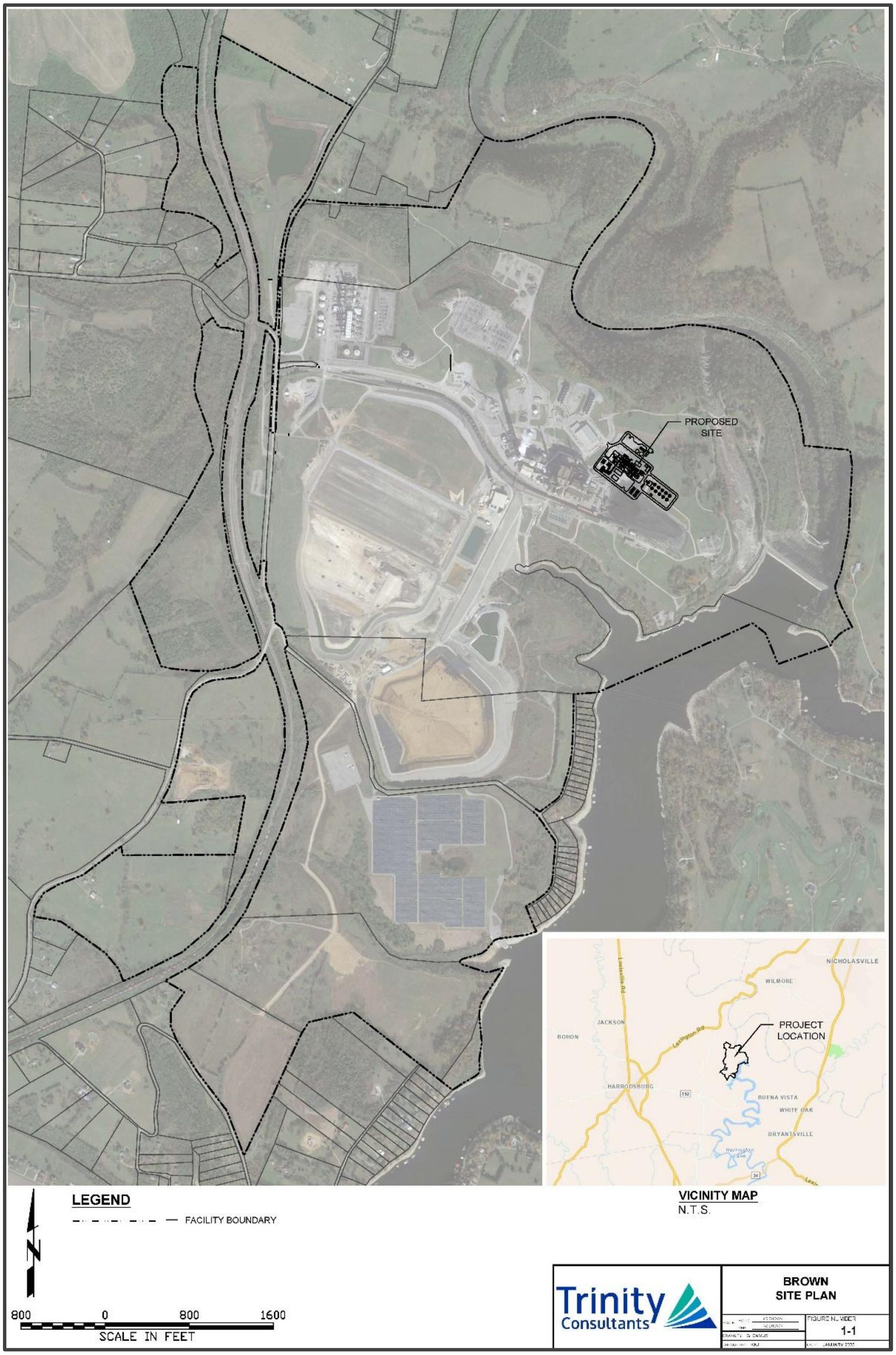


Figure 1-3. Brown Station Proposed NGCC Project Site Map

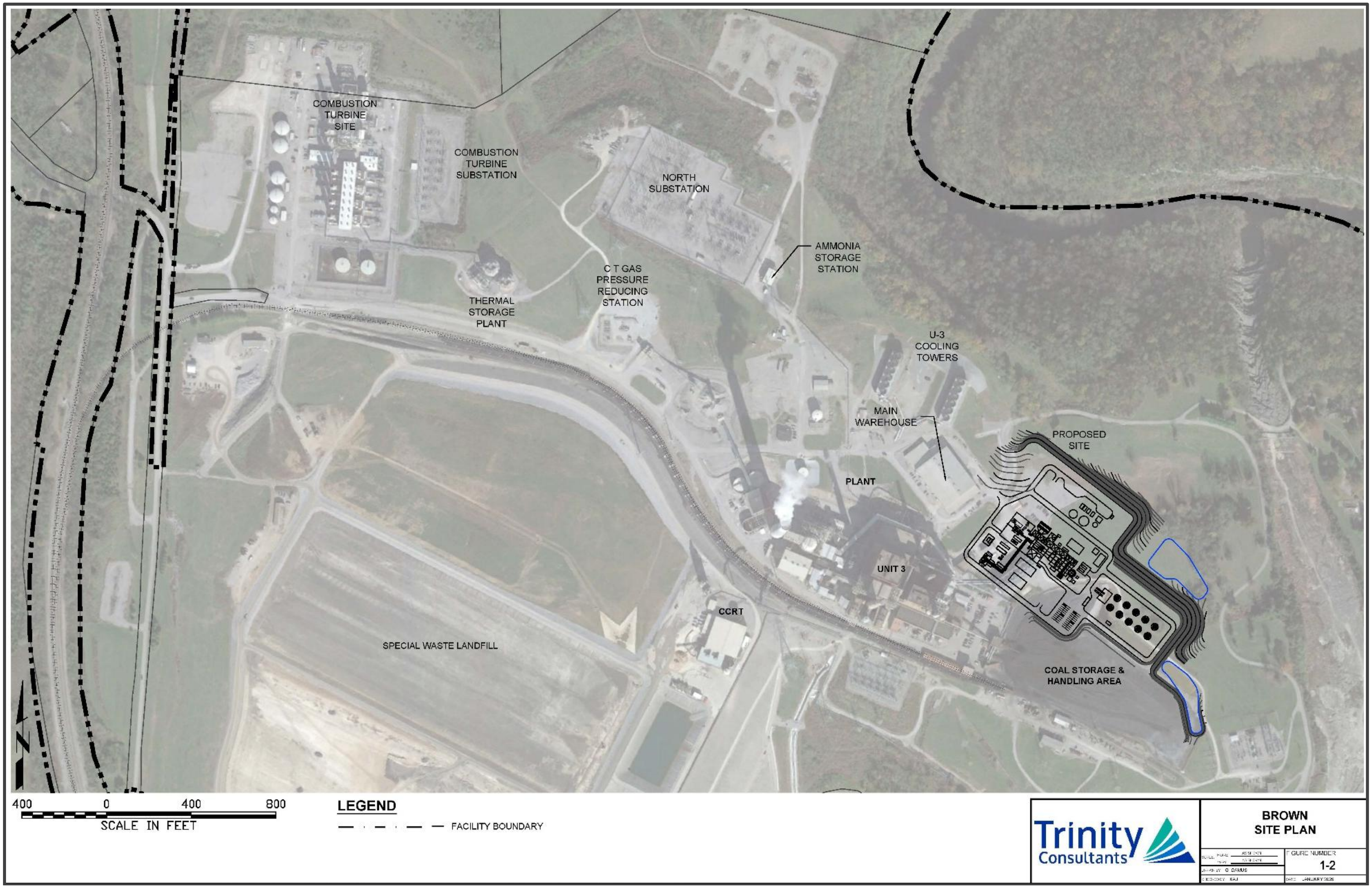


Figure 1-4. Proposed Plot Plan for NGCC Project

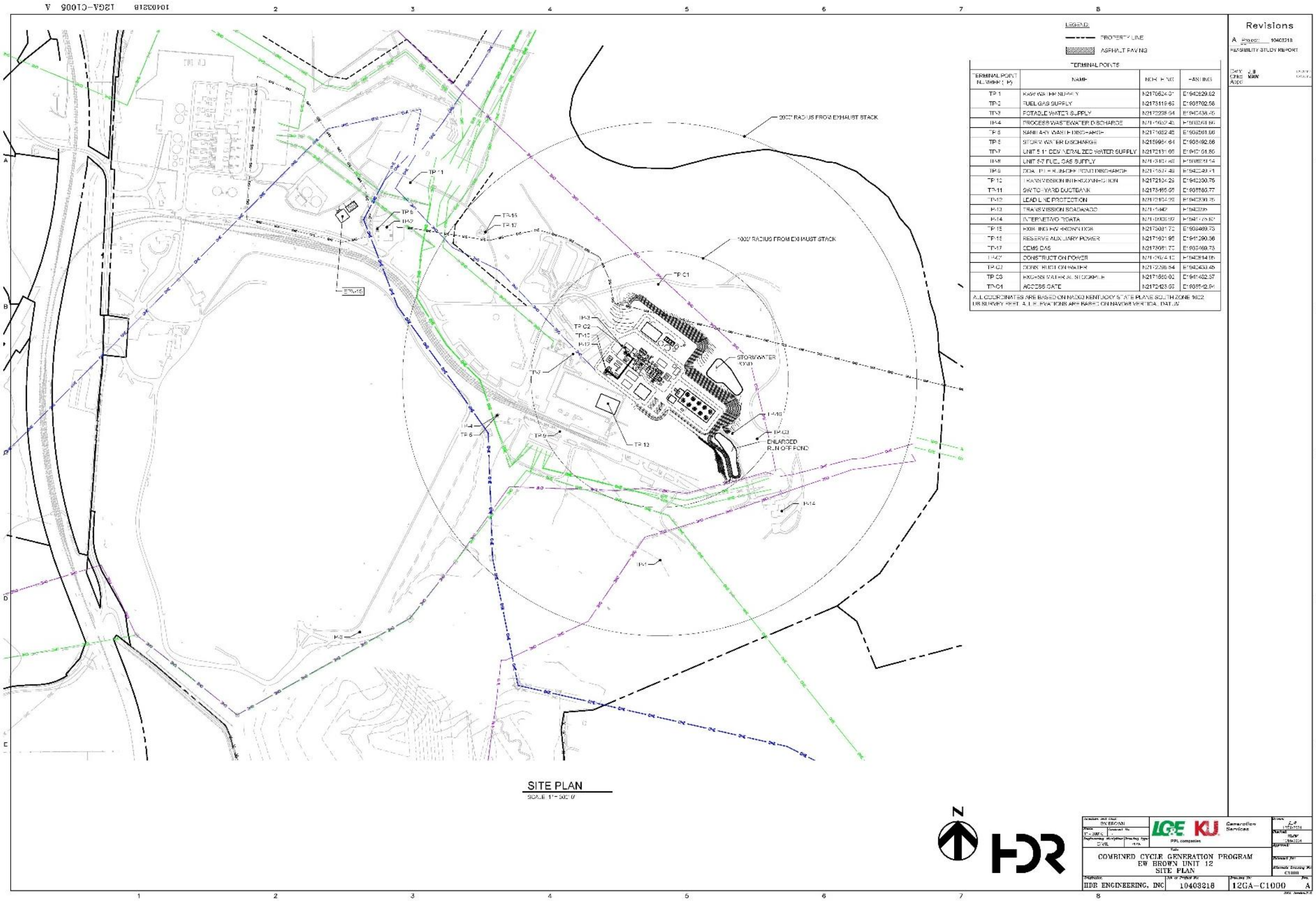
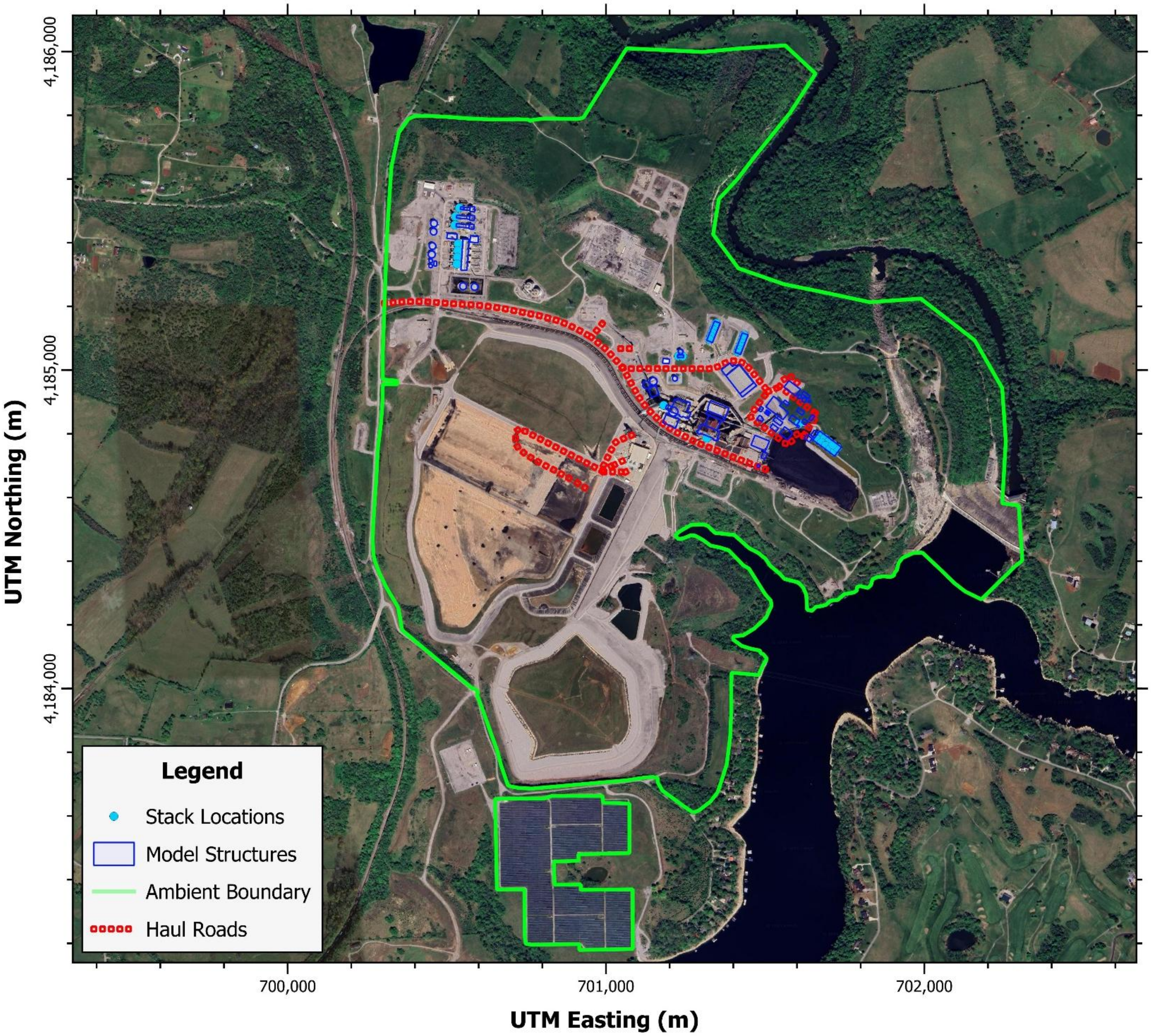


Figure 1-5. Site Layout at Brown Station



All coordinates shown in UTM Coordinates,
UTM Zone 16, NAD 83 Datum

As copied from Volume 1, Table 1-1 provides a summary of emission increases of regulated NSR pollutants associated with the proposed project.

Table 1-1. Project Emission Increases and PSD Applicability

Pollutant	"Step 1" Project Emissions Increase (tpy)	PSD Significant Emission Rate (tpy)	Project Triggers PSD Review? (Yes/No)
PM	**102.0**	25	Yes
PM_{10}	**101.7**	15	Yes
$PM_{2.5}$	**100.7**	10	Yes
NO_X	**169.2**	40	Yes
CO	**148.9**	100	Yes
VOC	**67.2**	40	Yes
SO_2	27.2	40	No
H_2SO_4	**23.7**	7	Yes
Lead	0.001	0.6	No
GHG (as CO_2e)	**2,321,537**	75,000	Yes

As shown in the table, the pollutants triggering PSD permitting requirements include particulate matter (PM), PM 10 microns or less in diameter (PM_{10}), PM 2.5 microns or less in diameter ($PM_{2.5}$), oxides of nitrogen (NO_X), carbon monoxide (CO), volatile organic compounds (VOC), sulfuric acid (H_2SO_4) mists, and greenhouse gases (GHG). KU provides Best Available Control Technology (BACT) analyses for each pollutant triggering PSD permitting requirements within Volume 1 application, with proposed BACT emission rates forming the basis of the emission calculations for each emission unit.

Air quality dispersion modeling will be conducted for PM_{10}, $PM_{2.5}$, NO_2, and CO. In addition, to address the formation of secondary $PM_{2.5}$ emissions, an analysis following U.S. Environmental Protection Agency (U.S. EPA) Modeled Emission rates for Precursors (MERPs) guidance will be performed.

As the emission increases of NO_X and VOC are each expected to exceed 40 tpy, an ozone ambient impact analysis will be required. An air quality analysis is not performed for GHGs because that are no ambient concentration-based thresholds for which a compliance demonstration is needed and the U.S. Environmental Protection Agency (U.S. EPA) does not have a regulatory model designed to simulate GHG pollutant dispersion. A visibility analysis will be conducted in consideration of the sulfuric acid mist emissions. No modeling will be performed for sulfur dioxide (SO_2) or lead as the project emission increases are less than the applicable significant emission rates (SERs)

The proposed air dispersion modeling will be completed in a matter that conforms to the applicable rules, guidance, and requirements in the following guidance documents:

- U.S.EPA's Guideline on Air Quality Models, 40 CFR Part 51 - Appendix W (latest rule update, Published November 29, 2024);
- U.S. EPA's AERMOD Implementation Guide (Updated November 2024); and
- U.S. EPA: User's Guide for the AMS/EPA Regulatory Model – AERMOD (November 2024).

The remainder of this modeling protocol is organized as follows:

- Section 2 discusses the Class II modeling requirements;
- Section 3 discusses the Class I modeling requirements;
- Section 4 discusses the additional impacts analysis;
- Section 5 discusses the secondary $PM_{2.5}$ Impact Assessment;
- Section 6 discusses the Ozone ambient impact analysis; and
- Section 7 discusses the air toxics analysis.

2. CLASS II DISPERSION MODELING REQUIREMENTS

Because sources and emissions in the proposed project are subject to the ambient air quality assessment requirements of the PSD program, modeling is required to meet specific objectives. Modeling will be used to demonstrate that emissions of NO_X, PM_{10}, $PM_{2.5}$, and CO pollutants after the proposed project is completed will not:

1) cause or significantly contribute to a violation of the NAAQS,

2) cause or significantly contribute to ambient concentrations that are greater than allowable PSD Increments, or

3) cause any other additional adverse impacts to the surrounding area (i.e., impairment to visibility, soils and vegetation and air quality impacts from general commercial, residential, industrial, and other growth associated with the facility expansion).

To facilitate this analysis (and allow it to be commensurate with the requirements to which the Division adheres), dispersion modeling methodologies will be consistent with U.S. EPA procedures specified in the *Guideline on Air Quality Models*. These guidelines are cited by reference in the Kentucky Administrative Regulations (refer to 401 KAR 51:017 Section 10).[1] The purpose of this protocol is to provide an overview of the proposed techniques and models to be used and review the modeling objectives for each required element of the PSD air quality analysis.

KU will complete all dispersion modeling and air impact assessments required under the regulations for PSD. This will include all Class II area modeling analyses as required. For the Class II analyses, the various stages of modeling that will be performed will be dependent on compliance at each step. To allow the Division to evaluate the various levels of proposed modeling methodologies, this protocol outlines each stage of modeling in the sequence as if each would be used. The modeling steps will include the following steps if required:

- Step 1 – Determine if ambient air quality impacts of the proposed new and modified sources are greater than or less than the Significant Impact Levels (SIL) on a per pollutant and per averaging time basis. Table 2-1 shows the applicable SILs and other important criteria pollutant thresholds for NO_2, PM_{10}, $PM_{2.5}$, and CO.

  Address the pre-construction monitoring requirements under 401 KAR 51:017 Section 7(5)(a) by conducting an assessment of potential pollutant impacts from the proposed project against the significant monitoring concentrations (SMCs) indicated in Table 2-1, as applicable. KU presumes that some pollutant impacts will exceed their corresponding SMCs.

- Step 2 – Perform NAAQS dispersion modeling if air modeling impacts are greater than the SILs (in Step 1) to estimate the NAAQS impacts of the new/modified project sources, existing emission units at Brown Station, and nearby regional inventory sources on a combined basis.

[1] 40 CFR 51, Appendix W, *Guideline on Air Quality Models* cited in 401 KAR 51:017 at http://www.lrc.ky.gov/kar/401/051/017.htm.

Table 2-1. Significant Impact Levels, NAAQS, PSD Class II Increments, and Significant Monitoring Concentrations for Applicable Criteria Air Pollutants

Pollutant	Averaging Period	PSD SIL (μg/m^3)	Primary NAAQS (μg/m^3)	Secondary NAAQS (μg/m^3)	Class II PSD Increment[1] (μg/m^3)	Significant Monitoring Concentration (μg/m^3)
CO	1-hour	2,000	40,000 (35 ppm)[2]	N/A	--	--
	8-hour	500	10,000 (9 ppm)[2]	N/A	--	575
NO_2	1-hour	7.5[3]	188 (100 ppb)[4]	--	--	--
	Annual	1	100 (53 ppb)[5]	100 (53 ppb)	25	14
PM_{10}	24-hour	5	150[6]	150	30	10
	Annual	1	--[7]	--	17[7]	--
$PM_{2.5}$	24-hour	1.2[8]	35[9]	35	9	0[11]
	Annual	0.13[8]	9[10]	15[10]	4	--

1. All short-term PSD Increments are not to be exceeded more than once per year.
2. Only a primary standard, not to be exceeded more than once per year.
3. No 1-hour NO_2 SIL has been promulgated by EPA. An interim SIL of 7.5 μg/m^3 (4 ppb) was selected based on the U.S. EPA Office of Air Quality Planning and Standards Memorandum from Ms. Anna Marie Wood to Regional Air Division Directors titled *General Guidance for Implementing the 1-hour NO_2 National Ambient Air Quality Standard in Prevention of Significant Deterioration Permits, Including an Interim 1-hour NO_2 Significant Impact Level* (June 28, 2010).
4. Only a primary standard, the 3-year average of the 98th percentile of the daily maximum 1-hour average concentrations.
5. Annual arithmetic average.
6. Not to be exceeded more than three times in 3 consecutive years.
7. U.S. EPA revoked the annual PM_{10} NAAQS in 2006, but the annual PM_{10} Class II PSD Increment remains in effect pursuant to 401 KAR 51:017 Section 2.
8. Although Kentucky Regulations (401 KAR 51:017, Section 9), indicate an Annual $PM_{2.5}$ SIL of 0.3 μg/m^3, KU is proposing to use a SIL of 0.13 μg/m^3 consistent with recent U.S. EPA Guidance. Specifically, U.S. EPA Supplement to the Guidance on Significant Impact Levels for Ozone and Fine Particles in the Prevention of Significant Deterioration Permitting Program, April 2024
9. The 3-year average of the 98th percentile 24-hour average concentrations.
10. On May 6, 2024, U.S. EPA published a final rule (89 FR 16202) that reduced the primary annual $PM_{2.5}$ NAAQS from 12 μg/m^3 to 9 μg/m^3 and retained the secondary annual $PM_{2.5}$ NAAQS at 15 μg/m^3. Both the primary and secondary standards are expressed as the 3-year average of the annual arithmetic average concentration.
11. The $PM_{2.5}$ SMC was vacated on January 22, 2013 (Sierra Club v. EPA, No. 10-1413 (D.C. Circuit), 2013 WL 216018). As such, the SMC is presumed to be 0 until a new value is promulgated. Even though that means any modeled concentration will exceed the SMC, it is assumed that existing state-run monitoring networks sufficiently address preconstruction monitoring requirements.

- Step 3 – Perform PSD Class II increment modeling if air modeling impacts are greater than or equal to the SILs (in Step 1) to estimate the PSD increment impacts of the new project sources as well as any increment affecting emissions from existing KU sources and nearby regional inventory sources.

- Step 4 – Prepare an "additional air impacts" analysis pursuant to 401 KAR 51:017 Section 13. This analysis will use the results of the Significance Analysis modeling in Step 1 to compare ambient impacts to critical levels applicable to impacts on soils and vegetation.[2] Incremental air quality impacts due to growth in the local infrastructure that may result from added employees and attendant industries will be qualitatively evaluated. Finally, Class II area visibility impacts will be evaluated on a screening basis using EPA's VISCREEN model.[3]

- Step 5 – Perform a case-by-case assessment to demonstrate dispersion modeling or other analyses should not be required for the air toxic pollutant emissions from the proposed project because these emissions are already regulated under a 401 KAR Chapter 63 emissions standard or are generated in such negligible quantities that a "no adverse impact" determination can be qualitatively asserted or otherwise demonstrated via simple screening modeling techniques.

2.1 Model Selection & Guidance

For Class II area modeling, a number of modeling guidelines are available to facilitate and provide detail on the methodologies required for conducting dispersion modeling for the proposed project at Brown Station. Trinity has prepared protocols and modeling reports for several industrial permitting activities over the past two decades and is familiar with what is acceptable and considered state-of-the-art by the Division. The air dispersion modeling analyses to be conducted will be in accordance with applicable U.S. EPA guidance documents, including the following:

- U.S. EPA's *Guideline on Air Quality Models,* 40 CFR Part 51, Appendix W (Published November 29, 2024), which Kentucky cites by reference in Section 10 of 401 KAR 51:017.[4]
- U.S. EPA 's AERMOD Implementation Guide (November 2024)[5]
- U.S. EPA's User's Guide for the AMS/EPA Regulatory Model – AERMOD (November 2024)[6]
- U.S. EPA's New Source Review Workshop Manual (Draft, October 1990)[7]

Given these guidance documents and typical modeling practices, KU will use the EPA-recommended AERMOD Model in its most recent Version 24142 released in November 2024. AERMOD is a refined, steady-state (both emissions and meteorology over a one hour time step), multiple source, dispersion model and was promulgated by U.S. EPA in December 2005 as the preferred model to use for industrial sources in this type of air quality analysis.[8] AERMOD will be used to model each emission point at the Brown Station. KU plans to apply AERMOD using the regulatory default options in all cases.

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[2] While KU intends to primarily assess the impacts to soils and vegetation based on an evaluation of compliance with the secondary NAAQS, potential impacts will also be evaluated using the methodology outlined in the U.S. EPA document entitled, *A Screening Procedure for the Impacts of Air Pollution Sources on Plants, Soils, and Animals* (December 1980).

[3] Note that CO and GHGs are not visibility affecting pollutants; therefore, the Class II area visibility analysis will only address project emissions increase for NO_X, PM, SO_2, and sufluric acid.

[4] 40 CFR 51, Appendix W, Guideline on Air Quality Models

[5] EPA, *AERMOD Implementation Guide*, November 2024, available at https://gaftp.epa.gov/Air/aqmg/SCRAM/models/preferred/aermod/aermod_implementation_guide.pdf

[6] *User's Guide for the AMS/EPA Regulatory Model (AERMOD)*, EPA-454/B-23-008, EPA, OAQPS, Research Triangle Park, NC, October 2023.

[7] EPA, *New Source Review Workshop Manual*, Draft October 1990, available at http://www.epa.gov/ttn/nsr/gen/wkshpman.pdf

[8] 40 CFR 51, Appendix W–*Guideline on Air Quality Models*, Appendix A.1– AMS/EPA Regulatory Model (AERMOD).

2.2 Tiered NO_2 Dispersion Modeling Methodology

In the "Models for Nitrogen Dioxide" section of the *Guideline* (Section 4.2.3.4), U.S. EPA recommends a tiered screening approach for estimating annual NO_2 impacts from point sources in PSD modeling analyses. Use of the tiered approach to NO_2 modeling for the 1-hour and annual NO_2 standard (SIL, NAAQS, and PSD Increment) will be considered. The approach used in each of the three tiers is described briefly below.

1. Under the initial and most conservative Tier 1 screening level, all NO_X emitted is modeled as NO_2 which assumes total conversion of NO (main chemical form of NO_X) to NO_2.
2. For the Tier 2 screening level, U.S. EPA recommends multiplying the Tier 1 results by the Ambient Ratio Method 2 (ARM2), which provides estimates of representative equilibrium ratios of NO_2/NO_X based on ambient levels of NO_2 and NO_X derived from national data from the EPA's Air Quality System (AQS). The ARM2 function, which is a default option within the latest version of AERMOD, will be used to complete this multiplication. The default minimum ambient NO_2/NO_X ratio of 0.5 and maximum ambient ratio of 0.9 will be used for this methodology.
3. Since the impact of an individual NO_X source on ambient NO_2 depends on the chemical environment into which the source's plume is emitted, modeling techniques that account for this atmospheric chemistry such as the Ozone Limiting Method (OLM) or the Plume Volume Molar Ratio Method (PVMRM) can be considered under the most accurate and refined Tier 3 approach identified by U.S. EPA. Additional model inputs required for the use of OLM or PVMRM could include source-specific in-stack NO_2/NO_X ratios, ambient equilibrium NO_2/NO_X ratios, and background ozone concentrations.

For NO_2 modeling, it is anticipated that the Tier 3 methodology will produce compliant modeling results. U.S. EPA memoranda does not indicate any preference between PVMRM and OLM. KU plans to use OLM as the proposed Tier 3 approach in the modeling analysis.

2.2.1 In-Stack Ratios

AERMOD includes a default in-stack ratio (ISR) that specifies the NO_2/NO_X conversion rate which is considered conservative. In lieu of using the default ISR, equipment-specific ISR data determined via equipment-specific testing, peer-reviewed papers, vendor guarantees, or EPA's SCRAM database may be used. Brown Station will utilized published ISR data from EPA, the Electric Power Research Institute (EPRI), and the San Joaquin Valley Air Pollution Control District (SJVAPCD), as presented in Table 2-2 below.

Table 2-2. In-Stack Ratio

Unit	Fuel	ISR	Source
Unit 3 Boiler	Coal	0.1	EPA ISR Database (Max of Coal-fired Boiler Date)
Unit 12 Gas Turbine	Natural Gas	0.5	EPRI Table 3-5, Average ISR for All Sizes and Loads
Simple Cycle Natural-Gas Fired Turbines	Natural Gas	0.23	EPRI Table 3-6, Average ISR for All Sizes and Loads
Auxiliary Boiler Fuel Gas Preheater	Natural Gas	0.1	SJVAPCD for natural gas-fired boilers
Emergency Generators	Diesel	0.2	SJVAPCD for diesel internal combustion engines
Nearby Sources[a]	Various	0.2	EPA NO_2 Clarification Memo (September 2014)

a. As noted by EPA, a default ISR of 0.2 is appropriate for sources greater than 1-3 km away. For any nearby sources within 3 km of Brown Station, KU will evaluate whether alternative ISRs are appropriate and provide justification in the modeling report.

2.3 Rural/Urban Option Selection in AERMOD

For any dispersion modeling exercise, the "urban" or "rural" determination of the area surrounding the subject source is important in determining the applicable atmospheric boundary layer characteristics that affect a model's calculation of ambient concentrations. Thus, a determination will need to be made of whether the area around Brown Station is urban or rural.

The first method discussed in Section 5.1 of the *AERMOD Implementation Guide* (also referring therein to Section 7.2.1.1b(i) of the Guideline on Air Quality Models, Appendix W) is called the "land use" technique because it examines the various land use within 3 km of a source and quantifies the percentage of area in various land use categories. If greater than 50% of the land use in the prescribed area is considered urban, then the urban option should be used in AERMOD. However, U.S. EPA cautions against the use of the "land use" technique for sources close to a body of water because the water body may result in a predominately rural land use classification despite being located in an urban area. If necessary, the second recommended urban/rural classification method in Appendix W Section 7.2.1.1.b(ii) is the Population Density Procedure. This technique evaluates the total population density within 3-kilometers of a source. If the population density is greater than 750 people per square kilometer, then U.S. EPA recommends the use of urban dispersion coefficients.

Based on aerial imagery of the area surrounding the Brown Station, the nearby land use is overwhelmingly rural. KU plans to confirm this conclusion using the aforementioned "land use" technique recommended by EPA, the results of which will be provided in the modeling report.

2.4 Building Downwash

The *Guideline* requires the evaluation of the potential for physical structures to affect the dispersion of emissions from stack sources. The exhaust from stacks that are located within specified distances of buildings may be subject to "aerodynamic building downwash" under certain meteorological conditions. The modeled emission units at the Brown Station will be evaluated in terms of their proximity to nearby structures.

In accordance with recent AERMOD updates, an emission point is assumed to be subject to the effects of downwash at all release heights even if the stack height is above the U.S. EPA formula height, which is defined by the following formula:

$$H_{GEP} = H + 1.5L, \text{ where:}$$

where,

H_{GEP}	=	GEP stack height,
H	=	structure height, and
L	=	lesser dimension of the structure (height or maximum projected width).

This equation is limited to stacks located within 5L of a structure. Stacks located at a distance greater than 5L are not subject to the wake effects of the structure.

Direction-specific equivalent building dimensions used as input to the AERMOD model to simulate the impacts of downwash will be calculated using the U.S. EPA-sanctioned Building Profile Input Program (BPIP-

PRIME), version 04274 and used in the AERMOD Model.[9]. BPIP-PRIME is designed to incorporate the concepts and procedures expressed in the GEP Technical Support document, the Building Downwash Guidance document, and other related documents and has been adapted to incorporate the PRIME downwash algorithms.[10]

A GEP analysis of all modeled point sources at the Brown Station in relation to each building will be performed to evaluate which building has the greatest influence on the dispersion of each stack's emissions. The GEP height for each stack calculated using the dominant structure's height and maximum projected width will also be determined. According to U.S. EPA dispersion modeling guidance, stacks with actual heights greater than either 65 meters or the calculated GEP height, whichever is greater, generally cannot take credit for their full stack height in a PSD modeling analysis. All modeled source stacks at the Brown Station are less than either 65 meters tall or their GEP formula height and therefore meet the requirements of GEP and credit for the entire actual height of each stack is used in this modeling analysis.

2.5 Elevated Terrain

Terrain elevations will be considered in the modeling analysis. The elevations of receptors, buildings, and sources will refine the modeling impacts between the sources at one elevation and receptor locations at various other elevations at the fence line and beyond. This will be accomplished through the use of the AERMOD terrain preprocessor called AERMAP (latest version 24142), which generates base elevations above mean sea level of sources, buildings, and/or receptors as specified by the user. For this analysis, AERMAP will be used for the existing source and building base elevations, whereas the NGCC project source and building elevations will be based on common base elevations equivalent to the anticipated final grade level. For all receptors, AERMAP will determine the base elevation of each and an effective hill height scale that determines the magnitude of each source plume-elevated terrain feature interaction. AERMOD uses both of these receptor-related values to calculate the effect of terrain on each plume. Base elevations for select sources and buildings, terrain elevations for receptors, and other regional source base elevations (if required in the NAAQS modeling analyses) input to the model will be read and interpolated from 1 arc second (approximately 30-meter resolution) National Elevation Dataset (NED) data obtained from the U.S. Geological Survey (USGS).[11]

2.6 Meteorological Data

For performing the Class II modeling in AERMOD, meteorological data must be preprocessed to put it into a format that AERMOD can use. Site-specific dispersion models require a sequential hourly record of meteorology representative of the region within which the source is located. For regulatory air quality modeling using AERMOD, the *Guideline on Air Quality Models* requires five years of reliable, quality-assured, and representative NWS meteorological data or at least one year of site-specific meteorological data. The representativeness of a particular observation site is evaluated with respect to four (4) factors:

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[9] Earth Tech, Inc., Addendum to the ISC3 User's Guide, The PRIME Plume Rise and Building Downwash Model, November 1997, http://www.epa.gov/scram001/7thconf/iscprime/useguide.pdf.

[10] U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, *Guidelines for Determination of Good Engineering Practice Stack Height (Technical Support Document for the Stack Height Regulations) (Revised),* Research Triangle Park, North Carolina, EPA 450/4-80-023R, June 1985.

[11] U.S. Geological Survey, USGS 3D Elevation Program (3DEP), accessed March 2024 at https://apps.nationalmap.gov/downloader/#/

1. The proximity of the meteorological monitoring site to the area under consideration;
2. The complexity of the terrain;
3. The exposure of the meteorological monitoring site; and
4. The period of time during which data is collected.

Surface observation stations form a relatively dense network across the U.S.; these stations are almost always found at airports and are typically operated by the NWS. There are fewer upper air stations taking vertical soundings of the atmosphere compared to surface observation locations. The NWS operates virtually all available upper air measurement stations in the U.S.

As shown in Table 2-3 below, eight candidate first-order NWS surface meteorological observation stations lie within 150 km of the Brown Station, and seven upper air stations lie within 500 km. Of these candidate sites, Blue Grass Airport (KLEX) is the closest meteorological station to Brown Station which also records ASOS one-minute data. Furthermore, the Division has recommended this meteorological station for modeling analyses conducted in Mercer County.[12] Therefore, the KLEX meteorological station was selected for use in the dispersion modeling analyses.

Table 2-3. Summary of Candidate Surface Meteorological Stations for Modeling Analysis

Station Name	WBAN Station ID	Station Call Sign	Lat.	Long.	ASOS One Minute Data Available	Distance to Brown (km)
Stuart Powell Field Airport	144	KDVK	37.578	-84.770	No	23.9
Blue Grass Airport	93820	KLEX	38.041	-84.606	Yes	29.6
Madison Airport	145	KI39	37.633	-84.333	No	37.7
Capital City Airport	53841	KFFT	38.185	-84.903	Yes	47.1
Mount Sterling Montgomery Cou	146	KIOB	38.067	-83.983	No	71.2
Somerset-Pulaski Co-J.T. Wils	63815	KSME	37.054	-84.615	No	82.2
Ldon-Crbn Apt-Mgee Fld Apt	3849	KLOZ	37.087	-84.077	Yes	96.2
Bowman Field Airport	13810	KLOU	38.228	-85.664	Yes	96.5
Louisville Intl-Standiford F	93821	KSDF	38.181	-85.739	Yes	99.9
Wayne County Airport	63882	KEKQ	36.855	-84.856	No	104.6
Godman Aaf Airport	13807	KFTK	37.900	-85.967	No	110.7
Julian Carroll Airport	3889	KJKL	37.591	-83.314	Yes	125.1
Glasgow Municipal Airport	361	KGLW	37.033	-85.950	No	137.7
Cincinnati/Northern Kentucky	93814	KCVG	39.044	-84.672	Yes	139.6
Cina Muni Apt/Lukn Fd Apt	93812	KLUK	39.103	-84.419	Yes	148.4

[12] Refer to Division for Air Quality, Available Meteorological Data, Surface and Upper Air: eec.ky.gov/Environmental-Protection/Air/Pages/Modeling and Meteorology.aspx

Table 2-4. Summary of Candidate Upper Air Stations for Modeling Analysis

Station Name	State	WMO Station ID	Station Call Sign	Lat.	Long.	Distance to Brown (km)
WILMINGTON	OH	72426	ILN	39.42	-83.82	197.3
NASHVILLE	TN	72327	BNA	36.25	-86.57	237.5
ROANOKE/BLACKSBURG	VA	72318	RNK	37.20	-80.41	385.3
GREENSBORO	NC	72317	GSO	36.08	-79.95	464.0
LINCOLN-LOGAN COUNTY AP	IL	74560	ILX	40.15	-89.33	477.6
PITTSBURGH/MOON TOWNSHIP	PA	72520	PIT	40.53	-80.23	492.2
PEACHTREE CITY	GA	72215	FFC	33.35	-84.56	493.8

For sources located in Mercer County, Kentucky, the Division recommends the use of upper air data from the Wilmington, OH (ILN) upper air station in conjunction with the KLEX surface station dataset. As discussed previously, the upper air data collection network is sparser than the surface data collection network due to the general homogeneity of the upper atmosphere across large distances. Therefore, the proximity of the upper air site to the facility of interest is generally the most heavily weighted factor with regard to making an upper air station selection. As provided in Table 2-4, the nearest upper air station to Brown Station is located in Wilmington, OH. Due to the proximity of the Wilmington upper air station and the similar upwind geographical coverage between Wilmington and Brown Station, the ILN upper air station was selected for the dispersion modeling analyses. The most recent available surface (KLEX) and upper air (ILN) datasets published by the Division cover the 2019-2023 meteorological data period. These datasets were downloaded from the Division's Modeling and Meteorology webpage for use in the dispersion modeling.[13]

2.7 Coordinate System

In all modeling analyses conducted, the location of emission sources, structures, and receptors will be represented in the Universal Transverse Mercator (UTM) coordinate system. The UTM grid divides the world into coordinates that are measured in north meters (measured from the equator) and east meters (measured from the central 500 km meridian of each UTM zone, where the world is divided into 36 north-south zones). The datum for the KU modeling analysis is based on North American Datum 1983 (NAD 83). UTM coordinates for this analysis all reside within UTM Zone 16 which will serve as the reference point for all model data as well as all regional receptors and sources.

2.8 Receptor Grids

For the Class II air dispersion modeling analyses, ground-level concentrations will be calculated from the fence line out to 10 km for the annual NO_2, 1-hour CO, 8-hour CO, annual PM_{10}, 24-hour PM_{10}, annual $PM_{2.5}$ and 24-hour $PM_{2.5}$ analyses and 50 km for the 1-hour NO_2 analyses using a series of nested receptor grids. These receptors will be used in the Significance analysis, in the PSD increment modeling, and in the overall NAAQS modeling. The following nested grids will be used to determine the extent of significance:

- **Fence Line Grid:** "Fence line" grid consisting of evenly spaced receptors 50 meters apart placed along the ambient air boundary of the Brown Station,

[13] Ibid.

- **Fine Cartesian Grid:** A "fine" grid containing 100-meter spaced receptors extending approximately 3 km from the center of the property and beyond the fence line,
- **Medium Cartesian Grid:** A "medium" grid containing 500-meter spaced receptors extending from 3 km to 10 km from the center of the facility, exclusive of receptors on the fine grid,
- **Coarse Cartesian Grid:** A "coarse grid" containing 1,000-meter spaced receptors extending from 10 km to 30 km from the center of the facility, exclusive of receptors on the fine and medium grids, and
- **Very Coarse Cartesian Grid:** A "very coarse grid" containing 2,500-meter spaced receptors extending from 30 km to 50 km from the center of the facility, exclusive of receptors on the fine, medium, and coarse grids.

This configuration and extent will capture the area of maximum modeled concentrations. If maximum modeled concentrations are located in an area with less than 100-meter receptor density, then the receptor density will be increased accordingly. Similarly, if maximum impacts are identified near the extents of the receptor grid, then the receptor grid will be expanded out to a maximum of 50 km (as necessary) to ensure the maximum modeled concentrations are appropriately captured.

The full NAAQS and PSD increment analyses will be conducted using only receptor locations at which impacts calculated for the sources related to the facility modification exceed the SIL for the respective pollutants and averaging time in consideration of directly modeled and secondary impacts as applicable. As compliance with the PSD increment analysis and NAAQS is only required in areas regulated as "ambient air," in developing the receptor grid for the modeling analysis, KU will exclude all company owned property to which public access is restricted, and thus, will not be considered "ambient air."

2.9 Source Emission Rates

KU will conduct a load analysis for the new turbine and existing boiler to determine the appropriate load scenario for inclusion in each of the modeling analyses. The load analysis will be conducted as follows:

1. A total of 38 different load scenarios were provided by the vendor for the turbine. These scenarios vary based on ambient conditions (temperature and relative humidity) and unit load (25% to 100%). KU will model the lowest exit velocity, lowest temperature, and highest emission rate for four different load conditions, representative of 100%, 75%, 50%, and a minimum emissions compliant load (MECL). In addition, KU will model the worst-case emission rate based on the series of startup and shutdown events listed in the permit application narrative. Each of these load conditions will be modeled as separate sources and combined with a series of source groups to ensure the "worst-case" impacts are modeled. For the case of NO_2, the source groupings will be separated into different modeling files to ensure NO_X:NO_2 conversion is correctly applied.

2. In the SIL analysis, KU will determine which is the worst-case load scenario for Unit 12. That scenario will be carried through to the cumulative analyses (if required).

Apart from Unit 12, dispersion modeling for the SIL will be conducted for all new sources using hourly or annual potential NO_2, PM_{10}, $PM_{2.5}$, and CO emission rates, where applicable, based on the averaging period of the underlying NAAQS or PSD Increment standard.

For PSD increment and NAAQS modeling analyses, all new or modified project sources will be modeled at their post-project potential emission rate to be conservative. If modeling results are overly conservative for the PSD increment, then emission rates may be adjusted to account for any emissions that would have been included in the baseline modeling. Existing emission units at Brown Station and nearby sources will also be modeled at their potential emission rates unless modeled impacts are unrepresentative, in which case the emission rates may be calculated in accordance with Table 8-2 of Appendix W.

2.10 Emergency/Intermittent Sources

KU operates several emergency units (emergency engine/fire pump) at the existing facility. Additionally, KU is proposing to install a number of emergency engines as part of the NGCC project. These units will be excluded from the 1-hr NO_2 SIL and NAAQS analyses, but will be included in the CO, $PM_{2.5}$, PM_{10}, and Annual NO_2 modeling analyses. For short-term averaging periods (1-hour, 8-hour, and 24-hour) the emergency units will be modeled assuming one hour of non-emergency operation per 24-hr period, with an adjusted emission rate. These units will be excluded from the 1-hr NO_2 analyses, for the following reasons:

- Emissions from these units is limited, as annual operational hours for these units is limited to 500 hours per year. Emissions calculations for the proposed emergency units will be provided in the NGCC Project PSD permit application.

- The frequency of maintenance and readiness testing for these emergency engines will be intermittent. Operation for readiness testing and maintenance checks will occur not more than weekly with annual operations limited to less than 100 hr/yr pursuant to the emergency engine operating requirements under applicable federal air regulations (e.g., 40 CFR 60 Subpart IIII).

As the operations of these units will be intermittent, available modeling guidance (e.g. March 1, 2011 Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hr NO_2 National Ambient Air Quality Standard) indicates that it would be inappropriate to model intermittent sources continuously, when modeling sources in that manner could have an inappropriate influence on modeled design values. Given the short term and intermittent nature of operation of these emission units, modeling of these units would have an inappropriate influence on modeling design concentrations for the 1-hr NO_2 NAAQS, given their actual limited use and operations. Therefore, the emergency units will not be included in any 1-hr NO_2 modeling evaluations for the Brown Station.

2.11 Nearby Regional Inventory

As per PSD modeling requirements, for any off-site air concentration impact calculated that is greater than the SIL for a given pollutant, the radius of the significant impact area (SIA) will be determined based on the extent to which the farthest receptor is located at which the SIL is exceeded. Thus, the SIA will encompass a circle centered on Brown Station with a radius extending out to either (1) the farthest location where the emissions increase of a pollutant from the project causes a significant ambient concentration [i.e., modeled impact above the SIL on a high-first-high (HFH) basis] or (2) a maximum distance of 50 km, whichever is less.[14] Under EPA's previous guidance in Section IV.C.1 of the draft *New Source Review Manual* applicable to "deterministic" NAAQS, all sources within the SIA no matter how small or distant would be included in the regional inventory, and the remaining sources outside of the SIA but within 50 km would be assumed to potentially contribute to ground-level concentrations within the SIA and would be evaluated for possible

[14] This is the maximum extent of the applicability of the AERMOD Model as per the *Guideline on Air Quality Models*.

inclusion in the NAAQS analysis.[15] An applicant would determine the SIA for each pollutant and averaging period and would use these calculations to determine which regional sources needed to be included in the NAAQS analysis. Sources in the raw inventories provided by state agencies would first be screened to remove sources located outside of the radius of impact (ROI) [i.e., the significant impact area (SIA) plus 50 km]. The remaining sources within the ROI would then be screened based on an emissions (Q) over distance (d) screening technique such as the "20D" procedure to identify small and distant sources that could be excluded from the NAAQS analysis because they were not anticipated to impact receptors in the SIA.[16] For deterministic NAAQS like the annual NO_2 standard and 1-hour and 8-hour CO standards, this procedure is generally still valid and will be used if modeled impacts from the Significance Analysis exceed the SIL.

For short-term probabilistic NAAQS like the 1-hour NO_2 standard, this procedure often produces an inordinately large number of regional inventory sources due to larger SIA distances caused by peak hourly impacts during certain low frequency meteorological events. Recognizing the limitations of the NSR Manual procedure developed at a time when no probabilistic 1-hour NAAQS were in effect, U.S. EPA now recommends a different regional inventory screening procedure focusing primarily on professional judgement by the dispersion modeler. As indicated in Appendix W, U.S. EPA states that "the number of nearby sources to be explicitly modeled in the air quality analysis is expected to be few except in unusual situations [and] in most cases, the few nearby sources will be located within the first 10 to 20 km from the source(s) under consideration." As such, KU will employ a subjective screening analysis in addition to the quantitative methods described above. Justification for inclusion or exclusion of specific regional sources will be included in the final modeling report.

KU has obtained regional source data from the Division.[17] The first screening step in the regional inventory screening process will be to apply the objective procedure outlined in the NSR Manual which U.S. EPA still considers to "generally be acceptable as the basis for permitting decisions, contingent on an appropriate accounting for the monitored contribution."[18] All sources within the SIA for the specific averaging period will be retained for further consideration in the remaining screening steps of the analysis, and any sources beyond the SIA but within this ROI will be screened using the "20D" procedure. Under this Q/d-based screening procedure, sources outside the SIA will be excluded from the inventories for short-term averaging periods if the entire facility's emissions (tpy) are less than 20 times the distance (km) from the facility to Brown Station, and sources outside the SIA will be excluded from the inventories for annual averaging periods if the entire facility's emissions (tpy) are less than 20 times the distance (km) from the facility to the nearest edge of the SIA.

In addition, the locations of the included and excluded regional sources based on the results of the "20D" screening analysis will be plotted in maps presented as part of an appendix to the modeling report. These plots will be reviewed to determine if any sources eliminated by the "20D" rule were in close enough proximity to one another that they could be considered a "cluster." The combined Q/d value for each identified cluster will be calculated using GIS software. If the aggregate Q/d for a cluster exceeds 20, the sources within the cluster excluded from the inventory on the basis of their individual facility Q/d value will

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[15] EPA, *New Source Review Workshop Manual*, Draft October 1990, available at http://www.epa.gov/ttn/nsr/gen/wkshpman.pdf

[16] 57 FR 8079, March 6, 1992.

[17] State-wide KyEIS emissions data obtained via email from Mr. Dane Ison, the Division on July 11, 2024.

[18] U.S. EPA Memorandum from Tyler Fox, *Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-Hour NO_2 National Ambient Air Quality Standard*, March 1, 2011.

be further evaluated for possible inclusion in the NAAQS/PSD Increment analyses. For each step in the regional inventory screening process, Excel spreadsheets and associated regional inventory summary tables will be included as an appendix to the modeling report to provide documentation of each emission unit removed from the inventory and each unit retained for inclusion in the NAAQS and PSD Increment analyses.

After completing the screening analysis, the remaining inventory sources will then be evaluated to determine whether any refinements to the data set are warranted or if the source could be removed from the inventory based on site-specific considerations. The two main problems expected to be encountered in finalizing the model input parameters for the remaining inventory sources are: 1) missing/non-representative stack parameters, and 2) overestimated potential emission rates due to overlapping process designations in the emissions inventory premised on continuous annual operation in multiple operating modes (i.e., one process ID for a boiler designating 8,760 hr/yr of operation at the maximum burner rating when firing natural gas and a second process ID designating 8,760 hr/yr of fuel oil firing). Missing/non-representative stack parameters for point sources will be filled based on the best available data for the source in question. To aid in the Division's review of the model input parameters assigned to regional sources, all of the assumptions and resources used for filling or correcting stack parameters will be documented through highlighting and embedded comments in the regional inventory spreadsheets. These modified parameters will be further documented through footnotes to the regional inventory model input parameter summary tables.

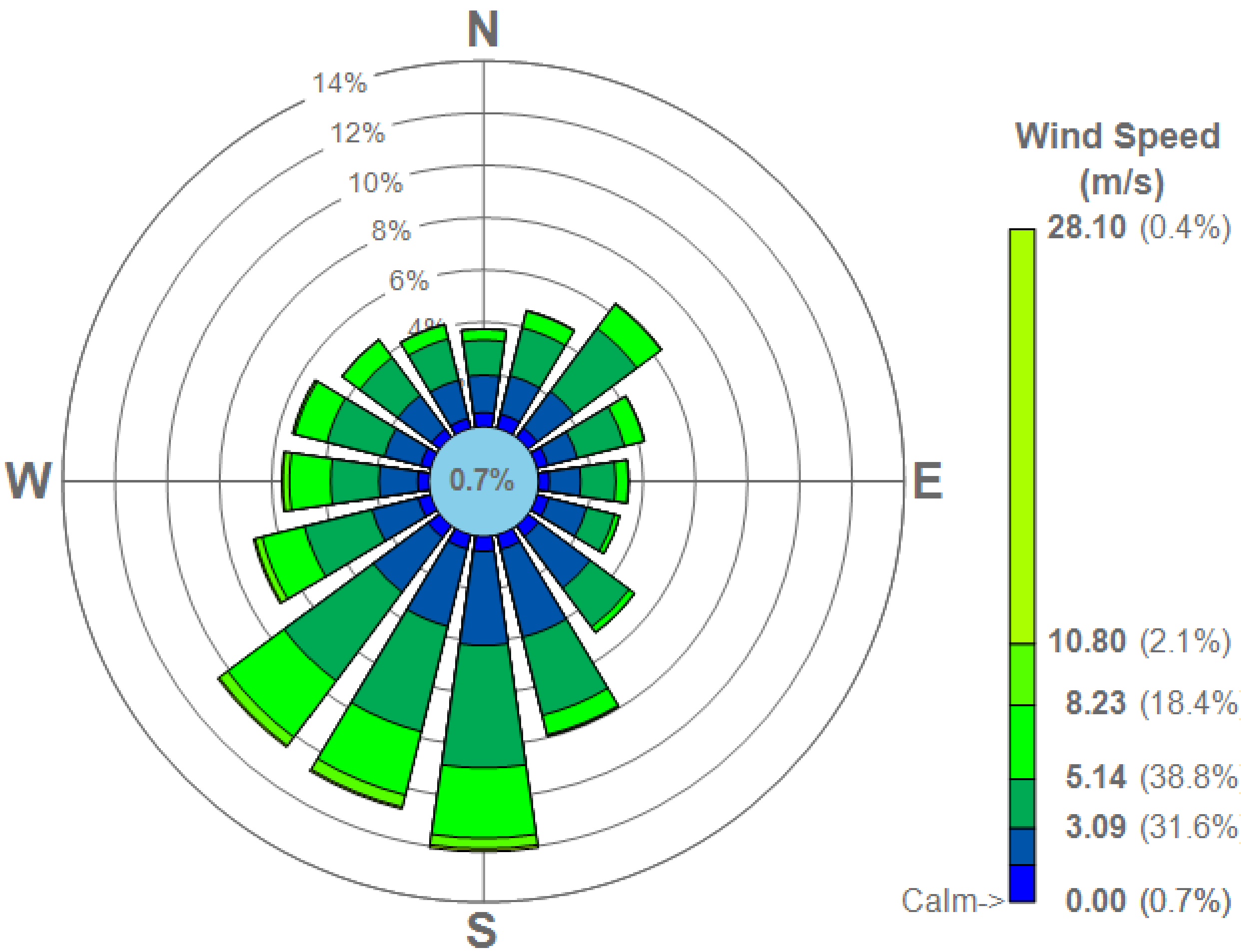
If a modeled exceedance is observed on property of a nearby source, then the so called "Mitsubishi Method" may be employed to demonstrate compliance at those on-property receptor locations.[19] Specifically, Brown Station and the nearby sources will be modeled to obtain total concentrations at all receptor locations. Where a receptor is located on a nearby source's non-ambient air property, the contribution from that specific nearby source may be subtracted from the total concentrations.

2.12 Background Concentrations

Background concentrations will be obtained from nearby monitoring locations to allow the determination of the cumulative impact assessment for pollutants which require a full NAAQS modeling analysis. Nominations for candidate monitors for CO, NO_2, PM_{10}, $PM_{2.5}$, and ozone concentrations will be made on the basis of monitor sites with data for the required pollutants, period of data collection, adherence to Federal U.S. EPA QA/QC procedures, proximity, and representativeness (based on similar land use and geographical setting between Brown Station and the monitor site). To select and confirm the validity and representativeness of nearby and distant ambient monitoring sites, a number of resources will be assessed. One of these is the five-year windrose (five years selected to be commensurate with the modeling requirements of the Guideline) presented in Figure 2-1 representing the wind speeds and directions for 2019 through 2023 at the Blue Grass Airport (KLEX). This data is the same as what is proposed for use in all modeling analyses herein and is provided in Figure 2-1 to illustrate the direction of prevailing winds that are characteristic of the area and applicable to Brown Station. As can be seen, prevailing winds are from the south.

[19] U.S. EPA Memorandum from Robert D. Bauman (Chief SO2/Particulate Matter Programs Branch) to Gerald Fontenot (Chief Air Programs Branch, Region VI), *Ambient Air,* October 17, 1989

Figure 2-1. Five-Year (2019-2023) Windrose for the Blue Grass Airport (KLEX)



2.12.1 Brown Station Airshed Characteristics

Mercer County covers an area of approximately 249.06 square miles, has a population of 23,097, and has a corresponding population density of 92.7 persons per square mile.[20] Mercer County is not part of any statistical areas as delineated by the Office of Management and Budget (OMB)[21] is classified under the 2023 Rural-Urban Continuum Codes as "Nonmetro - Urban population of 5,000 to 20,000, adjacent to a metro area."[22] Although Mercer County is adjacent to the core-based statistical area (CBSA) of Lexington-Fayette, KY, it is almost exclusively rural with a few small towns spread throughout the county at intersections of State highways. Based on these characteristics, Mercer County's airshed is not as significantly influenced by pollutant emissions from a CBSA as the candidate monitors located near the centers of MSAs and Combined

20 U.S. Census Bureau, State & County QuickFacts: Mercer County, Kentucky, July 1, 2023; available at: https://www.census.gov/quickfacts/fact/table/mercercountykentucky/PST045223

21 Office of Management and Budget, OMB Bulletin No. 23-01, available at https://www.whitehouse.gov/wp-content/uploads/2023/07/OMB-Bulletin-23-01.pdf

22 U.S. Department of Agriculture Economic Research Service, 2023 Rural-Urban Continuum Codes for Kentucky, available at http://www.ers.usda.gov/data-products/rural-urban-continuum-codes.aspx.

Statistical Areas (CSA).[23] The predominately rural characterization of Brown Station's modeling domain is a primary consideration for selecting representative monitors and introduced the primary selection criteria of population, population density, location relative to MSA and CSA, and surrounding land use.

2.12.2 NO_2 Background Concentration

As shown in Table 2-5, KU has identified the five (5) closest NO_2 monitoring locations to the Brown Station for potential use in defining a representative NO_2 background concentration for the modeling analysis.

Beyond the general selection criteria mentioned above, a key consideration for determining the representativeness of a NO_2 monitoring station is the relative proximity and exposure of the monitoring and plant sites to NO_X emissions from roadway traffic. In the final rule preamble for the 1-hour NO_2 NAAQS, U.S. EPA cited the following factors for reaching the conclusion that roadways account for the majority of exposures to peak 1-hour NO_2 concentrations.[24]

- Mobile sources account for the majority of NO_X emissions.
- The Integrated Science Assessment (ISA) stated that NO_2 concentrations in heavy traffic or on freeways "can be twice the residential outdoor or residential/arterial road level," that "exposure in traffic can dominate personal exposure to NO_2," and that "NO_2 levels are strongly associated with distance from major roads (i.e., the closer to a major road, the higher the NO_2 concentration)."
- The exposure assessment presented in the Risk and Exposure Assessment (REA) estimated that roadway-associated exposures account for the majority of exposures to peak NO_2 concentrations.
- Monitoring studies suggest that NO_2 concentrations near roads can be considerably higher than those in the same area but away from roads.
- In their comments on the approach to setting the 1-hour NO_2 standard, the majority of Clean Air Scientific Advisory Committee (CASAC) Panel members emphasized the importance of setting a standard that limits roadway-associated exposures to NO_2 concentrations that could adversely affect asthmatics. These CASAC Panel members favored the proposed approach, including its focus on roads.

23 According to the U.S. Census Bureau, CSA are groupings of adjacent metropolitan and/or micropolitan statistical areas that have social and economic ties as measured by commuting to work, but at lower levels than are found among counties within individual metropolitan and micropolitan statistical areas.

24 75 FR 6499, 40 CFR Parts 50 and 58 Primary National Ambient Air Quality Standards for Nitrogen Dioxide; Final Rule, February 9, 2010.

Table 2-5. NO_2 Background Concentrations from Candidate Monitoring Stations

Site ID	CBSA	County	State	Downwind Direction to Monitor	Distance to Facility (km)	Averaging Period	NO_2 Background Concentration ($\mu g/m^3$)
21-067-0012	Lexington-Fayette, KY	Fayette	KY	NE	36.1	Annual	11.3
						1-Hour	75.2
21-111-0067	Louisville/Jefferson County, KY-IN	Jefferson	KY	WNW	95.8	Annual	15.0
						1-Hour	75.2
21-111-0075	Louisville/Jefferson County, KY-IN	Jefferson	KY	WNW	98.4	Annual	24.4
						1-Hour	90.2
21-037-3002	Cincinnati, OH-KY-IN	Campbell	KY	N	138.7	Annual	9.4
						1-Hour	50.8
39-061-0040	Cincinnati, OH-KY-IN	Hamilton	OH	N	150.1	Annual	16.9
						1-Hour	73.3

Source: 2023 EPA Design Values Report

[1] Maximum monitor value from most recent three year period (2021 to 2023) for the annual concentration, and the three-year average (2021 to 2023) 98th percentile 1-hour daily maximum concentrations for the 1-hour concentration.

In the context of the previously cited background monitor selection criteria and EPA's statements regarding the significant influence of roadway NO_X emissions on ambient NO_2 concentrations, candidate monitoring locations are assessed for representativeness in the following discussion starting with the monitoring locations closest to Brown Station.

2.12.2.1 NO_2 Monitor Selection

The closest monitor to the Brown Station is located in Fayette County, Kentucky (Site ID 21-067-0012), which is located in the Lexington, Kentucky CBSA. The monitor is located in a highly urbanized area just 2 km north of the Lexington city center. Given the proximity of the monitor to the highly urbanized city center of Lexington, KY, the monitor would not accurately represent the rural area surrounding the Brown Station. However, compared to other nearby monitors, the Fayette County monitor is the best monitor in terms of proximity to the site and representation of the area around Brown Station, as the remaining four (4) monitors are in the larger metropolitan areas of Louisville, KY and Cincinnati, OH compared to the Fayette County monitor. KU is proposing to select the Fayette County monitor for use in the modeling analyses.

2.12.3 PM_{10} Background Concentration

Presented in Table 2-6 are the five (5) closest PM_{10} ambient monitoring stations to Brown Station that could be used for establishing the PM_{10} background concentrations. The closest monitor is the Fayette County monitor (Site ID 21-067-0012) and the remaining four (4) monitoring stations are also located in or near the city centers of Louisville, KY and Cincinnati, OH. To simplify the monitor selection and to remain conservative, KU is proposing to select the nearest PM_{10} monitoring station (Fayette County) for use in the modeling analyses.

Table 2-6. PM_{10} Background Concentrations from Candidate Monitoring Stations

Site ID	CBSA	County	State	Downwind Direction to Monitor	Distance to Facility (km)	Averaging Period	PM_{10} Background Concentration[1] ($\mu g/m^3$)
21-067-0012	Lexington-Fayette, KY	Fayette	KY	NE	36.1	24-hour	28.0
21-111-0067	Louisville/Jefferson County, KY-IN	Jefferson	KY	WNW	95.8	24-hour	59.0
18-019-0010	Louisville/Jefferson County, KY-IN	Clark	IN	WNW	105.7	24-hour	48.0
21-111-1041	Louisville/Jefferson County, KY-IN	Jefferson	KY	WNW	109.2	24-hour	61.0
39-061-0040	Cincinnati, OH-KY-IN	Hamilton	OH	N	150.1	24-hour	79.0

Source: 2023 EPA Design Values Report

[1] Fourth high 24-hour concentration over three years.

2.12.4 $PM_{2.5}$ Background Concentration

Presented in Table 2-7 are the five (5) $PM_{2.5}$ ambient monitoring stations that are closest to Brown Station that could be used for establishing the $PM_{2.5}$ background concentrations for the proposed project. The closest monitor is located in Fayette County (Site ID 21-067-0012). However, as discussed, this monitor is located near the Lexington city center. The Pulaski County monitor in Somerset, KY (Site ID 21-199-0003) is the next closest monitor to the facility and as it is located in a less densely populated area compared to the Fayette County monitor, it would be more representative of the background concentration at Brown Station. KU is proposing to use the data from the Pulaski County monitor to establish a representative background concentration for Brown Station.

Consistent with recent U.S. EPA guidance, KU plans to exclude atypical smoke events from the $PM_{2.5}$ design value calculations using U.S. EPA's Exceptional Events Design Value Tool.[25,26] Specifically, KU is proposing to exclude all monitoring data flagged with wildfire, prescribed fire, structural fire, or fireworks data flags. There are no regularly occurring agricultural fires (e.g., sugarcane burning) that occur within a close enough proximity to the Pulaski County monitor that would be expected to significantly impact monitored concentrations. As such, all smoke events near the Pulaski County monitor would be expected to be "atypical" and not appropriate for inclusion in a background concentration, which should be representative of typical ambient air quality for the area. By excluding these smoke events, the annual $PM_{2.5}$ design value concentration would change from 7.5 $\mu g/m^3$ to 6.9 $\mu g/m^3$, and the 24-hour $PM_{2.5}$ design value concentration would change from 20 $\mu g/m^3$ to 15 $\mu g/m^3$.

[25] Draft Guidance on Developing Background Concentrations for Use in Modeling Demonstrations (October 2023), EPA-454/P-23-001

[26] EPA's Exceptional Events Design Value Tool, https://www.epa.gov/air-quality-analysis/exceptional-events-design-value-tool

Table 2-7. $PM_{2.5}$ Background Concentrations from Candidate Monitoring Stations

Site ID	CBSA	County	State	Downwind Direction to Monitor	Distance to Facility (km)	Averaging Period	CO Background Concentration[1] (ppm)
21-111-0067	Louisville/Jefferson County, KY-IN	Jefferson	Kentucky	WNW	95.8	8-Hour	2.00
						1-Hour	3.20
21-111-0075	Louisville/Jefferson County, KY-IN	Jefferson	Kentucky	WNW	98.4	8-Hour	1.60
						1-Hour	2.50
21-061-0501	Bowling Green, KY	Edmonson	Kentucky	WSW	145.7	8-Hour	0.60
						1-Hour	0.70
39-061-0040	Cincinnati, OH-KY-IN	Hamilton	Ohio	N	150.1	8-Hour	1.00
						1-Hour	1.50
39-061-0048	Cincinnati, OH-KY-IN	Hamilton	Ohio	N	151.7	8-Hour	1.40
						1-Hour	1.70

Source: 2023 EPA Design Values Report

[1] Second high concentration over most recent two year period (2022-2023).

2.12.5 CO Background Concentration

Presented in Table 2-8 are the five (5) closest CO ambient monitoring stations to Brown Station that could be used for establishing the CO background concentrations. The closest monitors are in Jefferson County (Site IDs 21-061-0501 and 21-111-0075), which are located northwest of the Brown Station. The Jefferson County monitors are located within the CBSA of Louisville, KY and urban source impact on the monitor would not be representative of the urban impact on Brown Station. The next closest monitor is the Edmonson, KY monitor (Site ID 21-061-0501), which is located within the CBSA of Bowling Green, KY. However, the Edmonson County monitor is located near the edge of the CBSA and as such urban source impact on the monitor is expected to be limited. Given Brown Station's proximity to Lexington, KY, KU believes the urban impacts at the Edmonson County monitor would underestimate the impact from urban sources in Lexington, KY, due to the much higher population in Lexington (~76,000 in Bowling Green, ~320,000 in Lexington). As such, KU is proposing to select the nearest Jefferson County monitor (Site ID 21-111-0067) 2022-2023 design values for use as a background concentration in the CO modeling analyses.

Table 2-8. CO Background Concentrations from Candidate Monitoring Stations

Site ID	CBSA	County	State	Downwind Direction to Monitor	Distance to Facility (km)	Averaging Period	CO Background Concentration[1] (ppm)
21-111-0067	Louisville/Jefferson County, KY-IN	Jefferson	Kentucky	WNW	95.8	8-Hour	2.00
						1-Hour	3.20
21-111-0075	Louisville/Jefferson County, KY-IN	Jefferson	Kentucky	WNW	98.4	8-Hour	1.60
						1-Hour	2.50
21-061-0501	Bowling Green, KY	Edmonson	Kentucky	WSW	145.7	8-Hour	0.60
						1-Hour	0.70
39-061-0040	Cincinnati, OH-KY-IN	Hamilton	Ohio	N	150.1	8-Hour	1.00
						1-Hour	1.50
39-061-0048	Cincinnati, OH-KY-IN	Hamilton	Ohio	N	151.7	8-Hour	1.40
						1-Hour	1.70

Source: 2023 EPA Design Values Report

[1] Second high concentration over most recent two year period (2022-2023).

2.12.6 Ozone Background Concentration

Selecting an existing ozone monitoring site that best represents the air quality in the region surrounding the Brown Station is the first step in assessing the proposed facility's potential impacts on ozone formation. A monitoring station is selected from among the candidate monitors in the area based on an evaluation of the following criteria:

1. Proximity of the ambient monitoring station to the Brown Station;
2. Availability of complete ozone monitoring data that has undergone Quality Assurance and Quality Control (QAQC) for the most recent three calendar years (i.e., 2021 to 2023); and
3. Similarity of the emissions profile and surrounding airshed in the region of the monitoring station and the Brown Station.

2.12.6.1 Proximity and Data Completeness Criteria

As shown in Table 2-9, there are five (5) candidate ozone monitoring stations that collected three years of quality assured data in the period from 2021 to 2023 and that are located within 50 km of the Brown Station. The locations of these stations relative to Brown Station and their 8-hour ozone NAAQS design values in the most recent three-year period are indexed in Table 2-9Table 2-9. These candidate monitoring sites are evaluated further using the remaining criteria to determine their representativeness for establishing the ozone background concentration for the proposed facility.

Table 2-9. Candidate Ambient Ozone Monitoring Sites Based on Proximity and Data Availability

Site ID	CBSA	County	State	Downwind Direction to Monitor	Distance to Facility (km)	8-hr Average Ozone Concentration[1] (ppm)
21-113-0001	Lexington-Fayette, KY	Jessamine	KY	NE	15.9	0.066
21-229-9991		Washington	KY	WSW	30.8	0.063
21-067-0012	N/A	Fayette	KY	NE	36.1	0.066
21-199-0003	N/A	Pulaski	KY	S	77.3	0.060
21-111-0080	Lexington, KY	Jefferson	KY	WNW	87.2	0.070

Source: 2023 EPA Design Values Report

[1] Three-year average for 2021-2023 of the annual 4th highest daily maximum 8-hour concentrations.

As shown in Table 2-9, the ozone NAAQS design values from the monitoring stations in proximity to the Brown Station are fairly uniform, which reflects the regional nature of ozone formation and transport. The data in Table 2-9 suggests the candidate monitoring sites are all exposed to similar levels of ozone precursor emissions and are part of the same general ozone transport region.

With fairly uniform design concentrations across the region, the background monitor selection process is less critical than it would be if more of a disparity existed between the measured ozone concentrations across the observed candidate monitors. In addition, the margin between the 8-hr ozone NAAQS and the design values for all of the candidate ozone monitoring stations within the proximity of the Brown Station (i.e., 60 to 70 ppb) is likely adequate to accommodate any increase in ozone formation that may be attributable to the proposed project, so any one of these five (5) candidate monitors could be relied upon as the basis for the Brown Station ozone ambient impact analysis.

Of the five (5) candidate monitors presented in Table 2-9, the Jessamine County monitor was ultimately deemed to be representative of the airshed surrounding the Brown Station. This decision was primarily made based on the proximity of the monitor to Brown Station relative to the other candidate monitors. The design value for the selected Jessamine County monitor shown in Table 2-9 (66 ppb) is based on the three-year average of the 4^{th} highest 8-hr ozone concentrations in the most recent three years (i.e., 2021 to 2023) observed at this monitoring site.

Unfortunately, the Jessamine County monitor only operates during ozone season (i.e., March through October). The closest candidate ambient ozone monitor which operates year-round is the Washington County monitor. As KU plans to use OLM as a Tier 3 NO_2 modeling option, which requires hourly ozone background data, KU is proposing to use the Washington County monitor to supplement the Jessamine County monitor data during non-ozone season and missing hours. Hourly ozone data from 2021 through 2023 will be acquired for both monitors and data gaps of one hour will be filled with linear interpolation. If gaps of more than one hour remain after considering the available data, the maximum hourly ozone concentration for the hour of day and month will be used to substitute for missing hours.

2.13 Preconstruction Monitoring Waiver

Brown Station is subject to preconstruction review as part of the PSD permitting program. The PSD program can require at least one year of continuous air monitoring data for each criteria pollutant when the modification will result in a significant net emissions increase, pursuant to 401 KAR 51:017, Section 11. An exemption to this requirement exists if the ambient concentration increase due to the project is less than the Significant Monitoring Concentration (SMC), pursuant to 401 KAR 51:017, Section 7(5). To satisfy the 401 KAR 51:017, Section 11 monitoring requirement, the Division also allows the use of existing nearby ambient air quality data, if representative, as an alternative to requiring onsite preconstruction monitoring data in cases where the SMC are exceeded.

KU expects that the SMC will be exceeded for NO_2, PM_{10}, $PM_{2.5}$, CO, and ozone and that maximum modeled concentrations will occur at the ambient air boundary. Rather than obtaining site specific preconstruction monitoring data for these pollutants, KU is requesting a preconstruction monitoring waiver for the NGCC Project. As KU has identified in Section 2.12 existing monitors for these pollutants that are representative of the area surrounding the source being modeled, these monitors are also appropriate from satisfying the preconstruction monitoring requirements and for use as background data in the NAAQS analyses.

Therefore, KU requests that KDAQ waive the NO_2, PM_{10}, $PM_{2.5}$, CO, and ozone preconstruction monitoring requirements of 401 KAR 51:017, Section 11 for the NGCC Project based on the availability of representative monitoring data as described above.

3. CLASS I AREA DISPERSION MODELING ANALYSIS

As shown in Table 3-1, there are three (3) Class I areas within 300 km of the Brown Station. The closest Class I area to Brown Station is Mammoth Cave National Park located about 129 km from Brown Station to the nearest boundary of the park to the southwest of Brown Station. Class I areas are federally protected areas for which more stringent air quality standards apply to protect unique natural, cultural, recreational, and/or historic values. The Federal Land Managers (FLM) of these Class I areas have the authority to protect air quality and to consider, in consultation with the permitting authority, whether a proposed major emitting facility will have an adverse impact on air quality. There are two principal air quality impacts that are considered for Class I areas: PSD increments and air quality related values (AQRV)

Table 3-1. Distances to Class I Areas within about 300 km of the KU Brown Station

Class I Area	Distance from Brown Station (km)
Mammoth Cave (KY)	129
Great Smoky Mountains (NC/TN)	247
Joyce Kilmer-Slickrock (NC)	266

KU is required to assess PSD Increment consumption at the affected Class I areas. KU proposes to perform this evaluation using a screening methodology that is commonly applied. This methodology relies on the same Significance analysis model input parameters applied for the Class II area assessments. Modeling in AERMOD will be performed by placing arcs of receptors at distances of 50 km in the direction of each Class I area within 300 km, to demonstrate that impacts are below the Class I SILs. This Class I increment screening procedure is detailed in Section 4.2c of the Guideline on Air Quality Models, Appendix W).

Given the stringency of the PM_{10} and $PM_{2.5}$ Class I SILs, the AERMOD screening approach is overly conservative, especially for Class I areas beyond 100 km distances. KU will use an alternative to the overly conservative modeled screening approach using AERMOD that is outlined in EPA's latest MERPs guidance document.[27] This second-level assessment will use the hypothetical source photochemical modeling that was originally used in support of the secondary $PM_{2.5}$ MERP framework. This approach is still considered conservative since the primary $PM_{2.5}$ modeling was conducted without any plume-depleted processes enabled in the photochemical model.

The Class I SILs for the pollutants expected to exceed their respective SERs and for which there is an increment are presented in Table 3-2. KU assumes the $PM_{2.5}$ Class I Area SIL contained in EPA's "Supplement to the Guidance on Significant Impact Levels for Ozone and Fine Particles in the Prevention of Significant Deterioration Permitting Program" (April 2024) will be accepted for this PSD air quality analysis. If the Division does not intend to accept the proposed Class I SIL for $PM_{2.5}$, KU respectfully requests a notification as soon as possible to avoid any delays in preparation and submittal of the final Modeling Report.

[27] https://www.epa.gov/sites/default/files/2020-09/documents/epa-454_r-19-003.pdf

Table 3-2. Class I PSD SILs

Pollutant	Averaging Period	Class I SIL ($\mu g/m^3$)
NO_2	1-Hour	NA
	Annual	0.10
PM_{10}	24-Hour	0.32
	Annual	0.16
$PM_{2.5}$	24-Hour	0.27
	Annual	0.03

If the impacts within the 50 km arc in the direction of Class I areas exceed the SIL for a particular pollutant/averaging period, KU will proceed with full scale long-range transport modeling using EPA's recommended CALPUFF model for that pollutant/averaging period. Based on preliminary Class I Significance Analysis results, KU expects modeled concentrations to fall below the applicable Class I SILs, and thus no further refined modeling is expected to be required and a separate Class I modeling protocol for long range transport modeling will not be necessary.

4. ADDITIONAL IMPACTS ANALYSIS

Pursuant to 401 KAR 52:020, three additional impacts analyses will be performed as part of the PSD permitting action. These are: 1) a growth analysis, 2) a soil and vegetation analysis, and 3) a visibility analysis.

4.1 Growth Analysis

The purpose of the growth analysis is to quantify project associated growth; that is, to predict how much new growth is likely to occur in order to support the source or modification under review, and then to estimate the air quality impacts from this growth. Accordingly, KU will include a discussion of impacts resulting from any residential and commercial growth driven by the proposed project in the PSD permit application.

4.2 Soils and Vegetation Analysis

To assess soil and vegetation impacts, the modeling results from the NAAQS analysis will be primarily assessed against the secondary NAAQS standards. The secondary NAAQS, shown in Table 2-1 represent levels that provide protection for public welfare, including protection against decreased visibility, damage to animals, crops, vegetation, and buildings. While KU intends to primarily assess the impacts to soils and vegetation based on an evaluation of compliance with the secondary NAAQS, potential impacts will also be evaluated using the methodology outlined in the U.S. EPA document, *A Screening Procedure for the Impacts of Air Pollution Sources on Plants, Soils, and Animals*.[28] In this document, U.S. EPA developed a set of screening thresholds that are used to assess the potential for adverse impacts on soils and vegetation due to various types of air emission sources. U.S. EPA has not released any new editions of this document since it was first published in 1980, and it is still widely utilized by applicants and agencies for these types of analyses.

4.3 Visibility Analysis

To provide a demonstration that local visibility impairment will not result from the proposed project, KU will utilize the U.S. EPA VISCREEN model following the guidelines published in the *Workbook for Plume Visual Impact Screening and Analysis* to assess potential plume impairment.[29] The primary variables that affect whether a plume is visible or not at a certain location are (1) quantity of emissions, (2) types of emissions, (3) relative location of source and observer, and (4) the background visibility range. The VISCREEN model is designed to determine whether a plume from a facility may be visible from a given vantage point. KU will determine the nearest potentially sensitive Class II area for consideration in the VISCREEN modeling and the selection will be documented in the modeling report. Level 1 screening techniques are expected to be adequate to demonstrate plume impairment values below screening thresholds. Regardless, the Level 2 screening technique will be applied if necessary.

[28] EPA, Office of Air Quality Planning and Standards, *A Screening Procedure for the Impacts of Air Pollution Sources on Plants Soils and Animals*, Research Triangle Park, North Carolina, December 1980.

[29] EPA, *Workbook for Plume Visual Impact Screening and Analysis*, EPA-450/4-88-015, 1988.

5. SECONDARY $PM_{2.5}$ IMPACT ASSESSMENT

$PM_{2.5}$ precursor pollutants (e.g., NO_X, SO_2) can undergo photochemical reactions resulting in the formation of secondary $PM_{2.5}$ downwind of a stationary industrial source. The creation of $PM_{2.5}$ by secondary mechanisms increases the total concentration by adding to the direct emissions of $PM_{2.5}$ from a facility. Two of the largest constituents of secondarily formed $PM_{2.5}$ are sulfates (SO_4) and nitrates (NO_3), both of which are formed from their respective precursor pollutants (SO_2 for SO_4 and NO_X for NO_3). The current guideline model for Class II Area air dispersion modeling, AERMOD, does not account for the secondary $PM_{2.5}$ formation from atmospheric processes.

Based on the MERP guidance offered by EPA, KU will prepare a site-specific secondary $PM_{2.5}$ impact assessment to comprehensively demonstrate precursor emissions from the proposed project will not cause or contribute to a violation of the $PM_{2.5}$ NAAQS or PSD increment standards. In this analysis, calculated secondary $PM_{2.5}$ concentrations will be added to modeled impacts from AERMOD for the SIL, NAAQS, and PSD increment (Class I and II) analyses.

6. OZONE AMBIENT IMPACT ANALYSIS

The latest revisions to the *Guideline*, which was published in the Federal Register on January 17, 2017, recommend the use of MERPs to evaluate a proposed project's impact on ozone levels in the surrounding airshed. The *Guideline* establishes a two-tiered demonstration approach for addressing single-source impacts on ozone. Tier 1 demonstrations involve use of technically credible relationships between emissions and ambient impacts based on existing modeling studies deemed sufficient for evaluating a project source's impacts. Tier 2 demonstrations involve case-specific application of chemical transport modeling (e.g., with an Eulerian grid or Lagrangian model). MERPs are a type of Tier 1 demonstration that represent the level of increased ozone concentrations expected to occur due to precursor emissions. In other words, the relationship between precursor emission rates and modeled ozone concentrations for representative, hypothetical sources are used to estimate the impact of project emissions increases. In this analysis, the project emissions increases are multiplied by the ratio of the modeled concentrations to the modeled emission rates for a hypothetical source to estimate project related ozone concentrations.

Data for hypothetical sources will be obtained from EPA's MERPs View Qlik website.[30] The methodologies outlined in EPA's latest MERPs guidance document will be used in this analysis.[31] Should the project emissions increases yield a potential ozone impact in excess of U.S. EPA's recommended SIL value (1 ppb), an evaluation of cumulative impacts using the MERP-based impacts and the ozone design value discussed in Section 2.12.6 will be provided in the final report.

[30] www.epa.gov/scram/merps-view-qlik

[31] https://www.epa.gov/sites/default/files/2020-09/documents/epa-454_r-19-003.pdf

7. AIR TOXICS ANALYSES

7.1 Air Toxics Requirements

Kentucky's air toxics regulation, 401 KAR 63:020, applies to affected facilities that emit or may emit potentially hazardous or toxic substances ("TAP") as defined in the regulation, provided that the emissions are not elsewhere subject to the Division regulation. The Division evaluates on a case-by-case basis whether dispersion modeling or other analyses should be completed by applicants constructing or modifying equipment based on whether there is an increase in air toxic pollutant emissions, as defined in 401 KAR 63:020 Section 2 (2), deemed to be significant. This may be done so that there is a documented basis for affirming that a facility does not cause an adverse impact. Normally however, except in cases when new air toxics emissions are significant, the Division first conducts a screening modeling analysis as part of the review of the application and only requests the applicant to perform refined modeling of air toxics if those screening analyses show potentially adverse impacts.

All significant emission units generating air toxics emissions associated with the proposed project are anticipated to be regulated by a NESHAP subpart, and thus, will not be subject to the requirements of 401 KAR 63:020. Some relatively small natural gas combustion systems and low emitting sources of particulate-based air toxics included in the project scope have the potential to generate trace quantities of air toxics, but a "no adverse impact" determination can be qualitatively asserted based on the negligible emissions levels from these sources. Therefore, KU does not intend to prepare a refined air dispersion modeling analysis to evaluate ambient impacts of air toxics emissions from the proposed project. Rather, simplified screening techniques will be used to demonstrate the proposed sources of air toxics emissions not subject to a NESHAP and included in the proposed project scope will not cause or contribute to adverse impacts.