Technical Support Document:

Chapter 41
Final Round 3 Area Designations for the 2010 1-Hour SO_2 Primary National Ambient Air Quality Standard for the Commonwealth of Virginia

1. Summary

Pursuant to section 107(d) of the Clean Air Act (CAA), the U.S. Environmental Protection Agency (the EPA, we, or us) must 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). Our Notice of Availability (NOA)[1] and our Technical Support Document[2] for our intended designations for the round of designations we are required to complete by December 31, 2017, provided background on the relevant CAA definitions and the history of the designations for this NAAQS. Chapter 1 of this TSD for the final designations explains the definitions we are applying in these final designations. The TSD for the intended Round 3 area designations also described the Commonwealth of Virginia's (Virginia's or VA's) recommended designations, assessed the available relevant monitoring, modeling, and any other information, and provided our intended designations.

This TSD for the final Round 3 area designations for Virginia addresses any change by Virginia to Virginia's recommended designations since we communicated our intended designations for areas in Virginia. It also provides our assessment of additional relevant information that was submitted too close to the signature of the NOA to have been considered in our intended designations, or that has been submitted by Virginia or other parties since the publication of the NOA. This TSD does not repeat information contained in the TSD for our intended designations, except as needed to explain our assessment of the newer information and to make clear the final action we are taking and its basis, but that information is incorporated as part of our final designations. If our assessment of the information already considered in our TSD for our intended designations has changed based on new information, and we are finalizing a designation based on such change in our assessment, this TSD also explains that change. For areas of Virginia not explicitly addressed in this chapter, we are finalizing the designations described in our 120-day letters and the TSD for the intended Round 3 area designations. All the final designations are listed in Table 1 below.

Virginia submitted a response to EPA's intended designations, which included a comment letter dated October 23, 2017, expressing support for the EPA's intended designations of Virginia

[1] EPA Responses to Certain State Designation Recommendations for the 2010 Sulfur Dioxide Primary National Ambient Air Quality Standard: Notification of Availability and Public Comment Period, September 5, 2017 (82 FR 41903)

[2] Technical Support Document: Intended Round 3 Area Designations for the 2010 1-Hour SO_2 Primary National Ambient Air Quality Standard, August 2017. https://www.epa.gov/sulfur-dioxide-designations/initial-technical-support-documents-area-designations-round-3

jurisdictions, as well as additional modeling information that was originally provided to Virginia by Jewell Coke Company, L.P. ("Jewell" or "Jewell Coke"). Virginia's October 23, 2017 submission does not update Virginia's designation recommendations. Additionally, Virginia submitted to the EPA as a supplement to their October 23, 2017, submittal a letter from Jewell Coke to Virginia dated October 20, 2017. This letter is included in the docket for this designation action.

The EPA also received new relevant information from Sierra Club. In a letter dated October 5, 2017, Sierra Club provided comments and a modeling analysis for Jewell Coke in Buchanan County, Virginia. Based on the modeling analysis that Sierra Club performed and provided, Sierra Club argues a designation of nonattainment should be finalized for Buchanan County, Virginia. Additionally, the EPA also received comments from Jewell in a letter dated October 5, 2017, arguing that the EPA should finalize a designation of attainment/unclassifiable. After evaluation of all of this new information, the EPA is not changing its intended designation for Buchanan County, Virginia.

For the areas in Virginia that are part of the Round 3 designations process, Table 1 identifies the EPA's final designations and the counties or portions of counties to which they apply. It also lists Virginia's current recommendations; which Virginia has not changed during the 120-day process. The EPA's final designations for these areas are based on an assessment and characterization of air quality through ambient air quality data, air dispersion modeling, other evidence and supporting information, or a combination of the above.

Table 1. Summary of the EPA's Final Designations and the Designation Recommendations by Virginia

Area/County	Virginia's Recommended Area Definition	Virginia's Recommended Designation	EPA's Intended Designation	EPA's Final Area Definition	EPA's Final Designation[3]
Chesterfield County, Virginia	Chesterfield County	Attainment/ Unclassifiable	Unclassifiable/ Attainment	Same as Commonwealth's Recommendation	Attainment/ Unclassifiable
City of Hopewell, Virginia	City of Hopewell	Attainment/ Unclassifiable	Unclassifiable/ Attainment	Same as Commonwealth's Recommendation	Attainment/ Unclassifiable
City of Colonial Heights, Virginia	City of Colonial Heights	Attainment/ Unclassifiable	Unclassifiable/ Attainment	Same as Commonwealth's Recommendation	Attainment/ Unclassifiable

[3] Refer to Chapter 1 of Technical Support Document: Final Round 3 Area Designations for the 2010 1-Hour SO_2 Primary National Ambient Air Quality Standard for definitions of the designation categories and the terminology change from Unclassifiable/Attainment to Attainment/Unclassifiable.

Charles City County, Virginia	Charles City County	Attainment/ Unclassifiable	Unclassifiable/ Attainment	Same as Commonwealth's Recommendation	Attainment/ Unclassifiable
Henrico County, Virginia	Henrico County	Attainment/ Unclassifiable	Unclassifiable/ Attainment	Same as Commonwealth's Recommendation	Attainment/ Unclassifiable
City of Poquoson, Virginia	City of Poquoson	Attainment/ Unclassifiable	Unclassifiable/ Attainment	Same as Commonwealth's Recommendation	Attainment/ Unclassifiable
York County, Virginia	York County	Attainment/ Unclassifiable	Unclassifiable/ Attainment	Same as Commonwealth's Recommendation	Attainment/ Unclassifiable
City of Richmond, Virginia	City of Richmond	Attainment/ Unclassifiable	Unclassifiable/ Attainment	Same as Commonwealth's Recommendation	Attainment/ Unclassifiable
City of Newport News, Virginia	City of Newport News	Attainment/ Unclassifiable	Unclassifiable/ Attainment	Same as Commonwealth's Recommendation	Attainment/ Unclassifiable
City of Hampton, Virginia	City of Hampton	Attainment/ Unclassifiable	Unclassifiable/ Attainment	Same as Commonwealth's Recommendation	Attainment/ Unclassifiable
Halifax County, Virginia	Halifax County	Attainment/ Unclassifiable	Unclassifiable/ Attainment	Same as Commonwealth's Recommendation	Attainment/ Unclassifiable
Charlotte County, Virginia	Charlotte County	Attainment/ Unclassifiable	Unclassifiable/ Attainment	Same as Commonwealth's Recommendation	Attainment/ Unclassifiable
Mecklenburg County, Virginia	Mecklenburg County	Attainment/ Unclassifiable	Unclassifiable/ Attainment	Same as Commonwealth's Recommendation	Attainment/ Unclassifiable

City of Petersburg, Virginia	City of Petersburg	Attainment/ Unclassifiable	Unclassifiable/ Attainment	Same as Commonwealth's Recommendation	Attainment/ Unclassifiable
Buchanan County, Virginia	Buchanan County	Attainment/ Unclassifiable	Unclassifiable	Same as Commonwealth's Recommendation	Unclassifiable
Remaining Undesignated Areas to Be Designated[4]	County or City Boundary	Unclassifiable	Unclassifiable/ Attainment	Same as Commonwealth's Recommendation	Attainment/ Unclassifiable

Areas for which Virginia elected to install and began operation of a new, approved SO_2 monitoring network are listed in Table 2. The EPA is required to designate these areas, pursuant to a court ordered schedule, by December 31, 2020. Table 2 also lists the SO_2 emissions sources around which each new, approved monitoring network has been established.

Table 2 – Undesignated Areas Which the EPA Is Not Addressing in this Round of Designations (and Associated Source or Sources)

Area	Source(s)
Giles County	Lhoist North America – Kimballton Plant
Botetourt County	Roanoke Cement Company
City of Covington	WestRock Virginia Corporation - Covington
Alleghany County[5]	WestRock Virginia Corporation - Covington

[4] Except for areas that are associated with sources for which Virginia elected to install and timely began operation of a new SO_2 monitoring network meeting EPA specifications referenced in EPA's SO_2 DRR (see Table 2), the EPA is designating the remaining undesignated counties (or portions of counties) in Virginia as "attainment/unclassifiable." These areas that we are designating as attainment/unclassifiable (those to which this row of this table is applicable) are identified more specifically in section 11 of Chapter 41 (addressing Virginia) of the TSD for our intended designations.

[5] In its 2011 recommendation, Virginia had recommended unclassifiable for Alleghany County. Virginia did not update its recommendation for this county in its 2017 updated recommendation. Upon review, however, the EPA found that a the WestRock facility is located within both Covington City and Alleghany County. The majority of the facility resides in Covington with a portion in Alleghany. The monitor is located within Covington City. Therefore, the EPA will address both Covington City and Alleghany County in Round 4.

2. Technical Analysis of New Information for the Buchanan County, Virginia Area

2.1. Introduction

The EPA must designate the Buchanan County, Virginia, area by December 31, 2017, because the area has not been previously designated and Virginia has not installed and begun timely operation of a new, approved SO_2 monitoring network to characterize air quality in the vicinity of any source in Buchanan County, Virginia.

Two new modeling analyses were submitted to the EPA for the Buchanan, Virginia, area: (1) an analysis was conducted by Jewell Coke and submitted by Virginia; and (2) an analysis was submitted by Sierra Club. The analysis submitted by Virginia is a re-run of the analysis originally submitted in January 2017 with the exception of using the most current version of AERMOD. Jewell Coke asserts that EPA's criticism in the intended designations TSD was incorrect with regards to the receptor grid, and that the receptor grid they used in the analysis is correct. The company claims that the areas where no modeling receptors were included in the modeling are locations that meet the exclusion described in EPA's Modeling TAD as well as other documents related to monitor placement. Additionally, Jewell Coke provided further information regarding emissions and indicated that they think the emission rates modeled were appropriate. Finally, Jewell Coke commented that the modeled concentrations are not affected by the reformulation of the ADJ_U* option in AERMET version 15181 versus AERMET version 16216. Sierra Club re-ran the modeling files originally submitted by Virginia in January 2017, with the exception of including all the receptors that were omitted in the Virginia January 2017 analysis, and using the current version of AERMOD. However, Sierra Club's modeling used the older version of AERMET, that, as we noted in the intended designations TSD, contained a formulation bug.

2.2. Summary of Information Reviewed in the TSD for the Intended Round 3 Area Designations

The modeling submitted by Virginia (conducted by Jewell Coke) in January 2017 indicated that the 1-hour SO_2 NAAQS is not in violation at the receptor with the highest modeled concentration. The modeling indicated that the highest predicted 99th percentile daily maximum 1-hour concentration within the chosen modeling domain is 194.6 micrograms per cubic meter ($\mu g/m^3$), equivalent to 74.3 parts per billion (ppb). This modeled concentration included the background concentration of SO_2, and is based on actual calculated emissions from the Jewell Coke facility. While this modeling appears to show attainment, there are a number of factors that indicate this modeling is likely flawed. These issues are as follows: (1) Jewell Coke's model receptor grid is not in accordance with current model guidance outlined in EPA's Modeling TAD, and therefore, may not pick up the maximum modeled concentration; (2) the modeling analysis used ADJ_U* in AERMOD version 15181, which has a known formulation bug that

would lead to unrepresentative model concentrations; and (3) modeled concentrations could be under-predicted since the modeled emission rates were based on stack testing values.

In the 120-day letter notification to the governor of Virginia, and further explained in Chapter 41 of the TSD for the intended Round 3 area designations, the EPA stated that the intended designation for the Buchanan area was unclassifiable, based on all available information, including modeling information and monitoring information.

Table 3 identifies all the modeling assessments evaluated for the 120-day letters and discussed in the TSD for the intended Round 3 area designations. Additional details can be found in the TSD for the Intended Round 3 Area Designations, Chapter 41.[6]

Table 3. Modeling Assessments Evaluated in the TSD for the Intended Designation for the Buchanan Area

Organization Submitting Assessment	Date of the Assessment	Identifier used in the TSD for the Intended Round 3 Area Designations, Chapter 41	Distinguishing or Otherwise Key Features
Virginia	January 2017	Buchanan, Virginia Area of Analysis	Modeling submitted by Virginia (conducted by Jewell Coke)

Based on the information available at the time of the 120-day letter, the EPA stated that we intended to conclude that the Commonwealth's submitted modeling analysis was deficient and provided an inappropriate basis on which to determine the attainment status of the area.

2.3. Assessment of New Air Quality Monitoring Data for the Buchanan, Virginia Area

This factor considers the SO_2 air quality monitoring data in the area of Buchanan County, Virginia. There are no air quality monitors located in the Buchanan, Virginia, area of analysis.

2.4. Assessment of New Air Quality Modeling Analysis for the Buchanan, Virginia Area Addressing Jewell Coke

2.4.1. Introduction

[6] *See* https://www.epa.gov/sites/production/files/2017-08/documents/42_va_so2_rd3-final.pdf.

This section 2.4. presents all the newly available air quality modeling information for a portion of Buchanan County, Virginia, that includes Jewell Coke. (This portion of Buchanan County, Virginia will often be referred to as "the Buchanan area" within this section 2.4.). A survey of the area surrounding Jewell Coke indicated no other sources within 10 kilometers (km).[7] This area contains only one facility, Jewell Coke, for which Virginia is required by the DRR to characterize that area's SO_2 air quality, or alternatively to establish an SO_2 emissions limitation of less than 2,000 tons per year:

- The Jewell Coke facility emits 2,000 tons or more annually. Specifically, the Jewell Coke emitted 4,964.5 tons of SO_2 according to the 2014 NEI. This source meets the DRR criteria and thus is on the SO_2 DRR Source list, and Virginia has chosen to characterize it via modeling.

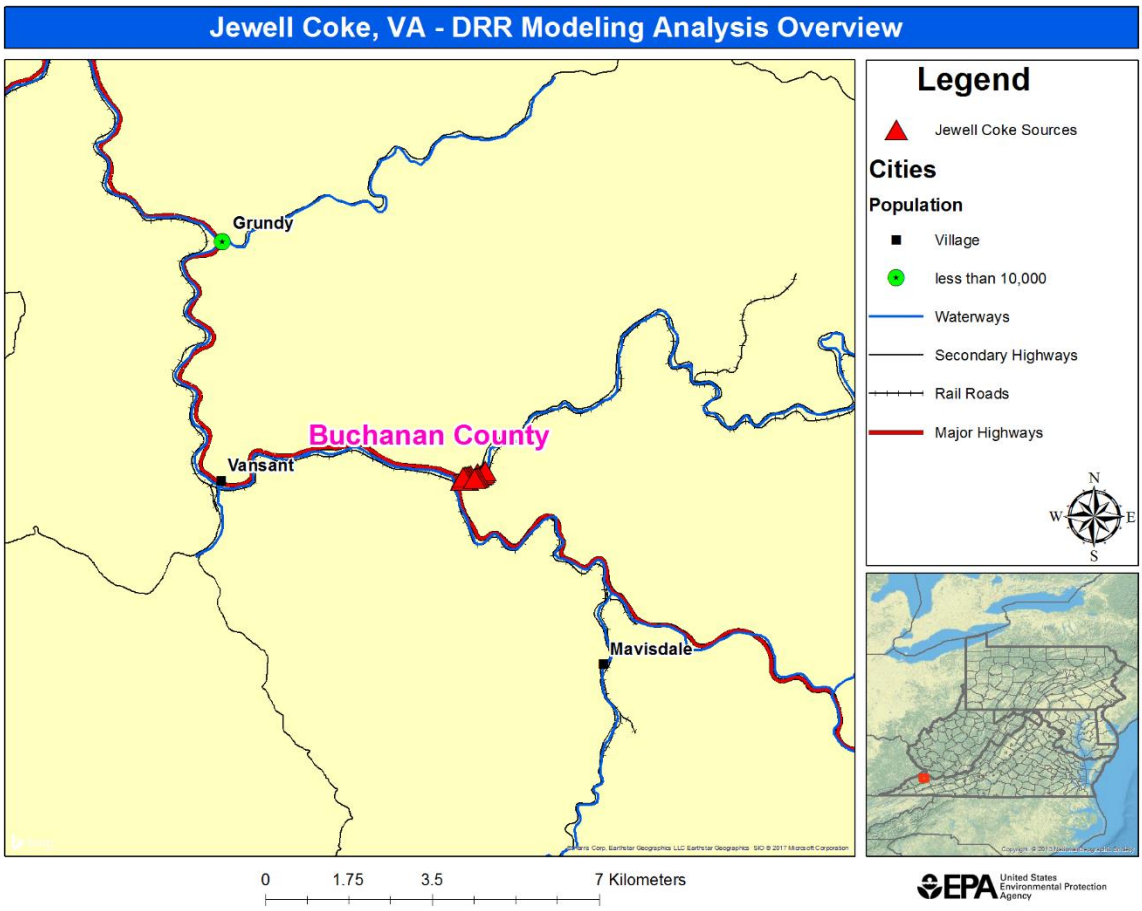
On October 23, 2017, Virginia submitted new modeling conducted by Jewell Coke analyzing air quality in the area surrounding the Jewell Coke facility. This new assessment and characterization was performed using air dispersion modeling software, i.e., AERMOD, analyzing actual emissions. The area that Virginia has assessed via air quality modeling is located in Buchanan County. Virginia's analysis supports a different designation than the EPA's intended designation for this area. The EPA expressed an intent to designate the area as unclassifiable, whereas Virginia's October 2017 analysis concludes that the area is not violating the 2010 SO_2 NAAQS.

In addition, on October 5, 2017, Sierra Club submitted new modeling analyzing air quality in the area surrounding Jewell Coke. This new assessment and characterization was performed using air dispersion modeling software, i.e., AERMOD, analyzing actual emissions. The area that Sierra Club has assessed via air quality modeling is located in Buchanan County. Sierra Club's analysis supports a different designation than the EPA's intended designation for this area. The EPA's intended designation for the area was unclassifiable, whereas Sierra Club's analysis shows violations of the 2010 SO_2 NAAQS and supports a designation of nonattainment. After careful review of Virginia's and the Sierra Club's new assessments, supporting documentation, and all available data, the EPA is not relying on any of the modeling analyses submitted to date as the EPA finds all the analyses to be deficient, providing the EPA with insufficient information for determining the attainment status of Buchanan County, Virginia. As such, the EPA is designating the area as unclassifiable. Our reasoning for this conclusion is explained in a later section of this chapter of the TSD, after all the available information is presented.

The area that Virginia has assessed via air quality modeling is located in Buchanan County. Figure 1 below shows the location of the Jewell Coke facility. There are no other SO_2 sources in the area. The EPA's final designation boundary for the Buchanan area is not shown in this figure, but is shown in Figure 12 in section 2.9 below that summarizes our final designation.

[7] Other than Jewell Coke, there are no point sources with SO_2 emission above 0.5 tons per year (tpy) in Buchanan County, according to the 2014 NEI.

Figure 1. Map of the Buchanan, Virginia Area Addressing the Jewell Coke



The discussion and analysis that follows below will reference the Modeling TAD and the factors for evaluation contained in the EPA's July 22, 2016, and March 20, 2015, guidance memorandums as cited in Chapter 1 of this TSD, as appropriate.

For this area, the EPA received and considered two different new modeling assessments, beyond those that were reviewed in its TSD for its intended designations, including one assessment from the Commonwealth and one assessment from another party. To avoid confusion in referring to these assessments, the following table lists them, indicates when they were received, 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 4. New Modeling Assessments for the Buchanan Area

Organization Submitting Assessment	Date of the Assessment	Identifier Used in this TSD	Distinguishing or Otherwise Key Features
Virginia	October 23, 2017	Virginia October 2017	Excluded many receptors, especially on steep terrain; used revised ADJ_U* (AERMET 16216)
Sierra Club	October 5, 2017	Sierra Club	Included all receptors excluded by Jewell Coke; used old version of ADJ_U* (AERMET 15181)

2.4.2. Modeling Analysis Provided by the Commonwealth

Virginia submitted a modeling analysis (conducted by Jewell Coke) for portions of Buchanan County surrounding Jewell Coke on October 23, 2017. Jewell Coke completed the modeling in response to several deficiencies noted in EPA's 120-day notice TSD.[8] Responses from the facility to these noted deficiencies were provided in a public comment letter from Jewell Coke to the EPA dated October 5, 2017. Additionally, Jewell Coke submitted a comment letter to Virginia dated October 20, 2017, which included comments in response to modeling submitted by the Sierra Club during the 120-day public comment period. This October 20, 2017, letter was provided to the EPA by Virginia and is included in the docket as part of Virginia's October 23, 2017 submittal.

2.4.2.1.Differences Among and Relevance of the Modeling Assessments

Virginia's October 2017 modeling analysis followed most of the preprocessing steps that were summarized in EPA's 120-day designation package for Buchanan County, Virginia. The Virginia October 2017 modeling utilized the current versions of AERMOD (16216r) and AERMET (16216). This fixed one of the deficiencies noted in the modeling by the EPA in our intended designations, as the use of the previous AERMET version's low wind ADJ_U* module contains a known formulation[9] bug that could lead to model under-predictions. Only the

[8] See section 6.2.2.10 of Virginia Technical Support Document for EPA's intended designations: https://www.epa.gov/sites/production/files/2017-08/documents/42_va_so2_rd3-final.pdf

[9] See EPA's March 8, 2017 *Clarification on the AERMOD Modeling System Version for Use in SO_2 Implementation Efforts and Other Regulatory Actions* for additional explanation: https://www3.epa.gov/ttn/scram/guidance/clarification/SO2_DRR_Designation_Modeling_Clarificaiton_Memo-03082017.pdf

AERMOD input, output, and summary files were included in Virginia's October 2017 submission.

2.4.2.2.Model Selection and Modeling Components

The EPA's Modeling TAD notes that for area designations under 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

As noted previously, the Commonwealth used the most current version of AERMOD (16216r) along with the newest version of the AERMET (16216), AERMOD's meteorological data preprocessor. This corrected the 120-day modeling submittal that contained a version of the AERMET preprocessor that contained a known formulation bug in the low-wind ADJ_U* option which could lead to model under-predictions. A discussion of the Commonwealth's approach to the individual components is provided in the corresponding discussion that follows, as appropriate.

2.4.2.3.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.

The application of AERMOD requires characterization of the local (within 3 kilometers) dispersion environment as either urban or rural, based on a USEPA-recommended procedure (commonly referred to as the Auer Method) that characterizes an area by prevalent land use. This land use approach classifies an area according to 12 land use types. In this scheme, areas of industrial, commercial, and compact residential land use are designated urban. According to USEPA modeling guidelines, if more than 50% of an area within a 3-km radius of the facility is classified as rural, then the urban model option in AERMOD should not be used in the dispersion modeling analysis. Conversely, if more than 50% of the area is urban, then it can be considered.

A visual inspection of the 3-km area surrounding Jewell Coke following the Auer method for the 120-day modeling analysis clearly shows the area is rural. No significant changes in land use in the areas surrounding Jewell Coke have occurred and therefore, using the urban model option in AERMOD is not justified. For the purpose of performing the modeling for the area of analysis, the Commonwealth determined that it was most appropriate to run the model in rural dispersion mode. The EPA agrees with the Commonwealth's assessment.

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

The 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.

Jewell Coke is the primary source of SO_2 emissions in this area as described in the introduction to this section. For the Buchanan area, Virginia has determined that there are no other emitters of SO_2 greater than 0.5 tpy within 10 km of Jewell Coke in any direction. Virginia determined that this was the appropriate distance to adequately characterize air quality through modeling to include the potential extent of any SO_2 NAAQS exceedances in the area of analysis and any potential impact on SO_2 air quality from other sources in nearby areas. The EPA agrees with Virginia's determination that there are no other emitters of SO_2 greater than 0.5 tpy within 10 km of Jewell Coke.

The model receptor grid used in Virginia's October 2017 modeling submission was identical to the grid used in the 120-day modeling submittal. The EPA determined that this receptor grid was too limited in extent to fully gauge the impacts from Jewell Coke's SO_2 emissions, and that excluding all model receptors with intermittent elevations (from 400-650 m) creates gaps in the receptor grid that could allow model plumes to escape detection in the model. The October 5, 2017, letter from Jewell Coke disagreed with EPA's assessment of the model receptor grid and restated its opinion that its receptor exclusion methodology was supported using guidance from the Modeling TAD as well as other guidance documents including EPA's *Optimum Site Exposure Criteria for SO_2 Monitoring* (1977) and *Ambient Monitoring Guidelines for Prevention of Significant Deterioration* (1987). Additionally, Jewell Coke also cited to EPA's analysis of modeling that excluded model receptors in steep terrain done for the State of Utah in our intended designations TSD.[10]

As noted previously, the Virginia October 2017 modeling utilized the identical model receptor grid used in the Virginia January 2017 modeling analysis. The model receptor grid extends out to 10 km from Jewell Coke and was developed according to the following principles:

[10] See Round 3 Utah TSD document for Emery County: https://www.epa.gov/sites/production/files/2017-08/documents/40_ut_so2_rd3-final.pdf

- Include receptors at a 100 meter (m) spacing outward from Jewell Coke to 10 km
- Exclude receptors that are located on land owned or controlled by Jewell Coke
- Exclude receptors that are located within rugged terrain areas that have terrain slopes of equal to or greater than 30 percent
- Exclude receptors that are located within the immediate industrial, transportation, and river areas around Jewell Coke operations

The model receptor network contained 13,498 receptors, and the network covered portions of the modeling domain that extended 10 km from Jewell Coke.

Figures 2 and 3, included in the Commonwealth's most recent submittal, show the Commonwealth's chosen area of analysis surrounding Jewell Coke, as well as the receptor grid for the area of analysis.

Figure 2. Area of Analysis for the Buchanan area

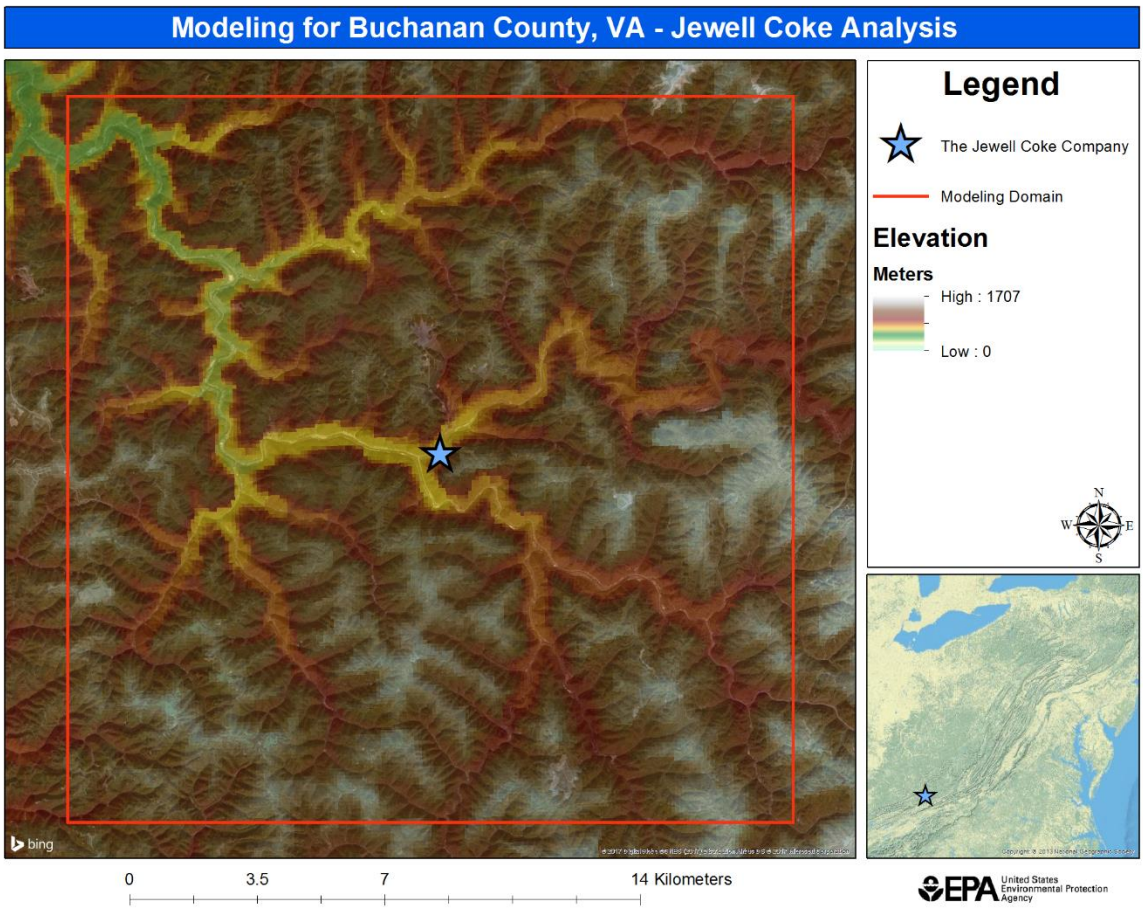
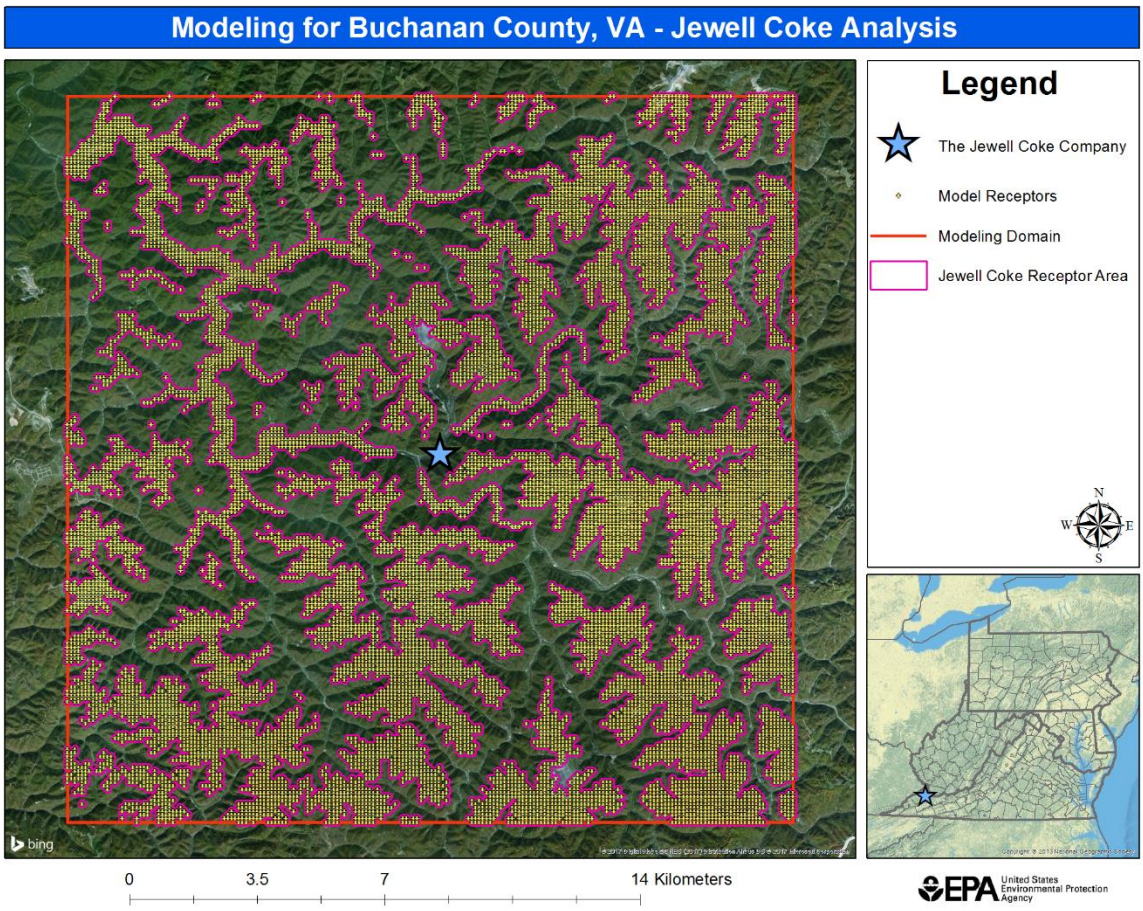


Figure 3. Receptor Grid for the Buchanan area



While the model receptor grid in the Virginia January 2017 and October 2017 modeling analyses was more extensive than the grid in Virginia's original DRR modeling protocol, it remains rather limited. Model receptors are placed over less than 50% of the modeling domain, meaning air quality in many locations are not sampled by the air dispersion model within the area. Jewell Coke's approach also restricts model receptor placement to certain valley floors and to the tops of the adjacent ridges. This leads to receptor clumping within limited elevation ranges and hill height scales. Table 5 shows the distribution of receptor grid elevations and hill height scale values. Receptor elevation values tend to be clustered between 300 to 400 meters and above 650 meters. Hill height scales are limited to ranges above 650 meters. The Virginia October 2017 receptor grid restricts areas in which AERMOD samples impacts on air quality from Jewell Coke's emissions, creating gaps in receptor elevations analyzed which could allow modeled plumes to escape detection in the model analysis. Without including information in these receptor "gaps," the Virginia October 2017 modeling of Jewell Coke's emissions cannot be relied on as representative of air quality in the area by the EPA when designating the Buchanan area.

Table 5. Table Showing Jewell Coke's Model Receptor Grid Elevation and Hill Scale Heights

Receptor Elevation (m)		Hill Height Scale (m)	
Bin	**Frequency**	**Bin**	**Frequency**
250	0	250	0
300	37	300	0
350	552	350	0
400	1,158	400	0
450	0	450	0
500	0	500	0
550	0	550	0
600	0	600	0
650	1,669	650	25
700	7,127	700	1,627
750	2,630	750	6,512
800	311	800	4,516
More	14	More	818

2.4.2.5.Modeling Parameter: Source Characterization

Jewell Coke uses SunCoke Energy's Jewell-Thompson non-recovery type of coke oven. In coke production from both non-recovery and byproduct ovens, the volatile fraction of the coal is driven off in a reducing atmosphere. Coke is essentially the remaining carbon and ash. For Jewell Coke's non-recovery ovens, all coal volatiles are oxidized within the ovens. No coke oven gas is produced and there is no flaring of gases with the non-recovery coke oven design. Because there is no recovery of the volatile fraction of the coal, non-recovery ovens do not have many of the emissions sources that byproduct facilities have such as offtakes, lids, and piping. Fugitive emissions from a non-recovery oven are limited to the pushing and charging processes and material handling.

Virtually all of the SO_2 emissions from Jewell are emitted from the vent and coal dryer stacks. Fugitive emissions from pushing, charging and material handling operations make up a much smaller fraction of Jewell Coke's total SO_2 emissions. The actual modeled stack emissions from the Jewell Coke facility were based upon emission testing that was performed at the facility on a representative vent (or coking) stack and the coal dryer stack. Emission testing at Jewell was performed recently on February 23-25, 2016 and previously on August 20-21, 2009, in accordance with Jewell's Title V permit. Actual emission rates and stack parameters were used for the modeling. Use of the compliance-based stack test data has the advantages of being actual emissions data from tests that were performed under a Virginia Department of Environmental Quality (DEQ)-approved test protocol and observed by representatives of the Virginia DEQ.

Virginia characterized this source within the area of analysis in accordance with the best practices outlined in the Modeling TAD. Specifically, Virginia used actual stack heights in

conjunction with actual emissions. Virginia also adequately characterized the source's building layout and location, as well as the stack parameters, e.g., exit temperature, exit velocity, location, and diameter. Where appropriate, the AERMOD component BPIPPRM was used to assist in addressing building downwash. Building and stack position information that Jewell Coke included in the modeling analysis was verified using GIS software. Plant emissions and stack temperatures and velocities were kept constant throughout the simulation. This is probably reflective of actual coking operations where shutdowns and down times are typically very infrequent. A survey of the modeled temperatures and velocities indicated they were within the realm of expected values.

As noted previously, the Commonwealth's most recent modeling submission mostly mirrors its 120-day modeling analysis. Source characterization was identical to the previous modeling submittal with the bulk of the SO_2 emissions from the coke ovens characterized as point sources via the facility's seventeen (17) vent stacks. Other SO_2 emissions characterized in the modeling included oven charging, oven pushing, and coke quenching. These sources were much smaller than the vent stacks and quenching emissions were actually omitted from the modeling analysis as being insignificant. Oven charging (adding coal to ovens for coking purposes) emissions were characterized as point sources while pushing (transfer of coke from the ovens to a rail car for quenching) emissions were modeled using AERMOD's BUOYLINE source type, which handles emissions sources with extremely high temperatures. The EPA believes Jewell Coke's sources are adequately characterized based on current information.

2.4.2.6.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 potential to emit (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 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."

The only source Virginia included in its modeling analysis was Jewell Coke. No other emitters of SO_2 over 0.5 tpy are located within 10 km of the facility. Virginia chose to model Jewell Coke's actual emissions for 2013 through 2015. The modeling analysis used the same emission rates that were in Virginia's 120-day modeling submittal.

For Jewell Coke, actual emissions were based on the source testing information discussed earlier. This information is summarized in Table 6. A description of how Virginia obtained hourly emission rates is given below this table.

Table 6. Actual SO_2 Emissions Between 2013 – 2015 from Facilities in the Buchanan Area

Modeled Emissions			
	SO_2 Emissions (tpy)		
Facility Name	**2013**	**2014**	**2015**
Jewell Coke- Vent Stacks	4,441.4	4,441.4	4,441.4
Jewell Coke- Thermal Dryer	2.2	2.2	2.2
Jewell Coke- Oven Charging	1.3	1.3	1.3
Jewell Coke- Pushing	63.5	63.5	63.5
Total Emissions from All Modeled Facilities in the Commonwealth's Area of Analysis	**4,508.4**	**4,508.4**	**4,508.4**

2014 NEI Emissions	
Facility	**2014 NEI SO_2 Emissions (tpy)**
Jewell Coke Company LLP	4,964.5

Virginia Emissions Inventory[11]			
	SO_2 Emissions (tpy)		
Facility Name	**2013**	**2014**	**2015**
Jewell Coke- Vent Stacks	4,752.43	4,964.48	4,844.646

[11] http://www.deq.virginia.gov/Programs/Air/AirQualityPlanningEmissions/EmissionInventory.aspx

For Jewell Coke, actual hourly emissions data were based on recent stack testing information as described in the previous section. The modeled emissions appear to be about 10% lower than what is in EPA's 2014 NEI. Emissions tabulated by Virginia also show modeled emissions are generally lower throughout the simulation period. Charging emissions from AP-42, pushing from stack test, and quenching emissions, as noted previously, were ignored. Since this is a non-recovery coking operation, quenching emissions are somewhat negligible when compared to the COG combustion numbers. This discrepancy in annual emissions was not fully accounted for in Virginia's most recent modeling submittal. Jewell Coke's October 5, 2017 response letter reiterates its opinion that basing its model emission rates on stack testing (from 2009 and 2016) is an accurate assessment of its actual emissions. However, the modeling period is supposed to represent emissions for 2013 through 2015, which lie outside the time periods in which the stack tests were conducted. The EPA also points out that facility emissions should be accurately reported to the Commonwealth of Virginia (see Annual Air Pollutant Emissions, DEQ Form 805 7/21/04).

2.4.2.7.Modeling Parameter: Meteorology and Surface Characteristics

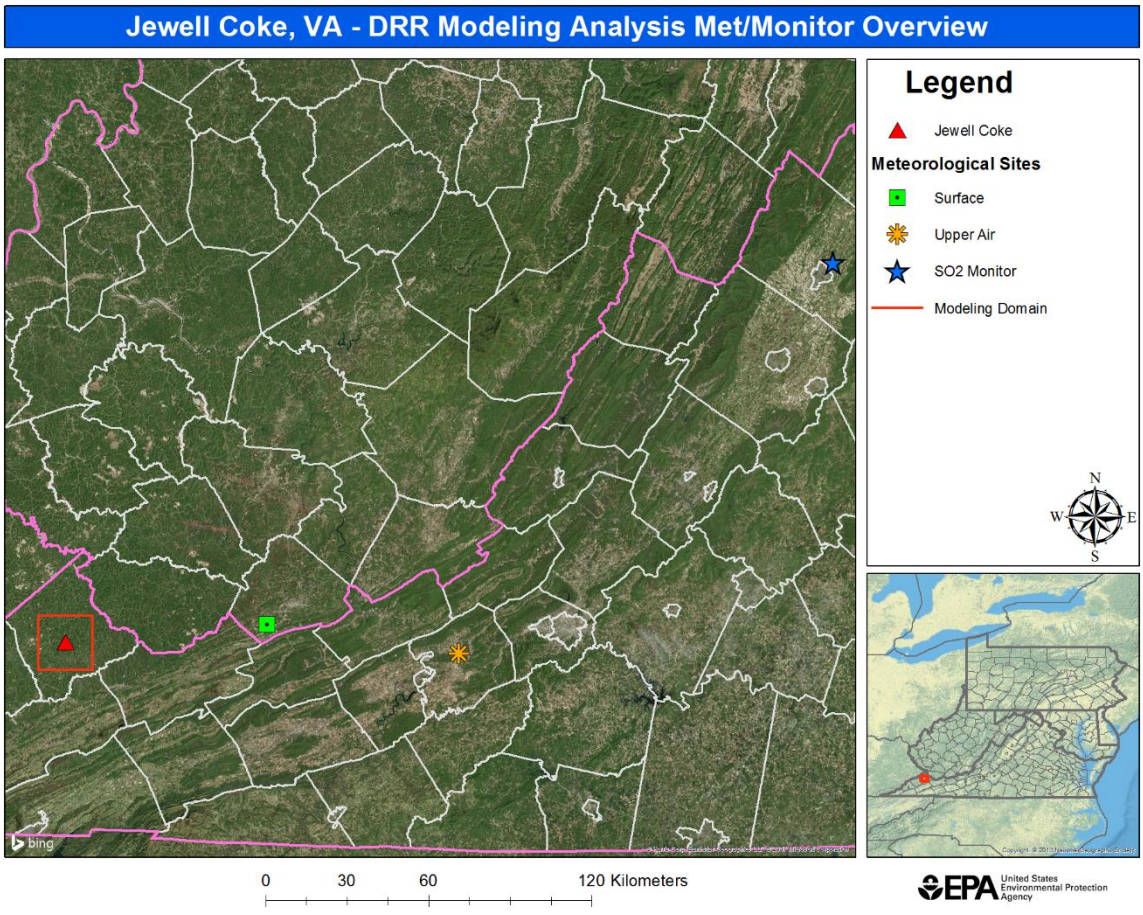
As noted in the Modeling TAD, the most recent 3 years of meteorological data (concurrent with the most recent 3 years of emissions data) should be used in designations efforts. The selection of data should be based on spatial and climatological (temporal) representativeness. The representativeness of 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.

The Virginia October 2017 modeling analysis largely utilized the same preprocessing steps as the Virginia January 2017 modeling analysis. No meteorological preprocessing files were included in Virginia's October 23, 2017 submittal. Based on the output file provided by Virginia, it appeared that the meteorological data was reprocessed using AERMET version 16216, which corrects a known formulation bug in the previous AERMET version (15181) that could lead to model under-predictions. The description of the meteorological data processing for the 120-day modeling analysis was included assuming the same steps were taken to produce the updated meteorological files used in the most recent modeling analysis. For the area of analysis for the Buchanan area, Virginia selected the surface meteorology from Bluefield/Mercer County Airport in Mercer County, WV, and coincident upper air observations from Roanoke–Blacksburg Regional Airport in Montgomery County, VA, as best representative of meteorological conditions within the area of analysis. Both airports are located to the east of Jewell Coke with Bluefield/Mercer County Airport roughly 74 km away and Roanoke–Blacksburg Regional Airport roughly 144 km away.

Virginia used AERSURFACE version 13016 using data from Bluefield/Mercer County Airport to estimate the surface characteristics of the area of analysis. Virginia estimated values for five (5) spatial sectors out to 1.0 km at a monthly temporal resolution for dry, wet, average conditions based on local actual and historical rainfall rates. Virginia also estimated values for albedo (the fraction of solar energy reflected from the earth back into space), the Bowen ratio (the method generally used to calculate heat lost or heat gained in a substance), and the surface roughness (sometimes referred to as "Zo"). AERSURFACE was run using non-default seasonal values with no snow cover. The lack of continuous monthly snow cover given the location of Jewell Coke seems unusual and should be verified.

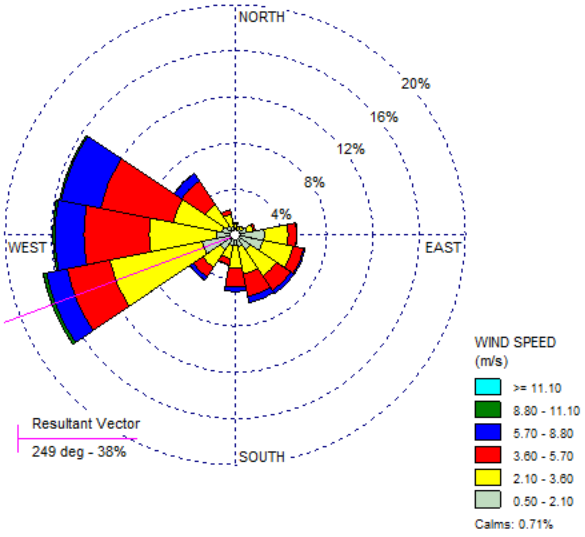
In the figure below, generated by the EPA, the locations of these NWS stations are shown relative to the area of analysis.

Figure 4. Area of Analysis and the NWS stations in the Buchanan Area



As part of its recommendation, Virginia provided the 3-year surface wind rose for Bluefield/Mercer County Airport. In Figure 5, the frequency and magnitude of wind speed and direction are defined in terms of from where the wind is blowing. The wind rose shows predominant winds from the west with the resultant wind vector direction for the 10-m wind measurements, which shows winds out of the west-southwest. Jewell Coke noted less than 10% of the wind speeds were less than 1.5 meters per second (m/s), which may have accounted for the final peak model concentration being identical to the previous 120-day modeling results even though the meteorological data was processed with the most recent version of AERMET that did not contain the formulation bug in the low wind ADJ_U* module. The EPA reanalyzed the wind speeds and determined less than 3% of the hourly wind speeds were below 1.0 m/s confirming that the meteorological data contains relatively few hours of light winds that could be adjusted using the low wind ADJ_U* module within AERMOD.

Figure 5. Bluefield/Mercer County Airport Cumulative Annual Wind Rose for Years 2013 – 2015



Meteorological data from the above surface and upper air NWS stations were used in generating AERMOD-ready files with the AERMET processor. The output meteorological data created by the AERMET processor is suitable for being applied with AERMOD input files for AERMOD modeling runs. Virginia followed the methodology and settings presented in their modeling protocol, which followed guidance set forth in the Modeling TAD, in the processing of the raw meteorological data into an AERMOD-ready format, and used AERSURFACE to best represent surface characteristics.

Hourly surface meteorological data records are read by AERMET, and include all the necessary elements for data processing. However, wind data taken at hourly intervals may not always portray wind conditions for the entire hour, which can be variable in nature. Hourly wind data may also be overly prone to indicate calm conditions, which are not modeled by AERMOD. In order to better represent actual wind conditions at the meteorological tower, wind data of 1-minute and 5-minute duration was provided from Bluefield/Mercer County Airport, but in a different formatted file to be processed by a separate preprocessor, AERMINUTE. These data were subsequently integrated into the AERMET processing to produce final hourly wind records of AERMOD-ready meteorological data that better estimate actual hourly average conditions and that are less prone to over-report calm wind conditions. This allows AERMOD to apply more hours of meteorology to modeled inputs, and therefore produce a more complete set of concentration estimates. As a guard against excessively high concentrations that could be produced by AERMOD in very light wind conditions, the Commonwealth set a minimum threshold of 0.5 meters per second in processing meteorological data for use in AERMOD. In setting this threshold, no wind speeds lower than this value would be used for determining concentrations. This threshold was specifically applied to the 1-minute and 5-minute wind data. Jewell Coke is located in a narrow valley incised by the Dismal River. Terrain rises quickly from where the plant is located, as noted in the final report, creating very steep grades. Elevation differences between the valley floor and the nearest terrain are on the order of 200 m. Conditions in these narrow valleys could create valley induced flows that may not be captured in the meteorological data used in this analysis. Similar valley flows have been documented in the Allegheny, Pennsylvania SO_2 SIP draft[12] for a similar coke facility. Jewell Coke emission temperatures are quite high, which could lead to buoyant plumes that at least have a possibility of lofting emissions out of the narrow valley and into the regional atmospheric flow, which is probably captured at the higher elevation collection points such as the Bluefield/Mercer County Airport. Due to the airport's high elevation, its winds are probably reflecting the regional wind flow. The valley in which the coke plant is located likely has different wind patterns than the surrounding elevated terrain. Given the buoyant nature of the coke oven emissions, the plumes probably loft out of the valley and are therefore subject to the regional winds measured at Bluefield.

2.4.2.8.Modeling Parameter: Geography, Topography (Mountain Ranges or Other Air Basin Boundaries) and Terrain

The Virginia October 2017 modeling analysis for Jewell Coke did not include preprocessing files for the development of the model receptor grid. The most recent model receptor grid matched the receptor grid used in the Virginia January 2017 modeling analysis, so the EPA infers that the area and the receptor grid preprocessing description is likely the same in both.

[12] http://www.achd.net/air/publichearing2017/SO2_2010_NAAQS_SIP_DRAFT_Mar-2-2017.pdf

The terrain in the area of analysis is best described as complex with narrow valleys incised by small creeks and rivers with elevations along the surrounding hill tops relatively uniform. Higher terrain lies well to the east of Jewell Coke. To account for these terrain changes, the Virginia January 2017 modeling used the AERMAP terrain program within AERMOD to specify terrain elevations for all the receptors. The source of the elevation data incorporated into the model is from the using 1/3 arc second National Elevation Data (NED) files obtained from the USGS.

EPA believes that the terrain within the modeling domain has likely been adequately characterized, but could not verify.

2.4.2.9.Modeling Parameter: Background Concentrations of SO_2

The Modeling TAD offers two 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. The Virginia October 2017 modeling files submitted by Virginia for Jewell Coke did not include a background concentration. Final concentrations, however, used the same value used for the Virginia January 2017 modeling analysis. The Virginia January 2017 modeling analysis used background concentrations taken from the Harrisonburg SO_2 monitoring site (Site ID 51-165-0003) in Rockingham County, Virginia. This monitor is roughly 314 km northeast of Jewell Coke. The single value of the background concentration for this area of analysis was determined by Virginia to be 13.1 μg/m^3, equivalent to 5 ppb when expressed in one significant figure,[13] and that value was incorporated into the final AERMOD results.

Given the isolation of Jewell Coke, the EPA finds it acceptable to use Harrisonburg as a regionally representative background site in accordance with section 8.3.2 (b) of Appendix W.

2.4.2.10. Summary of Modeling Inputs and Results

The AERMOD modeling input parameters for the Buchanan area of analysis are summarized below in Table 7.

[13] The SO_2 NAAQS level is expressed in ppb but AERMOD gives results in μg/m^3. The conversion factor for SO_2 (at the standard conditions applied in the ambient SO_2 reference method) is 1ppb = approximately 2.619 μg/m^3.

Table 7. Summary of AERMOD Modeling Input Parameters for the Area of Analysis for the Buchanan area

Input Parameter	Value
AERMOD Version	16216r
Dispersion Characteristics	Rural
Modeled Sources	Jewell Coke
Modeled Stacks	23
Modeled Structures	12
Modeled Fencelines	0
Total receptors	13,498
Emissions Type	Actual (based on extrapolation of stack test information)
Emissions Years	2013-2015
Meteorology Years	2013-2015
NWS Station for Surface Meteorology	Bluefield, WV
NWS Station Upper Air Meteorology	Roanoke, VA
NWS Station for Calculating Surface Characteristics	Bluefield, WV
Methodology for Calculating Background SO_2 Concentration	Tier 1 Design Value 2013-15
Calculated Background SO_2 Concentration	5 ppb or 13.1 ug/m^3

The results presented below in Table 8 show the magnitude location of the highest predicted modeled concentration based on the input parameters. Virginia's most recent modeling analysis did not include the entire output files so only information on the peak model concentrations was available.

Table 8. Predicted 99th Percentile Daily Maximum 1-Hour SO_2 Concentration Averaged Over Three Years for the Area of Analysis for the Buchanan area

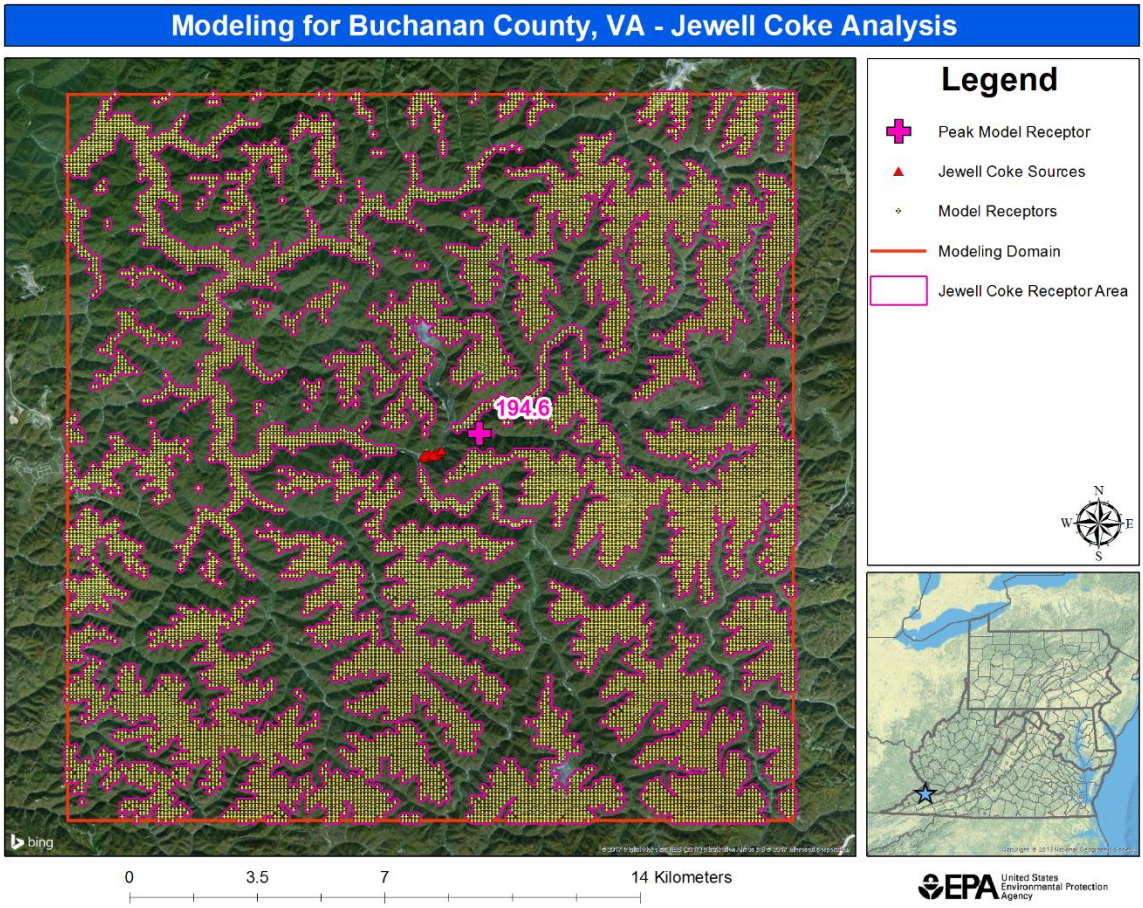
Averaging Period	Data Period	Receptor Location UTM zone 17		99th percentile daily maximum 1-hour SO_2 Concentration ($\mu g/m^3$)	
		UTM Easting	UTM Northing	Modeled concentration (including background)	NAAQS Level
99th Percentile 1-Hour Average	2013-2015	409,130.00	4,121,930.00	181.5 + 13.1 = **194.6**	196.4*

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

The Virginia October 2017 modeling indicates that the highest predicted 99th percentile daily maximum 1-hour concentration within the chosen modeling domain is 194.6 $\mu g/m^3$, equivalent to 74.99 ppb. This modeled concentration included the background concentration of SO_2, and is based on actual emissions from the Jewell Coke stack tests.

A comparison of model peak concentrations from the Virginia October 2017 submittal showed that peak concentrations were fractionally lower than peak concentrations from the Virginia January 2017 modeling analysis (for the same receptor); 181.48189 $\mu g/m^3$ for the Virginia October 2017 modeling analysis versus 181.48314 $\mu g/m^3$ for the Virginia January 2017 modeling analysis. Rounding to one figure yields the same final result for both analyses. Figure 6 below shows the peak model concentration that was provided in the Commonwealth's model files. As noted previously, the Virginia October 2017 submittal only included the output file and did not include the full complement of output files that could have been used to generate a figure showing results for all 13,498 model receptors. The Commonwealth's receptor grid is also shown in the figure as well as the Jewell Coke model stack locations. Peak model concentrations occur approximately 1.3 km east north-east of Jewell Coke.

Figure 6. Maximum Predicted 99th Percentile Daily Maximum 1-Hour SO_2 Concentrations Averaged Over Three Years for the Buchanan area



The most recent modeling submitted by Virginia does not indicate that the 1-hour SO_2 NAAQS is violated at the receptor with the highest modeled concentration. There continues, however, to be several deficiencies in the modeling analysis that prevents a definitive conclusion that actual emissions from Jewell Coke comply with the 1-hour SO_2 NAAQS in order for the area to be designated attainment/unclassifiable. These deficiencies are summarized below.

Model Receptor Grid: Jewell Coke's model receptor placement methodology limits receptor sampling without adequate justification for all receptor exclusions and could allow its emission plumes to bypass the model receptor grid due to receptor clustering at certain elevations and hill height scales.

Modeled Emission Rates Are Less Than Reported Annual SO_2 Emission Values: Jewell Coke based its modeled emission rates on stack test results excluding some minor ancillary sources (Quenching) taken in 2009 and 2016. The facility's total annual modeled emission rates are from 5 to 9% less than reported emissions for 2013 through 2015 without appropriate explanation for this deviation. The EPA notes that Virginia's Annual Air Pollutant Emissions form requires an accurate accounting of facility emissions. AERMOD concentrations are directly proportional to the model emission rates and therefore using under-reported emission rates for the 2013-2015 time period would generally lead to under-estimated model concentrations.

Low Wind (ADJ_U*): While Jewell Coke's most recent modeling submission appears to use the updated version of AERMET (16216), which corrects for a known formulation bug, the actual processed meteorological data was not included in the Commonwealth's most recent submission. Curiously, the model peak concentration was slightly lower than the Virginia January 2017 modeled peak concentration. The EPA felt that this receptor should have been subject to adjustments from the low wind (ADJ_U*) option. Given the version used in the Virginia January 2017 modeling submission that was prone to under-predictions, this should have caused the most recent modeling concentrations to increase. No definitive analysis could be performed to further analyze this change without having additional output files in addition to the final processed meteorological data.

2.4.2.11. The EPA's Assessment of the Modeling Information Provided by the Commonwealth

While the most recent modeling submitted during the public comment period shows that peak concentrations comply with the 1-hour SO_2 NAAQS, the submittal continues to have several deficiencies that prevent the EPA from definitively concluding that Virginia's October 2017 modeling analysis using actual emissions shows attainment of the 2010 SO_2 NAAQS. One of the deficiencies is that the model receptor grid omits over 50% of the area surrounding the Jewell Coke without adequate justification for all receptor exclusions and potentially excludes critical elevation receptors where peak impacts may be occurring. Also, model emission rates are from 5 to 9% lower than the reported 2013-2015 annual emission rates. This may be due to the use of stack test information (from 2009 and 2016), which was taken outside the simulation period. The most recent modeling submitted for the Jewell Coke appears to include the updated low wind (ADJ_U*) option, rather than an earlier version that contained a known formulation bug that could lead to model under-predictions. This change, however, only fractionally lowered the final peak model concentration and may have been due to the lack of low wind speeds (< 3% of winds below 1.0 m/s) in the meteorological data used in the analysis.

2.4.3. Modeling Analysis Provided by Sierra Club

During the public comment period additional modeling for Jewell Coke was submitted by Sierra Club. Sierra Club utilized most of the same files that were used in the Virginia January 2017 modeling submission with the exception of the development of a new modeling receptor grid that was more focused on the area within roughly 3 km of the Jewell Coke Company. This new model receptor grid "filled in" many of the areas surrounding the facility that were omitted in the Virginia January 2017 and October 2017 modeling receptor grids. In a letter from Jewell Coke dated October 20, 2017, the company commented that Sierra Club's model receptor grid includes areas that it feels should have been excluded from the analysis for the various reasons that have been discussed earlier in the EPA's analysis of the Virginia October 2017 modeling submission.

2.4.3.1.Differences Between and Relevance of the Modeling Assessment Submitted by the Sierra Club and Modeling Assessment(s) Submitted by Virginia

The most important difference in the Sierra Club's and the Virginia January 2017 and October 2017 modeling analyses for the Buchanan area is the model receptor grid. As noted previously, Sierra Club's model grid includes receptors over nearly the entire area surrounding Jewell Coke. The Commonwealth's receptor grid covers less than 50% of the area around the facility. Sierra Club's grid essentially "fills in" the areas not covered in the Commonwealth's grid. Jewell Coke maintains that the excluded areas comply with current EPA guidance due to accessibility, steep terrain, and other monitor siting considerations. Both the Virginia October 2017 and the Sierra Club modeling utilize AERMOD's low wind (ADJ_U*) option, but Sierra Club used an older version (AERMET version 15181) that contained a known formulation bug that could lead to model under-predictions (the Virginia October 2017, submission appeared to use the most recent version of AERMOD that corrected this formulation bug). Use of the low wind (ADJ_U*) option did not make a significant difference in the Virginia October 2017 final model concentration compared to the Virginia January 2017 modeling, possibly due to the infrequency of low winds in the meteorological data set used in the final modeling demonstration; less than 3% of the model hours had winds under 1.0 m/s.

2.4.3.2.Model Selection and Modeling Components

The EPA's Modeling TAD notes that for area designations under 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

The Sierra Club modeling submission used AERMOD version 16216r. As noted previously, the meteorological data used by the Sierra Club was processed using an older version of AERMET (version 15181) using the low wind (ADJ_U*) option. This version contained a known formulation bug that could lead to model under-predictions. A discussion of the Sierra Club's approach to the individual components is provided in the corresponding discussion that follows, as appropriate.

2.4.3.3.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.

For the purpose of performing the modeling for the Buchanan area, the Sierra Club determined that it was most appropriate to run AERMOD in rural mode. This was the same selection that the Virginia October 2017 modeling analysis used. The Commonwealth provided a reasonable justification for this determination that the EPA has reviewed and concurred with; Sierra Club's selection of running AERMOD using rural dispersion coefficients is also justified.

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

The 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.

The source of SO_2 emissions in this area are described in the introduction to this section. For the Buchanan area, Sierra Club has explicitly modeled no other emitters of SO_2 within three (3) km of Jewell Coke; as noted in the Virginia October 2017 modeling there are no other sources of SO_2 larger than 0.5 tpy within ten (10) km of Jewell Coke. Sierra Club determined that this was an appropriate distance to adequately characterize air quality through modeling to include the potential extent of any SO_2 NAAQS exceedances in the area of analysis and any potential impact on SO_2 air quality from other sources in nearby areas.

Sierra Club's model receptor grid was designed to "fill in" the areas where the Commonwealth excluded model receptors within three (3) km of Jewell Coke. The EPA believes this is reasonable since peak model concentrations are probably located within this distance from the facility and adequate justification was not provided to justify all the Virginia October 2017 receptor exclusions. The EPA noted that the Commonwealth's model receptors covered less than 50% of the area within its (20 x 20 km) modeling domain. The Commonwealth's model receptors cover only 36% of the area within the modeling domain chosen by Sierra Club (within roughly 3 km of the Jewell Coke Facility).

Elevations for Sierra Club's receptor grid were obtained from National Elevation Dataset (NED) GeoTiffdata. 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. EPA's software program AERMAP (version 11103) was used for development of the model receptor grid.

The grid receptor spacing for the area of analysis chosen by Sierra Club is as follows:

- A Cartesian grid of 50-meter spaced receptors out to a distance of 1,000 meters from Jewell Coke
- A Cartesian grid of 100-meter spaced receptors extending from 1,000 meters out to a distance of 3,000 meters from Jewell Coke
- Receptors that were located on buildings or structures that were part of Jewell Coke were omitted from the final grid

No fence line was established by Sierra Club for Jewell Coke since there are no formal man-made structures to restrict access to the facility. Additionally, there was no effort by Sierra Club to determine if there are any areas that would not be considered as ambient air, or any areas in which it would not be feasible to place a monitor as outlined in section 4.2 of the EPA's Modeling TAD. Sierra Club presented several reasons in its October 5, 2017 comments (see Appendix E of Sierra Club's comment submittal) to support its argument that the Virginia January 2017 modeling analysis (which is the same receptor grid as the Virginia October 2017 submission) removed too many areas for consideration from its modeling analysis, especially the areas where Sierra Club's modeling shows extremely high model concentrations. Sierra Club's model receptor grid, however, does seem to be consistent with the Modeling TAD considering that it states *"…[I]t may be in the best interest of air agencies and applicants to keep all ambient air receptors in the model run and exclude post-modeling to avoid the potential to have to rerun the model in case of disagreements in receptor exclusion with the EPA Regional Modeling Contact*."

Sierra Club's final model grid consisted of 4,957 receptors covering roughly a 6 by 6 km area centered on Jewell Coke and is contained entirely within Buchanan County, Virginia.

Figures 7, 8, and 9 produced using GIS software from the modeling files and elevation files provided by the Commonwealth and Sierra Club, show Sierra Club's chosen area of analysis surrounding Jewell Coke, as well as both the Commonwealth's and Sierra Club's model receptor grid for the area of analysis.

Figure 7. Area of Analysis for the Buchanan area

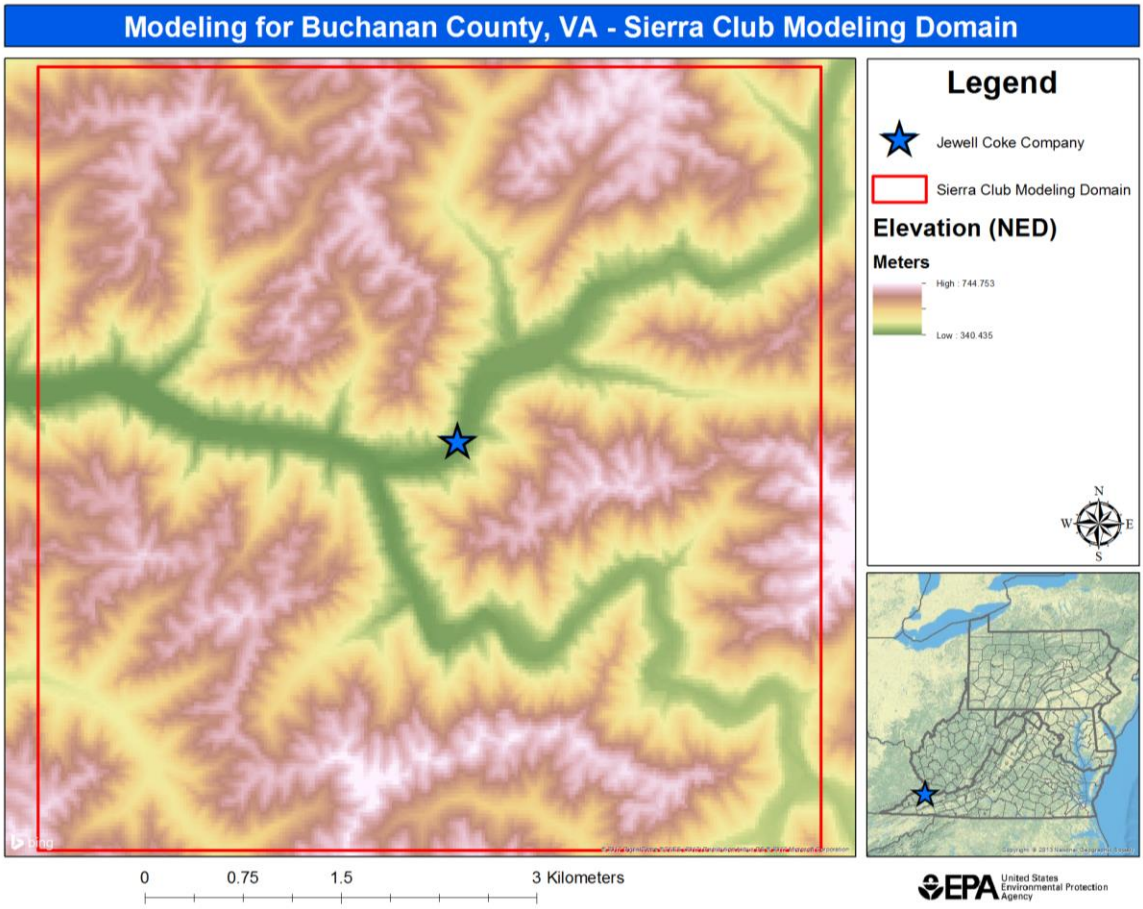


Figure 8. Receptor Grid for the Buchanan area in Virginia January 2017 and October 2017 Analyses

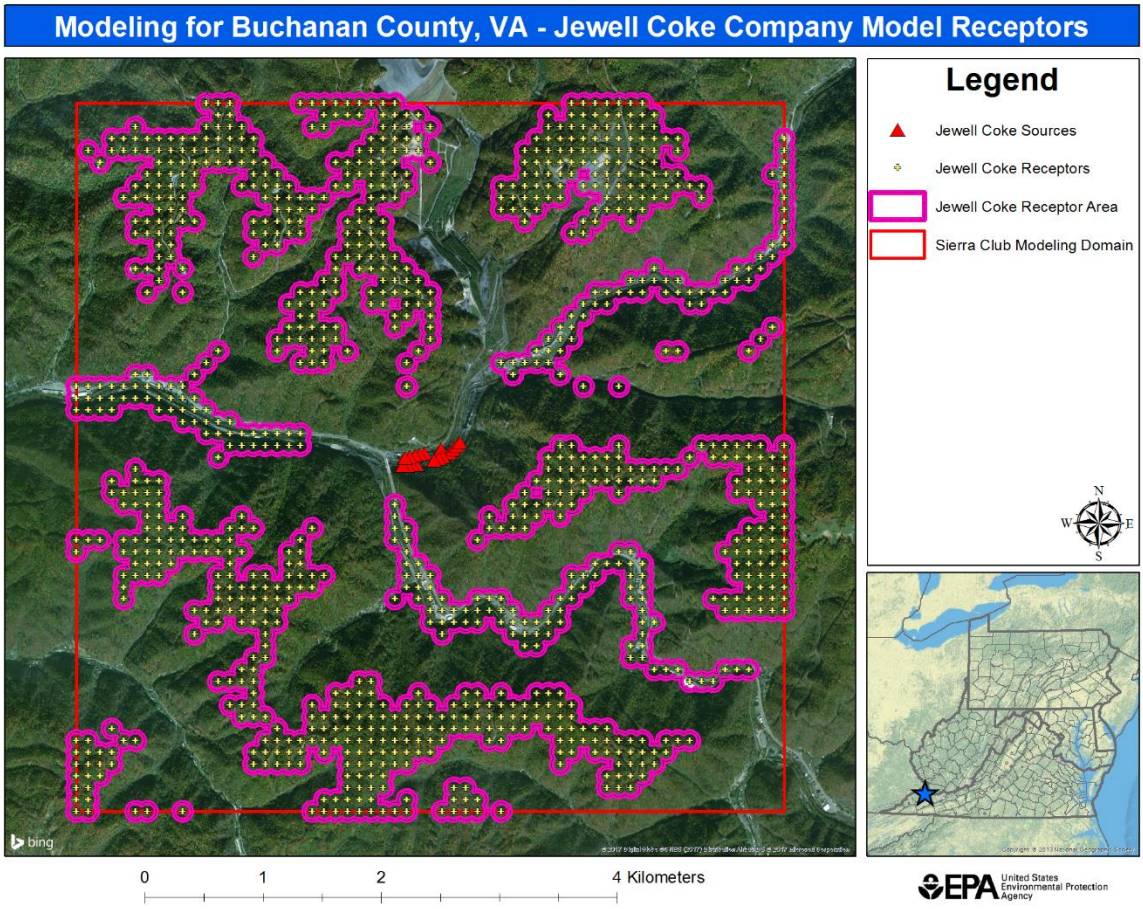
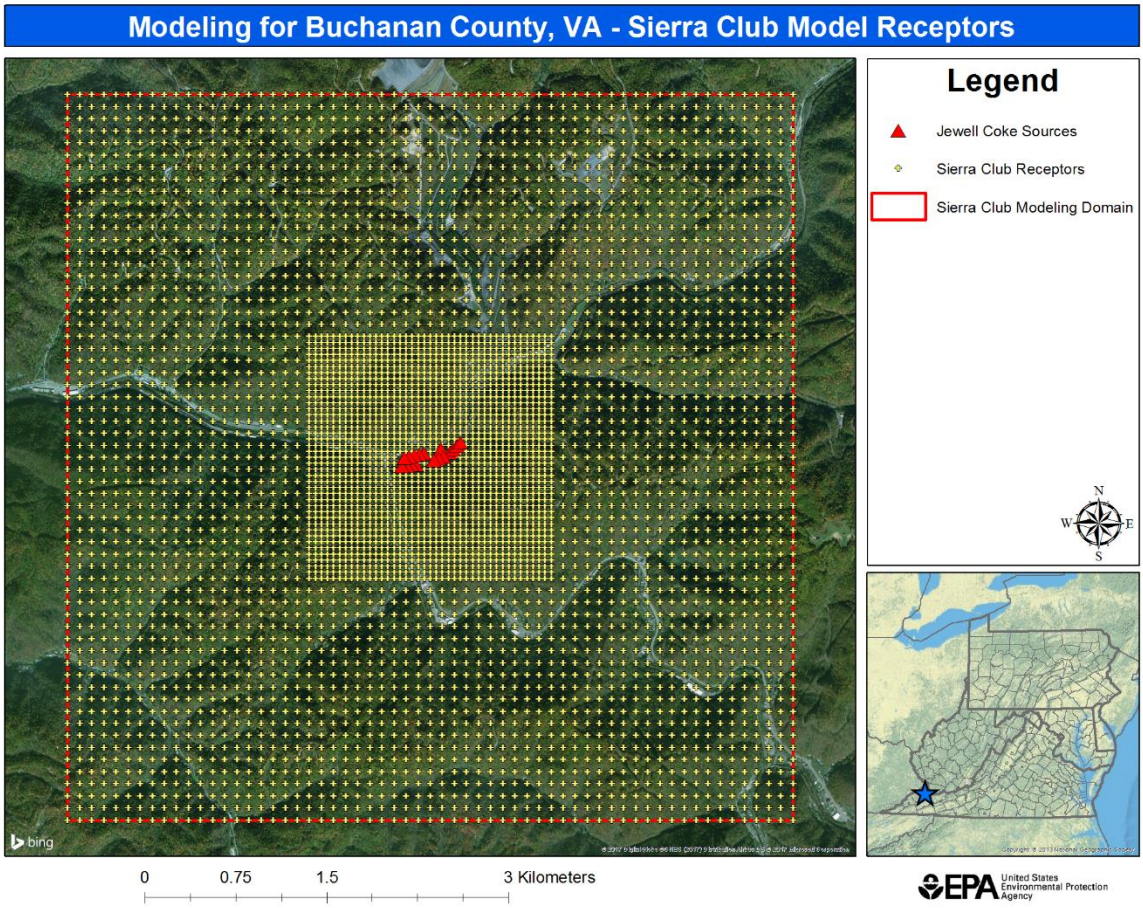


Figure 9. Receptor Grid for the Buchanan area in Sierra Club's Analysis



2.4.3.5.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.

Sierra Club's modeling analysis used the Commonwealth's January 2017 air modeling input file information, including the same building downwash information, stack parameters (including emission rates) and source characterizations. The EPA checked the Commonwealth and Sierra Club's input files and determined they were identical.

2.4.3.6.Modeling Parameter: Emissions

The 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 Modeling 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 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, organizations 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 an organization 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."

As noted in the previous section, Sierra Club's modeling used the emission rates developed in the Virginia January 2017 modeling analysis, which were identical to the Virginia October 2017 modeling submittal. The EPA has outlined what it believes are under-representations of Jewell Coke's actual emissions for the model period (2013-15) in the Commonwealth emissions section of this TSD. The EPA believes this under-representation is due to the Commonwealth basing emission rates on stack tests (from 2009 and 2016) that were taken outside the formal modeling period. Sierra Club's analysis, therefore, may also be under-predicting due to differences in the modeled and actual reported SO_2 emissions over the model simulation period.

2.4.3.7.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.

Sierra Club's analysis used the same meteorological data included in the Virginia January 2017 modeling submittal. This used a previous version of AERMET that contained a known formulation bug that could lead to under-predictions if the low wind (ADJ_U*) option is utilized. The use of this older version was discussed in a March 8, 2017, Clarification Memo available on the EPA's Support Center for Regulatory Atmospheric Modeling or SCRAM which states:

> *"[F]or state, local, and tribal air agencies, with or without alternative model approval, that submitted SO_2 DRR modeling based on AERMOD version 15181 that included AERMET version 15181 meteorological data processed with the ADJ_U* beta option, the SO_2 DRR modeling results would be affected by the formulation bug and, consequently, would not be considered sufficiently representative to inform the Round 3 – SO_2 designations."*

Since Sierra Club used the identical files as the Virginia January 2017 submission, the discussion of the meteorological processing steps will be omitted here. Readers are referred to the Commonwealth's meteorological section of this TSD for actual processing steps with the exception that Sierra Club used processed meteorological data using a previous version of AERMET (version 15181). Otherwise, the EPA believes the meteorological data used in the modeling analysis is generally representative of conditions near the Jewell Coke Company facility.

2.4.3.8.Modeling Parameter: Geography, Topography (Mountain Ranges or Other Air Basin Boundaries) and Terrain

The terrain in the area of analysis is best described as complex with narrow valleys incised by small creeks and rivers with elevations along the surrounding hill tops relatively uniform. Higher terrain lies well to the east of Jewell Coke. To account for these terrain changes, Sierra Club used the AERMAP terrain program within AERMOD to specify terrain elevations for all the receptors. As noted previously, the source of the elevation data incorporated into the model uses a 1 arc-second (30-meter) resolution NED file.

The EPA believes that the terrain within the modeling domain has been adequately characterized.

2.4.3.9.Modeling Parameter: Background Concentrations of SO_2

The Modeling TAD offers two 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. The modeling files submitted by Sierra Club included a background concentration. Final concentrations, therefore, reflect the model impacts from Jewell Coke plus a regionally representative background concentration that was nearly identical to (slightly lower than) the value submitted in the Virginia January 2017 modeling analysis. The Virginia January 2017 modeling analysis used a background concentrations taken from the Harrisonburg SO_2 monitoring site (Site ID 51-165-0003) in Rockingham County, Virginia. This monitor is roughly 314 km northeast of Jewell Coke. The single value of the background concentration for this area of analysis was determined by Virginia to be 13.1 μg/m^3, equivalent to 5 ppb when expressed in one significant figure.[14] Sierra Club, however, added a background concentration of 13.0 μg/m^3, slightly lower than the Commonwealth's value.

Given the isolation of Jewell Coke, the EPA finds it acceptable to use Harrisonburg as a regionally representative background site in accordance with section 8.3.2 (b) of Appendix W.

2.4.3.10. Summary of Modeling Inputs and Results

Sierra Club's AERMOD modeling input parameters for the Buchanan area of analysis are summarized below in Table 9.

[14] The SO_2 NAAQS level is expressed in ppb but AERMOD gives results in μg/m^3. The conversion factor for SO_2 (at the standard conditions applied in the ambient SO_2 reference method) is 1ppb = approximately 2.619 μg/m^3.

Table 9. Summary of Sierra Club's AERMOD Modeling Input Parameters for the Area of Analysis for the Buchanan area

Input Parameter	Value
AERMOD Version	16216r (AERMET, v15181)
Dispersion Characteristics	Rural
Modeled Sources	Jewell Coke
Modeled Stacks	23
Modeled Structures	12
Modeled Fencelines	0
Total receptors	4,957
Emissions Type	Actual (based on extrapolation of stack test information)
Emissions Years	2013-2015
Meteorology Years	2013-2015
NWS Station for Surface Meteorology	Bluefield, WV
NWS Station Upper Air Meteorology	Roanoke, VA
NWS Station for Calculating Surface Characteristics	Bluefield, WV
Methodology for Calculating Background SO_2 Concentration	Tier 1 Design Value 2013-15
Calculated Background SO_2 Concentration	5 ppb or 13.0 ug/m^3

The results presented below in Table 10 show the magnitude and geographic location of Sierra Club's highest predicted modeled concentration based on the input parameters.

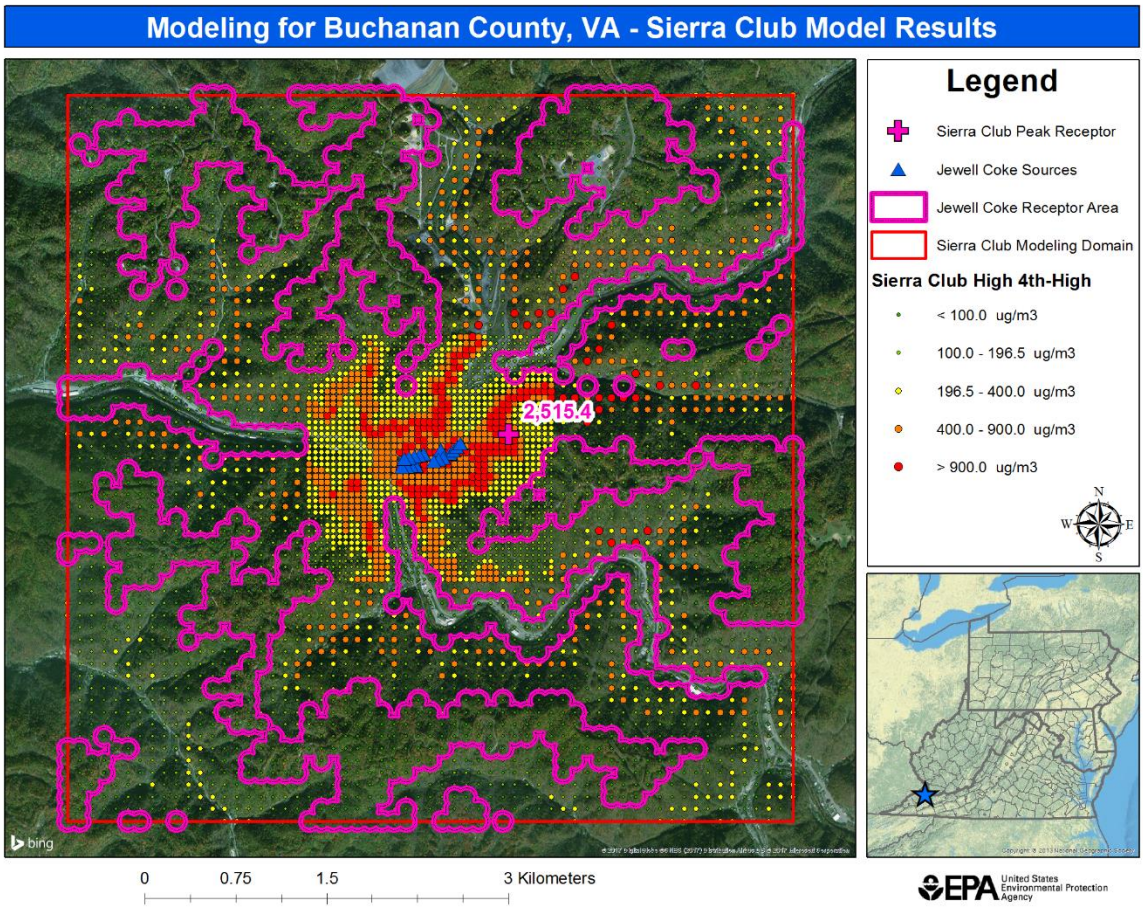
Table 10. Sierra Club's Predicted 99th Percentile Daily Maximum 1-Hour SO_2 Concentration Averaged Over Three Years for the Area of Analysis for the Buchanan Area

Averaging Period	Data Period	Receptor Location UTM zone 17		99th percentile daily maximum 1-hour SO_2 Concentration (µg/m^3)	
		UTM Easting	UTM Northing	Modeled concentration (including background)	NAAQS Level
99th Percentile 1-Hour Average	2013-2015	408,480	4,121,530	2,515.4	196.4*

*Equivalent to the 2010 SO_2 NAAQS of 75 ppb reflecting a 2.619 µg/m^3 conversion factor

Sierra Club's modeling indicates that the highest model predicted 99th percentile daily maximum 1-hour concentration within the chosen modeling domain is 2,515.4 µg/m^3, equivalent to 960 ppb. This modeled concentration is based on actual emissions that were also used in the Commonwealth's analysis for Jewell Coke and included a background concentration of SO_2 that was slightly below the value used in the Commonwealth's modeling analysis. Figure 10 below was generated using GIS software from Sierra Club's modeling output files, and indicates that the peak predicted value occurred less than 500 meters east north-east of the Jewell Coke Company. Peak model concentrations occurred within the 50 meter Cartesian grid but also extended out the edge of the model receptor grid. The areas outlined in magenta are the areas where the Commonwealth's model receptors were located, and the area outlined in red is the Sierra Club's modeling domain. The figure shows that there are few Sierra Club receptors that exceeded the NAAQS within the areas modeled by the Commonwealth. These areas are within the 50-meter Cartesian grid used in the Sierra Club modeling analysis.

Figure 10. Maximum Predicted 99th Percentile Daily Maximum 1-Hour SO_2 Concentrations Averaged Over Three Years for the Area of Analysis for the Buchanan Area



The modeling submitted by the Sierra Club indicates that the 1-hour SO_2 NAAQS is violated at the receptor with the highest modeled concentration. A total of 1,774 (out of 4,957) model receptors exceeded the 1-hour SO_2 NAAQS.

2.4.3.11. The EPA's Assessment of the Modeling Information Provided by the Sierra Club

EPA recognizes that the Sierra Club modeling shows that multiple locations within 3 km of the Jewell Coke in the Buchanan area significantly exceed the 1-hour SO_2 NAAQS. This modeling, however, had several deficiencies:

Use of the Low Wind (ADJ_U*) Option in AERMET Version 15181: The Sierra Club's modeling analysis used a version of AERMOD that contained a known formulation bug. EPA's March 8, 2017, Clearinghouse Memorandum clearly states that modeling analyses that utilize AERMOD with this formulation bug would *"…not be considered sufficiently representative to inform the Round 3 – SO_2 designations*."

Magnitude of Sierra Club's Model Concentrations: The peak model concentration presented by Sierra Club is over an order of magnitude above the 1-hour SO_2 NAAQS. These modeled values are approaching levels set for industrial worker safety (13,000 μg/m^3 OSHA TWA) and exceed levels where nearby vegetation would be expected to show visible signs of stress (917 μg/m^3)[15]. Sierra Club's model concentrations represent the 4th highest 1-hr value averaged over the three (3) year simulation which would suggest that peak model concentrations are higher. Model concentrations of this magnitude may be an indicator that AERMOD is over-predicting, since there is no anecdotal evidence to support that concentrations surrounding Jewell Coke are actually approaching these levels. After further review, the EPA believes that unique circumstances at Jewell Coke are causing AERMOD to over-predict concentrations in this specific application, i.e., the source characteristics and the surrounding terrain.

[15] See Table 3.1 of EPA's *A Screening Procedure for the Impacts of Air Pollution Sources on Plants, Soils and Animals*

In regard to source characterization, Jewell Coke is a non-recovery of by-product coke operation as well as non-recovery of heat, and is the only existing plant in the U.S. of this type. As noted in Table 6, over 98% of Jewell Coke's SO_2 emissions pass through its vent stacks, which are (properly) characterized as point sources within AERMOD. Fugitive emissions, modeled as buoyant line sources using AERMOD's BUOYLINE option, are generally limited to pushing, charging and quenching. Fugitive emissions of SO_2 are small relative to the emissions vented through stacks since this type of coke oven normally operates under negative pressure. Additionally, the coke oven batteries themselves are extremely hot (~ 2,000° F) and are large enough heat sources that they can create vertical buoyant updrafts directly above them. Emissions from the vent stacks, which are physically located on top of coke oven batteries, are likely being entrained into these updrafts. This buoyant upward motion provides additional lift for the vent stacks which could loft their emissions out of the immediate valley where Jewell Coke is located. A compounding issue here is the complex terrain surrounding Jewell Coke. Consequently, without the 'additional lift' noted above, AERMOD is likely confining the vent stack emissions within the surrounding valley and, thus, predicting extremely high SO_2 concentrations along the valley slopes that may not in fact be occurring.

Given the uniqueness of the Jewell Coke facility with regard to production and geographic setting (i.e., non-recovery of by-product and heat in a complex terrain environment), the modeling analysis would likely need further refinements to more appropriately account for the coke oven's added vertical buoyancy. EPA provides for such refinements of the preferred model for specific situations through the use of an alternative model as provided in Appendix W to 40 CFR Part 51, the *Guideline on Air Quality Models.*[16]

2.5. Emissions and Emissions-Related Data, Meteorology, Geography, and Topography for the Buchanan Area

These factors have been incorporated into the air quality modeling efforts and results discussed above. The EPA is giving consideration to these factors by considering whether they were properly incorporated and by considering the air quality concentrations predicted by the modeling.

[16] Section 3.2 of Appendix W to 40 CFR Part 51, the *Guideline on Air Quality Models* (Guideline) recognizes that the Guideline cannot provide an all-inclusive list of preferred models for all possible situations and provides the requirements for the use of an alternative model.

2.6. Jurisdictional Boundaries in the Buchanan Area

Existing jurisdictional boundaries are considered for the purpose of informing the EPA's designation action for Buchanan County. Our goal is to base designations on clearly defined legal boundaries, and to have these boundaries align with existing administrative boundaries when reasonable.

Virginia recommended Buchanan County as attainment/unclassifiable because the Virginia October 2017 modeling analysis did not show any violations of the NAAQS in the modeled area of analysis. However, Virginia's October 23, 2017, transmittal letter noted that Virginia supports the EPA's intended designation of unclassifiable.

2.7. Other Additional Information Relevant to the Designations for the Buchanan Area

There are no designated nonattainment areas or areas intended to be designated as nonattainment neighboring any of the counties or cities modeled in the Buchanan area of analysis.

2.8. The EPA's Assessment of the Available Information for the Buchanan Area

While Virginia's October 23, 2017, modeling submissions shows that peak concentrations comply with the 1-hour SO_2 NAAQS (the highest predicted 99th percentile daily maximum 1-hour concentration within the chosen modeling domain is 194.6 $\mu g/m^3$, equivalent to 74.99 ppb), the submittal continues to have several deficiencies that prevent the EPA from being able to rely on the modeling as a reliable and representative characterization of air quality in the area and from being able to conclude that its modeling of actual emissions shows attainment of the 2010 SO_2 NAAQS. The model deficiencies are as follows: (1) the model receptor grid omits over 50% of the area surrounding Jewell Coke without providing adequate justification for all excluded receptors and potentially excludes critical elevation receptors where peak impacts may be occurring; (2) model emission rates are from 5 to 9% lower than the reported 2013-2015 annual emission rates without adequate justification, including the modeling using stack test information (from 2009 and 2016) taken outside the simulation period without further justification of applicability; and (3) although the most recent modeling submitted for Jewell Coke did appear to include the updated low wind (ADJ_U*) option removing an earlier version that contained a known formulation bug that could lead to model under-predictions, no definitive analysis could be performed to further analyze this change without having additional output files in addition to the final processed meteorological data

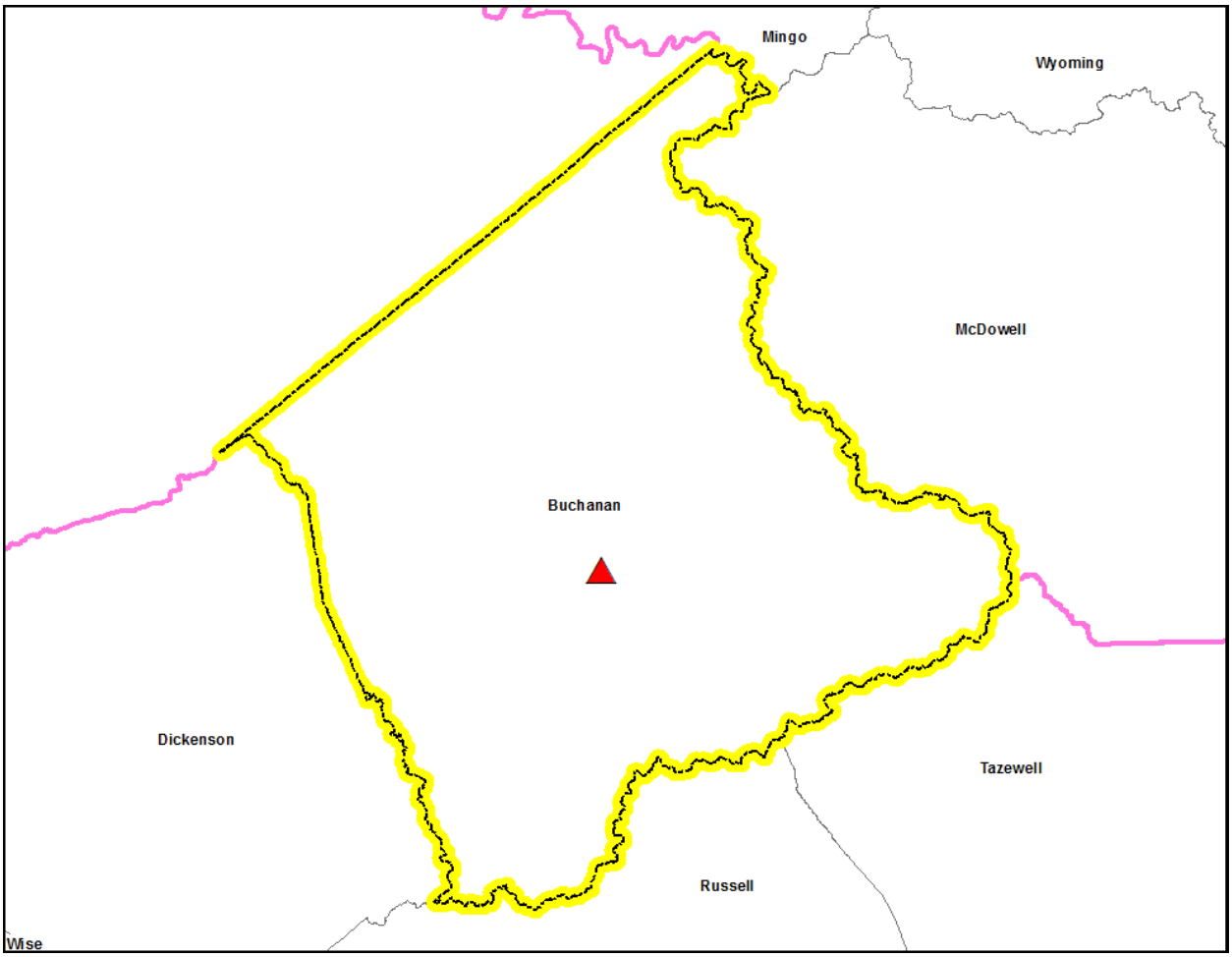
The modeling submitted by the Sierra Club indicates that the 1-hour SO_2 NAAQS is violated at the receptor with the highest modeled concentration (highest model predicted 99^{th} percentile daily maximum 1-hour concentration within the chosen modeling domain is 2,515.4 $\mu g/m^3$, equivalent to 960 ppb). This modeled concentration included a background concentration of SO_2 that was slightly below the value used in the Commonwealth's modeling analysis, and is based on actual emissions that were also used in the Commonwealth's analysis for Jewell Coke. The Sierra Club analysis, however, also has a critical deficiency that prevents the EPA from definitively concluding that the Buchanan area is violating the 2010 SO_2 NAAQS: Sierra Club's modeling analysis used a version of AERMOD that contained a known formulation bug (ADJ_U* option in AERMET version 15181). Furthermore, the peak model concentration presented in Sierra Club's analysis is over an order of magnitude above the 1-hour SO_2 NAAQS. Model concentrations of this magnitude should have led to a model reevaluation to determine if the model is functioning properly since there is no anecdotal evidence to support that concentrations surrounding Jewell Coke are actually approaching these levels. Such an extreme modeled concentration leads the EPA to believe Sierra Club's modeled results are unrealistic and therefore problematic.

For the reasons outlined above, the EPA finds that neither the Commonwealth nor the Sierra Club modeling analysis for the Buchanan area is representative of actual air quality in that area, and as such is unable to conclude that Buchanan County is or is not in attainment with the 1-hour SO_2 NAAQS. Although Virginia recommended that Buchanan County be designated as attainment/unclassifiable based on the modeling analysis for Jewell Coke described in this document, without having a modeling analysis conducted in accordance with the Modeling TAD, and other issued guidance, or that is otherwise technically reliable and representative of the area, the EPA has insufficient information to designate the Buchanan area as attainment/unclassifiable. In contrast to Virginia's designation recommendation, Sierra Club recommended that Buchanan County be designated as nonattainment based on the modeling analysis for Jewell Coke described in this document. After assessing the Sierra Club analysis, the EPA concludes that analysis likewise is not technically reliable and representative of the area, and as such, the EPA has insufficient information to designate the Buchanan area as nonattainment. Therefore, the EPA believes the most appropriate designation for Buchanan County is unclassifiable. The EPA finds that our unclassifiable area, bounded by Buchanan County's jurisdictional boundary, will have a clearly defined legal boundary, and given the mountainous terrain in the area, the EPA finds that emissions from Jewell are likely confined to Buchanan County and likely do not impact the air quality of neighboring counties. For this reason, the EPA also finds the jurisdictional boundary to be a suitable basis for defining our final unclassifiable area.

2.9. Summary of Our Final Designation for the Buchanan Area

After careful evaluation of the Commonwealth's recommendation and supporting information, as well as all available relevant information, the EPA is designating Buchanan County as unclassifiable for the 2010 SO_2 NAAQS because the modeling analyses provided both by the Commonwealth and Sierra Club have several deficiencies that prevent the EPA from definitively determining whether Buchanan County is attaining or violating the 2010 SO_2 NAAQS. With regards to contributing emissions to neighboring counties/cities or being impacted by emissions from neighboring counties/cities, the EPA finds that the mountainous terrain of Buchanan County likely prevents emissions from impacting the air quality of neighboring counties/cities and vice versa. The EPA is finalizing a designation of unclassifiable for the entirety of Buchanan County, Virginia. Figure 12 shows the boundary of this final designated area.

Figure 12. Boundary of the Final Buchanan County, Virginia Unclassifiable Area



At this time, our final designations for Virginia only apply to this area and the other areas presented in the EPA's TSD for the intended designations and as finalized in Table 1. The EPA intends in a separate action to evaluate and designate all remaining undesignated areas in Virginia by December 31, 2020.