Technical Support Document:

Intended Area Redesignation for the 2010 1-Hour Sulfur Dioxide Primary National Ambient Air Quality Standard for Portions of Westmoreland and Cambria Counties in Pennsylvania

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1. Summary

Pursuant to section 107(d) of the Clean Air Act (CAA), the U.S. Environmental Protection Agency (the EPA, we, or us) was required to designate areas as either “nonattainment,” “attainment,” or “unclassifiable” for the 2010 1-hour sulfur dioxide (SO_2) primary national ambient air quality standard (NAAQS) (2010 SO_2 NAAQS). The CAA defines a nonattainment area as an area that does not meet the NAAQS or that contributes to a nearby area that does not meet the NAAQS. An attainment area is defined by the CAA as any area that meets the NAAQS and does not contribute to a nearby area that does not meet the NAAQS. Unclassifiable areas are defined by the CAA as those that cannot be classified on the basis of available information as meeting or not meeting the NAAQS. See CAA section 107(d)(1)(A)(i)-(iii).

In previous final actions, the EPA issued designations for the 2010 SO_2 NAAQS for the entire country.[1] Once an area has been designated, the EPA Administrator, under CAA section 107(d)(3), “may at any time” notify a state that a designation should be revised “on the basis of air quality data, planning and control considerations, or any other air quality-related considerations the Administrator deems appropriate.” CAA section 107(d)(3)(A).

Based on recent modeling analyses described below, Table 1 identifies portions of two counties in Pennsylvania that EPA intends to redesignate from “attainment/unclassifiable” to “nonattainment,” and from “unclassifiable” to “nonattainment,” for the 2010 SO_2 NAAQS. As explained in the technical analysis below, modeled nonattainment area is centered around impacts in portions of Westmoreland and Cambria Counties resulting from SO_2 emissions from the Conemaugh Power Plant and Seward Station located in Indiana County, PA and is smaller than the presumptive county-wide boundary.

Table 1-1 identifies EPA’s intended revised designations for portions of Westmoreland and Cambria Counties in Pennsylvania. It also lists current designations.

Table 1-1. Summary of the EPA’s Intended Designations and the Current Designation

Area/County	Current Designation Boundary	Current Designation	EPA’s Intended Area Definition (Boundary)	EPA’s Intended Designation
Westmoreland	Westmoreland Entire County	Attainment/ Unclassifiable	Portion of Westmoreland County that includes St. Clair Township, including Seward borough and New	Nonattainment

[1] All areas of the U.S. were previously designated for the 2010 SO_2 NAAQS in actions published on August 5, 2013 (78 FR 47191), July 12, 2016 (81 FR 45039), December 13, 2016 (81 FR 89870), December 21, 2017 (83 FR 1098), March 28, 2018 (83 FR 14597) and March 26, 2021 (86 FR 16055).

			Florence borough	
Cambria	Cambria Entire County	Unclassifiable	Portion of Cambria County that includes Lower Yoder Township	Nonattainment

2. General Approach and Schedule

CAA section 107(d)(3) identifies the schedule for the redesignation process. Per CAA section 107(d)(3)(A) and (B), EPA will notify the Commonwealth of Pennsylvania of our intended redesignation, establishing a 120-day period for the state to respond. If EPA deems any modifications necessary to its intended redesignation, including modifications based on the state's response, EPA will inform Pennsylvania of such modification at least 60 days prior to issuing the redesignation. Although not required by the Act, EPA will also make our intended redesignation decision and supporting documentation for Westmoreland and Cambria Counties, PA available to the general public and announce a 30-day public comment period in the *Federal Register*.

A final redesignation of portions of Westmoreland and Cambria Counties to nonattainment for the 2010 SO_2 NAAQS would impose certain planning requirements on the Commonwealth of Pennsylvania to reduce SO_2 concentrations. These include, but are not limited to, the requirement per CAA section 191(a) to submit, within 18 months of redesignation, a revision to the Pennsylvania state implementation plan (SIP) that provides for attainment of the SO_2 standard as expeditiously as practicable, but no later than 5 years after the date of redesignation to nonattainment, per CAA section 192(a).

EPA issued a designations guidance document for the 2010 primary SO_2 NAAQS on March 20, 2015, which identified factors that EPA uses to evaluate whether areas are in violation of the 2010 SO_2 NAAQS.[2] The document also contains the factors that the EPA intends to evaluate in determining the boundaries for this area. These factors include: 1) air quality characterization via ambient monitoring and/or dispersion modeling results; 2) emissions-related data; 3) meteorology; 4) geography and topography; and 5) jurisdictional boundaries. EPA also issued guidance documents for designations for the 2010 primary SO_2 NAAQS on July 22, 2016 and September 5, 2019.[3]

[2] https://www.epa.gov/sites/default/files/2016-04/documents/20150320so2designations.pdf
[3] https://www.epa.gov/sites/default/files/2016-07/documents/areadesign.pdf
https://www.epa.gov/sites/production/files/2019-09/documents/round_4_so2_designations_memo_09-05-2019_final.pdf

3. Definitions

The following are definitions of important terms used in this document:

1) 2010 SO_2 NAAQS – The primary NAAQS for SO_2 promulgated in 2010. This NAAQS is 75 parts per billion (ppb), based on the 3-year average of the 99th percentile of the annual distribution of daily maximum 1-hour average concentrations. See 40 CFR 50.17.
2) Design Value - a statistic computed according to the data handling procedures of the NAAQS (in 40 CFR part 50 Appendix T) that, by comparison to the level of the NAAQS, indicates whether the area is violating the 2010 SO_2 NAAQS.
3) Designated nonattainment area –an area that, based on available information including (but not limited to) monitoring data and/or appropriate modeling analyses, EPA has determined either: (1) does not meet the 2010 SO_2 NAAQS, or (2) contributes to ambient air quality in a nearby area that does not meet the NAAQS.
4) Designated attainment/unclassifiable area – an area that, based on available information including (but not limited to) appropriate monitoring data and/or appropriate modeling analyses, EPA has determined meets the 2010 SO_2 NAAQS and does not likely contribute to ambient air quality in a nearby area that does not meet the NAAQS.
5) Designated unclassifiable area – an area for which the available information does not allow EPA to determine whether the area meets the definition of a nonattainment area or the definition of an attainment/unclassifiable area.
6) Modeled violation – a modeled design value impact above the 2010 SO_2 NAAQS demonstrated by air dispersion modeling.
7) Violating monitor – an ambient air monitor meeting 40 CFR parts 50, 53, and 58 requirements whose valid design value exceeds 75 ppb, based on data analysis conducted in accordance with Appendix T of 40 CFR part 50.
8) We, our, and us – these refer to the EPA.

4. Background

4.1. 2010 SO_2 NAAQS

On June 2, 2010, the U. S. Environmental Protection Agency (EPA) Administrator signed a final rule establishing a new SO_2 primary NAAQS as a 1-hour standard of 75 ppb, based on a 3-year average of the annual 99^{th} percentile of daily maximum 1-hour average concentrations. 75 FR 35520 (June 22, 2010), codified at 40 CFR 50.17. This action also provided for revocation of the existing 1971 primary annual and 24-hour standards, subject to certain conditions. 40 CFR 50.4(e). Following promulgation of a new or revised NAAQS, EPA is required by the CAA to designate areas throughout the United States as attaining or not attaining the NAAQS; this designation process is described in section 107(d)(1)-(2) of the CAA.

4.2. History of 2010 SO_2 NAAQS Designations

On August 5, 2013, EPA promulgated initial air quality designations for 29 areas for the 2010 SO_2 NAAQS (78 FR 47191). These designations became effective on October 4, 2013 and were based on violating air quality monitoring data for calendar years 2009–2011, where there was sufficient data to support a nonattainment designation. The Indiana, PA area, which consists of all of Indiana County and a portion of Armstrong County, was designated as nonattainment in this initial (first) round of designations, (78 FR 47191, Aug. 5, 2013).

On June 30, 2016, EPA completed a second round of area designations (81 FR 45039). This second round did not address Cambria and Westmoreland Counties. On December 21, 2017, EPA completed the third round of SO_2 designations during which Cambria County, PA was designated unclassifiable, and Westmoreland County was designated attainment/unclassifiable (81 FR 89870). During Round 3, Pennsylvania submitted a modeling analysis for Cambria County, but due to inadequacies, the modeling could not be used to determine if the county could be designated as attainment, and therefore an unclassifiable designation was determined. Pursuant to a court-ordered deadline of December 31, 2020, the Round 4 2010 SO_2 NAAQS designations action was signed by the EPA Administrator, Andrew Wheeler, on December 21, 2020. For administrative purposes only, and in compliance with requirements of the Office of the Federal Register, Acting Administrator Jane Nishida re-signed the same action on March 10, 2021 for publication in the *Federal Register* (86 FR 16055). This fourth round did not revisit the round 3 designations of Cambria and Westmoreland Counties.

4.3. History of Westmoreland, Cambria, Indiana, PA 2010 SO_2 Modeled violations

During the public comment period for the proposed approval of the Indiana, PA SO_2 attainment plan (83 FR 32606, July 13, 2018), the Sierra Club (in conjunction with the National Parks Conservation Association, PennFuture, Earthjustice, and Clean Air Council) submitted a modeling analysis using actual emissions for Conemaugh (coal-fired power plant) and Seward Station (Coal waste facility) which claimed to show violations of the SO_2 NAAQS outside of the nonattainment area, beyond the eastern border of Indiana county within nearby portions of Westmoreland and Cambria Counties. On October 19, 2020 (85 FR 66240), EPA finalized approval of the Indiana, PA Area SO_2 attainment plan, noting that the modeled violations outside the nonattainment area were not an independent reason to disapprove the attainment plan.

On December 18, 2020, the Sierra Club, Clean Air Council, and PennFuture filed a petition for judicial review with the U.S. Court of Appeals for the Third Circuit, challenging that final approval.[4] On April 5, 2021, EPA filed a motion for voluntary remand without vacatur of its approval of the Indiana, PA SO_2 attainment plan.

In a short order without any commentary, on August 17, 2021, the U.S. Court of Appeals for the Third Circuit granted EPA's request for remand without vacatur of the final approval of Pennsylvania's SO_2 attainment plan for the Indiana, PA Nonattainment area, and required that EPA take final action in response to the remand no later than one year from the date of the court's order (i.e., by August 17, 2022).

After reconsideration, on March 17, 2022, EPA proposed partial disapproval and partial approval of the Indiana, PA SO_2 attainment plan, and during the public comment period received air quality modeling (including modeling files) from the Sierra Club (in conjunction with the National Parks Conservation Association, PennFuture, Earthjustice, and Clean Air Council) using updated emissions data showing modeled violations in Westmoreland and Cambria Counties due to Conemaugh and Seward sources located in Indiana County, PA. EPA also received an air quality modeling report from Keystone-Conemaugh Projects, LLC (KEY-CON), the licensee of Keystone and Conemaugh power plants, which used updated emissions from Conemaugh and Seward plants and modeled concentrations that are below the NAAQS in Westmoreland and Cambria Counties. On April 20, 2022, KEY-CON emailed the modeling files to EPA. On August 18, 2022 (87 FR 502778), EPA finalized the partial disapproval and partial approval of the Indiana, PA SO_2 Attainment Plan. EPA explained that, although the attainment plan must be disapproved for other reasons, the modeled violations in Cambria and Westmoreland Counties were not a reason for that disapproval and noted that EPA was considering taking additional regulatory action to remedy the modeled violations.

EPA then conducted two modeling analyses, discussed in more detail in the following sections, which focused on the portions of Cambria and Westmoreland counties near the Conemaugh and Seward power plants.

5. Technical Analysis

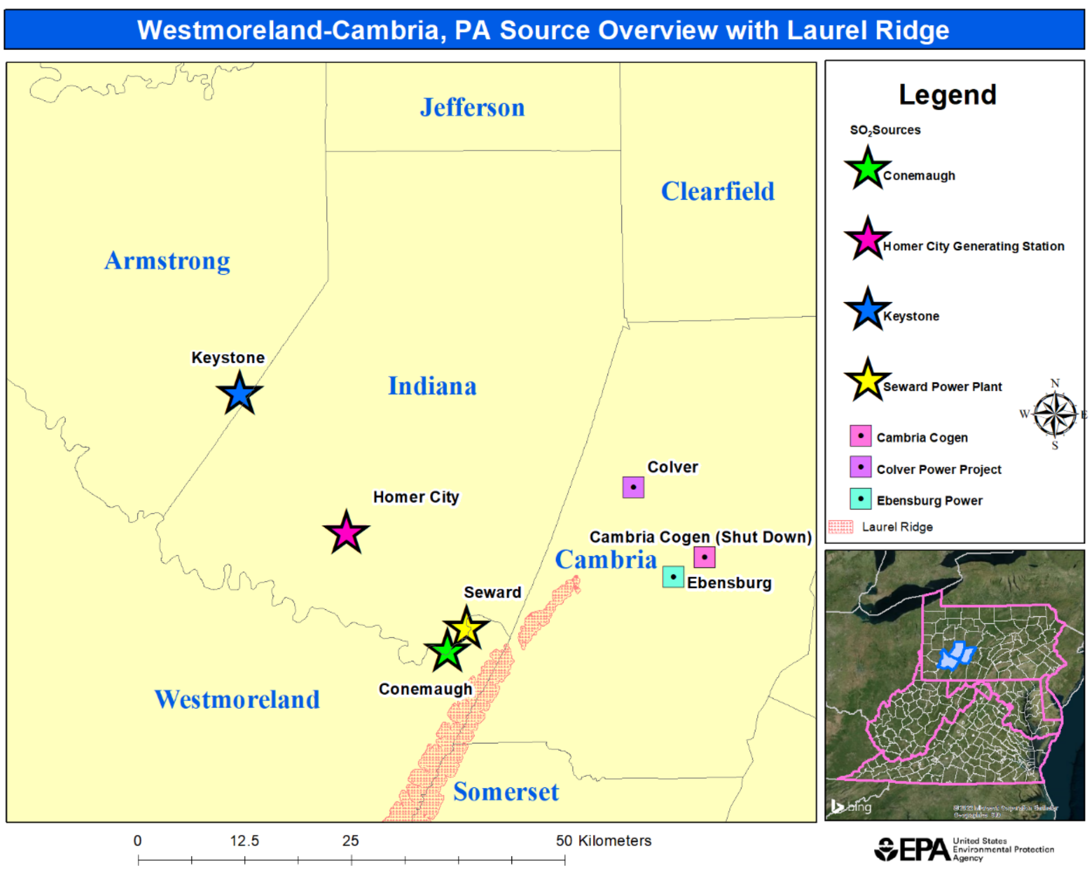
[4] *Sierra Club, et. al. v. EPA*, Case No. 20-3568 (3rd Cir.).

5.1. Overview

This section presents all the available air quality information for portions of Westmoreland and Cambria Area.

As seen in Figure 5-1 below, the Conemaugh and Seward facilities are located in Indiana County, while Cambria Cogen, Colver Power and Ebensburg Power are located in Cambria County. The figure also shows the location of the Laurel Ridge (shaded red) that lies east of the Indiana, PA 1-hour SO_2 nonattainment area. Cambria and Westmoreland counties were formally designated as Unclassifiable and Attainment/Unclassifiable, respectfully, during EPA's Round 3 designations (83 FR 1098, January 9, 2018).

Figure 5-1. Map of Point Sources Discussed in this Technical Support Document (TSD)



EPA conducted two assessments of the Westmoreland and Cambria areas focusing on the Laurel Ridge specifically at the county boundaries of Westmoreland, Cambria and Indiana, using air dispersion modeling software, i.e., AERMOD, analyzing actual emissions, which resulted in a peak modeled SO_2 concentration of 117.6 ppb. EPA's focus for this analysis was directed to a small portion of Cambria County near Conemaugh and Seward plants. Our analysis does not attempt to recharacterize the entirety of Cambria County, which was previously designated in Round 3 as Unclassifiable due to inconclusive modeling. After careful review of EPA's assessment, and other third-party assessments, supporting documentation, and all available data, the EPA intends to redesignate portions of the Westmoreland and Cambria Counties nonattainment. Our reasoning for this conclusion is explained in later sections of this TSD.

5.2. Air Quality Modeling Analysis for Westmoreland and Cambria Counties, PA

The discussion and analysis that follows below will reference the "SO_2 NAAQS Designations Modeling Technical Assistance Document" [5] (Modeling TAD) and the factors for evaluation contained in the EPA's September 5, 2019, guidance, July 22, 2016, guidance and March 20, 2015, guidance, as appropriate.

For this area, the EPA received and considered 2 different modeling assessments plus EPA provided its own 2 assessments. To avoid confusion in referring to these assessments, the following table lists them, provides an identifier for the assessment that is used in the discussion of the assessments that follow and identifies any distinguishing features of the modeling assessments. Table 5.2-2 summarizes EPA's modeling assessment inputs. These apply to both EPA simulations; one using the adjusted u-star option (no turbulence) and the other using the Ash Site #1 collected turbulence measurements. At this time, EPA is not endorsing the use of the adjusted u-star option or the turbulence measurements (see section 5.5.3 for additional discussion). In this case, the use of adjusted u-star or turbulence both result in air quality modeled design values above the NAAQS.

[5] https://www.epa.gov/sites/production/files/2016-04/documents/so2modelingtad.pdf.

Table 5.2-1. Modeling Assessments for the Westmoreland and Cambria Area

Assessment Submitted by	Identifier Used in this TSD	Distinguishing or Otherwise Key Features
Sierra Club (87 FR 502778)	Sierra Club	Actual emission (2019-2021), Johnstown-Cambria County Airport Meteorology data; 2016 Land cover
KEY-CON (87 FR 502778)	KEY-CON	Actual Emission (2019-2021), Site-Specific Meteorology, turbulence, 1992 Land Cover
EPA	EPA Site-Specific Adjusted U-star Modeling	Actual emissions (1 July 2017 through 30 June 2020), 1-year Site-Specific Meteorology, Adjust U-star, 2016 Land cover
EPA	EPA Site-Specific Turbulence Modeling	Actual emissions (1 July 2017 through 30 June 2020), 1-year Site-Specific Meteorology Turbulence, 2016 Land cover

Table 5.2-2: Summary of AERMOD Modeling Input Parameters for EPA's Modeling for the Westmoreland and Cambria Area

Input Parameter	Value
AERMOD Version	22112
Dispersion Characteristics	Rural
Modeled Sources	5
Modeled Stacks	7
Modeled Structures	33
Modeled Fencelines	None
Total receptors	10,705
Emissions Type	Actual
Emissions Years	1 July 2017 through 30 June 2020
Meteorology Years	1 September 2015 through 31 August 2016 Met Data transposed to fit emission period as per Modeling TAD
NWS Station for Surface Meteorology	Site-Specific/ automated surface observation system (ASOS) Ash Site #1 & Johnstown/Cambria County ASOS
NWS Station Upper Air Meteorology	Pittsburgh, PA
NWS Station for Calculating Surface Characteristics	Ash Site #1
Methodology for Calculating Background SO_2 Concentration	Season by Hour of Day, Strongstown, PA
Calculated Background SO_2 Concentration	Varies

5.2.1. Modeling Selection and Components

The EPA's Modeling TAD notes that for area designations for the 2010 SO_2 NAAQS, the AERMOD modeling system should be used, unless use of an alternative model can be justified. The AERMOD modeling system contains the following components:

- AERMOD: the dispersion model
- AERMAP: the terrain processor for AERMOD
- AERMET: the meteorological data processor for AERMOD
- BPIPPRM: the building input processor
- AERMINUTE: a pre-processor to AERMET incorporating 1-minute automated surface observation system (ASOS) wind data
- AERSURFACE: the surface characteristics processor for AERMET
- AERSCREEN: a screening version of AERMOD (not used for this analysis)

EPA used AERMOD version 22112 in regulatory default mode for its analysis. This was the most current regulatory version of the model available at the time of preparation. AERMOD was promulgated with the publication of EPA's revisions to the Guideline on Air Quality Models, which was published in the Federal Register on January 17, 2017[6]. AERMOD platform component versions will be noted as they are discussed in the following sections. Individual AERMOD component versions were current at the time EPA prepared this modeling analysis. EPA chose to utilize meteorological data processed with the adjusted u-star (ADJ_U*) option within the AERMET preprocessor, excluding the site-specific Ash Site #1 turbulence measurements as instructed following EPA guidance[7]. Meteorological processing, for this modeling analysis, is therefore consistent with the preprocessing steps completed for the Supplementary Analysis done for the southeast portion of the Indiana, PA nonattainment area.

Many of the elements used in EPA's modeling analysis were taken from AECOM's September 2020 modeling protocol and additional reports, the Pennsylvania Department of Environmental Protection (PA DEP) review and summary materials, electronic files that were included in Pennsylvania's original and supplemental SIP submittals, as well as other exchanges between EPA Region 3, PA DEP, the affected sources and AECOM.

A brief summary of modeling elements (and their sources/adjustments) are listed here:

- Indiana County Source Information
    - Building and stack information as provided by Pennsylvania. Information was checked versus information provided by the Armstrong/Indiana County sources from the SIP and Supplemental Analysis submissions.
    - Hourly emissions and stack parameters provided to Pennsylvania by Armstrong/Indiana County sources. Some adjustments were made based on EPA Clean Air Markets Division data.

[6] https://www.epa.gov/scram/clean-air-act-permit-modeling-guidance
[7] In accordance with section 4.7.6.5 of EPA's AERMET User's Guide

- Cambria County Source Information
  - Stack information taken from Pennsylvania's Round 3 designation modeling. No building information was considered given the distance between these 3 sources and the Laurel Ridge (downwash would not be important at distances greater than 10 km).
  - Hourly source emissions from CAMD. Stack velocity and temperatures based on linear relationships from source loading information as modeled by Pennsylvania for its Round 3 designation analysis.
- AERMOD Receptor Grid
  - EPA determined (locations) using current NED input files
- Meteorological Data
  - Ash Site #1: 1-year of site-specific 100-m tower and SODAR data submitted as part of Pennsylvania's Supplemental Analysis.
  - Pittsburgh International Airport: Upper-air data with additional EPA processing to account for missing surface observations.
  - Sector defined surface characteristics from AERSURFACE using 2016 land use-land cover, impervious surface, and tree canopy data.
  - Final processing for one of EPA's analyses excluded Ash Site #1 turbulence measurements with adjusted u-star option (to counter AERMOD's known overpredictions under some stable low-wind speed conditions). EPA chose to run this option because it is consistent with Pennsylvania's Indiana, PA SO_2 Attainment Plan submission.
  - A second air quality model run including the Ash Site #1 turbulence measurements without the adjusted u-star processing option. EPA has shown the use of turbulence and the adjusted u-star processing biases the model towards underprediction. Therefore, the EPA has determined that the ADJ_U* option should not be used in AERMET in combination with use of measured turbulence data because of the observed tendency for model underpredictions resulting from the combined influences of the ADJ_U* and the turbulence parameters within the current model formulation. (FR 82, 5187, January 17, 2017).

EPA runs use the most current version of AERMOD/AERMET (version 22112)

5.2.2. Modeling Parameter: Rural or Urban Dispersion

For any dispersion modeling exercise, the “urban” or “rural” determination of a source is important in determining the boundary layer characteristics that affect the model’s prediction of downwind concentrations. For SO_2 modeling, the urban/rural determination is important because AERMOD invokes a 4-hour half-life for urban SO_2 sources. Section 6.3 of the Modeling TAD details the procedures used to determine if a source is urban or rural based on land use or population density.

Section 7.2.1.1 of Appendix W Guideline on Air Quality Models, outlines 2 methods that can be used to choose the rural or urban options within AERMOD. One utilizes a population density survey surrounding a source and the other uses Auer land use classifications surveyed surrounding a source.

EPA utilized a land use survey to establish if the modeling analysis should use AERMOD’s rural or urban dispersion coefficients. We utilized the same land use/land cover information used to determine the surface characteristics for the Ash Site #1 meteorological tower. AERSURFACE was rerun using a 3 km survey area with only 1 sector (encompassing 360°) from the Conemaugh and Seward stacks. The U.S. Geological Survey (USGS) 2016 Land Use/Land Cover (LULC) data from the AERSURFACE log file was then examined to calculate the percentage of developed land categories versus the total number of parcel counts within 3-km of the Conemaugh and Seward stacks.

Figure 5.2-1 shows the USGS 2016 LULC within 3-km of the Conemaugh and Seward stacks. The pink and red parcels on the figure represent developed land use categories. EPA counted the low, medium and high developed categories as “urban”. The remaining parcel categories are treated as “rural”. Table 5.2-3 summarizes the parcel count for each LULC category within 3-km of the Conemaugh and Seward stacks. Percentages for the rural and urban LULC categories were then calculated by dividing these values by the total number of parcels within the 3-km buffer around the Conemaugh and Seward stacks.

Less than 7% of the USGS 2016 LULC categories within 3-km of either Conemaugh’s or Seward’s stacks fall within the defined urban categories. EPA’s analysis, therefore, will use AERMOD’s rural dispersion coefficients.

Figure 5.2-1. USGS 2016 LULC within 3-km of Ash Site #1

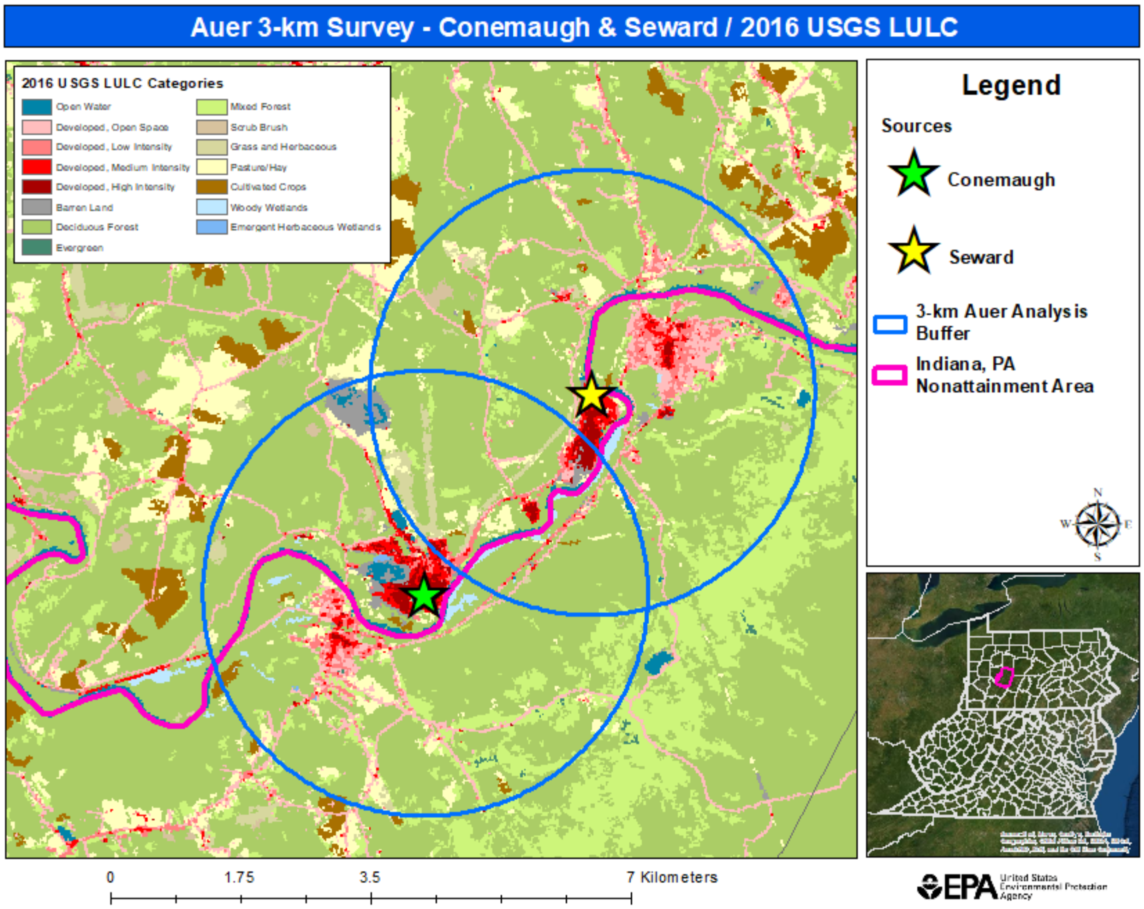


Table 5.2-3. 3-km Survey of USGS 2016 LULC Categories for Conemaugh and Seward

AERSURFACE 3-km 2016 LULC Survey Results			
Category	**2016 LULC Description**	**Conemaugh**	**Seward**
11	Open Water	835	815
21	Developed, Open Space	1,607	2,000
22	Developed, Low Intensity	899	1,126
23	Developed, Medium Intensity	676	515
24	Developed, High Intensity	471	372
31	Barren Land (Rock/Sand/Clay)	653	302
41	Deciduous Forest	20,400	20,198
42	Evergreen Forest	37	41
43	Mixed Forest	2,840	3,097
52	Shrub/Scrub	81	107
71	Grasslands/Herbaceous	725	736
81	Pasture/Hay	1,623	1,752
82	Cultivated Crops	212	125
90	Woody Wetlands	310	223
95	Emergent Herbaceous Wetland	32	3
22, 23, 24	Urban	2,046	2,013
All Others	Rural	29,355	29,399
	% Urban	6.52%	6.41%

5.2.3. Modeling Parameter: Area of Analysis (Receptor Grid)

EPA's Modeling TAD recommends that the first step towards characterization of air quality in the area around a source or group of sources is to determine the extent of the area of analysis and the spacing of the receptor grid. Considerations presented in the Modeling TAD include but are not limited to the location of the SO_2 emission sources or facilities considered for modeling; the extent of significant concentration gradients due to the influence of nearby sources; and sufficient receptor coverage and density to adequately capture and resolve the model predicted maximum SO_2 concentrations.

A preprocessor program, AERMAP, was developed to process terrain data in conjunction with a layout of receptors and sources to be used in AERMOD control files. The terrain elevation for each receptor, and emission source was determined using USGS 1/3 arc second National Elevation Data (NED). The NED, obtained from the U.S. Geological Survey (USGS), has terrain elevations at approximately 10-meter intervals. A total of 4 NED files were downloaded and processed following directions on EPA's Support Center for Regulatory Atmospheric Modeling (SCRAM) website. NED files downloaded from USGS are not directly usable by AERMAP and must be in an uncompressed format. The 4 NED files were converted to this uncompressed format in accordance with instructions posted on SCRAM[8]. These uncompressed files served as input data for AERMAP to determine the model receptor and source elevation heights. AERMAP also assigns hill height scales to all receptors. Hill height scales are used to calculate the critical dividing streamline height for each model receptor.

The model receptor grid used in EPA's modeling analysis was confined to portions of Cambria and Westmoreland counties within approximately 15 km of the Conemaugh and Seward power plants. It is not the same as the receptor grid described in AECOM's September 2020 modeling protocol. The model receptor grid includes portions of the Chestnut Ridge to the west and the Laurel Ridge, which lies just east of Conemaugh and Seward. Receptor spacing was initially set at 360 meters creating a coarse Cartesian grid over the previously described area. A finer 90-meter spaced grid was created to cover most of the Laurel Ridge which was then clipped to only cover portions of the Laurel Ridge inside Westmoreland County. The county border between Cambria and Westmoreland counties is roughly marked by the ridgeline of the Laurel Ridge. Two additional 45-meter Cartesian grids were created within the 90-m grid to provide additional model receptors near the areas of maximum modeled concentrations. The northern 45-m grid was also confined to portions within Westmoreland County.

The initial 360-m Cartesian grid was produced using R[9], filtered by distance from Conemaugh and Seward then imported into GIS and clipped to be within either Cambria or Westmoreland counties. The 90-m and 45-m grids were similarly constructed. EPA added three 22.5-m cartesian receptor grids around the areas on the Laurel Ridge with the highest model values to ensure that the final receptor grid captured the maximum modeled concentration as described in section 9.2.2 (d) of Appendix W.

Each grid was run through AERMAP (version 18181) then combined removing any identical model receptors the grids had in common. The final grid contains 10,705 individual model receptor points and should be adequate to properly resolve the maximum model concentrations from Conemaugh and Seward.

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[8] See Elevation Data Access section of https://www.epa.gov/scram/air-quality-dispersion-modeling-related-model-support-programs#aermap

[9] R Core Team (2021). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL https://www.R-project.org/.

AERMAP runs were broken down into smaller grid sections (within the same modeling domain) to create more manageable processing times and prevent losses that could occur during extended model run times. EPA notes that AERMAP run times can be exceptionally long, especially over network connected computers. Any network interruptions during a model run would lead to loss of data and necessitate a restarting of the simulation. Long run times on local computer drives can also be interrupted by the computer's power saving settings. For these reasons, AERMAP run times were generally kept to 8 hours or less. The final model receptor grid was a combination of all of the smaller grids processed in AERMAP.

Figure 5.2-2 displays the area that contains the model receptor grid used in the EPA modeling analysis. The figure also shows the sources included in EPA's modeling analysis and the Strongstown, PA SO_2 monitor. A close up of the actual model receptor locations along the Laurel Ridge in both Cambria and Westmoreland counties is shown in Figure 5.2-3. Both figures also display the local terrain elevations.

Both Conemaugh and Seward are located along the Conemaugh River in Indiana County and are contained within the Ligonier Valley. The Chestnut Ridge lies to the west of these facilities and the Laurel Ridge lies to the east. Both terrain features largely pinch out to the north but extend many miles to the south. Water drainage is to the west, eventually becoming part of the Ohio River Basin. The Conemaugh River bisects both ridges creating the Conemaugh River Gorge as it passes through the Laurel Ridge. This pattern indicates the general drainage patterns were established before the land experienced uplifting during the Cenozoic time period; the river systems incised downward into the land as it was raised upwards.

There are no fence-line receptors included in EPA's modeling receptor grid. Both Conemaugh and Seward, along with the 3 waste-coal units in Cambria County, do not contain a plant footprint inside the formal model receptor grid. Therefore, each source's ambient air boundary does not need to be delineated within EPA's model receptor grid.

Figure 5.2-2. Model Receptor Area for EPA Grid in Cambria and Westmoreland Counties

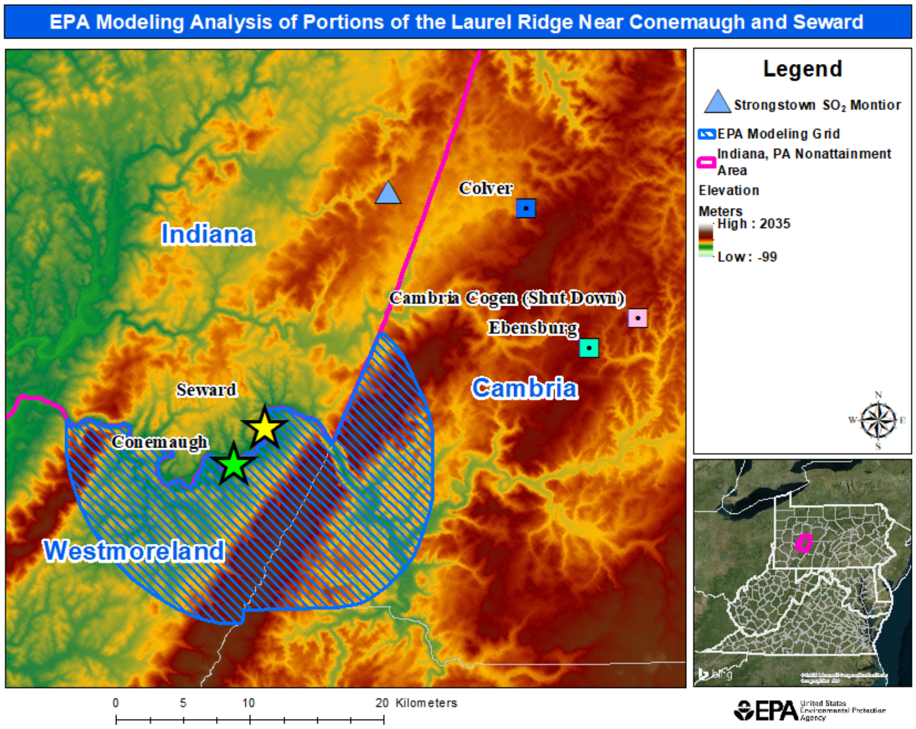
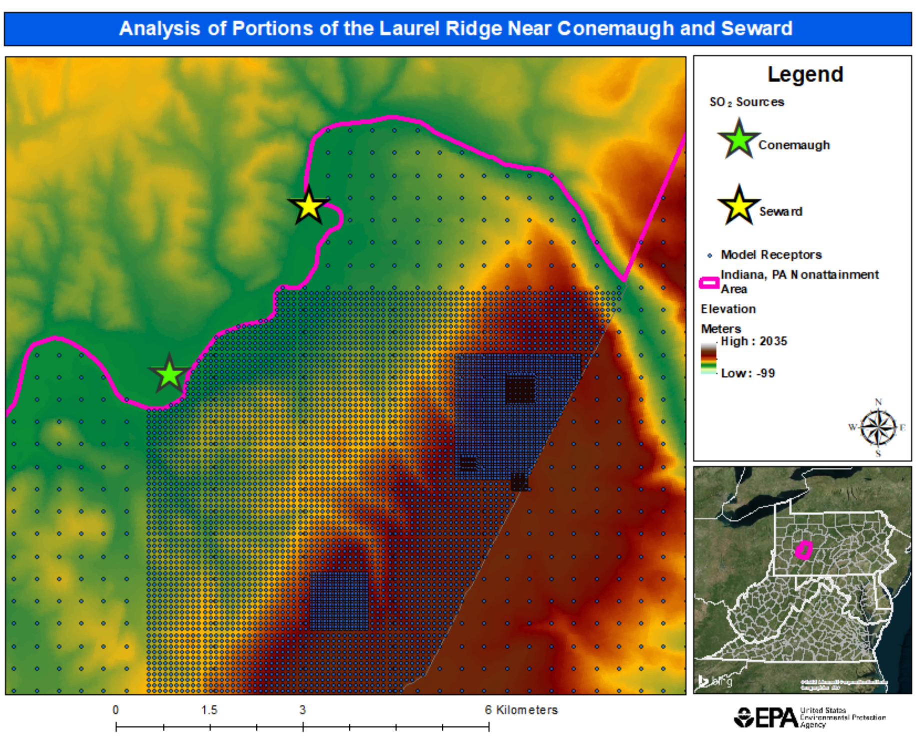


Figure 5.2-3. EPA Model Receptor Grid Along Portions of the Laurel Ridge



5.2.4. Modeling Parameter: Source Characterization

Section 6 of the Modeling TAD offers recommendations on source characterization including source types, use of accurate stack parameters, inclusion of building dimensions for building downwash (if warranted), and the use of actual stack heights with actual emissions or following GEP policy with allowable emissions.

The following are brief facility descriptions for each source included in EPA's modeling analysis:

Conemaugh: A traditional coal-fired boiler power plant burning western Pennsylvania bituminous coal. Two coal-fired units were commissioned in 1970 and 1971. A wet flue gas desulfurization (FGD) system was installed in the 1990s to control SO_2 emissions. A new FGD stack was added to properly handle saturated plume conditions exhausted from the FGD control system. Conemaugh can burn approximately 4 million tons of bituminous coal per year to produce about 1,800 megawatts of electricity (for the PJM managed electrical grid). The plant is located in Indiana County near New Florence, PA.

Seward: Utilizes waste coal feedstock, which is sometimes referred to as GOB or garbage of bituminous. The plant burns waste coal in 2 circulating fluidized bed (CFB) boilers, which were commissioned around 2004. SO_2 emissions are controlled through lime injection into the CFB units and into the flue gas prior to the facility's baghouse unit. Waste coal can have highly variable british thermal unit or BTU values along with percent sulfur values. Seward is the world's largest waste coal facility and can produce approximately 525 megawatts of electricity. The facility's current stack was built for a previous coal fired power plant; there has been a power plant operating on this site since the early 1900s. The plant is located in Indiana County near Seward, PA.

Cambria Cogen: A 85 MW, base load, waste-coal fired power plant located near Ebensburg, PA in Cambria County. The plant has 2 circulating fluidized bed (CFB) boilers that began commercial operations in 1991. SO_2 emissions are controlled via lime injection into the CFB units. The facility was deactivated from the PJM electric grid[10] in 2019. A Retirement Unit Exemption form was filed with EPA's Clean Air Markets Division or CAMD notifying the units' deactivation. This became effective in September of 2020. Emissions from this source ceased after the 2nd quarter of 2019 for EPA's simulation.

Colver Power or Colver Green Energy: A 118 MW, base load, waste-coal fired power plant located near Colver, PA in Cambria County. At full operation, the plant's CFB unit can consume 700,000 tons of waste-coal per year. SO_2 emissions are controlled via lime injection into the CFB unit. The plant began operations in 1995.

[10] https://www.pjm.com/planning/services-requests/gen-deactivations

Ebensburg Power: A 50-megawatt waste coal plant constructed in 1991 in Cambria County near Ebensburg, PA. The plant utilizes CFB combustion technology to force hot air and limestone into the boiler to burn low quality refuse coal mined from abandoned piles located throughout Western Pennsylvania. The limestone in the boiler captures SO_2 emissions in a controlled fashion rather than the free release that occurs over time when refuse piles spontaneously combust at the mine sites. All (7) stacks included in EPA's modeling analysis were modeled as point sources in AERMOD. EPA's modeling analysis largely borrowed previous building downwash analysis from Pennsylvania's original SIP and Supplementary Analysis submissions. Both of these analyses used EPA's Building Profile Input Program or BPIP (version 04274). Building positions for Seward were adjusted based on a visual inspection completed by the PA DEP and shared with EPA in March of 2022. No building downwash was included for the Cambia County sources. The Cambria County sources are greater than 10 km from the EPA model receptor grid. Any impact of building downwash from these sources within the model receptor grid was therefore expected to be minimal.

Each source's stack(s) and building information were entered into BPIP to generate building downwash information utilized in AERMOD. BPIP output also listed GEP formula height calculations for each stack. EPA's modeling analysis only included downwash information from Conemaugh and Seward.

BPIP GEP formula heights for Conemaugh's FGD stack came out higher than the actual stack height; 160 m versus BPIP's GEP calculated value of 173.36 m. Conemaugh's stack, built during the FGD installation in the mid-1990s, appears to comply with GEP.

One change was made to the Conemaugh stack for EPA's 3-year modeling analysis. As will be explained in a following section, Conemaugh was modeled using 3 separate stack options: a virtual merged stack when both Conemaugh units are operating simultaneously, and two single stacks for each individual unit when only one unit is operating (when only one unit is operating, each unit emits out of its own separate stack). When both units are operating, their plumes become merged shortly after exiting their individual flues. This merged plume enhances lift which can be accounted for by merging the stacks (in the modeling analysis) using an equivalent diameter stack to enhance the exit velocity. Stack locations for each stack were identical for modeling in BPIP. In reality, Conemaugh's FGD stack is a single dual-flue stack with each unit having 1 flue. The exact location of each flue is not known while the merged stack (with equivalent area diameter) is set at the central portion of the FGD stack. In reality, the individual unit flues are probably several meters from the center of the FGD stack. Any discrepancy in the exact locations of the unit flues within the stack is not expected to make any significant differences in the BPIP downwash calculations.

5.2.5. Modeling Parameter: Emissions

The EPA's Modeling TAD notes that for the purpose of modeling to characterize air quality for use in designations, the recommended approach is to use the most recent 3 years of actual emissions data and concurrent meteorological data. However, the TAD also indicates that it would be acceptable to use allowable emissions in the form of the most recently permitted (referred to as PTE or allowable) emissions rate that is federally enforceable and effective. The EPA believes that continuous emissions monitoring systems (CEMS) data provide acceptable historical emissions information when they are available. These data are available for many electric generating units. In the absence of CEMS data, the EPA's Modeling TAD highly encourages the use of AERMOD's hourly varying emissions keyword HOUREMIS, or through the use of AERMOD's variable emissions factors keyword EMISFACT. When choosing one of these methods, the EPA recommends using detailed throughput, operating schedules, and emissions information from the impacted source(s).

In certain instances, states and other interested parties may find that it is more advantageous or simpler to use PTE rates as part of their modeling runs. For example, where a facility has recently adopted a new federally enforceable emissions limit or implemented other federally enforceable mechanisms and control technologies to limit SO_2 emissions to a level that indicates compliance with the NAAQS, the state may choose to model PTE rates. These new limits or conditions may be used in the application of AERMOD for the purposes of modeling for designations, even if the source has not been subject to these limits for the entirety of the most recent 3 calendar years. In these cases, the Modeling TAD notes that a state should be able to find the necessary emissions information for designations-related modeling in the existing SO_2 emissions inventories used for permitting or SIP planning demonstrations. In the event that these short-term emissions are not readily available, they may be calculated using the methodology in Table 8-1 of Appendix W to 40 CFR Part 51 titled, "Guideline on Air Quality Models."

EPA utilized actual hourly emissions for the Conemaugh and Seward power plants in its modeling analysis of portions of Cambria and Westmoreland counties near these 2 power plants. We also included actual emissions from 3 waste coal facilities in the northern part of Cambria County east of the Indiana, PA nonattainment area. These latter sources were modeled as part of EPA's Data Requirement Rule (DRR) Round 3 designations. The DRR was set up to better characterize ambient air SO_2 concentrations near large polluting sources. Cambria County sources included Cambria Cogen, Colver Power and Ebensburg Power. All 3 of these sources burn waste coal via CFB boiler units.

EPA's modeling analysis included actual hourly emissions over a 3-year period, 1 July 2017 through 30 June 2020. This was the period included in the September 2020 AECOM modeling protocol submittal. Hourly SO_2 emissions and other data from CAMD over the identical time period were used to "check" these values. The remainder of this section will provide an overview of the construction of Conemaugh and Seward's emissions profiles, along with the 3 Cambria County sources, including actual hourly SO_2 emissions, stack temperatures and stack velocities used in EPA's modeling analysis.

EPA compared actual hourly emissions for Conemaugh and Seward from the AECOM protocol submittal with hourly emissions for each source as reported to EPA's CAMD database. Note that the AECOM protocol only included hourly data for Conemaugh and Seward, not the other waste coal sources in neighboring Cambria County. Hourly SO_2 emissions for Conemaugh's 2 coal-fired units and Seward's combined CFB units were largely identical between the protocol CEMS data and CAMD. Discrepancies between the 2 data sets for each source amounted to fewer than 72 hours over the 3-year simulation period. In all instances, when actual hourly emission values differed, the protocol hourly emissions were less than the values reported to CAMD. For some hours, the protocol emission values were lower than the corresponding CAMD database values even when the information in CAMD indicated hourly SO_2 emissions were marked as valid.

For hours where SO_2 emissions did not match, EPA substituted the higher CAMD hourly values over using values in the modeling protocol submittal. We felt this would be conservative. The infrequency of these differences makes it highly unlikely that the higher CAMD hourly emission values will cause any significant changes to the model results. This would only be true if the increased hourly emissions occurred during the worst-case meteorological conditions that determine the model simulation's 1-hr SO_2 design value.

In addition to hourly emission rates, EPA's modeling analysis needed hourly stack parameters for Conemaugh and Seward. This information is generally not available from the CAMD database, though CAMD does contain information on flow rate measurement validity. Hourly stack exhaust velocity and temperature were largely taken from the AECOM September 2020 protocol submittal. Missing hourly stack exhaust values were substituted using a linear relationship developed between each unit's heat input and corresponding stack velocity. This largely follows the same procedures used in AECOM's modeling protocol to fill in missing stack velocity data. Our analysis of valid flow rates taken from the CAMD database indicates each source had between 50 to 300 hours of invalid flow rate measurements (unusable stack exhaust rates). This indicates only a small fraction of the 3-year simulation period used stack exhaust flows inferred from operational data.

There was one last difference between the AECOM protocol and EPA's modeling analysis that will be described here. The AECOM protocol hourly emissions file utilized a merged stack for Conemaugh. Both Conemaugh unit emissions, stack exhaust rates and stack temperatures were combined into a (virtual) merged stack unit with an equivalent area diameter and flow weighted temperature representing Conemaugh's actual dual-flued FGD stack. This is permitted under EPA's October 10, 1985 memo entitled Questions and Answers on Implementing the Revised Stack Height Regulation and is more specifically described in EPA's answer provided to question 19, item 2[11].

[11] https://www.epa.gov/sites/default/files/2015-07/documents/reinders.pdf

EPA found some fault with the protocol's use of a merged stack for Conemaugh. More specifically, the use of a merged stack when only 1 of Conemaugh's 2 coal-fired units are operating. We note, however, that the use of a merged stack when both units are operating is acceptable. EPA Region 3 made this comment when it reviewed AECOM's modeling protocol submittal and included it as a formal comment that was provided to Pennsylvania in February of 2021. It's our understanding that EPA and PA DEP comments were both forwarded to AECOM. Conemaugh's hourly emissions were modeled using the individual flues for each unit and a merged stack when both units were operating simultaneously. This approach mimics what was done for the Brandon Shores units in the DRR Round 2 modeling submitted by the State of Maryland for its Round 2 SO_2 designations modeling for Anne Arundel-Baltimore County[12].

AECOM's modeling protocol did not address the Cambria County (waste-coal) sources so there were no hourly SO_2 emission rates, stack temperature or stack velocity information to utilize. EPA downloaded the reported CAMD hourly SO_2 emission rates for Cambria Cogen, Colver Power and Ebensburg Power. Physical stack parameters (stack positions, stack heights and stack diameters) for these sources were taken from Pennsylvania's Round 3 DRR modeling analysis.

Hourly stack velocity and temperature information is not available from the CAMD database. EPA took the previous modeling analysis Pennsylvania did as part of their DRR Round 3 modeling analysis and established linear trendlines between these variables and the corresponding CAMD source unit hourly heat inputs. Additional details regarding the construction of the modeled hourly source profiles for Conemaugh, Seward and the Cambria County sources are included in the following subsections.

5.2.5.1. Model Input Parameters for Conemaugh

Conemaugh Modeled Hourly Emission Rates: EPA downloaded (actual) hourly emissions for both Conemaugh coal-fired units (units 1 & 2) from the CAMD database. Hourly SO_2 emissions from Conemaugh's combined units from 2010-2020 are shown in Figure 5.2-4. The green shaded area of the graph is EPA's 3-year model period corresponding to Conemaugh's protocol spreadsheet information. Figure 5.2-5 shows Conemaugh's combined unit emissions over the 3-year simulation period (the green shaded area on Figure 5.2-4).

[12] https://www.epa.gov/sulfur-dioxide-designations/so2-designations-round-2-maryland-state-recommendation-and-epa-response See Maryland Round 2 State Recommendation Attachment 1 and EPA Response to Maryland Round 2 Recommendation Attachment.

Figure 5.2-4. Conemaugh Hourly CAMD SO_2 Emissions from 2010-2020

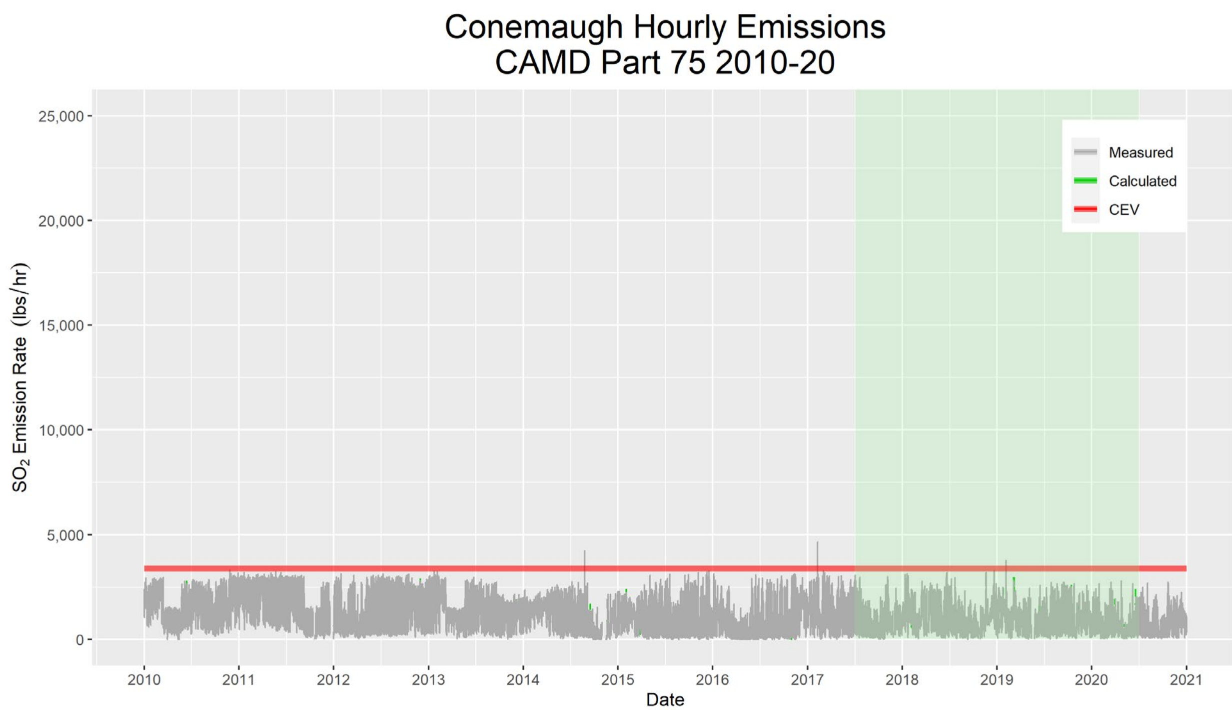
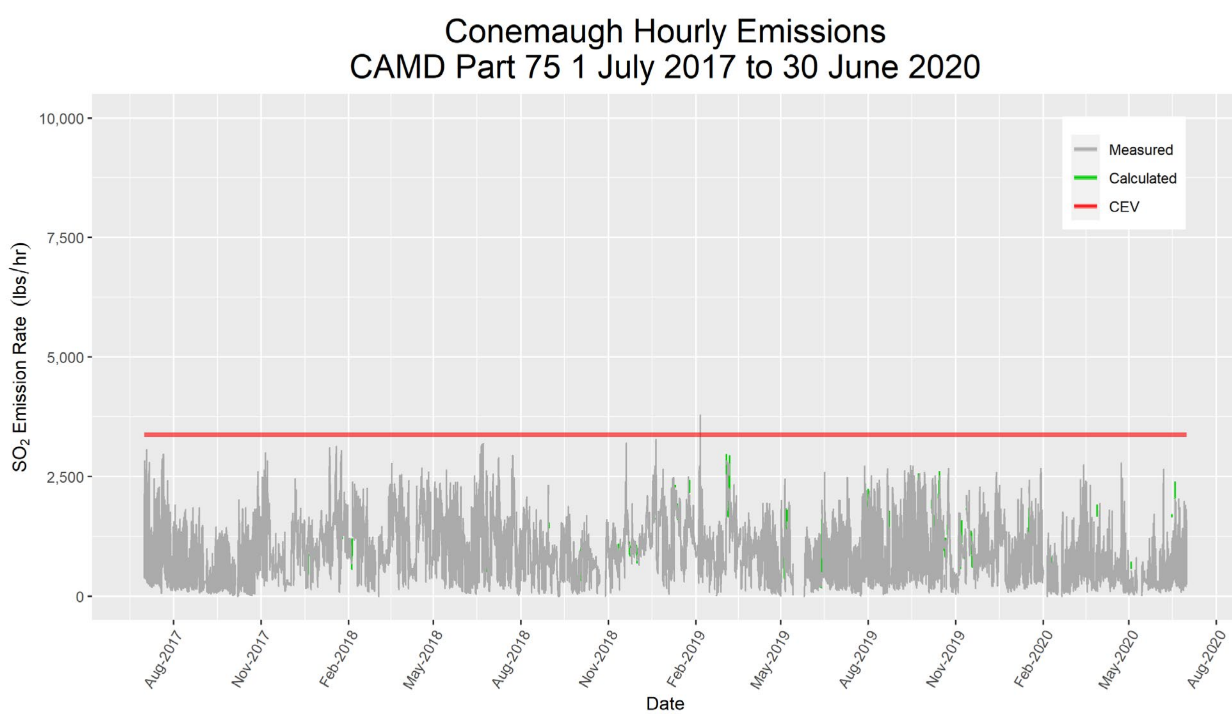


Figure 5.2-5. Conemaugh Hourly CAMD SO_2 Emissions over 3-year Simulation Period



Conemaugh's hourly CAMD SO_2 emissions shown in both figures include the facility's modeled Critical Emission Value or CEV. This represents the maximum hourly emission rate that is modeled within the Indiana, PA nonattainment area that does not exceed the 1-hr SO_2 NAAQS of 75 ppb. This was included for reference only and does not reflect what the CEV would be for areas outside the Indiana, PA nonattainment area. Conemaugh's CEV determined in Pennsylvania's Supplemental Analysis was 3,381 lbs/hr[13]. As noted in the hourly emissions figures, Conemaugh's actual hourly SO_2 emission rate rarely exceeds its model-defined CEV threshold.

The figures showing Conemaugh's (combined) hourly emission rates also include information regarding whether the (CAMD) hourly emission rate was measured or calculated. This is based on method of determination codes (MODC). These codes are listed in Table 4a section 75.57(c) of 40 CFR Part 75. Hourly SO_2 emissions are based on monitor concentration and flow rates measured by its CEMS. To have a valid measured value, both the monitor concentration and flow rate instruments must be functioning properly. If either or both of the instruments malfunction and there is not a redundant back up measurement available, the emission rate is calculated based on a predefined methodology. Thus, hourly emissions are either "measured" when all instruments are functioning in a given hour or "calculated" if there are instrument malfunctions. Calculated emission estimates can assume worst-case conditions if instrument down times are significant. This scenario ensures CEMS units are functioning most of the time; otherwise, a source will be forced to purchase emission offsets if it exceeds its yearly budget. Hours with "calculated" emission values could be much higher than what the actual emissions are. As seen on the graph, nearly all of Conemaugh's hourly emissions are measured (have valid MODC).

EPA used the protocol submittal information as a basis for the development of its (actual) hourly emissions for Conemaugh. Hourly SO_2 emission rates for units 1 and 2 were compared to corresponding hourly emissions from the CAMD database. Nearly all of Conemaugh's hourly emission rates from the protocol submittal matched the corresponding CAMD emission rates. Approximately 1-2 days' worth of hourly SO_2 emissions, however, were not the same over the 3-year simulation period.

[13] See Table ES-1 of AECOM (2019)

Table 5.2-4 summarized the results of the comparison of hourly SO_2 emission rates from the protocol submittal, also referred to as CEMS, and CAMD database for both Conemaugh and Seward. There are several dozen hours where the protocol and CAMD emission rates do not match. In all cases, the CAMD hourly emission rates were higher than the corresponding protocol hourly emission rates. Hours that did not match were divided between hours where the CAMD emission rate was measured (valid MODC) and calculated (invalid MODC). EPA is unsure why there are differences in hourly emission rates for the hours that have measured values according to CAMD, though these times make up a small fraction of the 3-year simulation period. EPA replaced Conemaugh's hourly SO_2 emissions with CAMD values for any hours over the 3-year simulation period where there were mismatches between the 2 databases. For all mismatched hours, the CAMD emissions exceeded the CEMS values. Model concentrations, therefore, would be higher using the CAMD values versus the CEMS values.

Table 5.2-4. Summary of Protocol and CAMD Emission Differences

Comparison of CEMS and CAMD Hourly SO2 Emissions 1 July 2017 to 30 June 2020			
Source	**Total Operating Hours**	**Hours CAMD > CEMS, Measured**	**Hours CAMD > CEMS, Calculated**
Conemaugh Unit 1	21,135	30	7
Conemaugh Unit 2	22,892	18	9
Seward	20,856	39	11

Conemaugh Modeled Hourly Stack Parameters: Stack parameters including stack temperatures and velocities for EPA's modeling analysis were largely taken from the AECOM protocol submittal. These values are generally not reported to any public data system such as CAMD. Flow rates for most CAMD reporting sources are submitted but these values are typically reported in standard cubic feet per hour. A conversion needs to be applied to transform these reported flow rates to actual cubic feet per hour, which could then be used to calculate stack exhaust velocities. Flow rate MODC, however, can still be (and were) used to flag hours where actual stack flow rates are not measured.

Stack temperatures were available for both Conemaugh units over the entire 3-year modeled period. Stack velocities for each unit were available for most hours in the protocol submittal. We note that there was an adjustment made to Conemaugh's stack flows due to differences in the diameters between the flow rate measurement site and Conemaugh's stack top openings. The flow measurement site's diameter was 33 feet while the stack top opening was 5 feet narrower. This meant that stack top velocities had to be increased by a ratio of 33 feet divided by 28 feet then raised to the second power (for both Conemaugh units).

EPA used Conemaugh's flow rate MODC to flag hours with possible invalid stack velocities. Table 5.2-5 summarizes the hours with invalid flow rate MODC over the 3-year simulation period for both Conemaugh units and Seward. MODC descriptions from table 4a from Part 75 are also included in the table.

Table 5.2-5. Summary of Flow Rate MODC over 3-Year Simulation Period (Hours)

Summary of Flow MODC Part 75 (Table 4a)
1 July 2017 to 30 June 2020

MODC	Part 75 Explanation	Conemaugh Unit 1	Conemaugh Unit 2	Seward
00	Off	5,169	3,412	5,448
01	Certified Primary Instrument	20,992	22,619	20,793
06	Average of the Prior and Following Hour	-	-	6
08	90th % Hourly Flow Rate	-	32	25
10	Maximum Hourly Flow Rate	-	-	2
11	Average of Hourly Flow Rates in Applicable Lookback Period	143	70	30
20	200% of the Full-Scale Range Setting	-	171	-

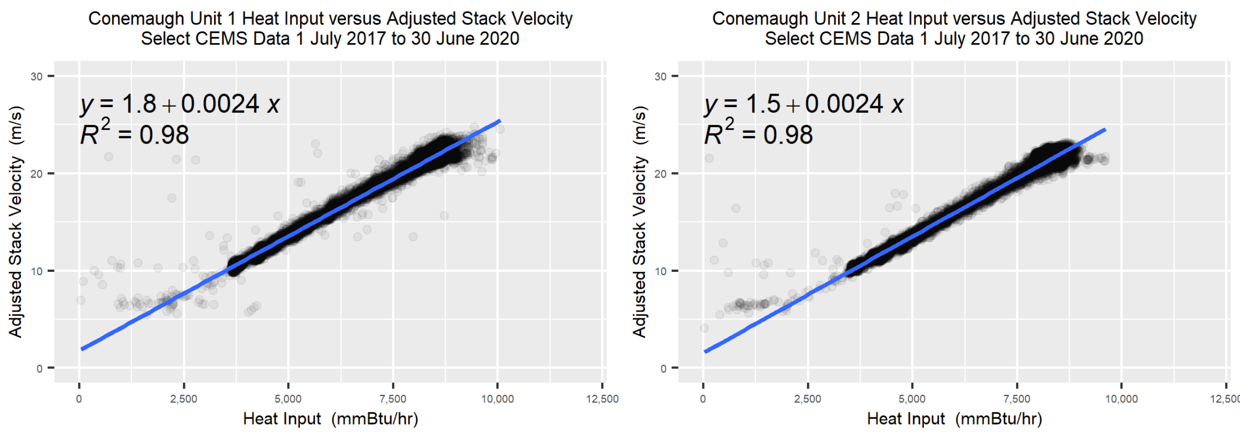
CAMD flow rate MODC indicate several hundred hours of possible invalid stack velocities for each of Conemaugh's coal-fired units. Several MODC indicate flow rates during some of the hours with invalid MODC can be quite high, often on the extreme end of the unit's overall distribution of measured flow rates or even exceeding them. For the Part 75 program, using exaggerated flow rates will result in exaggerated hourly emission rates. CAMD hourly emission rates are based on a concentration measurement and a flow rate measurement. For modeling purposes, however, using an exaggerated flow rate can enhance stack dispersion characteristics since higher stack velocities (especially from tall stacks) generally lower final model concentrations by lofting the initial plume higher above the surface. Use of exaggerated flow rates for invalid MODC hours, therefore, should be avoided for any modeling analysis.

To replace missing stack velocity values or values where exaggerated flow rates may be present, EPA used the same method to generate a more realistic stack velocity that was used in AECOM's September 2020 protocol submittal. A surrogate stack velocity was substituted for hours with missing or invalid flow rate measurements. Surrogate values were based on the unit's remaining (valid) measured heat input and stack velocities. In general, the higher the unit heat input (the heat released when coal is burned in the boiler unit) the higher the flow rate. A comparison of measured unit heat input verses stack velocity indicates an excellent linear correlation.

Figure 5.2-6 displays scatter plots of each unit's measured heat input in millions of British thermal units (mmBtu) versus its stack velocity (flow rate measurement). A linear trend line was fitted to the data and shows an excellent linear correlation (R^2 values very close to 1). The linear fit equations were then used to fill in all hours with invalid flow rate MODC. As an example, a missing stack velocity for unit 1 would be replaced by using the corresponding hour heat input value in the linear fitted trend line equation:

$$\text{Missing Unit 1 Stack Velocity (m/s)} = 1.8 + 0.0024 * \text{Unit 1 Heat Input (mmBtu/hr)}$$

Figure 5.2-6. Conemaugh Heat Input versus Stack Velocity and Linear Trend Lines



As mentioned previously, Conemaugh's emissions were passed through a virtual merged stack in the protocol submittal's final AERMOD-ready hourly emission file. Merged stack parameters were defined by considering each unit's stack temperature and final adjusted stack velocity (to account for the diameter differences between the unit's flow rate measurement site and stack top opening). Conemaugh's merged stack temperature was calculated using each unit's stack temperature weighted by the unit's flow rate. If one unit's flow rate was higher than the other, the merged stack modeled temperature would be slightly closer to the unit with the higher stack velocity than the average of the 2 units' temperatures. The merged stack velocity was just the average of each unit's stack velocity for Conemaugh in accordance with the September 2020 protocol.

EPA has expressed an issue with this approach. Mainly that using a merged stack may misrepresent stack dispersion characteristics when only a single unit is operating at Conemaugh. We do think, however, that using a merged stack is appropriate when both units are operating, but the actual stack characteristics should be modeled when only 1 unit is operating.

Using a merged stack when a single unit is operating may introduce some errors in actual stack dispersion. EPA processed both Conemaugh's protocol submittal stack information and its actual hourly AERMOD input file to illustrate the impact of a unit shut down on merged stack parameters. Table 5.2-6 shows a segment of modeled hours slightly before Conemaugh unit 1 shuts down and the hours after the unit ceases burning coal. In the table, unit 1, 2 and the merged stack emissions are highlighted in yellow, temperatures in green and stack velocities in blue. Unit 1 and 2 parameters are from the protocol spreadsheets and the merged stack parameters are from the AERMOD ready hourly emissions file provided in the protocol submittal.

Table 5.2-6. Merged Stack Parameters During Unit Shut Down

Conemaugh Hourly Emissions (by Unit) versus AERMOD Input File													
Date	HR	U1.lbshr	U1.mmBtu	U1.F	U1.fs	U2.lbshr	U2.mmBtu	U2.F	U2.fs	Q.lbshr	Temp.F	Vel.fs
2017-07-06	4	166.7	4,707.70	128.1	41.3	248.4	5,052.4	123.5	43.1	415.1	125.7	42.2
2017-07-06	5	177.9	4,736.10	128.5	41.1	242.8	5,050.5	123.5	43.1	420.7	125.9	42.1
2017-07-06	6	356.4	5,535.90	128.7	47.9	447.1	5,766.8	123.8	48.9	803.5	126.2	48.4
2017-07-06	7	1,242.3	8,102.10	130.2	67.6	1,339.6	8,112.2	124.4	68.2	2,581.9	127.2	67.9
2017-07-06	8	1,462.2	8,684.60	131.0	71.8	1,337.9	8,495.6	125.1	72.0	2,800.1	128.0	71.9
2017-07-06	9	364.5	2,219.76	131.2	57.2	1,364.3	8,532.5	125.1	72.2	1,728.8	127.7	64.7
2017-07-06	10	-	-	117.5	37.6	1,289.4	8,478.0	125.2	71.8	1,289.4	122.4	54.7
2017-07-06	11	-	-	112.4	41.7	1,291.9	8,451.1	125.3	71.0	1,291.9	120.2	56.3
2017-07-06	12	-	-	108.7	41.4	1,356.4	8,492.5	125.5	70.7	1,356.4	118.7	56.0
2017-07-06	13	-	-	105.8	41.0	1,159.0	8,535.3	125.0	71.7	1,159.0	117.3	56.3
2017-07-06	14	-	-	102.9	40.3	1,255.3	8,523.8	125.4	71.7	1,255.3	116.3	56.0
2017-07-06	15	-	-	100.4	39.4	1,334.0	8,573.8	125.1	72.8	1,334.0	115.1	56.1
2017-07-06	16	-	-	99.3	41.5	1,240.4	8,530.9	125.2	71.8	1,240.4	114.3	56.7
2017-07-06	17	-	-	97.4	41.5	1,330.1	8,479.2	125.2	71.4	1,330.1	113.3	56.5
2017-07-06	18	-	-	94.9	41.7	1,215.9	8,458.8	125.1	71.8	1,215.9	112.0	56.7
2017-07-06	19	-	-	92.2	41.3	1,385.1	8,553.4	125.0	72.1	1,385.1	110.7	56.7
2017-07-06	20	-	-	89.8	41.0	1,227.2	8,524.0	124.9	73.1	1,227.2	109.5	57.0
2017-07-06	21	-	-	88.0	45.1	1,034.2	8,241.0	125.0	70.6	1,034.2	107.4	57.9
2017-07-06	22	-	-	87.4	46.3	536.4	6,457.7	124.3	55.7	536.4	104.3	51.0
2017-07-06	23	-	-	87.8	46.4	314.9	5,448.1	123.7	47.9	314.9	103.0	47.2
2017-07-07	0	-	-	86.7	46.3	222.6	5,013.1	123.4	44.2	222.6	101.4	45.2
2017-07-07	1	-	-	85.1	45.8	216.9	4,980.7	122.9	44.7	216.9	100.3	45.3
2017-07-07	2	-	-	83.7	34.2	218.7	5,005.1	122.7	44.4	218.7	102.0	39.3
2017-07-07	3	-	-	83.1	1.8	264.5	5,017.3	122.9	44.6	264.5	120.7	23.2
2017-07-07	4	-	-	82.9	0.3	224.1	5,000.5	123.0	44.4	224.1	122.6	22.4
2017-07-07	5	-	-	87.2	1.4	275.9	5,187.2	122.9	44.9	275.9	121.4	23.1
2017-07-07	6	-	-	86.5	2.8	447.1	5,636.5	123.4	48.5	447.1	120.6	25.6
2017-07-07	7	-	-	86.6	2.9	489.4	6,051.8	123.5	52.4	489.4	120.8	27.6
2017-07-07	8	-	-	86.7	2.8	1,213.3	7,857.0	123.4	65.7	1,213.3	121.3	34.2

Conemaugh unit 1 ceased burning coal after hour 9 on July 6, 2017 (SO_2 emissions go to 0 after this hour). While the unit is no longer burning coal based on its SO_2 emission rate, the unit continues to report significant exhaust velocities and the unit temperature remains elevated though those values begin to decline after hour 9. Unit 1 stack exhaust velocities drop off significantly after hour 2 of July 7, 2017, indicating the unit is more fully shut down. While it's clear that unit 1 is shut down, the merged stack parameters are still being impacted by unit 1. Merged stack velocities decline after the unit shuts down even though unit 2's actual stack velocities remain high. A similar downward trend in the merged stack (modeled) temperature is also observed after unit 1 begins to shut down. This indicates using a single merged stack could contain a number of hours with "depreciated" stack parameters if one of Conemaugh's units shuts down (no longer burning coal). Under this scenario, merged stack velocities and temperatures would be reduced as the shutdown unit's temperature and exhaust velocity decline.

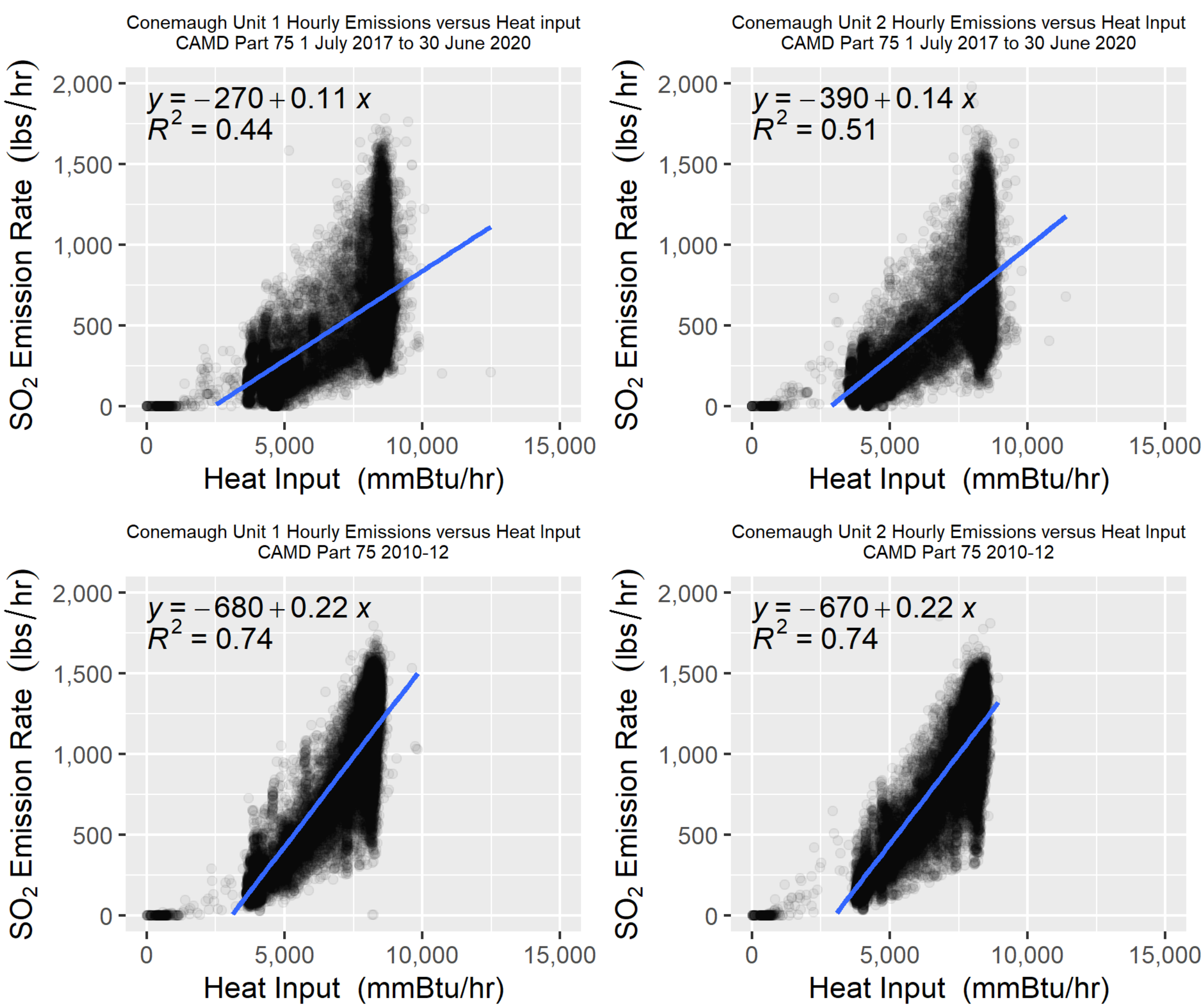
Because of this possibility and to better represent actual stack operations, EPA only used a merged stack when both of Conemaugh's coal units were actively operating (SO_2 emissions were greater than 0 lbs/hr). Each unit was modeled using its actual stack diameter when both units were not burning coal simultaneously. The final EPA AERMOD-ready file will show 3 stacks for Conemaugh but there will only be emissions from one stack for any given hour during the 3-year simulation when the plant is actually operating. Hourly SO_2 emissions will be entered into the model for unit 1, unit 2 or a merged stack when both units are operating.

Final emission rates for Conemaugh (and all other sources) were converted using the National Institute of Standards and Technology (NIST) conversion from pounds to grams (453.59237 g per pound). Stack parameters similarly used the NIST conversion from feet to meters (1 foot is 0.3048 meters). This conversion was necessary since AERMOD typically operates using metric values. Enforcement and permitting typically use imperial units (pounds and feet).

Conemaugh Heat Input versus SO_2 Emissions Analysis: EPA examined both Conemaugh units' heat input versus SO_2 emissions from the CAMD database for two 3-year periods. One for 2010-12 and another over the 3-year simulated period (1 July 2017 through 30 June 2020). Generally, one would expect a good linear relationship between the boiler heat input and SO_2 emissions. As more coal is burned in Conemaugh's boilers (higher boiler heat input) more SO_2 should be emitted as sulfur in the fuel is converted to SO_2. This assumes unit control efficiency via Conemaugh's wet FGD system and the feedstock coal percent sulfur has been relatively constant over the last decade.

EPA has reviewed coal summary statistics for the area near the Conemaugh and Seward power plants[14] and found the percent sulfur of coal in this area to be quite similar (around 2% sulfur). We therefore expect pre-control SO_2 emissions to be relatively stable over time if Conemaugh's coal continues to be mined from the locally available coal deposits. Figure 5.2-7 shows scatter plots for both units over the last decade. The linear relationship between each unit's heat input (coal consumed) and SO_2 emissions seems to have declined over the last decade. R^2 values, an approximation of a linear fit in the data, are much lower over the more recent 3-year simulation period than the earlier (2010-12) time period for both of Conemaugh's units. These values indicate a somewhat weak correlation between heat input and SO_2 emissions for the 2010-12 period (values closer to 1 indicate a good linear correlation). By the time of the 3-year simulation period, correlations become very poor to nonexistent.

Figure 5.2-7. Heat Input versus SO_2 Emissions and Linear Trend Lines for Conemaugh 3-Year Simulation Period versus 2010-12

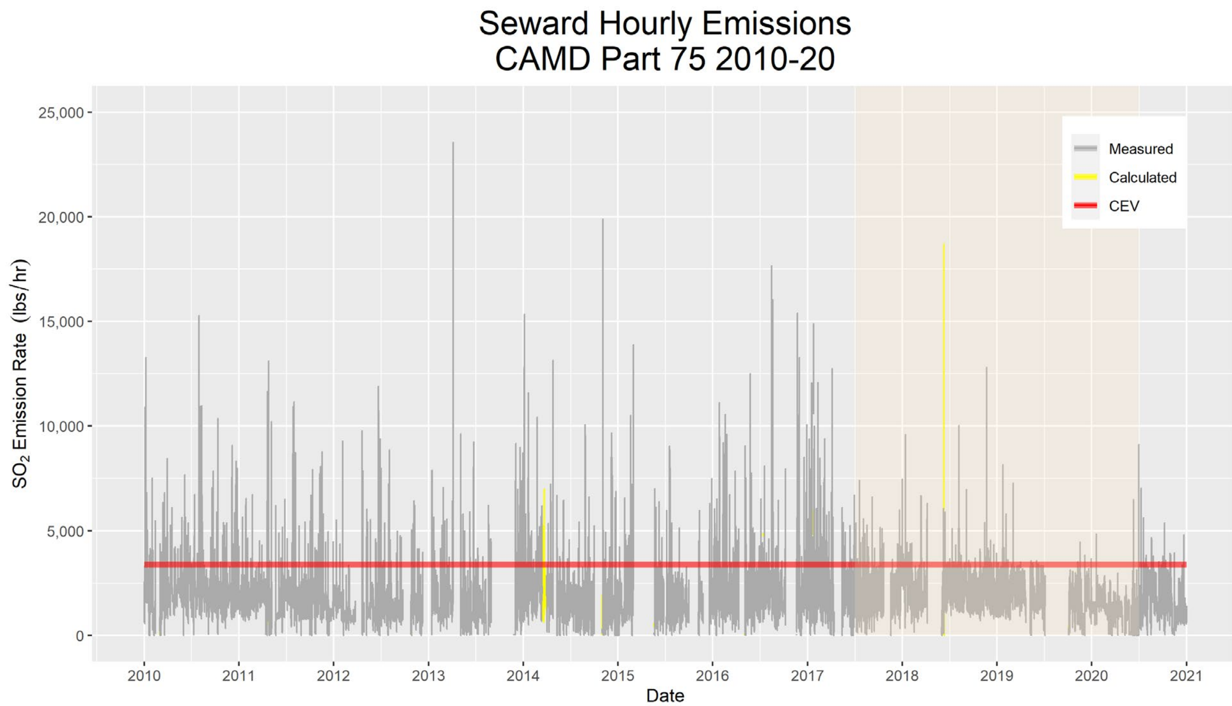


EPA speculates that Conemaugh's FGD control efficiency may be dropping over time possibly reflecting unit degredation. Records indicate Conemaugh's FGD units were installed in the mid-1990s and therefore have been operating for almost 30 years. Changes in the linear relationship between the Conemaugh unit's heat input versus SO_2 emissions may, however, be due to other factors, such as a change in coal characteristics or due to other unknown operational changes that could impact the FGD control efficiencies.

5.2.5.2. Model Input Parameters for Seward

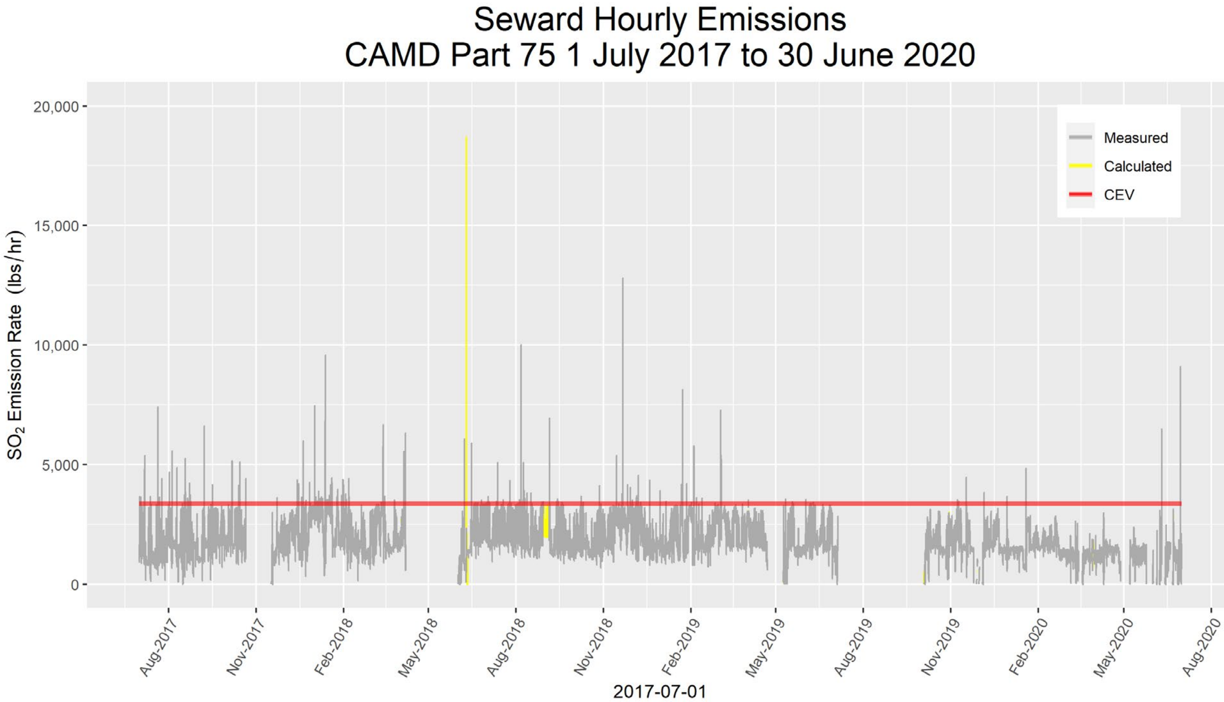
Seward Modeled Hourly Emission Rates: EPA downloaded (actual) hourly emissions for both Seward's waste-coal fired units (units 1 & 2) from the CAMD database. Hourly SO_2 emissions from Seward's combined units from 2010-2020 are shown in Figure 5.2-8. The shaded area of the graph is the 3-year period modeled by EPA. Figure 5.2-9 shows Seward's combined unit emissions over the 3-year simulation period.

Figure 5.2-8. Seward Hourly CAMD SO_2 Emissions from 2010-2020



[14] Geology and mineral resources of the New Florence quadrangle, Pennsylvania (Bolivar, New Florence, Wilpen, and Rachelwood 7.5-minute quadrangles, Indiana, Westmoreland, Cambria, and Somerset Counties), (1958), from PA DCNR: http://maps.dcnr.pa.gov/publications/Default.aspx?id=9

Figure 5.2-9. Seward Hourly CAMD SO_2 Emissions over 3-year Simulation Period



Seward's hourly CAMD SO_2 emissions shown in both figures include the facility's modeled CEV. This represents the maximum hourly emission rate that is modeled within the Indiana, PA nonattainment area that does not exceed the 1-hr SO_2 NAAQS of 75 ppb. This was included for reference only and does not reflect what the CEV would be for areas outside the Indiana, PA nonattainment area. Seward's CEV determined in Pennsylvania's Supplemental Analysis was 4,500 lbs/hr[15]. As shown in the hourly emissions figures, Seward's actual hourly SO_2 emission rate does, at times, exceed its model-defined CEV threshold and can, at times, be several factors higher than its modeled CEV.

The figures showing Seward's (combined) hourly emission rates also include information regarding whether the (CAMD) hourly emission rate was measured or calculated. This is based on MODC. These codes are listed in Table 4a section 75.57(c) of 40 CFR Part 75. Hourly SO_2 emissions are based on monitor concentration and flow rates measured by its CEMS. To have a valid measured value both the monitor concentration and flow rate instruments must be functioning properly. If either or both of these instruments malfunction and there is not a redundant back up measurement available, the emission rate is calculated based on a predefined methodology. Thus, hourly emissions are either "measured" when all instruments are functioning in a given hour or "calculated" if there are instrument malfunctions.

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[15] See Table 5-1 of AECOM (2019)

Calculated emission estimates can assume worst-case conditions if instrument down times are significant. This scenario ensures CEMS units are functioning most of the time; otherwise, a source will be forced to purchase emission offsets if it exceeds its yearly budget. Keep in mind hours with "calculated" emission values could be much higher than what the actual emissions are. As seen on the graph, the vast majority of Seward's hourly emissions are measured (have valid MODC). EPA is providing some additional explanation for Seward's sometimes extreme hourly SO_2 emission spikes that are observed in the CAMD database compared to its neighboring Conemaugh power plant. Each of Conemaugh's coal fired boilers have an estimated maximum heat input rating[16] of 8,280 mmBtu/hr. This is significantly larger, roughly 3 times larger, than Seward's estimated maximum heat input rating[17] of 2,532 mmBtu/hr for each of its CFB boilers. Even though Seward's fuel burning capacity is approximately one third of Conemaugh, hourly SO_2 emissions from Seward can at times be 4 times higher.

The discrepancy in hourly SO_2 emission spikes between Conemaugh and Seward is mainly due to the significant differences in the 2 power plants' fuel characteristics. Conemaugh is a traditional coal-fired boiler while Seward utilizes waste coal feedstock, which is sometimes referred to as GOB or garbage of bituminous. Due to differences in these materials, which are related to the depositional environments when these materials were created, Seward is prone to have much higher spikes in hourly SO_2 emissions than its neighbor.

Waste coal or GOB has significantly different characteristics than its parent material, western Pennsylvanian bituminous coal. We estimate that GOB has approximately one third the Btu heat value of the local bituminous coal stock that feeds Conemaugh's boilers and possibly 2 to 3 times the sulfur content. To get the same heat input value, 3 times as much material must be consumed in Seward's CFB units. Since GOB has a much higher sulfur content than bituminous coal, Seward's hourly SO_2 emissions can spike much higher than its neighbor Conemaugh if there are any issues with the Seward's SO_2 control efficiency even though the plant has a much smaller electric production capacity.

EPA used the September 2020 protocol submittal information as a basis for the development of its (actual) hourly emissions for Seward. Hourly SO_2 emission rates already represent the combined output of both of Seward's CFB units. This removed the need to combine unit emissions as was done with Conemaugh. A direct comparison of Seward's protocol submittal emissions and emissions from EPA's CAMD database could be made. Nearly all of Seward's hourly emission rates from the protocol submittal matched the corresponding CAMD emission rates. Approximately 1-2 days' worth of hourly SO_2 emissions, however, were not the same over the 3-year simulation period.

[16] Taken from SECTION A. Site Inventory List of Conemaugh's October 17, 2019 Title V/State Operating Permit
[17] Taken from SECTION A. Site Inventory List of Seward's July 29, 2021 Title V/State Operating Permit

Table 5.2-4 summarized the results of the comparison of hourly SO_2 emission rates from the protocol submittal, also referred to as CEMS, and the CAMD database for both Conemaugh and Seward. There are several dozen hours where the protocol and CAMD emission rates do not match. In all cases, the CAMD hourly emission rates were higher than the corresponding protocol hourly emission rates. Hours that did not match were divided between hours where the CAMD emission rate was measured (valid MODC) and calculated (invalid MODC). EPA is unsure why there are differences in hourly emission rates for the hours that have measured values according to CAMD, though these times make up a small fraction of the 3-year simulation period. EPA replaced Seward's hourly SO_2 emissions with CAMD values for any hours over the 3-year simulation period where there were mismatches between the 2 databases. For all mismatched hours (see Table 5.2-4), the CAMD emissions exceeded the CEMS values. Model concentrations, therefore, would be higher using the CAMD values versus the CEMS values.

Seward Modeled Hourly Stack Parameters: Stack parameters including stack temperatures and velocities for EPA's modeling analysis were largely taken from the September 2020 protocol submittal. These values are generally not reported to any public data system such as CAMD. Flow rates for most CAMD reporting sources are submitted but these values are typically reported in standard cubic feet per hour. A conversion needs to be applied to transform these reported flow rates to actual cubic feet per hour, which could then be used to calculate stack exhaust velocities. Flow rate MODC, however, can still be (and were) used to flag hours where actual stack flow rates are not measured. Seward's reported stack parameters, unlike Conemaugh, already represent combined impacts from both CFB units. No manipulation, other than conversion to metric units, was necessary for the Seward stack parameters.

Stack temperatures were available for Seward's CFB units over the entire 3-year modeling period. Stack velocities for each unit were available for most hours in the protocol submittal. Values for Seward, unlike Conemaugh, needed no significant manipulation for incorporation into the 3-year simulation period.

EPA used Seward's flow rate MODC (from CAMD) to flag hours with possible invalid stack velocities. Table 5.2-4 summarizes Seward's hours with invalid flow rate MODC over the 3-year simulation period. MODC descriptions from table 4a from Part 75 are also included in the table.

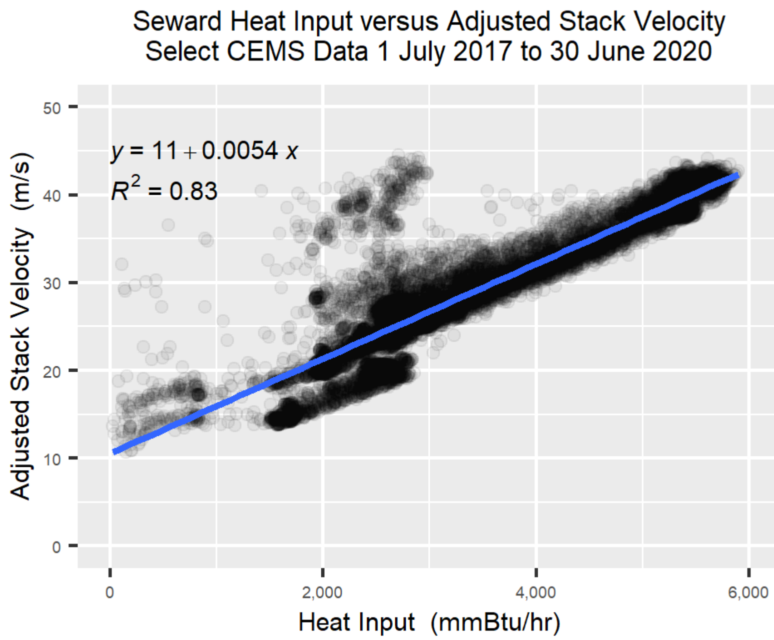
CAMD flow rate MODC indicate there were 63 hours of possible invalid stack velocities for Seward. Several MODC indicate flow rates during some of the hours with invalid MODC can be quite high often on the extreme end of Seward's overall distribution of measured flow rates. For the Part 75 program, using exaggerated flow rates will result in exaggerated hourly emission rates (note Seward's peak hourly emission rate over the 3-year simulation period was calculated). CAMD hourly mission rates are based on a concentration measurement and a flow rate measurement. For modeling purposes, however, using an exaggerated flow rate can enhance stack dispersion characteristics since higher stack velocities (especially from tall stacks) generally lower final model concentrations by lofting the initial plume higher above the surface. Use of exaggerated flow rates for invalid MODC hours, therefore, should be avoided in the modeling analysis.

To replace missing stack velocity values or values where exaggerated flow rates may be present, EPA used the same method to generate a more realistic stack velocity that was used in the September 2020 protocol submittal. A surrogate stack velocity was substituted for hours with missing or invalid flow rate measurements. Surrogate values were based on Seward's remaining measured heat inputs and stack velocities. In general, the higher the unit heat input (the heat released when waste coal is consumed in the CFB units) the higher the flow rate. A comparison of measured unit heat input verses stack velocity shows there is a good (and acceptable) linear correlation.

Figure 5.2-10 displays scatter plots for Seward's measured heat input in mmBtu versus its stack velocity (flow rate measurement). A linear trend line was fitted to the data and shows a good linear correlation (R^2 values close to 1). The linear fit equations were then used to fill in all hours with invalid flow rate MODC. As an example, a missing stack velocity for would be replaced by using the corresponding hour heat input value in the linear fitted trend line equation:

Missing Stack Velocity (m/s) = 11 + 0.0054 * Heat Input (mmBtu/hr)

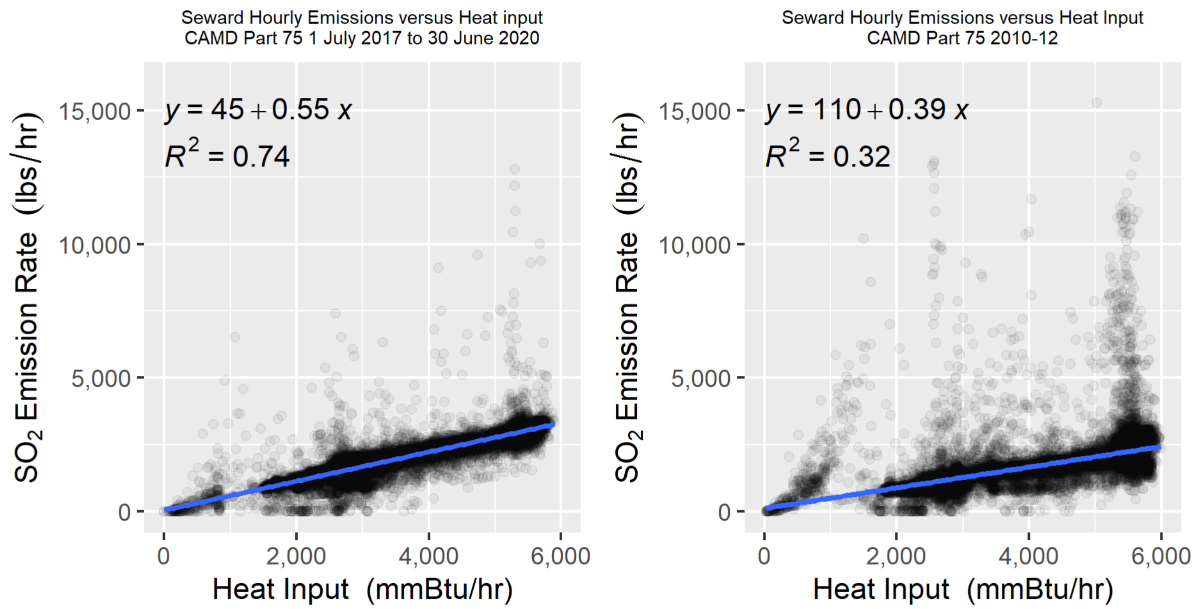
Figure 5.2-10. Seward Heat Input versus Stack Velocity and Linear Trend Lines



Seward Heat Input versus SO_2 Emissions Analysis: EPA examined Seward's hourly heat input versus SO_2 emissions from the CAMD database for two 3-year periods. One for 2010-12 and another over the 3-year simulated period (1 July 2017 through 30 June 2020). Generally, one would expect a good linear relationship between the boiler heat input and SO_2 emissions. As more coal waste is burned in Seward's CFB boilers (higher boiler heat input) more SO_2 should be emitted as sulfur in the fuel is converted to SO_2. This assumes control efficiency via Seward's limestone injection system and the percent sulfur of the feedstock material has been relatively constant over the last decade.

Figure 5.2-11 shows scatter plots for Seward over the last decade. The linear relationship between the heat input (waste-coal consumed) and SO_2 emissions seems to have significantly improved over the last decade. R^2 values, an approximation of a linear fit in the data, are much higher over the more recent 3-year simulation period than the earlier (2010-12) time period. These values indicate a very poor linear correlation between heat input and SO_2 emissions for the 2010-12 period; values between -0.3 and 0.3 are generally understood as having no correlation. By the time of the 3-year simulation period, R^2 values indicate there is a weak to somewhat good correlation between the units' heat input and SO_2 emissions. The graph for the 3-year simulation period shows points much more clustered around the linear trendline than the 2010-12 period does. We also note that points are more clustered in the higher emission/higher heat input (upper right quadrant) of the 2012 graph than during the 3-year simulation period (indicating fewer emission spikes when the plant is operating near its intended capacity).

Figure 5.2-11. Heat Input versus SO_2 Emissions and Linear Trend Lines for Seward 3-Year Simulation Period versus 2010-12



One possible explanation for this change is improved control efficiency at Seward. These changes, however, could also be due to changes in the feed-stock waste coal material. In AECOM's (2019) report it includes a short description of more recent operation changes at Seward. From the report:

> *"[I]n December 2016, Seward Station changed ownership. Operational changes during plant start-ups have been implemented. Seward is currently adding limestone to the combustor during initial firing to reduce SO_2 emissions. This is a change to the previous operating strategy and is expected to continue with this practice going forward. The distribution accounts for the frequency and duration observed during actual station operations, and this operation is expected to continue in a similar manner for future years."*

The linear correlation improvement EPA notes in Seward's heat input versus SO_2 emissions over the 3-year simulation period versus the 2010-12 appears to offer some tacit support that there have been recent operational changes made at Seward that are leading to fewer hourly SO_2 emission spikes. It would be helpful if the Commonwealth of Pennsylvania and/or Seward could more fully document these changes and when they occurred.

5.2.5.3. Overview of Model Input Parameters for Cambria County Sources

EPA downloaded information for the 3 Cambria County sources from its CAMD database. Yearly and quarterly SO_2 emissions tons per year (tpy) and operating hours for Cambria Cogen, Colver Power and Ebensburg Power are summarized in Tables 5.2-7 and 5.2-8. Cambria Cogen was deactivated in 2019 accounting for the drop off in emissions and operating hours in the summary tables. Both tables indicate the Cambria County (waste coal) sources generally operate on a fairly consistent basis over the 3-year simulation period. Collectively, these sources emitted between 7,000 and 8,000 tpy of SO_2 when they were all operating. With the closure of Cambria Cogen, emissions appear to be on the order of 4,000 to 5,000 tpy or about 30% lower than historic averages.

Table 5.2-7. Cambria County Source Yearly SO_2 Emissions and Operating Hours

Cambria County Sources Yearly SO2 Emissions and Operating Hours 1 July 2017 to 30 June 2020						
	Cambria Cogen		Colver Power		Ebensburg Power	
Year	SO2 (tpy)	Hours On	SO2 (tpy)	Hours On	SO2 (tpy)	Hours On
2017	1,207.91	4,416	1,317.75	3,803	776.85	4,174
2018	2,520.23	8,760	2,731.83	7,960	1,855.84	8,037
2019	491.36	4,344	2,265.65	7,600	1,145.33	6,919
2020	0.00	0	1,008.01	3,134	574.46	3,475

Table 5.2-8. Cambria County Source Quarterly SO_2 Emissions and Operating Hours

Cambria County Sources Quarterly SO2 Emissions and Operating Hours 1 July 2017 to 30 June 2020							
		Cambria Cogen		Colver Power		Ebensburg Power	
Year	Quarter	SO2 (tpy)	Hours On	SO2 (tpy)	Hours On	SO2 (tpy)	Hours On
2017	3	596.46	2,208	731.68	2,091	396.55	2,208
	4	611.45	2,208	586.07	1,712	380.30	1,966
2018	1	568.64	2,160	717.41	2,075	501.78	2,160
	2	626.57	2,184	703.38	2,029	416.13	1,850
	3	601.89	2,208	671.05	1,987	471.54	2,114
	4	723.13	2,208	639.99	1,869	466.38	1,913
2019	1	459.51	2,160	677.45	2,047	347.51	2,031
	2	31.84	2,184	417.71	1,844	221.55	1,689
	3	0.00	0	573.54	1,858	430.80	2,091
	4	0.00	0	596.96	1,851	145.47	1,108
2020	1	0.00	0	692.95	2,133	336.55	2,184
	2	0.00	0	315.06	1,001	237.90	1,291

The CAMD database includes hourly emissions as well as information on concentration and flow instrument validity via MODC. A summary of Cambria Cogen's, Colver Power's, and Ebensburg Power's SO_2 concentration MODC and flow MODC are shown in Table 5.2-9 and Table 5.2-10. Note there are fewer hours for Cambria Cogen since it ceased reporting to CAMD prior to the end of the 3-year modeling period.

Table 5.2-9. Cambria County Source SO_2 Concentration MODC

Summary of SO2 MODC Part 75 (Table 4a) 1 July 2017 to 30 June 2020					
MODC	**Part 75 Explanation**	**Cambria Cogen Unit 1**	**Cambria Cogen Unit 2**	**Colver**	**Ebensburg**
00	Off	3,307	3,766	3,807	3,699
01	Certified Primary Instrument	14,188	13,685	22,045	22,458
06	Average of the Hour Before and the Hour Following a Missing Data Period	24	65	286	68
08	90th Percentile Hourly SO2 Rate	0	0	28	0
12	Maximum Hourly SO2 Rate Over Lookback Period	1	3	1	0
16	SO2 Concentration Value of 2.0 ppm During Hours When Only Very Low Sulfur Fuel	0	0	87	0
21	Negative Hourly SO2 Concentration Replaced with 0	0	1	50	79

Table 5.2-10. Cambria County Source Flow MODC

Summary of Flow MODC Part 75 (Table 4a) 1 July 2017 to 30 June 2020					
MODC	**Part 75 Explanation**	**Cambria Cogen Unit 1**	**Cambria Cogen Unit 2**	**Colver**	**Ebensburg**
00	Off	3,307	3,766	3,807	3,699
01	Certified Primary Instrument	14,166	13,711	22,359	19,441
06	Average of the Hour Before and the Hour Following a Missing Data Period	0	0	27	541
08	90th Percentile Hourly Flow Rate	0	0	0	129
09	95th Percentile Hourly Flow Rate	0	0	0	142
10	Maximum Hourly Flow Rate Over Lookback Period	0	0	0	876
11	Average of Hourly Flow Rates Over Lookback Peiod	41	40	111	117
12	Maximum Potential Flow Rate	0	0	0	129
20	200% of the Full-Scale Range Setting	0	0	0	1,230
55	Other Substitute Data Approved Through Petition	6	3	0	0

CAMD reported (mass) emissions rates are based on CEMS flow rates and concentration instrumentation. As described earlier, measured mass flow rates represent hours with valid instrument values and calculated mass flow rates are generated for hours with instrument malfunctions. Since CAMD is part of an emissions trading program, calculated mass flow rates can sometimes be intentionally over estimated. These hours should be noted as they have the potential to impact hourly emission inputs into the 3-year modeling analysis.

For the Cambria County sources, the MODC concentration and flow rate summaries indicate most of the sources utilize measured mass emission values. Missing values for Cambria Cogen and Colver are largely replaced with reasonable estimations. Ebensburg Power, however, appears to have a significant number of hours with calculated flow rates that could lead to very high calculated hourly SO_2 emission rates. Exaggerated flow rates will return much higher hourly SO_2 emission rates since the flow rate figures into the mass emission calculation.

Given the distance from the area of focus in Cambria and Westmoreland counties and the average emission rates, the emissions of the Cambria County sources are not very impactful to the violating receptors (see Table 5.2-15). Conemaugh and Seward being closer and having higher hourly emission rates have significantly higher impacts. Additionally, the Cambria County sources peak impacts on the area of focus are expected to occur under northerly wind directions. Under those circumstances, emissions from Conemaugh and Seward would be pushed south into the Ligonier Valley and away from the Laurel Ridge. Thus, the Cambria County sources produce minimal impacts when Conemaugh and Seward emission are blown east towards the controlling Laurel Ridge topographic feature.

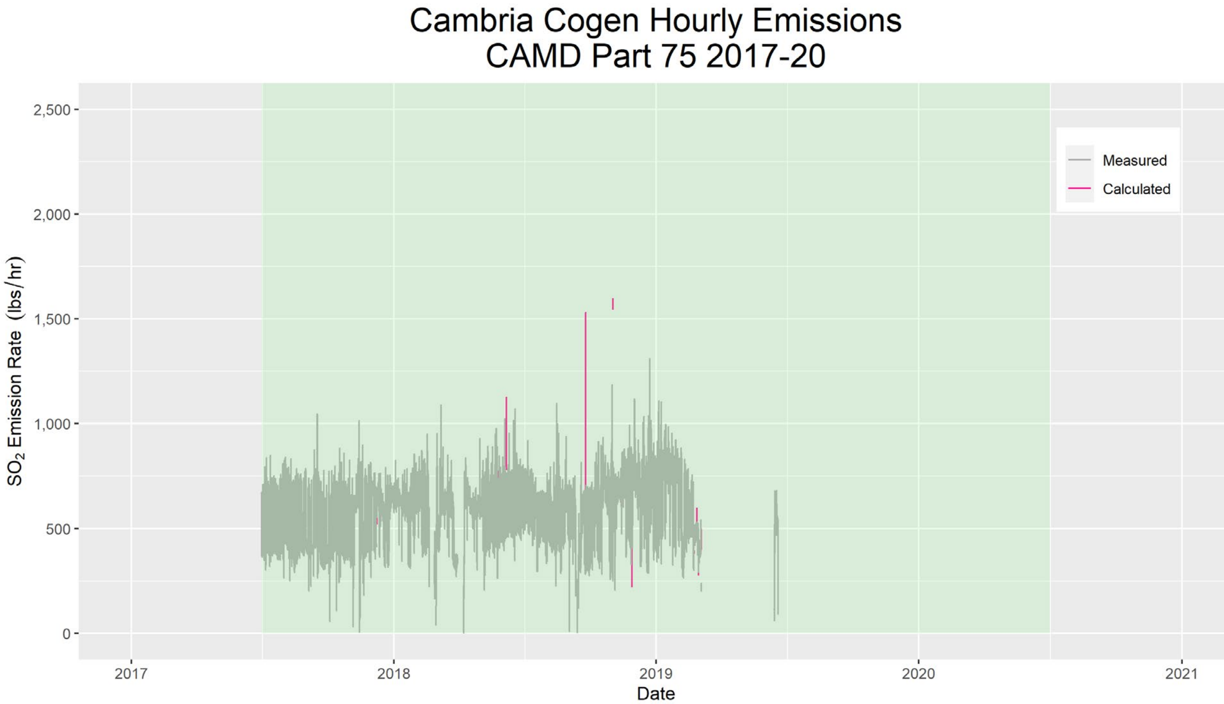
5.2.5.3.1. Model Input Parameters for Cambria Cogen

Cambria Cogen Modeled Hourly Emission Rates: EPA downloaded Cambria Cogen's (actual) hourly emissions for both its waste-coal fired units (units 1 & 2) over the 3-year model simulation period (1 July 2017 through 20 June 2020). The combined units' hourly emission rate was used in EPA's modeling analysis.

Similar to Seward, Cambria Cogen was fired with waste coal or GOB. Fuel is consumed in 2 CFB units with lime injection to control SO_2 emissions. Cambria Cogen's units, however, are much smaller than Seward's. Seward's listed Title V boiler ratings are 2,532 million British thermal units per hour (mmBtu/hr) for both of its units. For comparison, Cambria Cogen's listed Title V boiler ratings are 630 mmBtu/hr for each of its waste coal units. In total, Seward's combined boiler rating is about 8 times higher than Cambria Cogen. We note that a Retirement Unit Exemption form was filed with CAMD notifying the units' deactivation. This became effective in September of 2020.

Figure 5.2-12 shows Cambria Cogen's combined hourly SO_2 emission rate over the 3-year model simulation period (highlighted in green). Similar to Conemaugh and Seward, EPA identified which hours were "measured" (with valid flow and concentration MODC) and which hours were "calculated" (either invalid flow and/or concentration MODC).

Figure 5.2-12. Cambria Cogen's Hourly CAMD SO_2 Emissions over 3-year Simulation Period



Cambria Cogen's hourly SO_2 emissions generally average between 500 and 750 lbs/hr over the simulation period. Some emission spikes do occur, at times exceeding 1,000 pounds per hour. Like Seward, percent sulfur variability in the fuel source (coal waste or GOB) and control efficiency drops may account for these emission spikes. As mentioned previously, hourly emissions generally cease after the 1st quarter of 2019 marking the time these units were deactivated.

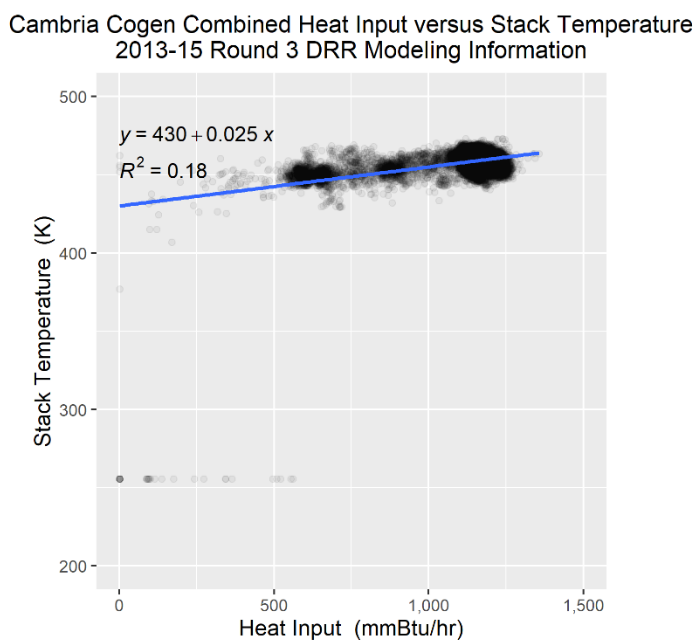
Cambria Cogen's Modeled Hourly Stack Parameters: Stack parameters including stack temperatures and velocities for EPA's modeling analysis were based on information that was used in Pennsylvania's Round 3 DRR modeling analysis combined with CAMD information pulled by EPA over the same time period (2013-15). Physical stack locations, stack heights and stack diameters were taken from the Pennsylvania Round 3 DRR modeling file. No building downwash was used since the Cambria County sources were located well away from the area of interest and would therefore have little or no effect on the model results.

CAMD data does include flow rate information. This flow rate information, however, is reported as an adjusted flow rate; standard cubic feet per hour (scfh). Actual flow rate information is not reported to CAMD and is usually only available from the source's CEMS units. Additionally, no information is available for hourly stack (emission) temperatures. For modeling purposes, the CAMD database can provide hourly SO_2 emission rates and information on which hours flow rates may be invalid.

To develop Cambria Cogen's hourly stack parameters, EPA utilized Pennsylvania's hourly emission file for its Round 3 DRR modeling analysis covering 2013-15 coupled with corresponding CAMD information. This information was used to establish relationships between the combined units' heat input and modeled hourly stack temperature and stack velocity. Relationships between Cambria Cogen's heat input, stack temperature and stack velocity from the DRR modeling period were then used to determine modeled stack temperature and velocity over EPA's 3-year simulation period.

Cambria Cogen's stack temperature versus combined unit heat input (for all operating hours) over the 3-year DRR Round 3 modeling period is shown on Figure 5.2-13. A best fit linear trendline was imposed on the data and is shown on the figure along with the linear equation and R-squared value, which indicates how well the linear trend line fits the data. While the R-squared value indicates a poor fit, EPA believes the developed linear fit line provides the best estimate of hourly varying stack temperatures over the 3-year simulation period. This was done by plugging Cambria Cogen's hourly heat input over the 3-year simulation period (1 July 2017 through 30 June 2020) into the liner fit line equation.

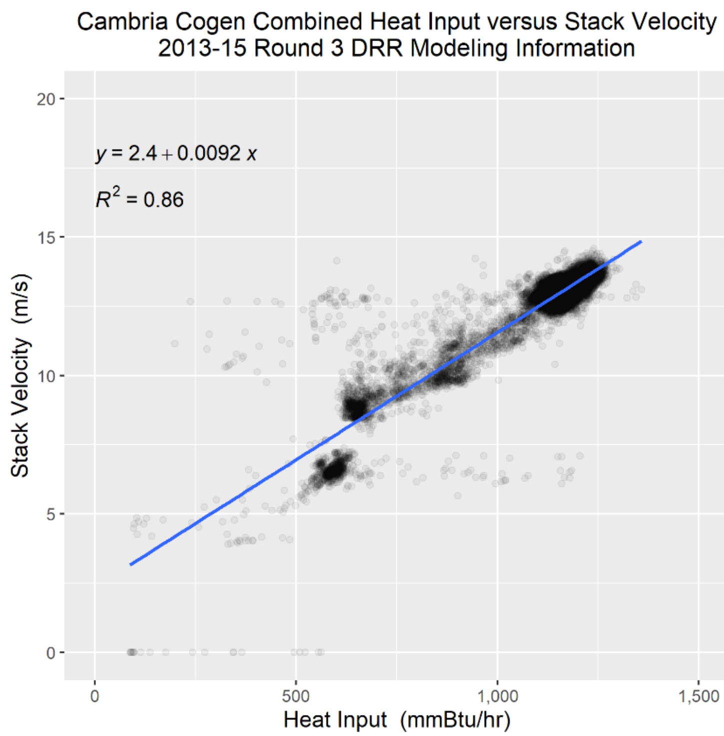
Figure 5.2-13 Cambria Cogen Linear Fitted Equation for Stack Temperature



EPA utilized a similar process to develop model hourly stack velocities for Cambria Cogen. Again, hourly stack velocities were coupled with hourly (combined) heat input to construct linear fits to the data. Unlike the temperature construction, CAMD flow MODC were used to screen out any hours with invalid (calculated) flow rates. Figure 5.2-14 shows Cambria Cogen's best linear fit between its DRR Round 3 model stack velocity and corresponding hourly heat input. R-squared values indicate a much better fit with the data than Cambria Cogen's stack temperatures. Of the 2, modeled stack velocities probably have the greater impact on final model concentrations.

Cambria Cogen's hourly stack velocities for the 3-year simulation period were determined by plugging in the hourly heat input information into the linear fit line equations. This information along with the corresponding hourly SO_2 emission rate and calculated stack temperature was then used to create an AERMOD hourly emission rate file for the 3-year simulation period.

Figure 5.2-14. Cambria Cogen Linear Fitted Equation for Stack Velocity



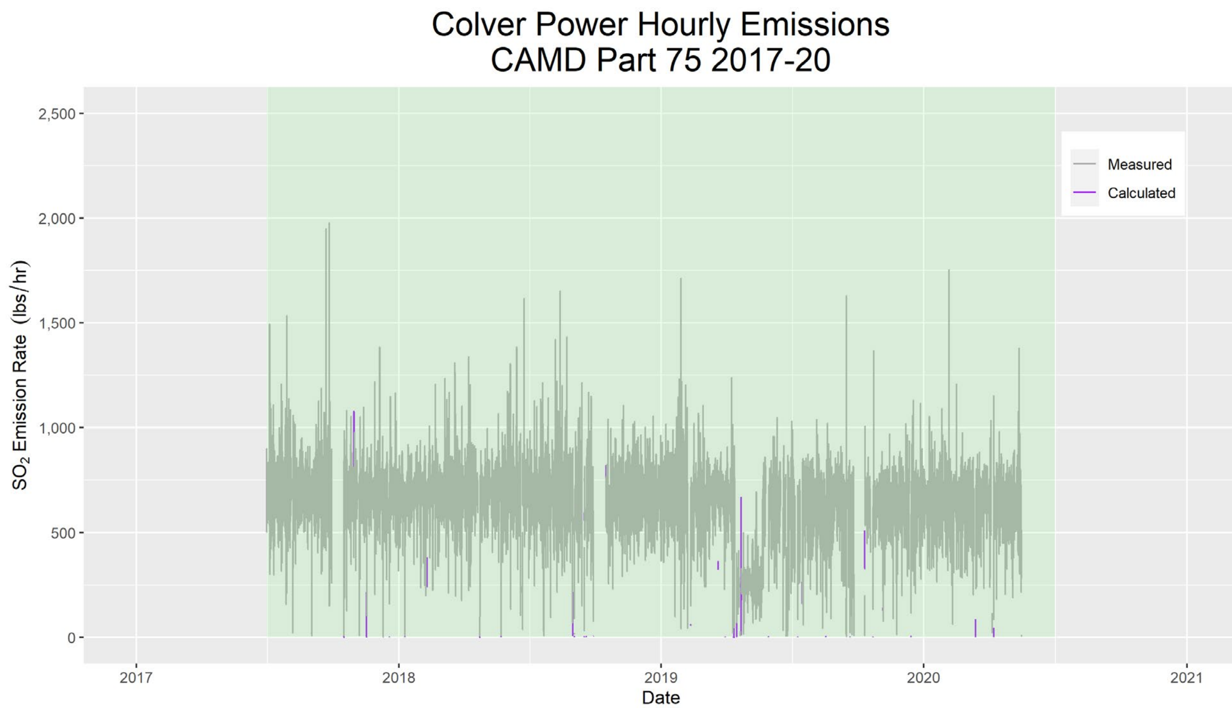
5.2.5.3.2. Model Input Parameters for Colver Power

Colver Power Modeled Hourly Emission Rates: EPA downloaded Colver Power's (actual) hourly emissions for its waste-coal fired unit over the 3-year model simulation period (1 July 2017 through 20 June 2020). The CAMD hourly emission rate was used in the modeling analysis.

Colver Power is 1 of 3 waste coal or GOB fired facilities in Cambria County. Similar to the other waste coal facilities, fuel is consumed in CFB units with lime injection to control SO_2 emissions. Colver Power's waste coal unit, like the other units in Cambria County, is much smaller than Seward's. Colver Power's listed Title V boiler rating is 1,214.5 mmBtu/hr making it Cambria County's largest single waste-coal unit. In boiler rating size, Colver Power is about one fourth of Seward's combined listed boiler rating.

Figure 5.2-15 shows Colver Power's hourly SO_2 emission rate over the 3-year model simulation period (highlighted in green). Similar to other sources, EPA identified which hours were "measured" (with valid flow and concentration MODC) and with hours were "calculated" (either invalid flow and/or concentration MODC).

Figure 5.2-15. Colver Power's Hourly CAMD SO_2 Emissions over 3-year Simulation Period

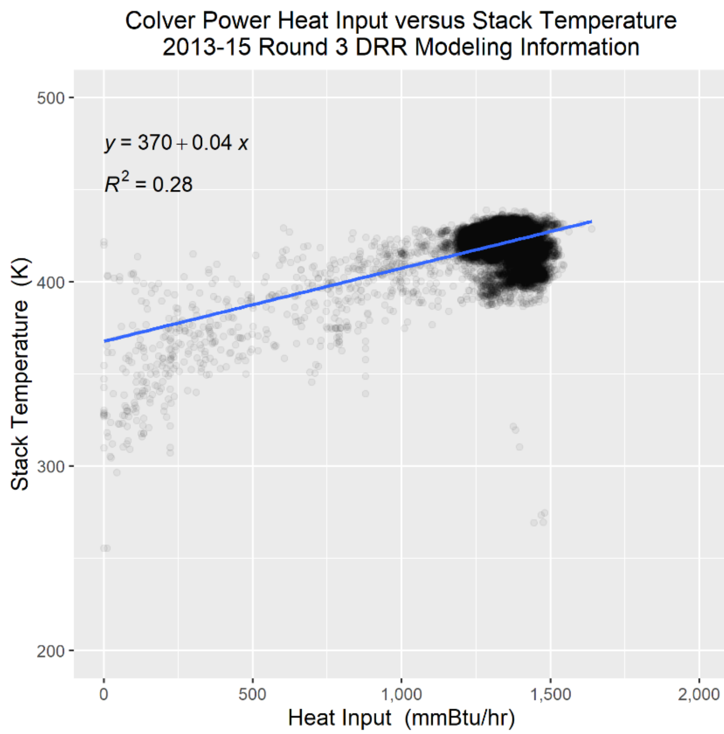


Colver Power's hourly SO_2 emissions generally average between 500 and 1,000 lbs/hr over the simulation period. Some emission spikes do occur, at times exceeding 1,500 pounds per hour. Like Seward, percent sulfur variability in the fuel source (GOB) and control efficiency drops may account for these emission spikes. Colver Power's hourly emissions profile indicates near constant operations over the 3-year simulation period.

Colver Power's Modeled Hourly Stack Parameters: EPA constructed Colver Power's modeled hourly stack temperature and stack velocity using the same strategy described previously. We used Pennsylvania's DRR Round 3 model information coupled with corresponding CAMD heat input to produce a linear relationship that could be used to estimate Colver Power's hourly stack temperature and stack velocity over the 3-year simulation period.

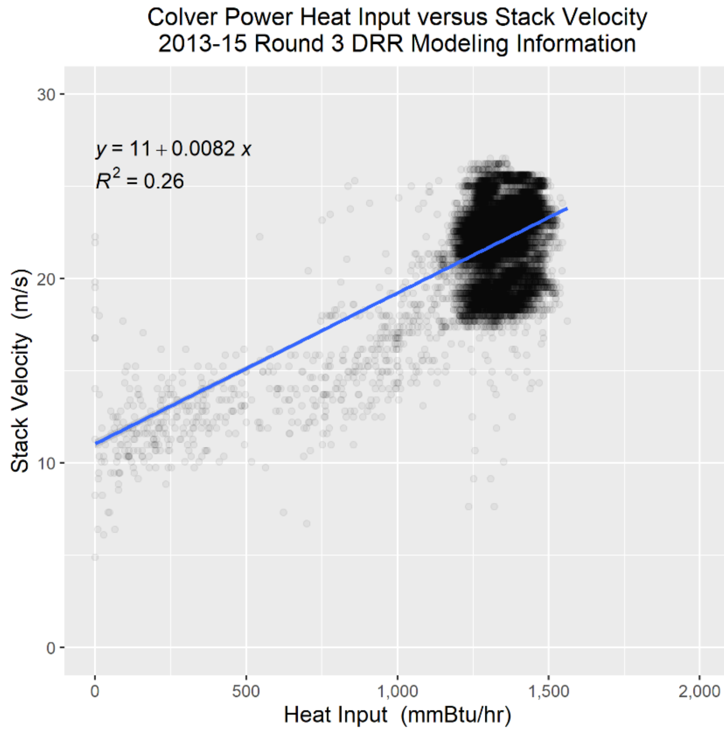
Figure 5.2-16 shows Colver Power's heat input versus stack temperature from CAMD and the DRR Round 3 modeling model hourly emission file. Similar to Cambria Cogen, R-squared values for the linear fit are poor. While the R-squared value indicates a poor fit, EPA believes the developed linear fit line provides the best estimate of hourly varying stack temperatures over the 3-year simulation period.

Figure 5.2-16. Colver Power Linear Fitted Equation for Stack Temperature



Stack velocities were configured using the same approach though hours with invalid flow MODC were excluded from the analysis. Figure 5.2-17 shows Colver Power's heat input versus stack velocity from CAMD and the DRR Round 3 modeling model hourly emission file. R-squared values for the linear fit are poor. While the R squared value indicates a poor fit, EPA believes the developed linear fit line provides the best estimate of hourly varying stack velocities over the 3-year simulation period. EPA utilized this equation to construct Colver Power's hourly varying stack velocity by plugging in the hourly unit heat input values over the 3-year model simulation period into the equation. This information along with the corresponding hourly SO_2 emission rate and hourly stack temperature was then put into the AERMOD emission input file for the final 3-year simulation period.

Figure 5.2-17. Colver Power Linear Fitted Equation for Stack Velocity



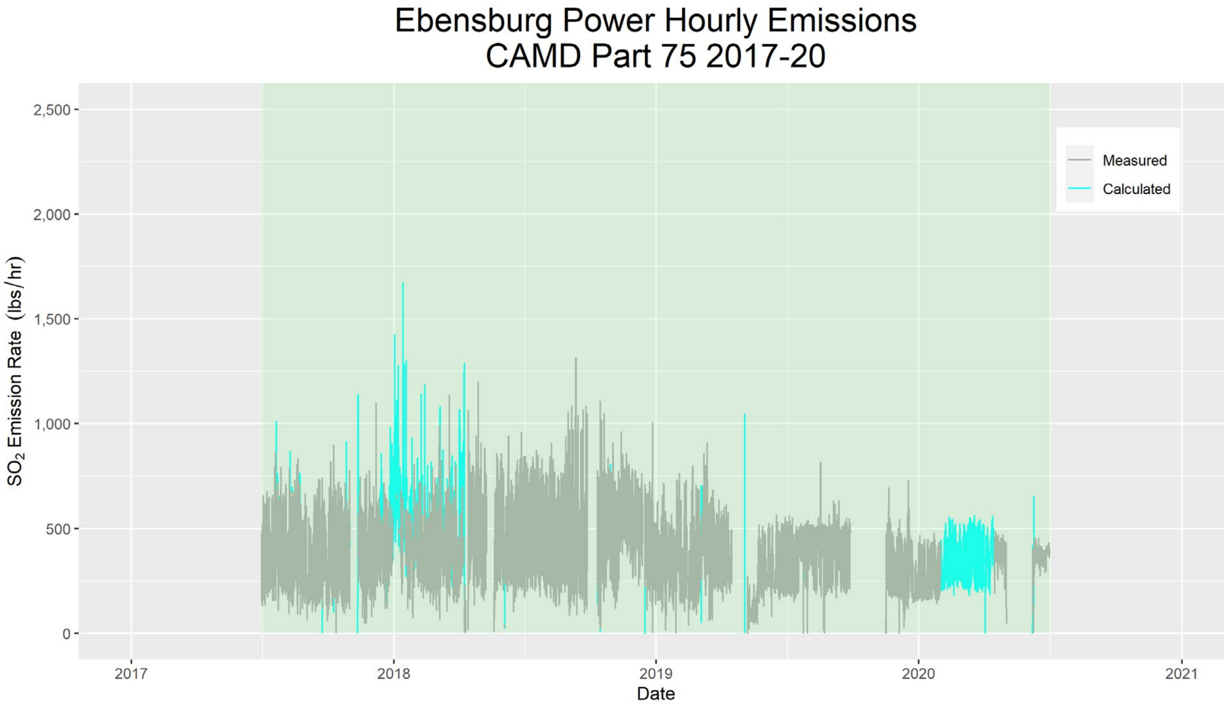
5.2.5.3.3. Model Input Parameters for Ebensburg Power

Ebensburg Power Modeled Hourly Emission Rates: EPA downloaded Ebensburg Power's (actual) hourly emissions for its waste-coal fired unit over the 3-year model simulation period (1 July 2017 through 20 June 2020). The CAMD hourly emission rate was used in the 3-year modeling analysis.

Ebensburg Power is one of the 3 waste-coal or GOB fired facilities in Cambria County. Waste coal is consumed in the CFB unit and controlled via lime injection to reduce SO_2 emissions. Ebensburg Power's listed Title V boiler rating is 820 mmBtu/hr making it Cambria County's smallest waste coal unit. As far as boiler rating size, Ebensburg Power is less than one fifth the size of Seward's combined listed boiler rating.

Figure 5.2-18 shows Ebensburg Power's hourly SO_2 emission rate over the 3-year model simulation period (highlighted in green). Similar to other sources, EPA identified which hours were "measured" (with valid flow and concentration MODC) and which hours were "calculated" (either invalid flow and/or concentration MODC).

Figure 5.2-18. Ebensburg Power's Hourly CAMD SO_2 Emissions for 3-yr Simulation Period



Ebensburg Power's hourly SO_2 emissions generally average about 500 lbs/hr over the simulation period. Some emission spikes do occur, at times exceeding 1,000 pounds per hour. Like Seward and the other Cambria County waste-coal sources, percent sulfur variability in the fuel source (GOB) and control efficiency drops may account for these emission spikes. Ebensburg Power's hourly emissions profile, as alluded to earlier, indicates there are a significant number of hours where the hourly emission rate is based on "calculated" values as opposed to "measured" values over the 3-year simulation period. This is due to an unusually high number of hours with invalid flow rate measurements that were filled with exaggerated values. The result is a significant number of modeled hours with potentially over estimated emission rates. Note the construction of Ebensburg Power's modeled stack velocities excluded impacts from hours with invalid flow measurements so any overestimation of stack velocity is avoided.

Ebensburg Power's Modeled Hourly Stack Parameters: EPA constructed modeled hourly stack temperature and velocity for Ebensburg Power using the same strategy described previously for the other Cambria County waste coal sources. We used Pennsylvania's DRR Round 3 model information coupled with corresponding CAMD heat input to produce a linear relationship that could be used to estimate Colver Power's hourly stack temperature and stack velocity over the 3-year simulation period.

Figure 5.2-19 shows Ebensburg Power's heat input versus stack temperature from CAMD and the DRR Round 3 modeling's hourly emission file. Unlike the other sources, R-squared values for the linear fit are relatively good. EPA utilized this equation to construct Ebensburg Power's hourly varying stack temperatures by plugging in its hourly unit heat input values over the 3-year model simulation period into the equation.

Stack velocities were configured using the same approach though hours with invalid flow MODC were excluded from the analysis. Figure 5.2-20 shows Ebensburg Power's heat input versus stack velocity from CAMD and the DRR Round 3 modeling model hourly emission file. R-squared values for the linear fit are excellent. EPA utilized this equation to construct Ebensburg Power's hourly varying stack velocity by plugging in the hourly unit heat input values over the 3-year model simulation period into the equation. This information along with the corresponding hourly SO_2 emission rate and hourly stack temperature was then put into the AERMOD hourly emission file for the final 3-year simulation period.

Figure 5.2-19. Ebensburg Power Linear Fitted Equation for Stack Temperature

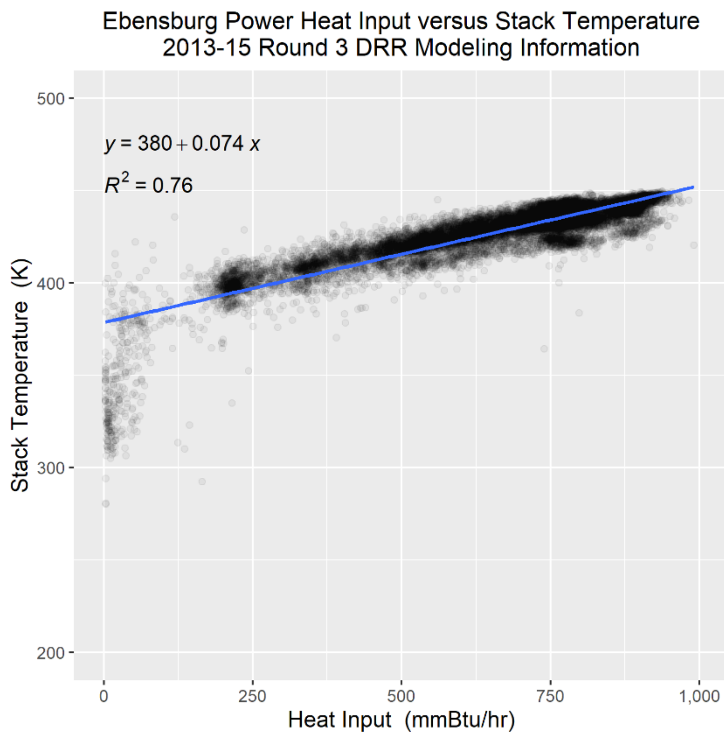
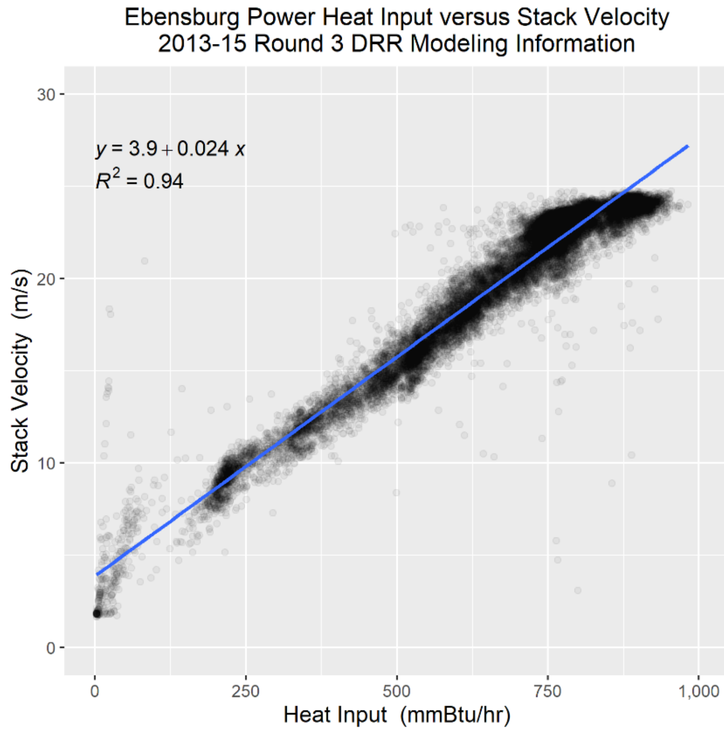


Figure 5.2-20. Ebensburg Power Linear Fitted Equation for Stack Velocity



5.2.6. Modeling Parameter: Meteorology and Surface Characteristics

As noted in the Modeling TAD, the most recent 3 years of meteorological data (concurrent with the most recent 3 years of emissions data) should be used in designations efforts. The selection of data should be based on spatial and climatological (temporal) representativeness. The representativeness of the data is determined based on: 1) the proximity of the meteorological monitoring site to the area under consideration, 2) the complexity of terrain, 3) the exposure of the meteorological site, and 4) the period of time during which data are collected. Sources of meteorological data include National Weather Service (NWS) stations, site-specific or onsite data, and other sources such as universities, Federal Aviation Administration (FAA), and military stations.

Site Specific Meteorological Data (Ash Site #1): Sensitivity and evaluation studies (Paine, 2001 and Paine *et al*, 2013) have shown that AERMOD has the potential to over-estimate the downwind plume impacts from sources located in or near hilly terrain like Conemaugh and Seward. This can be especially true if the analysis is performed using meteorological data that are not site-specific and consists of only a single low level (e.g., 10-m), wind measurements such as at National Weather Service stations. Significant improvement in AERMOD performance for impacts in complex terrain from tall-stack emissions would be expected with the use of site-specific multiple-level tower and SOnic Detection And Ranging (SODAR) wind profiler system.

It was for this reason that a plan for site-specific meteorological measurements was formulated to address dispersion characteristics near the Conemaugh and Seward power plants. This led to an EPA-approved meteorological monitoring protocol in the spring of 2015, and the installation of a 100-meter height meteorological tower equipped with multiple levels of meteorological sensors (at 2, 10, 50, 75, and 100 m) along with a SODAR wind profiler system (with measurements starting at 50 m and extending upwards in 50-m increments to 500 m).

A meteorological measurement site was located on the Ash Site #1 located between the Conemaugh and Seward power plants (see figures 5.2-21 and 5.2-22). AERMOD was specifically designed to accommodate multiple levels of meteorological data to more accurately estimate vertical profiles of meteorological variables used in the modeling. For the monitoring program, the EPA Guidelines for Air Quality Modeling (40 CFR Part 51, Appendix W) and EPA's meteorological monitoring guidance (EPA, 2000) provided the general guidance for sensor and parameter selection and siting of the tower and SODAR. A more detailed description of the monitoring equipment, collection site and data gathering procedures is described in AECOM's *Meteorological Monitoring Station Design and Quality Assurance Project Plan for the Conemaugh and Seward Generating Stations - Indiana County, PA* dated March 2015.

Figure 5.2-21. Site Specific Meteorological Data Collection Locations

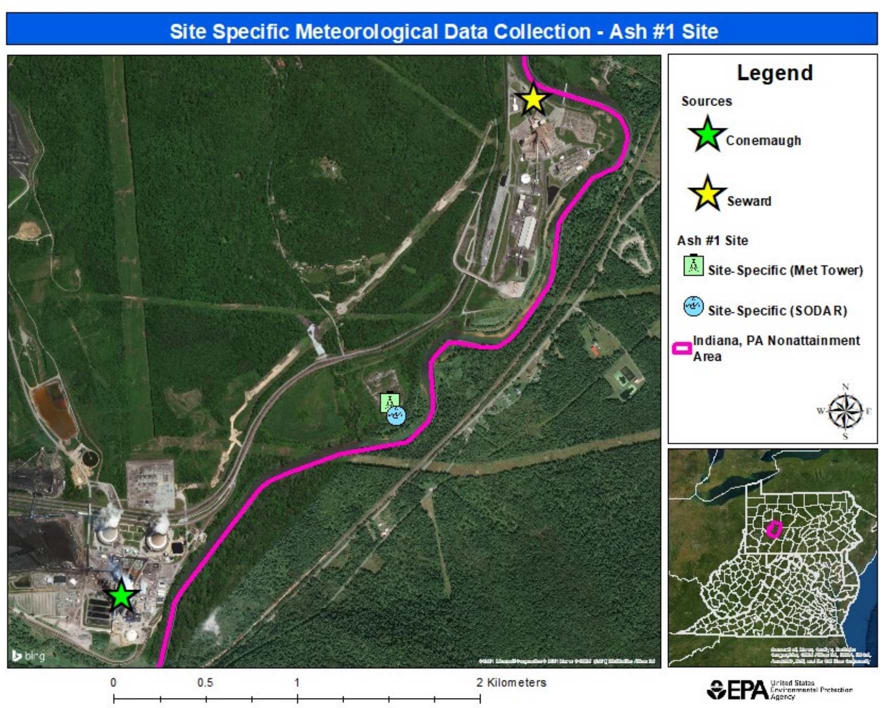


Figure 5.2-22. From AECOM-2, Figure 1-4, View of Meteorological Site, Conemaugh and Seward. Ligonier Valley, Looking Southwest with Chestnut Ridge in Background

Soil Moisture and Snow Cover Analysis/AERSURFACE Processing: AERMET, the meteorological preprocessor for AERMOD, has advanced boundary layer algorithms that require user-specified surface characteristics for albedo, Bowen ratio, and surface roughness length. To aid the user community with an objective method for determining these AERMET-required surface characteristics, EPA developed the AERSURFACE tool, which was first released in 2008. AERSURFACE generates estimates of realistic and reproducible surface characteristic values using LULC data from the National Land Cover Database (NLCD).

AERSURFACE is not a regulatory component of the AERMOD Modeling System as listed in Appendix A to the Guideline on Air Quality Models (or Appendix W to 40 CFR Part 51). Section 8.4.2(b) of Appendix W recommends the use of the latest version of AERSURFACE for determining surface characteristics when processing measured meteorological data through AERMET (i.e., representative site-specific data or data from a nearby National Weather Service or comparable station).

AERMET-ready surface characteristics including surface roughness length, albedo and Bowen ratio were based on the location of the meteorological site-specific collection site (Ash Site #1). Pennsylvania SIP submittals utilized a previous version of AERSURFACE. Surface characteristics need to be determined using the most recent version AERSURFACE. The newer version allows for the use of more recent LULC data that would better align with the site-specific meteorological data collection period. Site-specific meteorological data was collected over a 13-month period from 1 August 2015 through 31 August 2016. The final 1-year collection period used in PA's Supplemental Analysis spanned from 1 September 2015 through 31 August 2016. This was due to better SODAR data capture percentages over this period (AECOM, 2019).

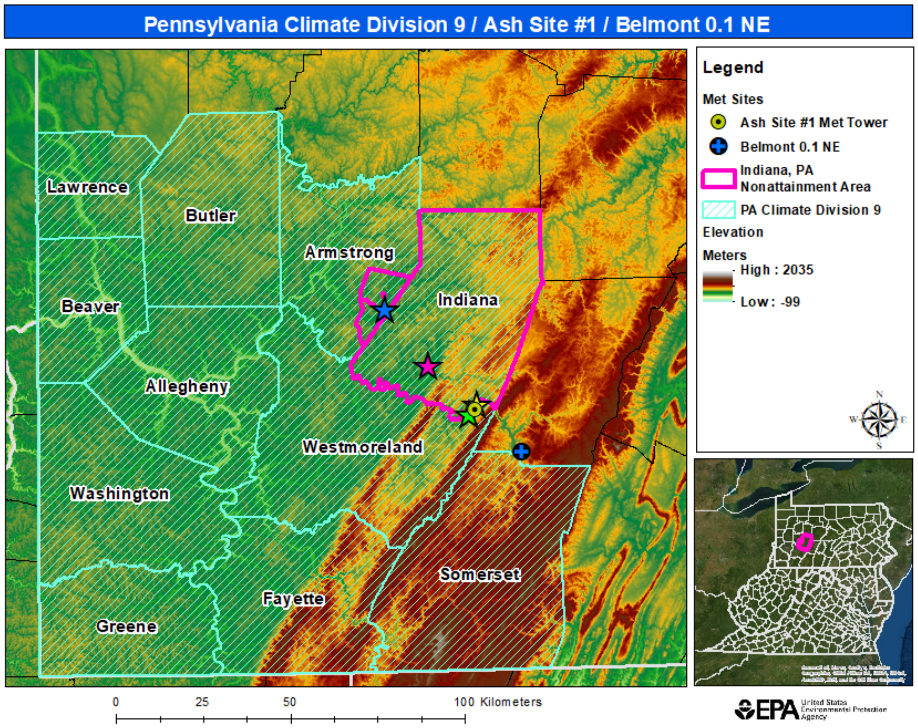
EPA reran AERSURFACE to generate surface characteristics using the 100-m meteorological tower location. The release of AERSURFACE version 20060 replaces version 13016 and finalizes many of the updates and enhancements implemented in the 19039_DRFT version. EPA used processing steps outlined in its AERMOD Implementation Guide, AERSURFACE users guide (EPA, 2020) and AERSURFACE transmission memo[18]. The AERMOD Implementation Guide recommends the use of a circular 1-km radius centered at the meteorological station site for surface roughness calculations. Bowen ratios and albedo values were determined in accordance with guidance using a 10-km by 10-km region centered on the measurement site.

AERSURFACE links various land cover categories to a set of seasonal surface characteristics and requires specification of the seasonal category for each month of the year that are assigned based on local conditions. Bowen ratios are dependent on surface wetness characteristics and were assigned "wet", "average" and "dry" categories in AERSURFACE using a 30-year precipitation data set for Pennsylvania Climate Division 9. Albedo values also need adjustments to account for wintertime (monthly) snow cover. A month is considered to have "continuous" snow cover if over half the days have at least 1 inch snow depths. Snow cover was retrieved from the Community Collaborative Rain, Hail, and Snow Network for the "Belmont 0.1 NE" site (PA-CM-4 on the CoCoRaHS website) located approximately 18 km southeast of the Conemaugh and Seward. Figure 5.2-23 shows the Pennsylvania Climate Division 9, the Ash Site #1 tower location and the Belmont 0.1 NE site used to assess snow cover.

EPA reexamined the surface wetness characteristics for its modeling analysis. Pennsylvania's supplemental modeling analysis utilized monthly precipitation from 1981 to 2010 as the 30-year period. We updated the time period and used PA Climate Division 9 monthly precipitation data from 1991 through 2020 for surface moisture determination. Actual AERSURFACE soil moisture categories were based off of monthly precipitation totals collected at the Ash Site #1. Soil moisture categories were determined by taking the Ash Site #1 monthly precipitation and comparing them to the 30-year precipitation data from Pennsylvania Climate Division 9 based on the divisions explained in section 2.3.3 of the AERSURFACE users guide.
Snow-cover from Pennsylvania's modeling analysis was also reexamined. Only the month of January (2016) had more than 50% of the days with at least 1 inch of snow cover during the site-specific meteorological data collection period. Other winter designated months (Nov, Dec, Feb and Mar) were not adjusted to account for continuous monthly snow cover.

Table 5.2-11 shows the soil moisture category breakdown during the site-specific meteorological data collection period. It includes the corresponding monthly Climate Division 9 precipitation and the cut off values for "wet" and "dry" months. Final soil categories were based on where the Ash Site #1's monthly precipitation fell within the Climate Division 9 thirty-year survey period.

Figure 5.2-23. Location of Met Tower, Belmont 0.1 NE and PA Climate Division 9



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[18] See EPA's Support Center for Regulatory Atmospheric Modeling (SCRAM) website:
https://www.epa.gov/scram/air-quality-dispersion-modeling-related-model-support-programs

Table 5.2-11. Monthly AERSURFACE Soil Moisture Category Breakdown

Ash Site #1 AERSURFACE Monthly Soil Moisture Category/Snow Cover							
Year	Month	Dry Cutoff	Wet Cutoff	PA Climate 09	Ash Site #1	Category	Snow Cover
2015	Sep	2.45	4.60	4.94	2.80	Average	
2015	Oct	2.36	4.29	3.49	2.89	Average	
2015	Nov	2.52	4.13	2.04	1.65	Dry	No Snow
2015	Dec	2.69	4.18	4.11	3.81	Average	No Snow
2016	Jan	2.33	3.84	2.25	1.40	Dry	Snow
2016	Feb	2.08	3.30	3.17	1.62	Dry	No Snow
2016	Mar	2.78	4.54	2.53	1.94	Dry	No Snow
2016	Apr	2.96	4.47	2.76	1.52	Dry	
2016	May	3.34	5.24	4.32	4.89	Average	
2016	Jun	3.72	5.59	4.24	4.26	Average	
2016	Jul	3.76	4.90	3.94	3.07	Dry	
2016	Aug	3.03	4.62	4.37	5.78	Wet	

EPA updated surface characteristics using AERSURFACE (20060) centered on the Ash Site #1's 100-m tower location. Standard settings were used to determine surface roughness values surrounding the met tower; ZORADIUS was set to 1.0 km. Albedo and Bowen ratios were determined by a 10 km by 10 km survey area centered on the tower location. Land use/land cover (LULC), impervious surface and tree canopy data for 2016 were downloaded from the Multi-Resolution Land Characteristics (MRLC) Consortium website and used as AERSURFACE's source data. Figure 5.2-24 shows the location of the Ash Site #1 met tower along with the surface roughness and albedo/Bowen ratio survey areas.

AESURFACE sectors can range from 1 to 12 for input to AERMET, though sectors must be a minimum of 30°. Surface roughness values were assigned to 8 sectors surrounding the Ash Site #1 met tower. Sector width spacing varied and was based on the visual presentation of the 2016 land use categories within 1-km of the Ash Site #1. All sectors were defined as non-airport (see section 2.3.2 of the AERSURFACE users guide for additional information). Figure 5.2-25 shows the chosen sectors and the 2016 LULC. The 2016 LULC contains much more developed LULC categories than the 1992 data used in the Indiana, PA SIP. The 1992 data was the only data available at the time of SIP preparation.

The bulk of the developed LULC categories in Figure 5.2-25 are generally confined to the Conemaugh and Seward power plants. The Ash Site #1 is also categorized as developed. This may be because the LULC category assignment is made using spectral analysis (possibly in the infrared) and the material in the ash landfill resembles properties of concrete or macadam surfaces. While this is a significant change from the 1992 LULC, EPA believes the impact of this change would be minimal since the Ash Site #1 makes up a small fraction of the 1 km survey area and its impacts are further reduced by dividing the area among the 8 defined sectors.

EPA also notes the 2016 LULC includes a significant area of woody wetlands along the southeastern side of the Conemaugh River but not on the power plant side of the river. We surmise that any low-lying areas near the Conemaugh and Seward power plants were probably filled in and raised to prevent either facility from being flooded, a common occurrence along this river over the last century or so. The last major flooding event on the Conemaugh River occurred in 1977 and permanently displaced residents from the hamlet of Robindale.

Impervious surface and tree canopy data (for 2016) were also processed in AERSURFACE to supplement the surface roughness calculations. These are displayed in Figure 5.2-26 and 5.2-27. Roads and railroads are clearly delineated in the impervious surface files. The Conemaugh and Seward power plant structures also show up in the impervious surface files, as does the Ash Site #1 landfill. EPA does not think the Ash Site #1 will make a significant impact on final surface roughness calculations since including the impervious surface information appears to only make small differences in the AERSURFACE derived values. Tree canopy data appears to be accurate. Roads and rail roads are clearly visible along with power line cuts. The Ash Site #1 does not appear to have any tree cover, which makes sense since disposal sites are generally prohibited from allowing any woody vegetation[19] to take hold (to protect any capping structures).

AERSURFACE was run multiple times to construct the monthly varying surface characteristics for the Ash Site #1 met tower location. This accounts for the different monthly soil characteristics and snow cover information (as listed in Table 5.2-11). Seasonal settings for the Ash Site #1 were identical to the ones assigned in Pennsylvania's original and supplemental SIP analysis. Winter included the months of November, December, January, February and March. Spring included April and May. Summer included the months of June, July and August. Autumn included the months of September and October. Given the variability in monthly soil moisture and continuous snow cover, 4 AERSURFACE runs were needed. These included Average (soil moisture) no snow, dry-snow, dry-no snow and wet-no snow. The results of these AERSURFACE runs were used as stage 2 input during the AERMET processing described in the next section.

[19] EPA is not certain if the Ash Site #1 is subject to state disposal site regulations but 25 PA Code § 288.237 (b) describing standards for successful revegetation of disposal areas prohibits trees, woody shrubs or deep-rooted plants that would allow the penetration of the disposal area's cap or drainage layer.

Figure 5.2-24. AERSURFACE Survey Areas for Surface Roughness, Albedo and Bowen Ratio

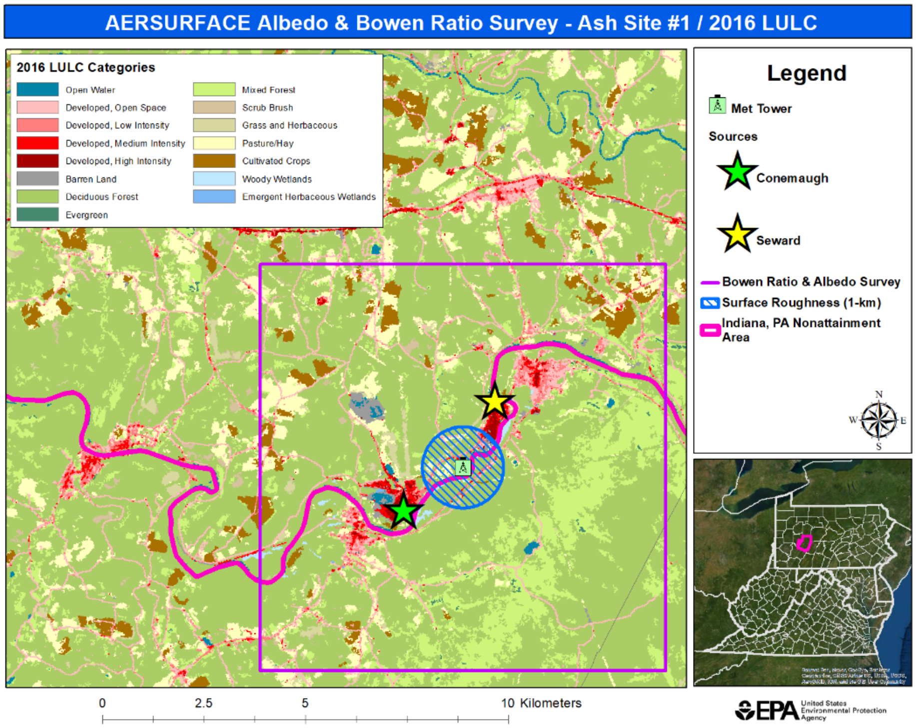


Figure 5.2-25. AERSURFACE Sector Assignment for Surface Roughness Calculations

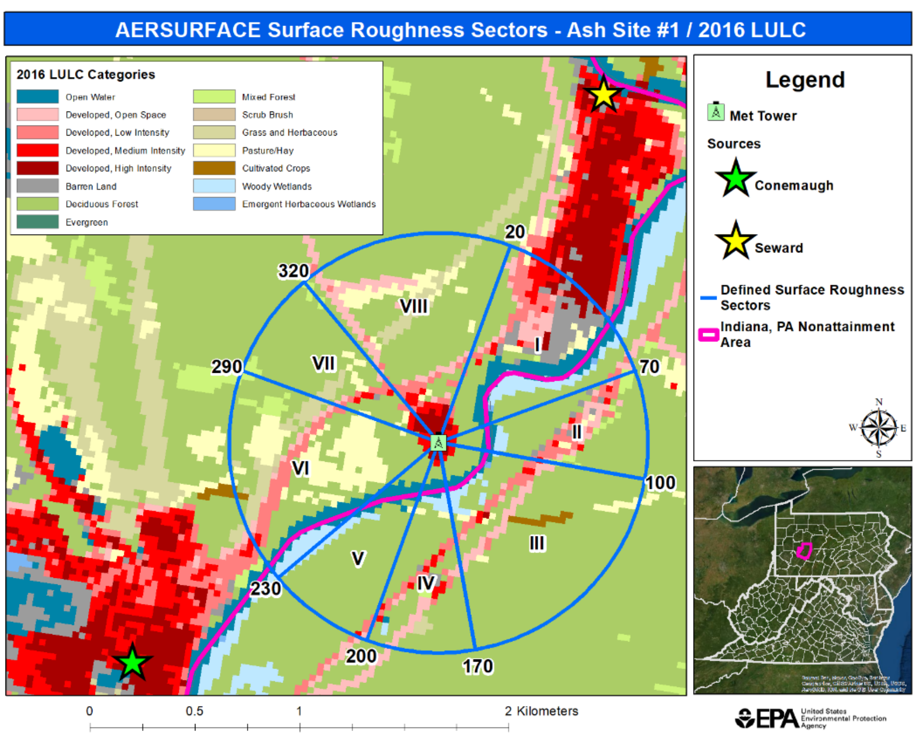


Figure 5.2-26. AERSURFACE Impervious Surface Input

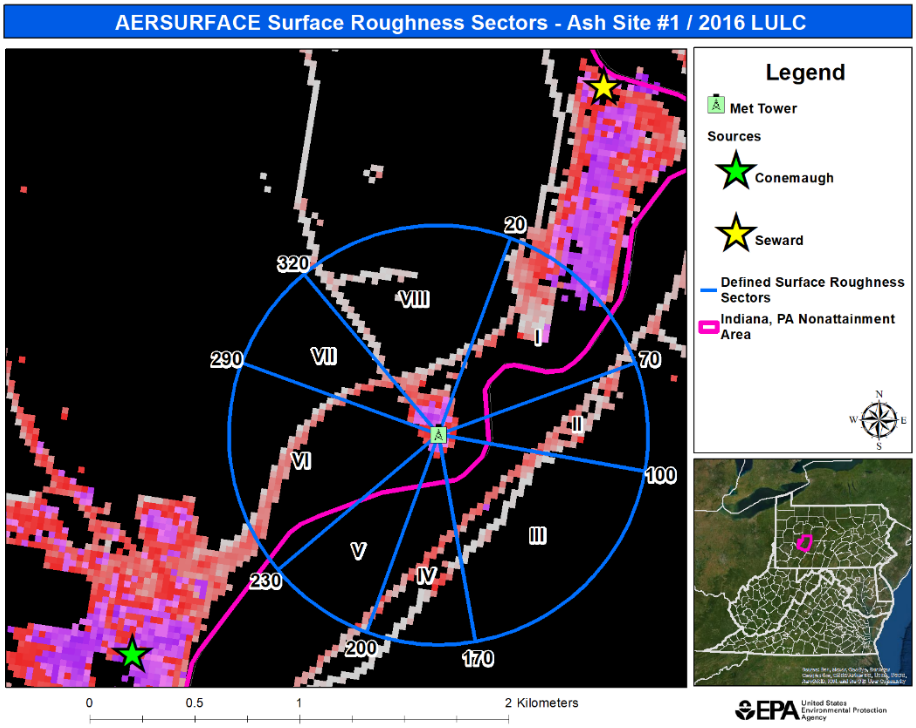
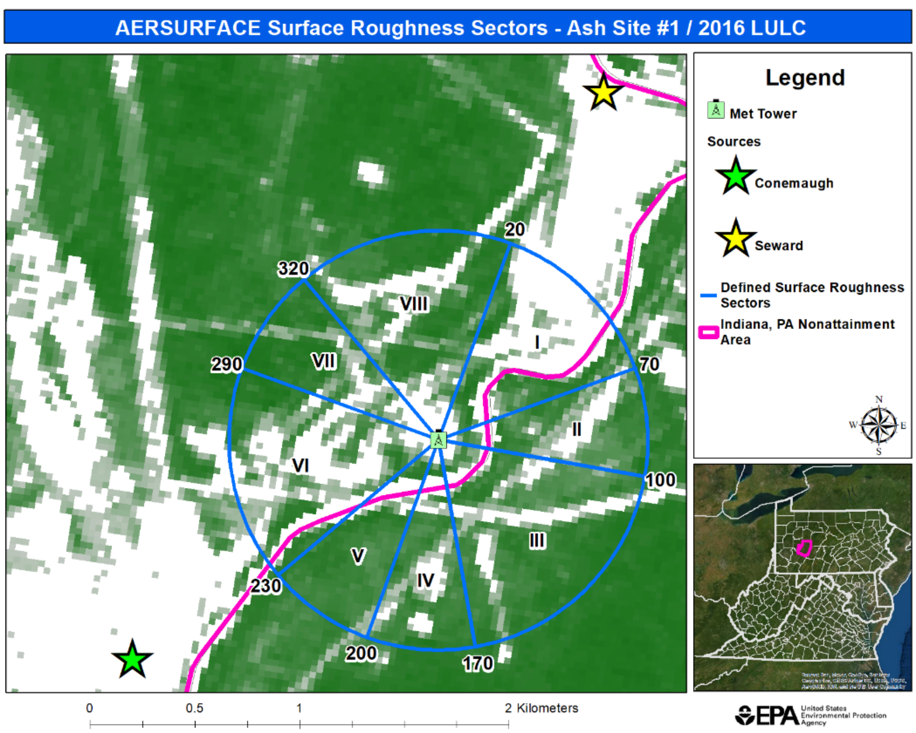


Figure 5.2-27. AERSURFACE Tree Canopy Input



AERMET Processing: Once the AERSURFACE files were generated using the 2016 LULC data, the Ash Site #1 met tower and SODAR collected data had to be run through EPA's AERMET preprocessor. EPA followed the same processing steps completed in Pennsylvania's SIP submission. This essentially updates the SIP modeling meteorological input files to use the most current versions and produced the final meteorological input files needed to run AERMOD.

Meteorological data from several sources were used in EPA's AERMET processor. Site-specific data was processed for the Ash Site #1 100-m tower and SODAR. Additional surface measurements from the nearby Johnstown-Cambria County airport were also included. Upper air data in the form of morning soundings came from a site near the Pittsburgh International Airport in western Pennsylvania.

The locations of these sites are shown on Figure 5.2-28. The Ash Site #1 is located between the Conemaugh and Seward power plants. This site is located within the Ligonier Valley at about the same elevation as Conemaugh and Seward and is within 2 km of either facility. The Johnstown-Cambria County airport is located approximately 20 km east of the Ash Site #1, Conemaugh and Seward. The airport's ASOS measurements are taken at nearly 700 m in elevation. This is nearly 360 m in elevation higher than the Ash Site #1. Upper air morning sounds taken near the Pittsburgh International Airport approximately 100 km west of Conemaugh and Seward (but at similar elevations to Conemaugh and Seward).

As described in Pennsylvania's supplemental modeling submittal, there were some problems with the SODAR capture[20]. Figure 5.2-29 shows the 150-m SODAR wind rose. There appears to be a "gap" in the southwest quadrant of the wind rose. The 100-m tower wind rose does not show the same feature (see Figure 5.2-30). The wind direction count suppression extended through all layers of the SODAR measurements. Figure 5.2-31 shows the 100-m met tower and 500-m SODAR wind roses.

After an analysis of the SODAR data and other research, this wind direction data gap in the southwest quadrant was attributed to moisture plumes from Conemaugh's 2 hyperbolic cooling towers. Moisture plumes interfered with the SODAR signals when winds were coming from this direction. As shown, this interference did not impact wind direction measurements taken on the 100-m met tower. To compensate for this wind direction interference, final processed wind directions were set to missing when SODAR level wind directions were between 235° and 290° as per AECOM's analysis. SODAR wind measurements outside of this range were retained so that wind information collected by the SODAR could still be utilized. Missing wind directions (in the SODAR measurements) would be filled by extending the 100-m tower wind direction data upwards for any given hour removed. SODAR wind speed and sigma w measurements taken during these hours were available for the final AERMET processed profile file.

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[20] See Appendix A of AECOM's *Supplemental SO_2 NAAQS Compliance Modeling Report for the Indiana, PA SO_2 Non-Attainment Area - Focus on Areas Near the Conemaugh and Seward Generating Stations (Revision No. 1)*, December 2019

As a check, EPA also created wind roses for each SODAR level using the 100-m tower wind direction substitution described previously. Figure 5.2-32 shows wind roses for the 150-m level with the 100-m tower wind direction substitution and wind roses showing all the actual 150-m SODAR collected data. Some "filling" is evident in the SODAR wind direction gap. Note that AERMET does not do this substitution explicitly within the AERMET profile file. Wind directions will be "extended" upwards from the next available level from the tower wind measurements.

Figure 5.2-28. Meteorological Collection Sites Used to Develop the AERMET Files

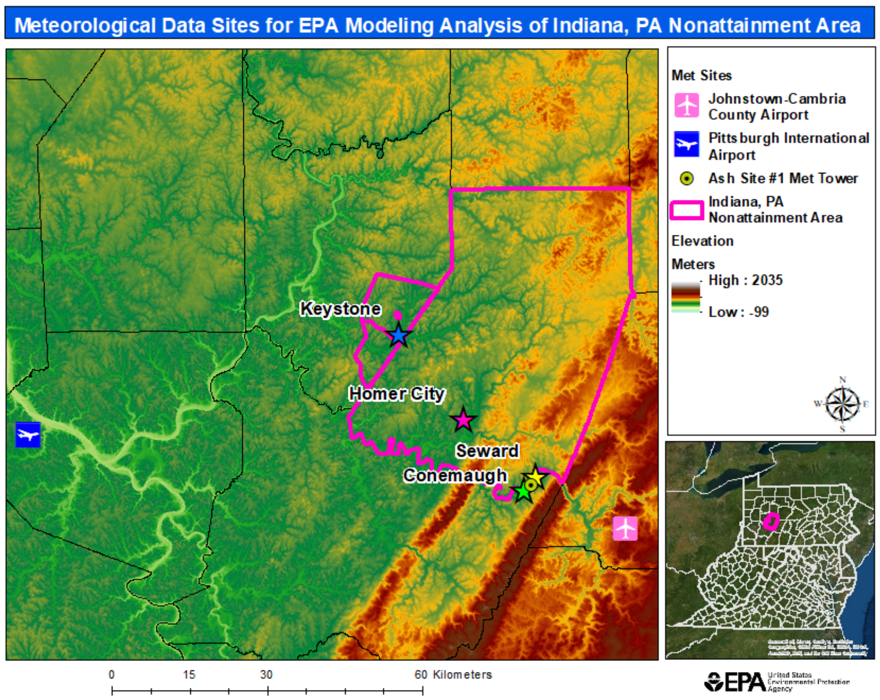


Figure 5.2-29. Ash Site #1 150-meter SODAR Wind Rose

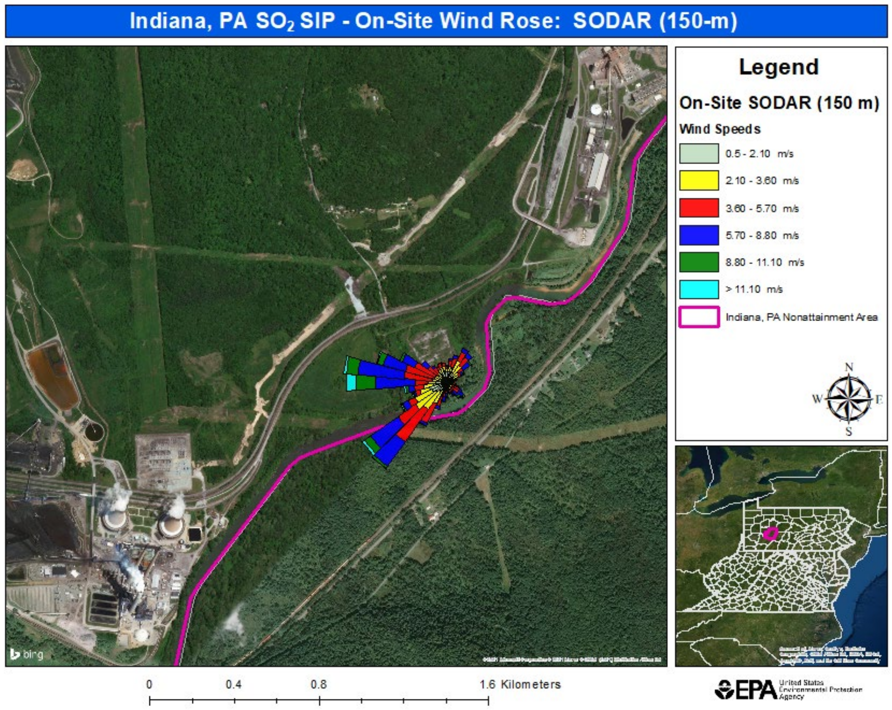


Figure 5.2-30. Ash Site #1 100-meter Tower Wind Rose

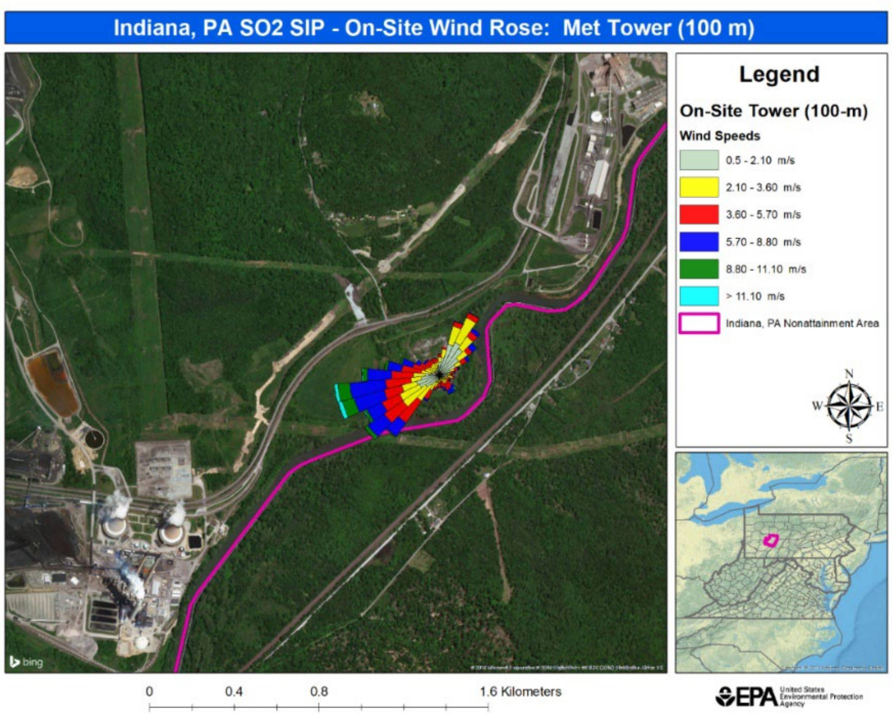


Figure 5.2-31. 100-meter Met Tower and 500-meter SODAR Wind Roses

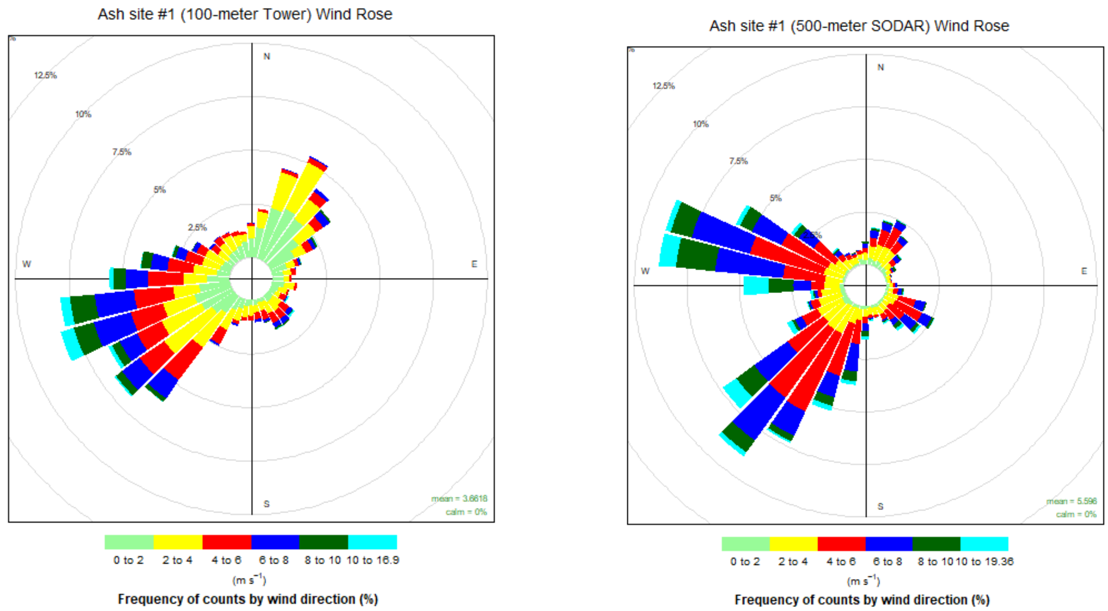
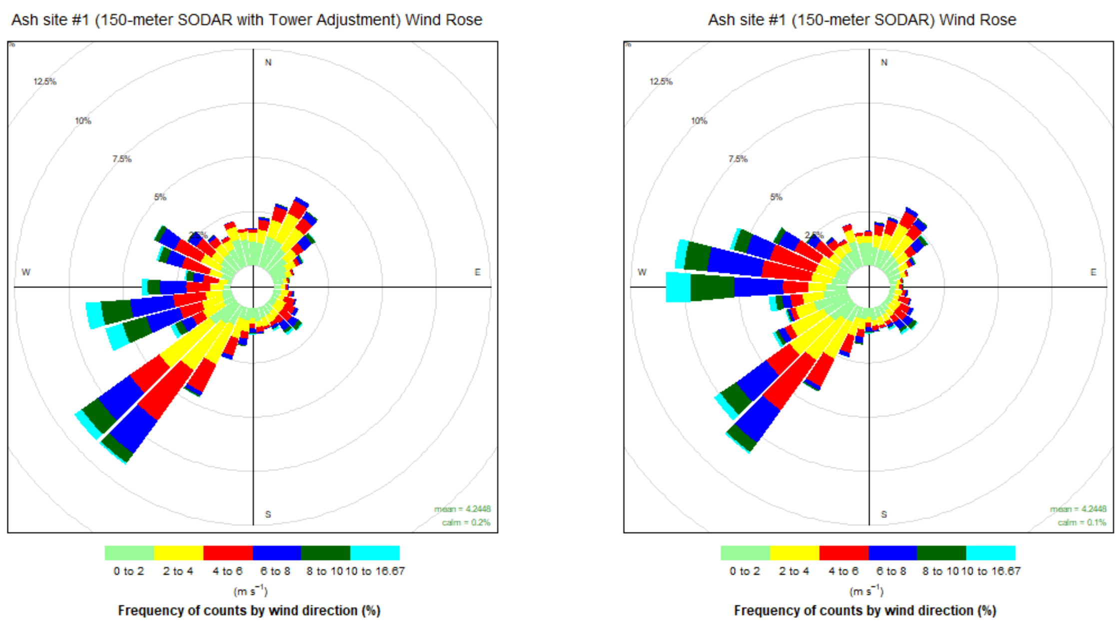


Figure 5.2-32. 150-meter SODAR Wind Roses With and Without 100-m Tower Substitution



EPA reprocessed the Ash Site #1 met tower and SODAR through AERMET using the previously described AERSURFACE settings. These impact the monthly surface roughness, albedo and Bowen ratio values (in the sfc output file). This was done within the AERMET stage 2 processing step. This generated multiple AERMET surface files for each of the AERSURFACE varying categories (as listed in Table 5.2-11). Files were generated for average-no snow, dry-no snow, dry-snow and wet-no snow settings within AERSURFACE. The final 1-year site specific surface met file had to be concatenated together based on each month's setting. This was done using R to produce the final surface file. The AERMET profile file did not need similar adjustments.

Tower and SODAR turbulence measurements were collected as part of the site-specific meteorological survey period. As noted in the AERMET users guide (section 4.7.6.5) and Appendix W, for site-specific data sets, such as the Ash Site #1 used in this modeling analysis, turbulence measurements should not be used in tandem with the adjusted u-star option. EPA's own analysis of its field study data (see FR 82, 5187, January 17, 2017; Appendix W) showed results with site-specific turbulence data did not show a bias toward underprediction without the adjusted u-star option (ADJ_U*) but did show a bias toward underprediction using turbulence data with the ADJ_U* option. Two sets of meteorological data were therefore available for final processing. One using the turbulence measurements and one excluding the turbulence measurements but utilizing the adjusted u-star (ADJ_U*) option in the final stage 2 AERMET processing step.

AERMET processing also included surface data from the National Weather Service (NWS) Johnstown-Cambria County airport ASOS site for the Ash Site #1 collection period. The stage 2 processing utilized AERMET's cloud cover and temperature substitutions. AERMET includes substitutions for missing cloud cover and temperature data based on linear interpolation across gaps of 1 or 2 hours. Linear interpolation across short gaps is a reasonable approach for these variables since ambient temperatures tend to follow a diurnal cycle and do not vary significantly from hour to hour. Additionally, AERMOD is relatively insensitive to hourly fluctuations in cloud cover, especially during convective hours since the heat flux is integrated across the day. Gaps of 1 or 2 hours for these parameters near the early morning transition to a convective boundary layer may result in all convective hours for that day being missing. A more complete description of cloud cover and temperature substitution procedures when using site-specific and NSW data in AERMET is available in section 4.7.6.6 of EPA's (2021) AERMET users guide.

AERMOD needs a morning temperature profile to characterize dispersion during the day. These can be provided from available NWS sites scattered across the United States. Upper air morning and evening (12 GMT and 24 or 0 GMT) soundings are scheduled to be taken on a daily basis near Pittsburgh, PA. These measurements are the closest site to the Conemaugh and Seward power plants and are representative of conditions near these facilities.

EPA reviewed the AERMET stage 1 reports after it processed the Ash Site #1 site-specific data and the corresponding upper air rawinsonde data from Pittsburgh. AERMET was run with the option to capture the morning sounding within ±3 hours of the normal 12 GMT sounding collection time. EPA noted that the AERMET stage 1 report contained several warning messages related to the Pittsburgh upper air measurement processed in AERMET. AERMET generated the following warning message:

UPPERAIR W31 READ_FSL SKIP SOUNDING; 1ST LEVEL TYPE 4 NOT TYPE 9, FOR SOUNDING # 1059 DATE: 20160606 HR 07

This warning message was attached to 3 dates across the 1-year Ash Site #1 collection period. They were 6 June 2016, 19 June 2016 and 26 August 2016. EPA reviewed the final concatenated AERMET surface file using R and determined that these 3 dates did not contain any convective mixing height calculations; all convective mixing heights in the sfc file were coded as missing. This was due to the morning soundings on these dates not being processed in AERMET. A review of the Pittsburgh, PA upper sounding file showed that vertical profile measurements existed on these 3 dates, but the surface code line (coded 9) was missing from these particular morning soundings.

To allow AERMET to process these 3 morning soundings, the upper-air input file was edited to include a line 9 code filled in with missing parameters to reflect the line of missing surface information[21]. This allowed the morning upper air soundings to be fully processed in AERMET to allow for AERMOD to generate model concentrations during the daytime hours for these 3 "missing" dates.

To the best of our ability, AERMET processing was conducted in accordance with current EPA guidance. AERMET produced the surface and profile files needed as input into AERMOD with some editing via R for the surface and upper air profile file described in this section.

Final Processing to Produce AERMOD-Ready Meteorological Data: EPA's Modeling TAD recommends modeling 3 years of emissions to assess source impacts. The most representative meteorological data available to assess the impacts of Conemaugh and Seward is the site-specific meteorological data collected at the Ash Site #1. This data set represents 1-year of data (1 Sep 2015 through 31 Aug 2016) whereas the emissions window is 3 years in length (1 Jul 2017 through 30 Jun 2020). The meteorological data, therefore, needed to be adjusted to match the dates of 3-year hourly emissions data.

EPA used R to change the years of the Ash Site #1 meteorological data to match the 3-year emission period. Following section 7.4 of EPA's Modeling TAD, months, days, and hours remain unchanged. Both the Ash Site #1 and emission period contained one leap year so the meteorological data for that date was only used once over the 3-year modeling interval. All other dates and hours were repeated 3 times over the simulation period, so the met data matched the

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[21] A more thorough explanation of the steps EPA took to ensure these missing line 9 codes were included for AERMET processing can be found in the Region 3 rundown presented during the 2022 Regional/State/Local Modelers workshop. See slides 5-7 available on EPA SCRAM website.

emissions.
As noted in EPA's Modeling TAD, the use of older site-specific data should be used with caution if source emissions are somewhat dependent on meteorological data. Electric Generating Units (EGUs) like Conemaugh, Seward and the Cambria County waste-coal sources are subject to load demands from the electric grid in which they are connected. Extremes in weather conditions, such as cold snaps or heat waves can increase electric demand and therefore influence emissions for sources providing power to the electric grid.

Conemaugh and Seward's maximum combined power generation is equal to approximately 2.4 gigawatts of electricity, enough power to supply approximately 1.5 million homes. These plants far surpass local power needs; the combined population of Indiana and Armstrong counties is less than 150,000 and both counties have experienced long-term population declines. The vast majority of the power generated by these plants is probably exported via the PJM electric grid. Based on this information, EPA feels it would be difficult to assess the impact of having older site-specific meteorological data matched with the more recent 3-year simulation period. We expect there to be some impact, but no analysis was undertaken to assess differences in grid demand and its impact on Conemaugh and Seward's SO_2 emissions between the 2 data sets.

5.2.7. Modeling Parameter: Background SO_2 Concentrations

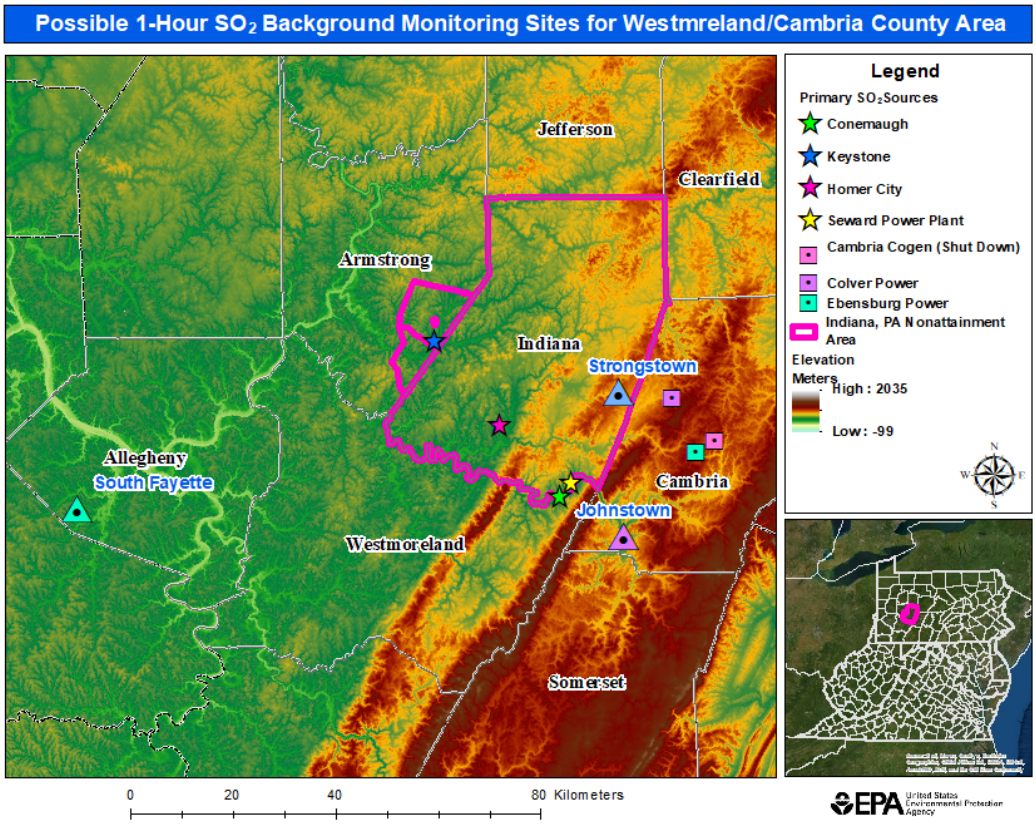
The Modeling TAD offers 2 mechanisms for characterizing background concentrations of SO_2 that are ultimately added to the modeled design values: 1) a "tier 1" approach, based on a monitored design value, or 2) a temporally varying "tier 2" approach, based on the 99th percentile monitored concentrations by hour of day and season or month. Section 8.3 of EPA's *Guideline on Air Quality Models* provides additional discussion on background monitoring concentrations for air quality analyses. Additional guidance points regarding the determination of background concentrations for the 1-hr SO_2 NAAQS are also outlined in EPA's March 1, 2011 1-hour NO_2 clarification memo including using temporally varying background concentrations.

Background concentrations are essential in constructing the design concentration, or total air quality concentration, as part of any NAAQS analysis. In selecting an appropriate background concentration, it is important to not include the ambient impacts of the project source under consideration. Typically, state or local air monitoring stations (SLAMS) provide background concentrations for air quality analyses.

To avoid source influence on background monitor concentrations from the primary Indiana, PA nonattainment sources, Pennsylvania constructed background concentrations from the South Fayette monitor in western Allegheny County in its original SIP and Supplementary Analysis. The South Fayette monitor is roughly 77 km southwest of Keystone, 85 km south-southwest from Homer City and 95 km west of Conemaugh and Seward.

Two other possible background monitors in the area include the Strongstown monitor in Indiana County and the Johnstown monitor located in neighboring Cambria County. Figure 5.2-33 shows the location of the Indiana, PA SIP sources, the 3 Cambria County waste-coal sources and the 3 SO_2 monitoring sites considered as possible background monitoring sites.

Figure 5.2-33. Background SO_2 Monitoring Sites



From a geographical perspective, the South Fayette monitor is the most distant monitor of the 3 considered. This monitor was used in the previous modeling analyses that supported Pennsylvania's original and Supplemental Analysis SIP submittals. It was chosen to represent a true background for the nonattainment area. South Fayette was considered far enough upwind of the nonattainment area to not be impacted by the 4 primary SIP sources in the Indiana County, PA nonattainment area. There are other SO_2 monitors that are closer to the Indiana, PA nonattainment area but they were found to be impacted by other nearby sources and therefore not representative of true background.

The next 2 background sites are the Johnstown and Strongstown sites. Of the 2, the Johnstown monitor is closest to the sources of interest (Conemaugh and Seward). The Johnstown monitor is located in the City of Johnstown roughly 15 km southeast of the Conemaugh and Seward power plants included in EPA's modeling analysis. Located along Stonycreek River, the Johnstown monitor sits at a significantly lower elevation, around 435 meters, than the surrounding terrain, which rises to over 800 meters in places.

The Strongstown monitor is located in elevated terrain in eastern Indiana County near its boundary with Cambria County. Base elevation at this monitor is approximately 580 meters. Unlike the Johnstown monitor, there are no real imposing terrain features between it and any of the 4 primary SIP sources in the Indiana, PA nonattainment area. The Chestnut and Laurel ridges, by contrast, present several physical impediments to plumes originating from the Indiana, PA SIP sources.

Historical Concentrations

EPA downloaded hourly SO_2 concentrations for the South Fayette, Johnstown and Strongstown monitors using R's RAQSAPI's library. This information was used to graphically display monitor hourly concentrations along with yearly exceedances (hours above the 1-hour SO_2 NAAQS of 75 ppb), yearly high 4^{th}-high concentrations (or 99^{th}% values) and design value concentration between 2009 and 2021. EPA's original Round 1 SO_2 designations were based on 2009-11 monitor design values though 2010-12 were also considered since designation were not completed until October of 2013. This was done to examine any trends at the individual monitors and determine and overall trends with the 3 monitoring sites to support the selection of the background monitoring site.

Hourly SO_2 Concentrations: South Fayette, Johnstown and Strongstowns' hourly SO_2 concentrations were downloaded using R. Hourly values from 2009 through 2021 were examined for each monitor. Plots showing hourly SO_2 concentrations, Figure 5.2-24a-c, along with the 1-hr SO_2 NAAQS (75 ppb) were developed from each monitor and show general trends over time.

Strongstown's hourly SO_2 concentrations appear to have more spikes than the other 2 monitors. South Fayette's hourly SO_2 concentrations appear to be the lowest of the 3 monitors. Spikes in monitor SO_2 concentrations have generally decreased over time at all 3 sites. Exceedances at Strongstown were much more common than the other 2 monitors. These instances also appear to have declined in recent years. The last exceedance at Strongstown appears to have occurred in early 2017.

Figure 5.2-24a. 2009 through 2021 Hourly SO_2 Concentrations South Fayette

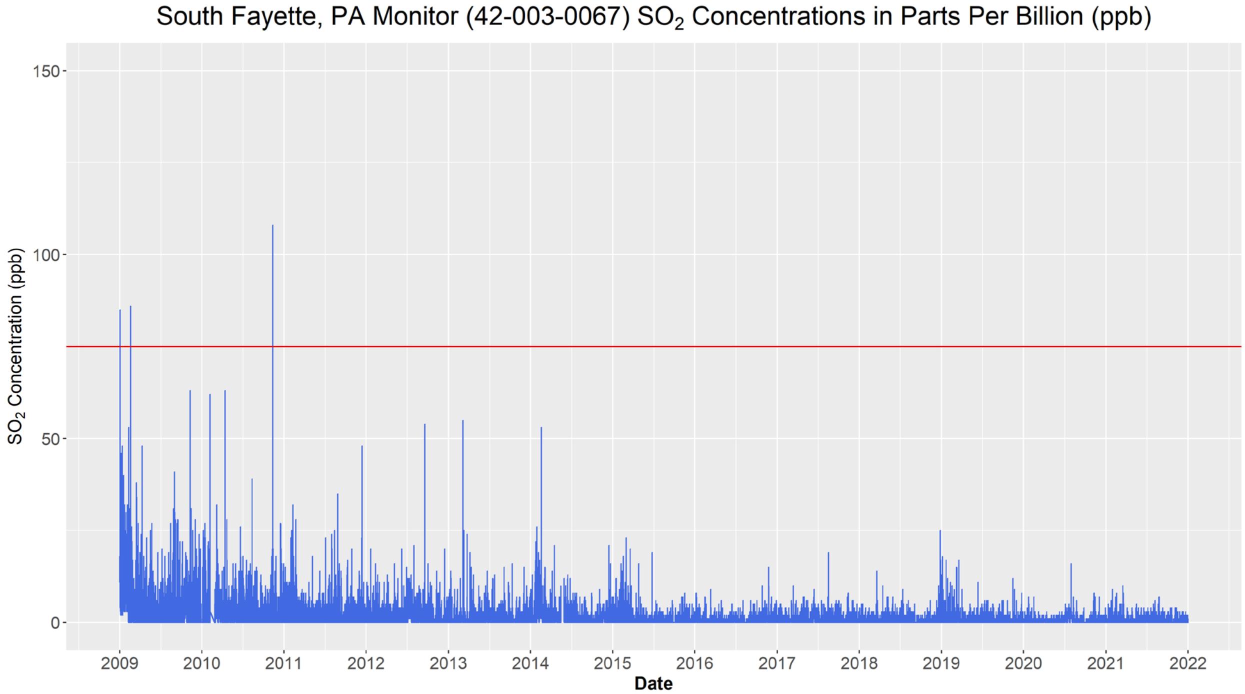


Figure 5.2-34b (Continued). 2009 through 2021 Hourly SO2 Concentrations Johnstown

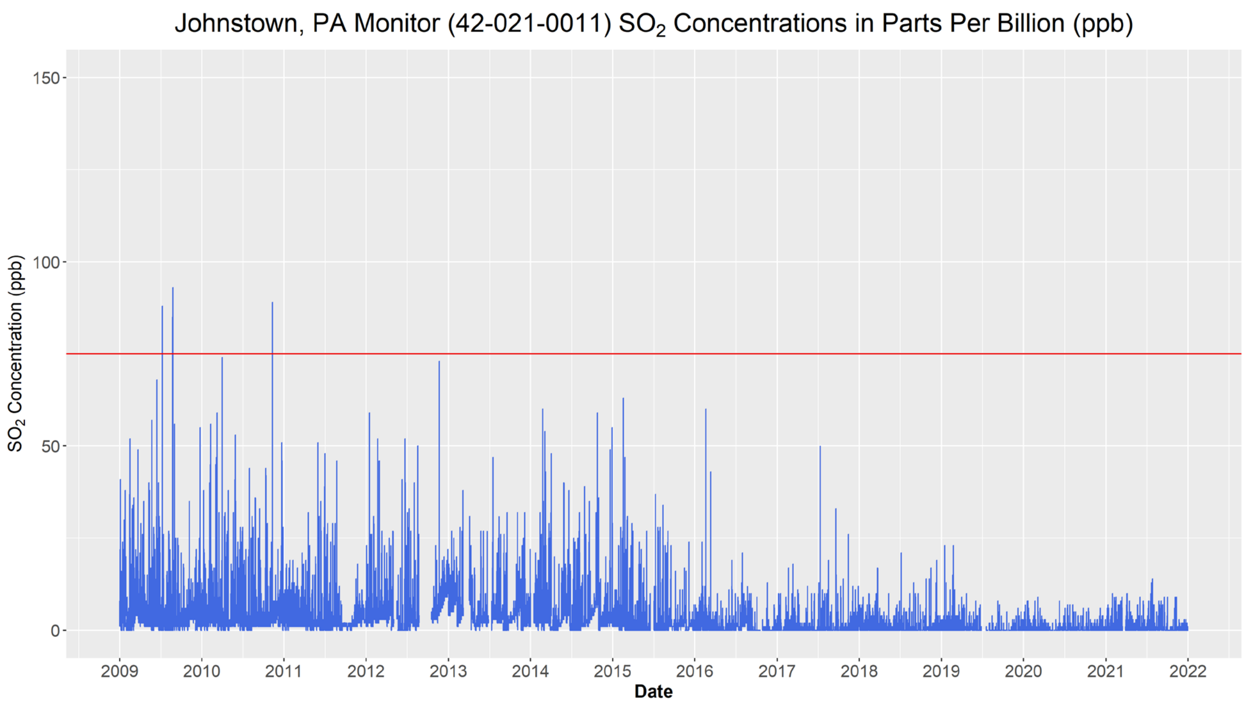


Figure 5.2-34c (Continued). 2009 through 2021 Hourly SO2 Concentrations Strongstown

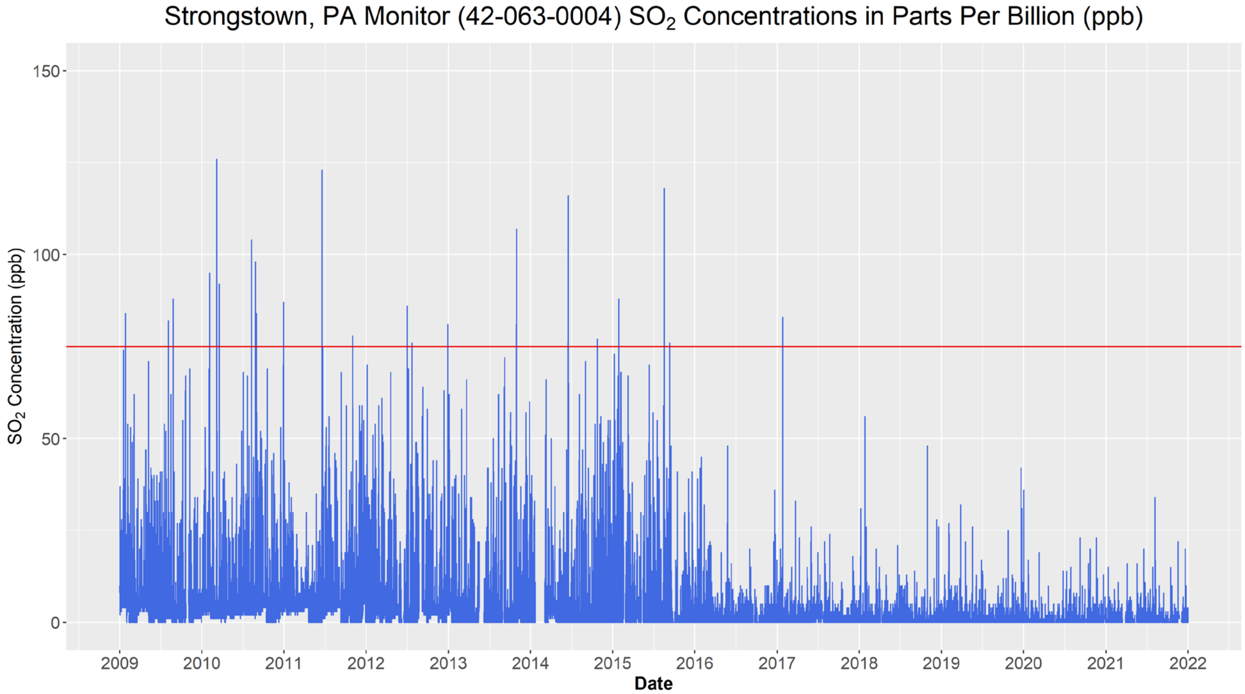


Table 5.2-12 summarizes the 3 monitors' 99th Percentile (%) (high 4th high), design value and days with 1 hr SO_2 concentrations above 75 ppb (exceedance) from 2009 through 2021.

As previously shown in the hourly monitor plots, Strongstown has the highest SO_2 concentrations of the 3 monitors considered for developing the background monitor concentrations. Strongstown' s design values and 99th% 1-hr SO_2 concentrations are about 2 times higher than either South Fayette or Johnstown. Recent values at Strongstown are about 5 times lower than they were a decade ago. There is also a marked decline at Strongstown beginning in 2016. Prior to 2016, Strongstown's 99th% values were in the mid-60 to mid-70 ppb range. Afterwards, they fell into the mid-20 ppb range.

EPA believes changes in SO_2 emissions at the Keystone and Homer City power plants account for the decline in Strongstown's measured 1-hr SO_2 concentrations. Homer City installed Novel Integrated Desulfurization or NIDs on units 1 and 2 in 2016. These units are sometimes called dry scrubbers since they use significantly less water than flue gas desulfurization or FGD units, such as the ones operating on Homer City unit 3 and at the Conemaugh and Keystone power plants.

Table 5.2-12. Summary of 99th%, Design Values and Exceedances: SO_2 in parts per billion

	South Fayette				Johnstown				Strongstown			
Year	H4H	Design	Exceedances	Valid	H4H	Design	Exceedances	Valid	H4H	Design	Exceedances	Valid
2009	63		2	Y	68		3	Y	82		4	Y
2010	39		1	Y	56		1	Y	95		7	Y
2011	28	43	0	Y	39	54	0	Y	68	82	2	Y
2012	20	29	0	Y	52	49 ***	0	N	69	77	3	Y
2013	19	22	0	Y	32	41 ***	0	N	66	68	2	Y
2014	21	20	0	Y	54	46 ***	0	Y	66	67 ***	3	N
2015	18	19	0	Y	34	40 ***	0	Y	73	68 ***	3	Y
2016	9	16	0	Y	24	37	0	Y	39	59 ***	0	Y
2017	8	12	0	Y	19	26	0	Y	24	45	1	Y
2018	10	9	0	Y	17	20	0	Y	26	30	0	Y
2019	15	11	0	Y	13	16	0	Y	27	26	0	Y
2020	7	11	0	Y	8	13	0	Y	20	24	0	Y
2021	8	10	0	Y	10	10	0	Y	20	22	0	Y

*** Data is Incomplete; Quarter(s) with < 75% Valid Days

EPA pulled SO_2 emissions for both Keystone and Homer City that are reported to EPA's Clean Air Markets Division (CAMD) as part of the Part 75 emissions reporting program. Each facility's hourly SO_2 emissions from 2009 through 2021 are depicted in Figure 5.2-35 and 5.2-36. Hourly emissions are either measured or calculated based on method of determination codes (MODC) for the flow and SO_2 concentration instruments. This distinction, however, isn't important for this analysis.

Keystone's CAMD SO_2 emissions in 2009 are much higher because this period preceded the installation of the facility's wet Flue-Gas Desulfurization (FGD) units. Additionally, the facility's SO_2 emissions show much less spiking after 2016. The red line on the figure represents Keystone's modeled critical emission value or CEV, which is 9,711.1 lbs/hr. The impacts of the installation of the NIDs controls on Homer City units 1 and 2 has a more dramatic impact on total hourly SO_2 emissions. Prior to 2016, Homer City's total SO_2 emissions ranged from 10,000 to 50,000 lbs/hr. After the NIDs were installed, Homer City's hourly emissions fell to under 5,000 lbs/hr. Homer City's combined unit CEV is 6,360 lbs/hr. Anecdotally, it appears that emission reductions at Homer City and possibly Keystone coincide with the dramatic drop in Strongstown' s monitored SO_2 values.

Figure 5.2-35. Keystone 2010-2020 Hourly SO_2 Emissions

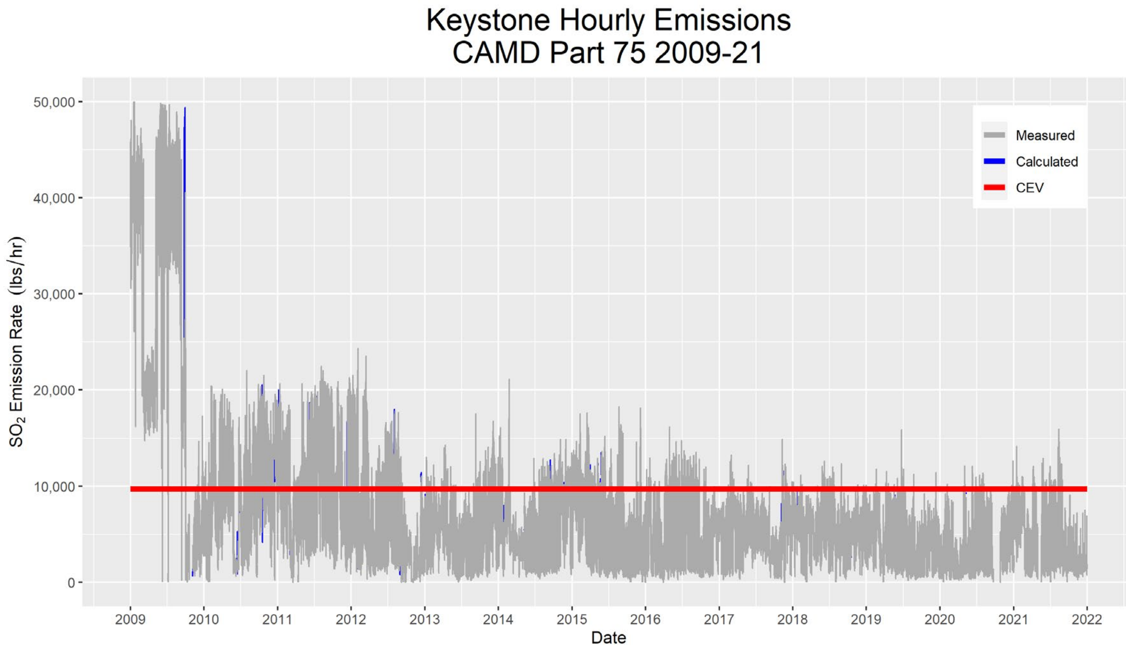
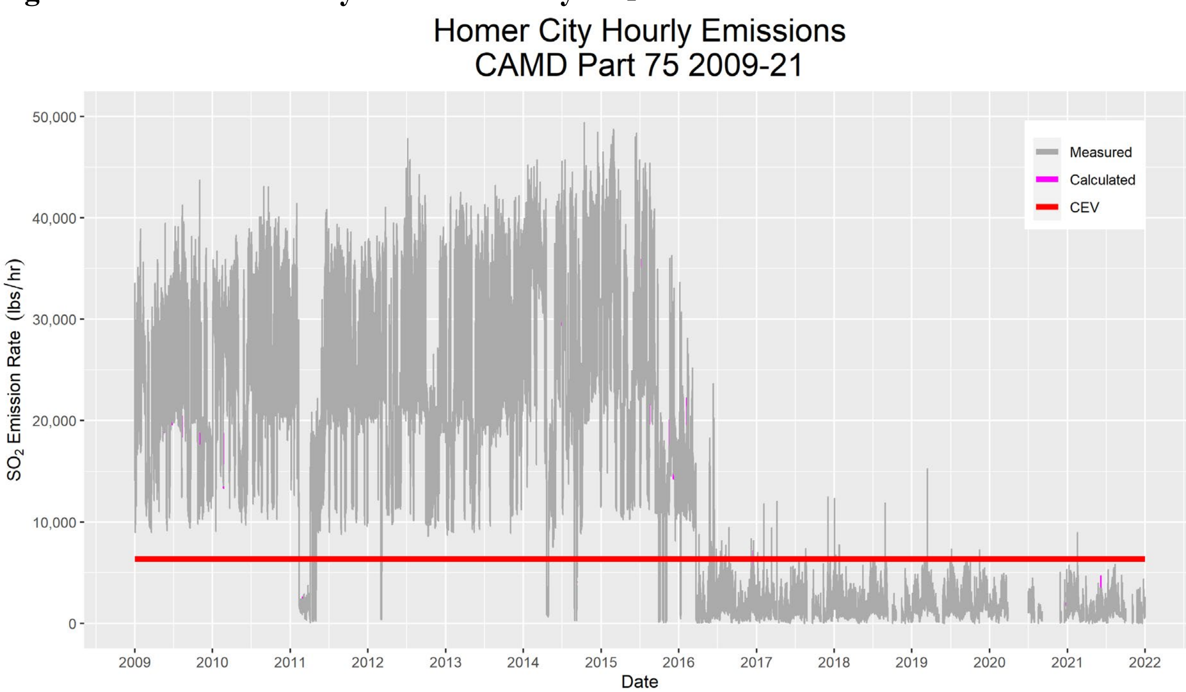


Figure 5.2-36. Homer City 2010-20 Hourly SO_2 Emissions



Model Background Values

Model background values can be determined using monitor concentrations. EPA's modeling analysis used a background concentration formulated following its March 1, 2011 1-hr NO_2 clarification memo.[22] Background concentrations were formulated using a season by hour of day method described in pages 18-20 of the previously referenced clarification memo. Model background values were constructed using R from 2019-21hourly monitoring data for the South Fayette, Johnstown and Strongstown monitors.

Each monitor's calculated season by hour of day background is shown in Tables 5.2-13a-c. The seasonal breakdown is as follows; winter includes the months of December, January and February, spring includes the months of March, April and May, summer includes the months of June, July and August and fall includes the months of September, October and November. Hour of day values represent the (seasonal) average of the 3-year sample period (2019-21). The table also includes the number of mission hours over the 3-year period and the total number of available hours for each hour of day.

Note that the Johnstown and Strongstown monitors have no valid measurements for hour 2. This is because the Commonwealth of Pennsylvania, who maintains these monitors, consistently performs maintenance checks (span checks for example) at this time preventing any sampling during these hours.
All 3 monitors tend to have higher overall concentrations during the Winter and Fall seasons. There is also a tendency for daytime (background) concentrations to be slightly higher than overnight concentrations. Background peaks also tend to occur between the late morning and early afternoon hours. This may be the result of downward mixing of overnight plumes as the boundary layer expands due to daytime surface heating.

[22] https://www.epa.gov/sites/default/files/2020-10/documents/additional_clarifications_appendixw_hourly-no2-naaqs_final_03-01-2011.pdf

Table 5.2-13a. South Fayette Monitor Season by Hour of Day Background Concentrations

South Fayette, PA (42-003-0067): 2019-21 Background SO2 Concentrations (ppb) by Season/Hour of Day												
	Winter			Spring			Summer			Fall		
Hour	Average	Missing	Total Hours	Average	Missing	Total Hours	Average	Missing	Total Hours	Average	Missing	Total Hours
1	2.3	0	271	2.3	0	276	2.0	0	276	2.7	0	273
2	3.3	0	271	2.3	0	276	2.0	0	276	2.7	0	273
3	3.0	0	271	2.7	0	276	1.7	0	276	2.0	0	273
4	3.7	0	271	3.7	0	276	2.0	0	276	2.0	0	273
5	3.0	0	271	2.0	0	276	1.7	0	276	2.3	0	273
6	3.7	0	271	2.7	0	276	2.0	0	276	2.0	0	273
7	2.7	0	271	3.0	0	276	2.3	0	276	2.0	0	273
8	3.0	0	271	3.3	6	276	3.3	8	276	2.7	6	273
9	3.7	2	271	3.3	3	276	3.3	1	276	2.3	0	273
10	4.0	1	271	3.0	12	276	3.0	23	276	3.0	10	273
11	5.7	9	271	3.0	25	276	3.0	21	276	3.0	24	273
12	4.7	27	271	3.0	14	276	3.0	6	276	3.0	14	273
13	4.7	13	271	2.3	7	276	3.0	5	276	4.3	8	273
14	4.7	6	271	2.0	1	276	3.3	4	276	4.0	2	273
15	4.0	1	271	2.3	1	276	3.3	4	276	2.7	0	273
16	4.7	0	271	2.0	0	276	4.0	2	276	2.7	0	273
17	3.3	1	271	2.3	0	276	5.0	1	276	3.7	0	273
18	3.7	0	271	2.3	0	276	5.0	0	276	4.0	0	273
19	3.7	0	271	3.3	0	276	4.3	0	276	2.7	0	273
20	4.0	0	271	3.3	0	276	4.0	0	276	2.3	0	273
21	2.7	0	271	3.0	0	276	3.7	0	276	2.0	0	273
22	4.3	0	271	2.0	0	276	2.7	0	276	2.7	0	273
23	3.3	0	271	2.7	0	276	3.0	0	276	2.7	0	273
24	3.3	0	271	2.3	0	276	2.0	0	276	2.7	0	273

Table 5.2-13b. Johnstown Monitor Season by Hour of Day Background Concentrations

Johnstown, PA (42-021-0004): 2019-21 Background SO2 Concentrations (ppb) by Season/Hour of Day												
	Winter			Spring			Summer			Fall		
Hour	Average	Missing	Total Hours	Average	Missing	Total Hours	Average	Missing	Total Hours	Average	Missing	Total Hours
1	3.3	3	271	3.3	13	276	0.7	21	276	1.0	6	273
2		271	271		276	276		276	276		273	273
3	3.3	2	271	2.3	15	276	0.3	21	276	1.0	4	273
4	3.7	2	271	2.3	14	276	0.3	21	276	0.7	3	273
5	3.0	3	271	1.7	13	276	0.3	21	276	0.3	3	273
6	3.7	3	271	3.3	13	276	0.7	21	276	0.0	3	273
7	3.0	3	271	3.3	14	276	0.7	21	276	0.7	3	273
8	3.0	3	271	3.3	14	276	1.7	21	276	1.3	2	273
9	3.7	2	271	3.7	15	276	2.3	21	276	1.7	4	273
10	4.0	2	271	4.7	15	276	4.0	24	276	2.7	3	273
11	6.0	2	271	6.3	14	276	5.7	26	276	3.0	5	273
12	6.0	5	271	5.3	15	276	6.3	23	276	3.3	4	273
13	7.0	4	271	3.7	14	276	4.3	26	276	4.0	2	273
14	10.0	7	271	3.7	16	276	4.0	23	276	5.0	5	273
15	9.0	6	271	3.0	17	276	4.7	22	276	3.3	4	273
16	8.0	4	271	3.3	14	276	4.7	22	276	4.7	3	273
17	8.0	1	271	3.3	13	276	5.3	21	276	4.0	2	273
18	4.3	2	271	4.0	13	276	5.3	21	276	3.0	3	273
19	4.3	2	271	3.3	13	276	3.7	21	276	2.0	4	273
20	4.0	2	271	3.0	13	276	2.7	21	276	2.0	4	273
21	3.0	3	271	3.7	13	276	2.7	21	276	1.3	5	273
22	4.7	3	271	3.7	13	276	1.3	21	276	1.3	4	273
23	4.7	3	271	3.0	13	276	1.3	21	276	1.3	4	273
24	3.7	3	271	2.7	13	276	0.7	21	276	1.0	4	273

Table 5.2-13c. Strongstown Monitor Season by Hour of Day Background Concentrations

Strongstown, PA (42-063-0004): 2019-21 Background SO2 Concentrations (ppb) by Season/Hour of Day												
	Winter			Spring			Summer			Fall		
Hour	Average	Missing	Total Hours	Average	Missing	Total Hours	Average	Missing	Total Hours	Average	Missing	Total Hours
1	3.3	6	271	2.0	19	276	1.3	4	276	3.0	7	273
2		271	271		276	276		276	276		273	273
3	3.0	6	271	3.3	18	276	2.7	6	276	2.3	7	273
4	3.3	6	271	2.7	19	276	2.0	5	276	2.0	8	273
5	2.7	6	271	1.7	18	276	1.0	5	276	2.3	8	273
6	3.0	7	271	2.3	18	276	1.3	5	276	2.7	8	273
7	4.3	6	271	2.7	19	276	3.7	5	276	1.7	7	273
8	3.3	5	271	3.3	18	276	8.3	6	276	3.0	8	273
9	3.7	5	271	5.7	20	276	6.7	7	276	5.3	8	273
10	5.0	9	271	7.0	24	276	7.0	9	276	9.0	12	273
11	9.0	9	271	5.0	23	276	8.7	9	276	9.7	10	273
12	8.3	9	271	4.7	20	276	5.0	5	276	5.3	12	273
13	9.3	7	271	4.3	19	276	4.7	5	276	6.0	12	273
14	11.7	5	271	3.3	17	276	4.3	3	276	5.7	13	273
15	7.7	7	271	4.0	17	276	5.3	4	276	4.0	11	273
16	6.0	6	271	3.3	17	276	5.3	4	276	4.3	9	273
17	6.3	6	271	4.3	18	276	4.3	3	276	2.7	8	273
18	7.7	6	271	2.0	17	276	5.7	3	276	2.0	8	273
19	6.7	6	271	2.3	17	276	4.7	4	276	2.0	8	273
20	4.0	6	271	2.3	17	276	4.7	4	276	3.3	8	273
21	3.7	5	271	3.3	17	276	3.3	4	276	5.3	8	273
22	3.0	6	271	2.7	17	276	4.0	4	276	3.0	8	273
23	3.3	5	271	2.3	17	276	4.3	4	276	2.0	8	273
24	4.0	5	271	3.7	18	276	2.3	4	276	2.0	8	273

Background Monitor Selection

The Strongstown monitoring site was selected over the Johnstown and South Fayette sites because it probably captures a reasonable background concentration from the Keystone and Homer City sources that are not explicitly modelled. Distance wise, Strongstown is nearly as distant from Keystone and Homer City as these sources are from the Laurel Ridge in Westmoreland County. Strongstown's elevation also would allow it to be exposed to tall-stack emissions from both plants. The Johnstown monitor is located along Stoneycreek in the Sandyvale Memorial Gardens and Conservancy just south of the Cambria War Memorial arena. Johnstown sits at a much lower elevation and is probably relatively unaffected by the tall stack emissions from the Indiana, PA SIP sources except during the day when there is good vertical mixing. Vertical mixing in the (Johnstown) valley may be impeded by local inversions given the terrain.

Once the background site (Strongstown) was selected, monitoring data was processed to determine the model background concentration for the analysis. EPA followed a method described in its March 1, 2011 1-hr NO_2 clarification memo to generate seasonal by hour of day background concentration that will be added to hourly generated AERMOD concentrations. These values were entered into AERMOD using the BACKGRND keyword. Strongstown's SO_2 concentrations for hour 2 were consistently missing due to this hour being used for monitor span checks and other maintenance activities. An interpolated value using the hour 1 and 3 values was used as a background concentration for the AERMOD simulation.

5.2.8. EPA Site-Specific Adjusted U-star Modeling Summary and Results

EPA ran AERMOD using actual hourly SO_2 emissions for the Conemaugh and Seward power plants in Indiana County and the Cambria County waste coal sources over a 3-year period as described previously. Hourly emissions for Conemaugh and Seward were provided as part of the September 2020 materials supplied by AECOM and shared with EPA and Pennsylvania. EPA developed hourly emissions for the Cambria County sources using CAMD emissions and unit heat input information to generate hourly varying stack parameters based on Round 3 DRR modeling done previously by Pennsylvania.

As previously described, AERMOD (version 22112) was used with adjustments made in BPIP to correct Seward's stack height and building layouts, seasonal by hour of day background concentrations from Strongstown, and reprocessed meteorological data utilizing AERSURFACE output and adjusted SODAR data from the Ash Site #1. Final processed meteorological data from the Ash Site #1 was reformatted to match the hourly emissions files for Conemaugh and Seward along with the Cambria County sources in accordance with EPA's Modeling TAD. We note that EPA utilized the VECTORWS option within AERMOD to account for vector (not scalar) measurements via the SODAR inputs in the AERMET preprocessor stage. Pennsylvania's Supplemental Analysis used both vector and scalar processing with AERMOD and determined the scalar version produced slightly higher model results. EPA did not make this comparison but chose to use the VECTORWS as the more appropriate option within AERMOD for its analysis based on the rationale provided above.

EPA produced 2 sets of final AERMOD-ready meteorological files. One set using the adjusted u-star option in AERMET (stage 2) without the Ash Site #1 tower and SODAR turbulence measurements (both horizontal and vertical, SA and SW) and another set using the Ash Site #1 tower and SODAR turbulence measurements (but not the adjusted u-star processing option). Results for the EPA Site-Specific Adjusted U-Star modeling are provided in this section, and the following section provides the EPA Site-Specific Turbulence results. Both modeling analyses conducted by EPA produced design values over the NAAQS. An analysis to determine if either meteorological data set is more appropriate was not conducted as part of EPA's modeling analyses.

Pennsylvania's Attainment Plan for the Indiana, PA SO_2 NAA utilized the adjusted u-star meteorological data set for areas near the Conemaugh and Seward power plants in the extreme southeast portions of the Indiana, PA 1-hr SO_2 nonattainment area.

Final design value concentrations for the EPA Site-Specific Adjusted U-star modeling are shown in Figure 5.2-37. The model peak concentration (117.9 ppb) occurred along the Laurel Ridge east of the Conemaugh and Seward power plants. Model concentrations exceeded the 1-hr SO_2 NAAQS along portions of the ridge. Figure 5.2-38 shows a close up focused on the areas where AERMOD shows receptors with modeled design values that exceed 75 ppb. Model violations of the 1-hr SO_2 NAAQS occur along the Laurel Ridge south of the Conemaugh River Gorge. Modeled violations occur in Westmoreland along the portion of the Laurel Ridge facing Conemaugh and Seward and also on the backside of the ridge in Cambria County. Violations extend about 7 km southwest along the ridgeline. The demarcation line dividing Cambria and Westmoreland counties roughly follows the top of the Laurel Ridge.

Figure 5.2-37. AERMOD Adjusted U-Star Results for All Sources Plus Background

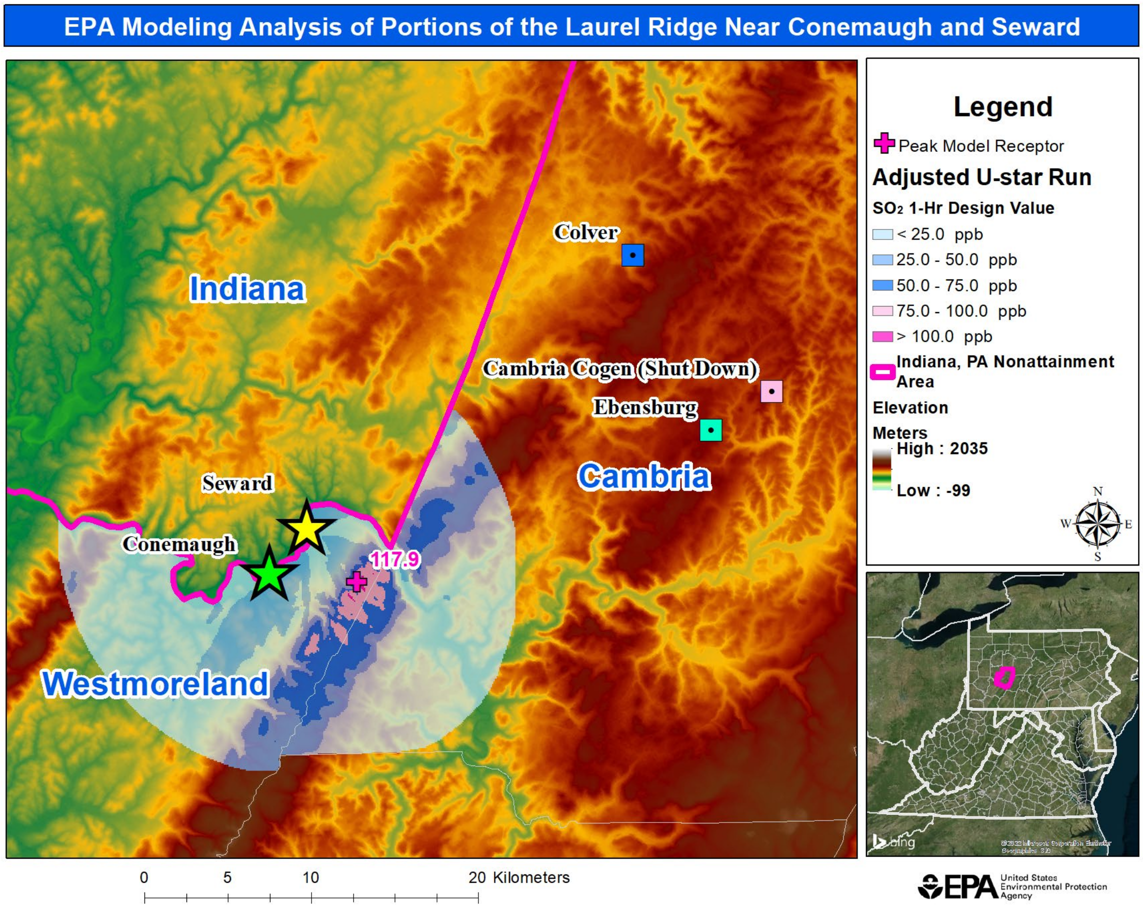


Figure 5.2-38. Close-up of Violating Receptors Along the Laurel Ridge

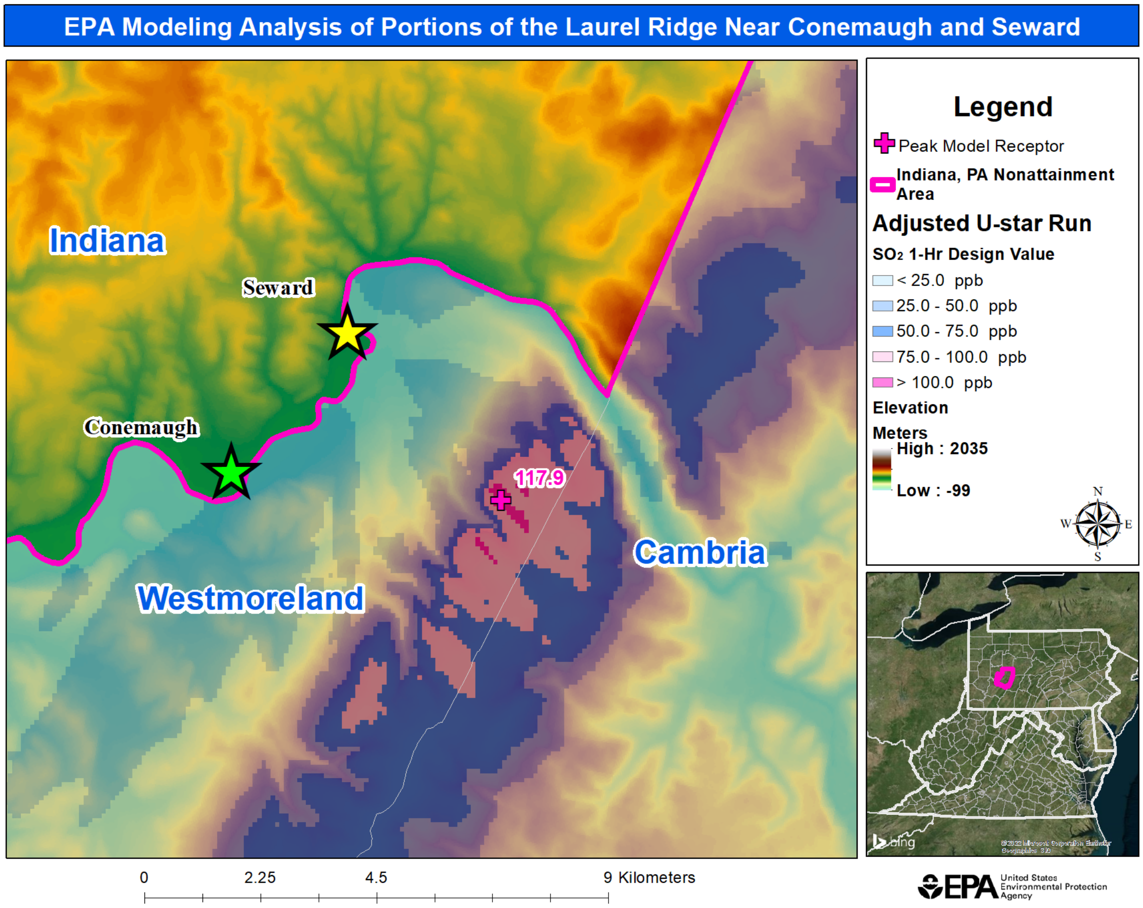


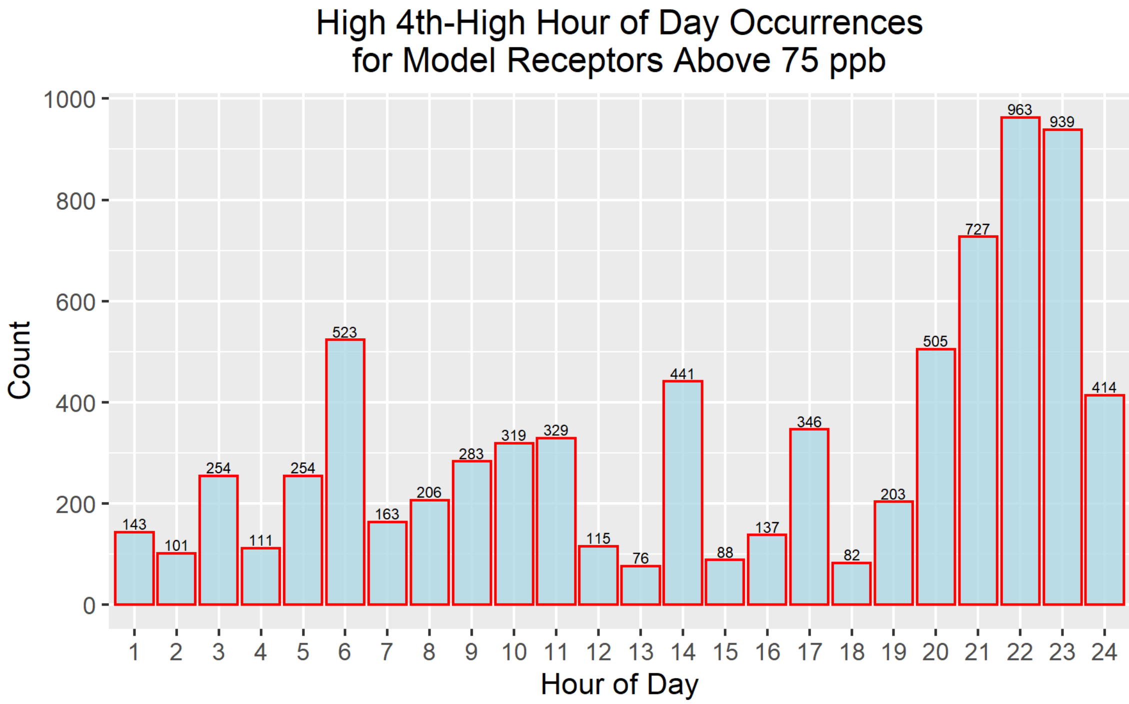
Table 5.2-14 summarizes results for the peak model receptor, which had a simulated design value of 117.9 ppb. EPA converted the AERMOD concentration from µg/m^3 to parts per billion or ppb by using a value of 196.4 µg/m^3 as representing the 1-hr SO_2 NAAQS value (75 ppb). Universal Transverse Mercator or UTM (zone 17) location, elevation and AERMOD hill-height scales are also included along with each year's 99th% value. Each 99th% value's corresponding date and hour of day during the 3-yr model simulation period are also included in the table. The simulated peak model receptor's design value is the average of each year's high 4th high (or 99th %) daily 1-hr maximums over the 3-year simulation period. Note there is some year-to-year variability in the 99th% values that contribute to the 3-year modeled design value. Model output indicates values exceed the 1-hr SO_2 NAAQS through the 12th rank.

Table 5.2-14. Final EPA Site-Specific Adjusted U-star Model Peak Receptor Summary

EPA AERMOD 22112 Adjusted U-star Run Summary for Peak Model Receptor	
Item	**EPA DRR Simulation Value**
UTM Easting (m)	669816
UTM Northing (m)	4471618
Elevation (m)	743.69
Hill Height Scale (m)	762.01
SO2 Design Value (ppb)	**117.87**
SO2 Design Value (ug/m3)	**308.67**
Year 1 SO2 High 4th High (ppb)	143.2
Year 1 Date	06-28-2018
Year 1 Hour	23
Year 2 SO2 High 4th High (ppb)	122.59
Year 2 Date	01-05-2019
Year 2 Hour	17
Year 3 SO2 High 4th High (ppb)	87.83
Year 3 Date	07-01-2019
Year 3 Hour	22

The peak model receptor's 99th% values generally occurred late in the day during the evening and overnight hours. To examine this possible trend, EPA pulled all 2,580 model receptors (including the peak model receptor) that violated the 1-hr SO_2 NAAQS and examined the hour of day for each of the 99th% values that made up the receptor's design value (3 hour of day values for each violating receptor). Figure 5.2-39 shows the hour of day occurances for the violating model receptors. The 99th% values for the violating model receptors appear to occur more frequently in the early overnight hours (hours 20 through 23) and hour 6. This suggest model concentrations, to some extent, tend to be higher under more stable atmospheric settings. There may also be an emission/operating trend that accounts for this observation since actual hourly varying emission rates were modeled.

Figure 5.2-39. Hour Of Day for 99th% Values for Violating Model Receptors



Beginning with version 11059, AERMOD has incorporated 3 output options to support the 1-hour NO_2 and SO_2 standards, especially the analyses that may be required to determine a source's (or group of sources) contributions to modeled violations of the NAAQS and for comparison to the Significant Impact Level (SIL). The form of these standards, based on averages of ranked values across multiple years, complicates this analysis, especially for the 1-hour NO_2 and SO_2 standards, which are based on ranked values from the distribution of daily maximum 1-hour averages. The MAXDCONT option within AEMOD, applicable to 1-hour SO_2 standards, can be used to determine the contribution of each user-defined source group to the high ranked values for a target source group, paired in time and space. This is accomplished as an internal post-processing routine after the main model run is completed. Section 3.7.2.8 of EPA's AERMOD user guide (2022) has a more detailed description of this processing option.

EPA utilized the MAXDCONT options within AERMOD to ascertain the contributions of emissions from Conemaugh, Seward and the Cambria County sources along with the background concentration to the final modeled design values. These are shown in Table **5.2-15** for the adjusted u-star run's peak model receptor. Seward is the largest contributor to the peak model receptor's AERMOD concentration, contributing to almost 96% of the peak receptor's modeled design value. The next largest contributor is the season by hour of day background concentration at almost 4%. Emissions from Conemaugh and the 3 Cambria County sources are minor contributors with a combined impact of less than 0.03%.

Table 5.2-15. MAXDCONT Output Source/Background Contribution to Peak Receptor Contributions in µg/m^3, Total Concentration Converted to ppb using 196.4 µg/m^3 = 75 ppb

EPA AERMOD 22112 Adjusted U-Star Run Peak Receptor Source Contribution in ug/m3				
Conemaugh	Seward	Cambria County Sources	Background	Total
0.08658	295.85021	0.00196	12.72997	**308.66872**

EPA was able to pull each source's hourly emission rates at for each of the 99th% occurances that made up the peak model receptor's modeled 1-hr SO_2 design value. Based on the peak model receptor's MAXDCON results, the only contributing source for the model simulation is Seward. Table 5.2-16 shows each modeled source's hourly emission rate at the time the 99th% modeled value occurred. Under the right meteorological conditions, it appears Seward can cause exceedances along the Laurel Ridge with SO_2 emission rates in the 1,500 to 1,600 lbs/hr range. Even lower rates may cause model exceedances since the simulation produced values above 75 ppb at ranks below the high 4th high according to the MAXDCON file output.

Table 5.2-16. Hourly Emission Rates for Modeled 99th% or High 4th-High Occurances

EPA AERMOD 22112 Adjusted U-star Run: Peak Receptor High-4th High & Corresponding SO2 Emission Rates								
Date	Hour	SO2 (ug/m3)	SO2 (ppb)	Conemaugh (lbs/hr)	Seward (lbs/hr)	Cambria Cogen (lbs/hr)	Colver (lbs/hr)	Ebensburg (lbs/hr)
06-28-2018	23	375.00234	143.20	634.1	3,245.2	711.92	711.92	380.17
01-05-2019	17	321.01417	122.59	370.5	1,553.1	807.16	711.12	239.69
07-01-2019	22	229.98964	87.83	1,467.2	1,514.6	0.00	706.36	294.45

5.2.9. EPA Site-Specific Turbulence Summary and Results

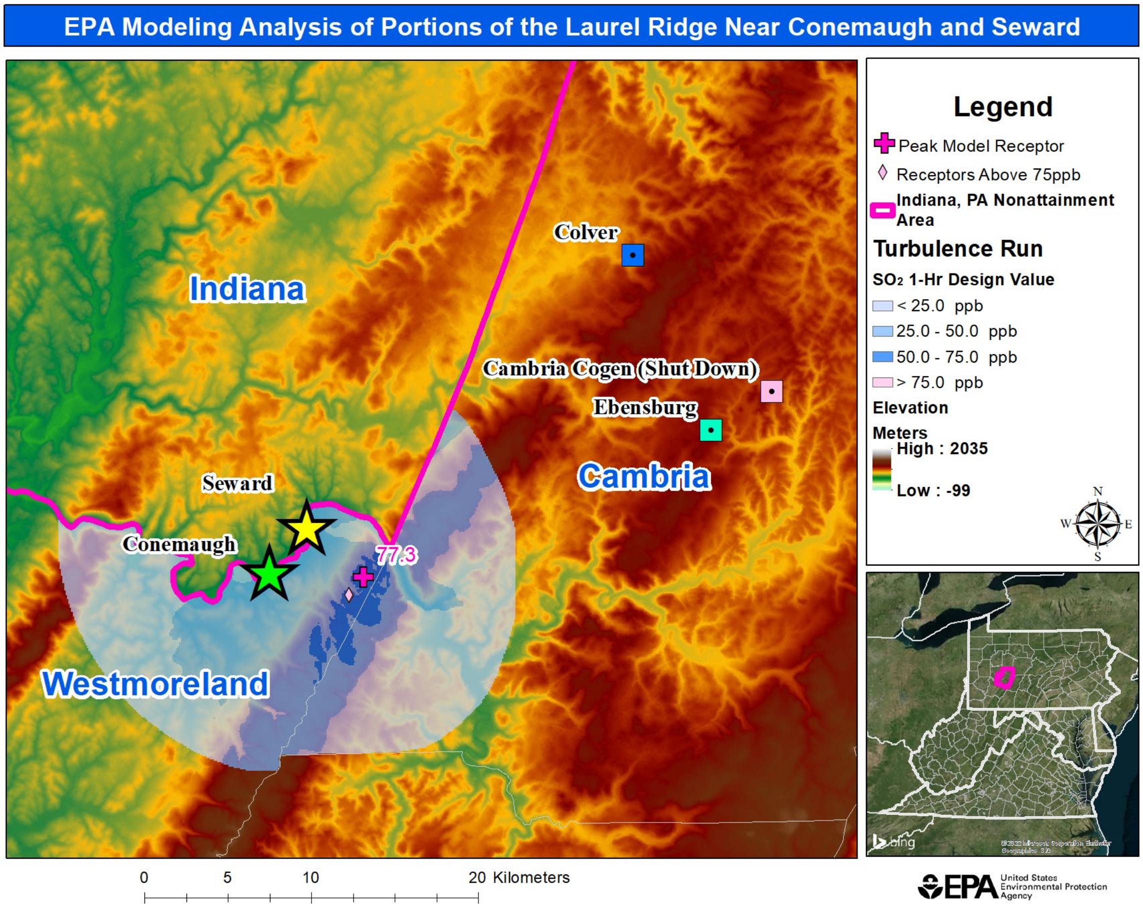
EPA also modeled using the site-specific (Ash Site #1) processed turbulence data as a designation analysis for portions of Cambria and Westmoreland counties near the Conemaugh and Seward power plants. Preprocessing steps for this analysis are identical to the processing steps contained in section 5.2.1- 5.2.7 of this document. The only difference is the meteorological processing for this modeling analysis utilized the site-specific turbulence measurements in the AERMET preprocessor (without using the adjusted u-star option in the AERMET stage 3 processing step). At this time, EPA is not endorsing either data set (adjusted u-star or turbulence) as the most suitable for the circumstances. As noted, the adjusted u-star data set is consistent with Pennsylvania's Indiana attainment plan SIP submission. EPA believes consistency in this modeling parameter is important because the area in Indiana County, PA and Cambria and Westmoreland Counties that are the focuses of these analyses are right next to each other, spanning only a small radius from the two key facilities of Seward and Conemaugh.

Final model results for the site-specific turbulence processed meteorological data showed violations of the 1-hr SO_2 NAAQS along the Laurel Ridge. The extent and magnitude of the modeled 1-hr SO_2 NAAQS violations were significantly reduced compared to the adjusted u-star values. The peak modeled concentration using the site-specific turbulence processed meteorological data was 77.3 ppb. A total of 24 model receptors violated the 1-hr SO_2 NAAQS. This is substantially fewer violating receptors than the adjusted u-star simulation.

Figure 5.2-40 shows model results using the site-specific turbulence measurements over the EPA model grid. The extent of the areas violating the 1-hr SO_2 NAAQS is much smaller than the adjusted u-star run.

A close up of portions of the Laurel Ridge containing the peak modeled values is shown in Figure 5.2-41. The area where modeled concentrations exceed the 1-hr SO_2 NAAQS is much smaller than the simulation using the adjusted u-star processed meteorological data. Modeled violations are confined to portions of the Laurel Ridge facing Conemaugh and Seward and do not extend past the ridgeline into Cambria County.

Figure 5.2-40. EPA Site-Specific Turbulence Modeling Results for All Sources Plus Background



If one compares modeled design values within the lower terrain of the Ligonier Valley from both simulations, it appears the simulation using the site-specific turbulence measurements produces higher model design values than the adjusted u-star simulation. Modeled design values for the site-specific turbulence simulation are about twice as high as the adjusted u-star in the Ligonier Valley though they are still well below the NAAQS. This result coupled with the higher adjusted u-star simulation design values versus the site-specific turbulence design values along the Laurel Ridge suggests there is an elevation sensitivity between the 2 meteorological data sets. The adjusted u-star processed meteorological data produces higher model concentration in elevated terrain compared to the meteorological data processed with the site-specific turbulence measurements. In lower terrain, it appears the opposite occurs, the adjusted u-star meteorological data produces lower model design values than the site-specific turbulence measurements.

As a clarifying point, EPA is not, at this time, endorsing the use of either the adjusted u-star or the use of the site-specific turbulence measurements as the appropriate meteorological input into AERMOD. The merits of each meteorological data set were not fully investigated for our analysis. As we have shown, the selection of either data set shows modeled design values along the Laurel Ridge in Westmoreland County exceed the 1-hour SO_2 design value (75 ppb) thus supporting EPA's contention that the area needs to be redesignated to nonattainment.

Figure 5.2-41. Close-up of Violating Receptors Along the Laurel Ridge

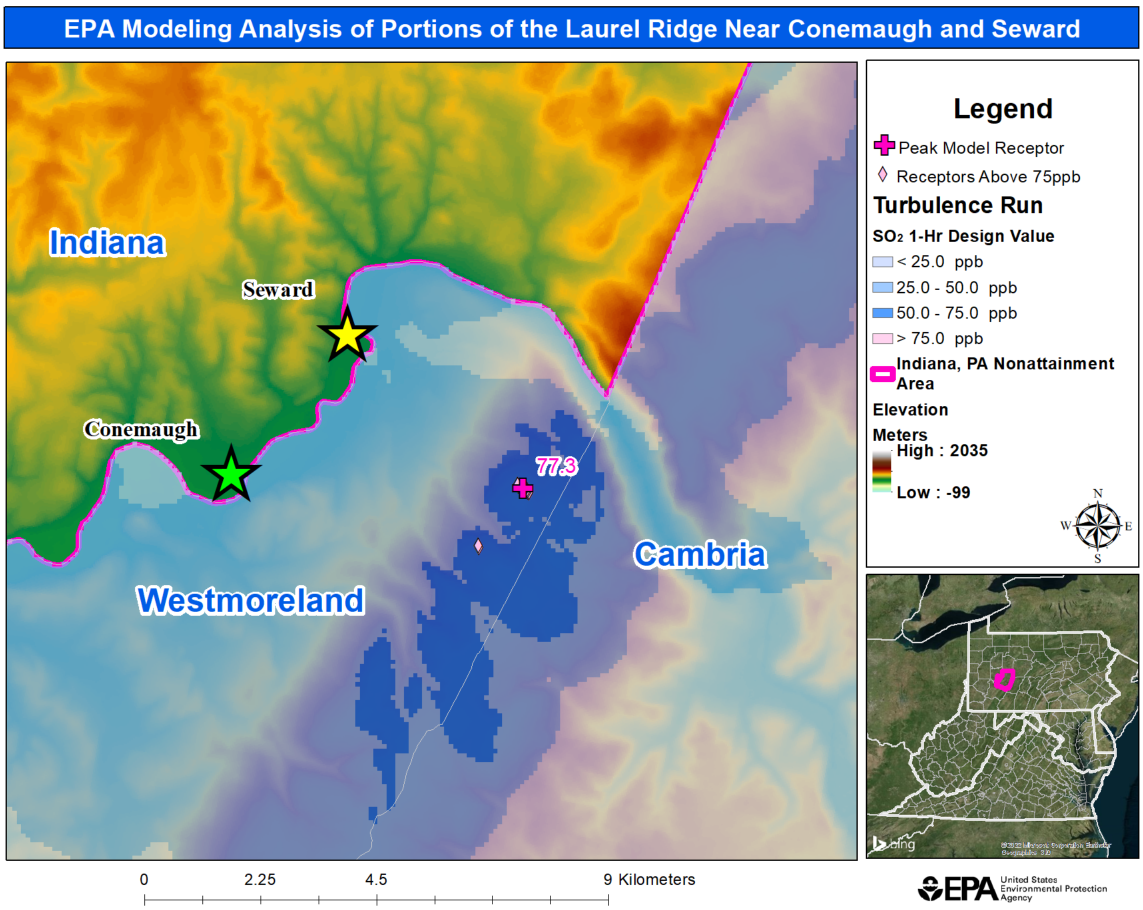


Table 5.2-17 summarizes results for the peak model receptor, which had a simulated design value of 77.3 ppb. EPA converted the AERMOD concentration from µg/m^3 to parts per billion or ppb by using a value of 196.4 µg/m^3 as representing the 1-hr SO_2 NAAQS value (75 ppb). Universal Transverse Mercator or UTM (zone 17) location, elevation and AERMOD hill-height scales are also included along with each year's 99th% value. Each 99th% value's corresponding date and hour of day during the 3-yr model simulation period are also included in the table. The simulated peak model receptor's design value is the average of each year's high 4th high (or 99th %) daily 1-hr maximums over the 3-year simulation period.

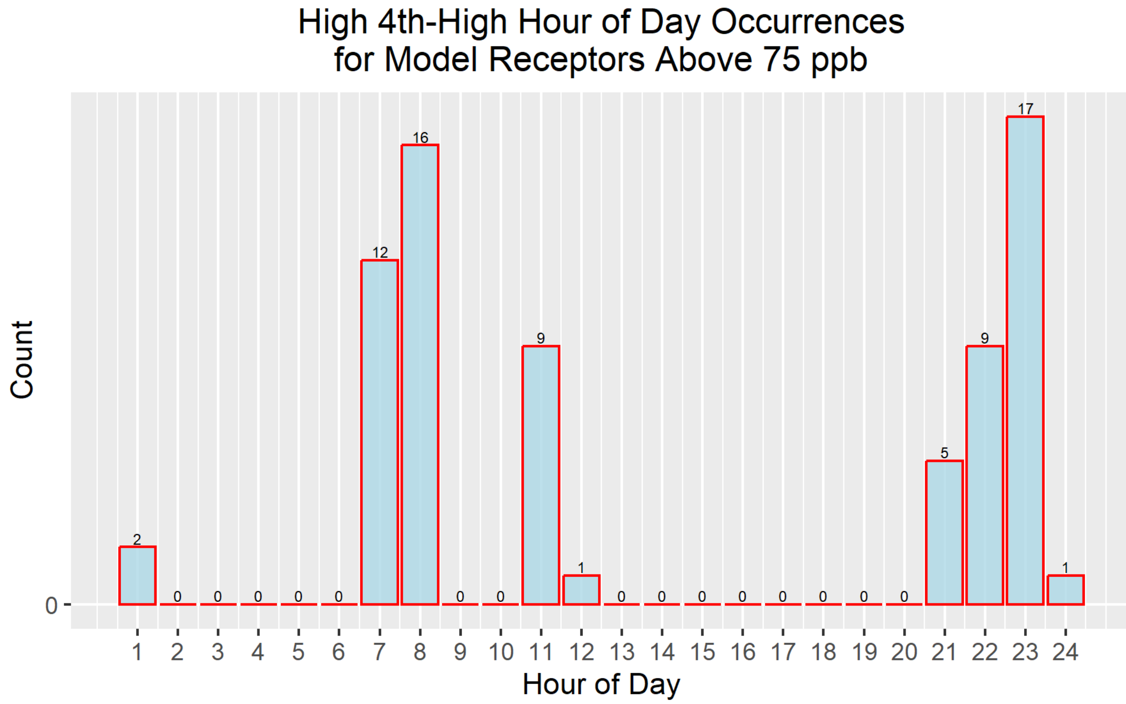
There is some year-to-year variability in the 99th% values that make up the 3-year modeled design value. The first year's 99th% value is just below 75 ppb and the third-year value is actually below 75 ppb. Second year modeled 99th% values is well above 75 ppb and brings the calculated modeled concentration above the 1-hr SO_2 NAAQS.

Table 5.2-17. Final EPA Model Peak Receptor Summary

EPA AERMOD 22112 Turbulence Run: Peak Receptor High-4th High & Corresponding SO2 Emission Rates	
Item	**EPA DRR Simulation Value**
UTM Easting (m)	670244
UTM Northing (m)	4471888
Elevation (m)	751.43
Hill Height Scale (m)	765.23
SO2 Design Value (ppb)	**77.28**
SO2 Design Value (ug/m3)	**202.38**
Year 1 SO2 High 4th High (ppb)	74.7
Year 1 Date	09-15-2017
Year 1 Hour	08
Year 2 SO2 High 4th High (ppb)	101.92
Year 2 Date	11-08-2018
Year 2 Hour	07
Year 3 SO2 High 4th High (ppb)	55.23
Year 3 Date	06-08-2020
Year 3 Hour	23

The modeled hour for each of the peak receptor's 99th% value appears to be more variable than the adjusted u-star simulation. EPA examined the hour of day for each of the violating receptors' 99th% values and plotted them. Figure 5.2-42 shows the distribution of hour of day for the violating receptors; 24 receptors with 3 99th% values. Given there are far fewer receptors to draw from, it's difficult to extrapolate any definitive patterns. It appears that higher values are still occuring in the early overnight hours and close to sunrise. This result indicates peak model concentrations may be occuring under stable atmospheric conditions.

Figure 5.2-42. Hour Of Day for 99th% Values for Violating Model Receptors



Utilizing AERMOD's MAXDCONT option, EPA examined all 24 violating model receptor's source contributions. Table 5.5-10 shows the source contributions for each model receptor that exceeded the 1-hr SO_2 NAAQS. Similar to the adjusted u-star peak model receptor results, Seward appears to be the most significant contributor to modeled violations. Background contributions are the next largest contributor but generally less than 10%. The Cambria County sources are contributing less than 1 ppb to modeled design values at the violating model receptors.

There are only 3 instances where Conemaugh is a significant contributor to modeled violations. They are highlighted in beige on the table. In these 3 instances, Seward's contribution is higher than Conemaugh's with Conemaugh contributing between 24 to 38% towards the receptor's modeled concentration.

Table 5.2-18. MAXDCONT Output Source/Background Contribution to Peak Receptor

EPA AERMOD 22112 Turbulence Run Peak Receptor Source Contribution in ug/m3													
Rank	Conemaugh	Seward	Cambria County	Background	Total	ppb	Rank	Conemaugh	Seward	Cambria County	Background	Total	ppb
1	0.03626	194.19771	0.29712	7.84724	202.37834	77.28	17	46.68970	134.71839	0.99311	15.08414	197.48534	75.41
2	0.04318	187.94874	1.12893	12.81716	201.93802	77.11	18	0.03791	188.98841	0.29480	7.84724	197.16836	75.29
3	0.03791	193.70608	0.29493	7.84724	201.88615	77.10	19	0.03679	181.52484	1.12327	14.21222	196.89712	75.19
4	0.03441	193.08195	0.29913	7.84724	201.26273	76.86	20	75.36091	111.66587	0.18139	9.59107	196.79925	75.15
5	0.03717	185.60357	1.12025	14.21222	200.97322	76.75	21	0.03480	181.35577	1.16082	14.21222	196.76362	75.14
6	0.03683	192.39006	0.29643	7.84724	200.57056	76.59	22	74.52908	113.97227	0.36118	7.84724	196.70977	75.12
7	0.03505	192.20603	0.29854	7.84724	200.38686	76.52	23	0.01868	186.91490	0.17191	9.59107	196.69656	75.11
8	0.04301	185.78020	1.11869	12.81716	199.75905	76.28	24	0.03005	189.14738	0.14893	7.32409	196.65045	75.10
9	0.03580	184.09130	1.13897	14.21222	199.47829	76.18	25						
10	0.03844	191.15933	0.29413	7.84724	199.33914	76.12	26						
11	0.03859	190.67668	0.29390	7.84724	198.85642	75.94	27						
12	0.02278	190.43648	0.12070	7.84724	198.42720	75.77	28						
13	0.04298	184.35491	1.13010	12.81716	198.34515	75.74	29						
14	0.02125	189.91990	0.11599	7.84724	197.90438	75.57	30						
15	0.03726	182.41378	1.08792	14.21222	197.75119	75.52	31						
16	0.02366	189.70684	0.12334	7.84724	197.70108	75.50	32						

EPA pulled each source's hourly emission rates for each of the 99^{th}% occurances that made up the peak model receptor's modeled 1-hr SO_2 design value. Based on the peak model receptor's MAXDCON results, the only contributing source for the model simulation is Seward. Table 5.2-19 shows each modeled source's hourly emission rate at the time the 99^{th}% modeled value occurred. Under the right meteorological conditions, it appears Seward can cause exceedances along the ridge with SO_2 emission rates slightly above the 1,800 lbs/hr range. Note that the 1^{st} and 3^{rd} year 99^{th}% occurrence resulted in model concentrations under 75 ppb.

Table 5.2-19. Hourly Emission Rates for Modeled 99^{th}% or High 4^{th}-High Occurances

EPA AERMOD 22112 Turbulence Run: Peak Receptor High-4th High & Corresponding SO2 Emission Rates								
Date	Hour	SO2 (ug/m3)	SO2 (ppb)	Conemaugh (lbs/hr)	Seward (lbs/hr)	Cambria Cogen (lbs/hr)	Colver (lbs/hr)	Ebensburg (lbs/hr)
09-15-2017	8	195.60960	74.70	515.1	1,799.5	450.01	734.93	303.18
11-08-2018	7	266.90361	101.92	1,370.3	2,158.0	667.47	677.00	379.37
06-08-2020	23	144.62180	55.23	114.0	1,223.1	0.00	0.00	253.18

5.3. Air Quality Monitoring Data for the Westmoreland and Cambria Counties, PA

The Johnstown monitor is located in the City of Johnstown roughly 15 km southeast of the Conemaugh and Seward power plants. Located along Stonycreek River, the Johnstown monitor sits at a significantly lower elevation, around 435 meters, than the surrounding terrain, which rises to over 800 meters in places. The location of this monitor is not in the area of maximum modeled concentration, therefore, the monitoring data from this site isn't sufficient to characterize air quality concentration for designation purposes.

EPA considered design values for the air quality monitor located in Cambria County by assessing the most recent 3 consecutive years (i.e., 2019-2021) of quality-assured, certified ambient air quality data in the EPA Air Quality System (AQS) using data from Federal Reference Method and Federal Equivalent Method monitors that are sited and operated in accordance with 40 CFR parts 50 and 58.[23] Procedures for using monitored air quality data to determine whether a violation has occurred are given in 40 CFR part 50 Appendix T, as revised in conjunction with the 2010 SO_2 NAAQS. The 2010 1-hour SO_2 NAAQS is met when the design value is 75 ppb or less. Table 5.3-1 contains the 2019-2021 design values for the area of analysis.

Table 5.3-1. 2010 SO_2 NAAQS Design Values in Cambria County

AQS Site ID	Monitor Location	2019-2021 Design Value (ppb)	2019 99th Percentile (ppb)	2020 99th Percentile (ppb)	2021 99th Percentile (ppb)
42-011-0021	Miller Auto Shop, 1 Messenger St., Johnstown, PA 40.309944, -78.915444	10	13	8	10

Based on available ambient air quality data collected between 2019-2021, Cambria County does not show a violation of the 2010 SO_2 NAAQS at its monitor. However, the absence of a violating monitor when considering the distance from Conemaugh and Seward Stations coupled with the terrain of the Laurel Ridge is not a sufficient technical justification to rule out that an exceedance of the 2010 SO_2 NAAQS may occur in the immediate vicinity of the Facilities. Therefore, EPA is considering air quality modeling to determine whether the areas in Westmoreland and Cambria Counties are in attainment.

5.4. Intended Designation Boundary Determination

Under CAA section 107(d)(3)(A), the Administrator may at any time inform the governor of a state that available information indicates that the designation of any area should be revised. Based on the air quality modeling information summarized above, the EPA is informing the governor of Pennsylvania that portions of Westmoreland and Cambria counties should be redesignated to nonattainment. In this section, we consider the appropriate geographical extent of the nonattainment area.

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[23] SO_2 air quality data are available from EPA's website at https://www.epa.gov/outdoor-air-quality-data. SO_2 air quality design values are available at https://www.epa.gov/air-trends/air-quality-design-values.

In notifying the governor of the boundaries of our intended redesignation, the EPA is relying on the same technical bases used for its initial designations process for the 2010 SO_2 NAAQS. For those initial designations, EPA designated as nonattainment those areas containing the area violating the NAAQS (e.g., the area around a violating monitor or encompassing modeled violations), as well as any nearby areas (e.g., counties or portions thereof) that contain emissions sources contributing to ambient air quality in the violating area. (*See* CAA section 107(d)(l)(A)(i)). Accordingly, although EPA considers county boundaries as the analytical starting point for determining SO_2 nonattainment areas, an evaluation of five factors for each area may be considered in determining the geographic scope of a nonattainment boundary.

Thus, boundaries area evaluated on five factors: 1) ambient air quality data or dispersion modeling results; 2) emissions-related data; 3) meteorology; 4) geography and topography; and 5) jurisdictional boundaries, as well as other relevant available information. While the factors are presented individually, they are not independent. Instead, the five-factor analysis process carefully considers their interconnections and the dependence of each factor on one or more of the others.

5.4.1. Factor 1: Ambient Air Quality Data and Dispersion Modeling Results

As described above in section 5.2, EPA modeled actual emissions for Seward and Conemaugh, Colver Power and Ebensburg Power, and results are depicted in Figure 5.2-37. The model receptors with concentrations over the standard are noted in blue. The violating model receptors are located in Lower Yoder Township in Cambria County, and St. Clair Township in Westmoreland County. EPA also considered other modeling analyses which are discussed in detail in section 5.5. which showed peak modeled receptors generally in the same location.

There are no monitors located in St. Clair Township or in Lower Yoder Township. As noted above, the Johnstown monitor (42-011-0021), which has a 2021 design value of 10 ppb, is located at significantly lower terrain, and the Laurel Ridge hinders emissions from the two facilities in Indiana County from significantly impacting that monitor. Thus, lack of a monitored violation at that location, does not rule out a violation of the standard closer to the facilities (which EPA modeling indicates).

5.4.2. Factor 2: Emissions-Related Data

EPA believes that it is reasonable to evaluate SO_2 emissions data from EPA's Emission Inventory System (EIS) and CEMS data. Table 5.4-2 shows the most recent four years of emissions data for the facilities that are being characterized by the modeling analyses described previously.

Table 5.4-2. SO_2 Emissions of Sources in the Indiana/ Westmoreland/ Cambria Area

County	Facility Name	2018 SO_2 Emissions (tons)	2019 SO_2 Emissions (tons)	2020 SO_2 Emissions (tons)	2021 SO_2 Emissions (tons)
Indiana	Conemaugh	4831	4299	2758	2888
Indiana	Seward	7963	5782	6314	7569
Cambria	Colver Power	2728	2259	1565	2334
Cambria	Ebensburg Power	1855	1319	1359	1022
Cambria	Cambria Cogen	2520	491	0	0

The EPA has not received any additional information on emissions reductions resulting from controls put into place after the date of the emissions inventory data provided in the table above.

5.4.3. Factor 3: Meteorology

EPA evaluated meteorological data to determine how weather conditions, including wind speed and direction, affect the plume of sources contributing to the ambient SO_2 concentrations. A detailed description of the meteorology of the area is included in section 5.2.6. EPA conducted two modeling analyses, which included site specific meteorology data (collected between Conemaugh and Seward plants).

5.4.4. Factor 4: Geography and Topography

EPA examined the physical features of the land that may affect the distribution of emissions and may help define nonattainment area boundaries. A detailed description of the land use data used in the modeling analysis was provided earlier.

Both Conemaugh and Seward are located along the Conemaugh River in Indiana County and are contained within the Ligonier Valley. The Chestnut Ridge lies to the west of these facilities and the Laurel Ridge lies to the east. Both terrain features largely pinch out to the north but extend many miles to the south. Water drainage is to the west, eventually becoming part of the Ohio River Basin. The Conemaugh River bisects both ridges creating the Conemaugh River Gorge as it passes through the Laurel Ridge. The Chestnut and Laurel ridges present several physical impediments to plumes originating from Conemaugh and Seward.

5.4.5. Factor 5: Jurisdictional Boundaries

EPA considers existing jurisdictional boundaries for the purposes of providing a clearly defined legal boundary for carrying out the air quality planning and enforcement functions for the area. Our goal is to base designations on clearly defined legal boundaries that align with existing administrative boundaries when reasonable. Existing jurisdictional boundaries used to define a nonattainment area must encompass the area that has been identified as meeting the nonattainment definition.

Modeled violations are constrained to St. Clair Township in Westmoreland County and Lower Yoder Township in Cambria County. The main impacting sources are located in East and West Wheatfield Townships in Indiana County (a nonattainment area), across the Conemaugh River from the modeled violations.

5.4.6. Intended Nonattainment Area Boundary

In consideration of the five factors, EPA intends to designate the Township of St. Clair in Westmoreland County, and the Township of Lower Yoder in Cambria County as nonattainment for the 2010 SO_2 NAAQS (see Figure 6-1). This new nonattainment area would not include the main contributing sources of Conemaugh and Seward power plants, which reside in neighboring Indiana County, an already designated nonattainment area for the 2010 SO_2 NAAQS. EPA considered options for a nonattainment area boundary that included Conemaugh and Seward plants, which are discussed below. Ultimately, EPA believes that an attainment plan for the intended Westmoreland/Cambria nonattainment area would require the same stringency in terms of emission limits as one for a nonattainment area whose boundary included the townships where Conemaugh and Seward plants are located. Specifically, EPA recognizes that the state's obligation under section 110(a) of the CAA in developing an attainment plan for a nonattainment area is to submit ''. . . a plan which provides for implementation, maintenance, and enforcement of such primary standard in each air quality control region (or portion thereof) within such State.'' CAA section 110(a)(1). Section 110 further provides that ''[i]n the case of a plan or plan revision for an area designated as a nonattainment area, meet the applicable requirements of part D of this subchapter (relating to nonattainment areas).'' CAA section 110(a)(2)(I). Section 172(c)(6) then requires the SIP for a nonattainment area to include enforceable emission limitations and control measures as necessary or appropriate to provide for NAAQS attainment ''in such area.'' CAA section 172(c)(6). Therefore, EPA maintains that a nonattainment area without the contributing sources does not preclude the state from requiring emission limits on sources contributing to the air quality violations in the nonattainment area.

EPA considered whether the townships where Seward and Conemaugh power plants are located should be included in the Westmoreland and Cambria nonattainment area. While it is EPA's general policy to include sources that cause violations within the nonattainment area boundary, EPA recognizes the uniqueness of this situation in that Seward and Conemaugh power plants are already included in the Indiana, PA SO_2 nonattainment area, and thus those townships are already subject to CAA Part D nonattainment planning requirements. Additionally, the attainment plan for the Indiana, PA area was recently partially disapproved and partially approved, which initiated a sanctions clock under CAA section 179, providing for emission offset sanctions for new sources if EPA has not fully approved a revised SIP attainment plan within 18 months after final partial disapproval, and providing for highway funding sanctions if EPA has not fully approved a revised plan within 6 months thereafter. The sanctions clock can be stopped only if the conditions of EPA's regulations at 40 CFR 52.31 are met. This action also initiated an obligation for EPA to promulgate a Federal implementation plan within 24 months unless Pennsylvania has submitted, and EPA has fully approved, a plan addressing these attainment planning requirements. In order to avoid SIP planning uncertainty for the existing Indiana, PA nonattainment area, EPA believes the intended boundary proposed for the new Westmoreland/Cambria nonattainment area, which does not include the culprit sources, is reasonable, as it will result in Pennsylvania ultimately needing to demonstrate that the emissions from Seward and Conemaugh are sufficient to provide for NAAQS attainment in both areas without disrupting the pre-existing requirement that Pennsylvania demonstrate, on the already established schedule for that duty, that the emissions from those sources and other sources in the Indiana County area are sufficient to provide for Indiana County's attainment.

5.5. Modeling Analyses Provided by Other Parties

The EPA received additional information relevant to the designation of this area. This section will outline several different modeling analyses that were submitted during the public comment period for EPA's partial disapproval and partial approval of the Indiana, PA attainment plan, and an additional analysis EPA conducted using an alternatively processed meteorological data set. EPA's designation modeling used site-specific meteorological data processed with the adjusted u-star option (without the site-specific turbulence measurements in accordance with EPA guidance). For completeness considerations, EPA included the site-specific turbulence AERMET processed data in this section.

Table 5.5-1 summarizes the results from the 3 additional modeling analyses covering areas of Cambria and Westmoreland counties near the Conemaugh and Seward power plants. Additional details regarding for each of these additional analyses are provided in sections following the additional modeling summary tables.

Table 5.5-1: Summary of AERMOD Modeling Input Parameters for the Area of Analysis for the Westmoreland and Cambria Area

Input Parameter	Sierra Club Value	KEY-CON	EPA–Turbulence
AERMOD Version	21112	21112	22112
Dispersion Characteristics	Rural	Rural	Rural
Modeled Sources	Conemaugh and Seward (Conemaugh single stack)	Indiana, PA SIP Sources (Conemaugh, Homer City, Keystone, Seward)	Conemaugh, Seward, Cambria Cogen, Colver Power, Ebensburg Power
Modeled Stacks	2	6 (Merged Stack for Conemaugh)	7 (Conemaugh 3 stacks; 2 for individual unit flue and merged)
Modeled Structures		33	33
Modeled Fencelines		None	None
Total receptors		34,040	10,705
Emissions Type	Actual (CAMD)	Actual	Actual
Emissions Years	2015-17, 2016-18, 2017-19, 2018-20 and **2019-21**	2019-21	1 July 2019 through 30 June 2020
Meteorology Years	Same as modeled emissions periods	1 September 2015 through 31 August 2016 Met Data transposed to fit emission period as per Modeling TAD	1 September 2015 through 31 August 2016 Met Data transposed to fit emission period as per Modeling TAD
NWS Station for Surface Meteorology	Johnstown-Cambria County ASOS	Source Specific/ASOS Ash Site #1 & Johnstown/Cambria County ASOS	Source Specific/ASOS Ash Site #1 & Johnstown/Cambria County ASOS
NWS Station Upper Air Meteorology	Pittsburgh, PA	Pittsburgh, PA	Pittsburgh, PA
NWS Station for Calculating Surface Characteristics	Johnstown-Cambria County ASOS (uniform 30° sectors)	Ash Site #1 (uniform 30° sectors)	Ash Site #1 (user defined sectors)
Methodology for Calculating Background SO_2 Concentration	Season by Hour of Day, South Fayette (2016-18)	Season by Hour of Day, South Fayette, PA	Season by Hour of Day, Strongstown, PA
Calculated Background SO_2 Concentration	Variable	Variable	Variable

The results presented below in Table 5.5-2 and Figure in the following sections show the geographic extent of the predicted modeled violations based on the input parameters.

Table 5.5-2. Predicted 99th Percentile Daily Maximum 1-Hour SO_2 Concentration Averaged Over Three Years for the Area of Analysis for the Westmoreland and Cambria Area

			Receptor Location [UTM zone 17]		99th percentile daily maximum 1-hour SO_2 Concentration ($\mu g/m^3$)	
Modeler	Averaging Period	Data Period	UTM, Easting	UTM, northing	Modeled concentration (including background)	NAAQS Level
Sierra Club	99th Percentile 1-Hour Average	2019-20	669597.38	4471747.00	244.64084	196.4*
KEY-CON	99th Percentile 1-Hour Average	2019-21	670337.39	4471875.04	193.23181	196.4
EPA – turbulence	99th Percentile 1-Hour Average	1 July 2019 to 30 June 2020	670244	4471888	220.18960	196.4

*Equivalent to the 2010 SO_2 NAAQS of 75 ppb using a 2.619 $\mu g/m^3$ conversion factor

5.5.1. KEY-CON

A protocol for conducting modeling to evaluate the impacts outside of the Indiana, PA NAA was submitted by KEY-CON and Seward Stations to the Pennsylvania Department of Environmental Protection (PA DEP) in September 2020. EPA and PA DEP provided comments to this protocol in a 17 February 2021 email sent to John Shimshock (KEY-CON) from PA DEP's Andrew Fleck. Actions to pursue this modeling, however, were suspended while the review of the modeling for the area inside the nonattainment area was ongoing. KEY-CON performed the modeling study based on the September 2020 modeling protocol with minor updates. KEY-CON submitted its results during the public comment period for the proposed partial disapproval and partial approval of the Indiana, PA attainment plan (87 FR 15166). A brief overview of the modeling analysis and the results will be discussed in the following sections.

5.5.1.1. Modeled Emissions/Stack Parameters

KEY-CON modeled emissions over a slightly different 3-year period than it included in its modeling protocol. The time period from the September 2020 modeling protocol was 1 July 2017 through 30 June 2020. The (updated) modeling period for the KEY-CON submitted modeling was 1 Jan 2019 through 31 Dec 2021.

All sources that were included in the Indiana, PA SIP modeling were also included in the KEY-CON modeling analysis. These included Conemaugh (one stack), Homer City (3 stacks), Keystone (1 stack) and Seward (1 stack); Keystone and Homer City were not sources included in the September 2020 modeling protocol. Stack locations, base elevations and stack diameters for each of the 5 KEY-CON modeled stacks in the AERMOD input files were compared to Pennsylvania's original SIP and Supplementary Analysis documentation. EPA verified that stack base elevations, stack heights and stack diameters used by KEY-CON matched values in the original Indiana, PA SIP modeling input files. We also note that modeled stack diameters for Conemaugh and Keystone represent merged diameters representing an equivalent area of the source's individual flues within their FGD stack structures. As noted previously, merged stack diameters, while appropriate when both coal-fired units are operating, may not be appropriate for times when only one unit is operating over the 3-year model simulation period.

EPA checked KEY-CON's modeled hourly SO_2 emission rates versus hourly emission rates from EPA's CAMD database. Hourly CAMD emissions, MODC flow and concentration information was downloaded using EPA's FACT software. These were then processed using R for direct comparison with the KEY-CON hourly input file. EPA had no real ability to check KEY-CON's model inputs for each stack's stack temperature and stack velocity. These were based on each facility's CEMS measured data. While stack flow rates are part of CAMD reported emissions, they are generally not usable since the flow information is adjusted to standard cubic feet per hour, not actual cubic feet per hour. Flow MODC could, however, be used to identify hours with potentially invalid stack velocities.

The following sections examine the hourly CAMD emissions for each source included in the KEY-CON modeling analysis over the 3-year simulation period. Comparisons of the modeled hourly emission rates and CAMD emissions were also conducted.

Conemaugh Modeled Hourly Emission Rates: Figure 5.5-1 shows Conemaugh's combined CAMD hourly emissions over the KEY-CON model simulation period. EPA combined hourly emissions for both of Conemaugh's coal-fired units. As noted previously, CAMD hourly data include information on the validity of the flow rate and concentration instruments used to measure hourly SO_2 emissions. If flow and concentration codes are valid, a "measured" value is generated and if either or both flow and concentration instruments malfunction a "calculated" hourly SO_2 emission value is generated. The modeled critical emission value, or CEV is also included on the figure. Pennsylvania's Supplemental Analysis modeling indicated that Conemaugh's CEV was 3,381 lbs/hr. This represents the level where modeled emissions just meet the 1-hr SO_2 NAAQS. As the figure shows, Conemaugh's hourly SO_2 emissions rarely exceed its modeled CEV.

Figure 5.5-1. Conemaugh Combined Unit CAMD SO_2 Emissions for 2019 through 2021

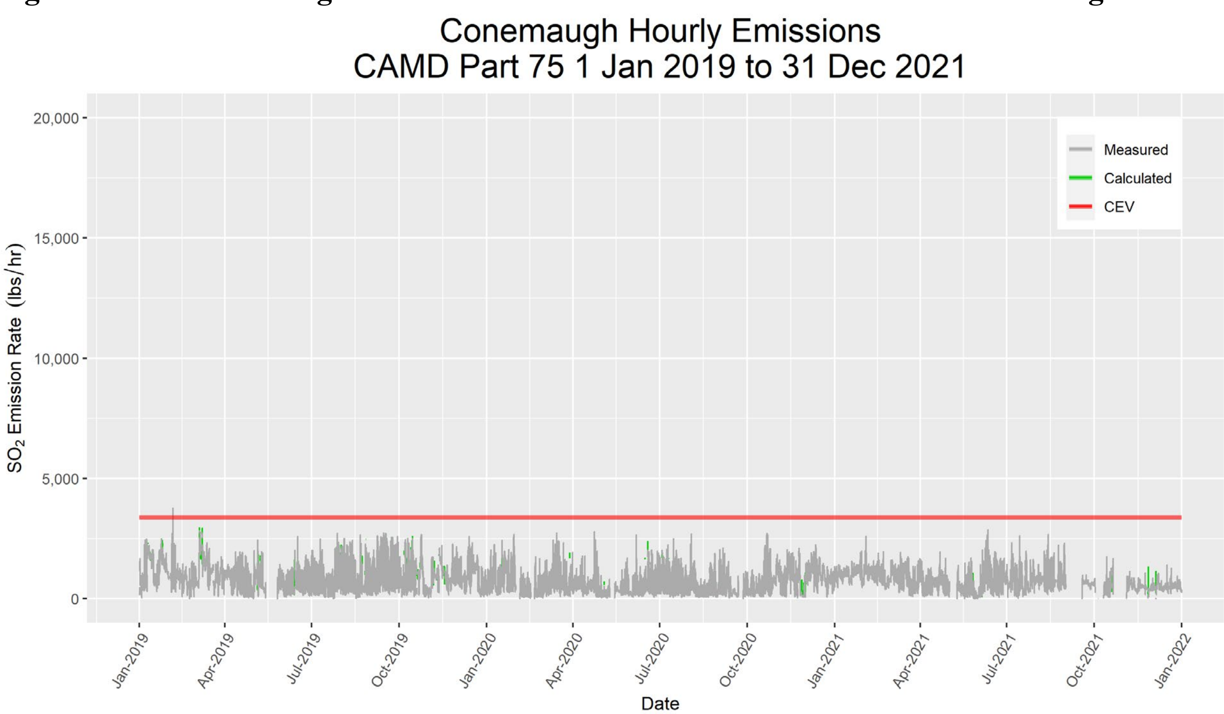
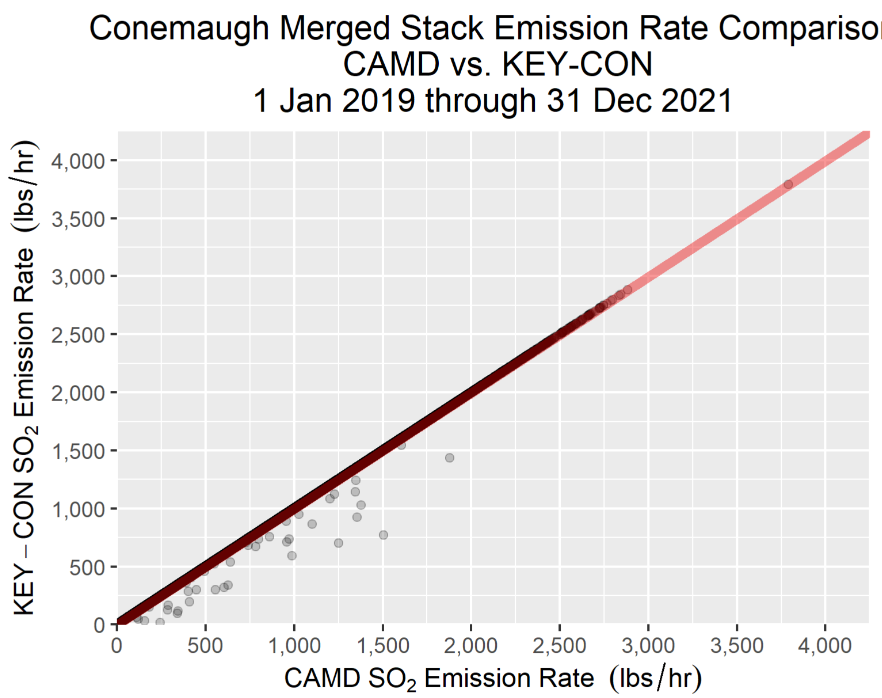


Figure 5.5-2 shows a comparison of hourly emissions over the 3-year simulation period. A 1-to-1 (red) tend line is also included on the figure. If the CAMD and KEY-CON's modeled hourly SO_2 emission rates are identical, then they will graph as a point along the 1-to-1 (red) trend line.

Hourly CAMD emissions and KEY-CON's modeled emission rates are overall well matched. There only 18 hours across the simulation period where CAMD hourly SO_2 emissions are more than 50 lbs/hr higher than KEY-CON's modeled emission rates.

Figure 5.5-2. Conemaugh's CAMD versus KEY-CON Hourly SO_2 Emissions



Homer City Unit 1: Homer City is comprised of 3 coal-fired units. Each unit has a dedicated stack meaning emissions from each coal unit are vented to a single stack structure. CAMD emissions over the 3-year simulation period were therefore plotted for each unit separately. The KEY-CON model simulation contained separate stacks for each Homer City coal-fired unit.

Figure 5.5-3 shows CAMD hourly emissions over the 3-year KEY-CON simulation period. The figure also includes the modeled CEV for unit 1, which is 1,550 lbs/hr. As described previously, hourly SO_2 emissions are differentiated between measured and calculated values on the figure. Over the 3-year simulation period, CAMD information indicates Homer City unit 1 was off 13,336 hours out of 26,304 total hours. Unit 1 emissions appear to exceed the model CEV periodically over the 3-year simulation period.

Figure 5.5-4 shows a comparison of CAMD and modeled hourly SO_2 emissions over the 3-year simulation period. A 1-to-1 (red) tend line is also included on the figure. If the CAMD and KEY-CON's modeled hourly SO_2 emission rates are identical, then they will graph as a point along the 1-to-1 (red) trend line.

Figure 5.5-3. Homer City Unit 1 CAMD SO_2 Emissions for 2019 through 2021

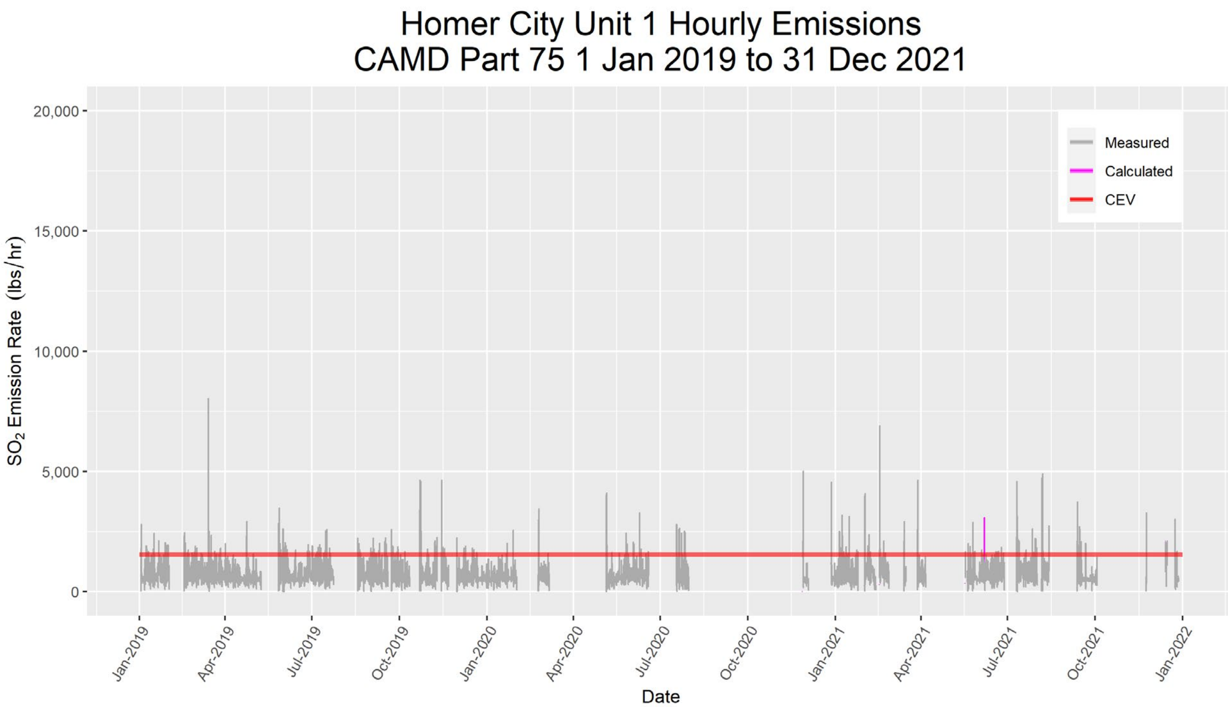
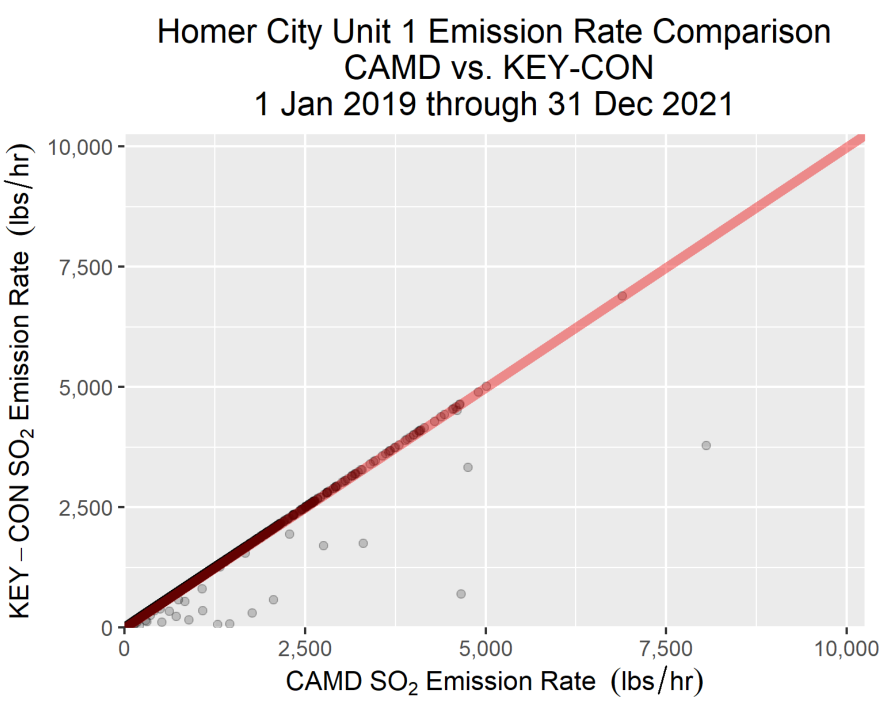


Figure 5.5-4. Homer City Unit 1 CAMD versus KEY-CON Hourly SO_2 Emissions



Hourly CAMD emissions and KEY-CON's modeled emission rates are overall well matched. There only 31 hours across the simulation period where CAMD hourly SO_2 emissions are more than 50 lbs/hr higher than KEY-CON's modeled emission rates.

Homer City Unit 2: Figure 5.5-5 shows CAMD hourly emissions over the 3-year KEY-CON simulation period. The figure also includes the modeled CEV for unit 2, which is 1,550 lbs/hr. Hourly SO_2 emissions are differentiated between measured and calculated values on the figure. Over the 3-year simulation period, CAMD information indicates Homer City unit 2 was off 14,487 hours out of 26,304 total hours. Unit 2 emissions appear to exceed the model CEV periodically over the 3-year simulation period.

Figure 5.5-5. Homer City Unit 2 CAMD SO_2 Emissions for 2019 through 2021

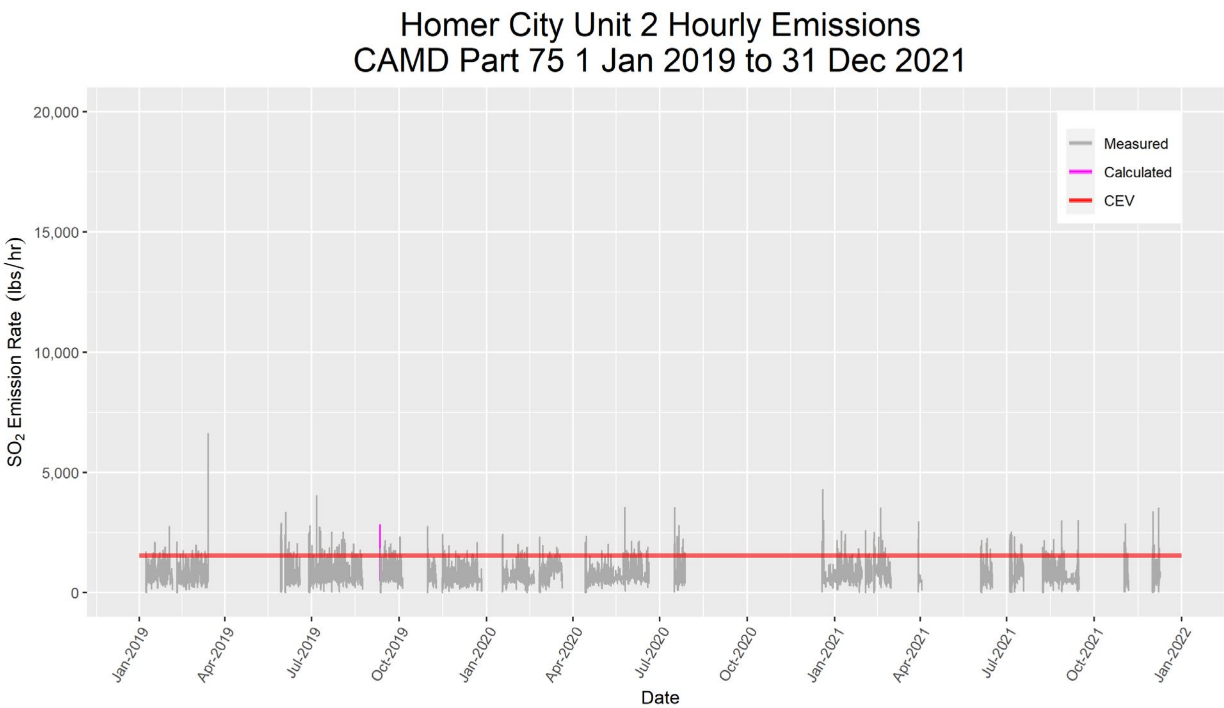
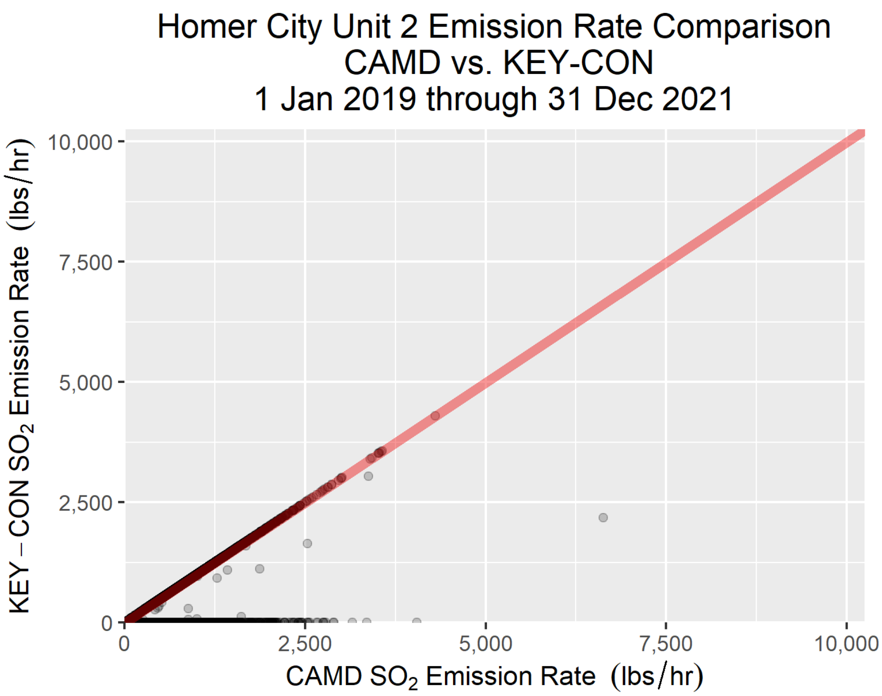


Figure 5.5-6 shows a comparison of CAMD and modeled hourly SO_2 emissions over the 3-year simulation period. A 1-to-1 (red) tend line is also included on the figure. If the CAMD and KEY-CON's modeled hourly SO_2 emission rates are identical, then they will graph as a point along the 1-to-1 (red) trend line.

Hourly CAMD emissions and KEY-CON's modeled emission rates are for the most part well matched. There appear, however, to be a substantial number of hours where CAMD records hourly SO_2 emissions that are not in the KEY-CON model input file. There 3,526 hours across the simulation period where CAMD hourly SO_2 emissions differ by more than ±50 lbs/hr than KEY-CON's modeled emission rates. Most of these hours appear to be confined to 2020. These potentially missing hours may have an impact on the final KEY-CON model simulation.

Figure 5.5-6. Homer City Unit 2 CAMD versus KEY-CON Hourly SO_2 Emissions



Homer City Unit 3: Figure 5.5-7 shows CAMD hourly emissions over the 3-year KEY-CON simulation period. The figure also includes the modeled CEV for unit 3, which is 3,260 lbs/hr. Hourly SO_2 emissions are divided between measured and calculated values on the figure. Over the 3-year simulation period, CAMD information indicates Homer City unit 3 was off 11,464 hours out of 26,304 total hours. Unit 3 emissions appear to occasionally exceed the model CEV over the 3-year simulation period.

Figure 5.5-8 shows a comparison of CAMD and modeled hourly SO_2 emissions over the 3-year simulation period. A 1-to-1 (red) tend line is also included on the figure. If the CAMD and KEY-CON's modeled hourly SO_2 emission rates are identical, then they will graph as a point along the 1-to-1 (red) trend line.

Figure 5.5-7. Homer City Unit 3 CAMD SO_2 Emissions for 2019 through 2021

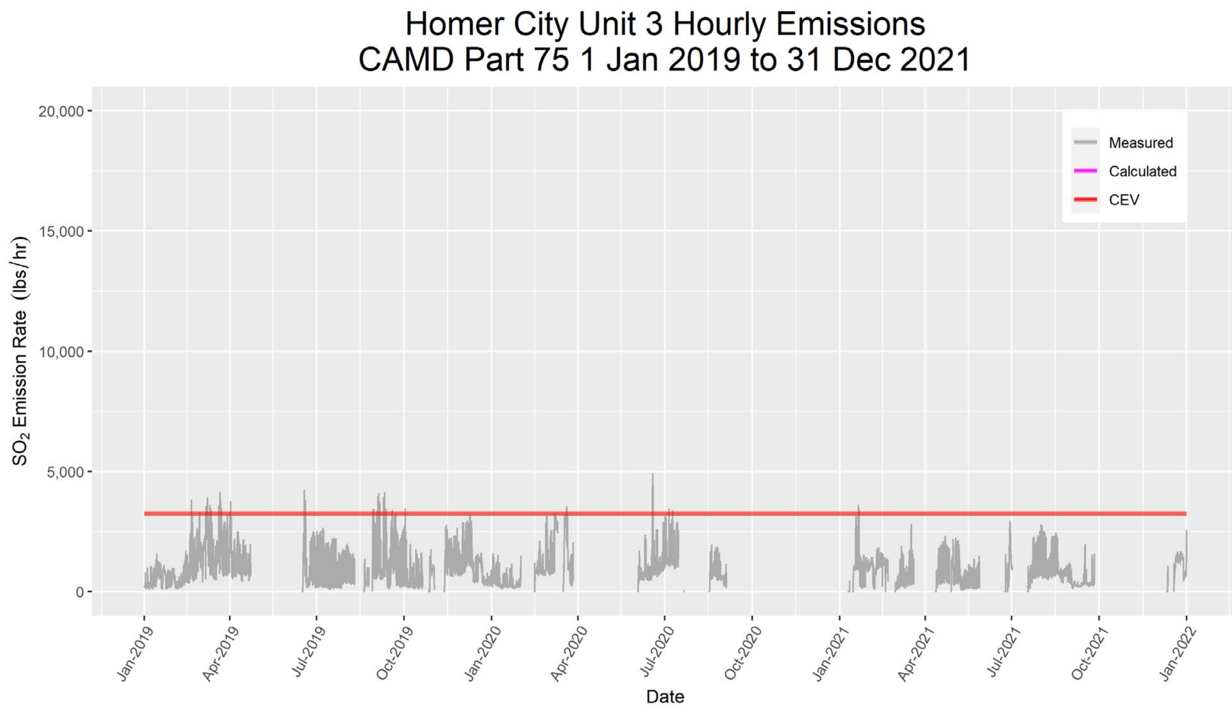
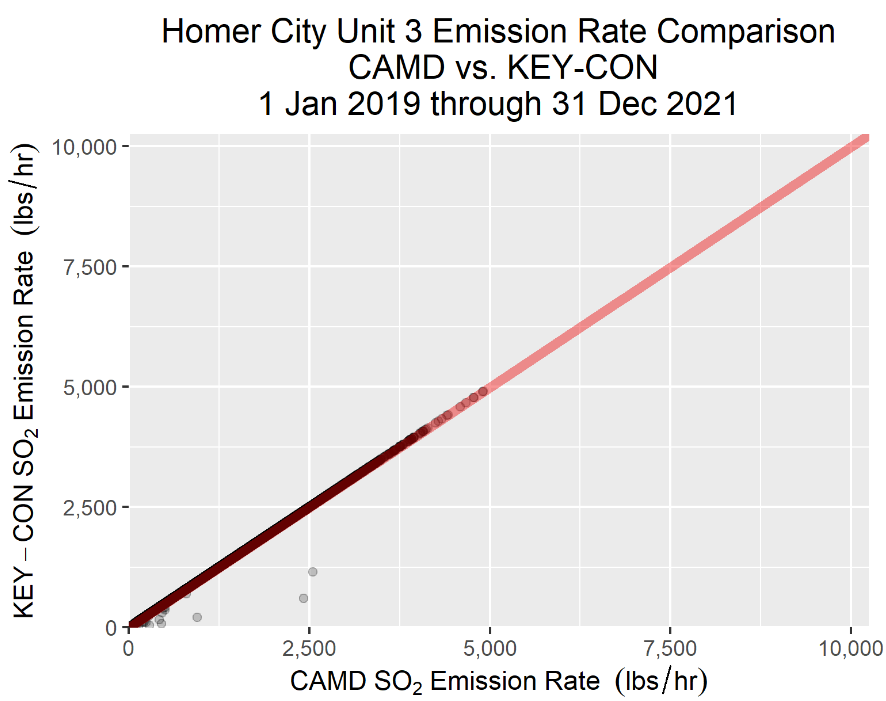


Figure 5.5-8. Homer City Unit 3 CAMD versus KEY-CON Hourly SO_2 Emissions



Hourly CAMD emissions and KEY-CON's modeled emission rates are overall well matched. There only 19 hours across the simulation period where CAMD hourly SO_2 emissions are more than 50 lbs/hr higher than KEY-CON's modeled emission rates.

Keystone Modeled Hourly Emission Rates: Figure 5.5-9 shows Keystone's combined CAMD hourly emissions over the KEY-CON model simulation period. Keystone and Conemaugh are sister plants sharing a similar configuration. EPA combined hourly emissions for both of Keystone's coal-fired units. Emission lines are labeled "measured" or "calculated" following the same conventions described previously. The modeled critical emission value, or CEV is also included on the figure. Pennsylvania's SIP modeling indicated Keystone's CEV was 9,711 lbs/hr. This represents the level where modeled emissions just meet the 1-hr SO_2 NAAQS. As the figure shows, Keystone's hourly SO_2 emissions do exceed its modeled CEV. Overall, Keystone's SO_2 emissions are consistently higher than the other KEY-CON modeled sources.

Figure 5.5-9. Keystone's Combined Unit CAMD SO_2 Emissions for 2019 through 2021

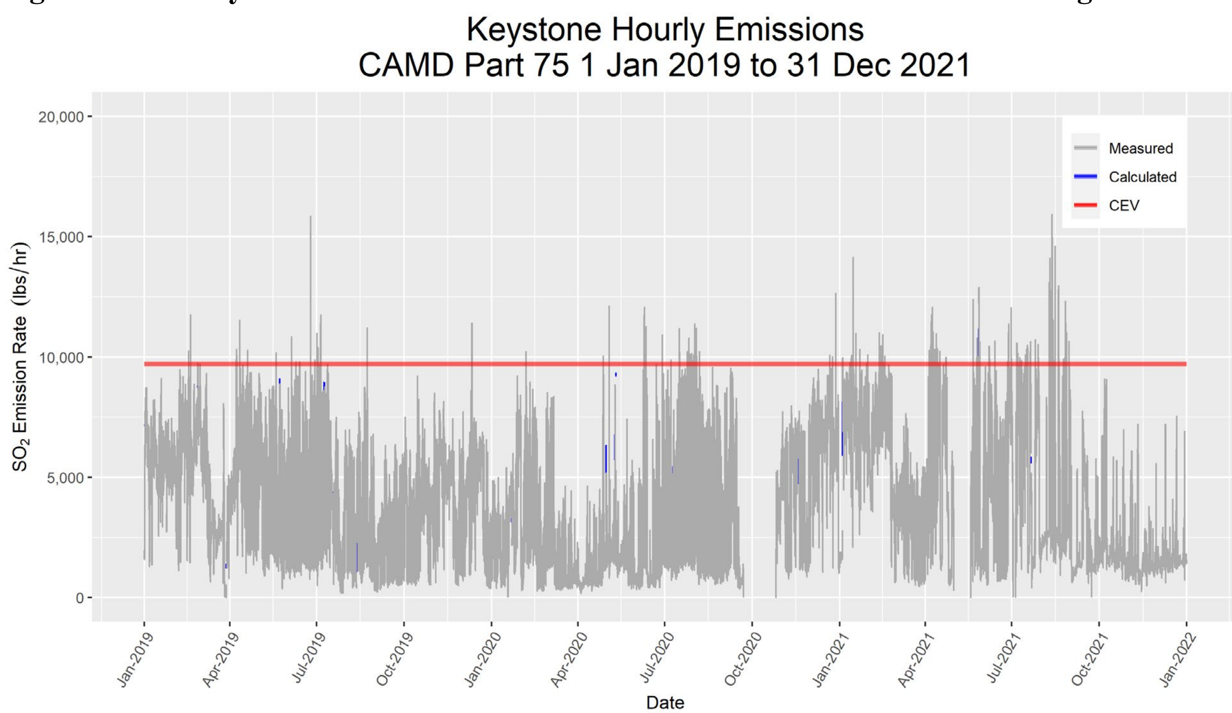
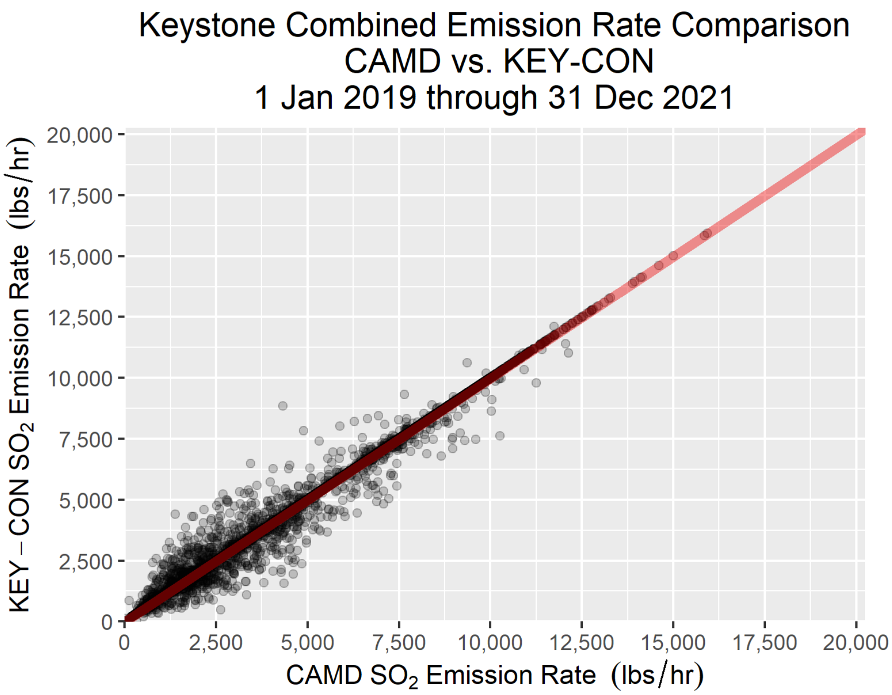


Figure 5.5-10 shows a comparison of hourly emissions over the 3-year simulation period. A 1-to-1 (red) tend line is also included on the figure. If the CAMD and KEY-CON's modeled hourly SO_2 emission rates are identical, then they will graph as a point along the 1-to-1 (red) trend line.

Hourly CAMD emissions and KEY-CON's modeled emission rates show a lot more spread around the 1-to-1 trend line than the other modeled sources. There is a total of 1,655 hours across the simulation period where differences between the CAMD reported hourly and KEY-CON modeled hourly SO_2 emissions are more than ±50 lbs/hr. The bulk of these differences occurred over the 2020 portion of the 3-year modeling period. The impact of these emission differences may be minor considering Keystone is over 40 km northwest of the Laurel Ridge.

Figure 5.5-10. Keystone's Combined CAMD versus KEY-CON Hourly SO_2 Emissions



Seward Modeled Hourly Emission Rates: Figure 5.5-11 shows Seward's CAMD hourly emissions over the KEY-CON model simulation period. Emission lines are labeled "measured" or "calculated" following the same conventions described previously. The modeled critical emission value, or CEV is also included on the figure. Pennsylvania's Supplemental Analysis modeling established Seward's CEV at 4,500 lbs/hr. This represents the level where modeled emissions just meet the 1-hr SO_2 NAAQS. As the figure shows, Seward's hourly SO_2 emissions occasionally exceed its modeled CEV.

Figure 5.5-11. Seward's CAMD SO_2 Emissions for 2019 through 2021

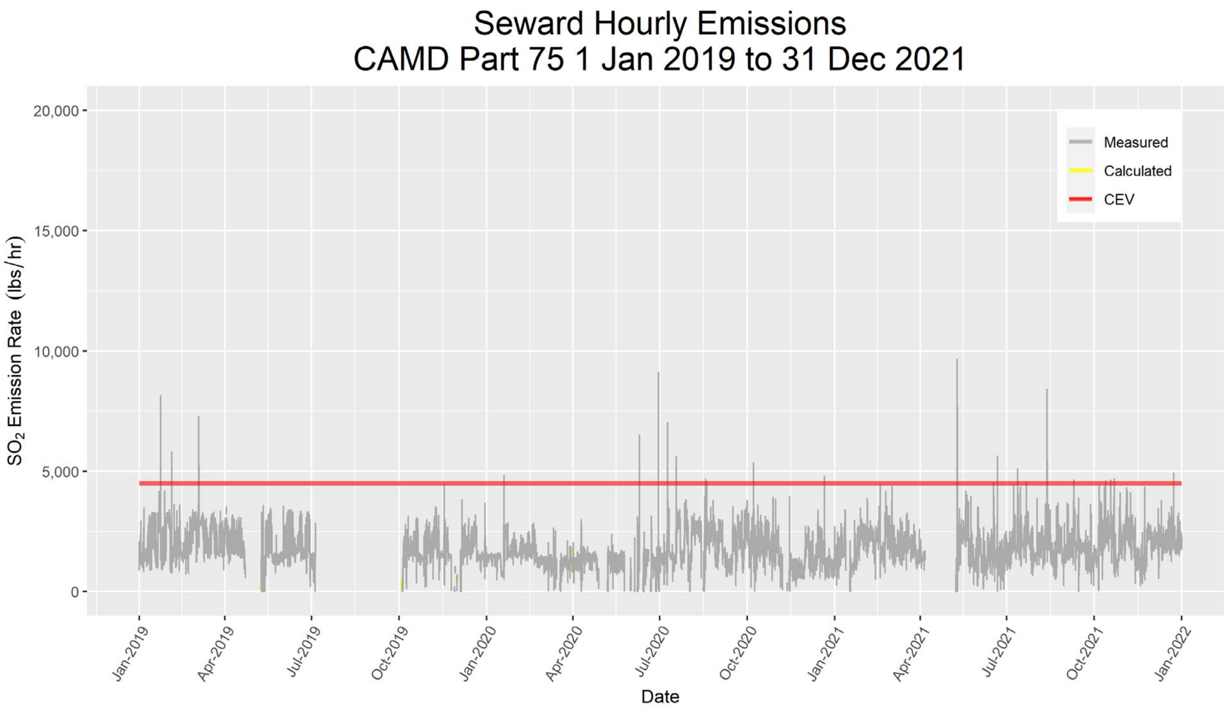
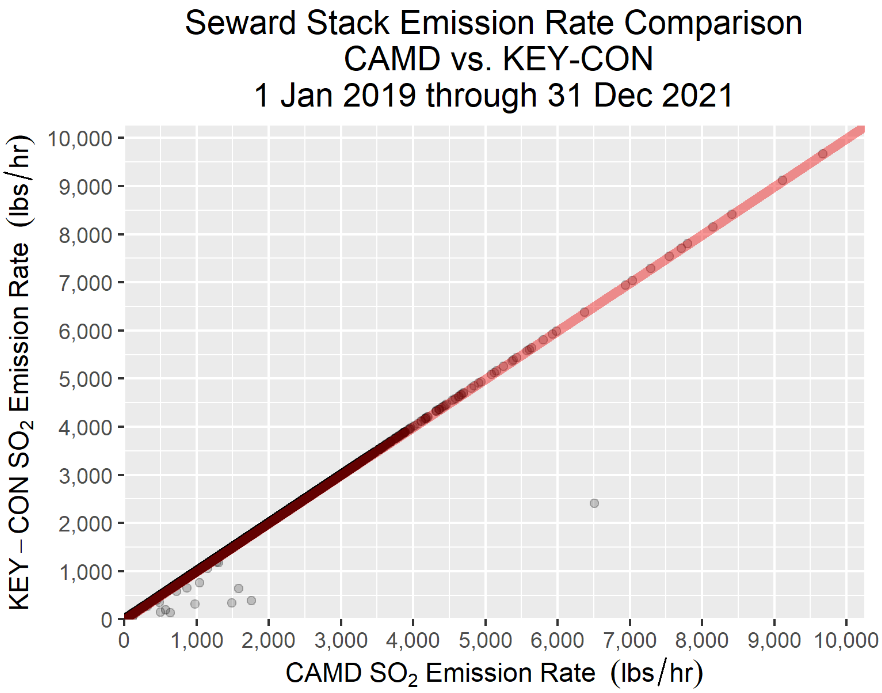


Figure 5.5-12 shows a comparison of hourly emissions over the 3-year simulation period. A 1-to-1 (red) tend line is also included on the figure. If the CAMD and KEY-CON's modeled hourly SO_2 emission rates are identical, then they will graph as a point along the 1-to-1 (red) trend line.

CAMD emissions and KEY-CON's modeled emission rates largely fall along the 1-to-1 trend line indicating good agreement. There only 9 hours across the simulation period where CAMD hourly SO_2 emissions were more than 50 lbs/hr higher than the KEY-CON modeled emission rates.

Figure 5.5-12. Seward's CAMD versus KEY-CON Hourly SO_2 Emissions



5.5.1.2. Meteorology and Surface Characteristics

KEY-CON used the site-specific meteorological data that EPA utilized for its modeling analysis. This data was collected and used for Pennsylvania's Supplemental Analysis for the southeast portion of the Indiana, PA nonattainment area near Conemaugh and Seward. It consists of 1 year (September 2015 – August 2016) of hourly surface observations from the on-site meteorological tower and SODAR along with 1 year of concurrent cloud cover data from the Johnstown-Cambria County airport (JST) and upper air data from Pittsburgh International Airport. AERSURFACE (version 20060) and AERMET (version 21112) were used to produce the final processed meteorological data

In general, the processing steps performed by KEY-CON largely resemble the processing steps completed for EPA's analysis as described in section 5.2.6. EPA notes the following differences between what EPA used in its analysis and KEY-CON's final processed meteorological data:

- an additional month of continuous snow cover (Feb 2016) was processed in AERSURFACE
- AERSURFACE was run using 12 equal (30°) sectors versus EPA's use of 8 surface varying sectors
- AERSURFACE utilized the USGS 1992 land use-land cover (LULC)

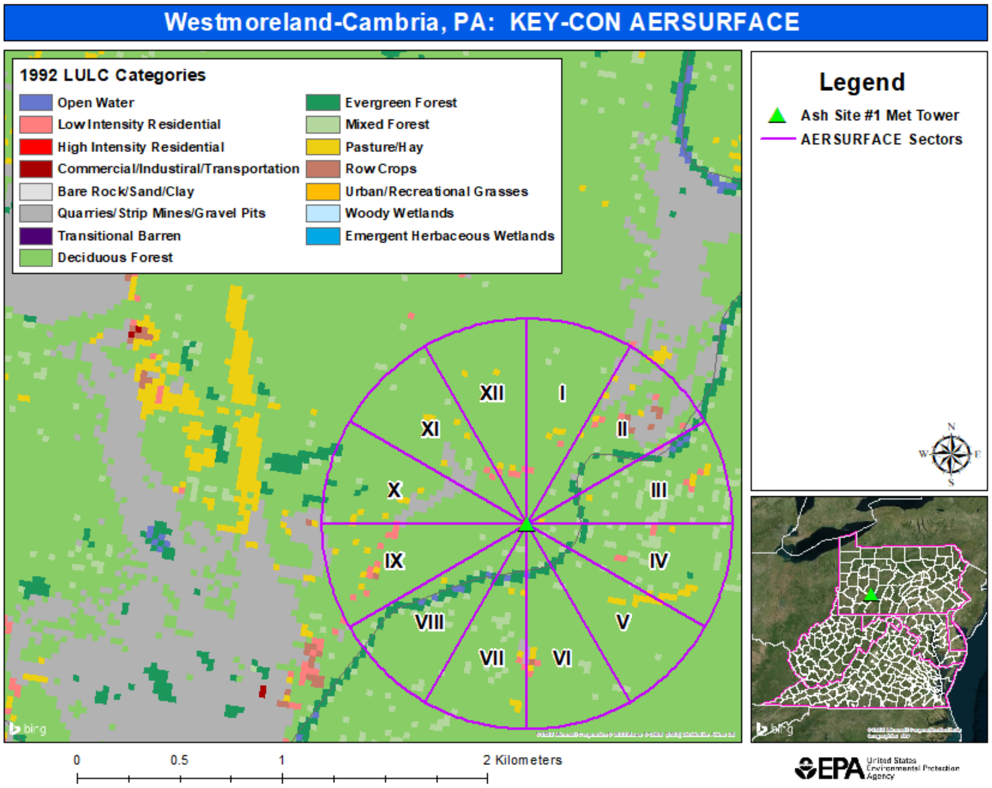
In regard to using the 1992 LULC data in AERSURFCE, KEY-CON's September 2020 protocol offers the following support for its decision:

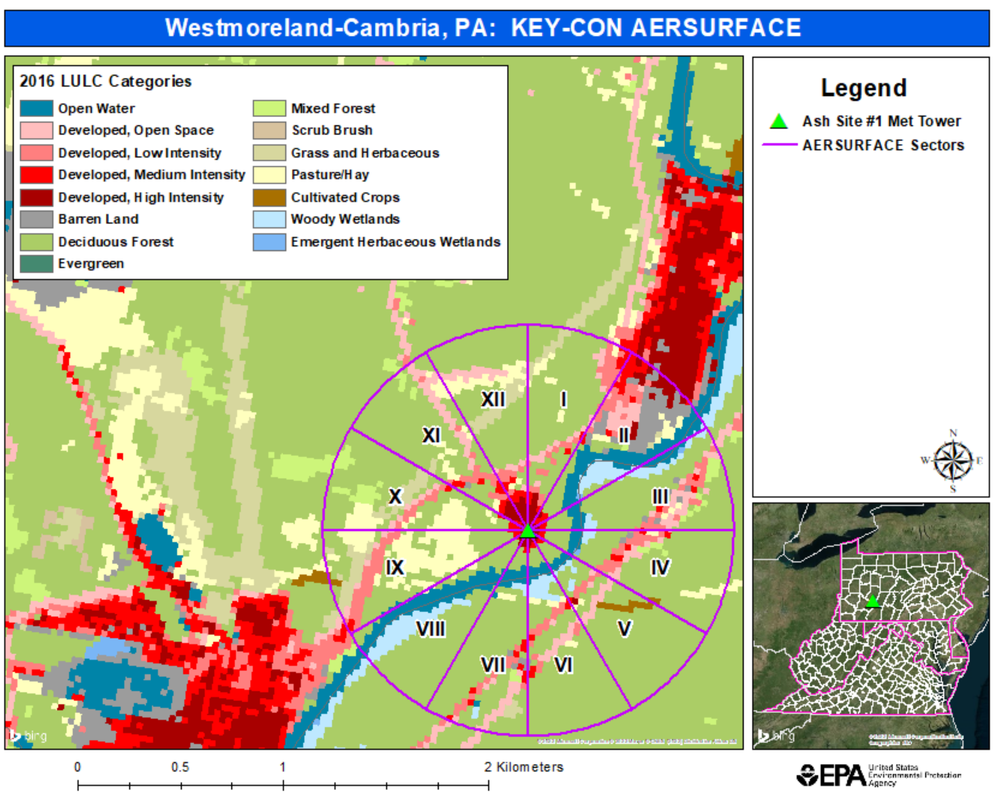
> *[O]ver the period from 1992 through 2016, the land cover has remained relatively unchanged, ... However, after visual inspection of the NLCD 1992 and 2016 datasets within 1 km of the on-site tower, there are significant differences noted. The most obvious difference is in the 2016 data the land cover being classified within approximately 150 m of the on-site tower is developed/high intensity. This apparent misclassification is typically reserved for highly industrialized areas and is not representative of the actual land cover. Accordingly, we are proposing to use the 1992 land cover data in this modeling for the AERSURFACE application, which the most representative and is consistent with previous modeling demonstrations for this area.*

Figure 5.5-13 shows both the 1992 and 2016 LULC classifications within 1 km of the site-specific met tower collection site (Ash Site #1). EPA generally recommends using LULC data sets that represent conditions at the time of the meteorological collection period. In this case, the 2016 LULC data would more closely match land use at the time of the site-specific meteorological collection period (1 Sep 2015 through 31 Aug 2016).

While we note KEY-CON's odd LULC categories near the Ash Site #1 met tower, we'd also counter that the ash landfill should not be covered with deciduous forest as shown in the 1992 LULC data (assuming woody vegetation is prohibited on a capped disposal area). Additionally, the Seward power plant (in sector II) was rebuilt in the early 2000s and therefore not correctly captured using the 1992 LULC data. We would also point out that the Conemaugh River area and associated wetlands are poorly defined in the 1992 LULC dataset.

Figure 5.5-13. Land Use Land Cover Within 1-km of the Ash Site #1 Meteorological Tower





EPA reprocessed the AERSURFACE processing using the 2016 LULC (and impervious surface and tree canopy information) following the sector definitions chosen by KEY-CON. Surface moisture conditions and snow cover were entered into AERSURFACE's CLIMATE keyword following KEY-CON's September 2020 modeling protocol. Table 5.5-3 summarizes the AERSURFACE CLIMATE settings over the site-specific simulation period.

Table 5.5-3. KEY-CON AERSURFACE CLIMATE Keyword Settings

KEY-CON AERSURFACE CLIMATE Keyword Settings		
Date	**Surface Moisture**	**Snow Cover**
Sep 2015	AVG	
Oct 2015	AVG	
Nov 2015	DRY	
Dec 2015	WET	
Jan 2016	DRY	SNOW
Feb 2016	DRY	SNOW
Mar 2016	DRY	
Apr 2016	DRY	
May 2016	AVG	
Jun 2016	AVG	
Jul 2016	DRY	
Aug 2016	WET	

AERSURFACE (version 20060) was rerun for each of the CLIMATE keyword categories covering the site-specific collection period. Results were then processed in R so that comparisons between the 1992 LULC and 2016 LULC data sets could be made for AERSURFACE determined albedo, Bowen ratio and surface roughness lengths.

Table 5.5-4 shows the AERSURFACE generated albedo values using the 1992 LULC and 2016 LULC data sets. Albedo values are determined by a simple geometric mean of the values of the individual grid cells that make up the 10 km x 10 km area centered on the measurement site. The same value is used for all sectors so only the monthly values are displayed on the table.

There are only small variations in the Albedo values between the 1992 and 2016 LULC data sets. These are not expected to have much impact on AERMOD concentrations once they are processed in AERMET.

Table 5.5-4. AERSURFACE Generated Albedo Values for the 1992 and 2016 LULC Data Sets

KEY-CON AERSURFACE Albedo Comparison		
Month	Albedo 1992 LULC	Albedo 2016 LULC
1	0.50	0.49
2	0.50	0.49
3	0.17	0.17
4	0.16	0.15
5	0.16	0.15
6	0.16	0.16
7	0.16	0.16
8	0.16	0.16
9	0.16	0.16
10	0.16	0.16
11	0.17	0.17
12	0.17	0.17

Table 5.5-5 shows the AERSURFACE generated Bowen ratio values using the 1992 LULC and 2016 LULC data sets. Bowen ratio values are determined using the same methodology as the albedo values described previously; a simple geometric mean of the values of the individual grid cells that make up the 10 km x 10 km area centered on the measurement site. As with albedo, the same value is used for all sectors so only the monthly values are displayed on the table.

Table 5.5-5. AERSURFACE Generated Bowen Ratio Values for the 1992 and 2016 LULC Data Sets

KEY-CON AERSURFACE Bowen Ratio Comparison		
Month	Bowen Ratio 1992 LULC	Bowen Ratio 2016 LULC
1	0.50	0.49
2	0.50	0.49
3	1.98	1.87
4	1.47	1.37
5	0.66	0.61
6	0.33	0.34
7	0.68	0.72
8	0.22	0.22
9	0.96	0.90
10	0.96	0.90
11	1.98	1.87
12	0.41	0.39

Bowen ratio values also do not appear to vary significantly between the 1992 and 2016 LULC data sets. Differences of this magnitude should not impact final AERMOD concentrations once they are processed in AERMET.

Surface roughness lengths are based on inverse distance-weighted geometric means. The mean is calculated from the roughness values associated with the land cover category that defines each land cover grid cell within the area or individual sectors out to a fixed radial distance from the meteorological tower. KEY-CON used the 1 km recommended and default radial in its AERSURFACE processing.

AESURFACE sector and monthly varying surface roughness lengths (z0) for both the 1992 and 2016 LULC data sets are summarized in Table 5.5-6a-c. Unlike the albedo and Bowen ratio values, there appears to be significant differences between values extracted from the 1992 LULC data set and values from the 2016 LULC data sets. In general, the 1992 LULC data set yields higher surface roughness lengths than the 2016 LULC data set (complimented with impervious surface and tree canopy data). Sectors 10 and 11 are highlighted since these cover the wind directions that are most likely to impact AERMOD concentrations along the Laurel Ridge.

Table 5.5-6a. AERSURFACE Generated Surface Roughness Lengths (z0) for the 1992 and 2016 LULC Data Sets

Months 1-4 (Jan – Apr)

KEY-CON AERSURFACE Surface Roughness Lengths															
Month	Sector	z0 1992 LULC	z0 2016 LULC	Month	Sector	z0 1992 LULC	z0 2016 LULC	Month	Sector	z0 1992 LULC	z0 2016 LULC	Month	Sector	z0 1992 LULC	z0 2016 LULC
1	1	0.476	0.250	2	1	0.476	0.250	3	1	0.573	0.317	4	1	0.949	0.489
1	2	0.422	0.039	2	2	0.422	0.039	3	2	0.493	0.060	4	2	0.724	0.073
1	3	0.456	0.156	2	3	0.456	0.156	3	3	0.546	0.197	4	3	0.844	0.283
1	4	0.501	0.221	2	4	0.501	0.221	3	4	0.597	0.277	4	4	0.945	0.415
1	5	0.474	0.267	2	5	0.474	0.267	3	5	0.572	0.329	4	5	0.928	0.488
1	6	0.507	0.197	2	6	0.507	0.197	3	6	0.606	0.247	4	6	0.975	0.367
1	7	0.455	0.177	2	7	0.455	0.177	3	7	0.541	0.219	4	7	0.847	0.327
1	8	0.494	0.114	2	8	0.494	0.114	3	8	0.579	0.133	4	8	0.891	0.189
1	9	0.467	0.078	2	9	0.467	0.078	3	9	0.561	0.115	4	9	0.921	0.183
1	10	0.453	0.140	2	10	0.453	0.140	3	10	0.538	0.194	4	10	0.849	0.320
1	11	0.456	0.212	2	11	0.456	0.212	3	11	0.543	0.275	4	11	0.865	0.401
1	12	0.462	0.183	2	12	0.462	0.183	3	12	0.557	0.241	4	12	0.920	0.385

Table 5.5-6b. AERSURFACE Generated Surface Roughness Lengths (z0) for the 1992 and 2016 LULC Data Sets

Months 5-8 (May – Aug)

KEY-CON AERSURFACE Surface Roughness Lengths															
Month	Sector	z0 1992 LULC	z0 2016 LULC	Month	Sector	z0 1992 LULC	z0 2016 LULC	Month	Sector	z0 1992 LULC	z0 2016 LULC	Month	Sector	z0 1992 LULC	z0 2016 LULC
5	1	0.949	0.489	6	1	1.248	0.643	7	1	1.248	0.643	8	1	1.248	0.643
5	2	0.724	0.073	6	2	0.932	0.084	7	2	0.932	0.084	8	2	0.932	0.084
5	3	0.844	0.283	6	3	1.119	0.346	7	3	1.119	0.346	8	3	1.119	0.346
5	4	0.945	0.415	6	4	1.232	0.531	7	4	1.232	0.531	8	4	1.232	0.531
5	5	0.928	0.488	6	5	1.233	0.630	7	5	1.233	0.630	8	5	1.233	0.630
5	6	0.975	0.367	6	6	1.268	0.474	7	6	1.268	0.474	8	6	1.268	0.474
5	7	0.847	0.327	6	7	1.100	0.411	7	7	1.100	0.411	8	7	1.100	0.411
5	8	0.891	0.189	6	8	1.122	0.227	7	8	1.122	0.227	8	8	1.122	0.227
5	9	0.921	0.183	6	9	1.210	0.369	7	9	1.210	0.369	8	9	1.210	0.369
5	10	0.849	0.320	6	10	1.100	0.547	7	10	1.100	0.547	8	10	1.100	0.547
5	11	0.865	0.401	6	11	1.119	0.541	7	11	1.119	0.541	8	11	1.119	0.541
5	12	0.920	0.385	6	12	1.215	0.549	7	12	1.215	0.549	8	12	1.215	0.549

Table 5.5-6c. AERSURFACE Generated Surface Roughness Lengths (z0) for the 1992 and 2016 LULC Data Sets

Months 9-12 (Sep – Dec)

Month	Sector	z0 1992 LULC	z0 2016 LULC	Month	Sector	z0 1992 LULC	z0 2016 LULC	Month	Sector	z0 1992 LULC	z0 2016 LULC	Month	Sector	z0 1992 LULC	z0 2016 LULC
9	1	1.248	0.622	10	1	1.248	0.622	11	1	0.573	0.317	12	1	0.573	0.317
9	2	0.932	0.081	10	2	0.932	0.081	11	2	0.493	0.060	12	2	0.493	0.060
9	3	1.119	0.336	10	3	1.119	0.336	11	3	0.546	0.197	12	3	0.546	0.197
9	4	1.232	0.518	10	4	1.232	0.518	11	4	0.597	0.277	12	4	0.597	0.277
9	5	1.233	0.617	10	5	1.233	0.617	11	5	0.572	0.329	12	5	0.572	0.329
9	6	1.268	0.461	10	6	1.268	0.461	11	6	0.606	0.247	12	6	0.606	0.247
9	7	1.100	0.403	10	7	1.100	0.403	11	7	0.541	0.219	12	7	0.541	0.219
9	8	1.122	0.227	10	8	1.122	0.227	11	8	0.579	0.133	12	8	0.579	0.133
9	9	1.210	0.362	10	9	1.210	0.362	11	9	0.561	0.115	12	9	0.561	0.115
9	10	1.100	0.538	10	10	1.100	0.538	11	10	0.538	0.194	12	10	0.538	0.194
9	11	1.119	0.520	10	11	1.119	0.520	11	11	0.543	0.275	12	11	0.543	0.275
9	12	1.215	0.533	10	12	1.215	0.533	11	12	0.557	0.241	12	12	0.557	0.241

5.5.1.3. Aera of Analysis/Receptor Grid

KEY-CON's model receptor grid was detailed in it September 2020 modeling protocol provided to Pennsylvania and EPA Region 3. It describes the model receptor grid construction as follows:

[T]he receptor grid is centered at approximately the center point between Seward and Conemaugh Stations and extends outward approximately 10 km to areas outside Indiana County. Receptors throughout the modeling domain are spaced no more than 100 m apart. Receptors in areas expected to be associated with peak modeled impacts have been spaced at 25-m intervals, as shown in the figure.
Elevations and receptor height scales (used in AERMOD) are developed by AERMAP, the terrain preprocessor for AERMOD, which requires processing of terrain data files. The height scale is the terrain elevation in the vicinity of a receptor that is used in the critical dividing streamline height calculation for interaction of the plume with terrain.
The current version of AERMAP has the ability to process USGS National Elevation Dataset (NED) data in place of Digital Elevation Model files. The appropriate file for 1/3-arc-second, or 10-m, NED data was obtained from the Multi-Resolution Land Characteristics Consortium (MRLC) link at http://www.mrlc.gov/viewerjs/.

Figure 5.5-14 shows an overview of the KEY-CON modeling grid along with the primary SO_2 sources included in the modeling analysis. Overall, the grid has 34,040 receptors. A close up view around the Conemaugh and Seward power plants is shown in Figure 5.5-15. This shows the model receptor grid density along the Laurel Ridge to the southeast of the power plants. As noted previously, Model receptor spacing is 100 m throughout the modeling domain with a 25-m spaced Cartesian grid placed on portions of the Laurel Ridge (with the highest model concentrations). This finer grid should ensure peak model concentrations are captured in KEY-CON's modeling analysis.

Figure 5.5-14. KEY-CON Model Receptor Grid and Primary Modeled SO_2 Sources

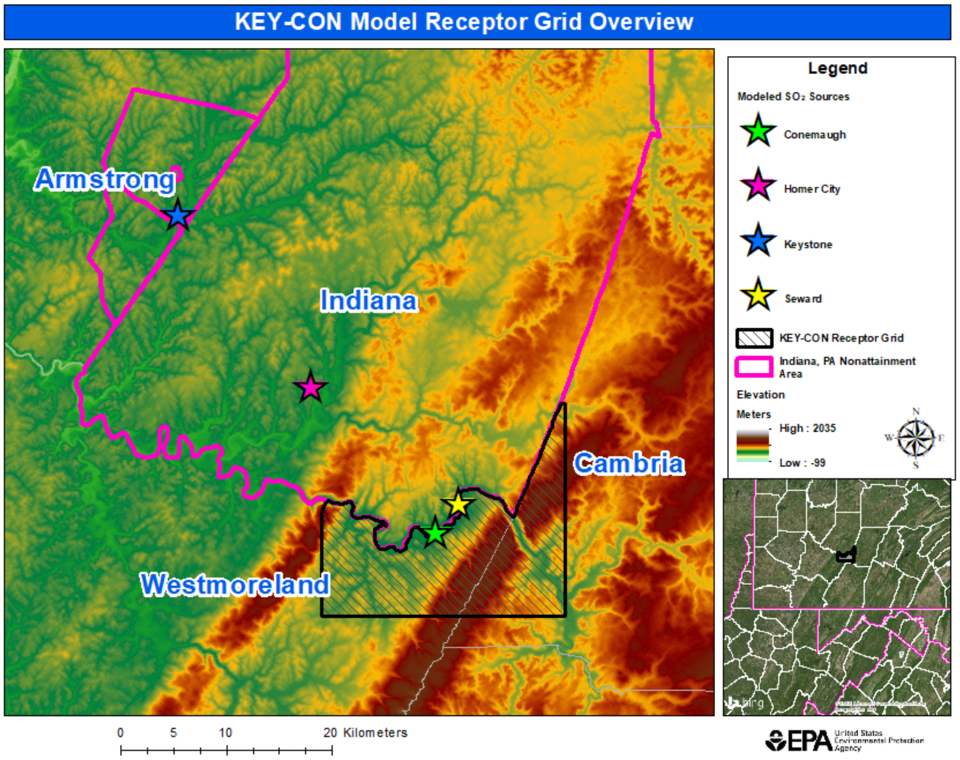
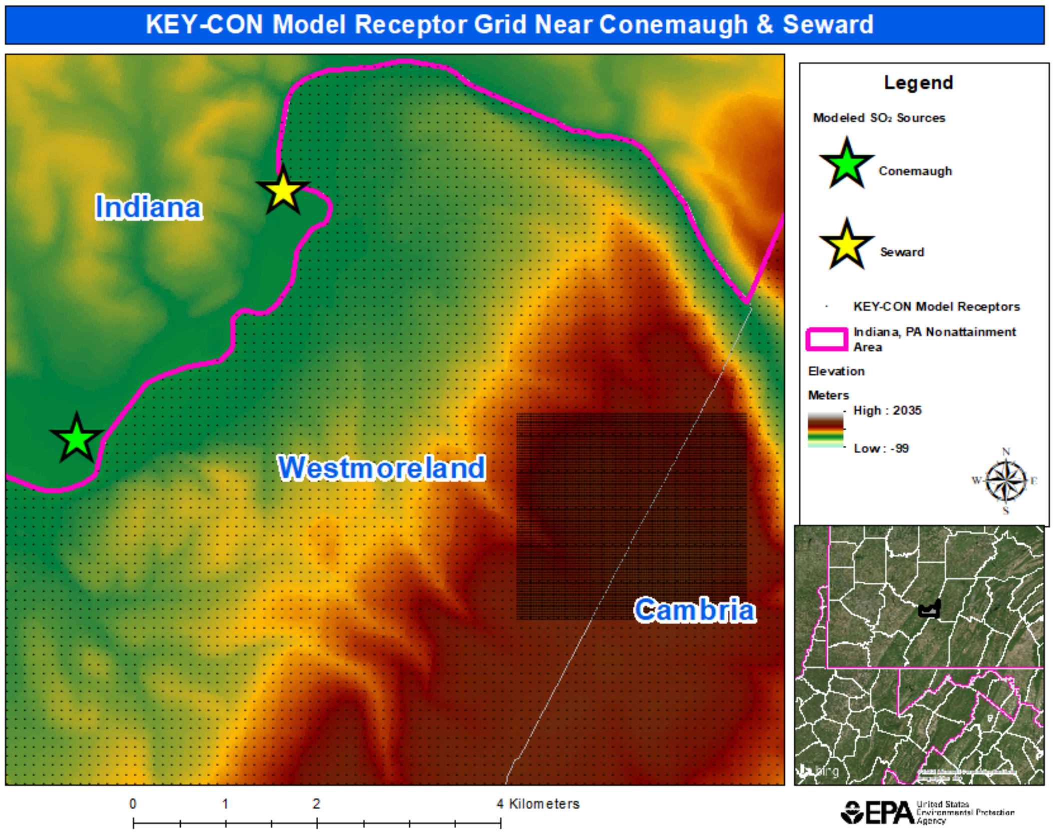


Figure 5.5-15. KEY-CON Model Receptor Grid and Primary Modeled SO_2 Sources



5.5.1.4. Background Concentration

KEY-CON's modeling analysis included a season by hour of day varying background concentration. This follows the background concentration construction method outlined in EPA's March 1, 2011 1-hour NO_2 clarification memo for use of a temporally varying background concentrations. Season by hour of day 1-hr SO_2 background concentrations were taken from the South Fayette monitor located in Allegheny County. KEY-CON's AERMOD input file identifies the monitor and period (2019-21) used to develop the model background concentration.

EPA downloaded hourly SO_2 concentrations for the South Fayette monitor using R's RAQSAPI's library for the 2019-21 time period. We used R to configure the season by hour of day 1-hr SO2 background concentrations in accordance with our March 1, 2011 guidance. Table 5.5-7 summarizes EPA's constructed season by hour of day background concentrations from South Fayette's 2019-21 monitor values. The values shown in EPA's table generally match the values KEY-CON used in their AERMOD input file. We note that KEY-CON's season by hour of day background concentrations (in parts per billion or ppb) were entered to 2 decimal places. Our values, also in ppb, preserve 1 decimal place. EPA's table also includes information on the number of missing and total hours available.

Table 5.5-7. EPA Constructed 2019-21 Season by Hour of Day Background Concentrations for the South Fayette, PA Monitor Located in Allegheny County.

	Winter			Spring			Summer			Fall		
South Fayette, PA (42-003-0067): 2019-21 Background SO2 Concentrations (ppb) by Season/Hour of Day												
Hour	Average	Missing	Total Hours	Average	Missing	Total Hours	Average	Missing	Total Hours	Average	Missing	Total Hours
1	2.3	0	271	2.3	0	276	2.0	0	276	2.7	0	273
2	3.3	0	271	2.3	0	276	2.0	0	276	2.7	0	273
3	3.0	0	271	2.7	0	276	1.7	0	276	2.0	0	273
4	3.7	0	271	3.7	0	276	2.0	0	276	2.0	0	273
5	3.0	0	271	2.0	0	276	1.7	0	276	2.3	0	273
6	3.7	0	271	2.7	0	276	2.0	0	276	2.0	0	273
7	2.7	0	271	3.0	0	276	2.3	0	276	2.0	0	273
8	3.0	0	271	3.3	6	276	3.3	8	276	2.7	6	273
9	3.7	2	271	3.3	3	276	3.3	1	276	2.3	0	273
10	4.0	1	271	3.0	12	276	3.0	23	276	3.0	10	273
11	5.7	9	271	3.0	25	276	3.0	21	276	3.0	24	273
12	4.7	27	271	3.0	14	276	3.0	6	276	3.0	14	273
13	4.7	13	271	2.3	7	276	3.0	5	276	4.3	8	273
14	4.7	6	271	2.0	1	276	3.3	4	276	4.0	2	273
15	4.0	1	271	2.3	1	276	3.3	4	276	2.7	0	273
16	4.7	0	271	2.0	0	276	4.0	2	276	2.7	0	273
17	3.3	1	271	2.3	0	276	5.0	1	276	3.7	0	273
18	3.7	0	271	2.3	0	276	5.0	0	276	4.0	0	273
19	3.7	0	271	3.3	0	276	4.3	0	276	2.7	0	273
20	4.0	0	271	3.3	0	276	4.0	0	276	2.3	0	273
21	2.7	0	271	3.0	0	276	3.7	0	276	2.0	0	273
22	4.3	0	271	2.0	0	276	2.7	0	276	2.7	0	273
23	3.3	0	271	2.7	0	276	3.0	0	276	2.7	0	273
24	3.3	0	271	2.3	0	276	2.0	0	276	2.7	0	273

5.5.1.5. KEY-CON Model Results

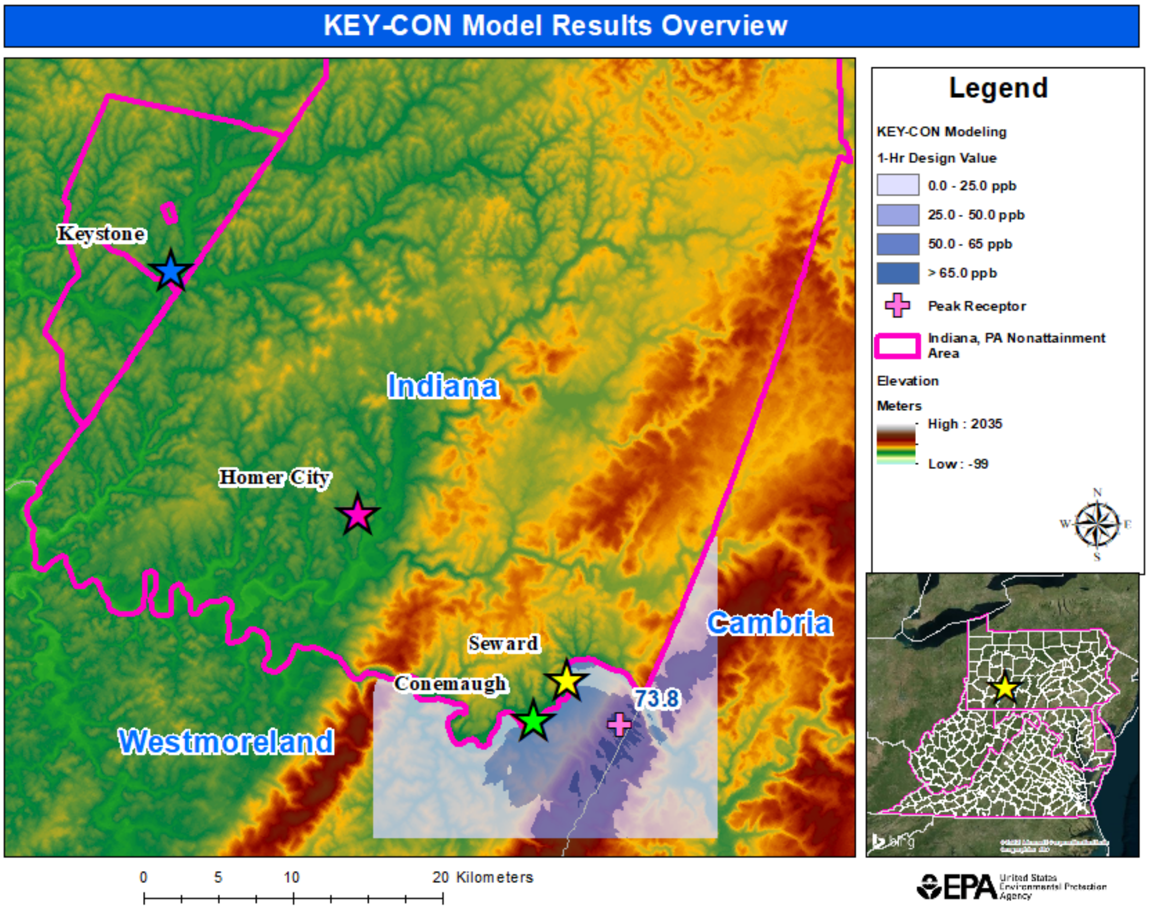
KEY-CON's modeling generally followed EPA's Modeling TAD. EPA reviewed the modeling with actual 2019-21 SO_2 emissions from all 4 Indiana, PA nonattainment area sources. KEY-CON's modeling analysis was confined to portions of Westmoreland and Cambria counties adjacent to the Indiana, PA nonattainment area.

Figure **5.5-16** shows KEY-CON's 2019-21 modeled 1-hr SO_2 design values over its entire modeling domain. KEY-CON's AERMOD concentrations were converted to parts per billion or ppb by multiplying the model concentrations by a conversion factor; 75 ppb over 196.4 $\mu g/m^3$. Model concentrations are overlain over the local topographic elevations.

Model 1-hr SO_2 design values are highest along the Laurel Ridge southeast of Conemaugh and Seward as noted in Figure 5.5-16. The peak receptor had a modeled design value of 73.8 ppb. KEY-CON's modeled design values are just below the 1-hr SO_2 NAAQS (75 ppb) along the

Laurel Ridge facing Conemaugh and Seward. We note that KEY-CON's 25-m or fine Cartesian grid doesn't extend along the entire ridge. It may be possible that there are other model peaks occuring along the Laurel Ridge that may exceed KEY-CON's peak model values.

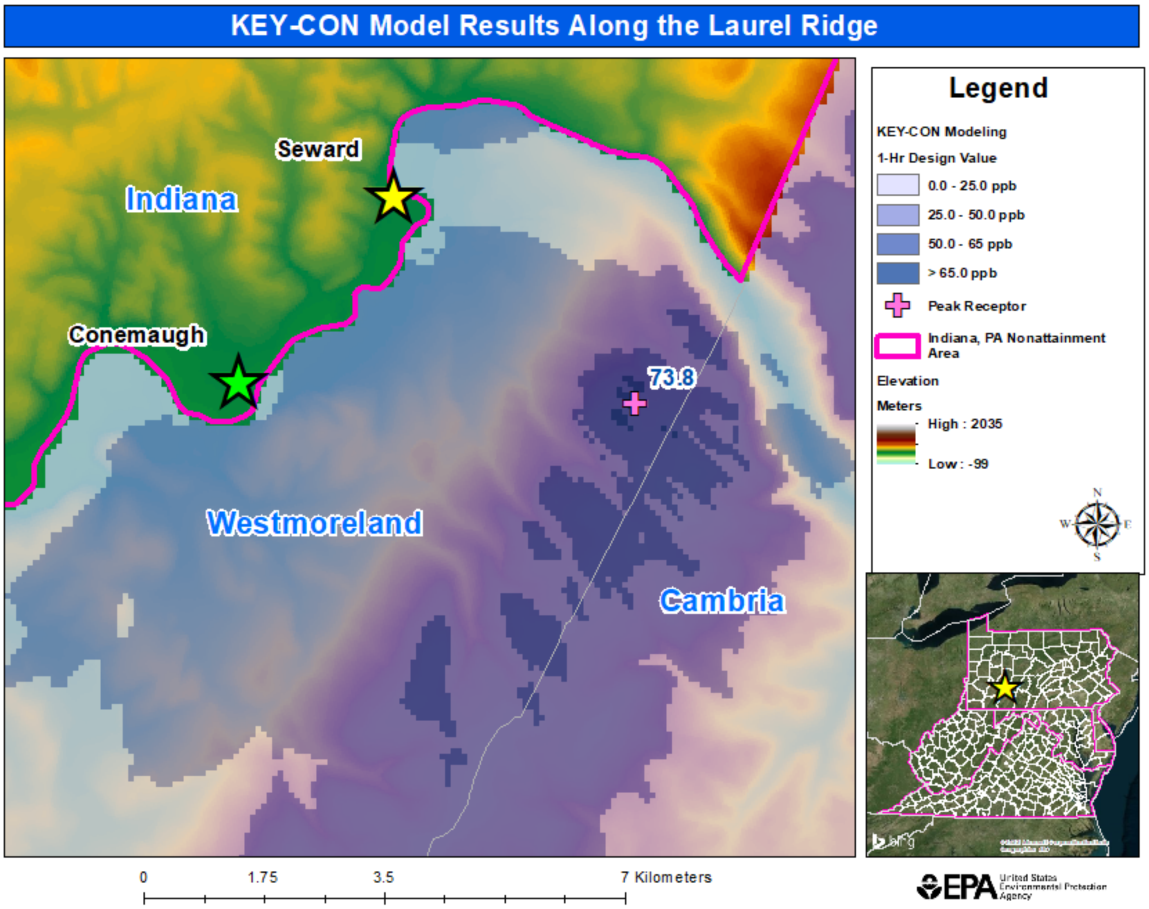
Figure 5.5-16. KEY-CON AERMOD Results for All Sources Plus Background



As noted previously, EPA believes KEY-CON used an outdated LULC (1992) data set in its meteorological data processing. Section 5.5.1.2 outlines the differences between this data set and the more up to date 2016 LULC data set that, in EPA's opinion, is more reflective of conditions that were present during the site-specific meteorological data collection period.

EPA reran KEY-CON's analysis using the 2016 LULC data in the meteorological preprocessing to see what difference using the more up to date land used information had on peak model design values. The final peak model design value (not shown) along the Laurel Ridge was 76.4 ppb or just slightly above the 1-hr SO_2 NAAQS. It appears the 2016 LULC (smaller) surface roughness lengths, shown in Table 5.5-6a-c, increased final model concentrations by about 3.6%. This value is roughly in line with EPA's modeling analysis using the site-specific turbulence data (to be discussed in section 5.5.3). EPA's analysis differs slightly from KEY-CON using slightly different meteorological processing steps, a different model receptor grid, a different 3-year emission period and different background concentrations. Despite these differences EPA's final model design value (using the site specific turbulence data), 77.3 ppb, was very close to the value derived using KEY-CON's analysis with the 2016 LULC data.

Figure 5.5-17. KEY-CON AERMOD Results Along the Laurel Ridge



5.5.2. Sierra Club

Sierra Club conducted air modeling impact analysis to determine if large emission sources are causing exceedances of the 1-hour SO_2 NAAQS. This section provides a brief summary of the modeling analysis, results and procedures for evaluating emissions from the Seward Generating Station (Seward) in Seward, Pennsylvania and Conemaugh Generating Station (Conemaugh) in New Florence, Pennsylvania. Both plants are located in Indiana County. This analysis determined if the plants contribute to exceedances of the NAAQS in and around the Indiana County nonattainment area.

EPA summarized Sierra Club's modeling analysis based on the report summary provided in the comment period (Exhibit 4) from Wingra Engineering, dated 13 April 2022. EPA's summary assessment is also based on a review of the modeling files submitted during the public comment period.

5.5.2.1. Modeled Emissions/Stack Parameters

Actual hourly emission rates for the Conemaugh and Seward power plants were used for Sierra Club's modeling analysis. Because emission rates from either of the facilities' continuous emissions monitoring systems (CEM) were not publicly available, the Sierra Club modeling analysis relied on hourly emissions data from EPA's CAMD database. Source emissions were modeled for 5 distinct 3-year periods: 2015-17, 2016-18, 2017-2019, 2018-20, and 2019-21. EPA's summary focuses on the last 3-year (2019-21) period for its assessment. The other 3-year simulation periods had higher final modeled concentrations (along the Laurel Ridge) and may indicate over time that there were some reductions in Seward's actual hourly SO_2 emissions as noted by EPA in its Remand documentation.

Physical stack parameters, such as stack base elevation, stack heights and stack diameter were obtained from the December 2019 report prepared by AECOM for the Conemaugh and Seward power plants. Pennsylvania's Supplemental Analysis was focused on the areas in the southeast portion of the Indiana, PA nonattainment area where Sierra Club's previous modeling had identified 1 area along the Laurel Ridge inside the Indiana, PA nonattainment area that exceeded the 1-hr SO_2 NAAQS.

The Sierra Club model input files did not explicitly name the 2 sources that were modeled; they were referred to in the input model input files as source "S01" and "S09". EPA matched the stack location and elevation parameters with the Supplemental Modeling input files to identify source "S01" as Conemaugh's merged FGD stack and source "S09" as Seward's combine CFB units' stack. EPA verified that Sierra Club's location, stack base elevation matched what was in Pennsylvania's Supplemental Analysis modeling input file.

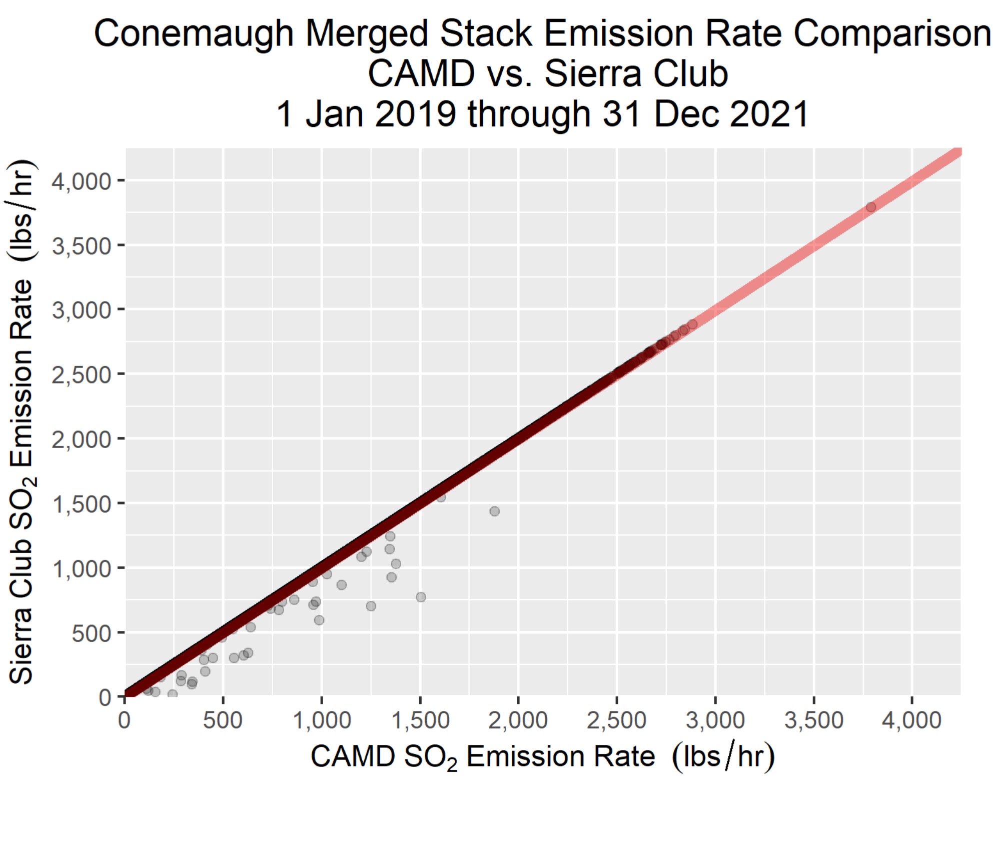
Modeled stack diameters for Seward were identical for the Sierra Club and Supplement Modeling input files. Sierra Club used Conemaugh's Supplemental Modeling analysis' merged (FGD) stack diameter. Conemaugh's FGD stack has 2 individual flues (each with 7.32 meter stack diameters) that service each individual coal-fired boiler units. Using the merged stack diameter may impact final model concentrations since their combined flow rates were used to estimate hourly stack emissions. This is especially important for hours when only one of Conemaugh's coal-fired units is operating. Passing the CAMD flow rates through a merged stack diameter, which is intended to be used when both units are on simultaneously, probably underestimates stack velocity (and increases modeled concentrations).

EPA examined the Sierra Club's hourly emission file, which included hourly varying emission rates, stack temperature and stack velocity inputs into AERMOD. Hourly emissions rates were compared with the corresponding measurements for Conemaugh and Seward that EPA downloaded using its CAMD FACT software for the 2019 through 2021 time period. Each source will be examined separately in the following sections.

Conemaugh Modeled Hourly Emission Rates: Hourly emissions from Sierra Club's AERMOD input file and CAMD were processed using R so that they could be directly compared over the 3-year simulation period (1 Jan 2019 through 31 Dec 2021). Note that AERMOD inputs utilized metric units while CAMD reports in Imperial units. Conversions were made to the AERMOD input file to convert all hourly emission rates to pounds per hour (versus grams per second) using National Institute of Standards and Technology or NIST conversion factors. EPA utilized information on instrument validity (MODC discussed previously) to identify hours with valid measurements, referred to as "measured" versus invalid hours which are referred to as "calculated". Unless otherwise noted, most comparisons were limited to hours CAMD identified as "measured". Total "calculated" hours are generally limited to less than 100 hours over the 3-year simulation period. Therefore, excluding these hours is not important as far as identifying any serious potential differences between Sierra Club's modeled emission rates and ones from the CAMD database.

Conemaugh's hourly CAMD SO_2 emission rates over the 2019 to 2021 simulation period were shown in the KEY-CON section and for brevity are omitted here. Figure 5.5-17 shows a comparison of hourly emissions over the 3-year simulation period. A 1-to-1 (red) tend line is also included on the figure. If the CAMD and Sierra Club's modeled hourly SO_2 emission rates are identical, then they will graph as a point along the 1-to-1 (red) trend line.

Figure 5.5-17. Conemaugh's CAMD versus Sierra Club Hourly SO_2 Emissions



Hourly CAMD emissions and the Sierra Club's modeled emission rate show, for the most part, a good match between Sierra Club's modeled emission rates and CAMD. There only 18 hours across the simulation period where CAMD hourly SO_2 emissions were more than 50 lbs/hr higher than the Sierra Club's modeled emission rates. We note that the Sierra Club's hourly SO_2

emission rates for Conemaugh are nearly identical to the hourly SO_2 emission rates used by KEY-CON.

Conemaugh Modeled Hourly Stack Temperatures: In general, hourly stack temperatures and stack velocities are only available from stack CEMS units, which are not usually available for public examination. Sierra Club' modeling utilized a constant stack temperature for Conemaugh's FGD (merged) stack. A stack temperature of 325 K was selected based on Table 2-2 from Pennsylvania's Supplemental Analysis' model documentation. EPA confirmed this temperature by reviewing the Supplemental Analysis documentation and Sierra Club's model input file. For comparison, KEY-CON's modeled stack temperatures (based on CEMS data) for Conemaugh ranged from 291.074 K to 327.928 K with a mean of 322.6 K. Based on this comparison, Sierra Club's modeled stack temperature for Conemaugh seems reasonable.

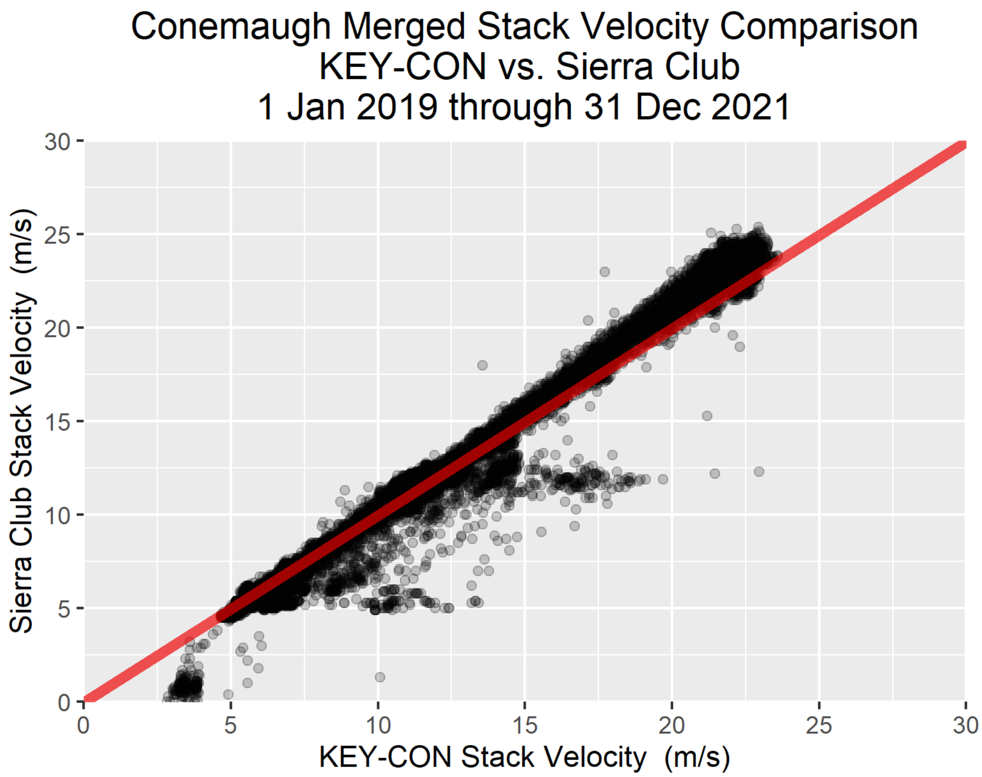
Conemaugh Modeled Hourly Stack Velocities: Sierra Club's construction of Conemaugh's (merged FGD) modeled hourly varying stack velocities is described on page 4 of its modeling documentation (Exhibit 4). Supporting spreadsheets were provided by the Sierra Club to show how it constructed a flow to heat input ratio to determine modeled exit (stack) velocities.

EPA compared Sierra Club's modeled hourly stack velocities (in meters per second or m/s) to the corresponding hours from the KEY-CON simulation. KEY-CON's hourly stack velocities for Conemaugh's (merged FGD) stack were based on CEMS data. EPA combined the CAMD and KEY-CON hourly emissions to eliminate hours with invalid flow MODC to ensure only hours with valid flow data (according to CAMD) were compared. There are 23,783 hours identified with "measured" values. The simulation period included a total of 26,304 hours, the difference being hours with both of Conemaugh's units off or having "calculated" values.

Figure 5.5-18 shows a comparison of the Sierra Club's stack velocity for Conemaugh versus the corresponding hour value from the KEY-CON input files. A 1-to-1 (red) trend line is added onto the graph. Hourly stack velocities on or close to the 1-to-1 (red) trend line indicate Sierra Club's modeled stack velocity is or is nearly identical to the CEMS based stack velocity (from KEY-CON).

Overall, the Sierra Club's stack velocities appear to exceed ones based on Conemaugh's CEMS data. There is a slight overestimation bias of about 0.398 m/s. We also note that the Sierra Club's stack velocities on the upper end of the distribution appear to be above the corresponding CEMS values. This could mean Sierra Club's stack velocities are biased high when the units are near maximum operations (and correspondingly at their maximum emission rates). Both of these observations may lead to model underpredictions since higher stack velocities are generally associated with lower dispersion model concentrations.

Figure 5.5-18. Conemaugh's KEY-CON versus Sierra Club Hourly Stack Velocity Comparison



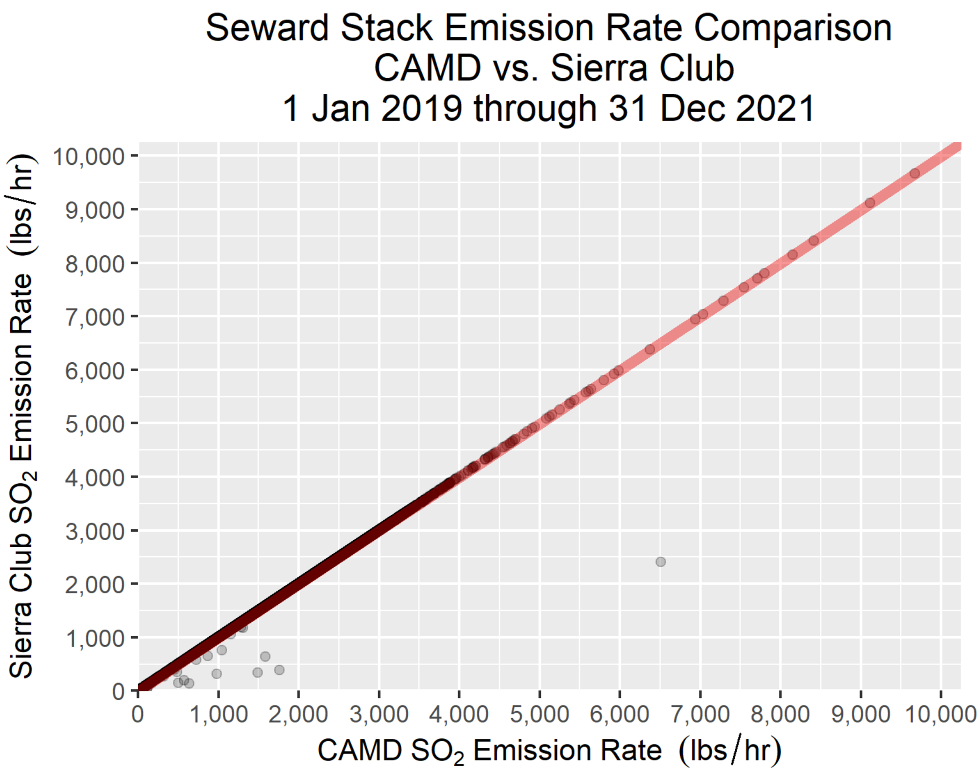
Seward Modeled Hourly Emission Rates: EPA used the same processing steps described earlier to compare the Sierra Club's hourly modeled emission rates with corresponding hourly emissions from the EPA's CAMD database. Again, our comparisons were limited to hours CAMD identified as "measured". Total "calculated" hours are generally limited to 129 hours over the 3-year simulation period. Therefore, excluding these hours is not important as far as identifying any serious potential differences between Sierra Club's modeled emission rates and ones from the CAMD database.

Seward's hourly CAMD SO_2 emission rates over the 2019 to 2021 simulation period were shown in the KEY-CON section and for brevity are omitted here. Figure 5.5-19 shows a comparison of hourly emissions over the 3-year simulation period. A 1-to-1 (red) trend line is also included on the figure. If the CAMD and modeled SO_2 hourly emission rates are identical, then they will graph as a point along the 1-to-1 (red) tend line.

Hourly CAMD emissions versus the Sierra Club's modeled emission rate shows, for the most part, the modeled and CAMD SO_2 emissions are well matched. There only 9 hours across the simulation period where CAMD hourly SO_2 emissions were more than 50 lbs/hr higher than the

Sierra Club's modeled emission rates. We note that the Sierra Club's hourly SO_2 emission rates for Seward are nearly identical to the hourly SO_2 emission rates used by KEY-CON.

Figure 5.5-19. Seward's CAMD versus Sierra Club Hourly SO_2 Emissions



Seward Modeled Hourly Stack Temperatures: As noted earlier, actual stack temperature data is only available from CEMS instruments, which are not publicly available. Sierra Club's modeling utilized a constant stack temperature for Seward. A stack temperature of 362 K was selected based on Table 2-2 from the Supplemental Analysis' model documentation. EPA confirmed this temperature by reviewing Pennsylvania's Supplemental Analysis documentation and Sierra Club's model input file. For comparison, KEY-CON's modeled stack temperatures for Seward that it included in its modeling analysis (based on CEMS data) ranged from 311.539 K to 392.539 K with a mean of 350.2 K. Based on this comparison, Sierra Club's modeled stack temperature for Conemaugh seems reasonable.

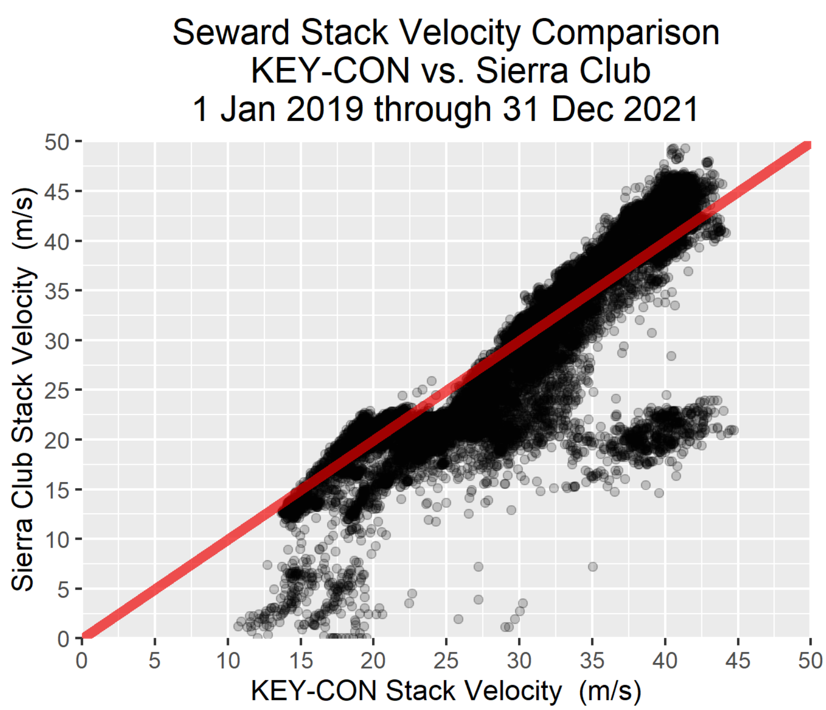
Seward Modeled Hourly Stack Velocities: Sierra Club's construction of Seward's modeled hourly varying stack velocities is described on page 4 of its modeling documentation (Exhibit 4). Supporting spreadsheets were provided by the Sierra Club to show how it constructed a flow to heat input ratio to determine modeled exit (stack) velocities.

EPA compared Sierra Club's modeled hourly stack velocities (in meters per second or m/s) to the corresponding hours from the KEY-CON simulation. KEY-CON's hourly stack velocities for Seward's stack were based on their CEMS data. EPA combined the CAMD and KEY-CON hourly emissions to eliminate hours with invalid flow MODC to ensure only hours with valid flow data (according to CAMD) were compared. There are 21,657 hours identified with "measured" values. The simulation period included a total of 26,304 hours, the difference being hours with Seward's units not operating or having "calculated" values.

Figure 5.5-20 shows a comparison of the Sierra Club's stack velocity for Seward versus the corresponding hour value from the KEY-CON model input files. A 1-to-1 (red) trend line is added to the graph. Hourly stack velocities on or close to the 1-to-1 (red) trend line indicate Sierra Club's modeled stack velocity is or is nearly identical to the CEMS based stack velocity (from KEY-CON).

Overall, the Sierra Club's stack velocities appear to exceed ones based on Seward's CEMS data. There is an overall underestimation bias of about -1.533 m/s. There doesn't appear to be a good match between the stack velocities Sierra Club used versus stack velocities KEY-CON constructed from its CEM data. There is a large grouping of stack velocities where Sierra Club's stack velocities are about half of the corresponding KEY-CON values. Underestimating stack velocities on this magnitude will probably contribute to higher model concentrations and significantly impact where peak model concentrations are simulated by the model.

Figure 5.5-20. Seward's KEY-CON versus Sierra Club Hourly Stack Velocity Comparison



5.5.2.2. Meteorology and Surface Characteristics

Sierra Club processed surface meteorological data from the Johnstown-Cambria County airport (JST) ASOS tower with concurrent upper air data collected near the Pittsburgh International airport in Allegheny County, PA. Multiple 3-year periods from 2015 through 2021 were processed with AERMET (version 21112). One and five-minute data was processed using AERMINUTE (version 15272) to supplement the hourly collected Integrated Surface Database (ISD) data.

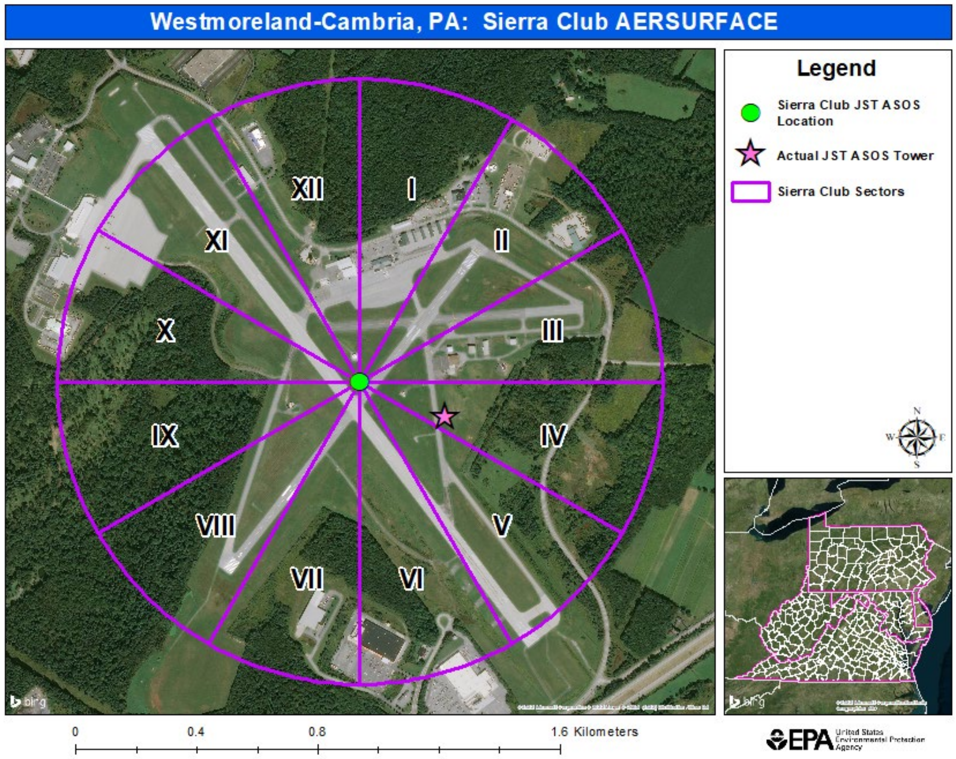
Surface characteristics were included in the AERMET processing for JST. This was done by running AERSURFACE (version 20060) for the JST ASOS tower location. Sierra Club's modeling utilized default values for determining surface roughness, z_0 radius set to 1 km, with Bowen and albedo values determined for a 10 km area surrounding the ASOS tower.

AERSURFACE sector widths were set to 12 equal 30° sectors from the input tower location with all sectors set to airport settings. Monthly values were exported for each sector with average (moisture) and snow cover assumed for all winter month according to Sierra Club's AERSURFACE input file. The month season settings from the AERSURFACE input file were set accordingly; winter (Jan, Feb, Dec with snow cover), spring (Mar, Apr, May), summer (Jun, Jul, Aug) and fall (Sep, Oct, Nov).

Figure 5.5-21 shows the AERSURFACE sectors used by Sierra Club. The aerial photo shows how the AERSURFACE sectors are aligned. EPA checked the AERSURFACE configuration Sierra Club used and found the following possible flaws in Sierra Club's AERSURFACE processing:

- The JST ASOS tower location Sierra Club used is approximately 300 m west-northwest of where the ASOS tower is actually located. This could introduce significant errors in the surface roughness calculations made by AERESURFACE.
- No adjustments were made to the FREQ_SECT's airport_flag values in the AERSURFACE input file (see section 3.2.9 of the AERSURFACE User's Guide for additional discussion). A visual inspection of the sectors shows some sectors are probably not confined to the formal airport footprint (sector IV for example). AERSURFACE uses the airport_flag value to adjust the sector surface roughness values. Non-airport defined sectors, especially if they include significant tree cover in the land use/land cover settings, may have significantly different surface roughness values without the non-airport distinction.
- Snow cover was assumed for all winter months without supporting evidence (a survey of local snow cover information). Assumed snow cover over the winter months (Jan, Feb, Dec) significantly changes the albedo values calculated by AERSURFACE and may impact final AERMOD concentrations during these months.
- Average soil moisture values were assumed over the entire modeling period. AERSURFACE modifies Bowen ratio values based on monthly rainfall totals compared to long-term 30-year climate averages (see section 2.3.3 of AERSURFACE User's Guide). Not properly accounting for seasonal variability in precipitation/soil moisture values will impact the final AERMOD simulation values.

Figure 5.5-21. Sierra Club Modeling AERSURFACE Sector Definition

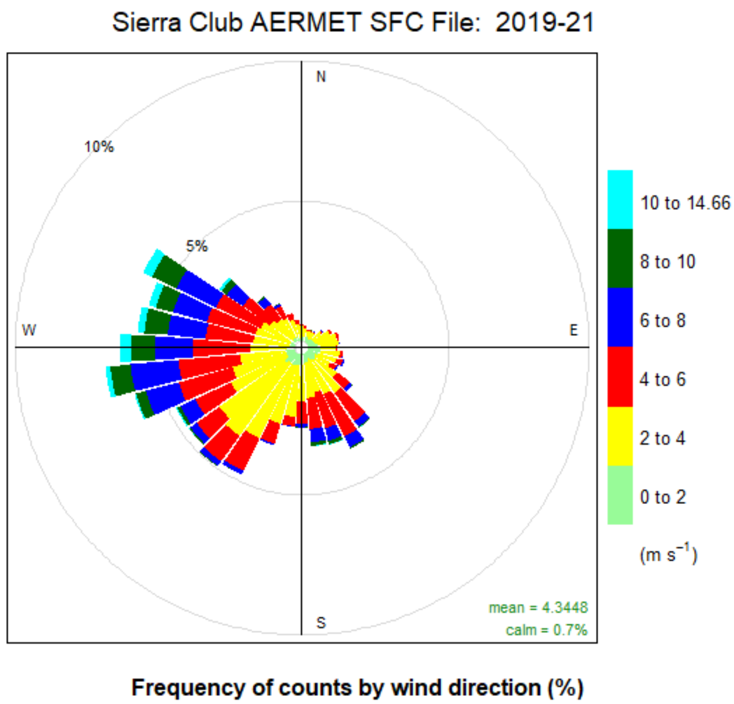


Sierra Club chose to use the Johnstown-Cambria County airport in its modeling analysis due to the site's close proximity to the Conemaugh and Seward power plants; the airport is nearly 20 km east of Conemaugh and Seward. As noted previously, there are significant elevation (and terrain) differences between the location of the Johnstown-Cambria County airport and Conemaugh and Seward. Base elevations at the airport are almost 360 m higher than the Conemaugh and Seward power plants. Additionally, the power plants are located in the Ligonier Valley with significant terrain features to the west (Chestnut Ridge) and east (Laurel Ridge). Johnstown-Cambria County airport is located on very high terrain (base elevations around 700 m) making it very exposed to the elements. By contrast, the Conemaugh and Seward power plants reside in a broad valley that is probably subject to topographically induced flow patterns.

Given the unique features impacting local meteorological patterns, a site-specific meteorological collection program was undertaken with collocated meteorological tower instruments and SODAR instruments deployed to collect 1 year of data at the Ash Site #1 to represent conditions near the Conemaugh and Seward power plants. This data was used in EPA's analysis since it best represents local conditions that impact the emissions from these plants. Utilizing surface meteorological data from the Johnstown-Cambria County airport will probably not entirely capture transport characteristics in the vicinity of the Conemaugh and Seward power plants.

Figure 5.5-22 shows a wind rose for the 3-year Johnstown-Cambria County airport reviewed by EPA. It is taken from the AERSURFACE processed AERMET file included in Sierra Club's public comment submittal and was produced using R's openair package. Predominant winds were from the west. Winds from the northeast quadrant occur very infrequently. Average wind speeds were about 4.3 m/s or a little over 8 nautical miles per hour or knots. As noted, the Johnstown-Cambria County airport is located in exposed elevated terrain and is therefore subject to higher wind speeds.

Figure 5.5-22. Johnstown-Cambria County Airport Wind Rose for 2019-21



EPA would also like to document the following potential issues with Sierra Club's AERMET processing:

- Sierra Club set Johnstown-Cambria County's anemometer height at 7.82 m (in the stage 3 AERMET (version 21112) input file. The actual anemometer height is 26 feet or 7.92 m.
- There are several warning messages in the AERMET stage 1 and 3 output files noting missing morning upper air soundings. EPA described the issue previously (section 5.2.6) and how they can be filled to ensure the data is processed into the final AERMET ready meteorological output files.

5.5.2.3. *Area of Analysis and Receptor Grid*

Sierra Club's model receptor grid was described in its 13 April 2022 Evaluation of Compliance Report from Wingra Engineering as follows:

> *[T]wo receptor grids were employed:*
>
> - *A 100-meter Cartesian receptor grid centered on the two plants and extending out 10 kilometers.*
> - *A 500-meter Cartesian receptor grid centered on the two plants and extending out 20 kilometers.*
>
> *To reflect a representative inhalation level, a flagpole height of 1.5 meters was not used for all modeled receptors. The use of a flagpole height is not expected to significantly affect the predicted impacts. This is similar to the approach used for the December 2019 modeling report.*
>
> *Elevations for receptors were obtained from National Elevation Dataset (NED) GeoTiff data. GeoTiff is a binary file that includes data descriptors and geo-referencing information necessary for extracting terrain elevations. These elevations were extracted from 1 arc-second (30 meter) resolution NED files. The USEPA software program AERMAP v. 18081 is used for these tasks.*

EPA confirmed Sierra Club's model receptor spacing description; we did not reprocess the receptor grid through AERMAP to confirm receptor elevations and hill-height scales. Figure 5.5-23 shows an overview of the Sierra Club model receptor grid, which cover parts of the Indiana, PA nonattainment area and extends into portions of Cambria, Indiana, Somerset and Westmoreland counties near the Conemaugh and Seward power plants.

Figure 5.5-24 shows model receptor spacing near the power plants and along the Laurel Ridge. Note that Conemaugh and Seward's ambient air boundaries are not defined in the Sierra Club's model receptor grid. The 100-m grid spacing may not be fine enough to capture the maximum modeled concentration for the Sierra Club simulation. A more refined grid along the Laurel Ridge would probably yield higher model concentrations.

Figure 5.5-23. Sierra Club Model Receptor Grid and Primary Modeled SO_2 Sources

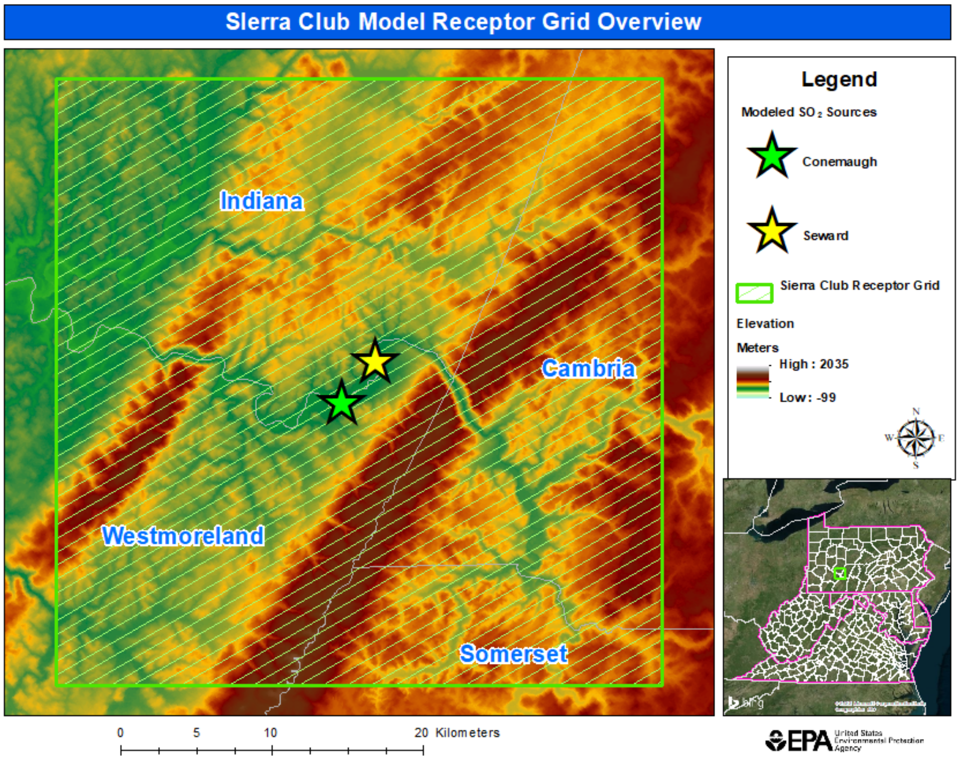
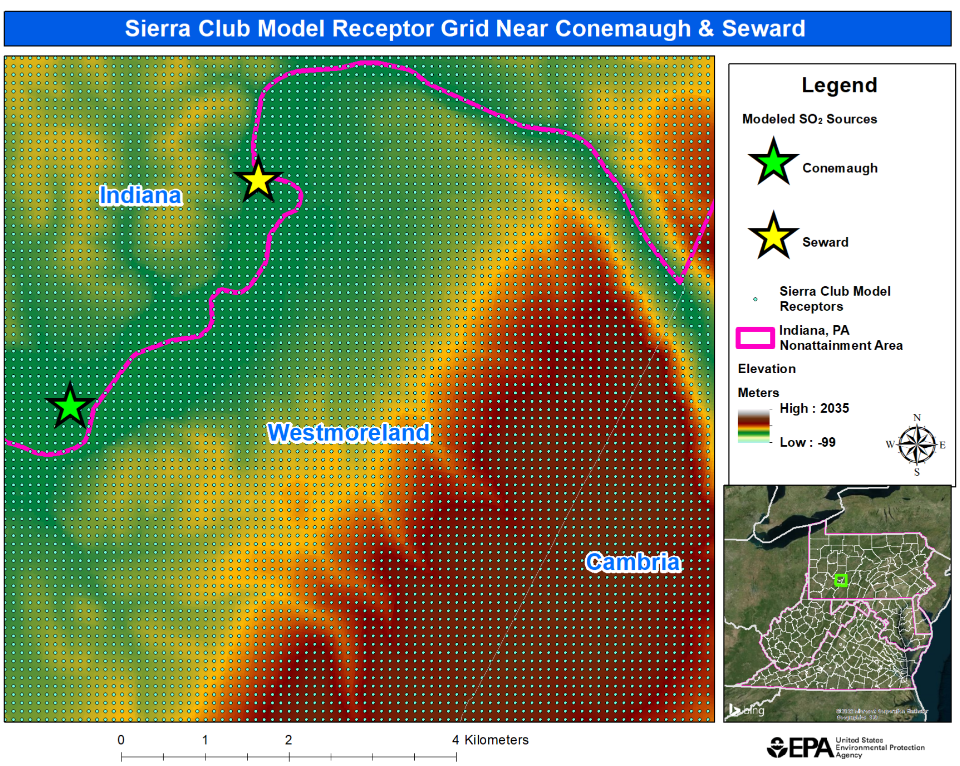


Figure 5.5-24. Sierra Club Model Receptor Grid and Primary Modeled SO_2 Sources



5.5.2.4. Background Concentration

Sierra Club's modeling analysis included a season by hour of day varying background concentration. This follows the background concentration construction method outlined in EPA's March 1, 2011 1-hour NO_2 clarification memo allowing for the use of a temporally varying background concentrations. Season by hour of day 1-hr SO_2 background concentrations were taken from the South Fayette monitor located in Allegheny County. Sierra Club's AERMOD input file identifies the monitor and period (2016-18) used to develop the model background concentration. This is the same monitor and period used in Pennsylvania's Supplemental Analysis. EPA compared Sierra Club's and Pennsylvania's Supplemental Analysis and verified that the season by hour of day background values matched.

EPA downloaded hourly SO_2 concentrations for the South Fayette monitor using R's RAQSAPI's library for the 2016-18 time period. We used R to configure the season by hour of day 1-hr SO2 background concentrations in accordance with our March 1, 2011 guidance. Table 5.5-8 summarizes EPA's constructed season by hour of day background concentrations from South Fayette's 2016-18 monitor values. This allows a comparison of the Sierra Club's modeled background concentrations versus EPA's and KEY-CON's. We note that KEY-CON's season by hour of day background concentrations (in parts per billion or ppb) were entered to 2 decimal places. Our values, also in ppb, preserve 1 decimal place.

Generally, the model background concentrations used in Sierra Club's modeling analysis are slightly higher than the ones used by EPA and KEY-CON. This may reflect slightly more regional coal usage over the background period Sierra Club used versus more recently.

Table 5.5-8. EPA Constructed 2019-21 Season by Hour of Day Background Concentrations for the South Fayette, PA Monitor Located in Allegheny County.

	Winter			Spring			Summer			Fall		
South Fayette, PA (42-003-0067): 2016-18 Background SO2 Concentrations (ppb) by Season/Hour of Day												
Hour	Average	Missing	Total Hours	Average	Missing	Total Hours	Average	Missing	Total Hours	Average	Missing	Total Hours
1	4.0	0	271	3.3	1	276	2.7	2	276	3.3	1	273
2	4.0	0	271	2.0	1	276	3.3	3	276	3.3	0	273
3	4.3	0	271	2.0	1	276	1.7	2	276	3.0	0	273
4	3.3	0	271	2.0	1	276	1.7	2	276	3.0	0	273
5	3.7	0	271	2.3	1	276	1.7	2	276	2.3	0	273
6	4.0	0	271	3.0	1	276	2.0	2	276	2.3	0	273
7	5.0	0	271	5.0	1	276	2.3	3	276	2.3	0	273
8	4.3	0	271	4.7	1	276	3.3	3	276	3.0	0	273
9	5.3	0	271	3.7	3	276	3.3	3	276	4.3	0	273
10	5.3	0	271	4.7	7	276	4.7	21	276	3.3	8	273
11	5.0	3	271	3.7	32	276	3.0	32	276	3.3	23	273
12	4.3	27	271	2.7	9	276	3.3	4	276	4.0	16	273
13	3.3	7	271	2.7	2	276	3.3	3	276	2.7	2	273
14	3.3	1	271	3.3	1	276	3.0	4	276	2.7	2	273
15	4.0	0	271	3.0	1	276	4.0	4	276	4.0	1	273
16	3.3	0	271	3.0	1	276	4.0	1	276	3.7	0	273
17	2.7	0	271	3.3	1	276	3.7	1	276	4.3	0	273
18	3.3	0	271	4.7	1	276	3.7	1	276	5.0	0	273
19	3.3	0	271	6.0	1	276	4.0	2	276	4.0	0	273
20	4.0	0	271	3.7	1	276	4.0	2	276	3.7	0	273
21	3.3	0	271	2.7	1	276	2.7	2	276	4.0	0	273
22	4.0	0	271	2.7	1	276	2.3	2	276	3.3	0	273
23	4.3	0	271	2.7	1	276	2.7	2	276	2.7	0	273
24	4.0	0	271	2.3	1	276	2.3	2	276	3.3	0	273

5.5.2.5. Sierra Club Model Results

Sierra Club's modeling roughly followed EPA's Modeling TAD. EPA reviewed the modeling processing for the 2019-21 time period, which is the most recent of the 3-year periods Sierra Club submitted during the Remand comment period.

Figure 5.5-25 shows Sierra Club's 2019-21 modeled 1-hr SO_2 design values over its entire modeling domain. Sierra Club's AERMOD concentrations were converted to parts per billion or ppb by multiplying the model concentrations by a conversion factor; 75 ppb over 196.4 $\mu g/m^3$. Model concentrations are overlain over the local topographic elevations.

Model 1-hr SO_2 design values are elevated along the Laurel Ridge that resides southeast of Conemaugh and Seward as noted in Figure 5.5-26. The peak receptor had a modeled design value of 93.4 ppb. Sierra Club's modeling shows patches of areas with 1-hr SO_2 design values above 75 ppb along the Laurel Ridge. All areas above the 1-hr SO_2 NAAQS are confined to portions of the Laurel Ridge that face Conemaugh and Seward. There are also minor peaks in model 1-hr SO_2 design values along the Chestnut Ridge west of the plants and also peaks to the northeast near Robindale Heights in East Wheatfield Township, Indiana County.

Figure 5.5-25. Sierra Club AERMOD Results for All Sources Plus Background

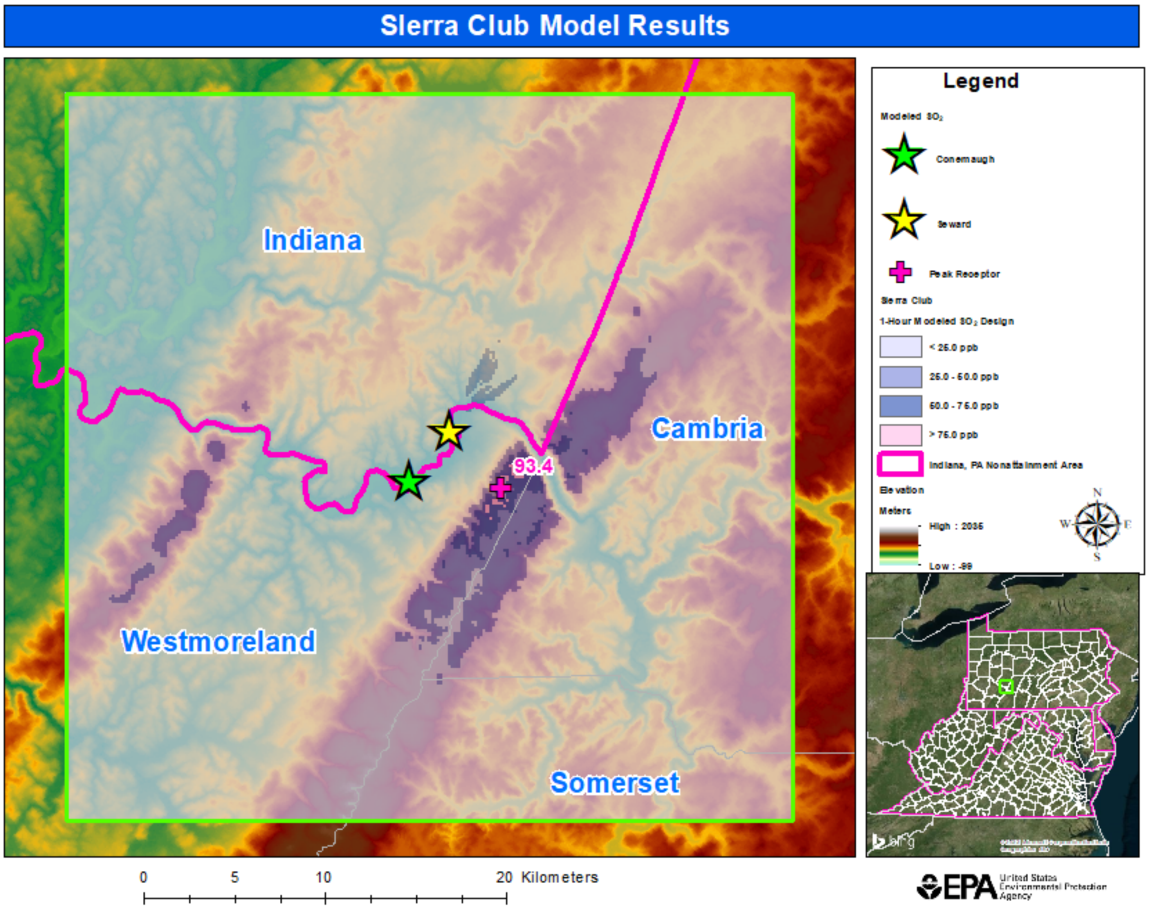
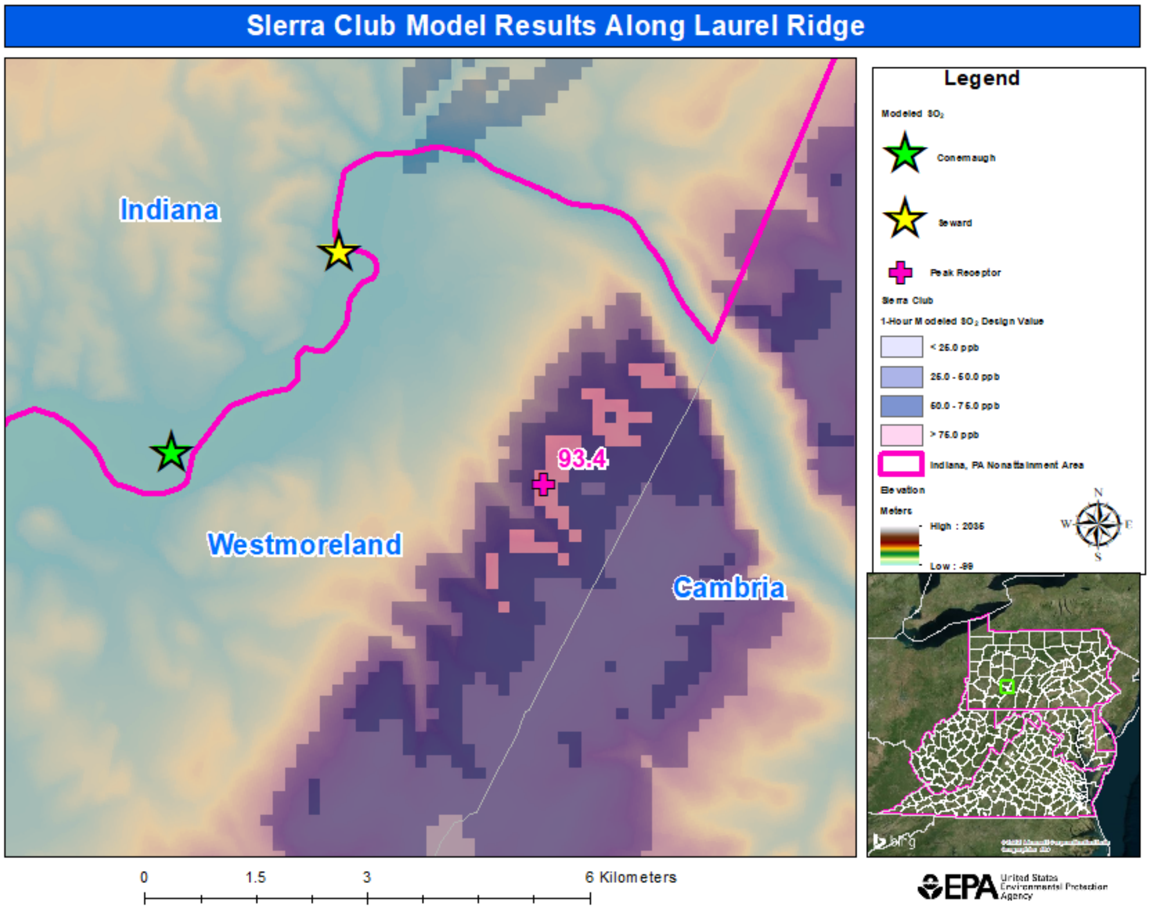


Figure 5.5-26. Sierra Club AERMOD Results Along the Laurel Ridge

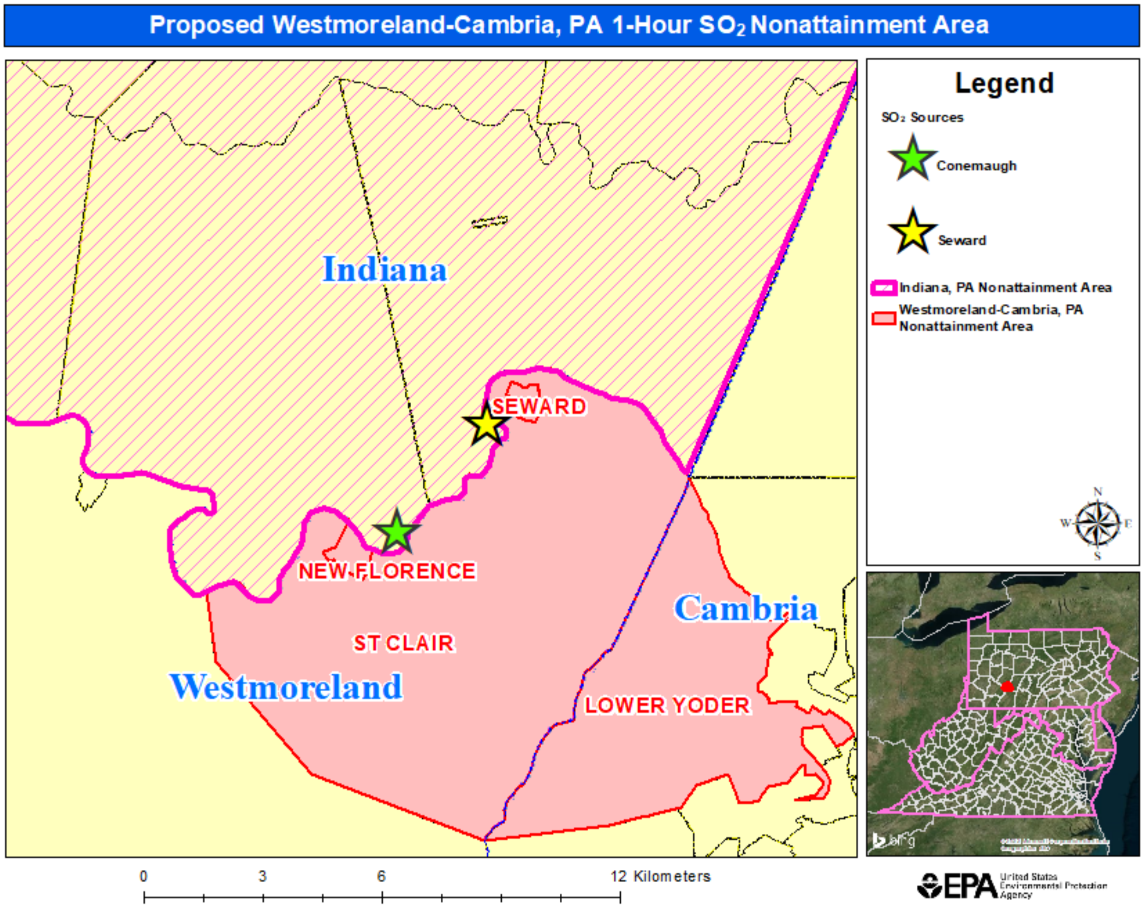


6. Summary of EPA's Intended Redesignation for the Westmoreland and Cambria Area

After careful evaluation of all modeling analyses and other technical information, as well as all available relevant information, the EPA is notifying Pennsylvania that the designation for portions of Westmoreland and Cambria Counties should be revised to nonattainment for the 2010 SO_2 NAAQS. Specifically, the boundaries of the revised area should be comprised of Lower Yoder Township in Cambria County and St. Clair Township (including the boroughs of New Franklin and Seward) in Westmoreland County. Figure 6-1 shows the boundary of this intended revised designated area.

Additionally, the EPA does not intend to change the designations of the remainder of Westmoreland and Cambria counties.

Figure 6-1. Boundary of the Intended Revised Westmoreland and Cambria Nonattainment Area



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