Technical Support Document

Illinois
Area Designations for the 2010 SO_2 Primary National Ambient Air Quality Standard

Summary

Pursuant to section 107(d) of the Clean Air Act (CAA), the U.S. Environmental Protection Agency (EPA, or the Agency) must designate areas as either "unclassifiable," "attainment," or "nonattainment" for the 2010 one-hour sulfur dioxide (SO_2) primary national ambient air quality standard (NAAQS). The CAA defines a nonattainment area as one that does not meet the NAAQS or that contributes to a violation in a nearby area. An attainment area is defined as any area other than a nonattainment area that meets the NAAQS. Unclassifiable areas are defined as those that cannot be classified on the basis of available information as meeting or not meeting the NAAQS.

Illinois submitted updated recommendations on September 18, 2015, ahead of a July 2, 2016, deadline for EPA to designate certain areas established by the U.S. District Court for the Northern District of California. This deadline is the first of three deadlines established by the court for EPA to complete area designations for the 2010 SO_2 NAAQS. Table 1 below lists Illinois' recommendations and identifies the counties or portions of counties in Illinois that EPA intends to designate by July 2, 2016 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. Illinois' Recommended and EPA's Intended Designations

Area	**Illinois' Recommended Area Definition**	**Illinois' Recommended Designation**	**EPA's Intended Area Definition**	**EPA's Intended Designation**
Alton Township Area, Illinois	Within Alton Twp. of Madison Co., Area east of Corporal Belchik Memorial Expressway, south of East Broadway, south of Route 3, and north of Route 143	Nonattainment	Same as State's Recommendation	Nonattainment

Wood River Township Area, Illinois	Within Madison Co., All of Wood River Township, and the area north of Cahokia Diversion Channel in Chouteau Township.	Attainment	Same as State's Recommendation	Unclassifiable/ Attainment
Rest of Madison County, Illinois	Within Madison Co.: Remainder of Madison County.	Unclassifiable	Same as State's Recommendation	No designation
Massac County Area, Illinois	Massac County	Attainment	Same as State's Recommendation	Unclassifiable/ Attainment
Jasper County Area, Illinois	Jasper County	Attainment	Same as State's Recommendation	Unclassifiable/ Attainment
Putnam/Bureau County Area, Illinois	Putnam County and Bureau County	Attainment	Same as State's Recommendation	Unclassifiable/ Attainment
Williamson County Area, Illinois	Williamson County	Attainment	Same as State's Recommendation	Nonattainment

Background

On June 3, 2010, EPA revised the primary (health based) SO_2 NAAQS by establishing a new one-hour standard at a level of 75 parts per billion (ppb) which is attained when the three-year average of the 99th percentile of one-hour daily maximum concentrations does not exceed 75 ppb. This NAAQS was published in the Federal Register on June 22, 2010 (75 FR 35520) and is codified at 40 CFR 50.17. EPA determined this is the level necessary to protect public health with an adequate margin of safety, especially for children, the elderly, and those with asthma. These groups are particularly susceptible to the health effects associated with breathing SO_2. The two prior primary standards of 140 ppb evaluated over 24 hours, and 30 ppb evaluated over an entire year, codified at 40 CFR 50.4, remain applicable.[1] However, EPA is not currently designating areas on the basis of either of these two primary standards. Similarly, the secondary standard for SO_2, set at 500 ppb evaluated over 3 hours has not been revised, and EPA is also not currently designating areas on the basis of the secondary standard.

[1] 40 CFR 50.4(e) provides that the two prior primary NAAQS will no longer apply to an area one year after its designation under the 2010 NAAQS, except that for areas designated nonattainment under the prior NAAQS as of August 22, 2010, and areas not meeting the requirements of a SIP Call under the prior NAAQS, the prior NAAQS will apply until that area submits and EPA approves a SIP providing for attainment of the 2010 NAAQS. The Illinois areas above are not subject to these exceptions.

General Approach and Schedule

Section 107(d) of the Clean Air Act requires that not later than one year after promulgation of a new or revised NAAQS, state governors must submit their recommendations for designations and boundaries to EPA. Section 107(d) also requires EPA to provide notification to states no less than 120 days prior to promulgating an initial area designation that is a modification of a state's recommendation. If a state does not submit designation recommendations, EPA will promulgate the designations that it deems appropriate. If a state or tribe disagrees with EPA's intended designations, they are given an opportunity within the 120 day period to demonstrate why any proposed modification is inappropriate.

On August 5, 2013, EPA published a final rule establishing air quality designations for 29 areas in the United States for the 2010 SO_2 NAAQS, based on recorded air quality monitoring data from 2009 - 2011 showing violations of the NAAQS (78 FR 47191). In that rulemaking, EPA committed to address, in separate future actions, the designations for all other areas for which the Agency was not yet prepared to issue designations.

Following the initial August 5, 2013 designations, three lawsuits were filed against EPA in different U.S. District Courts, alleging the Agency had failed to perform a nondiscretionary duty under the CAA by not designating all portions of the country by the June 2013 deadline. In an effort intended to resolve the litigation in one of those cases, plaintiffs Sierra Club and the Natural Resources Defense Council and EPA filed a proposed consent decree with the U.S. District Court for the Northern District of California. On March 2, 2015, the court entered the consent decree and issued an enforceable order for EPA to complete the area designations according to the court-ordered schedule.

According to the court-ordered schedule, EPA must complete the remaining designations by three specific deadlines. By no later than July 2, 2016 (16 months from the court's order), EPA must designate two groups of areas: (1) areas that have newly monitored violations of the 2010 SO_2 NAAQS and (2) areas that contain any stationary sources that had not been announced as of March 2, 2015 for retirement and that according to EPA's Air Markets Database emitted in 2012 either (i) more than 16,000 tons of SO_2 or (ii) more than 2,600 tons of SO_2 with an annual average emission rate of at least 0.45 pounds of SO_2 per one million British thermal units (lbs SO_2/MMBTU). Specifically, a stationary source with a coal-fired unit that as of January 1, 2010 had a capacity of over 5 megawatts and otherwise meets the emissions criteria, is excluded from the July 2, 2016 deadline if it had announced through a company public announcement, public utilities commission filing, consent decree, public legal settlement, final state or federal permit filing, or other similar means of communication, by March 2, 2015, that it will cease burning coal at that unit.

The last two deadlines for completing remaining designations are December 31, 2017, and December 31, 2020. EPA has separately promulgated requirements for states and other air agencies to provide additional monitoring or modeling information on a timetable consistent with these designation deadlines. We expect this information to become available in time to help

inform these subsequent designations. These requirements were promulgated on August 21, 2015 (80 FR 51052), in a rule known as the SO_2 Data Requirements Rule (DRR).

Updated designations guidance was issued by EPA through a March 20, 2015 memorandum from Stephen D. Page, Director, U.S. EPA, Office of Air Quality Planning and Standards, to Air Division Directors, U.S. EPA Regions I-X. This memorandum supersedes earlier designation guidance for the 2010 SO_2 NAAQS, issued on March 24, 2011, and it identifies factors that EPA intends to evaluate in determining whether areas are in violation of the 2010 SO_2 NAAQS. The guidance also contains the factors EPA intends to evaluate in determining the boundaries for all remaining areas in the country, consistent with the court's order and schedule. These factors include: 1) Air quality characterization via ambient monitoring or dispersion modeling results; 2) Emissions-related data; 3) Meteorology; 4) Geography and topography; and 5) Jurisdictional boundaries. This guidance was supplemented by two technical assistance documents intended to assist states and other interested parties in their efforts to characterize air quality through air dispersion modeling or ambient air quality monitoring for sources that emit SO_2. Notably, EPA released its most recent versions of documents titled, "SO_2 NAAQS Designations Modeling Technical Assistance Document" (Modeling TAD) and "SO_2 NAAQS Designations Source-Oriented Monitoring Technical Assistance Document" (Monitoring TAD) in December 2013.

Based on ambient air quality data collected between 2012 and 2014, no violations of the 2010 SO_2 NAAQS have been recorded in any undesignated part of Illinois.[2] However, there are five sources in the state meeting the emissions criteria of the consent decree for which EPA must complete designations by July 2, 2016. In this draft technical support document, EPA discusses its review and technical analysis of Illinois' updated recommendations for the areas that we must designate. EPA also discusses any intended modifications from the state's recommendation based on all available data before us.

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 ppb, based on the three year average of the 99th percentile of the annual distribution of daily maximum one-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 NAAQS.
3) Designated nonattainment area – an area which EPA has determined has violated the 2010 SO_2 NAAQS or contributed to a violation in a nearby area. A nonattainment

[2] For designations based on ambient air quality monitoring data that violates the 2010 SO_2 NAAQS, the consent decree directs EPA to evaluate data collected between 2013 and 2015. Absent complete, quality assured and certified data for 2015, the analyses of applicable areas for EPA's intended designations will be informed by data collected between 2012 and 2014. States with monitors that have recorded a violation of the 2010 SO_2 NAAQS during these years have the option of submitting complete, quality assured and certified data for calendar year 2015 by April 19, 2016 to EPA for evaluation. If, after our review, the ambient air quality data for the area indicates that no violation of the NAAQS occurred between 2013 and 2015, the consent decree does not obligate EPA to complete the designation. Instead, we intend to designate the area and all other previously undesignated areas in the state on a schedule consistent with the prescribed timing of the court order, i.e., by December 31, 2017, or December 31, 2020.

designation reflects considerations of state recommendations and all of the information discussed in this document. EPA's decision is based on all available information including the most recent 3 years of air quality monitoring data, available modeling analysis, and any other relevant information.

4) Designated unclassifiable area – an area which EPA cannot determine based on all available information whether or not it meets the 2010 SO_2 NAAQS.
5) Designated unclassifiable/attainment area – an area which EPA has determined to have sufficient evidence to find either is attaining or is likely to be attaining the NAAQS. EPA's decision is based on all available information including the most recent 3 years of air quality monitoring data, available modeling analysis, and any other relevant information.
6) Modeled violation – a violation based on air dispersion modeling.
7) Recommended attainment area – an area a state or tribe has recommended that EPA designate as attainment.
8) Recommended nonattainment area – an area a state or tribe has recommended that EPA designate as nonattainment.
9) Recommended unclassifiable area – an area a state or tribe has recommended that EPA designate as unclassifiable.
10) Recommended unclassifiable/attainment area – an area a state or tribe has recommended that EPA designate as unclassifiable/attainment.
11) Violating monitor – an ambient air monitor meeting all methods, quality assurance and siting criteria and requirements whose valid design value exceeds 75 ppb, based on data analysis conducted in accordance with Appendix T of 40 CFR part 50.

Technical Analysis for the Madison County, Illinois Area

Introduction

Madison County, Illinois contains a stationary source that according to EPA's Air Markets Database emitted in 2012 either more than 16,000 tons of SO_2 or more than 2,600 tons of SO_2 and had an annual average emission rate of at least 0.45 pounds of SO_2 per one million British thermal units (lbs SO_2/MMBTU). As of March 2, 2015, this stationary source had not met the specific requirements for being "announced for retirement." Specifically, in 2012, the Wood River Power Station ("Wood River") emitted 6,756 tons of SO_2, and had an emissions rate of 0.476 lbs SO_2/MMBTU. Pursuant to the March 2, 2015 court-ordered schedule, EPA must designate the area surrounding the facility by July 2, 2016.

In its submission, Illinois recommended that a portion of Madison County be designated as nonattainment for the 2010 1-hour SO_2 NAAQS – specifically, that portion of southern Alton Township that is east of the Corporal Belchik Memorial Expressway, south of East Broadway Street and Illinois Route 3, and north of Illinois Route 143. Illinois also recommended that all of Wood River Township and that portion of Chouteau Township north of the Cahokia Diversion Channel be designated as attainment. Lastly, Illinois recommended that the remainder of Madison County be designated as unclassifiable. These recommendations were based on an assessment and characterization of air quality from the facility and other nearby sources which may have a potential impact in the area of analysis where maximum concentrations of SO2 are expected. This assessment and characterization was performed using air dispersion modeling software, i.e., AERMOD, analyzing actual emissions. After careful review of the state's assessment, supporting documentation, and all available data, EPA agrees that the area surrounding Wood River, specifically all of Wood River Township and the portion of Chouteau Township north of the Cahokia Diversion Channel is attaining standard, and intends to designate it as unclassifiable/attainment. Additionally, EPA agrees that portions of Madison County should be designated nonattainment, consistent with the state's recommendation, i.e., the area east of Corporal Belchik Memorial Expressway, south of East Broadway, south of Route 3, and north of Route 143 within Alton Township in Madison County. Lastly, while the state has recommended that the remainder of Madison County be designated unclassifiable, EPA does not intend to promulgate any designation at this time with respect to this area. Instead, EPA intends to evaluate and designate the remainder of Madison County by either December 31, 2017, or December 31, 2020, consistent with the March 2, 2015 court-ordered schedule.

Wood River is located in south-central Illinois near St. Louis, Missouri in western Madison County. As seen in Figure 1 below, the facility is located near the junction of the Mississippi River and the river named Wood River. Also included in the figure are nearby emitters of SO_2, and the state's recommended area for the nonattainment designation. Figure 2 shows EPA's intended nonattainment designation for the Alton Township area and unclassifiable/attainment designation for the Wood River Township area.

Figure 1. Illinois' recommended nonattainment area within Madison County, Illinois

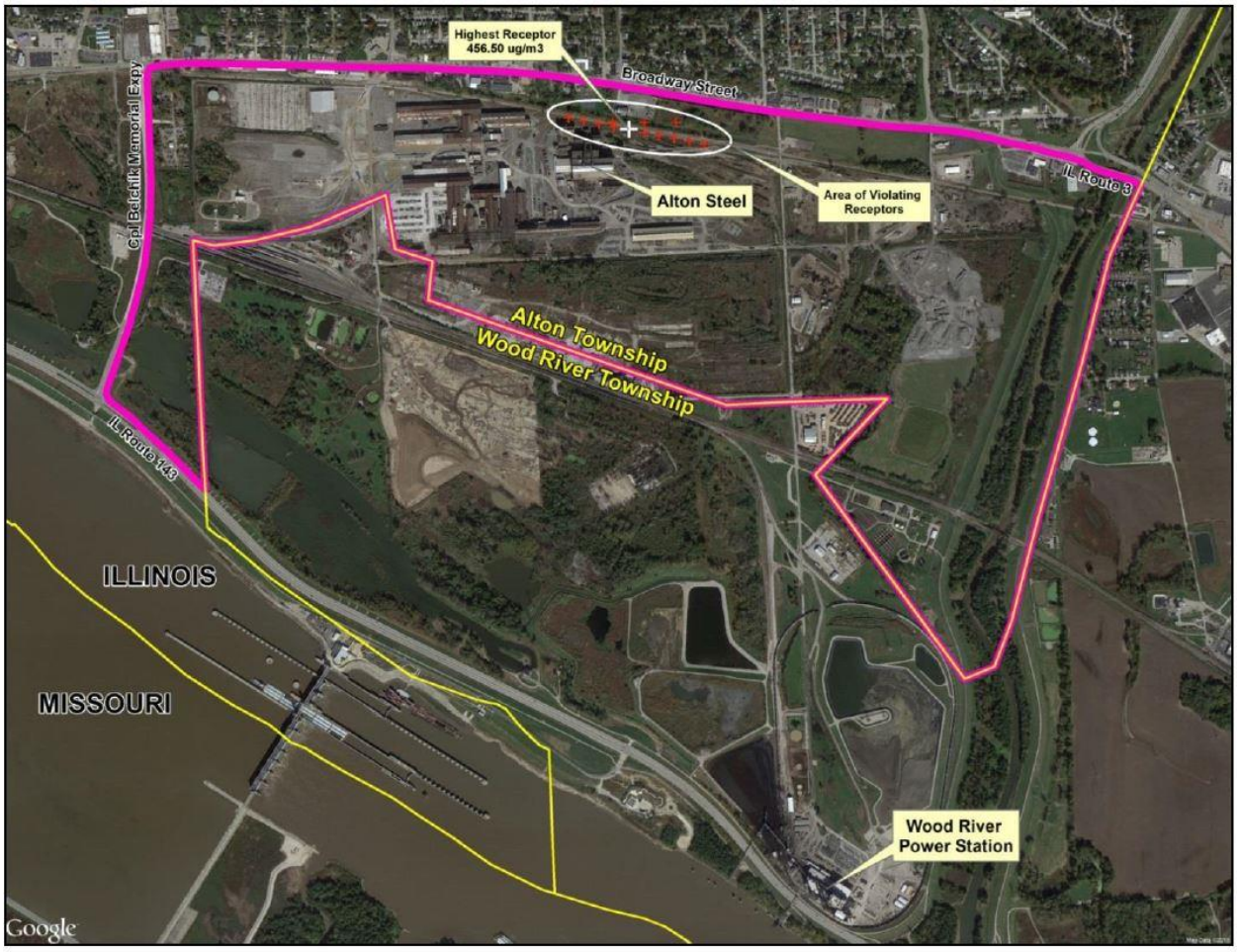
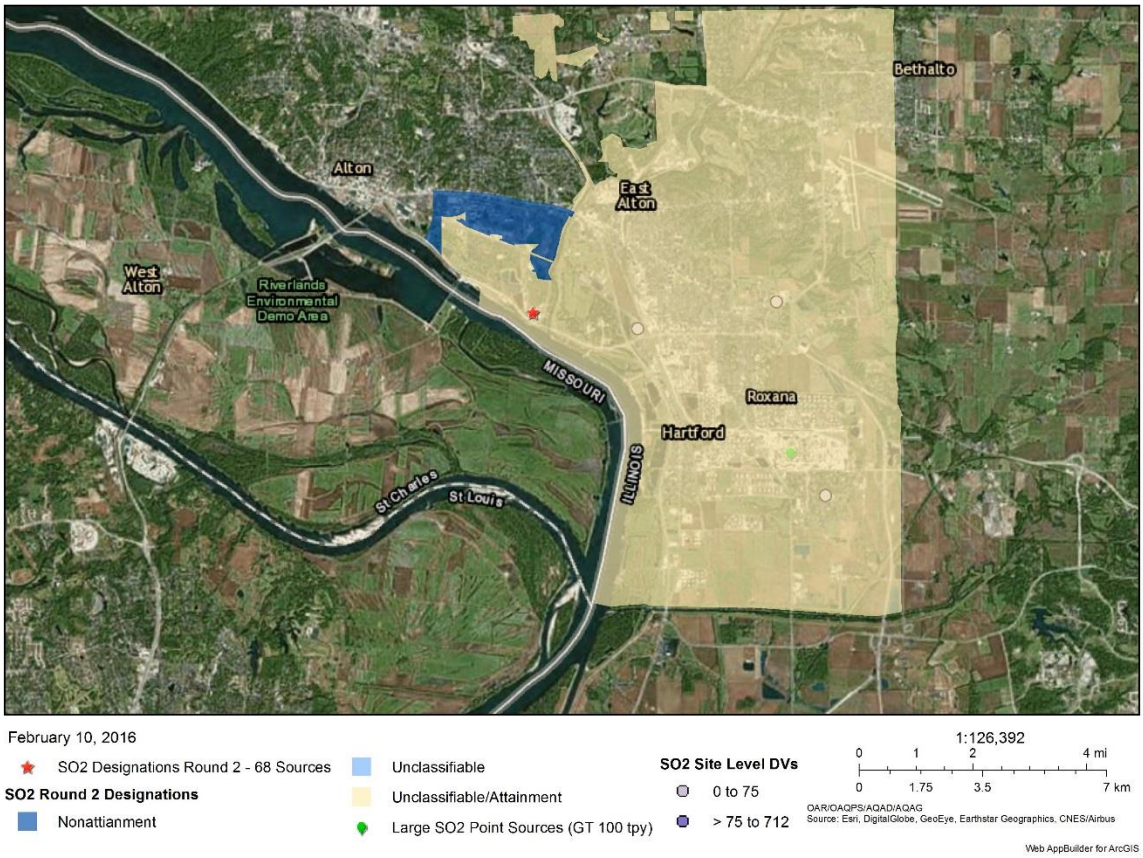


Figure 2. EPA's intended designations in Madison County, Illinois

Madison County, Illinois Area



The discussion and analysis that follows below will reference the state's use of the Modeling TAD, EPA's assessment of the state's modeling in accordance with the Modeling TAD, and the factors for evaluation contained in EPA's March 20, 2015 guidance, as appropriate.

Detailed Assessment

Model Selection and Modeling Components

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. In some instances the recommended model may be a model other than AERMOD, such as the BLP model for buoyant line sources. 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
- BPIPPRIME: 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 state used AERMOD version 15181, the most recent version, and a discussion of the individual components will be referenced in the corresponding discussion that follows, as appropriate.

Modeling Parameter: Rural or Urban Dispersion

EPA's recommended procedure for characterizing an area by prevalent land use is based on evaluating the dispersion environment with 3 km of the facility. According to EPA's modeling guidelines, rural dispersion coefficients are to be used in the dispersion modeling analysis if more than 50% of the area within a 3 km radius of the facility is classified as rural. Conversely, if more than 50% of the area is urban, urban dispersion coefficients should be used in the modeling analysis. The state performed an Auer's analysis for the area near Wood River in order to determine which mode was appropriate for the modeling. The analysis indicated that the study area is approximately 80.1% rural and 19.9% urban, showing that the rural option was appropriate to apply to all emission sources in the modeling domain. Figure 3 and Table 2 below show the results of the state's Auer's analysis.

Figure 3. Auer's Analysis – Area Near Wood River

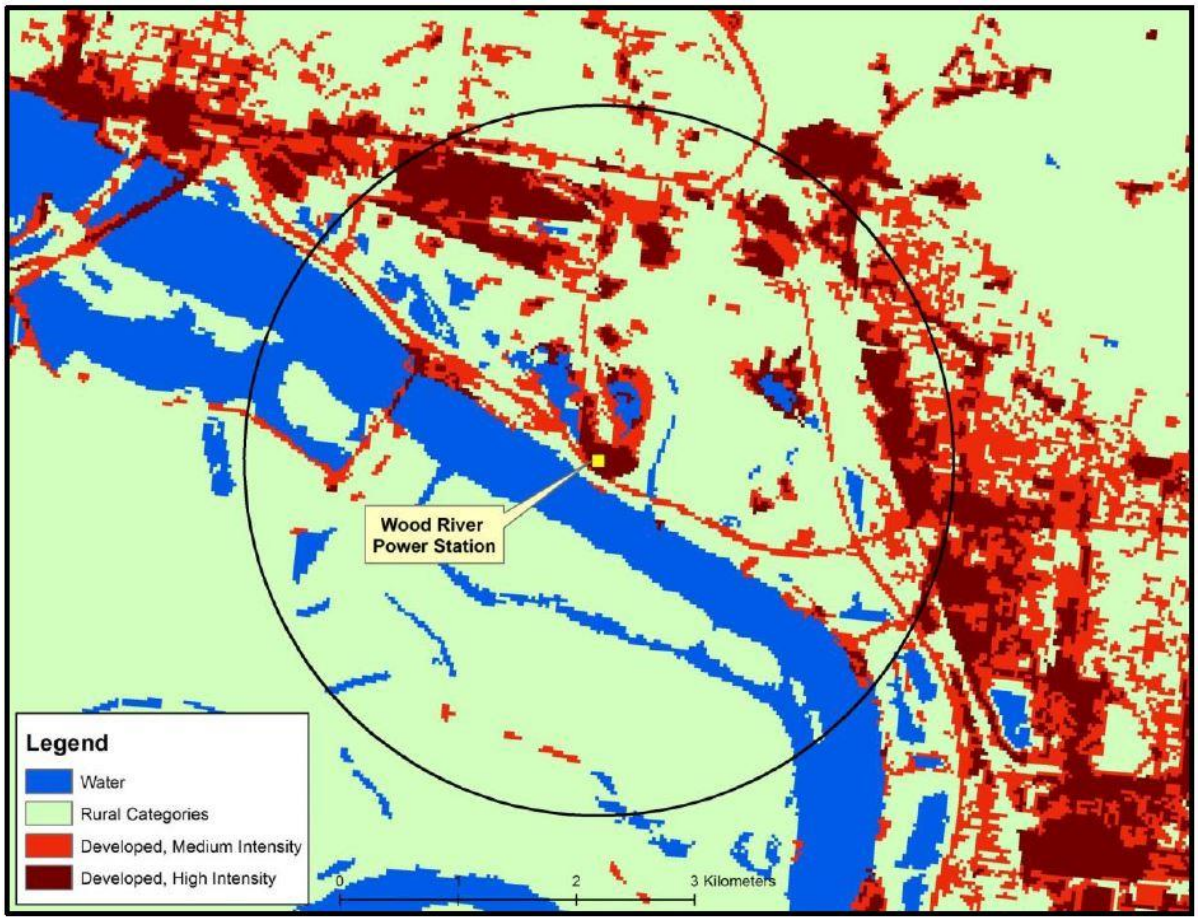


Table 2. Auer's Analysis Land Use Percentages by Category – Area Near Wood River

SO_2 NAA Modeling Auer's Analysis - NLCD 2011				Wood River 3 km Ring		
NLCD Value	NLCD 2011 Description	Auer's Code	Auer's Class	Cell Count	Percentage	Totals
23	Developed, Medium Intensity	R2/R3	Urban	3,562	11.34%	19.88%
24	Developed, High Intensity	I1/I2/C1		2,683	8.54%	
11	Open Water	A5		5,379	17.13%	
21	Developed, Open Space	A1/R4		2,644	8.42%	
22	Developed, Low Intensity	R1		4,090	13.02%	
31	Barren Land (Rock/Sand/Clay)	A3		81	26.00%	
41	Deciduous Forest	A4		5,825	1.67%	
42	Evergreen Forest	A4		0	0.00%	
43	Mixed Forest	A4	Rural	6	0.00%	80.12%
52	Shrub/Scrub	A4		69	0.22%	
71	Grassland/Herbaceous	A3		45	0.14%	
81	Pasture/Hay	A3		216	0.69%	
82	Cultivated Crops	A2		6,989	22.25%	
90	Wood Wetlands	A4		4,699	14.96%	
95	Emergent Herbaceous Wetlands	A3		421	1.34%	
Analysis based on 30 meter by 30 meter raster cells extracted for each area.			*Grand Totals:*	*31,409*	*100.00%*	

Modeling Parameter: Area of Analysis (Receptor Grid)

A reasonable first step towards characterization of air quality in the area surrounding Wood River is to determine the extent of the area of analysis, i.e., 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 of nearby sources; and sufficient receptor coverage and density to adequately capture and resolve the model predicted maximum SO_2 concentrations. For the Madison County area, the state has included four other emitters of SO_2 within 10 kilometers (km) of Wood River in any direction. The state determined that, aside from exceptionally large sources, sources farther than 10 km from Wood River would not cause significant concentration gradients in the area near Wood River and therefore need not be modeled. The four emitters of SO_2 within the 10 km radius included in the area of analysis other than Wood River are: WRB Refining Inc. (formerly named ConocoPhillips), Alton Steel, Inc., Christ Brothers Products LLC, and National Maintenance and Repair facilities. The Ameren UE Sioux Power Plant, located just west of Portage Des Sioux, Missouri, was also included in the modeling due to its tall stacks and high annual emissions. Ameren UE Sioux Power Plant is located approximately 18 kilometers west-northwest of the center of the study area.

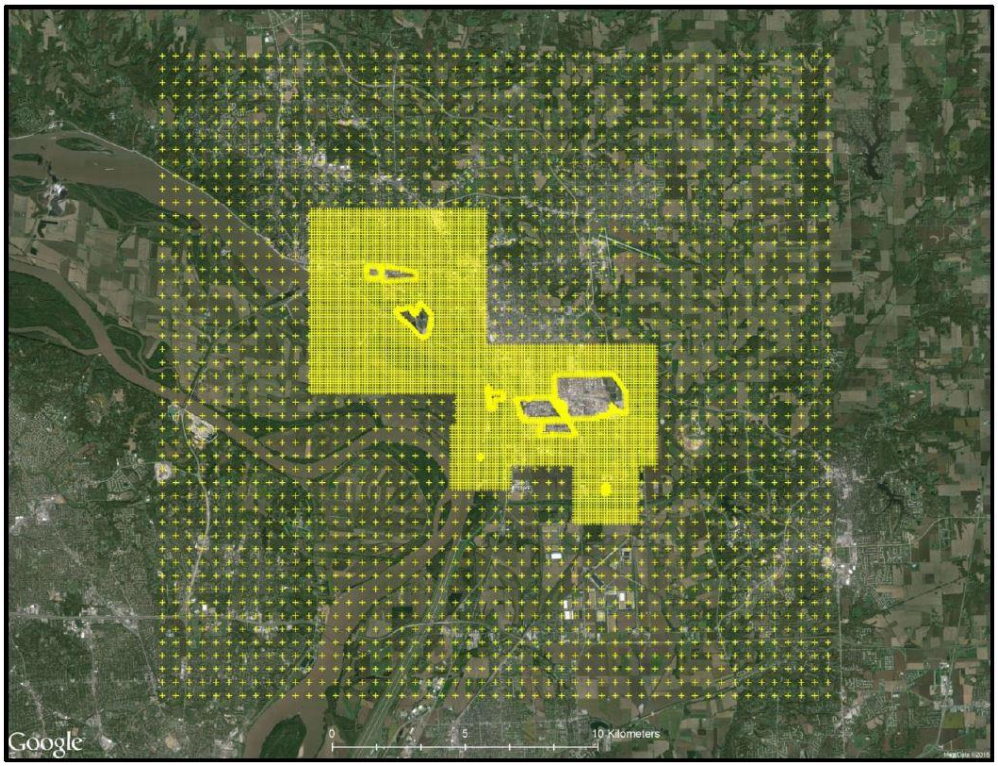
The grid receptor spacing for the area of analysis chosen by the state is as follows:

- 50 meters along the fenceline (six facilities)
- 100 meters from the fenceline out to 1.0 to 2.0 kilometers
- 500 meters from 1.0 to 2.0 kilometers out to 9.0 kilometers

The receptor network contained 11,746 receptors, and the network covered west-central Madison County in Illinois, and eastern edges of St. Louis and St. Charles Counties in Missouri.

For the purposes of this designation effort, the Modeling TAD states that the receptor grid need not include receptors in areas where it would not be feasible to place a monitor and record ambient air impacts, such as bodies of water. With the exception of receptor locations within plant fencelines, Illinois conservatively included the full grid of receptors, including some over the Mississippi River. Figure 4 shows the receptor grid for the area of analysis.

Figure 4. Receptor Grid for the Madison County Area of Analysis



Modeling Parameter: Source Characterization

The state characterized the sources within the area of analysis in accordance with the best practices outlined in the Modeling TAD. Specifically, the state used actual stack heights in conjunction with actual emissions. The state also adequately characterized the modeled sources' building layout and location, as well as the stack parameters, e.g., exit temperature, exit velocity, location, and diameter. The AERMOD component BPIPPRIME was used to assist in addressing building downwash.

Modeling Parameter: Emissions

EPA's Modeling TAD notes that for the purposes 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 does provide for the flexibility of using allowable emissions in the form of a federally enforceable limit on the emissions rate (referred to as PTE or allowable emissions rate).

EPA believes that continuous emissions monitoring systems (CEMS) data provide acceptable historical emissions information, when it is available, and that these data are available for many electric generating units. In the absence of CEMS data, 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, EPA believes that detailed throughput, operating schedules, and emissions information from the impacted sources should be used.

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. Specifically, a facility may have recently adopted a new federally enforceable emissions limit, been subject to a federally enforceable consent decree, or implemented other federally enforceable mechanisms and control technologies to limit SO_2 emissions to a level that indicates compliance with the NAAQS. These new limits or conditions may be used in the application of AERMOD. In these cases, the Modeling TAD notes that the existing SO_2 emissions inventories used for permitting or SIP planning demonstrations should contain the necessary emissions information for designations-related modeling. 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 previously noted, the state included Wood River and four other emitters of SO_2 within 10 km of Wood River as well as one large source approximately 15 km from Wood River. The modeled facilities and their associated annual actual SO_2 emissions between 2012 and 2014 are summarized below.

Table 3. Actual SO_2 Emissions for 2012 – 2014 from Facilities in the Madison County, Illinois Area of Analysis

	SO_2 Emissions (tons per year)			**Approximate Distance to Wood River (km)**
Facility Name	**2012**	**2013**	**2014**	
Wood River	6,719.49	7,662.27	7,034.66	N/A
WRB Refining LLC	1,966.48	1,203.08	1,103.42	6.46
Alton Steel, Inc.	42.75	38.00	39.35	2.45
Christ Brothers Products	7.20	7.20	7.20	8.83
National Maintenance and Repair	3.93	3.93	3.93	4.28
Ameren Missouri Sioux Power Station	2,658.45	2,799.27	1,483.75	14.94
Total Emissions From All Facilities in the State's Area of Analysis	**11,398.30**	**11,713.75**	**9,672.31**	

For Wood River, the state used actual emissions from the most recent 3-year data set, i.e., 2012 – 2014. The state used CEMS SO_2 emissions data provided by Wood River for its boiler stacks, along with temporally varying exit temperature and exit velocity.

For WRB Refining LLC, the state used company-provided hourly varying emissions, temperature, and exit velocity.

For Alton Steel, Inc., the state constructed a three-year emission profile for the Electric Arc Furnace (EAF) and Ladle Metallurgy Furnace (LMF) using company-provided operating schedule and yearly emissions. The state used a conservative worst-case emissions year for all three years for the two other sources at this facility.

For Christ Brothers Products, and National Maintenance and Repair, the state used the worst-case emission year for the entire simulation.

For Ameren Missouri Sioux Power Station, the state used hourly CEMS SO_2 emissions data.

In instances where seasonal throughput was available, emissions were allocated appropriately via the EMISFACT keyword in AERMOD and applied to the three-year period. For sources lacking hourly varying temperature or exit velocity, replacement values were obtained either from the Illinois EPA database or from company-provided emission reports.

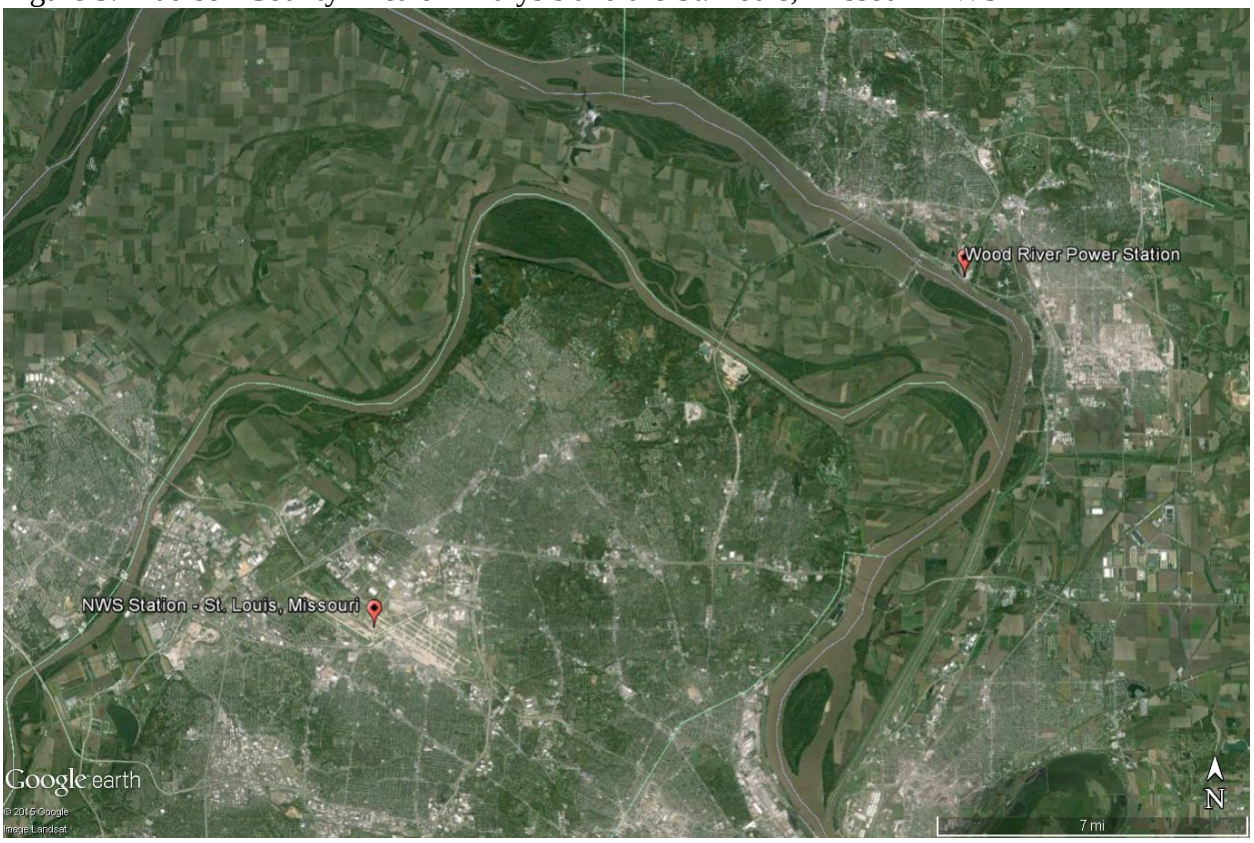
Modeling Parameter: Meteorology and Surface Characteristics

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

For the Madison County area of analysis, surface meteorology from the NWS station in St. Louis, Missouri, 27 km to the southwest, and coincident upper air observations from the NWS station in Lincoln, Illinois, 158 km to the northeast were selected as best representative of meteorological conditions within the area of analysis.

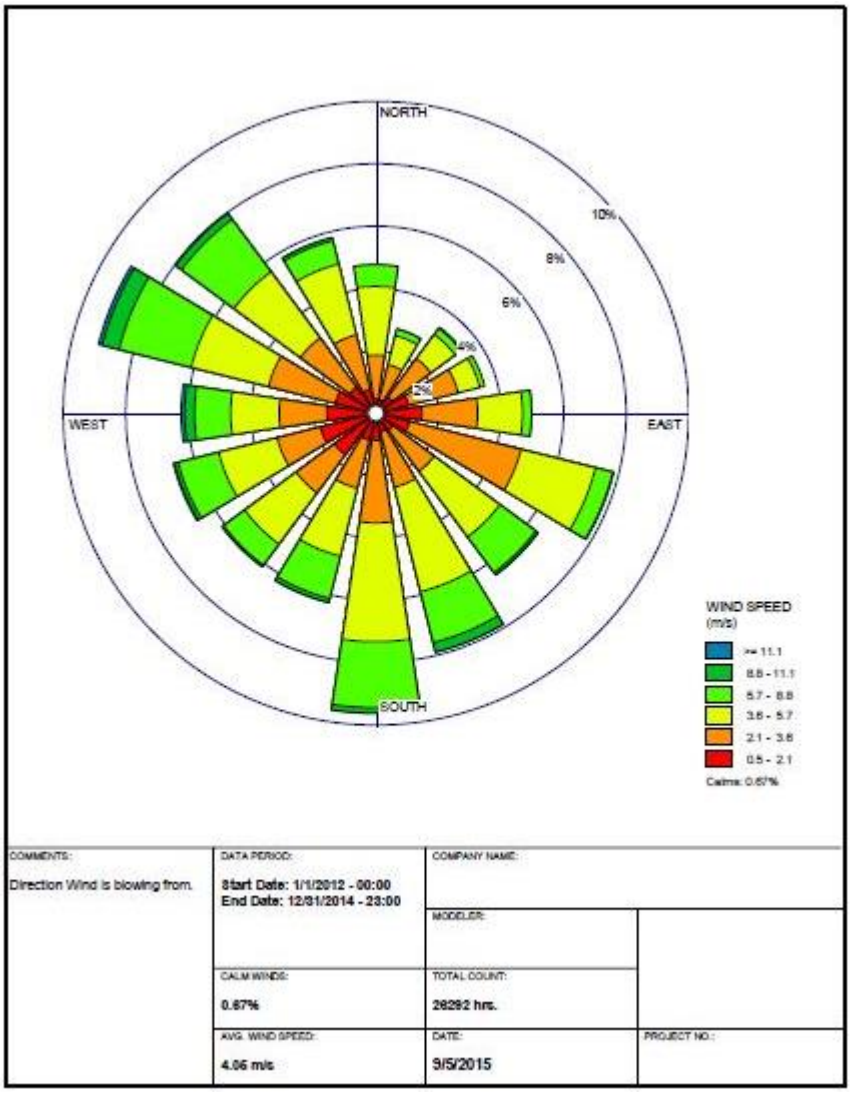
The state used AERSURFACE version 13016 using data from the NWS station in St. Louis, Missouri located at (38.75, -90.37) to estimate the surface characteristics of the area of analysis. These surface characteristics are the albedo (the fraction of solar energy reflected from the earth back into space), the Bowen ratio (representing the ratio of sensible heat flux to latent heat flux at the ground level), and the surface roughness (representing the influence of ground features such as buildings and vegetation on surface wind flow). In Figure 5 below, generated by EPA, the location of the St. Louis, Missouri NWS station is shown relative to the Madison County area of analysis.

Figure 5. Madison County Area of Analysis and the St. Louis, Missouri NWS



As part of its recommendation, the state provided the 3-year surface wind rose for St. Louis, Missouri. In Figure 6, the frequency and magnitude of wind speed and direction are defined in terms of from where the wind is blowing. The most predominant wind direction during the three-year time period used in the modeling is from the southeast to southwest, occurring approximately 9.6% of the time. The highest percentage wind speed range, occurring 33.8% of the time, was in the 3.6 – 5.7 m/s range.

Figure 6. St. Louis, Missouri Cumulative Annual Wind Rose for Years 2012 – 2014



Meteorological data from the above surface and upper air 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. The state followed the methodology and settings presented in the U.S. EPA's *User's Guide for the AERMOD Meteorological Preprocessor* (November 2004) 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 one minute duration was provided from the same instrument tower, 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 state set a minimum threshold of 0.5 meters per second in processing meteorological data for use in AERMOD. This approach is consistent with a March 2013 EPA memo titled, "Use of ASOS meteorological data in AERMOD dispersion Modeling." In setting this threshold, no wind speeds lower than this value would be used for determining concentrations. This threshold was specifically applied to the one minute wind data.

Modeling Parameter: Geography and Terrain

The terrain in the area of analysis is best described as flat to gently rolling. To account for these terrain changes, the AERMAP terrain program within AERMOD was used to specify terrain elevations for all the receptors. The source of the elevation data incorporated into the model is from the USGS National Elevation Database (NED).

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 "first tier" approach, based on monitored design values, or 2) a temporally varying approach, based on the 99th percentile monitored concentrations by hour of day and season. For the Madison County area of analysis, the state chose to use the latter. The background concentrations for this area of analysis ranged from 7 to 39 micrograms per cubic meter ($\mu g/m^3$), or approximately 3 to 15 ppb.[3] AERMOD incorporated these hourly/seasonal values into the final results.

Summary of Modeling Results

The AERMOD modeling parameters for the Madison County area of analysis are summarized below in Table 4.

Table 4. AERMOD Modeling Parameters for the Madison County, Illinois Area of Analysis

Madison County, Illinois Area of Analysis	
AERMOD Version	15181
Dispersion Characteristics	Rural
Modeled Sources	6
Modeled Stacks	82
Modeled Structures	527
Modeled Fencelines	10
Total receptors	11,746
Emissions Type	Actual
Emissions Years	2012-2014
Meteorology Years	2012-2014

[3] The conversion factor for SO_2 (at the standard conditions applied in the ambient SO_2 reference method) is 1ppb = approximately 2.62$\mu g/m^3$.

Surface Meteorology Station	St. Louis, Missouri
Upper Air Meteorology Station	Lincoln, Illinois
Methodology for Calculating Background SO_2 Concentration	Temporally Varying
Calculated Background SO_2 Concentration	3 to 15 ppb

The results presented below in Table 5 show the magnitude and geographic location of the highest predicted modeled concentration based on actual emissions.

Table 5. Maximum Predicted 99th Percentile 1-Hour SO_2 Concentration in the Madison County Area of Analysis Based on Actual Emissions

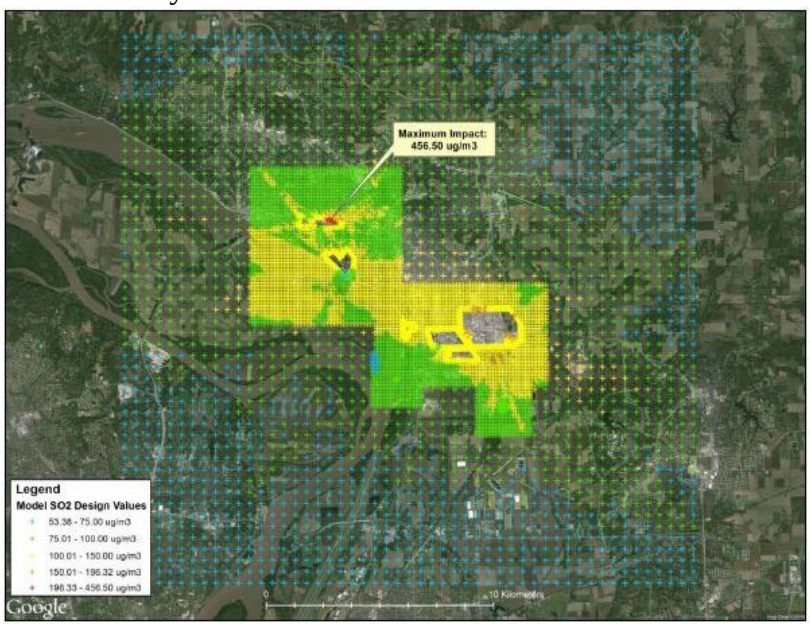
Averaging Period	**Data Period**	**Receptor Location**		**SO_2 Concentration ($\mu g/m^3$)**	
		UTM/Latitude	**UTM/Longitude**	**Modeled (including background)**	**NAAQS**
99th Percentile 1-Hour Average	2012-2014	748051	4307978	456.40	196.4*

*Equivalent to the 2010 SO_2 NAAQS set at 75 ppb

The state's modeling indicates that the predicted 99th percentile 1-hour average concentration within the chosen modeling domain is 456.40 $\mu g/m^3$, or 174.2 ppb. This modeled concentration included the background concentration of SO_2, and is based on actual emissions from the facilities. Illinois performed a culpability analysis which demonstrated that only a small group of receptors exceeded the 2010 SO_2 NAAQS, and these receptors were primarily affected by emissions from Alton Steel, which are greatly influenced by downwash. High concentrations near Alton Steel (over twice the standard) are a consequence of building downwash combined with stacks that point downward, and primarily occur when winds are blowing from the southwest, a direction that maximizes the impact of the Alton Steel building in causing downwash and downwash-influenced concentrations in nearby ambient air locations. Since Wood River is to the south-southeast of Alton Steel, the primary impacts of the power plant on the critical days are likely to be well to the east of Alton Steel, and the critical day impacts of the power plant at the location of modeled violations at the fenceline of Alton Steel are likely to be minimal. Although impacts of Wood River at the Alton Steel location are somewhat higher when the wind is blowing from the south-southeast, carrying emissions directly from the power plant to Alton Steel, these are not occurring on modeled violation days, and so are not indicative of the power plant's emissions contributing to violations near Alton Steel. We have reviewed the pertinent evidence and the State's analysis, and we agree with Illinois' recommendation to conclude that Wood River does not contribute to the modeled violation near Alton Steel. Rather, the violation appears to be predominantly the result of Alton Steel's building downwash-influenced emissions, with minimal impact from Wood River or other sources.

Figure 7 below was included as part of the state's recommendation, and indicates that the maximum estimated concentration occurred within the dense 100-meter grid near Alton Steel, approximately 2.5 kilometers northwest of the Wood River main stacks. The state's receptor grid is also shown in the figure.

Figure 7. Maximum Predicted 99th Percentile 1-Hour SO_2 Concentrations in the Madison County Area of Analysis Based on Actual Emissions



As noted above, portions of Illinois' modeling domain extend into Missouri and other areas beyond the area Illinois recommended be designated either as attainment or nonattainment. Illinois identified no violations in those portions of the modeling domain. However, Illinois has focused its analysis on the area relatively close to Wood River, the analysis is most reliable in this area, and so EPA intends to designate only the area that Illinois recommended either to be nonattainment or attainment. Missouri made no recommendations regarding this area, and EPA intends not to include any portion of Missouri in the designations for this area.

Jurisdictional Boundaries:

Once the geographic area of analysis associated with Wood River, other nearby sources, and background concentration is determined, existing jurisdictional boundaries are considered for the purpose of informing our intended designations, specifically with respect to clearly defined legal boundaries. EPA believes that Illinois' recommended nonattainment area, consisting of a portion of southern Alton Township that is east of the Corporal Belchik Memorial Expressway, south of East Broadway Street and Illinois Route 3, and north of Illinois Route 143, is specified using clearly defined boundaries, and we find these boundaries to be a suitably clear basis for defining our intended nonattainment area. The intended unclassifiable/attainment area is based on township boundaries and a well-known water body, which are also suitably clear for defining designated areas.

We find that Illinois' recommended boundaries for this area are justified by the modeling data and the meteorology in the area. Illinois modeled attainment, and recommended a designation of attainment, for the area near Wood River (Wood River Township and part of Chouteau Township), but they modeled a violation, and recommended a designation of nonattainment, in

the immediate vicinity of Alton Steel (southern part of Alton Township). The state found the violation to be predominantly associated with emissions from Alton Steel. Illinois provided suitable evidence that Wood River should be judged not to contribute to the modeled violation.

Illinois' modeling included the nearby sources which are most likely to have a significant concentration gradient near Wood River. The recommended nonattainment area contains the region of modeled nonattainment and the sources contributing to the high concentrations. Wood River and the other modeled sources outside the recommended nonattainment area, as well as the more distant SO_2 sources in Madison County and neighboring counties which were not included in Illinois' Wood River modeling analysis, are unlikely to cause or contribute to violations in any portion of Madison County that EPA will be designating as nonattainment.

Other Relevant Information

There was no additional relevant information submitted regarding Wood River or Madison County.

Conclusion

After careful evaluation of the state's recommendation and supporting information, as well as all available relevant information, EPA intends to designate the area around Wood River as unclassifiable/attainment for the 2010 SO_2 NAAQS. Specifically, the unclassifiable/attainment area is comprised of Wood River Township and the portion of Chouteau Township north of the Cahokia Diversion Channel. EPA believes that Illinois' modeling analysis supports this designation. EPA also intends to designate the area around Alton Steel as nonattainment. Specifically, the nonattainment boundaries are comprised of Corporal Belchik Memorial Expressway on the west, East Broadway Street and Illinois Route 3 on the north, and Alton Township borders on the east and south, extending to Illinois Route 143 as the remainder of the southern boundary. This area contains the region of modeled nonattainment and the sources contributing to the high concentrations. EPA reiterates that while Illinois recommended that the remainder of Madison County be designated as unclassifiable, we do not intend to designate the remainder of Madison County at this time. EPA views this deferral as consistent with Illinois' recommendation that EPA defer any substantive designation of the remainder of Madison County (i.e., promulgating a designation of attainment, unclassifiable/attainment, or nonattainment), pending analysis of "additional large SO_2 emitting facilities in other parts of the county that will likely need to be addressed later by the Illinois EPA in accordance with the Data Requirements Rule."

At this time, our intended designations for the state only apply to the specified nonattainment and unclassifiable/attainment areas described above and the other areas discussed elsewhere in this technical support document. Consistent with the conditions in the March 2, 2015 court-ordered schedule, EPA will evaluate and designate the remainder of Madison County and all other remaining undesignated areas in Illinois by either December 31, 2017, or December 31, 2020.

Technical Analysis for the Massac County, Illinois Area

Introduction

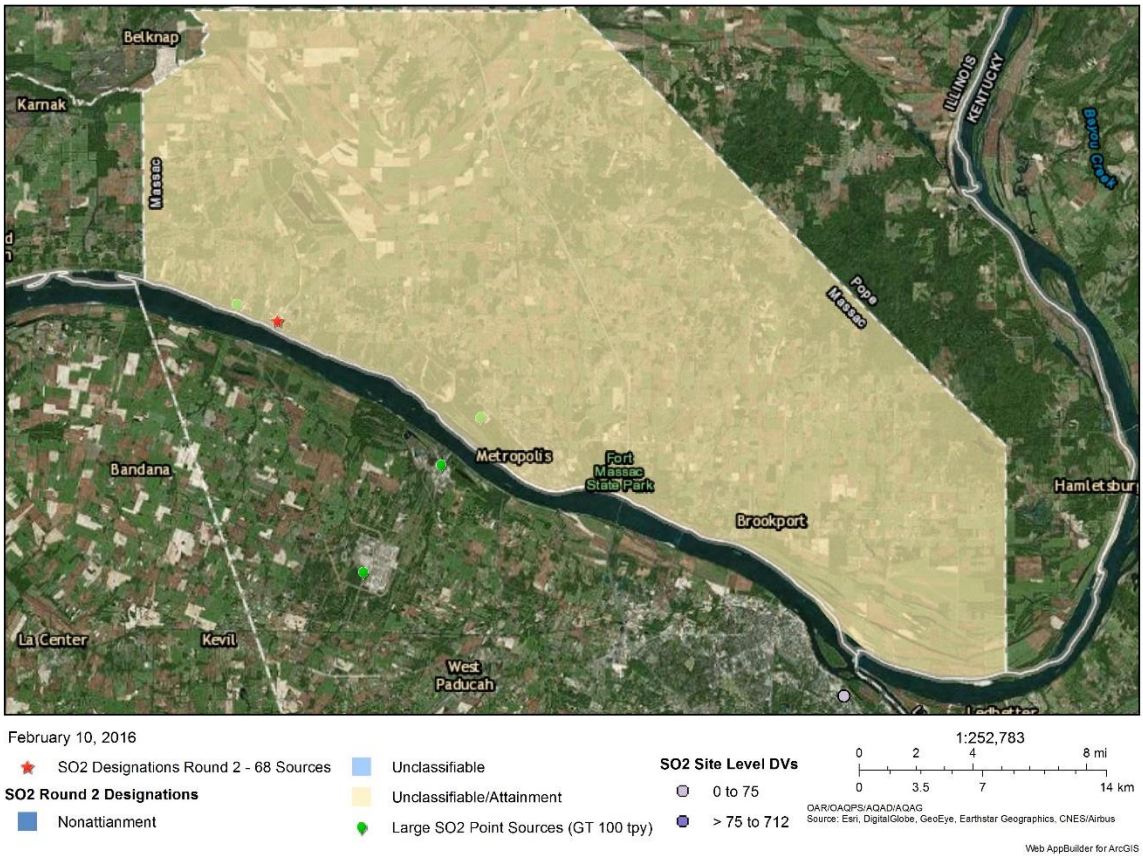
Massac County, Illinois contains a stationary source that according to EPA's Air Markets Database emitted in 2012 either more than 16,000 tons of SO_2 or more than 2,600 tons of SO_2 and had an annual average emission rate of at least 0.45 pounds of SO_2 per one million British thermal units (lbs SO_2/MMBTU). As of March 2, 2015, this stationary source had not met the specific requirements for being "announced for retirement." Specifically, in 2012, the Joppa Power Station ("Joppa") emitted 16,991 tons of SO_2, and had an emissions rate of 0.475 lbs SO_2/MMBTU. Pursuant to the March 2, 2015 court-ordered schedule, EPA must designate the area surrounding the facility by July 2, 2016.

In its submission, Illinois recommended that the area surrounding Joppa, specifically the entirety of Massac County, be designated as attainment based on an assessment and characterization of air quality from the facility and other nearby sources which may have a potential impact in the area of analysis where maximum concentrations of SO_2 are expected. This assessment and characterization was performed using air dispersion modeling software, i.e., AERMOD, analyzing actual emissions. After careful review of the state's assessment, supporting documentation, and all available data, EPA agrees that the area is attaining the standard, and intends to designate Massac County as unclassifiable/attainment.

Joppa is located in southern Illinois in western Massac County. As seen in Figure 8 below, the facility is located approximately 1 km northwest of the center of the town of Joppa. Also included in the figure are nearby emitters of SO_2, the state's recommended area for the attainment designation, and EPA's intended unclassifiable/attainment designation for the area.

Figure 8. EPA's intended designation for Massac County, Illinois

Massac County, Illinois Area



The discussion and analysis that follows below will reference the state's use of the Modeling TAD, EPA's assessment of the state's modeling in accordance with the Modeling TAD, and the factors for evaluation contained in EPA's March 20, 2015 guidance, as appropriate.

Detailed Assessment

Model Selection and Modeling Components

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. In some instances the recommended model may be a model other than AERMOD, such as the BLP model for buoyant line sources. 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
- BPIPPRIME: 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 state used AERMOD version 15181, the most recent version, and a discussion of the individual components will be referenced in the corresponding discussion that follows, as appropriate.

Modeling Parameter: Rural or Urban Dispersion

EPA's recommended procedure for characterizing an area by prevalent land use is based on evaluating the dispersion environment with 3 km of the facility. According to EPA's modeling guidelines, rural dispersion coefficients are to be used in the dispersion modeling analysis if more than 50% of the area within a 3 km radius of the facility is classified as rural. Conversely, if more than 50% of the area is urban, urban dispersion coefficients should be used in the modeling analysis. The state performed an Auer's analysis for the Joppa study area in order to determine which mode was appropriate for the modeling. The analysis indicated that the study area is approximately 96% rural and 4% urban, showing that the rural option applied to all emission sources in the modeling domain. Figure 9 and Table 6 below show the results of the state's Auer's analysis.

Figure 9. Auer's Analysis –Area Near Joppa

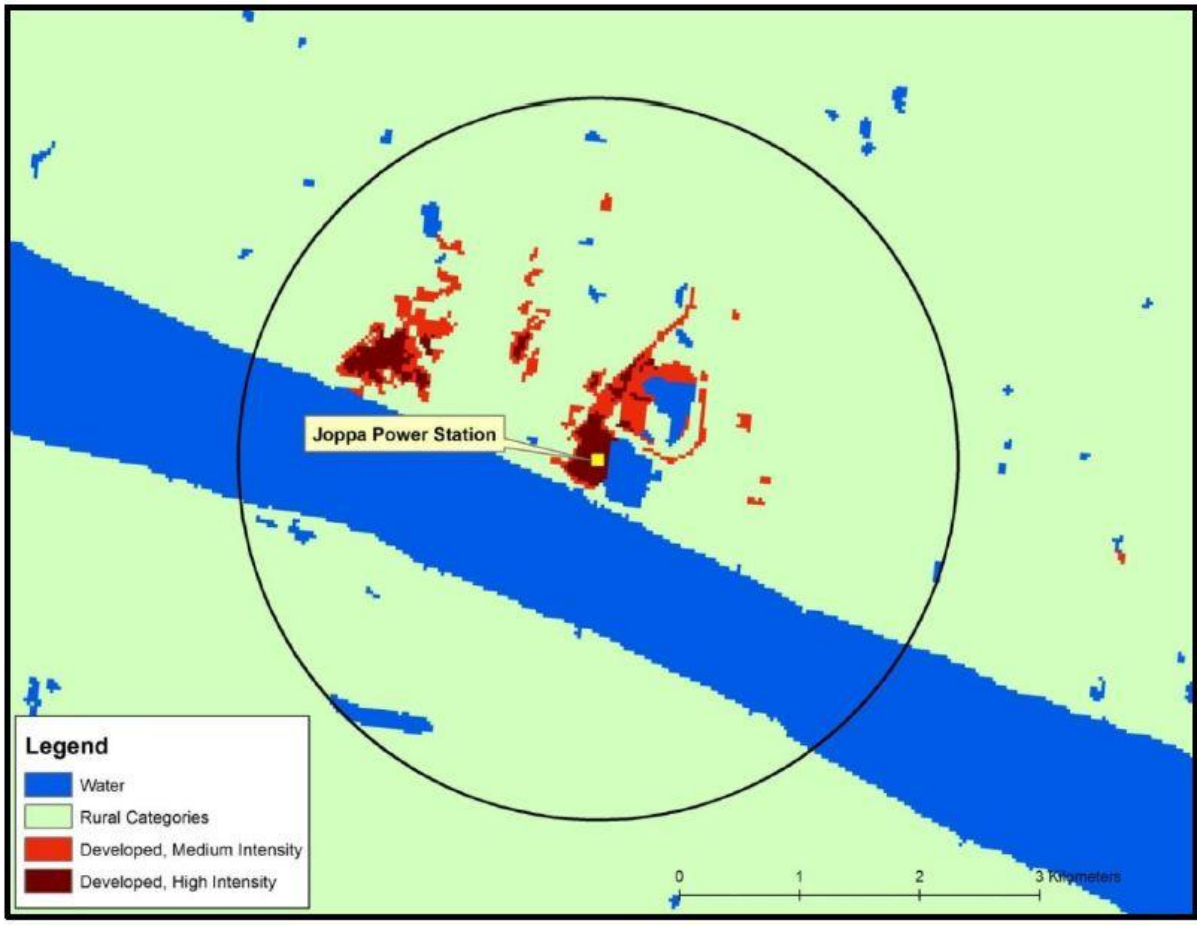


Table 6. Auer's Analysis Land Use Percentages by Category – Area Near Joppa

SO_2 NAA Modeling Auer's Analysis - NLCD 2011				Joppa 3 km Ring		
NLCD Value	NLCD 2011 Description	Auer's Code	Auer's Class	Cell Count	Percentage	Totals
23	Developed, Medium Intensity	R2/R3	Urban	825	2.63%	3.99%
24	Developed, High Intensity	I1/I2/C1		427	1.36%	
11	Open Water	A5		7,189	22.89%	
21	Developed, Open Space	A1/R4		1,756	5.59%	
22	Developed, Low Intensity	R1		1,196	3.81%	
31	Barren Land (Rock/Sand/Clay)	A3		163	0.52%	
41	Deciduous Forest	A4		6,400	20.38%	
42	Evergreen Forest	A4		0	0.00%	
43	Mixed Forest	A4	Rural	0	0.00%	96.01%
52	Shrub/Scrub	A4		0	0.00%	
71	Grassland/Herbaceous	A3		0	0.00%	
81	Pasture/Hay	A3		7,677	24.44%	
82	Cultivated Crops	A2		3,623	11.53%	
90	Wood Wetlands	A4		1,963	6.25%	
95	Emergent Herbaceous Wetlands	A3		191	0.61%	
Analysis based on 30 meter by 30 meter raster cells extracted for each area.			*Grand Totals:*	*31,409*	*100.00%*	

Modeling Parameter: Area of Analysis (Receptor Grid)

A reasonable first step towards characterization of air quality in the area surrounding Joppa is to determine the extent of the area of analysis, i.e., 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 of nearby sources; and sufficient receptor coverage and density to adequately capture and resolve the model predicted maximum SO_2 concentrations. For the Joppa area, the state has included four other emitters of SO_2 within approximately 10 km of Joppa in any direction. The state determined that, aside from exceptionally large sources, sources farther than 10 km from Joppa would not cause significant concentration gradients in the Joppa area and therefore need not be modeled. However, Illinois also included TVA-Shawnee Power Plant, which is approximately 11 km from Joppa, based on a determination that this source had sufficient emissions to warrant its inclusion. In addition to Joppa and TVA-Shawnee Power Plant, the other emitters of SO_2 included in Illinois' modeling analysis, all within approximately 10 km of Joppa, are: Lafarge Midwest Inc., Midwest Electric Power Inc., Trunkline Gas Company, Honeywell International Inc.

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

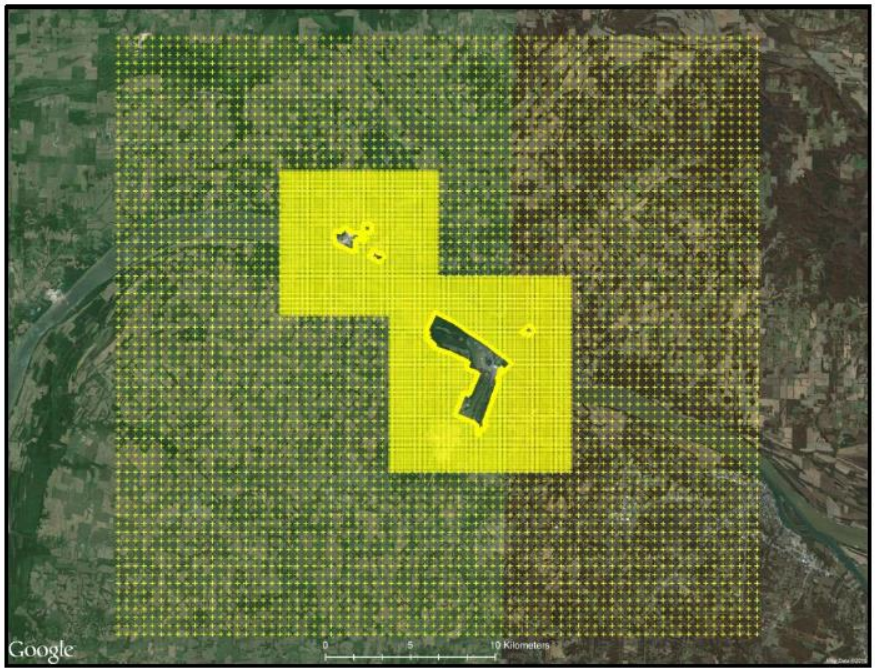
- 50 meters spacing along the fenceline (six facilities)
- 100 meters out to approximately 3.0 kilometers
- 500 meters from 3.0 kilometers out to approximately 8.0 kilometers
- 1,000 meters from 8.0 kilometers out to approximately 12 kilometers

The receptor network contained 25,649 receptors, and the network covered the northwestern portion of Massac County in Illinois, the northeastern portion of Ballard County in Kentucky, and the northwestern portion of McCracken County in Kentucky.

Figure 10 below, included in the state's recommendation, shows the receptor grid for the area of analysis.

For the purposes of this designation effort, the Modeling TAD states that the receptor grid need not include receptors in areas where it would not be feasible to place a monitor and record ambient air impacts, such as bodies of water. With the exception of receptor locations within plant fencelines, Illinois conservatively included the full grid of receptors, including some over the Ohio River.

Figure 10. Receptor Grid for the Massac County, Illinois Area of Analysis



Modeling Parameter: Source Characterization

The state characterized the sources within the area of analysis in accordance with the best practices outlined in the Modeling TAD. Specifically, the state used actual stack heights in conjunction with actual emissions. The state also adequately characterized the modeled sources' building layout and location, as well as the stack parameters, e.g., exit temperature, exit velocity, location, and diameter. The AERMOD component BPIPPRIME was used to assist in addressing building downwash.

Modeling Parameter: Emissions

EPA's Modeling TAD notes that for the purposes 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 does provide for the flexibility of using allowable emissions in the form of a federally enforceable limit on the emissions rate (referred to as PTE or allowable emissions rate).

EPA believes that continuous emissions monitoring systems (CEMS) data provide acceptable historical emissions information, when it is available, and that these data are available for many electric generating units. In the absence of CEMS data, 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, EPA believes that detailed throughput, operating schedules, and emissions information from the impacted sources should be used.

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. Specifically, a facility may have recently adopted a new federally enforceable emissions limit, been subject to a federally enforceable consent decree, or implemented other federally enforceable mechanisms and control technologies to limit SO_2 emissions to a level that indicates compliance with the NAAQS. These new limits or conditions may be used in the application of AERMOD. In these cases, the Modeling TAD notes that the existing SO_2 emissions inventories used for permitting or SIP planning demonstrations should contain the necessary emissions information for designations-related modeling. 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 previously noted, the state included Joppa, one relatively large source 11 km from Joppa, and four other emitters of SO_2 within approximately 10 km from Joppa. The facilities in the area of analysis, their associated annual actual SO_2 emissions between 2012 and 2014 are summarized below, along with their distance from Joppa.

Table 7. Actual SO_2 Emissions between 2012 – 2014 from Facilities in the Massac County, Illinois Area

Facility Name	SO_2 Emissions (tons per year)			Approximate Distance to Joppa (km)
	2012	2013	2014	
Joppa PS (Electric Energy Inc.)	17,007.07	16,557.74	18,229.24	N/A
Lafarge Midwest Inc.	552.60	553.28	491.65	1.97
Midwest Electric Power Inc. (MEPI)	5.68	0.00	0.00	1.40
Trunkline Gas Company	0.866	0.866	0.866	1.42
Honeywell International Inc.	162.51	58.73	143.15	10.14
TVA – Shawnee Power Plant	27,114.87	27,210.73	29,734.54	11.41
Total Emissions From All Facilities in the State's Area of Analysis	**44,843.60**	**44,381.46**	**48,599.45**	

For Joppa, the state used actual emissions from the most recent 3-year data set, i.e., 2012 – 2014. The state used CEMS SO_2 emissions data provided by the Joppa for its boiler stacks, along with hourly specific exit temperatures and exit velocities.

For Lafarge Midwest Inc., the state used company-provided hourly varying emissions, temperature, and exit velocity.

For MEPI, the state used company-provided hourly varying emissions.

For Trunkline Gas Company, the state used emissions found in the company's Annual Emissions Reports, which included yearly emissions data and seasonal throughput. These seasonal emissions were averaged over three years (2012-2014), multiplied by a scalar (via EMISFACT keyword in AERMOD), and then applied to the three-year modeling period.

For Honeywell International Inc., the state constructed a three-year hourly profile based on seasonal throughput.

For TVA-Shawnee Boiler Stacks, the state used CEMS data obtained via U.S. EPA's Clean Air Markets Division (CAMD) database to construct hourly emission rates.

For all the sources that lacked CEMS data, the state used constant values for exit temperature and exit velocity, which were obtained either from the Illinois EPA database or from company-provided emission reports.

Modeling Parameter: Meteorology and Surface Characteristics

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

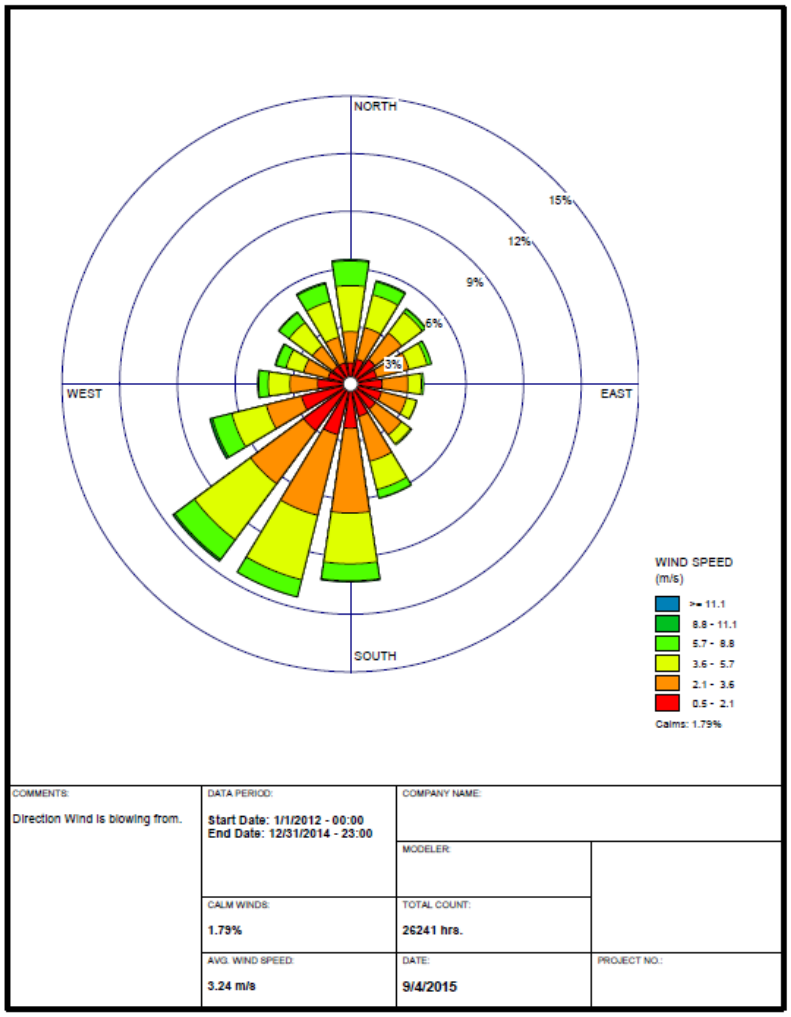
For the Massac County area of analysis, surface meteorology from the NWS station in Paducah, Kentucky, 18 km to the southeast, and coincident upper air observations from the NWS station in Nashville, Tennessee, 228 km to the southeast were selected as best representative of meteorological conditions within the area of analysis.

The state used AERSURFACE version 13016 using data from the NWS station in Paducah, Kentucky located at (37.05822 °N, 88.57251 °W) to estimate the surface characteristics of the area. These surface characteristics are the albedo (the fraction of solar energy reflected from the earth back into space), the Bowen ratio (representing the ratio of sensible heat flux to latent heat flux at the ground level), and the surface roughness (representing the influence of ground features such as buildings and vegetation on surface wind flow). In Figure 11 below, generated by EPA, the location of the Paducah, Kentucky NWS station is shown relative to the Joppa Power Station area of analysis.

Figure 11. Massac County Area of Analysis and the Paducah, Kentucky NWS

As part of its recommendation, the state provided the 3-year surface wind rose for Paducah, Kentucky. In Figure 12, the frequency and magnitude of wind speed and direction are defined in terms of from where the wind is blowing. The predominant wind direction during the three-year time period used for the modeling is from the southwest, occurring approximately 11.4% of the time. The highest percentage wind speed range, occurring 32.9% of the time, was in the 2.1 – 3.6 m/s range.

Figure 12. Paducah, Kentucky Cumulative Annual Wind Rose for Years 2012 – 2014



Meteorological data from the above surface and upper air 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. The state followed the methodology and settings presented in the U.S. EPA's *User's Guide for the AERMOD Meteorological Preprocessor* (November 2004) 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 one minute duration was provided from the same instrument tower, 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 state set a minimum threshold of 0.5 meters per second in processing meteorological data for use in AERMOD. This approach is consistent with a March 2013 EPA memo titled, "Use of ASOS meteorological data in AERMOD dispersion Modeling." In setting this threshold, no wind speeds lower than this value would be used for determining concentrations. This threshold was specifically applied to the one minute wind data.

Modeling Parameter: Geography and Terrain

The terrain in the area of analysis is best described as flat to gently rolling. To account for these terrain changes, the AERMAP terrain program within AERMOD was used to specify terrain elevations for all the receptors. The source of the elevation data incorporated into the model is from the USGS National Elevation Database (NED).

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 "first tier" approach, based on monitored design values, or 2) a temporally varying approach, based on the 99th percentile monitored concentrations by hour of day and season or month. For the Joppa area of analysis, the state chose to use the latter. The background concentrations for this area of analysis ranged from 2.6 to 34 $\mu g/m^3$, or 1 to 13 ppb.[4] AERMOD incorporated these hourly/seasonal values into the final results.

Summary of Modeling Results

The AERMOD modeling parameters for the Joppa area of analysis are summarized below in Table 8.

Table 8. AERMOD Modeling Parameters for the Massac County Area of Analysis

Massac County, Illinois Area of Analysis	
AERMOD Version	15181
Dispersion Characteristics	Rural
Modeled Sources	6
Modeled Stacks	18
Modeled Structures	127
Modeled Fencelines	6
Total receptors	25,649
Emissions Type	Actual
Emissions Years	2012-2014

[4] The conversion factor for SO_2 (at the standard conditions applied in the ambient SO_2 reference method) is 1ppb = approximately 2.62$\mu g/m^3$.

Meteorology Years	2012-2014
Surface Meteorology Station	Paducah, Kentucky
Upper Air Meteorology Station	Nashville, Tennessee
Methodology for Calculating Background SO_2 Concentration	Temporally Varying
Calculated Background SO_2 Concentration	1 to 13 ppb

The results presented below in Table 9 show the magnitude and geographic location of the highest predicted modeled concentration based on actual emissions.

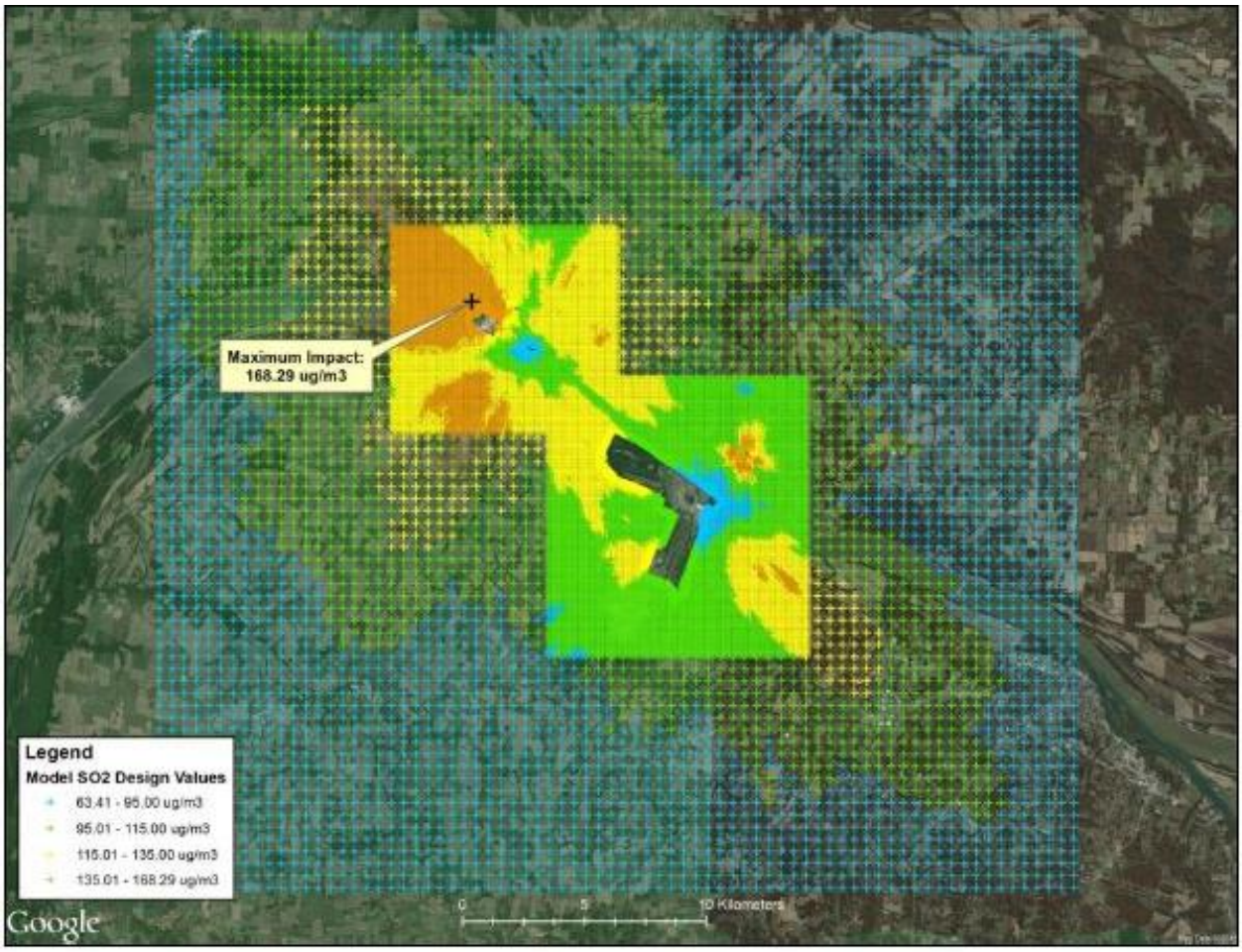
Table 9. Maximum Predicted 99th Percentile 1-Hour SO_2 Concentration in the Massac County, Illinois Area of Analysis Based on Actual Emissions

Averaging Period	**Data Period**	**Receptor Location**		**SO_2 Concentration ($\mu g/m^3$)**	
		UTM/Latitude	**UTM/Longitude**	**Modeled (including background)**	**NAAQS**
99th Percentile 1-Hour Average	2012-2014	332800	4121600	168.29	196.4*

*Equivalent to the 2010 SO_2 NAAQS set at 75 ppb

The state's modeling indicates that the predicted 99th percentile 1-hour average concentration within the chosen modeling domain is 168.29 $\mu g/m^3$, or 64.2 ppb. This modeled concentration included the background concentration of SO_2, and is based on actual emissions from the facilities. Figure 13 below was included as part of the state's recommendation, and indicates that the predicted value occurred within the dense 100-meter grid approximately 2.9 km northwest of the Joppa Power Station main stacks and 0.4 km northwest of the Lafarge northern fenceline. The state's receptor grid is also shown in the figure.

Figure 13. Maximum Predicted 99th Percentile 1-Hour SO_2 Concentrations in the Massac County, Illinois Area of Analysis Based on Actual Emissions



As noted above, portions of Illinois' modeling domain extend into Kentucky and other areas beyond the area Illinois recommended be designated as attainment. Illinois identified no violations in those portions of the modeling domain. However, Illinois has focused its analysis on the area relatively close to Joppa, the analysis is most reliable in this area, and so EPA intends to designate only the area that Illinois recommended designating attainment. Kentucky made no recommendations regarding this area, and EPA intends not to include any portion of Kentucky in the designations for this area.

Jurisdictional Boundaries:

Once the geographic area of analysis associated with Joppa, other nearby sources, and background concentrations are determined, existing jurisdictional boundaries are considered for the purpose of informing our intended unclassifiable/attainment area, specifically with respect to clearly defined legal boundaries. EPA believes that our intended unclassifiable/attainment area, consisting of Massac County, is comprised of clearly defined legal boundaries, and we find these boundaries to be a suitably clear basis for defining our intended unclassifiable/attainment area.

As previously discussed, emissions from 6 facilities were included in the modeling analysis for the area around Joppa, including Joppa and another large emitter of SO_2, i.e., TVA's Shawnee Power Station, which is located in neighboring McCracken County, Kentucky. The area of analysis was found to show compliance with the standard, and EPA has determined that there are

no additional sources of SO_2 within Massac County, but for those included in the state's modeling analysis, emitting at or above 100 tpy, according to the 2011 NEI. As a result, EPA does not believe that sources or emissions from Massac County cause or contribute to a violation of the NAAQS in any area. EPA anticipates that further analysis of air quality in McCracken County, Kentucky, notably to assess the impact of the TVA's Shawnee Generating Station in that county, will be conducted pursuant to the data requirements rule, supporting designation action for that county at a future time.

There are two facilities in Calvert City, Marshall County, Kentucky, which are 13 km from the Massac County border. Given their emissions (1,976 tpy for Isp Chemicals and 860 tpy for CC Metals and Alloys in the 2011 NEI) and the distance, they are not likely to cause or contribute to violations in Massac County. Additionally, their emissions are likely to be accounted for in the background values measured at the Paducah monitor (AQS ID 21-145-1024), which is located between the Calvert City facilities and the Joppa study area. The 2012 – 2014 design value collected at this monitor was 21 ppb.

Other Relevant Information

The Sierra Club submitted a modeling analysis to EPA for the Joppa Power Station, asserting that Joppa was contributing to modeled violations. Sierra Club provided this information to Illinois, and Illinois has reviewed this information and identified several deviations from recommendations in the Modeling TAD. First, the Sierra Club's analysis used a lower-than-actual stack height. The Sierra Club used a higher, fixed background value, taken from Oglesby, in north central Illinois, whereas Illinois's background data for Joppa came from Paducah, Kentucky, much closer to the Joppa modeling domain. Sierra Club used fixed stack gas temperatures and flow rates, whereas Illinois used hourly varying data for these parameters for Joppa. These differences likely explain why the Sierra Club results were greater than Illinois' modeling results. The Sierra Club analysis did not provide information refuting the appropriateness of Illinois' analysis of the Joppa area for this round of SO_2 designations, and EPA does not find that the Sierra Club analysis has provided compelling information for EPA's designation decision for Massac County to differ from Illinois' recommendation.

Conclusion

After careful evaluation of the state's recommendation and supporting information, as well as all available relevant information, EPA intends to designate the area around Joppa as unclassifiable/attainment for the 2010 SO_2 NAAQS. Specifically, EPA intends to designate an unclassifiable/attainment area consisting of the entirety of Massac County.

At this time, our intended designations for the state only apply to this area and the other areas presented in this technical support document. Consistent with the conditions in the March 2, 2015 court-ordered schedule, EPA will evaluate and designate all remaining undesignated areas in Illinois by either December 31, 2017, or December 31, 2020.

Technical Analysis for the Jasper County, Illinois Area

Introduction

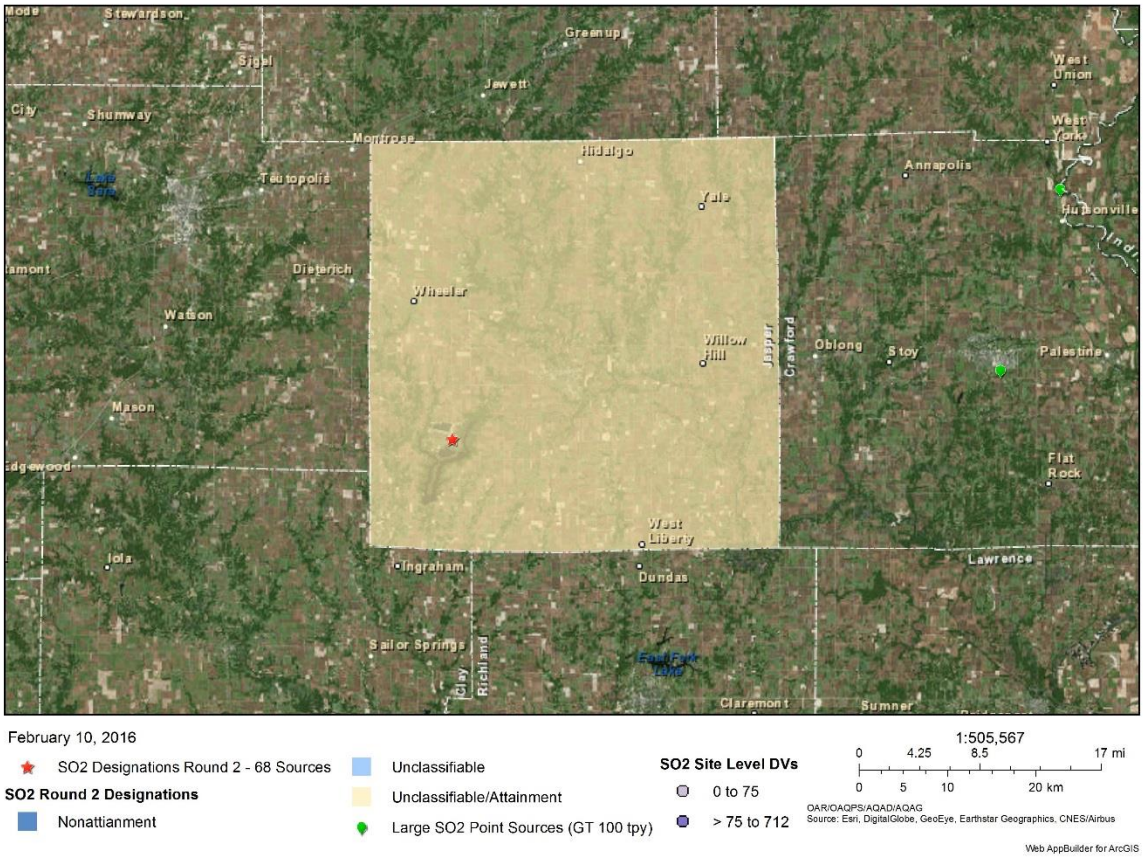
Jasper County, Illinois contains a stationary source that according to EPA's Air Markets Database emitted in 2012 either more than 16,000 tons of SO_2 or more than 2,600 tons of SO_2 and had an annual average emission rate of at least 0.45 pounds of SO_2 per one million British thermal units (lbs SO_2/MMBTU). As of March 2, 2015, this stationary source had not met the specific requirements for being "announced for retirement." Specifically, in 2012, Illinois Power Generating Company's Newton Power Station ("Newton") emitted 16,519 tons of SO_2, and had an emissions rate of 0.590 lbs SO_2/MMBTU. Pursuant to the March 2, 2015 court-ordered schedule, EPA must designate the area surrounding the facility by July 2, 2016.

In its submission, Illinois recommended that the area surrounding Newton, specifically the entirety of Jasper County, be designated as attainment based on an assessment and characterization of air quality from the facility and other nearby sources which may have a potential impact in the area of analysis where maximum concentrations of SO_2 are expected. This assessment and characterization was performed using air dispersion modeling software, i.e., AERMOD, analyzing actual emissions. After careful review of the state's assessment, supporting documentation, and all available data, EPA agrees that the area is attaining the standard, and intends to designate Jasper County as unclassifiable/attainment

Newton is located in southeastern Illinois in southwestern Jasper County. The facility is located approximately seven miles southwest of the City of Newton in a rural area bounded on the east and south by Newton Lake. Figure 14 shows EPA's intended designation for this area.

Figure 14. EPA's intended designation for the Jasper County Area

Jasper County, Illinois Area



The discussion and analysis that follows below will reference the state's use of the Modeling TAD, EPA's assessment of the state's modeling in accordance with the Modeling TAD, and the factors for evaluation contained in EPA's March 20, 2015 guidance, as appropriate.

Detailed Assessment

Model Selection and Modeling Components

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. In some instances the recommended model may be a model other than AERMOD, such as the BLP model for buoyant line sources. 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
- BPIPPRIME: 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 state used AERMOD version 15181, the most recent version, and a discussion of the individual components will be referenced in the corresponding discussion that follows, as appropriate.

Modeling Parameter: Rural or Urban Dispersion

EPA's recommended procedure for characterizing an area by prevalent land use is based on evaluating the dispersion environment with 3 km of the facility. According to EPA's modeling guidelines, rural dispersion coefficients are to be used in the dispersion modeling analysis if more than 50% of the area within a 3 km radius of the facility is classified as rural. Conversely, if more than 50% of the area is urban, urban dispersion coefficients should be used in the modeling analysis. The state performed an Auer's analysis for the Newton study area in order to determine which mode was appropriate for the modeling. The analysis indicated that the study area is approximately 98.2% rural and 1.8% urban, showing that the rural option applied to all emission sources in the modeling domain. Figure 15 and Table 10 below show the results of the state's Auer's analysis.

Figure 15. Auer's Analysis – Area Near Newton

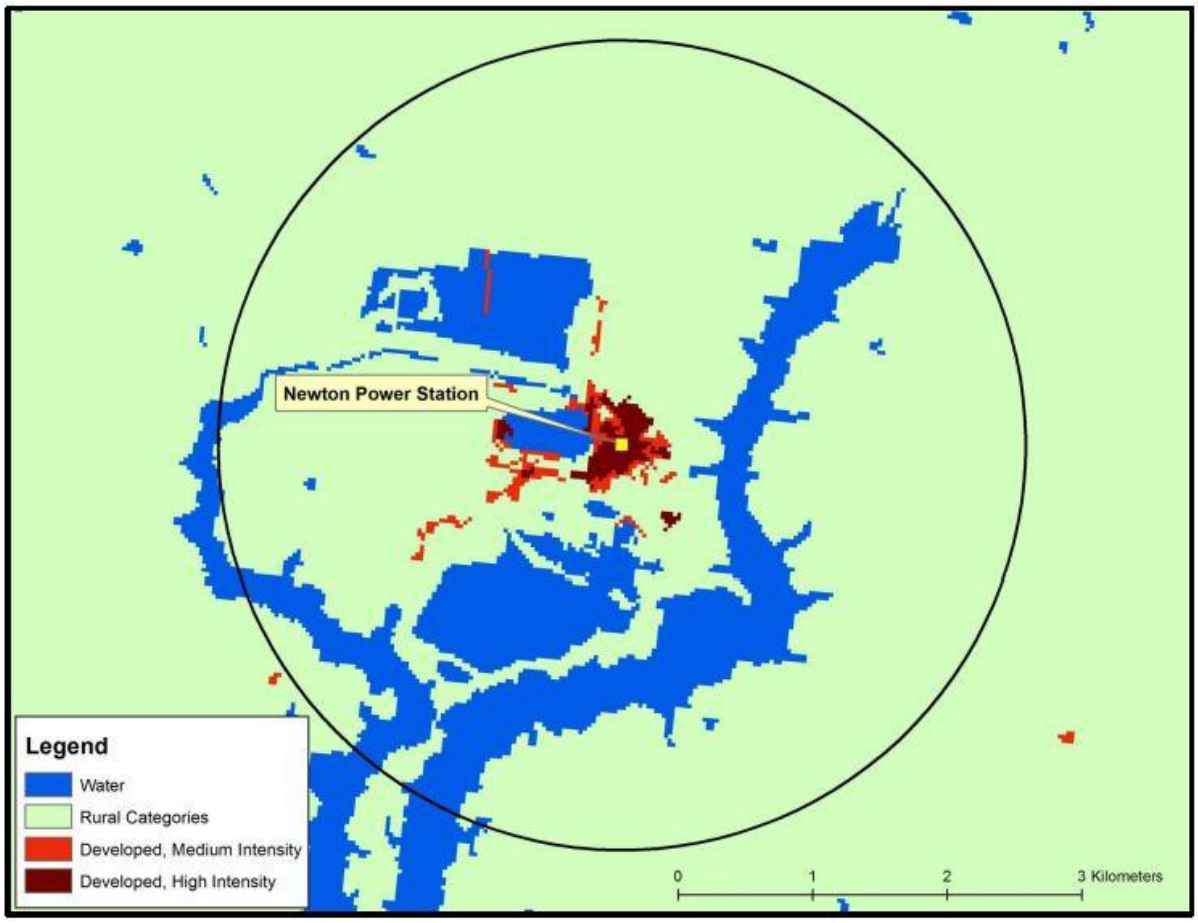


Table 10. Auer's Analysis Land Use Percentages by Category – Newton Study Area

Newton Study Area Auer's Analysis				Newton 3 km Ring		
NLCD Value	NLCD 2011 Description	Auer's Code	Auer's Class	Cell Count	Percentage	Totals
23	Developed, Medium Intensity	R2/R3	Urban	306	0.97%	1.78%
24	Developed, High Intensity	I1/I2/C1		253	0.81%	
11	Open Water	A5		6,370	20.29%	
21	Developed, Open Space	A1/R4		1,024	3.26%	
22	Developed, Low Intensity	R1		390	1.24%	
31	Barren Land (Rock/Sand/Clay)	A3		157	0.50%	
41	Deciduous Forest	A4		8,345	26.58%	
42	Evergreen Forest	A4		0	0.00%	
43	Mixed Forest	A4	Rural	0	0.00%	98.22%
52	Shrub/Scrub	A4		6	0.02%	
71	Grassland/Herbaceous	A3		1,001	3.19%	
81	Pasture/Hay	A3		2,546	8.11%	
82	Cultivated Crops	A2		10,997	35.03%	
90	Wood Wetlands	A4		0	0.00%	
95	Emergent Herbaceous Wetlands	A3		2	0.01%	
Analysis based on 30 meter by 30 meter raster cells extracted for each area.			*Total*	*31,397*	*100.00%*	*100.00%*

Modeling Parameter: Area of Analysis (Receptor Grid)

A reasonable first step towards characterization of air quality in the area surrounding the Newton Power Station is to determine the extent of the area of analysis, i.e., 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 of nearby sources; and sufficient receptor coverage and density to adequately capture and resolve the model predicted maximum SO_2 concentrations. For the Jasper County area, the state identified no other significant emitters of SO_2 in the area within or beyond 10 km of Newton in any direction. In the absence of exceptionally large sources within 30 km of Newton, the state determined that 10 km was the appropriate distance within which to include moderate sized sources in order to adequately characterize air quality from the facility and other nearby sources which may have a potential impact in the area of analysis where maximum concentrations of SO_2 are expected. Again, Newton is the only significant SO_2 source within the 10-kilometer study area, and there are no sources beyond ten kilometers that Illinois EPA considers to have the potential to cause significant gradient impacts within the study area.

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

- 50 meters along the fenceline
- 100 meters from the fenceline out to 5.0 kilometers
- 500 meters from 5.0 kilometers out to 8.0 kilometers

The receptor network contained 12,165 receptors, and the network covered the southwestern section of Jasper County and small portions of Effingham and Clay counties.

Figures 16, included in the state's recommendation, shows the state's receptor grid for the area of analysis.

For the purposes of this designation effort, the Modeling TAD states that the receptor grid need not include receptors in areas where it would not be feasible to place a monitor and record ambient air impacts, such as bodies of water. With the exception of receptor locations within plant fencelines, Illinois conservatively included the full grid of receptors, including some over Newton Lake.

Figure 16. Receptor Grid for the Jasper County, Illinois Area of Analysis

Modeling Parameter: Source Characterization

The state characterized the source within the area of analysis in accordance with the best practices outlined in the Modeling TAD. Specifically, the state used actual stack heights in conjunction with actual emissions. The state also adequately characterized Newton's building layout and location, as well as the stack parameters, e.g., exit temperature, exit velocity, location, and diameter. The AERMOD component BPIPPRIME was used to assist in addressing building downwash.

Modeling Parameter: Emissions

EPA's Modeling TAD notes that for the purposes 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 does provide for the flexibility of using allowable emissions in the form of a federally enforceable limit on the emission rate (referred to as PTE or allowable emissions rate).

EPA believes that continuous emissions monitoring systems (CEMS) data provide acceptable historical emissions information, when it is available, and that these data are available for many electric generating units. In the absence of CEMS data, 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, EPA believes that detailed throughput, operating schedules, and emissions information from the impacted source should be used.

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. Specifically, a facility may have recently adopted a new federally enforceable emissions limit, been subject to a federally enforceable consent decree, or implemented other federally enforceable mechanisms and control technologies to limit SO_2 emissions to a level that indicates compliance with the NAAQS. These new limits or conditions may be used in the application of AERMOD. In these cases, the Modeling TAD notes that the existing SO_2 emissions inventories used for permitting or SIP planning demonstrations should contain the necessary emissions information for designations-related modeling. 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 previously noted, the state included only Newton within its modeling analysis. The facility in the area of analysis and its associated annual actual SO_2 emissions between 2012 and 2014 are summarized below.

Table 11. Actual SO_2 Emissions for 2012 – 2014 from Facilities in the Jasper County, Illinois Area of Analysis

Facility Name	SO_2 Emissions (tons per year)		
	2012	2013	2014
Newton	16,533.83	16,144.5	16,372.76
Total Emissions From All Facilities in the State's Area of Analysis	16,533.83	16,144.5	16,372.76

For Newton, the state used hourly varying 2012-2014 CEMS data, coupled with company-provided hour-specific exit temperatures and exit velocities.

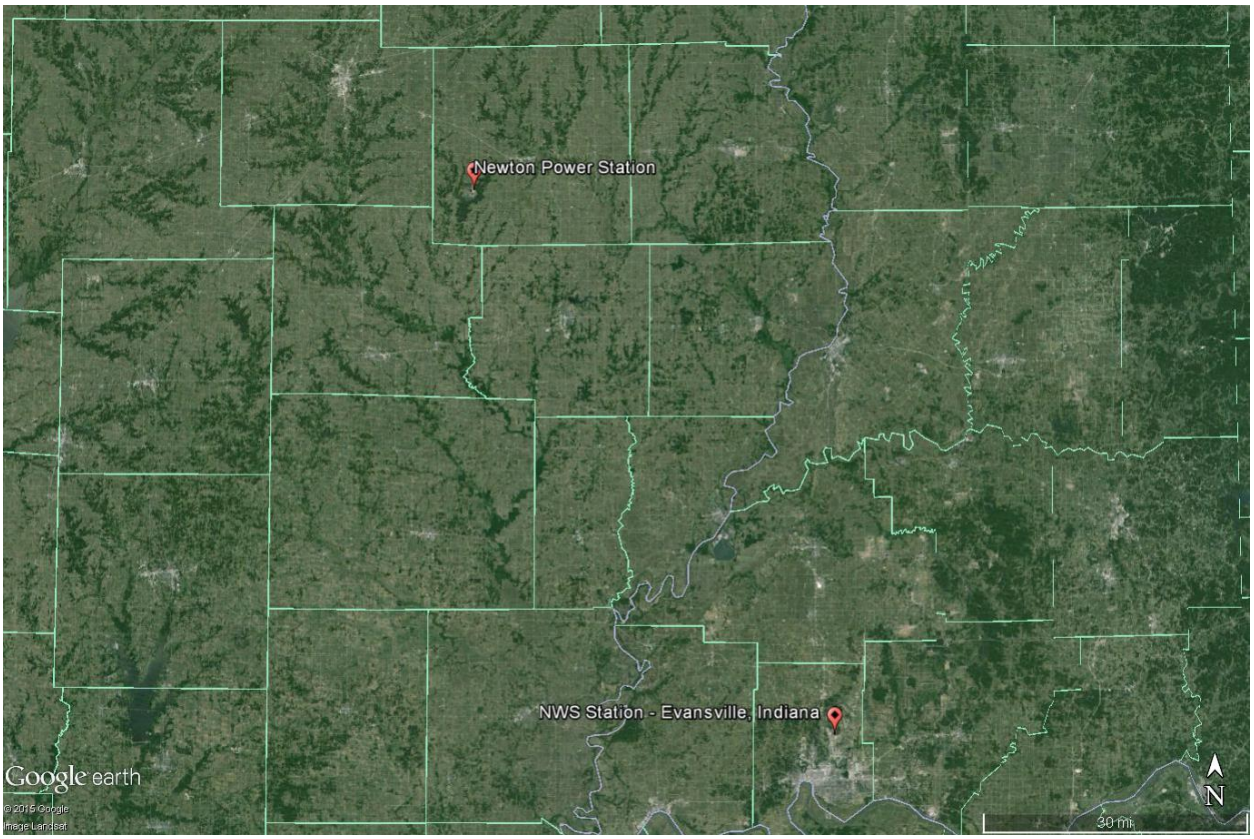
Modeling Parameter: Meteorology and Surface Characteristics

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

For the Jasper County area of analysis, surface meteorology from the NWS station in Evansville, Indiana, 123 km to the southeast, and coincident upper air observations from the NWS station in Lincoln, Illinois, 164 km to the northwest were selected as best representative of meteorological conditions within the area of analysis.

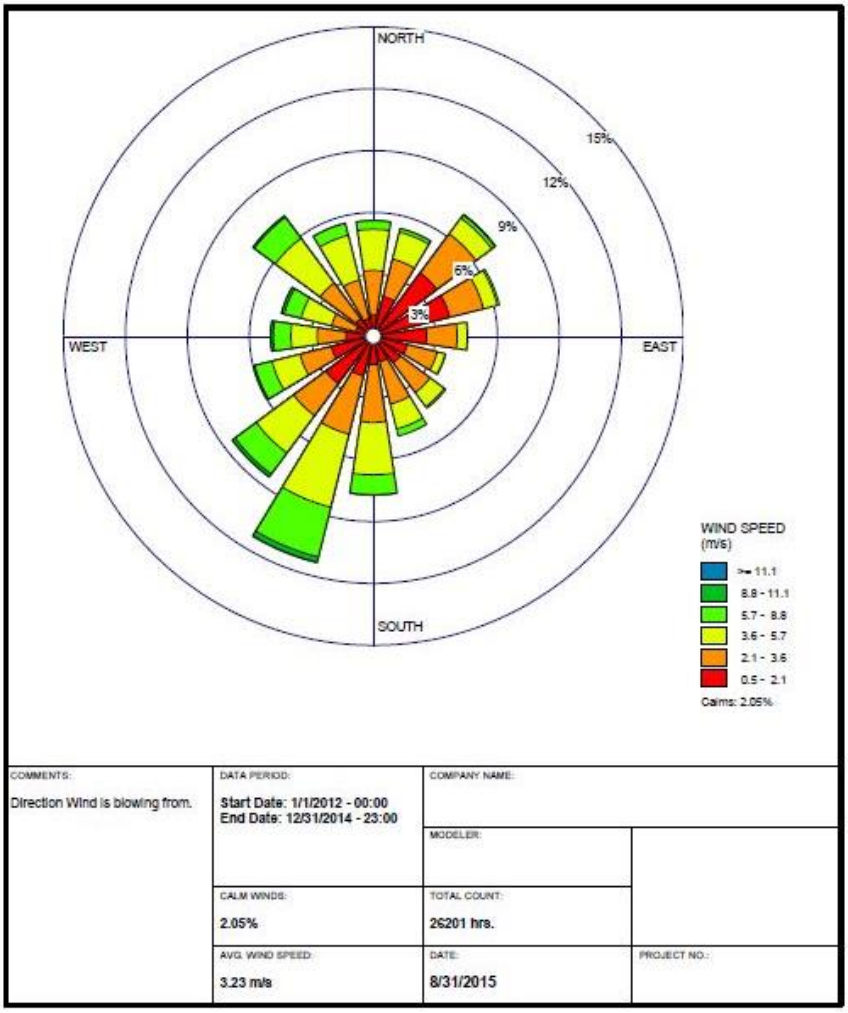
The state used AERSURFACE version 13016 using data from the NWS station in Evansville, Indiana located at (38.05 °N, 87.53 °W) to estimate the surface characteristics of the area of analysis. These surface characteristics are the albedo (the fraction of solar energy reflected from the earth back into space), the Bowen ratio (representing the ratio of sensible heat flux to latent heat flux at the ground level), and the surface roughness (representing the influence of ground features such as buildings and vegetation on surface wind flow). In Figure 17 below, generated by EPA, the location of the Evansville, Indiana NWS station is shown relative to the Jasper County area.

Figure 17. Jasper County Area and the Evansville, Indiana NWS



As part of its recommendation, the state provided the 3-year surface wind rose for Evansville, Indiana. In Figure 18, the frequency and magnitude of wind speed and direction are defined in terms of from where the wind is blowing. The predominant wind direction during the three-year time period represented in the modeling is from the southwest, occurring approximately 11.3% of the time. The highest percentage wind speed range, occurring 25.3% of the time, was in the 3.6 – 5.7 m/s range.

Figure 18. Evansville, Indiana Cumulative Annual Wind Rose for Years 2012 – 2014



Meteorological data from the above surface and upper air 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. The state followed the methodology and settings presented in the U.S. EPA's *User's Guide for the AERMOD Meteorological Preprocessor* (November 2004) 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 one minute duration was provided from the same instrument tower, 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 state set a minimum threshold of 0.5 meters per second in processing meteorological data for use in AERMOD. This approach is consistent with a March 2013 EPA memo titled, "Use of ASOS meteorological data in AERMOD dispersion Modeling." In setting this threshold, no wind speeds lower than this value would be used for determining concentrations. This threshold was specifically applied to the one minute wind data.

Modeling Parameter: Geography and Terrain

The terrain in the area of analysis is best described as flat to gently rolling. To account for these terrain changes, the AERMAP terrain program within AERMOD was used to specify terrain elevations for all the receptors. The source of the elevation data incorporated into the model is from the USGS NED.

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 "first tier" approach, based on monitored design values, or 2) a temporally varying approach, based on the 99th percentile monitored concentrations by hour of day and season or month. For the Jasper County area of analysis, the state chose to use the latter. The background concentrations for this area of analysis ranged from 3.3 to 15.5 $\mu g/m^3$, or 1.3 to 6 ppb.[5] AERMOD incorporated these hourly/seasonal values into the final results.

Summary of Modeling Results

The AERMOD modeling parameters for the Jasper County area of analysis are summarized below in Table 12.

Table 12. AERMOD Modeling Parameters for the Jasper County, Illinois Area of Analysis

Jasper County, Illinois Area of Analysis	
AERMOD Version	15181
Dispersion Characteristics	Rural
Modeled Sources	1
Modeled Stacks	2
Modeled Structures	9
Modeled Fencelines	1
Total receptors	12,165
Emissions Type	Actual
Emissions Years	2012-2014
Meteorology Years	2012-2014

[5] The conversion factor for SO_2 (at the standard conditions applied in the ambient SO_2 reference method) is 1ppb = approximately 2.62$\mu g/m^3$.

Surface Meteorology Station	Evansville, Indiana
Upper Air Meteorology Station	Lincoln, Illinois
Methodology for Calculating Background SO_2 Concentration	Temporally Varying
Calculated Background SO_2 Concentration	1.3 to 6 ppb

The results presented below in Table 13 show the magnitude and geographic location of the highest predicted modeled concentration based on actual emissions.

Table 13. Maximum Predicted 99th Percentile 1-Hour SO_2

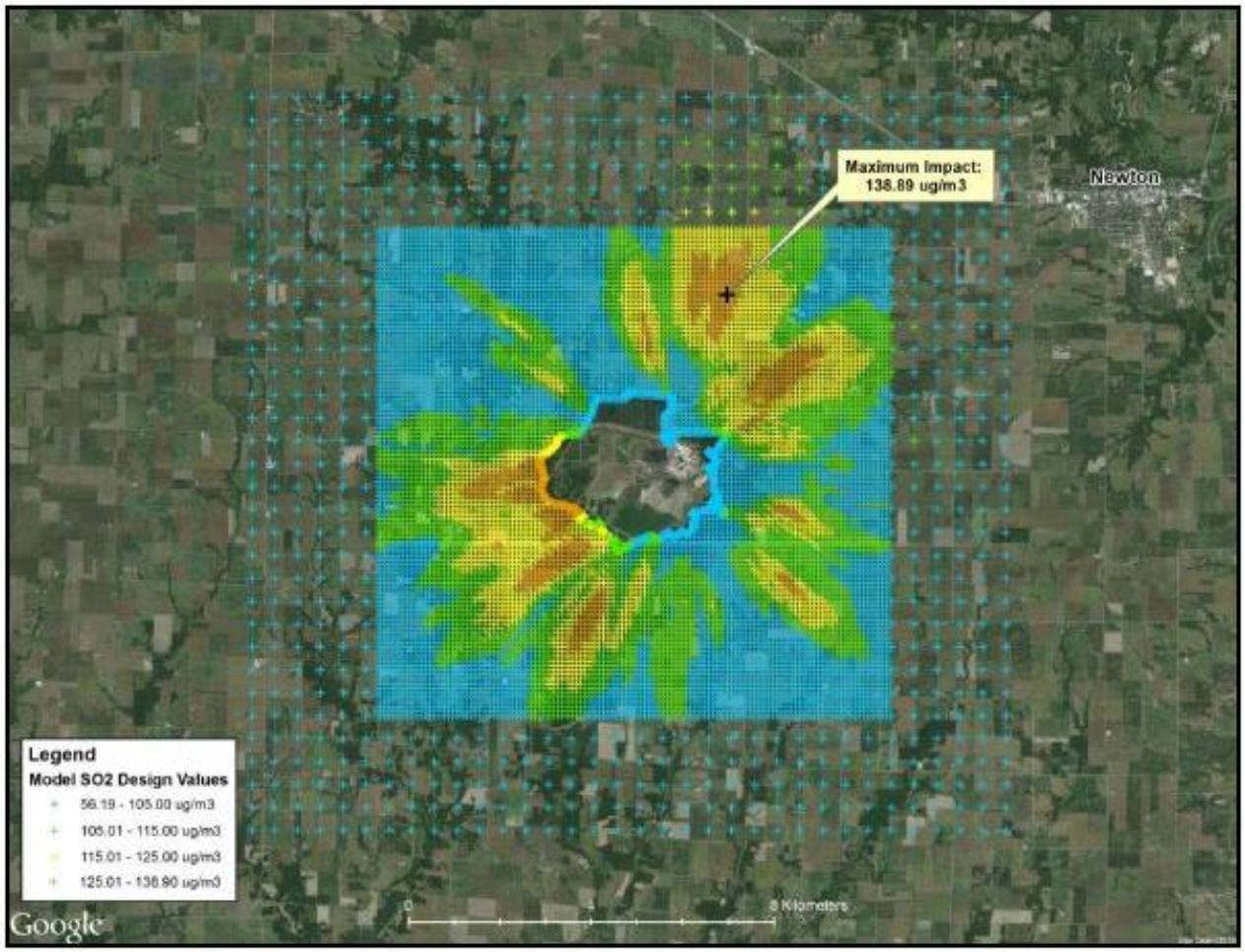
Concentration in the Jasper County, Illinois Area of Analysis Based on Actual Emissions

		Receptor Location		**SO_2 Concentration ($\mu g/m^3$)**	
Averaging Period	**Data Period**	**UTM/Latitude**	**UTM/Longitude**	**Modeled (including background)**	**NAAQS**
99th Percentile 1-Hour Average	2012-2014	390400	4314200	138.89	196.4*

*Equivalent to the 2010 SO_2 NAAQS set at 75 ppb

The state's modeling indicates that the predicted 99th percentile 1-hour average concentration within the chosen modeling domain is 138.89 $\mu g/m^3$, or 53.0 ppb. This modeled concentration included the background concentration of SO_2, and is based on actual emissions from the facilities. Figure 19 below was included as part of the state's recommendation, and indicates that the predicted value occurred approximately 3.85 km northeast of the Newton main stack. The state's receptor grid is also shown in the figure.

Figure 19. Maximum Predicted 99th Percentile 1-Hour SO_2 Concentrations in the Jasper County, Illinois Area of Analysis Based on Actual Emissions



Jurisdictional Boundaries

Once the air quality in the area of analysis associated with Newton is determined, existing jurisdictional boundaries are considered for the purpose of informing the boundaries of the intended area to be designated, specifically with respect to clearly defined legal boundaries. EPA believes that our intended unclassifiable/attainment area, consisting of Jasper County, has clearly defined legal boundaries, and we find these boundaries to be a suitable basis for defining our intended unclassifiable/attainment area.

There are no SO_2 sources over 100 tpy in most of the neighboring counties surrounding Jasper County. According to the 2011 NEI, there are two sources emitting over 100 tpy of SO_2 in Crawford County, to the east. While the 2011 emissions would make both of these sources candidates for future characterization under the DRR (with 2011 emissions for CII Carbon of 5,521 tons/year and for Ameren Hutsonville of 3,167 tons/year), these facilities are approximately 50 km from Newton and 25-30 km from the Jasper County border. Based on the distance from these facilities to the county border, EPA does not believe that their emissions are likely to cause or contribute to a violation of the NAAQS in Jasper County. Therefore, EPA

believes that it is reasonable to designate Jasper County as unclassifiable/attainment based on Illinois' modeling analysis which shows that Newton is not causing violations of the 2010 SO_2 NAAQS in conjunction with the fact that no other sources are expected to cause or contribute to violations in Jasper County.

Other Relevant Information

The Sierra Club submitted a modeling analysis to EPA for Newton asserting that the plant was contributing to modeled violations. The Sierra Club's analysis used actual Air Markets Database emissions for Newton with fixed temperature and velocity values. Illinois used hourly temperature and velocity values. The Sierra Club used a much higher, fixed background value, taken from Oglesby, in north central Illinois, whereas Illinois's background data for Newton, reflecting seasonal and hour-of-day variations in background concentrations, came from Nilwood, Macoupin County, Illinois, which is closer to the modeling domain and more likely to characterize background concentrations at Newton accurately. These differences appear to account for the differences between the Sierra Club results and Illinois' results. Since Illinois' modeling inputs reflect a more accurate characterization of relevant conditions, the Illinois results must be considered more reliable. The Sierra Club analysis did not provide information refuting the appropriateness of Illinois' inputs to its analysis of the Jasper County area for this round of SO_2 designations, and since Illinois' inputs appear more appropriate, EPA does not find that the Sierra Club analysis has provided compelling information to revise EPA's designation decision for Jasper County.

Conclusion

After careful evaluation of the state's recommendation and supporting information, as well as all available relevant information, EPA intends to designate the area around Newton as unclassifiable/attainment for the 2010 SO_2 NAAQS. Specifically, the area consists of the entirety of Jasper County.

At this time, our intended designations for the state only apply to this area and the other areas presented in this technical support document. Consistent with the conditions in the March 2, 2015 court-ordered schedule, EPA will evaluate and designate all remaining undesignated areas in Illinois by either December 31, 2017, or December 31, 2020.

Technical Analysis for the Putnam/Bureau Counties, Illinois Area

Introduction

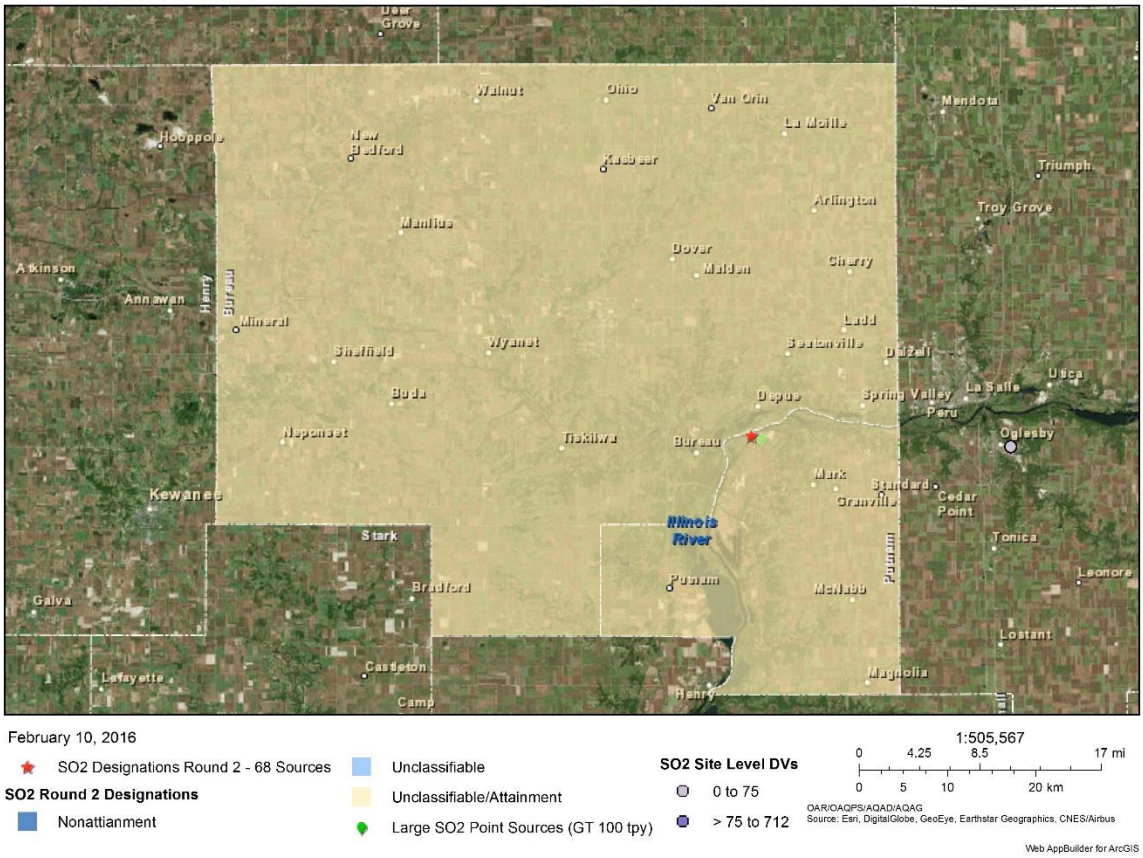
Putnam County contains a stationary source that according to EPA's Air Markets Database emitted in 2012 either more than 16,000 tons of SO_2 or more than 2,600 tons of SO_2 and had an annual average emission rate of at least 0.45 pounds of SO_2 per one million British thermal units (lbs SO_2/MMBTU). As of March 2, 2015, this stationary source had not met the specific requirements for being "announced for retirement." Specifically, in 2012, the Hennepin Power Station ("Hennepin") emitted 5,906 tons of SO_2, and had an emissions rate of 0.501 lbs SO_2/MMBTU. Pursuant to the March 2, 2015 court-ordered schedule, EPA must designate the area surrounding the facility by July 2, 2016.

In its submission, Illinois recommended that the area surrounding Hennepin, specifically Putnam County and neighboring Bureau County, be designated as attainment based on an assessment and characterization of air quality from the facility and other nearby sources which may have a potential impact in the area of analysis where maximum concentrations of SO_2 are expected. This assessment and characterization was performed using air dispersion modeling software, i.e., AERMOD, analyzing actual emissions. After careful review of the state's assessment, supporting documentation, and all available data, EPA agrees that the area is attaining the standard, and intends to designate Putnam and Bureau Counties as unclassifiable/attainment.

Hennepin is located in north-central Illinois at the northwestern edge of Putnam County on its border with Bureau County. As seen in Figure 20 below, the facility is located approximately 5.6 km northeast of the town of Hennepin in a rural area bounded on the north by the Illinois River. Also included in the figure are nearby emitters of SO_2, the state's recommended area for the attainment designation, and EPA's intended unclassifiable/attainment designation for the area.

Figure 20. EPA's intended designation for Putnam and Bureau Counties, Illinois

Putnam/Bureau Counties, Illinois Area



The discussion and analysis that follows below will reference the state's use of the Modeling TAD, EPA's assessment of the state's modeling in accordance with the Modeling TAD, and the factors for evaluation contained in EPA's March 20, 2015 guidance, as appropriate.

Detailed Assessment

Model Selection and Modeling Components

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. In some instances the recommended model may be a model other than AERMOD, such as the BLP model for buoyant line sources. 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
- BPIPPRIME: 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 state used AERMOD version 15181, the most recent version, and a discussion of the individual components will be referenced in the corresponding discussion that follows, as appropriate.

Modeling Parameter: Rural or Urban Dispersion

EPA's recommended procedure for characterizing an area by prevalent land use is based on evaluating the dispersion environment with 3 km of the facility. According to EPA's modeling guidelines, rural dispersion coefficients are to be used in the dispersion modeling analysis if more than 50% of the area within a 3 km radius of the facility is classified as rural. Conversely, if more than 50% of the area is urban, urban dispersion coefficients should be used in the modeling analysis. The state performed an Auer's analysis for the Putnam/Bureau Counties study area in order to determine which mode was appropriate for the modeling. The analysis indicated that the study area is approximately 98.1% rural and 1.9% urban, showing that the rural option applied to all emission sources in the modeling domain. Figure 21 and Table 14 below show the results of the state's Auer's analysis.

Figure 21. Auer's Analysis – Area Near Hennepin

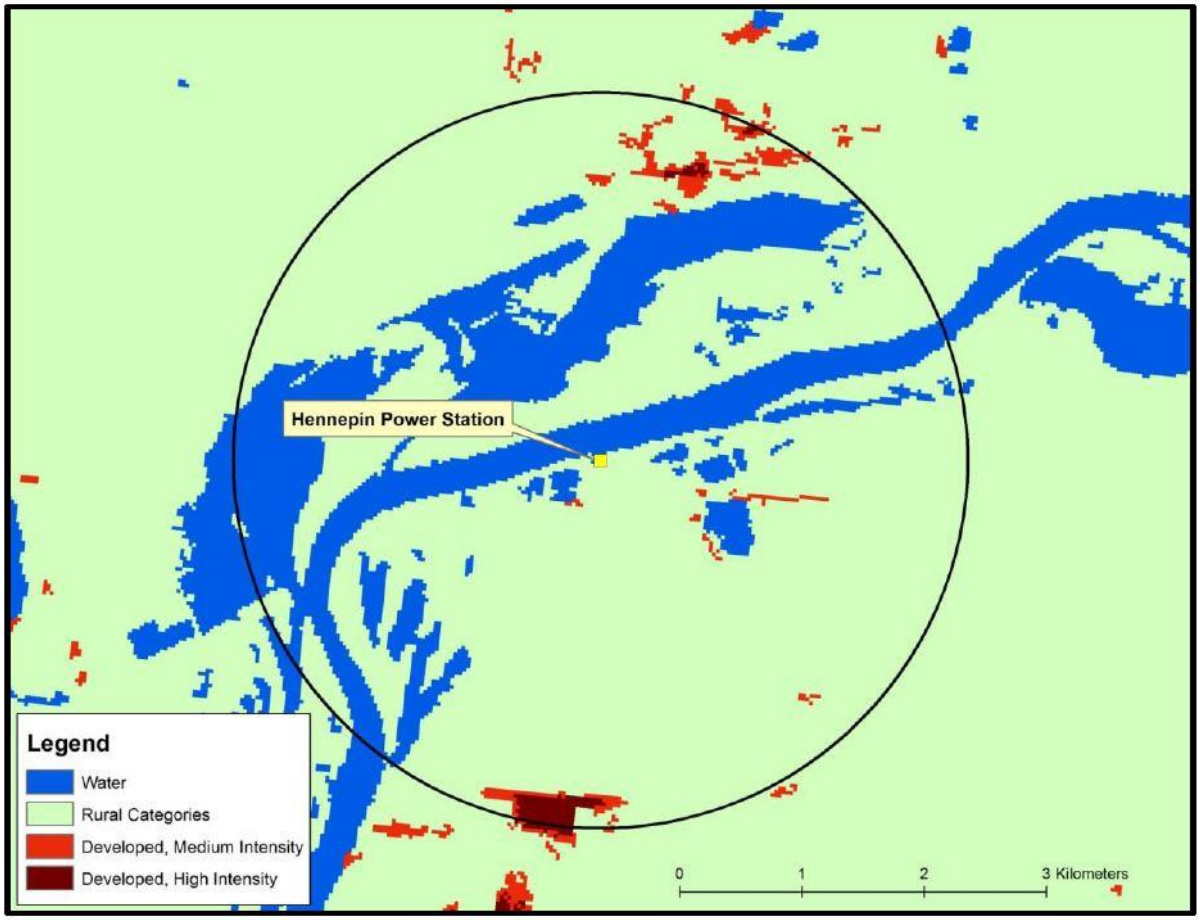


Table 14. Auer's Analysis Land Use Percentages by Category – Putnam/Bureau Counties Study Area

SO_2 NAA Modeling Auer's Analysis - NLCD 2011				Hennepin 3 km Ring		
NLCD Value	NLCD 2011 Description	Auer's Code	Auer's Class	Cell Count	Percentage	Totals
23	Developed, Medium Intensity	R2/R3	Urban	417	1.33%	1.86%
24	Developed, High Intensity	I1/I2/C1		166	0.53%	
11	Open Water	A5	Rural	7,222	23.01%	98.14%
21	Developed, Open Space	A1/R4		738	2.35%	
22	Developed, Low Intensity	R1		1,338	4.26%	
31	Barren Land (Rock/Sand/Clay)	A3		338	1.08%	
41	Deciduous Forest	A4		4,063	12.94%	
42	Evergreen Forest	A4		0	0.00%	
43	Mixed Forest	A4		0	0.00%	
52	Shrub/Scrub	A4		48	0.15%	
71	Grassland/Herbaceous	A3		1,797	5.72%	
81	Pasture/Hay	A3		141	0.45%	
82	Cultivated Crops	A2		8,861	28.23%	
90	Wood Wetlands	A4		5,302	16.89%	
95	Emergent Herbaceous Wetlands	A3		962	3.06%	
Analysis based on 30 meter by 30 meter raster cells extracted for each area.			*Grand Totals:*	*31,393*	*100.00%*	

Modeling Parameter: Area of Analysis (Receptor Grid)

A reasonable first step towards characterization of air quality in the area surrounding Hennepin is to determine the extent of the area of analysis, i.e., 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 of nearby sources; and sufficient receptor coverage and density to adequately capture and resolve the model predicted maximum SO_2 concentrations. For the Putnam/Bureau Counties area, the state has included three other emitters of SO_2 within 10 km of Hennepin in any direction. The state determined that, aside from exceptionally large sources, sources farther than 10 km from Hennepin would not cause significant concentration gradients in the Putnam/Bureau Counties area and therefore need not be modeled. In addition to Hennepin, the other emitters of SO_2 included in the area of analysis are: Washington Mills, Advanced Asphalt, and Marquis Energy. The state identified no sources beyond 10 km from Hennepin with sufficient emissions to warrant including in this analysis.

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

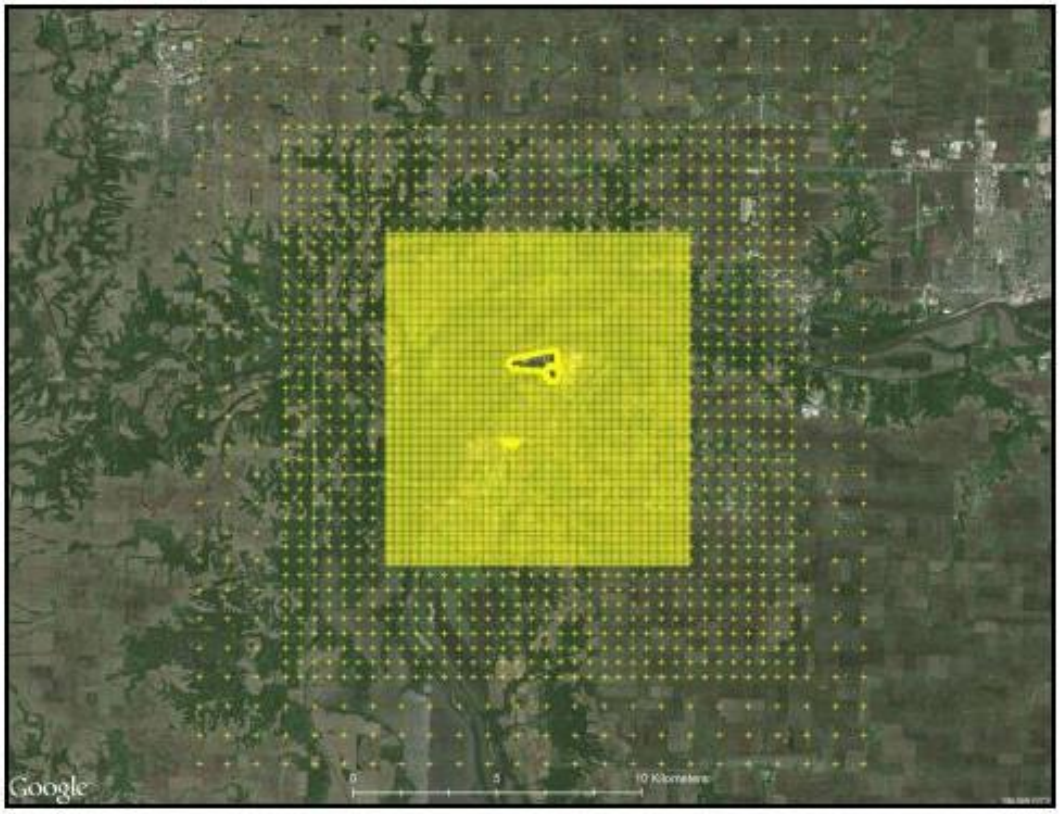
- 50 meters along the fenceline (four facilities)
- 100 meters from the fenceline out to a distance of approximately 4.0 kilometers
- 500 meters from 4.0 kilometers out to a distance of approximately 8.0 kilometers
- 1,000 meters from 8.0 kilometers out to a distance of approximately 11 kilometers

The receptor network contained 13,430 receptors, and the network covered the northern two-thirds of Putnam County and the southeast portion of Bureau County.

Figure 22, included in the state's recommendation, shows the state's receptor grid for the area.

For the purposes of this designation effort, the Modeling TAD states that the receptor grid need not include receptors in areas where it would not be feasible to place a monitor and record ambient air impacts, such as bodies of water. With the exception of receptor locations within plant fencelines, Illinois conservatively included the full grid of receptors, including some over the Illinois River.

Figure 22. Receptor Grid for the Putnam/Bureau Counties, Illinois Area of Analysis



Modeling Parameter: Source Characterization

The state characterized the sources within the area of analysis in accordance with the best practices outlined in the Modeling TAD. Specifically, the state used actual stack heights in conjunction with actual emissions. The state also adequately characterized the modeled sources' building layout and location, as well as the stack parameters, e.g., exit temperature, exit velocity, location, and diameter. The AERMOD component BPIPPRIME was used to assist in addressing building downwash.

Modeling Parameter: Emissions

EPA's Modeling TAD notes that for the purposes 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 does provide for the flexibility of

using allowable emissions in the form of a federally enforceable limit on the emissions rate (referred to as PTE or allowable emissions rate).

EPA believes that continuous emissions monitoring systems (CEMS) data provide acceptable historical emissions information, when it is available, and that these data are available for many electric generating units. In the absence of CEMS data, 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, EPA believes that detailed throughput, operating schedules, and emissions information from the impacted sources should be used.

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. Specifically, a facility may have recently adopted a new federally enforceable emissions limit, been subject to a federally enforceable consent decree, or implemented other federally enforceable mechanisms and control technologies to limit SO_2 emissions to a level that indicates compliance with the NAAQS. These new limits or conditions may be used in the application of AERMOD. In these cases, the Modeling TAD notes that the existing SO_2 emissions inventories used for permitting or SIP planning demonstrations should contain the necessary emissions information for designations-related modeling. 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 previously noted, the state included Hennepin and three other emitters of SO_2 within 10 km in the area of analysis, and the state concluded that no significant sources existed beyond 10 km from Hennepin that warranted inclusion. The facilities in the area of analysis and their associated annual actual SO_2 emissions between 2012 and 2014 are summarized below.

Table 15. Actual SO_2 Emissions in 2012 – 2014 from Facilities in the Putnam/Bureau Counties, Illinois Area of Analysis

Facility Name	SO_2 Emissions (tons per year)			Approximate Distance to Hennepin (km)
	2012	2013	2014	
Hennepin	5,911.25	4,274.35	3,965.36	N/A
Washington Mills	890.20	929.43	1,035.01	1.01
Advanced Asphalt	13.63	13.62	5.46	1.59
Marquis Energy	8.56	9.30	4.05	2.82
Total Emissions From All Facilities in the State's Area of Analysis	**6823.64**	**5226.70**	**5009.88**	

For Hennepin, the state used actual emissions from the most recent 3-year data set, i.e., 2012 – 2014. The state used CEMS SO_2 emissions data provided by Hennepin, along with hourly-specific exit temperature and exit velocity.

For Washington Mills, the state used company-provided hourly varying emissions, temperature, and exit velocities for the largest emitting furnace stack (99.9% of the facility emissions). For the two smaller emitting units, Washington Mills provided operating information that allowed the state to construct an hourly varying emissions rate coupled with constant temperature and exit velocity values.

For Advanced Asphalt, the state constructed an hourly profile based on company-provided seasonal throughput.

For Marquis Energy, the state used a combination of seasonal emissions factors (EMISFACT) and an hourly emissions profile.

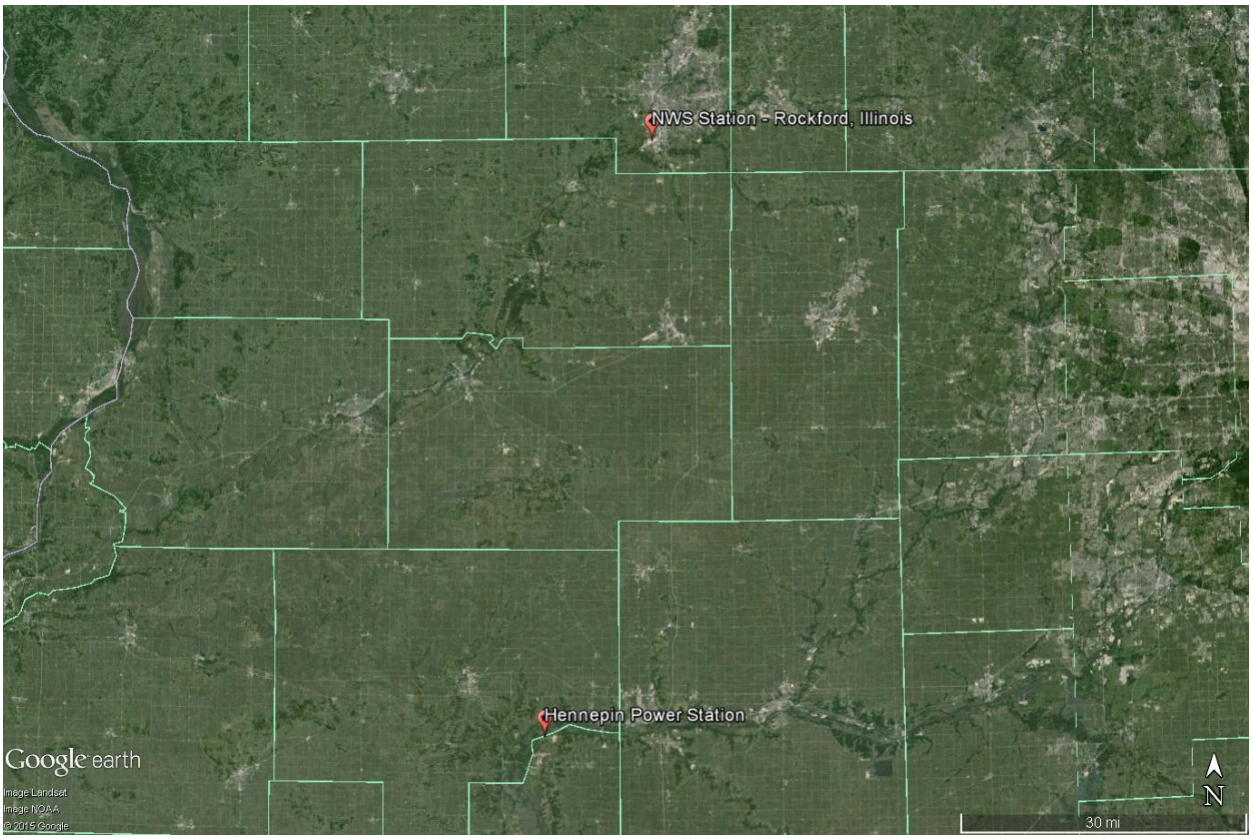
Modeling Parameter: Meteorology and Surface Characteristics

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

For the Putnam/Bureau Counties area of analysis, surface meteorology from the NWS station in Rockford, Illinois, 111 km to the north, and coincident upper air observations from the NWS station in Davenport, Iowa, 110 km to the northwest, were selected as best representative of meteorological conditions within the area of analysis.

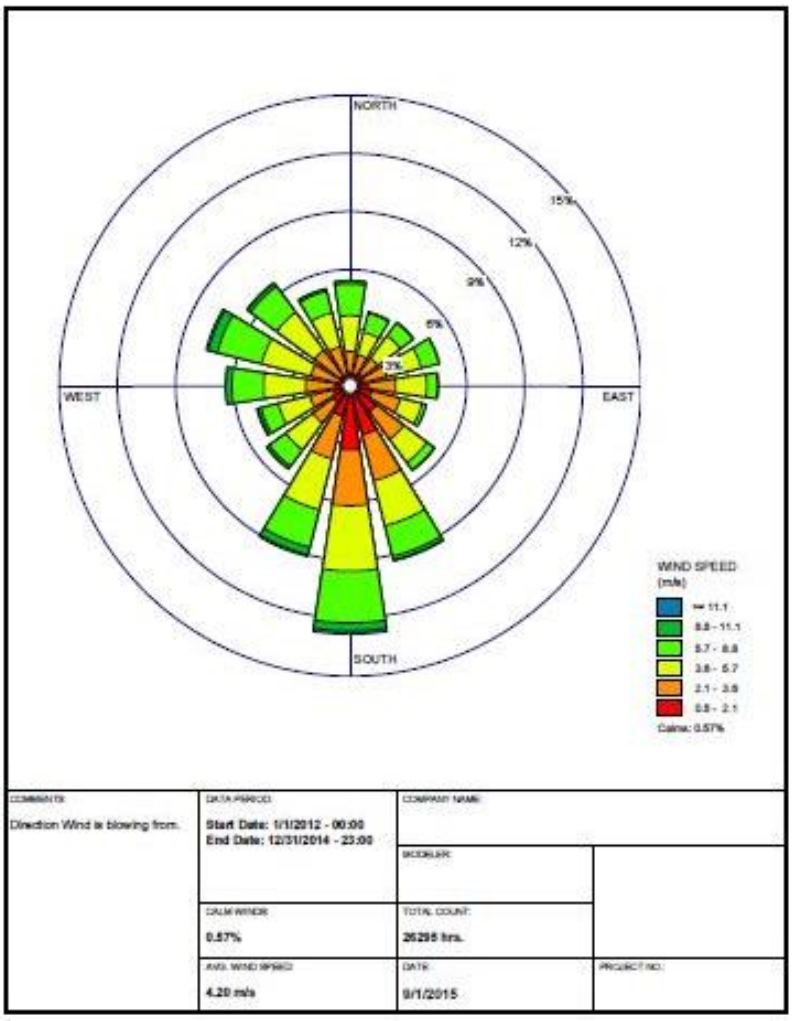
The state used AERSURFACE version 13016 using data from the NWS station in Rockford, Illinois located at (42.20 °N, 89.10 °W) to estimate the surface characteristics of the area of analysis. These surface characteristics are the albedo (the fraction of solar energy reflected from the earth back into space), the Bowen ratio (representing the ratio of sensible heat flux to latent heat flux at the ground level), and the surface roughness (representing the influence of ground features such as buildings and vegetation on surface wind flow). In the figure below, generated by EPA, the location of the Rockford, Illinois NWS station is shown relative to the Putnam/Bureau Counties area.

Figure 23. Putnam/Bureau Counties Area and the Rockford, Illinois NWS



As part of its recommendation, the state provided the 3-year surface wind rose for Rockford, Illinois. In Figure 24, the frequency and magnitude of wind speed and direction are defined in terms of from where the wind is blowing. The predominant wind direction during the three-year time period used in the modeling is from the south, occurring approximately 12.8% of the time. The highest percentage wind speed range, occurring 31.4% of the time, was in the 3.6 – 5.7 m/s range.

Figure 24. Rockford, Illinois Cumulative Annual Wind Rose for Years 2012 – 2014



Meteorological data from the above surface and upper air 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. The state followed the methodology and settings presented in the U.S. EPA's *User's Guide for the AERMOD Meteorological Preprocessor* (November 2004) 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 one minute duration was provided from the same instrument tower, 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 state set a minimum threshold of 0.5 meters per second in processing meteorological data for use in AERMOD. This approach is consistent with a March 2013 EPA memo titled, "Use of ASOS meteorological data in AERMOD dispersion Modeling." In setting this threshold, no wind speeds lower than this value would be used for determining concentrations. This threshold was specifically applied to the one minute wind data.

Modeling Parameter: Geography and Terrain

The terrain in the area of analysis is best described as flat to gently rolling. To account for these terrain changes, the AERMAP terrain program within AERMOD was used to specify terrain elevations for all the receptors. The source of the elevation data incorporated into the model is from the USGS National Elevation Database (NED).

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 "first tier" approach, based on monitored design values, or 2) a temporally varying approach, based on the 99th percentile monitored concentrations by hour of day and season or month. For the Putnam/Bureau Counties area of analysis, the state chose to use the latter. The background concentrations for this area of analysis ranged from 2 to 15 μg/m^3, or approximately 0.8 to 5.7 ppb.[6] AERMOD incorporated these hourly/seasonal values into the final results.

Summary of Modeling Results

The AERMOD modeling parameters for the Putnam/Bureau Counties area of analysis are summarized below in Table 16.

Table 16. AERMOD Modeling Parameters for the Putnam/Bureau Counties, Illinois Area of Analysis

Putnam/Bureau Counties, Illinois Area of Analysis	
AERMOD Version	15181
Dispersion Characteristics	Rural
Modeled Sources	4
Modeled Stacks	7
Modeled Structures	90
Modeled Fencelines	4
Total receptors	13,429
Emissions Type	Actual
Emissions Years	2012-2014

[6] The conversion factor for SO_2 (at the standard conditions applied in the ambient SO_2 reference method) is 1ppb = approximately 2.62μg/m^3.

Meteorology Years	2012-2014
Surface Meteorology Station	Rockford, Illinois
Upper Air Meteorology Station	Davenport, Iowa
Methodology for Calculating Background SO_2 Concentration	Temporally Varying
Calculated Background SO_2 Concentration	0.8 to 5.7 ppb

The results presented below in Table 17 show the magnitude and geographic location of the highest predicted modeled concentration based on actual emissions.

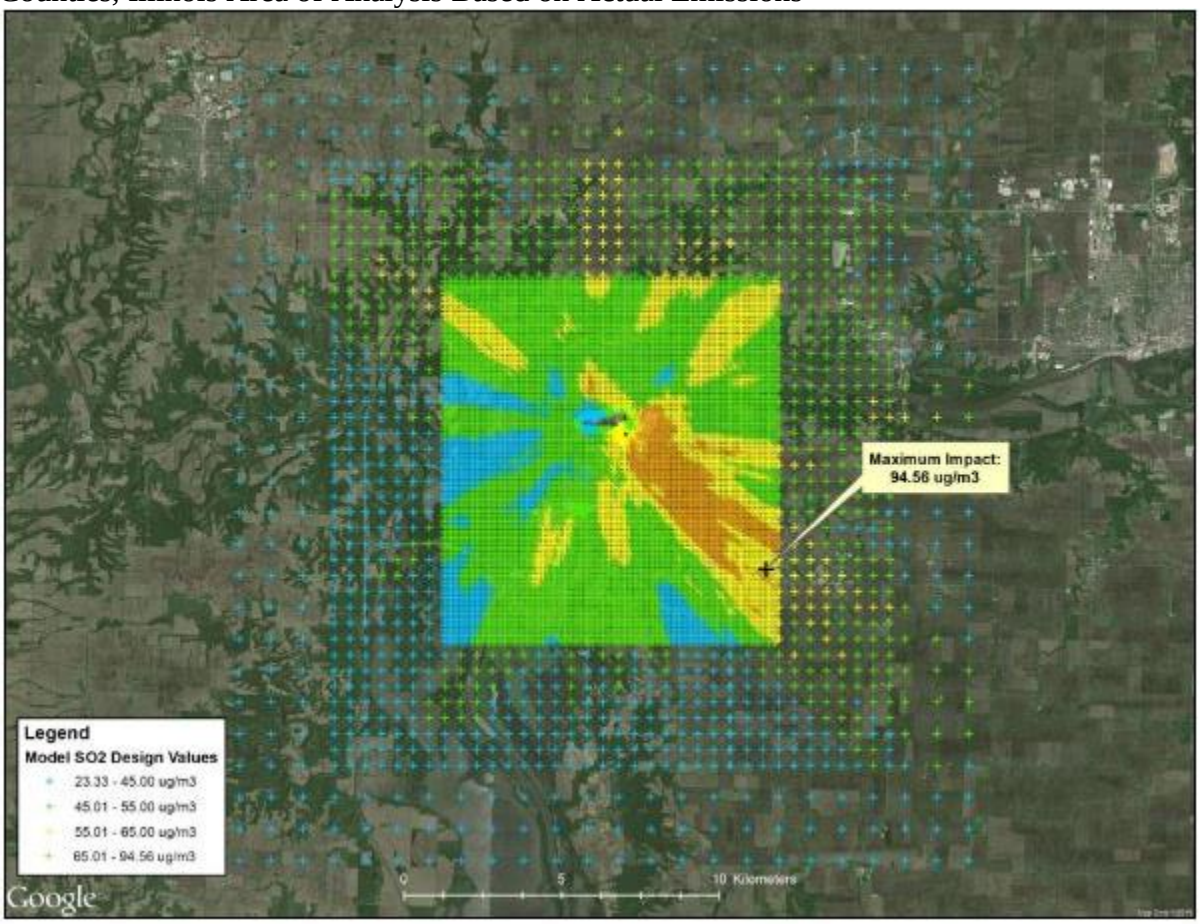
Table 17. Maximum Predicted 99th Percentile 1-Hour SO_2 Concentration in the Putnam/Bureau Counties Area Based on Actual Emissions

		Receptor Location		**SO_2 Concentration ($\mu g/m^3$)**	
Averaging Period	**Data Period**	**UTM/Latitude**	**UTM/Longitude**	**Modeled (including background)**	**NAAQS**
99th Percentile 1-Hour Average	2012-2014	311600	4570200	94.56	196.4*

*Equivalent to the 2010 SO_2 NAAQS set at 75 ppb

The state's modeling indicates that the predicted 99th percentile 1-hour average concentration within the chosen modeling domain is 94.56 $\mu g/m^3$, or 36.1 ppb. This modeled concentration included the background concentration of SO_2, and is based on actual emissions from the facilities. Figure 25 below was included as part of the state's recommendation, and indicates that the predicted value occurred within the dense 100-meter grid at an elevated location 7.2 km southeast of Hennepin. The state's receptor grid is also shown in the figure.

Figure 25. Maximum Predicted 99th Percentile 1-Hour SO_2 Concentrations in the Putnam/Bureau Counties, Illinois Area of Analysis Based on Actual Emissions



Jurisdictional Boundaries:

Once the geographic area of analysis associated with Hennepin, other nearby sources, and background concentrations are determined, existing jurisdictional boundaries are considered for the purpose of informing our intended unclassifiable/attainment area, specifically with respect to clearly defined legal boundaries. EPA believes that our intended unclassifiable/attainment area, consisting of Putnam and Bureau Counties, are comprised of clearly defined legal boundaries, and we find these boundaries to be a suitably clear basis for defining our intended unclassifiable/attainment area. Illinois' modeling demonstrated that Hennepin and the nearby SO_2 sources did not cause or contribute to violations in the modeled domain, which included the portions of Putnam and Bureau Counties likely to experience the highest concentrations in the area. EPA reviewed the SO_2 sources located in neighboring counties which were not included in Illinois' modeling analysis of the Hennepin, and determined that none are expected to contribute to violations of the 2010 SO_2 NAAQS in Putnam or Bureau Counties.

EPA has confirmed that there are no additional sources in Putnam or Bureau Counties or any adjacent county that would be likely candidates for future characterization under the DRR. Two facilities located in neighboring LaSalle County, Pilkington and Owens-Brockway, emit over 100 tpy, but are located over 20 km from the Putnam County line. An ambient air quality

monitor (AQS ID 170-99-0007) located between these facilities and the county line recorded a 2012 – 2014 design value of 8 ppb, which suggests that the impact of these facilities in Putnam County is even smaller. Therefore, EPA does not believe that these sources cause or contribute to a violation of the NAAQS in Putnam County.

Sterling Steel, located approximately 20 km from the Bureau County border in neighboring Whiteside County, emitted 208 tpy of SO_2 according to the 2011 NEI. Based on these levels of emissions in conjunction with the distance from the county border, EPA does not believe that emissions from Sterling Steel cause or contribute to a violation of the NAAQS in Bureau County.

Additional sources of SO_2 emitting above 100 tpy are all over 50 km from the Putnam and Bureau County borders. As a result, EPA does not believe that they cause or contribute to a violation of the NAAQS in either county. The consent decree directs EPA to designate the area around Hennepin, which may be confined to the county where the facility is located, i.e., Putnam County. In this case, however, the source is on the border between two counties, and the information provided by Illinois and confirmed by EPA equally addresses air quality in Putnam and Bureau Counties. Therefore, EPA intends to follow Illinois' recommendation to include both counties in the unclassifiable/attainment area.

Other Relevant Information

There was no additional relevant information submitted for Hennepin or Putnam or Bureau Counties.

Conclusion

After careful evaluation of the state's recommendation and supporting information, as well as all available relevant information, EPA intends to designate the area around Hennepin as unclassifiable/attainment for the 2010 SO_2 NAAQS. Specifically, the boundaries are comprised of the Putnam and Bureau County lines.

At this time, our intended designations for the state only apply to this area and the other areas presented in this technical support document. Consistent with the conditions in the March 2, 2015 court-ordered schedule, EPA will evaluate and designate all remaining undesignated areas in Illinois by either December 31, 2017, or December 31, 2020.

Technical Analysis for the Williamson County, Illinois Area

Introduction

Williamson County contains a stationary source that according to EPA's Air Markets Database emitted in 2012 either more than 16,000 tons of SO_2 or more than 2,600 tons of SO_2 and had an annual average emission rate of at least 0.45 pounds of SO_2 per one million British thermal units (lbs SO_2/MMBTU). As of March 2, 2015, this stationary source had not met the specific requirements for being "announced for retirement." Specifically, in 2012, the Marion Power Station ("Marion") emitted 5,850 tons of SO_2, and had an emissions rate of 0.489 lbs SO_2/MMBTU. Pursuant to the March 2, 2015 court-ordered schedule, EPA must designate the area surrounding the facility by July 2, 2016.

In its submission, Illinois recommended that the area surrounding Marion, specifically the entirety of Williamson County, be designated as attainment based on an assessment and characterization of air quality from the facility and other nearby sources which may have a potential impact in the area of analysis where maximum concentrations of SO_2 are expected. This assessment and characterization was performed using air dispersion modeling software, i.e., AERMOD, analyzing an emissions rate described as the "maximum actual emissions expected" from this plant. After careful review of the state's assessment, supporting documentation, and all available data, EPA disagrees with the state's recommendation. As discussed below, Illinois modeled Marion as emitting 5,512 tons per year, but this emission rate cannot be characterized as reflecting either actual emissions or allowable emissions. In this respect, Illinois' modeling is contrary to the recommendations of the Modeling TAD. Illinois provided no justification for using this emission rate, and EPA is finding that the state's modeling does not support an attainment or an unclassifiable/attainment designation for this area.

In contrast, Sierra Club provided modeling that relied on actual emissions data for 2012 to 2014, consistent with an approach recommended in the Modeling TAD. While this modeling addresses some modeling inputs in a less reliable fashion than Illinois, EPA finds overall, especially considering the superior treatment of emissions, that Sierra Club's modeling provides a more reliable assessment of whether the area near Marion is meeting the SO_2 NAAQS. Sierra Club estimated a maximum concentration in Williamson County of 110.3 ppb.

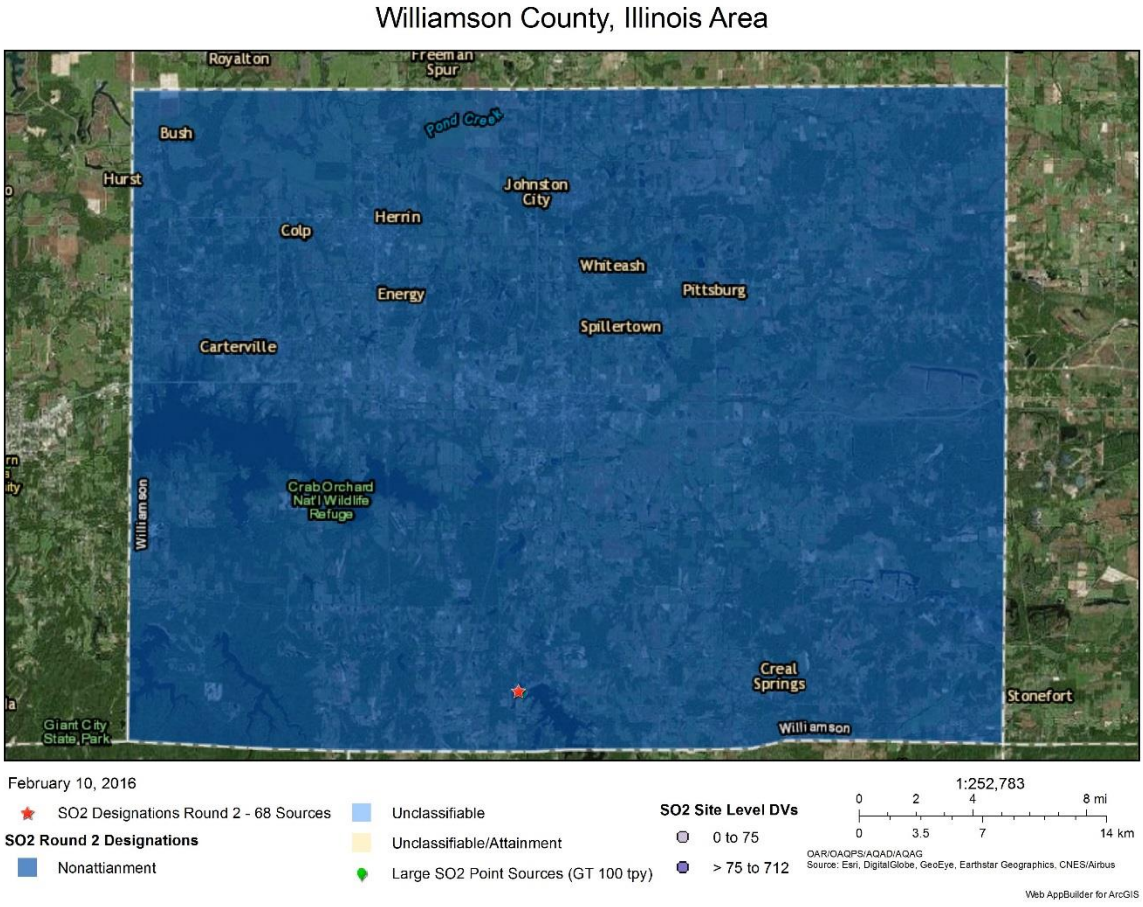
For 2012 to 2014, emissions of SO_2 from Marion averaged 7,620 tons per year, approximately 38 percent higher than the emission rate Illinois modeled. As a result, the results that Illinois obtained using an SO_2 emission rate of 5,512 tons per year, finding a maximum estimated concentration of 74.3 ppb, suggests that modeling using actual emissions would also have shown a violation of the SO_2 NAAQS. Consequently, based on Sierra Club's modeling, with supplemental evidence from Illinois' modeling, EPA concludes that the Williamson County area is violating the SO_2 NAAQS.

Although Marion is only 1.5 km from the border of Williamson County with Johnson County, Sierra Club's modeling using actual emissions indicates that violations are occurring only in Williamson County. Given the uncertainties in the available evidence, EPA is not attempting to

determine whether portions of Williamson County might warrant being designated unclassifiable/attainment. Therefore, EPA's current intent is to designate the entirety of Williamson County as nonattainment.

Marion is located in southern Illinois in southern Williamson County, in a rural area adjacent to the Lake of Egypt on the east. As seen in Figure 26 below, the facility is located approximately 11 km south-southwest of the center of Marion. Also included in the figure are nearby emitters of SO_2, the state's recommended attainment area, and EPA's intended nonattainment area.

Figure 26. EPA's intended designation for Williamson County, Illinois



The discussion and analysis that follows below will reference the state's use of the Modeling TAD, EPA's assessment of the state's modeling in accordance with the Modeling TAD, and the factors for evaluation contained in EPA's March 20, 2015 guidance, as appropriate.

Detailed Assessment

Model Selection and Modeling Components

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. In some instances the recommended model may be a model other than AERMOD, such as the BLP model for buoyant line sources. 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
- BPIPPRIME: 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 state used AERMOD version 15181, the most recent version, and a discussion of the individual components will be referenced in the corresponding discussion that follows, as appropriate.

Modeling Parameter: Rural or Urban Dispersion

EPA's recommended procedure for characterizing an area by prevalent land use is based on evaluating the dispersion environment with 3 km of the facility. According to EPA's modeling guidelines, rural dispersion coefficients are to be used in the dispersion modeling analysis if more than 50% of the area within a 3 km radius of the facility is classified as rural. Conversely, if more than 50% of the area is urban, urban dispersion coefficients should be used in the modeling analysis. The state performed an Auer's analysis for the Marion study area in order to determine which mode was appropriate for the modeling. The analysis indicated that the study area is approximately 98.5% rural and 1.5% urban, showing that the rural option applied to all emission sources in the modeling domain. Figure 27 and Table 18 below show the results of the state's Auer's analysis.

Figure 27. Auer's Analysis – Area Near Marion

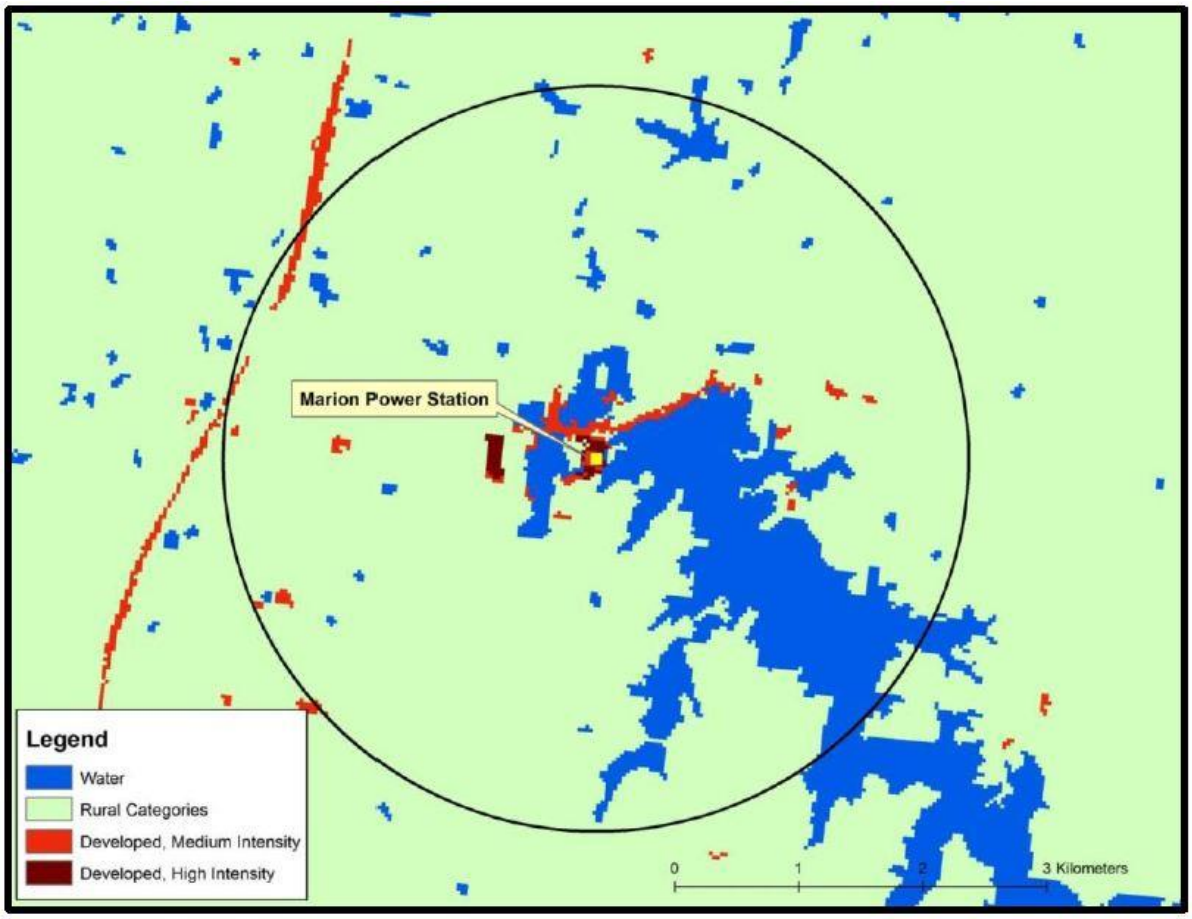


Table 18. Auer's Analysis Land Use Percentages by Category – Williamson County Study Area

SO_2 NAA Modeling Auer's Analysis - NLCD 2011				Marion 3 km Ring		
NLCD Value	NLCD 2011 Description	Auer's Code	Auer's Class	Cell Count	Percentage	Totals
23	Developed, Medium Intensity	R2/R3	Urban	388	1.24%	1.54%
24	Developed, High Intensity	I1/I2/C1		96	0.31%	
11	Open Water	A5		4,735	15.08%	
21	Developed, Open Space	A1/R4		1,684	5.36%	
22	Developed, Low Intensity	R1		2,549	8.12%	
31	Barren Land (Rock/Sand/Clay)	A3		57	0.18%	
41	Deciduous Forest	A4		10,349	32.95%	
42	Evergreen Forest	A4		562	1.79%	
43	Mixed Forest	A4	Rural	0	0.00%	98.46%
52	Shrub/Scrub	A4		0	0.00%	
71	Grassland/Herbaceous	A3		254	0.81%	
81	Pasture/Hay	A3		9,744	31.02%	
82	Cultivated Crops	A2		991	3.16%	
90	Wood Wetlands	A4		0	0.00%	
95	Emergent Herbaceous Wetlands	A3		0	0.00%	
Analysis based on 30 meter by 30 meter raster cells extracted for each area.			*Grand Totals:*	*31,409*	*100.00%*	

Modeling Parameter: Area of Analysis (Receptor Grid)

A reasonable first step towards characterization of air quality in the area surrounding Marion is to determine the extent of the area of analysis, i.e., 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 of nearby sources; and sufficient receptor coverage and density to adequately capture and resolve the model predicted maximum SO_2 concentrations. The state determined that, aside from exceptionally large sources, sources farther than 10 km from Marion would not cause significant concentration gradients in the Williamson County area and therefore need not be modeled. For the Williamson County area, the state identified one other significant emitter of SO_2 within 10 km of Marion in any direction, and the state identified no significant emitter of SO_2 beyond 10 km that warranted inclusion in the analysis. In addition to Marion, the other emitter of SO_2 included in the area of analysis is the United States Penitentiary.

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

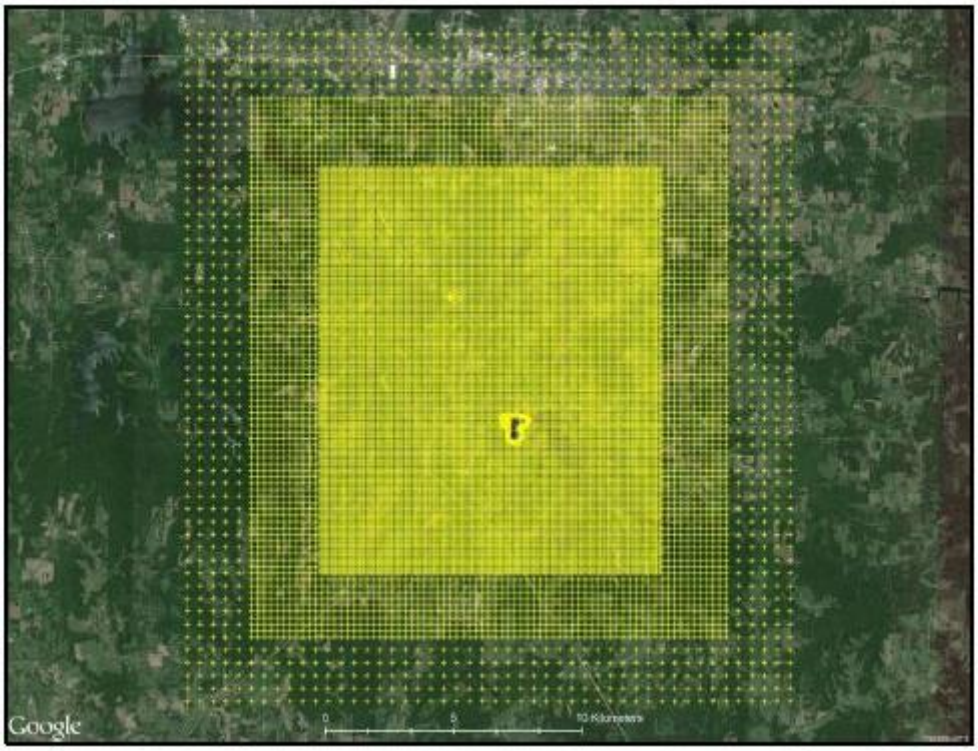
- 50 meters along the fenceline (two facilities)
- 100 meters from the fenceline out to approximately 5.0 kilometers
- 500 meters from 5.0 kilometers out to approximately 8.0 kilometers
- 1,000 meters from 8.0 kilometers out to approximately 10 kilometers

The receptor network contained 25,118 receptors, and the network covered central and south-central Williamson County, the northeast corner of Union County, and the northwest and north-central part of Johnson County.

Figure 28, included in the state's recommendation, shows the state's chosen receptor grid for the area.

For the purposes of this designation effort, the Modeling TAD states that the receptor grid need not include receptors in areas where it would not be feasible to place a monitor and record ambient air impacts, such as bodies of water. With the exception of receptor locations within plant fencelines, Illinois conservatively included the full grid of receptors, including some over the Lake of Egypt and other nearby bodies of water.

Figure 28. Receptor Grid for the Williamson County, Illinois Area of Analysis



Modeling Parameter: Source Characterization

The state characterized the physical plant of Marion in accordance with the best practices outlined in the Modeling TAD. Specifically, the state used actual stack heights. The state also adequately characterized the building layout and location for the modeled sources, as well as the stack parameters, e.g., exit temperature, exit velocity, location, and diameter. The AERMOD component BPIPPRIME was used to assist in addressing building downwash.

Modeling Parameter: Emissions

EPA's Modeling TAD notes that for the purposes 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 does provide for the flexibility of using allowable emissions in the form of a federally enforceable limit on the emissions rate (referred to as PTE or allowable emissions rate).

EPA believes that continuous emissions monitoring systems (CEMS) data provide acceptable historical emissions information, when it is available, and that these data are available for many electric generating units. In the absence of CEMS data, 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, EPA believes that detailed throughput, operating schedules, and emissions information from the impacted sources should be used.

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. Specifically, a facility may have recently adopted a new federally enforceable emissions limit, been subject to a federally enforceable consent decree, or implemented other federally enforceable mechanisms and control technologies to limit SO_2 emissions to a level that indicates compliance with the NAAQS. These new limits or conditions may be used in the application of AERMOD. In these cases, the Modeling TAD notes that the existing SO_2 emissions inventories used for permitting or SIP planning demonstrations should contain the necessary emissions information for designations-related modeling. 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 previously noted, the state included Marion and one other emitter of SO_2 within 10 km in the area of analysis, namely the U.S. Penitentiary. No other sources within or beyond 10 km were determined by the state to have the potential to cause significant concentration gradient impacts within the area of analysis.

Illinois modeled fixed emission rates for the two facilities in this area. Illinois' submittal states, "The four Marion Power Station stacks were modeled at maximum actuals expected from the source." Specifically, Illinois modeled this facility as having a fixed emission rate of 5,512 tons per year in each of 2012, 2013, and 2014.

However, the actual emission rates that the facility reported to the CAMD database are substantially higher than those that Illinois modeled. The reported emission rates are shown in Table 19 below. Based on these data, for 2012 to 2014, average actual emissions were 7,620 tons per year, or approximately 38 percent higher than the emissions modeled by Illinois.

Illinois provides no discussion of this discrepancy. Illinois provides no discussion of the derivation of the particular emission rate that it modeled, and Illinois provides no rationale for modeling an emission rate lower than the recent emission rates at the facility. That is, while Illinois states that it modeled Marion at the maximum actual emission rate expected for the facility, Illinois identified no reason for EPA to believe that this facility can be expected to emit so much less than it emitted in 2012-2014. Normally, "maximum actual emissions" would mean the maximum emission rate that has actually occurred in the recent past. "Allowable emissions" would mean the maximum emission rate that would be allowed for the facility, which to be creditable for consideration in this designations process would need to meet relevant criteria, in particular being federally enforceable and requiring compliance adequately in advance of EPA's promulgation of the designation to quality as representing current air quality as of the time of the designation. Illinois has provided no information to indicate that its modeled emission rate for Marion corresponds to either of these means of determining an emission rate to model. In short, Illinois has provided no justification for determining the designation for the Williamson County area on the basis of an emission rate that is substantially below recent actual emission rates.

For the other source in the Williamson County area that Illinois modeled, namely the U.S. Penitentiary, Illinois states that in absence of data to indicate the temporal variability of this facility's emissions, "the conservative worst-case year emissions were applied to each year and

spread uniformly throughout every hour." The emission rate for this facility in the 2011 NEI is 0.02 tons per year, well below the 0.18 tons per year that Illinois modeled, so this emission rate indeed appears to provide a suitable, conservative assessment of this facility's impact.

Table 19 shows actual emission rates for 2012 to 2014 along with the emission rates modeled by Illinois. For Marion, the actual emission rates reflect data reported to CAMD. Although annual emissions rates for the U.S. Penitentiary were not reported by Illinois and are not otherwise available, the emission rate modeled by Illinois appears conservative as compared to the emission rate included in the 2011 NEI.

Table 19. Actual SO_2 Emissions between 2012 – 2014 from Facilities in the Williamson County, Illinois Area, Compared to the Emissions Illinois Modeled

Facility Name	Actual SO_2 Emissions (tons per year)			Emission Rate Illinois Modeled	Approximate Distance to Marion (km)
	2012	2013	2014		
Marion (SIPCO)	5850	8357	8652	5512.11	N/A
United States Penitentiary	N/A	N/A	N/A	0.18	5.57
Total Emissions From All Facilities in the State's Area of Analysis	**5850**	**8357**	**8652**	**5512.29**	

Modeling Parameter: Meteorology and Surface Characteristics

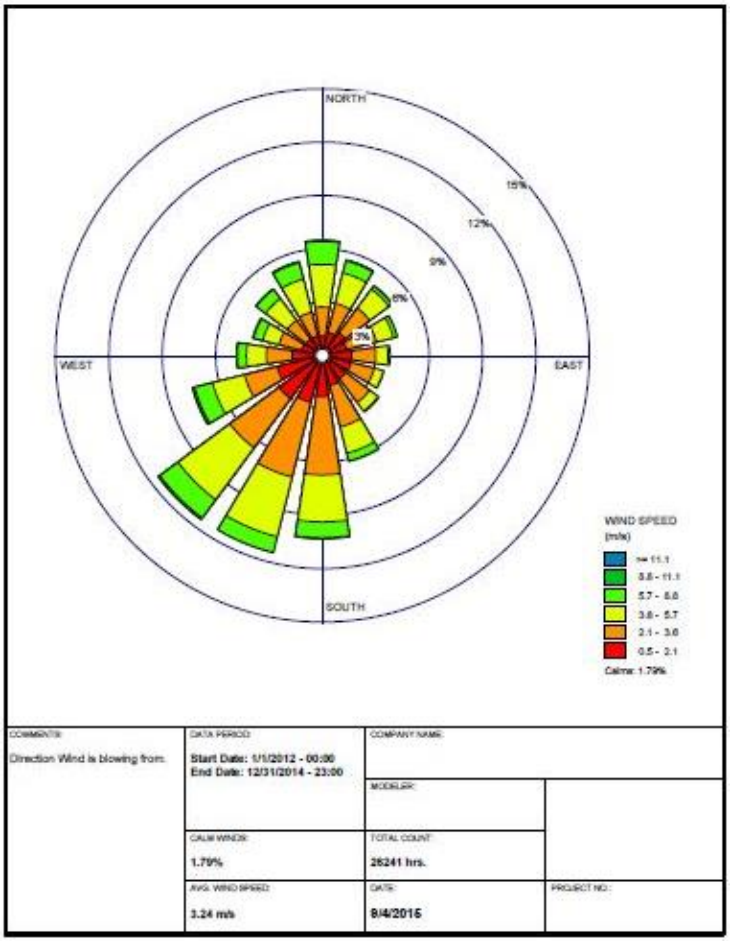
The most recent 3 years of meteorological data (concurrent with the most recent 3 years of emissions data) should be used in designations efforts. As noted in the Modeling TAD, the selection of data should be based on spatial and climatological (temporal) representativeness. The representativeness of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

For the Williamson County area, surface meteorology from the NWS station in Paducah, Kentucky, 64km to the southeast, and coincident upper air observations from the NWS station in Nashville, Tennessee, 260 km to the southeast were selected as best representative of meteorological conditions within the area of analysis.

The state used AERSURFACE version 13016 using data from the NWS station in Paducah, Kentucky located at (37.05822 °N, 88.77251 °W) to estimate the surface characteristics of the area of analysis. These surface characteristics are the albedo (the fraction of solar energy reflected from the earth back into space), the Bowen ratio (representing the ratio of sensible heat flux to latent heat flux at the ground level), and the surface roughness (representing the influence of ground features such as buildings and vegetation on surface wind flow).

As part of its recommendation, the state provided the 3-year surface wind rose for Paducah, Kentucky. In Figure 29, the frequency and magnitude of wind speed and direction are defined in terms of from where the wind is blowing. The predominant wind direction during the three-year time period used in the modeling is from the southwest, occurring approximately 11.4% of the time. The highest percentage wind speed range, occurring 32.9% of the time, was in the 2.1 – 3.6 m/s range.

Figure 29. Paducah, Kentucky Cumulative Annual Wind Rose for Years 2012 – 2014



Meteorological data from the above surface and upper air 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. The state followed the methodology and settings presented in the U.S. EPA's *User's Guide for the AERMOD Meteorological Preprocessor* (November 2004) 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 one minute duration was provided from the same instrument tower, 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 state set a minimum threshold of 0.5 meters per second in processing meteorological data for use in AERMOD. This approach is consistent with a March 2013 EPA memo titled, "Use of ASOS meteorological data in AERMOD dispersion Modeling." In setting this threshold, no wind speeds lower than this value would be used for determining concentrations. This threshold was specifically applied to the one minute wind data.

Modeling Parameter: Geography and Terrain

The terrain in the area of analysis is best described as complex to gently rolling (south to north). To account for these terrain changes, the AERMAP terrain program within AERMOD was used to specify terrain elevations for all the receptors. The source of the elevation data incorporated into the model is from the USGS National Elevation Database (NED).

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 "first tier" approach, based on monitored design values, or 2) a temporally varying approach, based on the 99th percentile monitored concentrations by hour of day and season or month. For the Williamson County area of analysis, the state chose to use the latter. The background concentrations for this area of analysis ranged from 3.6 to 32.8μg/m^3, or 1.4 to 12.5 ppb.[7] AERMOD incorporated these hourly/seasonal values into the final results.

Summary of Modeling Results

Illinois' AERMOD modeling parameters for the Williamson County area of analysis are summarized below in Table 20.

Table 20. AERMOD Modeling Parameters for the Williamson County, Illinois Area of Analysis

Williamson County, Illinois Area of Analysis	
AERMOD Version	15181
Dispersion Characteristics	Rural
Modeled Sources	2

[7] The conversion factor for SO_2 (at the standard conditions applied in the ambient SO_2 reference method) is 1ppb = approximately 2.62μg/m^3.

Modeled Stacks	8
Modeled Structures	37
Modeled Fencelines	2
Total receptors	25,118
Emissions Type	Not explained
Emissions Years	Unspecified
Meteorology Years	2012-2014
Surface Meteorology Station	Paducah, Kentucky
Upper Air Meteorology Station	Nashville, Tennessee
Methodology for Calculating Background SO_2 Concentration	Temporally Varying
Calculated Background SO_2 Concentration	1.4 to 12.5 ppb

The results presented below in Table 21 show the magnitude and geographic location of the highest predicted modeled concentration based on PTE emissions.

Table 21. Maximum Predicted 99th Percentile 1-Hour SO_2 Concentration in the Williamson County, Illinois Area Based on Illinois' Modeled Emissions

		Receptor Location		**SO_2 Concentration ($\mu g/m^3$)**	
Averaging Period	**Data Period**	**UTM/Latitude**	**UTM/Longitude**	**Modeled (including background)**	**NAAQS**
99th Percentile 1-Hour Average	2012-2014	327200	4166200	194.48	196.4*

*Equivalent to the 2010 SO_2 NAAQS set at 75 ppb

The state's modeling indicates that the predicted 99th percentile 1-hour average concentration within the chosen modeling domain is 194.48 $\mu g/m^3$, or 74.3 ppb. This modeled concentration included the background concentration of SO_2, and is based on emission values that, particularly for Marion, have not been justified to be an appropriate basis for designation of this area. Figure 30 below was included as part of the state's recommendation, and indicates that Illinois' predicted value occurred within the dense 100-meter grid 1.2 km north-northwest of Marion. The state's receptor grid is also shown in the figure.

As discussed above, a more appropriate basis for determining the designation for this area would be a modeling analysis that reflects actual emissions from Marion, which as discussed above averaged approximately 38 percent higher than the emission rate that Illinois modeled. A full modeling analysis would be necessary to determine precisely the air quality that would be estimated based on actual 2012 to 2014 emissions from this facility. Nevertheless, since Marion is the dominant source in the area, and insofar as impacts of this source may be assumed to be

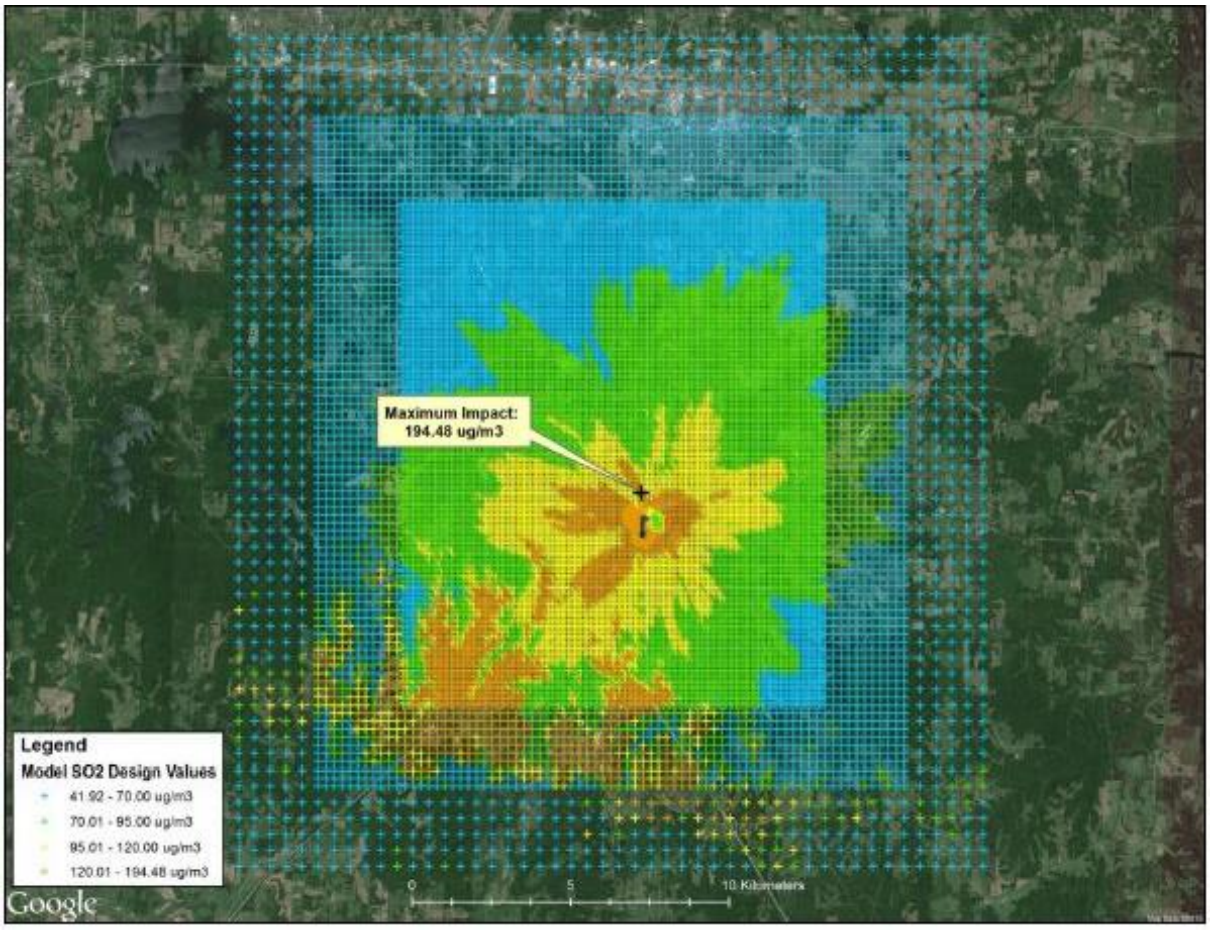
proportionate to emission levels[8], Illinois' modeling provides strong evidence that modeling using actual emissions that average approximately 38 percent higher than the emission rate Illinois modeled would estimate concentrations well over the SO_2 NAAQS.

There are no other sources within Williamson County that emit over 100 tpy of SO_2, but there are two sources with emissions above 100 tpy in neighboring counties. In Jackson County, Southern Illinois University is listed in the 2011 NEI as emitting 746 tons per year and is approximately 5.5 km to the west of the Williamson County border. This facility has not been listed for future characterization under the DRR. When considered with the distance from the county border, EPA finds it unlikely that this facility is causing or contributing to a violation of the NAAQS in Williamson County. (For comparison purposes, Illinois estimated the maximum modeled impact from Marion to be 1.2 km from the facility.) Similarly, in Union County, Clyde Choate Mental Health Center is listed in the 2011 NEI as emitting 740 tons per year and is approximately 16 km to the southwest of the Williamson County border. This facility also has not been listed for future characterization under the DRR, and is also sufficiently distant from the Williamson County border that EPA believes that it also is unlikely to cause or contribute to a violation of the NAAQS within Williamson County.

As discussed elsewhere in this document, the Joppa Power Plant is 43 km south of the Williamson County border, and the area surrounding the facility has been found to be attaining the standard. Therefore, EPA does not believe that any of these sources cause or contribute to a violation of the 2010 SO_2 NAAQS in Williamson County. Figure 30 shows Illinois' modeling results, reflecting an emission rate for Marion that is inconsistent with recommendations in the Modeling TAD.

[8] The difference in concentrations estimated by modeling actual emissions versus concentrations estimated by modeling a fixed 5,512 tons per year rate would depend on how emissions on the critical days compare to a 5,512 tons per year emission rate. Nevertheless, the difference between the emission rate that Illinois modeled (5,512 tons per year) and the average 2012-2014 emission rate (7,620 tons per year, on average 38 percent higher) provides an approximation of the likely difference in estimated concentrations that use of actual emissions would be expected to yield.

Figure 30. Maximum Predicted 99th Percentile 1-Hour SO_2 Concentrations in the Marion, Illinois Area of Analysis Based on Inappropriate Emission Rates



Other Relevant Information

The Sierra Club submitted a modeling analysis to EPA for the Marion concluding that it was contributing to modeled violations. The Sierra Club's analysis used actual Air Markets Database emissions for Marion. This modeling analysis used AERMOD. Sierra Club modeled both actual and allowable emissions for Marion. Because the analysis using actual emissions more accurately represents current air quality, EPA considers that analysis to be a more appropriate basis for determining the designation of this area.

Sierra Club modeling used surface meteorological data from the NWS station at the Paducah Barkley Regional Airport and upper air data from the Nashville, Tennessee upper air station, which are the same data that Illinois used. Sierra Club used AERSURFACE output files provided by Illinois EPA. Sierra Club used the following Cartesian grid of receptors:

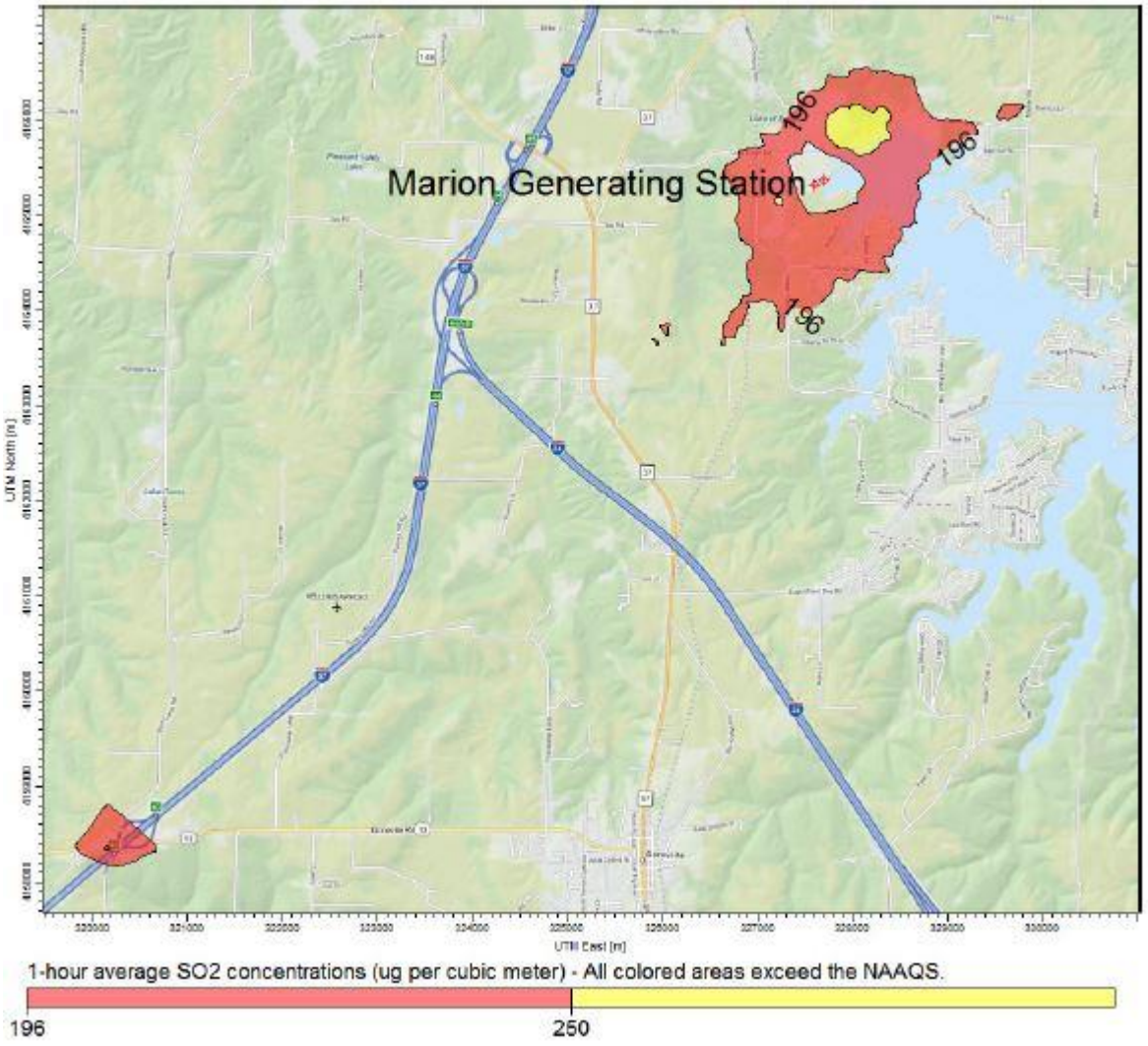
- Receptors every 100 meters from Marion out to 5 km from Marion,
- Receptors every 500 meters from 5 to 10 km, and
- Receptors every 1,000 meters from 10 km to 50 km

"A flagpole height of 1.5 meters was used for all these receptors." No building downwash was considered. Background concentrations were based on the design value from a monitor in

LaSalle, Illinois, which Sierra Club identifies as the lowest design value in Illinois for 2011 to 2013. Sierra Club modeled emissions from both Marion and Joppa (43 km south-southeast of Marion).

From this modeling, Sierra Club estimated a maximum concentration (based on actual emissions) in the Williamson County area of 288.9 µg/m^3, or 110.3 ppb. A map of these results is shown in Figure 31. Significantly, although Marion is only 1.5 km from the border of Williamson County with Johnson County, these Sierra Club modeling results indicate that violations are occurring only in Williamson County.

Figure 31. Sierra Club modeling results near Marion using actual emissions



Illinois has identified concerns with Sierra Club's modeling. Illinois considers its background value, derived from a monitor in Randolph County (with exclusions for hours with potentially significant impacts from nearby sources), and reflecting hour-of-day and seasonal variability, to be more representative than a fixed value obtained from a monitor much further from Marion.

Illinois expressed concern that Sierra Club used receptors 1.5 meters above ground, contrary to the recommendation of the Modeling TAD. Illinois noted that Sierra Club's modeling used fixed stack parameters (flow rates and exit temperatures), whereas Illinois used hourly actual values.

Although a complete evaluation of the significance of these differences would require a full modeling analysis, which was not provided to EPA, EPA considered the likely significance of these differences. Compared to Sierra Club's background concentration of 8.0 ppb, Illinois used background concentrations ranging from 1.4 to 12.5 ppb, with an average value of 4.5 ppb. Use of "flagpole height" receptors is not prone to affect concentrations substantially. Use of hourly varying stack parameters can yield a significant impact on estimated concentrations.

Nevertheless, the most critical difference between Illinois' modeling and Sierra Club's modeling is the fact that the Sierra Club modeled actual emissions, consistent with the recommendations in the Modeling TAD, whereas Illinois used a substantially lower emission rate with no evident relationship to either actual or allowable emission rates and no justification for its use. If one approximates the results that Illinois might have obtained by scaling the state's results according to the degree by which Illinois understated recent average emissions, these results would be expected to be similar to the results obtained by the Sierra Club. Thus, while in other respects EPA finds Illinois' modeling to be more reliable, the most important difference between the two analyses appears to be the emission rates used, in particular that the Sierra Club used emission rates consistent with the recommendations of the Modeling TAD and Illinois did not.

Sierra Club modeling shows that the Joppa plant, in Massac County, located 43 km to the south of Marion, has minimal impact on violations in Williamson County. Therefore, this analysis supports a conclusion that Joppa should be considered not to be a nearby contributor to the violations in Williamson County and should therefore not be included in the nonattainment area.

Jurisdictional Boundaries:

Once the nature of the designation of the Williamson County area is determined, and once EPA has reviewed other considerations as to the spatial extent of over which air quality is known and over which other nearby sources are located, existing jurisdictional boundaries are considered for the purpose of informing our intended area to be designated, specifically to assure that the area is defined using clearly defined legal boundaries. EPA believes that our intended nonattainment area, consisting of Williamson County, is comprised of clearly defined legal boundaries, and we find these boundaries to be a suitably clear basis for defining our intended nonattainment area. This is the same area that Illinois recommended be designated attainment. Although the available evidence suggests that portions of the county are attaining the SO_2 NAAQS, EPA did not attempt to define a subcounty area to differentiate what portion of Williamson County is and is not violating the SO_2 NAAQS.

Conclusion

After careful evaluation of the state's recommendation and supporting information, as well as all available relevant information, EPA intends to designate the area around Marion as nonattainment for the 2010 SO_2 NAAQS. Specifically, the boundaries are comprised of the Williamson County boundary lines.

At this time, our intended designations for the state only apply to this area and the other areas presented in this technical support document. Consistent with the conditions in the March 2, 2015 court-ordered schedule, EPA will evaluate and designate all remaining undesignated areas in Illinois by either December 31, 2017, or December 31, 2020.