Technical Support Document
Oklahoma
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) 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.

Oklahoma submitted updated recommendations on August 17, 2015, ahead of a July 2, 2016, deadline for the 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 the EPA to complete area designations for the 2010 SO_2 NAAQS. Table 1 below lists Oklahoma's recommendations and identifies the counties or portions of counties in Oklahoma that the 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: Oklahoma Recommendations and the EPA's Intended Designations

Area	Oklahoma's Recommended Area Definition	Oklahoma's Recommended Designation	EPA's Intended Area Definition	EPA's Intended Designation
Muskogee County, Oklahoma	Muskogee County Borders	Unclassifiable	13.5 km^2 Rectangular Area Surrounding OG&E Muskogee Generating Station (2.3 km x 5.85 km) UTM Coordinates: 291500 ; 3961600 291500 ; 3955750 294500 ; 3955750 294500 ; 3961600	Nonattainment
Choctaw County, Oklahoma	Choctaw County Borders	Attainment	Same as State's Recommendation	Unclassifiable/ Attainment
Noble County, Oklahoma	Noble County Borders	Attainment	Same as State's Recommendation	Unclassifiable/ Attainment

Background

On June 3, 2010, the 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. The 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, the 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 the EPA is also not currently designating areas on the basis of the secondary standard.

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 the 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, the EPA will promulgate the designations that it deems appropriate. If a state or tribe disagrees with the 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, the 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, the 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 the 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 the 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 the EPA to complete the area designations according to the consent decree schedule.

[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.

According to the consent decree, the EPA must complete the remaining designations on a schedule that contains three specific deadlines. By no later than July 2, 2016 (16 months from the court's order), the 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 the 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. The 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 the 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 the EPA intends to evaluate in determining whether areas are in violation of the 2010 SO_2 NAAQS. The guidance also contains the factors the 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, the 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 the state.[2] However, there are 3

[2] For designations based on ambient air quality monitoring data that violates the 2010 SO_2 NAAQS, the consent decree directs the EPA to evaluate data collected between 2013 and 2015. Absent complete, quality assured and certified data for 2015, the analyses of applicable areas for the 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 the EPA for evaluation. If after our review, the ambient air quality data for the area indicates

source(s) in the state meeting the emissions criteria of the consent decree for which the EPA must complete designations by July 2, 2016. In this technical support document, the EPA discusses its review and technical analysis of Oklahoma's updated recommendations for the areas that we must designate. The 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 the EPA has determined has violated the 2010 SO_2 NAAQS or contributed to a violation in a nearby area. A nonattainment designation would reflect considerations of state recommendations and all of the information discussed in this document. The EPA's decision would be 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 the 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 the EPA has determined to have sufficient evidence to find either is attaining or is likely to be attaining the NAAQS. The EPA's decision would be 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 the EPA designate as attainment.
8) Recommended nonattainment area – an area a state or tribe has recommended that the EPA designate as nonattainment.
9) Recommended unclassifiable area – an area a state or tribe has recommended that the EPA designate as unclassifiable.
10) Recommended unclassifiable/attainment area – an area a state or tribe has recommended that the 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.

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that no violation of the NAAQS occurred between 2013 and 2015, the consent decree does not obligate the EPA to complete the designation. Instead, we may designate the area and all other previously undesignated areas in the state on a schedule consistent with the prescribed timing of the consent decree, i.e., by December 31, 2017, or December 31, 2020.

Technical Analysis for the Muskogee County, Oklahoma Area

Introduction

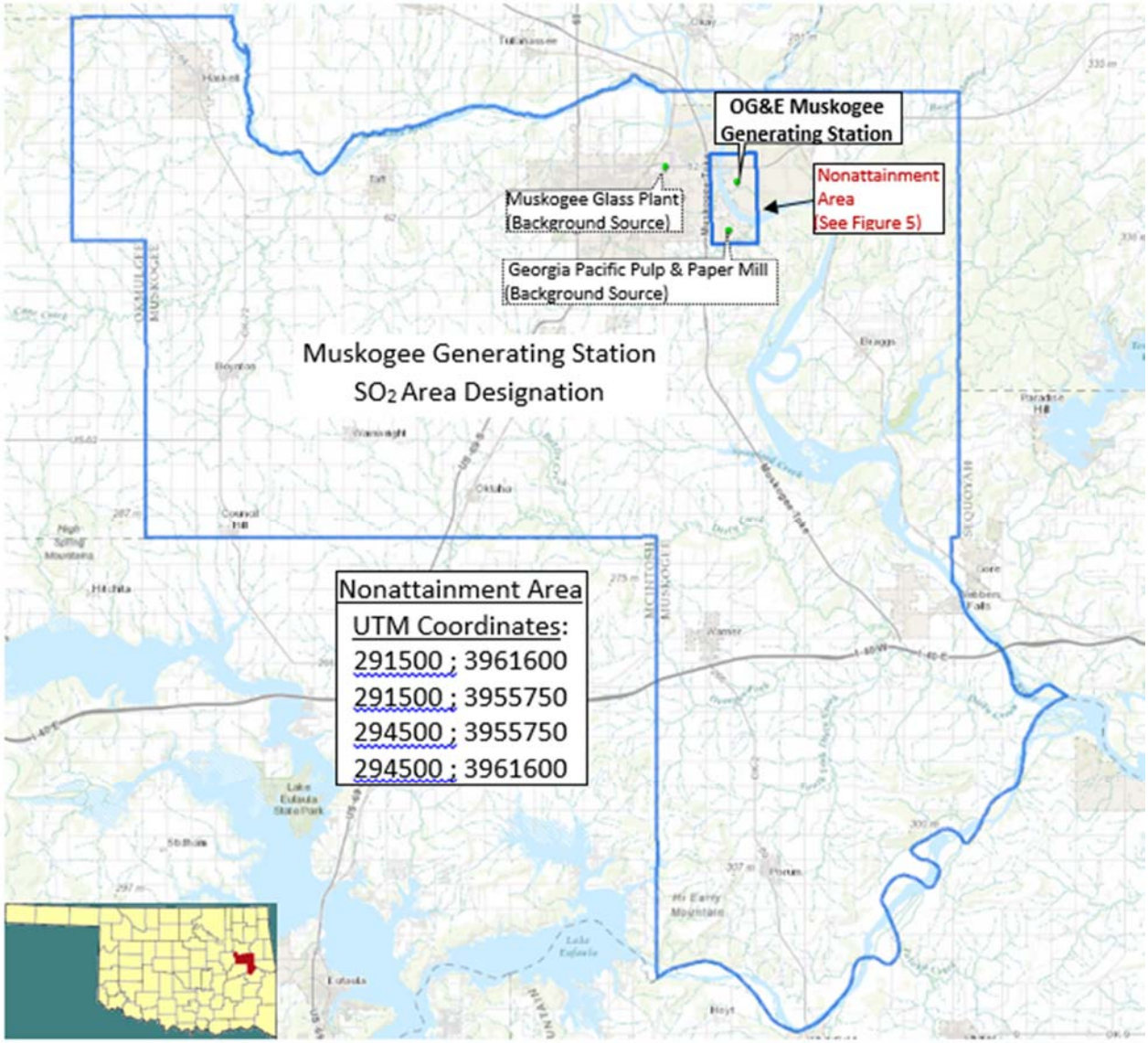
The Muskogee County area contains a stationary source that according to the EPA's Air Markets Database emitted in 2012 either more than 16,000 tons of SO_2 in 2012 or more than 2,600 tons of SO_2 and had an annual average emission rate of at least 0.45 pounds of SO_2 per one million British thermal units (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 OG&E Muskogee Generating Station (Muskogee station) emitted 22,647 tons of SO_2, and had an emissions rate of 0.50 lbs SO_2/mmBTU. Pursuant to the March 2, 2015 consent decree, the EPA must designate the area surrounding the facility by July 2, 2016.

In its submission, Oklahoma recommended that the area surrounding the Muskogee station, specifically the entirety of Muskogee County, be designated as unclassifiable 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, the EPA does not agree with the state's county area recommendation for designation. Instead, we intend to designate the area around Muskogee station as nonattainment with these boundaries: a 17.5 km^2 rectangular area surrounding the facility (3.0 km x 5.85 km) with the following Universal Transverse Mercator (UTM) coordinates (NAD 83 Zone 15):

X	Y
291500	3961600
291500	3955750
294500	3955750
294500	3961600

The Muskogee station is located in eastern Oklahoma in the northeastern portion of Muskogee County. As seen in Figure 1 below, the facility is located approximately 5 km west of the center of Fort Gibson. Also included in the figure is the EPA's intended nonattainment designation boundary for the area, which is a different recommended area than the state's intended attainment county designation. The EPA intends to designate a 17.5 square km area defined by UTM coordinates around the Muskogee station as nonattainment instead of using the county boundary.

Figure 1: The EPA's intended Area Designation for OG&E Muskogee Generating Station



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

Detailed Assessment

Air Quality Data

There is a SO_2 air quality monitor in Muskogee County but it is approximately 4 km from the Muskogee station. The monitoring data for 2012 to 2014 (three year average of the 99th percentile 1-hour daily maximum values) is 49.3 ppb which is approximately 129.2 $\mu g/m^3$. The monitored concentration is approximately 66% of the NAAQS (75 ppb). This monitor is several

kilometers to the North and West of Muskogee station and is not representative of the maximum concentration from Muskogee station and other cumulative sources. ODEQ also conducted modeling for monitor siting (discussed below) that indicates that the existing monitor is not in an area that a monitor would be sited based on EPA's monitoring TAD. There are no SO_2 air quality monitors in surrounding counties. Therefore there is no monitoring data that is representative of the maximum or higher elevated levels of SO_2 around the Muskogee station.

Model Selection and Modeling Components

The EPA's December 2013 SO_2 Designations Technical Assistance Document (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 the previous version of AERMOD version 14134, and a discussion of the individual components will be referenced in the corresponding discussion that follows as appropriate. EPA released a newer version of AERMOD (version 15181) in July 2015 while ODEQ's modeling work was already well underway. The EPA does not believe that substantial changes in the modeling results would have been seen if the state used the more recent version.

Modeling Parameter: Rural or Urban Dispersion

The EPA's recommended procedure for characterizing an area by prevalent land use is based on evaluating the dispersion environment within 3 km of the facility. According to the 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.

Determination of whether or not the domain of an affected source should be classified as urban or rural was based mainly on land use (the preferred method). However, Oklahoma reviewed whether the urban heat island affect was potentially appropriate since the facility is near Muskogee. Ultimately, when performing the modeling for the area of analysis, the state determined that it was most appropriate to run the model in rural mode.

The aerial photos are included in Appendix B of Oklahoma's modeling report. We have reviewed the materials and concur with the selection of rural dispersion.

Modeling Parameter: Area of Analysis (Receptor Grid)

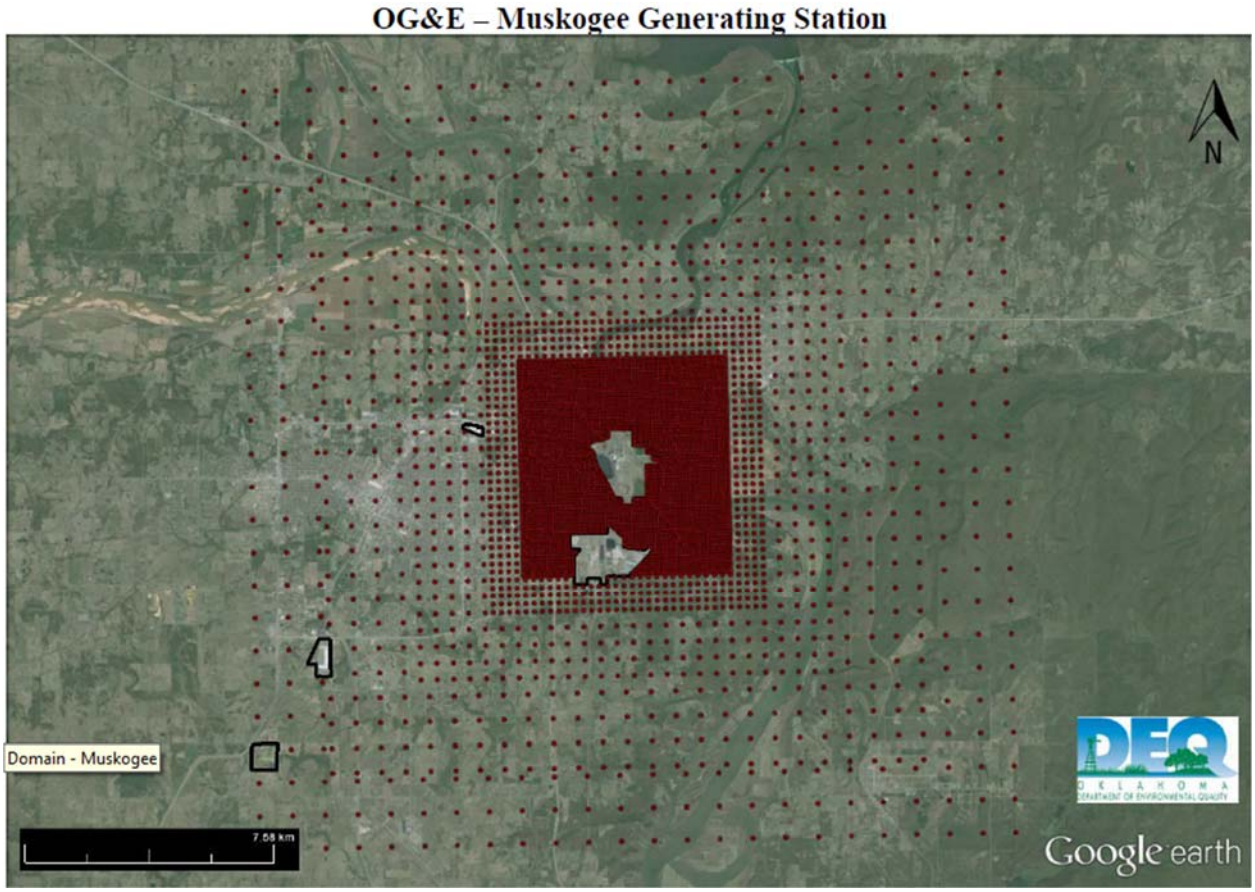
The EPA believes that a reasonable first step towards characterization of air quality in the area surrounding the Muskogee station is to determine the extent of the area of analysis, i.e., receptor grid. Considerations presented in the Modeling TAD include but are not limited to: the location of the 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 area of analysis, the state has included 6 total emitters of SO_2; 2 of which are major emitters within Muskogee County and within 20 kilometers (km) of Muskogee station in any direction. There is 1 major emitter in Mayes County that was modeled and is the largest emitter. The other modeled emitters are less than 100 tpy. In addition to the Muskogee station, the other emitters of SO_2 included in the area of analysis are: Georgia Pacific (3 km south) and Owens Brockway (4.7 km west) both located in Muskogee County. The Grand River Dam Authority (large coal fired power plant) is located 47 km to the north in Mayes County. The state determined that there were no other nearby sources that could cause concentration gradients in the study area. There were no other major SO_2 sources (>100 tpy of SO_2) within 50 km of Muskogee station. Therefore the sources that Oklahoma modeled are reasonable 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. EPA evaluated 2011 National Emissions Inventory (NEI) data plotted on GIS and concurs with Oklahoma's conclusion that there were no other major sources that were large enough or close enough to be necessary to include in the modeling other than the facilities that they included. In addition to the Muskogee station, the other emitters of SO_2 included in the area of analysis that could generate concentration gradients in the area of study (Muskogee County and elevated impact area around Muskogee station) were explicitly included in the modeling. The grid receptor spacing for the area of analysis chosen by the state is as follows:

- Receptors spaced at 100 m along the fence line of the affected sources;
- Receptors spaced at 100 m from the fence line out to 2 km;
- Receptors spaced at 250 m from 2 km out to 3 km;
- Receptors placed at 500 m from 3 km to 5 km; and
- Receptors spaced at 1 km from 5 km out to edge of domain (~10 km).

Figure 2 shows the state's chosen area of analysis surrounding the Muskogee station, as well as receptor grid for the area of analysis.

Figure 2: OG&E Muskogee Generating Station Receptor Grid for the Area of Analysis



Consistent with the Modeling TAD, receptors for the purposes of this designation effort were placed only in areas where it would also be feasible to place a monitor. The impacts of the area's geography and topography will follow in the appropriate section. While Oklahoma only modeled receptors out to approximately 10 km from the Muskogee station, review of the modeling concentrations indicate that this was reasonable enough for quantification of the higher impacts from the Muskogee station and the higher cumulative impacts of all sources (Muskogee and other sources) that potentially impact concentration gradients in Muskogee County. The receptors were place out to 10 km from the facility and as discussed below this covered most of Muskogee County and the cumulative gradients (with monitoring background added) were approximately 40 - 70% of the standard at the edge of the receptor grid and concentration gradients were decreasing in the outer receptors. Therefore the 10 km grid does allow for characterization of the air quality in the immediate vicinity around the Muskogee and Georgia (GP) facilities (facilities with the largest impacts) and model values in the rest of Muskogee County would be expected to be at values below the standard if modeled. EPA agrees that the 10 km grid is large enough to determine whether SO_2 air quality levels are above/below the standard and what area models above the standard. The discussion of the impacts of the area's geography and topography will follow in the appropriate section.

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 correctly characterized the sources' building layout and location, as well as the stack parameters, e.g., exit temperature, exit velocity, location, and diameter. Where appropriate, the AERMOD component BPIPPRIME was used to assist in addressing building downwash.

Modeling Parameter: Emissions

The 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 the most recently permitted, (referred to as PTE or allowable) emissions rate.

The 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, the EPA's Modeling TAD highly encourages the use of AERMOD's hourly varying emissions keyword HOUREMIS, or through the use of AERMOD's variable emissions factors keyword EMISFACT. When choosing one of these methods, the EPA believes that detailed throughput, operating schedules, and emissions information from the impacted source(s) 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 the Muskogee station and two other major emitters of SO_2 within 20 km in the area of analysis. Oklahoma also modeled two other facilities that could potentially cause concentration gradients of concern in the study area. There was one major emitter (the Grand River Energy Center) greater than 20 km away in Mayes County that contributed impacts to the area of analysis. There were no other facilities within 50 km that had large enough emissions to potentially cause a concentration gradient in the study area. The area of analysis and its associated annual actual SO_2 emissions between 2012 and 2014 are

summarized in Table 1 below. Table 2 contains modeled stack parameters for the sources in the area of analysis.

Table 1: Actual SO_2 Emissions 2012 – 2014 in the Area of Analysis

Company ID	Facility Name	SO_2 Emissions (tons per year)		
		2012	2013	2014
OG&E	Muskogee Station	22,647	16,671	20,538
Dalitalia	Porcelain Floor Tile Plant	4	4	Not available
Boral	Brick Plant	50	202	Not available
Georgia Pacific	Pulp and Paper Mill	2,011	2,011	2,145
Owens Brockway	Glass Plant	129	126	Not available
U.S. Lime	St Claire Plant	76.4	85.9	Not available
Grand River Dam Authority (GRDA)	Grand River Energy Center (Mayes County)	14,946	14,224	12,254
Total Emissions	**All Facilities**	39,863	33,323	>32,792

Table 2: Modeled Stack Parameters for Contributing Sources in Area of Analysis

		Easting	Northing	Elevation	Stk Ht	Stk Temp	Velocity	Stk Dia	SO_2
Source ID	Facility	(m)	(m)	(m)	(ft)	(°F)	(fps)	(ft)	(lb/hr)
UNIT 4	OG&E Muskogee	293116.7	3959729.8	156.2	350.0	264	44.96	24.0	2,010.98
UNIT 5	OG&E Muskogee	293172.0	3959739.3	156.8	350.0	264	41.80	24.0	1,912.21
UNIT 6	OG&E Muskogee	293240.4	3959757.7	157.0	500.0	264	55.01	21.5	2,206.57
DAL20	Dalitalia	284208.4	3953784.7	171.2	46.3	130	29.80	4.95	0.11
DAL23	Dalitalia	284164.9	3953711.7	170.8	46.0	130	45.08	2.70	0.05
DAL29	Dalitalia	284093.8	3953787.7	171.0	51.3	130	24.10	5.36	0.09
BORSCRUB	Boral	282161.2	3951159.0	183.5	70.0	355	36.29	6.2	43.60
GPSTACK1	Georgia Pacific	292555.0	3956494.1	161.9	260.0	353	28.46	10.0	85.33
GPSTACK3	Georgia Pacific	292594.0	3956513.0	162.0	260.0	306	28.24	13.8	412.56
OBFURNA	Owens Brockway	288620.7	3960596.6	179.6	150.0	918	29.16	5.3	9.30
OBFURNB	Owens Brockway	288656.6	3960582.4	180.0	80.0	389	28.89	7.1	18.61
M1	US Lime	334096.8	3940641.2	203.6	150.0	266	57.09	5.3	20.31
K1	US Lime	334000.6	3940571.3	204.5	96.0	155	31.20	7.0	0.17
UNIT 1	GRDA	294138.0	4007357.0	189.5	504.0	300	68.14	20.0	2,881.26
UNIT 2	GRDA	294211.0	4007262.0	188.8	507.0	190	90.98	20.0	922.97

For Muskogee station in the area of analysis, the state used actual emissions from the most recent 3-year data set, i.e., 2012 – 2014. CEMS data was used to generate hourly emissions files for the affected sources. The emission data was downloaded from the Clean Air Markets Database (CAMD). The monthly data was combined generating annual emission data files for each source at an affected facility with CEMS data. The three variables used in an hourly emission file are emissions, velocity, and temperature. These hourly values were generated from the CAMD datasets and formatted into the units used by AERMOD. The emissions were converted from lb/hr values into g/s. The heat input given in the CAMD data was used with Method 19, CO_2 concentration, moisture concentration, and stack temperature from recent relative accuracy test audits (RATA), to generate the flow rate and resultant velocity. If a unit was operating it was

assigned the normal stack temperature. The data was then reviewed for continuity and for missing data. If there was a single hour of missing data, it was replaced with the average of surrounding non-missing hours. If there are periods of missing data with more than a single missing value, operational data from the affected facility was reviewed to fill the missing hours.

Oklahoma provided three scenarios of Muskogee station's emissions. The scenario we evaluated used 2012-2014 CEMS data (denoted as Scenario 1 by Oklahoma). Oklahoma also conducted two other scenarios that were a combination of actual emissions and a switch to natural gas (NG) on some units. These two scenarios were Scenario 2 (Muskogee station Unit 4 converted to NG and Units 5 & 6 based on 99th percentile level of 2013-2014 actuals) and Scenario 3 (Muskogee station Units 4 & 5 converted to NG and Unit 6 based on 99th percentile level of 2013-2014 actuals). Since neither Scenario 2 nor Scenario 3 will be enforceable by the required date for these designations our review has focused on Oklahoma's Scenario 1 modeling.

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 Muskogee County area, 2012-2014 meteorological data were utilized for the 2010 1-hour SO_2 primary NAAQS designations modeling. The State of Oklahoma utilizes Oklahoma Mesonet surface data, along with NWS surface data in Integrated Surface Hourly Database (ISHD) format, obtained from National Climatic Data Center (NCDC), and National Oceanic and Atmospheric Administration (NOAA) Earth System Research Laboratory (ESRL) Global Systems Division (GSD) formerly Forecast Systems Laboratory (FSL) Upper Air (UA) data, with all air dispersion modeling. Oklahoma Mesonet data is incorporated to help make more accurate forecasts of ambient impacts from the affected sources. Use of the Oklahoma Mesonet data also promotes use of more recent, more accurate, and more representative data. Processed Oklahoma Mesonet surface data is combined with ISHD surface data and ESRL UA radiosonde data using AERMET to produce the surface and profile files used by AERMOD. However, if the ISHD station is closer to the facility being modeled and the station is an ASOS station with sub-hourly observations, Mesonet data is not utilized with the modeling since the ISHD surface data would be more representative. There is further discussion about the representativeness of the surface meteorology below.

For each affected source domain, a specific meteorological data set was developed based on spatial and climatological (temporal) representativeness. The representativeness of the specific meteorological data set to the affected source domain was based mainly on proximity and terrain.

Representativeness of the surface characteristics (albedo, Bowen ratio, and surface roughness) were also reviewed when assigning a specific metrological data set to an affected source domain.

There are approximately 83 ISHD automated weather stations in and around Oklahoma that were evaluated for combining with Oklahoma Mesonet data to accurately represent the individual modeling domains. These stations usually take atmospheric measurements once every hour. The ISH data files were downloaded from the NCDC ISHD web site: ftp://ftp.ncdc.noaa.gov/pub/data/noaa. Some of the sites are ASOS stations with continuous sub-hourly values.

The ISH data sites were reviewed for completeness by evaluating the number of hours that were recorded at each site. If a specific site contained a significant amount of missing hours, then those specific sites were not considered when assigning ISH sites to specific Oklahoma Mesonet sites. Since data from the Oklahoma Mesonet is combined with the ISHD data, there is generally no need to replace missing values for individual variables. One of the main variables utilized from the ISH data is cloud cover (GF1). For each ISHD data file, the specific number of missing cloud cover values was also evaluated. If a specific site had a significant number of missing cloud cover values, it was also excluded.

The NCDC began archiving 1-minute ASOS wind data (TD-6405), beginning January 2000 for first-order NWS ASOS stations, and beginning March 2005 for all other ASOS stations. For those ASOS sites, AERMINUTE (version 14337) data was used to incorporate continuous sub-hourly wind data. The ASOS (6405) files were downloaded and then processed using AERMINUTE. The ASOS 1-minute files were downloaded from http://www1.ncdc.noaa.gov/pub/data/ for each year and applicable ASOS station. There is an ASOS site (KMKO) near the affected facility (Muskogee station) with sub-hourly data.

The Oklahoma Mesonet measures a large variety of meteorological conditions at many sites across Oklahoma. At each site, the meteorological conditions are continuously measured and packaged into 5-minute observations. These 5-minute observations from the Oklahoma Mesonet were processed into an AERMET acceptable format. No missing data interpolation was performed for the 5-minute data sets.

Specific NCDC ISHD data sites and ESRL UA rawinsonde observation (RAOB) data sites were assigned to each Oklahoma Mesonet site based on distance and representativeness. Appendix E of Oklahoma's submittal lists the Oklahoma Mesonet sites used in the ambient air quality analyses and the assigned NCDC ISHD data site and ESRL UA RAOB data site for each Oklahoma Mesonet site. Since the Davis Field Airport NCDC ISHD Station (KMKO) in Muskogee was closer to the Muskogee modeling domain and is more representative than the closest Mesonet Station (Porter) only data from the NCDC ISHD Station was utilized when modeling the Muskogee area. Wind roses for the specific domains are contained in Oklahoma's submittal Appendix F.

The ESRL operates nine RAOB weather stations in and around Oklahoma. These stations usually take soundings twice a day. The ESRL data files were downloaded from the ESRL RAOB web site: http://esrl.noaa.gov/raobs/.

The UA data were reviewed for missing soundings. A single missing sounding will cause a whole day (24 hours) of missing meteorological data values. To reduce the number of missing meteorological data, replacement soundings were substituted for the missing soundings. The replacement soundings were selected from a site with similar thermodynamic profiles. Each UA data station was assigned a primary and a secondary replacement UA station. The primary station is basically the station that is closest to the station being reviewed. Each replacement sounding was documented. The Norman/Max Westheimer station was used for upper air data for the Muskogee area modeling.

When using AERMET (version 14134), to prepare the meteorological data for AERMOD, three surface characteristics (Albedo, Bowen Ratio, and Surface Roughness Length) must be determined for each surface site. Albedo is the fraction of total incident solar radiation reflected by the surface back to space without absorption. Bowen ratio, an indicator of surface moisture, is the ratio of sensible heat flux to latent heat flux. Surface roughness length relates the height of obstacles to the wind flow and is an important factor in determining the magnitude of mechanical turbulence and the stability of the boundary layer. Albedo and Bowen Ratio are used for determining planetary boundary layer parameters for convective conditions driven by the surface sensible heat flux.

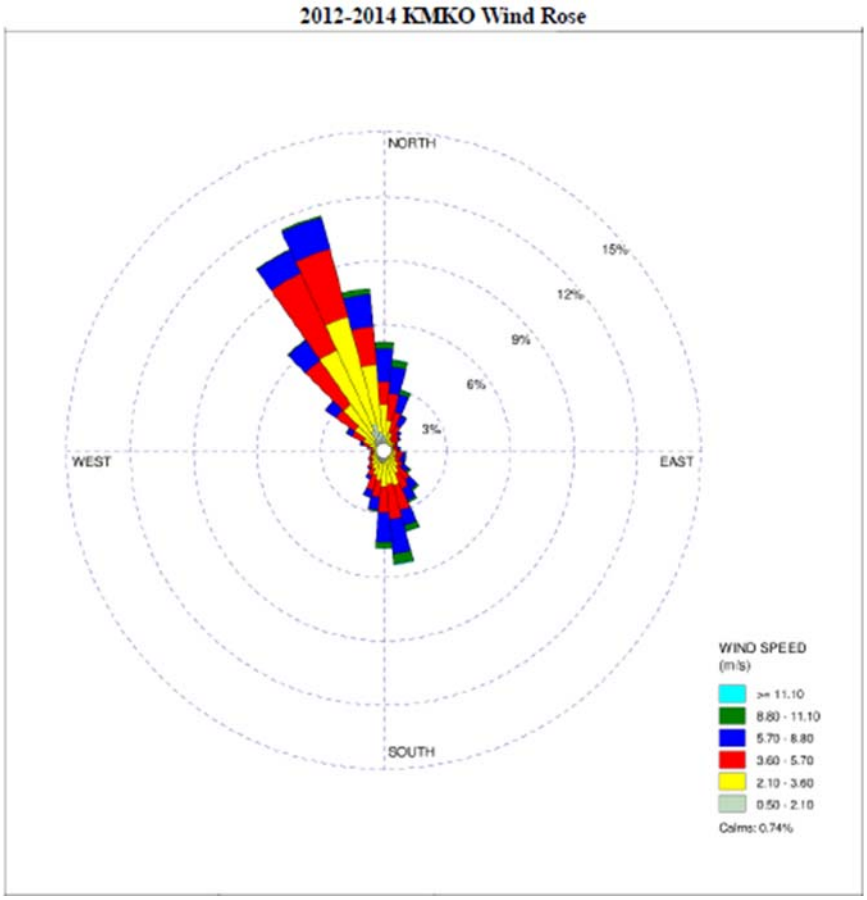
AERSURFACE (version 13016) uses land cover data from the U.S. Geological Survey (USGS) National Land Cover Data 1992 archives (NLCD92) to determine the land cover types for a specified location.

AERSURFACE matches the NLCD92 land cover categories to seasonal values of Albedo, Bowen Ratio, and Surface Roughness and then calculates the surface characteristics for input into AERMET. NLCD92 data in GeoTIFF format was downloaded from the Multi-Resolution Land Characteristics (MRLC) Consortium at the following link: http://www.mrlc.gov/viewerjs/. The surface characteristics of the individual domains are included in Appendix G.

The monthly rainfall since establishment of the Mesonet program (approximately 20 years) has been analyzed for each Mesonet site. The surface moisture conditions (Average, Wet, Dry) for each of the Oklahoma Mesonet stations for each month were then determined using the monthly rainfall amounts compared to the average rainfall. These determinations were based on the guidance contained in the AERSURFACE Users Guide. The Bowen Ratio was then assigned based on the monthly surface moisture conditions for each Oklahoma Mesonet station.

The 3-year surface wind rose for the Muskogee station is depicted in Figure 3. In this figure, the frequency and magnitude of wind speed and direction are defined in terms of where the wind is blowing from.

Figure 3: Muskogee Cumulative Annual Wind Rose for Years 2012 – 2014



Modeling Parameter: Geography and Terrain

Terrain data was included in all 2010 1-hour SO_2 designations modeling analyses. Terrain data was obtained from the USGS Seamless Data Server at http://viewer.nationalmap.gov/viewer/. The 1/3 arc-second NED data was obtained in the GeoTIFF format for use in AERMAP. Interpolation of receptor and source heights from the 1/3 arc-second NED elevation data was based on the current AERMAP guidance in Section 4.4 of the *User's Guide for the AERMOD Terrain Preprocessor (AERMAP)* (EPA-454/B-03-0003, 10/2004). AERMAP uses a distance weighted bilinear interpolation method.

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 Muskogee station area of

analysis, the state chose background concentrations based on the most recent thee complete years (2012-2014) of available monitoring data. Oklahoma evaluated all SO_2 monitors in the state and found a monitor in Oklahoma City that was not impacted by a large SO_2 source. The 2012-2014 background concentration DV for this area of analysis was determined by the state to be 9.6 micrograms per cubic meter ($\mu g/m^3$), or 3.67 ppb,[3] and that value was incorporated into the final AERMOD results.

Summary of Modeling Results

The AERMOD modeling parameters for the Muskogee station area of analysis are summarized below in Table 3:

Table 3: AERMOD Modeling Parameters for the Area of Analysis

Muskogee station Area of Analysis	
AERMOD Version	14134
Dispersion Characteristics	Rural
Modeled Sources	7
Modeled Stacks	15
Modeled Structures	Yes
Modeled Fence Lines	Yes (see Figure 4)
Total receptors	Large Grid
Emissions Type	Actual
Emissions Years	2012-2014
Meteorology Years	2012-2014
Surface Meteorology Station	Porter (ISHD) surface data
Upper Air Meteorology Station	Norman, OK
Methodology for Calculating Background SO_2 Concentration	1st tier monitoring data
Calculated Background SO_2 Concentration	3.67 ppb or 9.6 $\mu g/m^3$

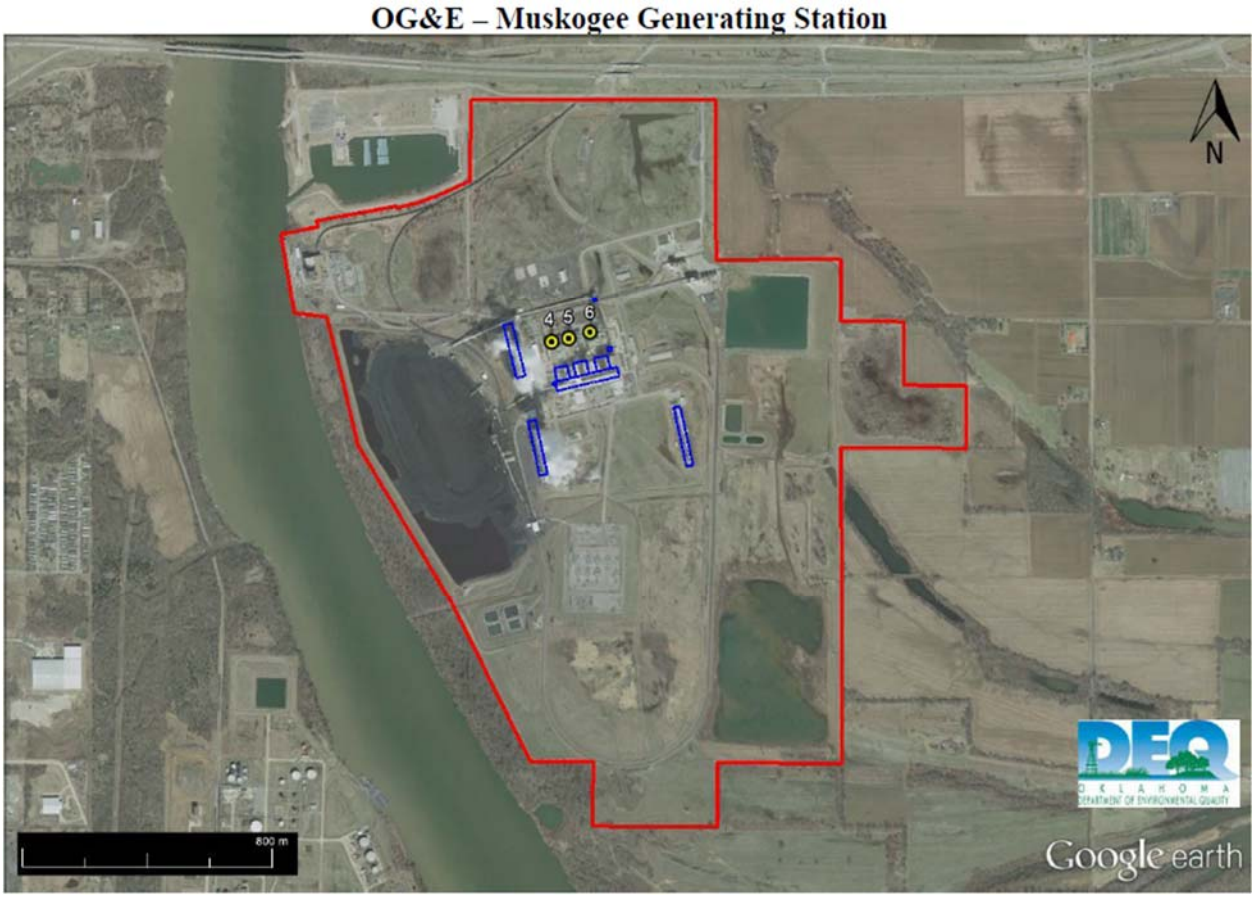
The results presented below in Table 4 show the magnitude and geographic location of the highest predicted modeled concentration based on actual emissions.

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

Table 4: 2012 – 2014 Max Predicted 99th Percentile 1-Hour SO_2 Conc. Based on Actual Emissions

		Modeled Impact	Background	Total Impact
Domain	Source Group	($\mu g/m^3$)	($\mu g/m^3$)	($\mu g/m^3$)
D36	ALL	214.0	9.6	223.6
	OGE	201.4		
	GEORG	120.1		
	DALTIA	1.4		
	BORAL	56.3		
	OWENS	49.4		
	GRDA	23.5		
	USLIME	3.5		

Figure 4: Muskogee station Modeled Fence Lines



The state's modeling indicates that the predicted 99th percentile 1-hour average concentration is 223.6 $\mu g/m^3$ (85.42 ppb), which exceeds the NAAQS standard of 75 ppb (196 $\mu g/m^3$). This modeled exceedance concentration included the background concentration of SO_2 and is based

on actual emissions from the facility (see Figures 5 and 6). The modeling indicated that a number of receptors exceeded the standard with contributions primarily from Muskogee station sources and some impacts from Georgia Pacific emissions sources.

Figure 5: The EPA's intended Area Designation for OG&E Muskogee Generating Actual Emissions

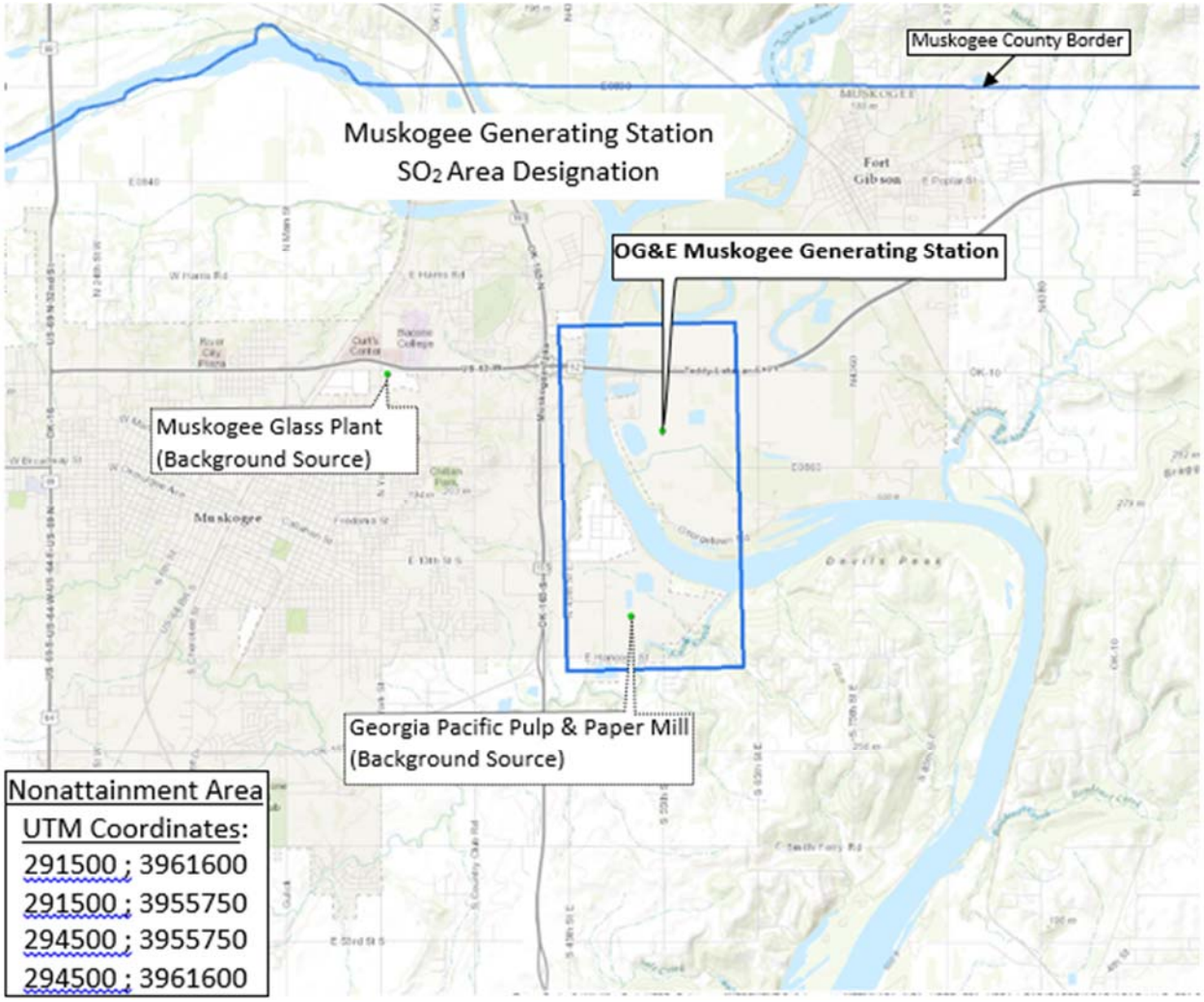
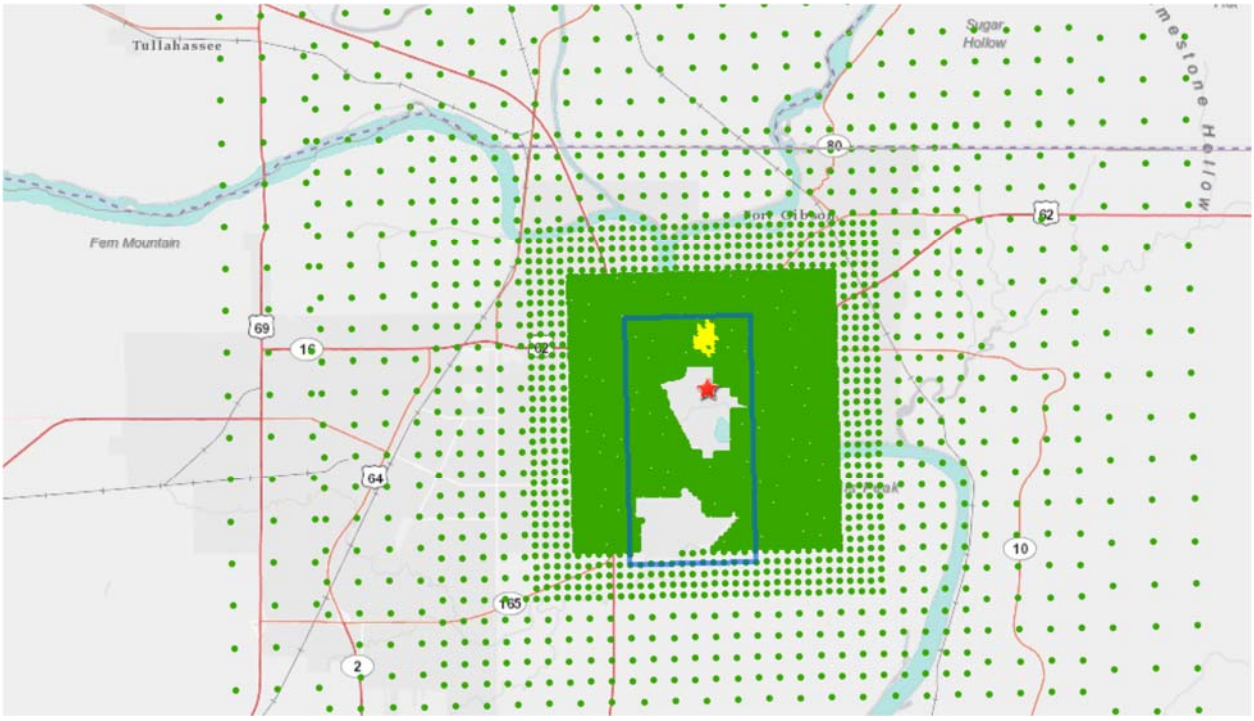


Figure 6: Modeling results and EPA's intended Area Designation for Muskogee station Actual Emissions.



*Yellow receptors are above the standard and green receptors are below the standard.

Jurisdictional Boundaries:

Once the geographic area of analysis associated with the Muskogee station is determined, existing jurisdictional boundaries are considered for the purpose of informing our intended nonattainment area, specifically with respect to clearly defined legal boundaries. The boundary is large enough to include all modeled exceedances and the primary contributors to the modeled exceedances. The GP facility is included in the Southwest corner of the nonattainment area (the area without receptors is GP) since it contributes significantly to the modeled exceedances.

The EPA believes that our intended nonattainment area, consisting of a 17.5 square km area around the Muskogee station is comprised of clearly defined legal boundaries, and we find these boundaries to be a suitably clear basis for defining our intended nonattainment area.

Other Relevant Information

In addition to the modeling, Oklahoma also provided a weight of evidence analysis in an attempt to show that the modeling for Muskogee area should not be relied upon to make a nonattainment decision and to support their unclassifiable recommendation. We have reviewed Oklahoma's modeling and find that it is modeling of a high quality that is consistent with EPA's guidelines for air quality modeling. Oklahoma has compared the results of the modeling to measurements at

a monitor located to the north and west of the facility. We have also evaluated Oklahoma's met data analysis, surface roughness, and terrain issues. Oklahoma also provided modeling that is consistent with EPA's SO_2 monitoring TAD for monitor location selection.[4] As described below, they find that the model appears to somewhat overestimate when compared to the monitor design value. We do not believe that the concerns raised by Oklahoma, however, are sufficient to discount the modeling for making the designation decision.

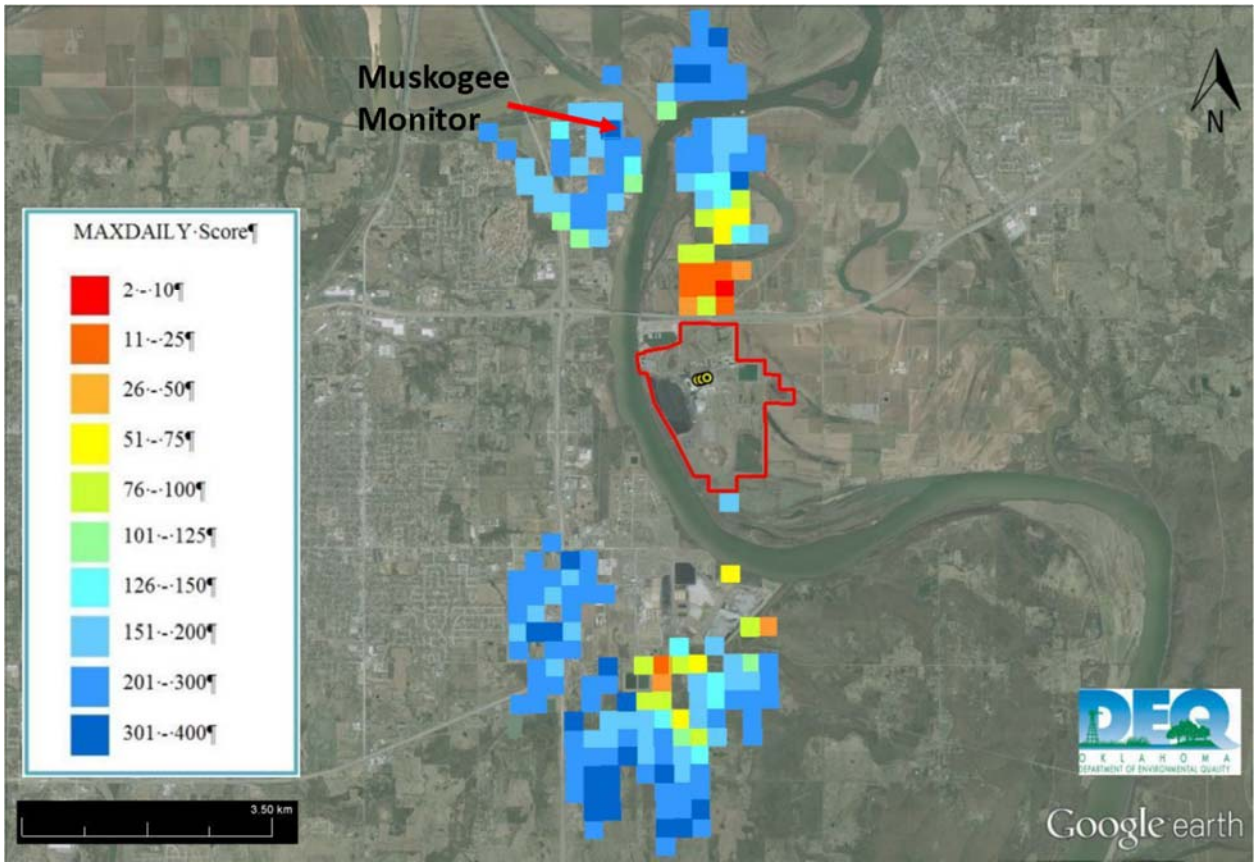
Current ambient monitoring data in Muskogee County does not report a violation of the 2010 1-hour SO_2 NAAQS, but the monitor has been shown to not be sited in the area of expected maximum ambient concentration impacted by the sources, nor is it in an area that would be selected if a monitor were being sited based on EPA's SO_2 monitoring TAD (see discussion below). Oklahoma indicated that the predicted impacts using modeling do not correlate well with the ambient monitoring data at the monitoring site in Muskogee area. Oklahoma indicated that this raises questions regarding meteorological data representativeness. Oklahoma also indicated that additional studies of the modeling analyses should be conducted to examine the issues related to correlation of predicted modeling impacts and actual monitor impacts. Oklahoma indicated that additional meteorological data (e.g. on-site), which is more representative of the modeling domain, should be collected to generate modeling which accurately represents the area impacted by the Muskogee station. As discussed here and further below we do not agree that model performance can be evaluated using only one monitor that is not located in the maximum or near maximum location. AERMOD model performance is best at predicting maximums in a modeling domain. We note that the AERMOD results are within 15.7% of the monitored DV at the monitor, which is actually pretty good for this limited analysis and does not lead us to conclude that the modeling is not usable for our determination in this action. As discussed below, since there is no on-site meteorological data collected at the Muskogee facility, a selection of the most representative meteorological data from existing meteorological stations was completed and we concur that the NWS surface station (KMKO) used in the modeling above is the most representative for the analysis of the Muskogee facility area.

Oklahoma's analysis that followed EPA's SO_2 monitoring TAD included the top 200 receptors ranked based on a scoring methodology utilizing the NDV and the frequency of days having the largest 1-hour normalized concentration. The scoring methodology provides a rank based on the maximum impacts and the number of times the receptor had a maximum impact for the area. This scoring analysis is depicted in Figure 7 below.

The red (2-10) receptors are the most frequent locations of maximum values and would be the preferred locations for siting a monitor if a source was siting a monitor factoring in other information and analyses as appropriate. As can be seen the monitor is not in a very good spot for siting in accordance with the EPA SO_2 monitoring TAD.

[4] "Source-Oriented Sulfur Dioxide (SO_2) Monitoring Technical Assistance Document" December 2013 DRAFT; available http://www3.epa.gov/airquality/sulfurdioxide/implement.html

Figure 7: MAXDAILY Scoring Analysis



The monitoring data for 2012 to 2014 (three year average of the 99th percentile 1-hour daily maximum values) is 49.3 ppb which is approximately 129.2 µg/m^3. The monitored concentration is approximately 66% of the NAAQS (75 ppb). The modeled 2012 to 2014 three-year average of the 99th percentile 1-hour daily maximum values is 149.5 µg/m^3 (57.1 ppb). The modeled concentration is approximately 76% of the NAAQS (75 ppb). However, we note that the AERMOD results are within 15.7% of the monitored DV at the monitor, which is actually pretty good for this limited analysis and does not lead us to conclude that the modeling is not usable for our determination in this action.

Oklahoma raised concerns that the KMKO surface meteorological station, which is at an airport in Muskogee may not be entirely representative of the meteorology impacting dispersion of emissions in the area. They evaluated wind data at surrounding sites and raised the concern that terrain and river valley impacts may be impacting dispersion. They conducted a number of modeling runs evaluating other surface meteorology and different combinations of alternative surface data comparing model results to the monitoring DV. The results of their analysis indicated ranges of 6 - 46.1 % with the various met data combinations. They concluded that the area surrounding the Muskogee station is not adequately characterized by the available meteorological data. The terrain effects on the wind direction and speed of the area surrounding the modeling domain are not adequately characterized by the area surrounding the KMKO.

Oklahoma also evaluated surface roughness at the KMKO and other areas and asserted that it is not representative of the surface roughness of the modeling domain. Oklahoma concluded that additional meteorological monitoring in the area of the Muskogee station is needed to address questions regarding meteorological data representativeness.

Oklahoma proposed that a meteorological station located at or near the center of the domain would enhance the accuracy of the modeling. The meteorological data should include upper air data to characterize the atmospheric conditions within the modeling domain. The station should be equipped with a meteorological tower of sufficient height to characterize the vertical structure of the atmosphere (100 m) or a SODAR (Sonic Detection and Ranging) instrument, radar wind profiler (RWP), radio acoustic sounding systems (RASS), or similar instrument to characterize the thermodynamic structure of the lower layer of the atmosphere.

On terrain, Oklahoma indicated the base elevation of the area is defined by the Arkansas River which flows through the area. An area of hilly terrain 200 feet to 350 feet above the river (700 to 850 feet above mean sea level) exists about 2 to 5 miles from the south to the east of the Muskogee station. The Muskogee station emits significant levels of SO_2 from three smokestacks: two at 350 feet and one at 500 feet above ground level. The ground elevation at the Muskogee station is approximately 525 feet above mean sea level.

We note that local terrain may have influence on dispersion in the area but for the most part the airport KMKO surface meteorological data at the airport is likely more representative of the meteorology that impacts the transport of the tall elevated stacks that have further plume height equivalency due to the buoyancy from elevated stack temperatures. Looking at the modeling results and source grouping attributions almost all of the peak concentrations are due to Muskogee station's sources with GP's emissions adding to overall concentrations to a much lesser extent for the area of modeled nonattainment north of Muskogee station.

We appreciate Oklahoma's thorough research into the variability of meteorology, surface roughness and potential terrain influences. Surface and upper air data collected on-site at Muskogee station might yield slightly different results but the surface data may not be as representative of the meteorology that affects the dispersion of Muskogee station emissions that are above local terrain. During the periods that Oklahoma identified the maximum modeled rates occur the meteorology above ground level and near the stack height would likely be more important in the dispersion yielding maximum values that would be monitored at a monitor in the peak modeled area. Therefore, our position is that the KMKO surface meteorology and the Norman, OK upper air data are more representative of the transport phenomena driving the dispersion of these elevated buoyant plumes and driving the modeled exceedances.

We note that the monitor is at an elevated impact location (2012-2014 DV of 129.2 $\mu g/m^3$) but is not near the standard or the maximum modeled value. For comparison the modeled value was 149.5 $\mu g/m^3$, approximately 66% of the modeled maximum value of 223.6 $\mu g/m^3$.

While Oklahoma's analysis looked at many potential scenarios, there are several things to consider in deciding if the information impacts the conclusions of the modeling of Scenario 1.

1. Only one monitor that is not near the maximum is not sufficient to try and do a full model performance and determine if the modeling system and inputs give a biased result.
2. Many more monitors would be needed for a model performance analysis.
3. Scenario 1 modeling results at the monitor are within 15% of the monitored value, which is adequate for an isolated analysis of one monitor.
4. Analysis did not focus on the full suite of metrics that EPA typically evaluates for model performance analyses.
5. AERMOD is strongest at predicting the maximum values in a modeling domain and fairly good at temporal and spatial.
6. 40 CFR App. W Guideline on Air Quality Models (2005) prohibits model calibration.[5]

After reviewing all of the materials that Oklahoma provided, we do not agree that the issues raised by the state would cause enough uncertainty in the modeling results to override the model results that are 27 $\mu g/m^3$ above the standard.

Conclusion

After careful evaluation of the state's recommendation and supporting information, as well as all available relevant information, the EPA intends to designate the area around Muskogee station in Muskogee County, Oklahoma as nonattainment for the 2010 SO_2 NAAQS. Specifically, the boundaries are comprised of a small rectangular area around the Muskogee station (3.0 km x 5.85 km = 17.55 square km area). The area is defined by UTM coordinates (NAD 83 Zone 15):

X	Y
291500	3961600
291500	3955750
294500	3955750
294500	3961600

When evaluating the modeling submitted from the state, no major issues with the state modeling were identified. The modeling shows nonattainment and the modeling follows the TAD and EPA guidance. We are proposing a 17.55 square km area around the Muskogee station, instead all of Muskogee County, since the contributing emission source impacts were in the northern part of Muskogee County. Also, the largest generator and 4th highest contributing source to the NAAQS

[5] 7.2.9 Calibration of Models
a. Calibration of models is not common practice and is subject to much error and misunderstanding. There have been attempts by some to compare model estimates and measurements on an event-by-event basis and then to calibrate a model with results of that comparison. This approach is severely limited by uncertainties in both source and meteorological data and therefore it is difficult to precisely estimate the concentration at an exact location for a specific increment of time. Such uncertainties make calibration of models of questionable benefit. Therefore, model calibration is unacceptable.

concentration is in Mayes County north of the Muskogee station. The wind rose indicates that the plumes will be directed north of Muskogee station.

At this time, our intended designation 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 consent decree, the EPA will evaluate and designate all remaining undesignated areas in Oklahoma by either December 31, 2017, or December 31, 2020.

Technical Analysis for the Choctaw County, Oklahoma Area

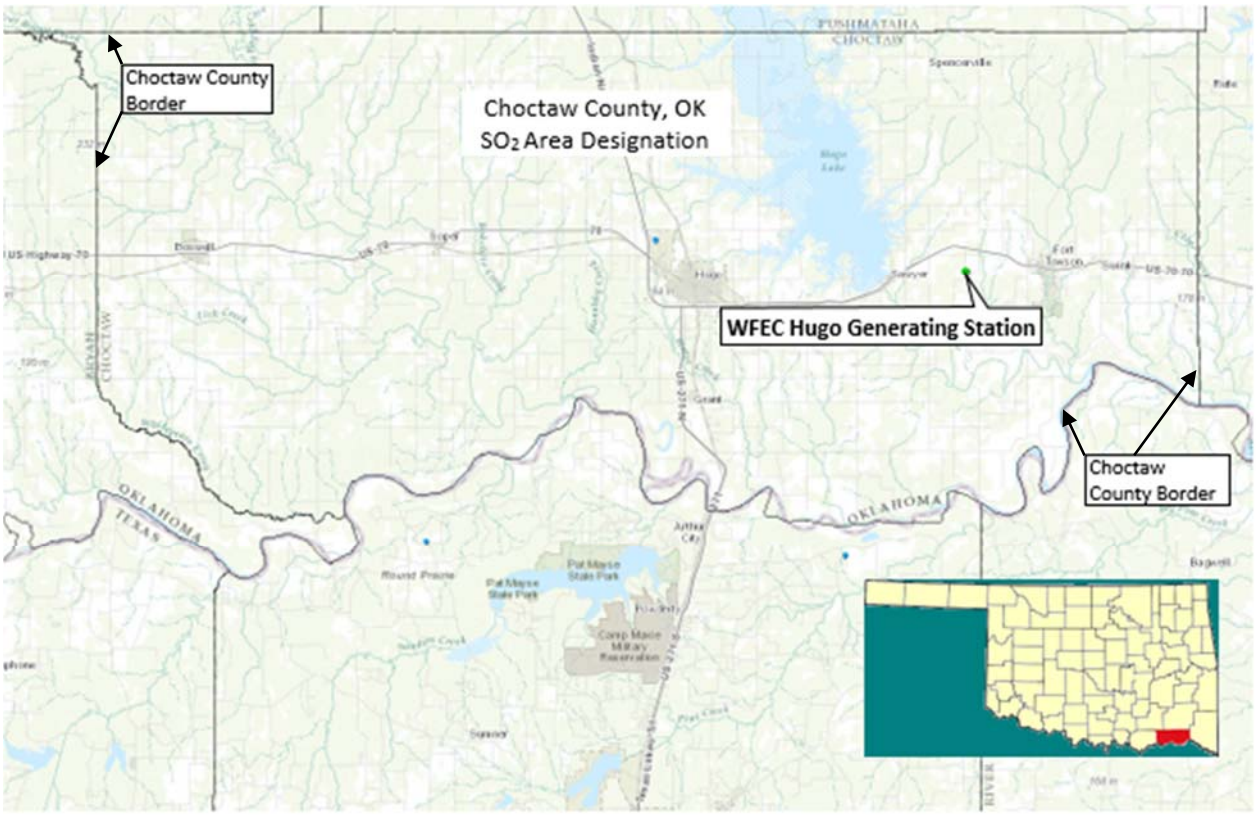
Introduction

The Choctaw County area contains a stationary source that according to the 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 WFEC Hugo Generating Station (WFEC Hugo station) emitted 8,066 tons of SO_2, and had an emissions rate of 0.60 lbs SO_2/mmBTU. Pursuant to the March 2, 2015 consent decree, the EPA must designate the area surrounding the facility by July 2, 2016.

In its submission, Oklahoma recommended that the area surrounding WFEC Hugo station, specifically the entirety of Choctaw 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, the EPA intends to designate Choctaw County as unclassifiable/attainment.

The WFEC Hugo station is located in southeastern Oklahoma in the eastern portion of Choctaw County. As seen in Figure 1 below, the facility is located approximately 10 km southeast of the center of Hugo Lake. Also included in the figure is the EPA's intended unclassifiable/attainment designation county boundary for the area, which is the same recommended area as the state's intended attainment designation.

Figure 1: The EPA's intended designation(s) for Choctaw County, Oklahoma



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

Detailed Assessment

Air Quality Data

There are no SO_2 air quality monitors in Choctaw County. There are no SO_2 air quality monitors in surrounding counties.

Model Selection and Modeling Components

The EPA's Modeling TAD notes that for area designations under the 2010 SO_2 NAAQS, the AERMOD modeling system should be used, unless use of an alternative model can be justified. 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 the most recent AERMOD version 14134, and a discussion of the individual components will be referenced in the corresponding discussion that follows as appropriate.

Modeling Parameter: Rural or Urban Dispersion

The EPA's recommended procedure for characterizing an area by prevalent land use is based on evaluating the dispersion environment within 3 km of the facility. According to the EPA's modeling guidelines, urban 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 urban. Otherwise, the source is considered a rural source. When performing the modeling for the area of analysis, the state determined that it was most appropriate to run the model in rural mode due to aerial photos indicating the area surrounding the facility. The aerial photos are included in Appendix B of Oklahoma's modeling report. We have reviewed the materials and concur with the selection of rural dispersion.

Modeling Parameter: Area of Analysis (Receptor Grid)

The EPA believes that a reasonable first step towards characterization of air quality in the area surrounding the WFEC Hugo 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.

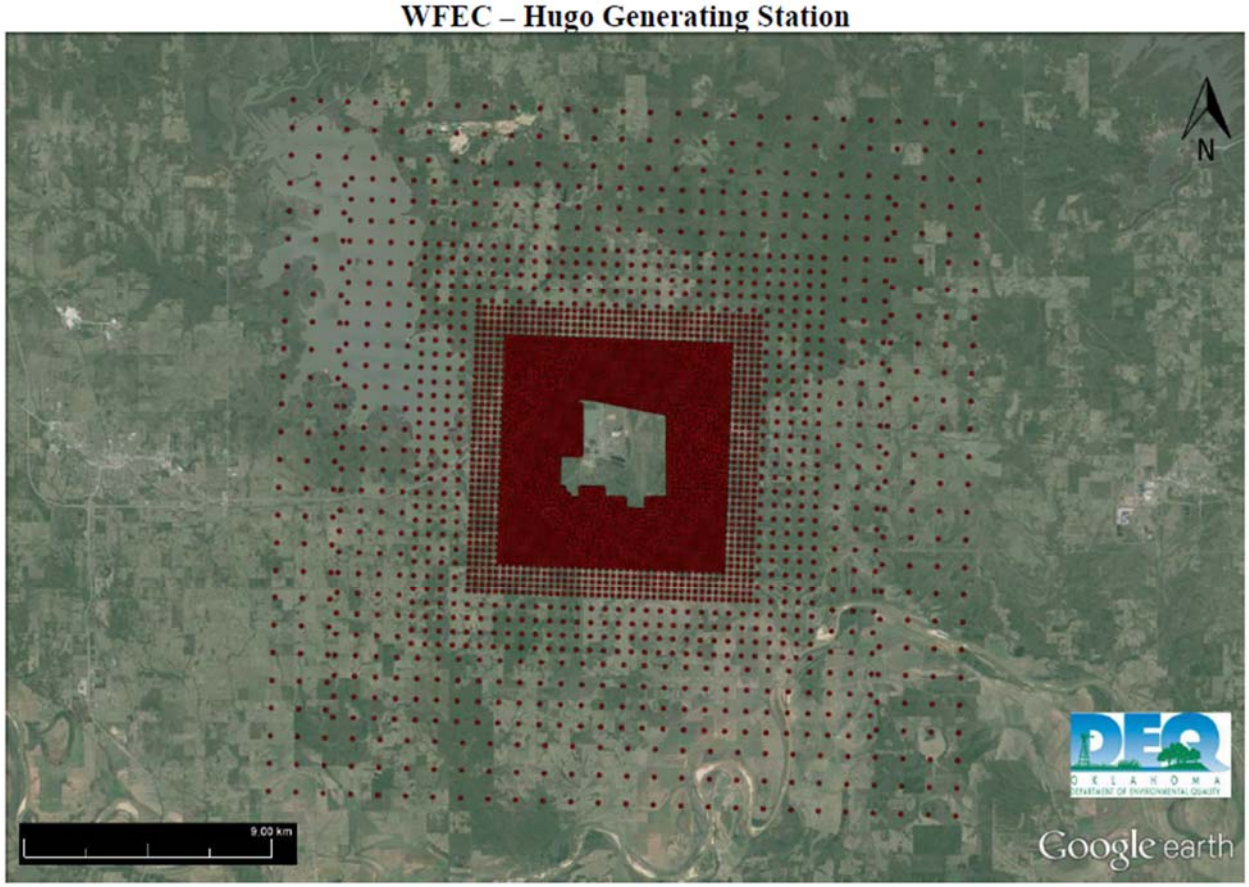
For the Choctaw County area, the state has included 2 other emitters of SO_2 within 20 kilometers (km) of WFEC Hugo station in any direction. Outside of these two sources there are no other large SO_2 sources that would be expected to potentially have a significant concentration gradient in the area of concern as the nearest other large source is over 50 km away from the WFEC Hugo station. Therefore, the sources that Oklahoma modeled are reasonable 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. EPA evaluated 2011 NEI data plotted on GIS and concurs with Oklahoma's conclusion that there were no other major sources that were large enough or close enough to be necessary to include in the modeling other than the two that they included. In addition to the WFEC Hugo station, the other emitters of SO_2 included in the area of analysis that could generate concentration gradients in the area of study (Choctaw County and elevated impact area around WFEC Hugo station) are: International Paper and BDM Eng. facilities, both located within 20 km of WFEC Hugo station. The grid spacing is appropriate since they capture the concentration gradient changes in the impact contours from the facility, which show decreases at greater distances from the WFEC Hugo's facility. The state determined that this was the appropriate distance 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. In addition to the WFEC Hugo station, the other emitters of SO_2 included in the area of analysis are: BDM Eng. and International Paper. The grid receptor spacing for the area of analysis chosen by the state is as follows:

- Receptors spaced at 100 m along the fence line of the affected sources;
- Receptors spaced at 100 m from the fence line out to 2 km;
- Receptors spaced at 250 m from 2 km out to 3 km;
- Receptors placed at 500 m from 3 km to 5 km; and
- Receptors spaced at 1 km from 5 km out to edge of domain (~10 km).

Figure 2 shows the state's chosen area of analysis surrounding the WFEC Hugo station, as well as receptor grid for the area of analysis.

Figure 2: WFEC Hugo Generating Station Receptor Grid for the Area of Analysis



Consistent with the Modeling TAD, receptors for the purposes of this designation effort were placed only in areas where it would also be feasible to place a monitor and record ambient air impacts. The impacts of the area's geography and topography will follow in the appropriate section. While the 10+ km grid around WFEC Hugo station is on the small side, given the rural nature and lack of many nearby SO_2 sources that can lead to interaction of sources in a

cumulative analysis, the grid utilized by Oklahoma is adequate to characterize the air quality and concentration gradients within the area of study around WFEC Hugo station and Choctaw County.

Modeling Parameter: Source Characterization

The state characterized the source(s) 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 correctly characterized the source'(s) building layout and location, as well as the stack parameters, e.g., exit temperature, exit velocity, location, and diameter. Where appropriate, the AERMOD component BPIPPRIME was used to assist in addressing building downwash.

Modeling Parameter: Emissions

The 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 the most recently permitted, (referred to as PTE or allowable) emissions rate.

The 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, the EPA's Modeling TAD highly encourages the use of AERMOD's hourly varying emissions keyword HOUREMIS, or through the use of AERMOD's variable emissions factors keyword EMISFACT. When choosing one of these methods, the EPA believes that detailed throughput, operating schedules, and emissions information from the impacted source(s) 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 the WFEC Hugo station and 2 other emitters of SO_2 within 20 km in the area of analysis. No representative monitoring data is nearby or in the county, so the spacing is appropriate to cover any possible contributions from contributing sources in adjacent counties. These facilities were selected because the state believes that these sources and the area of analysis adequately represents the area that could cause or contribute to a

NAAQS violation in the vicinity of the affected source. No other sources beyond 20 km were determined by the state to have the potential to cause significant concentration gradient impacts within the area of analysis. The area of analysis and its associated annual actual SO_2 emissions between 2012 and 2014 are summarized in Table 1 below. Table 2 contains modeled stack parameters for contributing sources in the area of analysis.

Table 1: Actual SO_2 Emissions Between 2012 – 2014 from Facilities in the Choctaw County Area of Analysis

Company ID	Facility Name	SO_2 Emissions tpy		
		2012	2013	2014
WFEC	Hugo Generating Station	8,066	10,878	8,965
Total Emissions	All Facilities	8,066	10,878	8,965

Table 2: Modeled Stack Parameters for Contributing Sources in Area of Analysis

Source ID	Facility	Easting (m)	Northing (m)	Elevation (m)	Stk Ht (ft)	Stk Temp (°F)	Velocity (fps)	Stk Dia (ft)	SO_2 (lb/hr)
UNIT 1	WFEC – Hugo	839782.8	3769894.6	147.1	500.0	260	47.00	26.0	2,391.03
PLT76[1]	BDM Eng	834500.0	3780048.7	156.3	25.0	160	96.67	3.0	8.98
IPBRKBLR	International Paper	859439.4	3768633.0	151.3	246.0	133	42.60	11.0	4.62
IPPRBLR	International Paper	859435.2	3768628.3	151.2	296.0	439	88.80	14.5	8.55
IPNRFN	International Paper	859499.9	3768626.1	152.5	296.0	439	88.80	14.5	32.60
IPLIMEKILN	International Paper	859486.6	3768587.3	152.6	148.0	469	44.70	5.8	0.36

For WFEC Hugo station in the area of analysis, the state used actual emissions from the most recent 3-year data set, i.e., 2012 – 2014. CEMS data was used to generate hourly emissions files for the affected sources. The emission data was downloaded from the Clean Air Markets Database (CAMD). The monthly data was combined generating annual emission data files for each source at an affected facility with CEMS data. The three variables used in an hourly emission file are emissions, velocity, and temperature. These hourly values were generated from the CAMD datasets and formatted into the units used by AERMOD. The emissions were converted from lb/hr values into g/s. The heat input given in the CAMD data was used with Method 19, CO_2 concentration, moisture concentration, and stack temperature from recent relative accuracy test audits (RATA), to generate the flow rate and resultant velocity. If a unit was operating it was assigned the normal stack temperature. The data was then reviewed for continuity and for missing data. If there was a single hour of missing data, it was replaced with the average of surrounding non-missing hours. If there are periods of missing data with more than a single missing value, operational data from the affected facility was reviewed to fill the missing hours.

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.

2012-2014 meteorological data was utilized for the 2010 1-hour SO_2 primary NAAQS designations modeling. The State of Oklahoma utilizes Oklahoma Mesonet surface data, along with National Climatic Data Center (NCDC) Integrated Surface Hourly Database (ISHD) NWS surface data and National Oceanic and Atmospheric Administration (NOAA) Earth System Research Laboratory (ESRL) Global Systems Division (GSD) formerly Forecast Systems Laboratory (FSL) Upper Air (UA) data, with all air dispersion modeling. Oklahoma Mesonet data is incorporated to help make more accurate forecasts of ambient impacts from the affected sources. Use of the Oklahoma Mesonet data also promotes use of more recent, more accurate, and more representative data. Processed Oklahoma Mesonet surface data is combined with ISHD surface data and ESRL UA radiosonde data using AERMET to produce the surface and profile files used by AERMOD. However, if the NWS station is closer to the facility being modeled and the station is an ASOS station with sub-hourly observations, Mesonet data is not utilized with the modeling since the ISHD surface data would be more representative.

For each affected source domain a specific meteorological data set was developed based on spatial and climatological (temporal) representativeness. The representativeness of the specific meteorological data set to the affected source domain was based mainly on proximity and terrain. Representativeness of the surface characteristics (albedo, Bowen ratio, and surface roughness) were also reviewed when assigning a specific metrological data set to an affected source domain.

There are approximately 83 NWS automated weather stations in and around Oklahoma that were evaluated for combining with Oklahoma Mesonet data to accurately represent the individual modeling domains. These stations usually take atmospheric measurements once every hour. The ISH data files were downloaded from the NCDC ISHD web site: ftp://ftp.ncdc.noaa.gov/pub/data/noaa. Some of the sites are ASOS stations with continuous sub-hourly values.

The ISH data sites were reviewed for completeness by evaluating the number of hours that were recorded at each site. If a specific site contained a significant amount of missing hours, then those specific sites were not considered when assigning ISH sites to specific Oklahoma Mesonet sites. Since data from the Oklahoma Mesonet is combined with the ISHD data, there is generally no need to replace missing values for individual variables. One of the main variables utilized from the ISH data is cloud cover (GF1). For each ISHD data file, the specific number of missing cloud cover values was also evaluated. If a specific site had a significant number of missing cloud cover values, it was also excluded.

The NCDC began archiving 1-minute ASOS wind data (TD-6405), beginning January 2000 for first-order NWS ASOS stations, and beginning March 2005 for all other ASOS stations. For those ASOS sites, AERMINUTE (version 14337) data was used to incorporate continuous sub-hourly wind data. The ASOS (6405) files were downloaded and then processed using AERMINUTE. The ASOS 1-minute files were downloaded from http://www1.ncdc.noaa.gov/pub/data/ for each year and applicable ASOS station. There was an ASOS sites (KHHW) near the affected facility (WFEC Hugo station) with sub-hourly data.

The Oklahoma Mesonet measures a large variety of meteorological conditions at many sites across Oklahoma. At each site, the meteorological conditions are continuously measured and packaged into 5-minute observations. These 5-minute observations from the Oklahoma Mesonet were processed into an AERMET acceptable format. No missing data interpolation was performed for the 5-minute data sets.

Specific NCDC ISHD data sites and ESRL UA rawinsonde observation (RAOB) data sites were assigned to each Oklahoma Mesonet site based on distance and representativeness. Oklahoma's Appendix E lists the Oklahoma Mesonet sites used in the ambient air quality analyses and the assigned NCDC ISHD data site and ESRL UA RAOB data site for each Oklahoma Mesonet site. Wind roses for the specific domains are contained in Oklahoma's Appendix F.

The ESRL operates nine RAOB weather stations in and around Oklahoma. These stations usually take soundings twice a day. The ESRL data files were downloaded from the ESRL RAOB web site: http://esrl.noaa.gov/raobs/.

The UA data was reviewed for missing soundings. A single missing sounding will cause a whole day (24 hours) of missing meteorological data values. To reduce the number of missing meteorological data, replacement soundings were substituted for the missing soundings. The replacement soundings were selected from a site with similar thermodynamic profiles. Each UA data station was assigned a primary and a secondary replacement UA station. The primary station is basically the station that is closest to the station being reviewed. Each replacement sounding was documented.

When using AERMET (version 14134), to prepare the meteorological data for AERMOD, three surface characteristics (Albedo, Bowen Ratio, and Surface Roughness Length) must be determined for each surface site. Albedo is the fraction of total incident solar radiation reflected by the surface back to space without absorption. Bowen ratio, an indicator of surface moisture, is the ratio of sensible heat flux to latent heat flux. Surface roughness length relates the height of obstacles to the wind flow and is an important factor in determining the magnitude of mechanical turbulence and the stability of the boundary layer. Albedo and Bowen Ratio are used for determining planetary boundary layer parameters for convective conditions driven by the surface sensible heat flux.

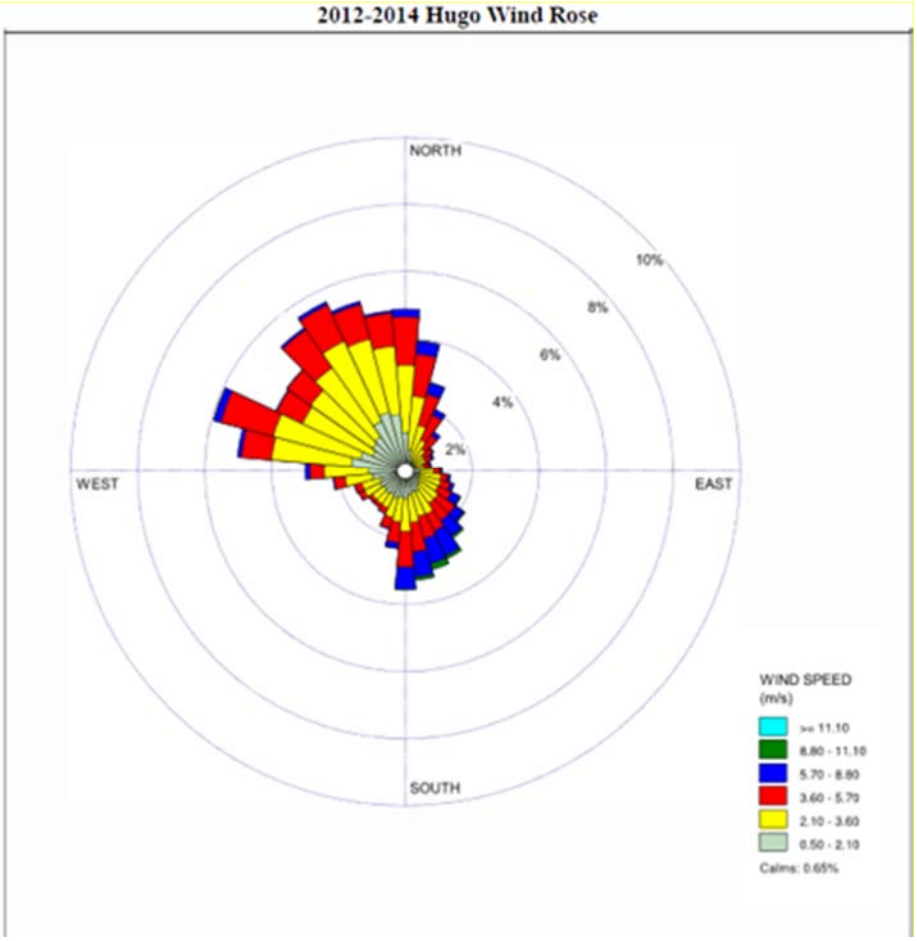
AERSURFACE (version 13016) uses land cover data from the U.S. Geological Survey (USGS) National Land Cover Data 1992 archives (NLCD92) to determine the land cover types for the area surrounding the surface meteorological station.

AERSURFACE matches the NLCD92 land cover categories to seasonal values of Albedo, Bowen Ratio, and Surface Roughness and then calculates the surface characteristics for input into AERMET. NLCD92 data in GeoTIFF format was downloaded from the Multi-Resolution Land Characteristics (MRLC) Consortium at the following link: http://www.mrlc.gov/viewerjs/. The surface characteristics of the individual domains are included in Appendix G of Oklahoma's modeling report.

The monthly rainfall since establishment of the Mesonet program (approximately 20 years) has been analyzed for each Mesonet site. The surface moisture conditions (Average, Wet, Dry) for each of the Oklahoma Mesonet stations for each month were then determined using the monthly rainfall amounts compared to the average rainfall. These determinations were based on the guidance contained in the AERSURFACE Users Guide. The Bowen Ratio was then assigned based on the monthly surface moisture conditions for each Oklahoma Mesonet station.

The 3-year surface wind rose for WFEC Hugo station is depicted in Figure 3. In this figure, the frequency and magnitude of wind speed and direction are defined in terms of where the wind is blowing from.

Figure 3: WFEC Hugo station Cumulative Annual Wind Rose for Years 2012 – 2014



Modeling Parameter: Geography and Terrain

Terrain data was included in all 2010 1-hour SO_2 designations modeling analyses. Terrain data was obtained from the USGS Seamless Data Server at http://viewer.nationalmap.gov/viewer/. The 1/3 arc-second NED data was obtained in the GeoTIFF format for use in AERMAP. Interpolation of receptor and source heights from the 1/3 arc-second NED elevation data was based on the current AERMAP guidance in Section 4.4 of the *User's Guide for the AERMOD Terrain Preprocessor (AERMAP)* (EPA-454/B-03-0003, 10/2004). AERMAP uses a distance weighted bilinear interpolation method.

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 Choctaw County area of analysis, the state chose background concentrations based on the 2012-2014 years of available

monitoring data. The background concentration for this area of analysis was determined by the state to be 9.6 micrograms per cubic meter ($\mu g/m^3$), or 3.67 ppb,[6] using the 3 year average of 99th percentile 1-hour daily maximum, and that value was incorporated into the final AERMOD results. The monitor was located in Oklahoma County, Oklahoma, and was chosen as a site located away from the areas of interest but impacted by similar natural and distant man-made sources. All other monitors in the state are impacted by other large SO_2 sources except for Oklahoma County.

Summary of Modeling Results

The AERMOD modeling parameters for the Choctaw County, OK area of analysis are summarized below in Table 3:

Table 3: AERMOD Modeling Parameters for the Choctaw County Area of Analysis

Choctaw County, OK Area of Analysis	
AERMOD Version	14134
Dispersion Characteristics	Rural
Modeled Sources	3
Modeled Stacks	6
Modeled Structures	-
Modeled Fence Lines	Yes (see Figure 4)
Total receptors	-
Emissions Type	Actual
Emissions Years	2012-2014
Meteorology Years	2012-2014
Surface Meteorology Station	Integrated Surface Hourly Database (ISHD) surface data
Upper Air Meteorology Station	9 weather stations in and around OK
Methodology for Calculating Background SO_2 Concentration	1st tier monitoring data
Calculated Background SO_2 Concentration	3.67 ppb or 9.6 $\mu g/m^3$

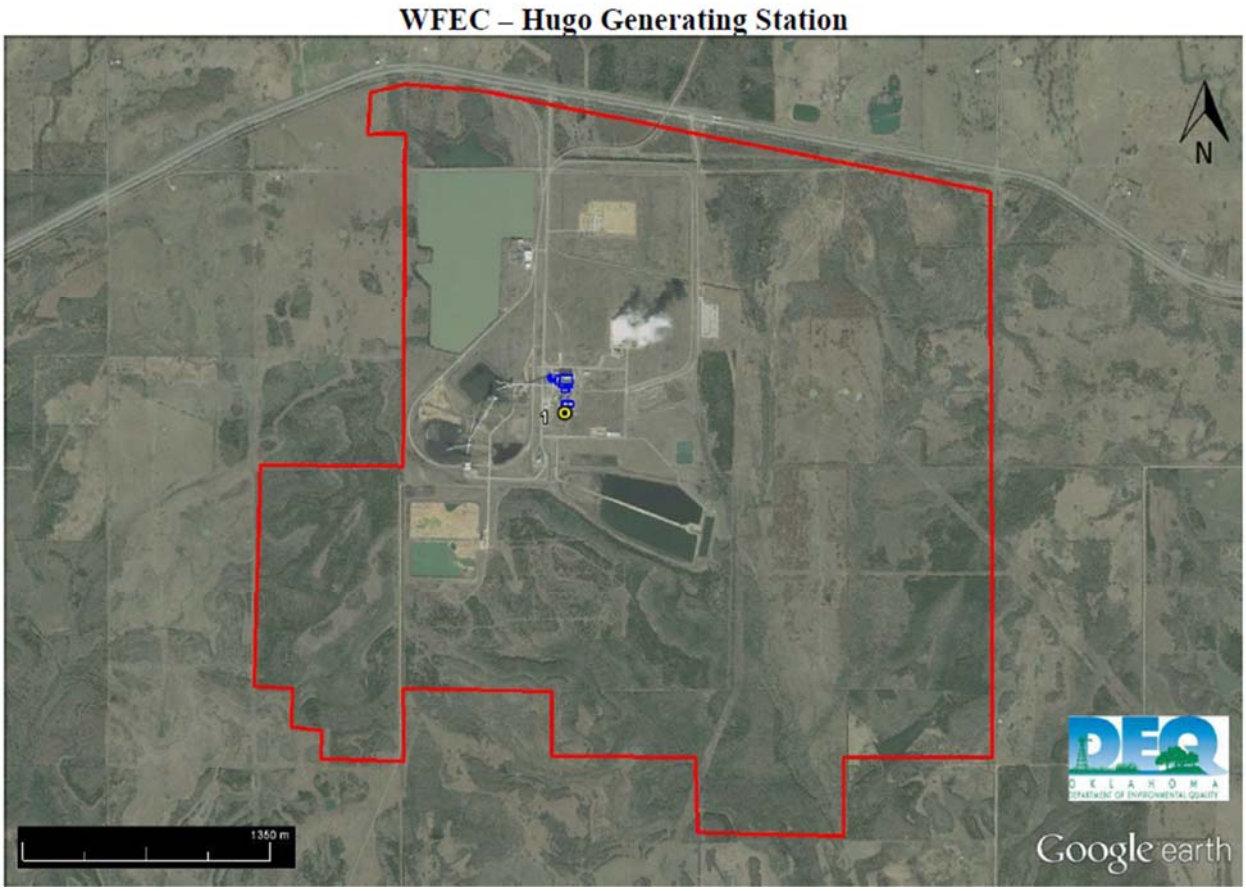
The results presented below in Table 4 show the magnitude and geographic location of the highest predicted modeled concentration based on actual emissions.

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

Table 4: 2012 – 2014 Max Predicted 99th Percentile 1-Hour SO_2 Concentration in the Choctaw County Area of Analysis based on Actual Emissions

		Modeled Impact	Background	Total Impact
Domain	Source Group	($\mu g/m^3$)	($\mu g/m^3$)	($\mu g/m^3$)
D20	ALL	108.6	9.6	118.2
	HUGO	108.5		
	IP	2.5		
	BDM	9.9		

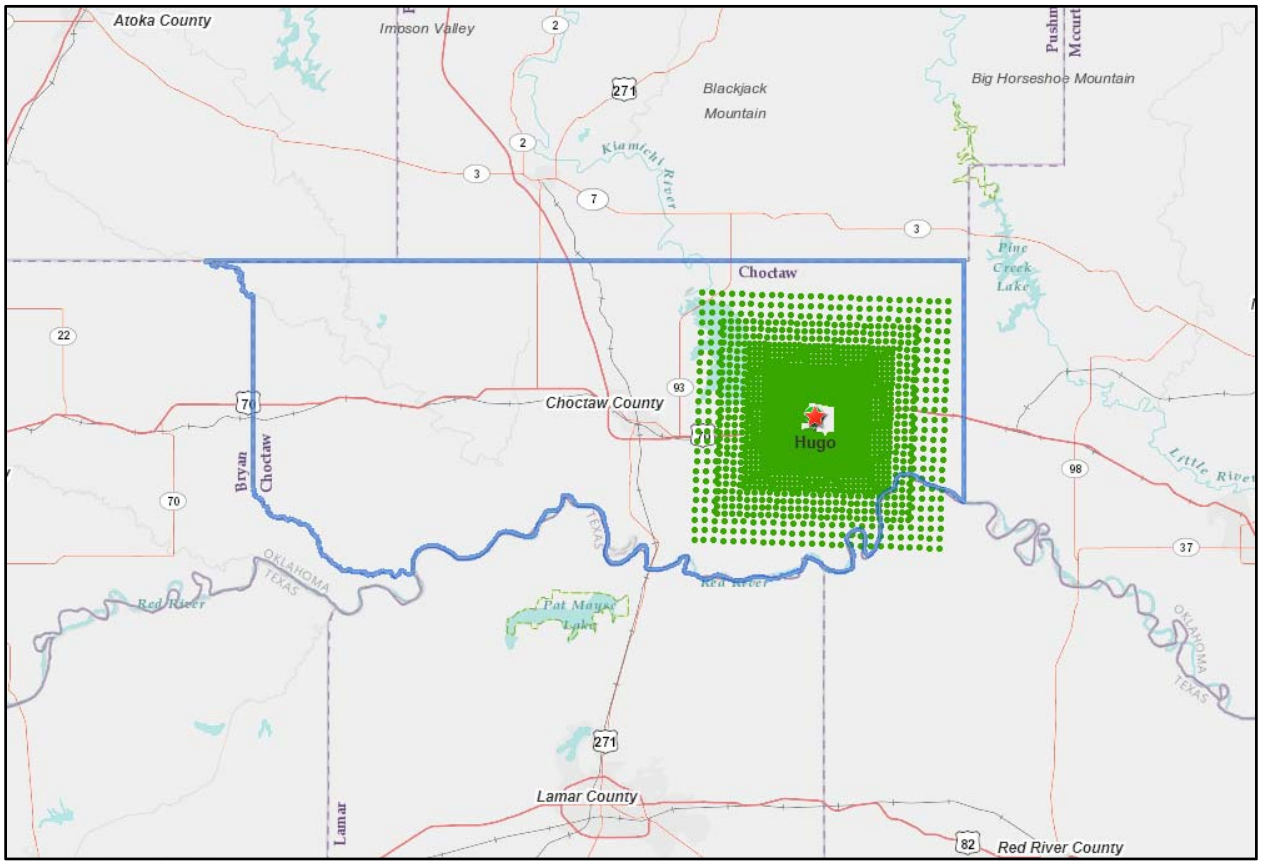
Figure 4: WFEC Hugo Generating Station Modeled Fence Lines



The state's modeling indicates that the predicted 99th percentile 1-hour average concentration within the chosen modeling domain is 118.2 $\mu g/m^3$, or 45.15 ppb. This modeled concentration included the background concentration of SO_2, and is based on actual emissions from the facilities.

Figure 5 shows the cumulative modeling results with all receptors below the standard (denoted with green color). The wind rose for the area indicates the maximum impacts from the WFEC Hugo station emissions is to the West of the facility. While the modeling grid located below only extended to 10 km, it does cover most of Choctaw County and the facility is isolated with only two SO_2 sources near enough to potentially cause a significant concentration gradient. When the wind is out of the East to Southeast, as happens much of the time, modeled concentrations on the western/northwestern receptors 10+ km from WFEC Hugo station are well below the standard in the 40-50s $\mu g/m^3$. When the winds are from the north, the southern edge of receptors 10+ km from WFEC Hugo station are also well below the standard in the 30-40s $\mu g/m^3$. Therefore, while the receptor grid is on the small side it is adequate to characterize the air quality levels in the area of concern.

Figure 5: Cumulative modeling results, Choctaw County boundary in blue and all receptors below the standard.



Jurisdictional Boundaries:

Once the geographic area of analysis associated with the WFEC Hugo station, other nearby sources, and background concentration is determined, existing jurisdictional boundaries are

considered for the purpose of informing our intended unclassifiable/attainment area, specifically with respect to clearly defined legal boundaries.

The EPA has confirmed that the only facility within the state's recommended boundaries and areas within 20 km of Choctaw County's borders emitting above 100 tpy based on 2011 NEI and state inventories for 2012-2014 reported values is WFEC Hugo station and the two other modeled facilities (IP and BDM), which have been modeled to show attainment with the NAAQS. There are no other sources over 100 tpy of SO_2 within over 50 km (nearest source was over 75 km from WFEC Hugo station). As a result, the EPA believes that there are no sources or emissions with Choctaw County or its neighbors that could potentially generate concentration gradients within Choctaw County. Therefore there are no other sources that are likely to cause or contribute to a violation of the NAAQS within Choctaw County.

The EPA believes that our intended unclassifiable/attainment area, consisting of Choctaw County, Oklahoma, 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.

Other Relevant Information

The EPA did not receive any other relevant information for the area around WFEC Hugo station.

Conclusion

After careful evaluation of the state's recommendation and supporting information, as well as all available relevant information, the EPA intends to designate the area around WFEC Hugo station as unclassifiable/attainment for the 2010 SO_2 NAAQS. Specifically, the boundaries are comprised of all area within Choctaw County Borders.

When evaluating the modeling submitted by the state, no major issues were identified. The modeling shows attainment, and the modeling follows EPA guidance, including the Modeling TAD. We came to the decision of choosing the area within Choctaw County as the boundary area for this designation based upon the state's recommendation. Additionally, the EPA has confirmed that there are no other sources in Choctaw County or near its borders that are likely to cause or contribute to a violation of the NAAQS within Choctaw 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 consent decree, the EPA will evaluate and designate all remaining undesignated areas in Oklahoma by either December 31, 2017, or December 31, 2020.

Technical Analysis for the Noble County, Oklahoma Area

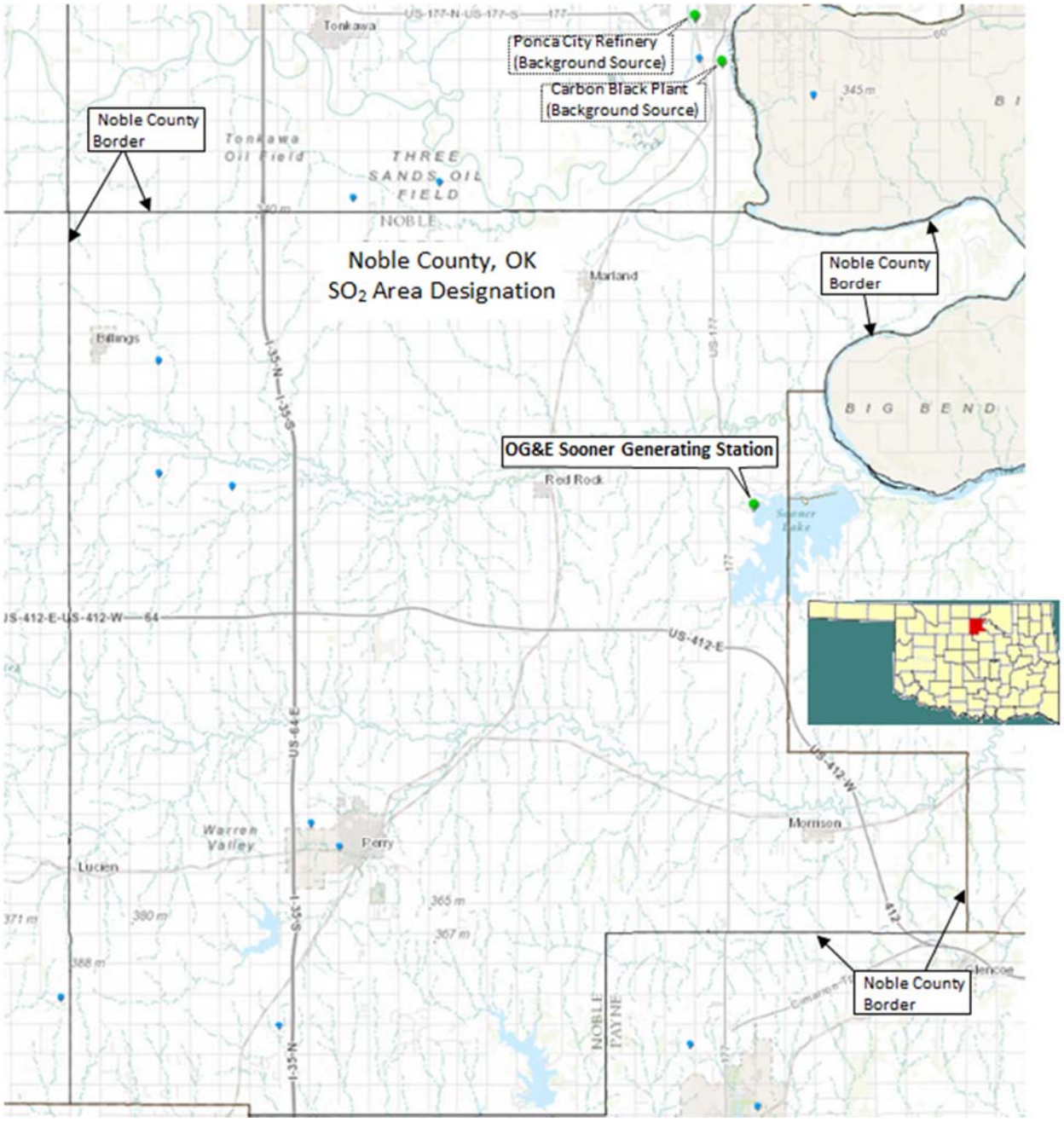
Introduction

The Noble County, Oklahoma area contains a stationary source that according to the 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 OG&E Sooner Generating Station (Sooner station) emitted 15,884 tons of SO_2, and had an emissions rate of 0.50 lbs SO_2/mmBTU. Pursuant to the March 2, 2015 consent decree, the EPA must designate the area surrounding the facility by July 2, 2016.

In its submission, Oklahoma recommended that the area surrounding the Sooner station, specifically the entirety of Noble 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, the EPA agrees that the area is attaining the standard, and intends to designate Noble County as unclassifiable/attainment.

The Sooner station is located in northcentral Oklahoma in the central portion of Noble County. As seen in Figure 1 below, the facility is located approximately 3 km west of the center of Sooner Lake. Also included in the figure is the EPA's intended unclassifiable/attainment designation county boundary for the area, which is the same recommended area as the state's intended attainment designation.

Figure 1: The EPA's intended Area Designation for OG&E Sooner Generating Station



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

Detailed Assessment

Air Quality Data

There are no SO_2 air quality monitors in Noble County. There are no SO_2 air quality monitors in surrounding counties that are representative of the maximum or higher elevated levels of SO_2 around the Sooner station facility. There is monitoring data in Kay County to the north but it is sited to pick up the higher impacts from the refinery.

Model Selection and Modeling Components

The EPA's Modeling TAD notes that for area designations under the 2010 SO_2 NAAQS, the AERMOD modeling system should be used, unless use of an alternative model can be justified. 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 the most recent AERMOD version 14134, and a discussion of the individual components will be referenced in the corresponding discussion that follows as appropriate.

Modeling Parameter: Rural or Urban Dispersion

The EPA's recommended procedure for characterizing an area by prevalent land use is based on evaluating the dispersion environment within 3 km of the facility. According to the 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. When performing the modeling for the area of analysis, the state determined that it was most appropriate to run the model in rural mode using aerial photos.

The aerial photos are included in Appendix B of Oklahoma's modeling report. We have reviewed the materials and concur with the selection of rural dispersion.

Modeling Parameter: Area of Analysis (Receptor Grid)

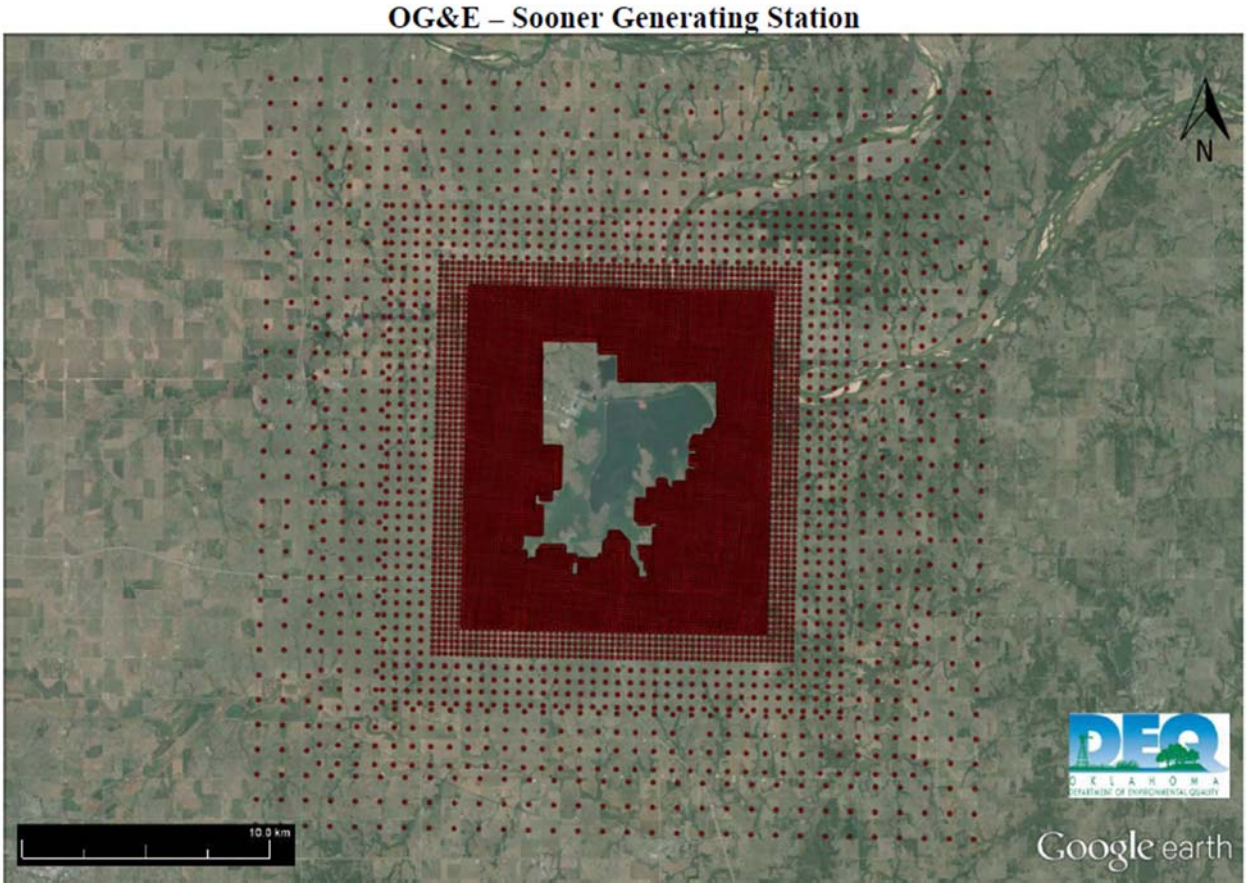
The EPA believes that a reasonable first step towards characterization of air quality in the area surrounding the Sooner station is to determine the extent of the area of analysis, i.e., receptor grid. Considerations presented in the Modeling TAD include but are not limited to: the location of the SO_2 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. The only significant source in Noble County is the Sooner station. For the area surrounding Noble County, the state has included 2 other emitters of SO_2 within 27 kilometers (km) of Sooner station in any direction. The state determined that there were no other nearby sources that could cause concentration gradients in the study area. There were no other major SO_2 sources within 50 km of the Sooner station. Therefore the sources that Oklahoma modeled are reasonable 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. EPA evaluated 2011 NEI data plotted on GIS and concurs with Oklahoma's conclusion that there were no other major sources that were large enough or close enough to be necessary to include in the modeling other than the two that they included. In addition to the Sooner station, the other emitters of SO_2 included in the area of analysis that could generate concentration gradients in the area of study (Noble County and elevated impact area around Sooner station) are: Phillips 66 Refinery and Continental Carbon, both located approximately 22-26 km north in Kay County. The grid receptor spacing for the area of analysis chosen by the state is as follows:

- Receptors spaced at 100 m along the fence line of the affected sources;
- Receptors spaced at 100 m from the fence line out to 2 km;
- Receptors spaced at 250 m from 2 km out to 3 km;
- Receptors placed at 500 m from 3 km to 5 km; and
- Receptors spaced at 1 km from 5 km out to edge of domain (~10 km).

Figure 2 shows the state's chosen area of analysis surrounding the Sooner station, as well as receptor grid for the area of analysis.

Figure 2: OG&E Sooner Generating Station Receptor Grid for the Area of Analysis



Consistent with the Modeling TAD, receptors for the purposes of this designation effort were placed only in areas where it would also be feasible to place a monitor and record ambient air impacts. While Oklahoma only modeled receptors out to approximately 10 km from the Sooner station facility, review of the modeling concentrations indicate that this was reasonable enough for quantification of the higher impacts from the Sooner station and the higher cumulative impacts of all sources (Sooner and other sources) that potentially impact concentration gradients in Noble County. The receptors were placed out to 10 km from the facility and as discussed below, this covered most of Noble County, and the cumulative gradients were less than 1/3 the standard at the edge of the receptor grid. The impacts of the area's geography and topography will follow in the appropriate section.

Modeling Parameter: Source Characterization

The state characterized the source(s) 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 correctly characterized the source'(s) building layout and location, as well as the stack parameters, e.g., exit temperature, exit velocity, location, and diameter. Where appropriate, the AERMOD component BPIPPRIME was used to assist in addressing building downwash.

Modeling Parameter: Emissions

The 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 the most recently permitted, (referred to as PTE or allowable) emissions rate.

The 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, the EPA's Modeling TAD highly encourages the use of AERMOD's hourly varying emissions keyword HOUREMIS, or through the use of AERMOD's variable emissions factors keyword EMISFACT. When choosing one of these methods, the EPA believes that detailed throughput, operating schedules, and emissions information from the impacted source(s) 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 the Sooner station and 2 other emitters of SO_2 within 20 km in the area of analysis. The other sources are approximately 22.5 and 26 km from OG&E and approximately 7.5 km and 10 km from the Noble County border. Oklahoma modeled out to 10 km from OG&E's facility and chose to include sources within a 20+ km distance of the grid that they thought could potentially cause a significant concentration gradient in the 20 km x 20 km grid that they modeled around the OG&E facility. Oklahoma thought this distance was sufficient to adequately represent emission sources in the area that could cause or contribute to any potential modeled NAAQS violation in the vicinity of the affected source (OG&E). No other sources beyond 20 km were determined by the state to have the potential to cause significant concentration gradient impacts within the area of analysis. We reviewed 2011 NEI sources over 100 tpy of SO_2 emissions and the closest source was over 70 km away and not normally upwind. Based on EPA's permit modeling guidance and best modeling practices we agree that Oklahoma selection of sources to model and modeling grid adequately assess the area around OG&E's facility. In addition, Oklahoma used the 1st tier approach to determine background concentration from the Oklahoma City monitor (large urban area vs. rural Noble County), which is the only SO_2 monitor in Oklahoma not largely impacted by a nearby SO_2 source. The area of analysis and its associated annual actual SO_2 emissions between 2012 and 2014 are summarized in Table 1

below. Table 2 contains modeled stack parameters for contributing sources in the area of analysis.

Table 1: Actual SO_2 Emissions 2012 – 2014 in the Noble County Area of Analysis

Company ID	Facility Name	SO_2 Emissions tpy		
		2012	2013	2014
OG&E	Sooner Generating Station	15,884	14,380	14,076
Continental Carbon	Ponca City Plant	3,134	4,841	5887
Phillips 66 Company	Ponca City Refinery	160	201	102
Total Emissions	**All Facilities**	**19,182**	**19,422**	**20,065**

Table 2 Modeled Stack Parameters for Contributing Sources in Area of Analysis

		Easting	Northing	Elevation	Stk Ht	Stk Temp	Velocity	Stk Dia	SO_2
Source ID	Facility	(m)	(m)	(m)	(ft)	(°F)	(fps)	(ft)	(lb/hr)
Unit 1	OG&E Sooner	674572.1	4036106.8	286.1	500.0	264	60.05	20.0	2,012.10
Unit 2	OG&E Sooner	674497.9	4036137.0	286.2	500.0	264	59.04	20.0	1,841.85
TO4	Continental Carbon	672587.8	4059257.6	293.2	213.3	1817	159.90	7.0	447.12
TO12	Continental Carbon	672416.8	4059290.6	293.4	150.0	1671	109.00	11.5	629.15
TO3	Continental Carbon	672538.8	4059261.6	293.6	150.0	1601	104.00	9.5	340.00
NO.4FCC	Phillips Refinery	671244.4	4062452.8	300.7	175.0	423	81.30	4.5	1.12
NO.5FCC	Phillips Refinery	671146.1	4061061.4	307.0	175.0	147	46.30	8.5	8.24
FLARESP	Phillips Refinery	671369.5	4060672.6	301.0	199.0	1832	65.30	3.0	1.02
FLARECC	Phillips Refinery	670807.4	4061307.2	301.3	150.0	1832	65.60	2.5	10.63
FLAREEP	Phillips Refinery	671187.6	4062248.4	296.1	245.0	1832	65.60	2.5	3.13
B0008	Phillips Refinery	670832.1	4061973.3	304.6	162.0	336	12.60	8.0	1.43
B9/B10	Phillips Refinery	670828.5	4062066.5	304.9	89.0	305	31.80	11.8	1.85

For Sooner station in the area of analysis, the state used actual emissions from the most recent 3-year data set, i.e., 2012 – 2014. CEMS data was used to generate hourly emissions files for the affected sources. The emission data was downloaded from the Clean Air Markets Database (CAMD). The monthly data was combined generating annual emission data files for each source at an affected facility with CEMS data. The three variables used in an hourly emission file are emissions, velocity, and temperature. These hourly values were generated from the CAMD datasets and formatted into the units used by AERMOD. The emissions were converted from lb/hr values into g/s. The heat input given in the CAMD data was used with Method 19, CO_2 concentration, moisture concentration, and stack temperature from recent relative accuracy test audits (RATA), to generate the flow rate and resultant velocity. If a unit was operating it was assigned the normal stack temperature. The data was then reviewed for continuity and for missing data. If there was a single hour of missing data, it was replaced with the average of surrounding non-missing hours. If there are periods of missing data with more than a single missing value, operational data from the affected facility was reviewed to fill the missing hours.

For the two other sources (Continental Carbon and Phillips Refinery) Oklahoma obtained tpy emission rates for each unit and the hours of operation each year to generate the lb/hr emission rate for each source. They then averaged the emission rate for the three years to generate the emission rates used in the modeling.

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.

2012-2014 meteorological data was utilized for the 2010 1-hour SO_2 primary NAAQS designations modeling. The State of Oklahoma utilizes Oklahoma Mesonet surface data, along with National Weather Service surface data in Integrated Surface Hourly Database (ISHD) format, obtained from National Climatic Data Center (NCDC), and National Oceanic and Atmospheric Administration (NOAA) Earth System Research Laboratory (ESRL) Global Systems Division (GSD) formerly Forecast Systems Laboratory (FSL) Upper Air (UA) data, with all air dispersion modeling. Oklahoma Mesonet data is incorporated to help make more accurate forecasts of ambient impacts from the affected sources. Use of the Oklahoma Mesonet data also promotes use of more recent, more accurate, and more representative data. Processed Oklahoma Mesonet surface data is combined with ISHD surface data and ESRL UA radiosonde data using AERMET to produce the surface and profile files used by AERMOD. However, if the NWS station with ISHD format data is closer to the facility being modeled and the station is an ASOS station with sub-hourly observations, Mesonet data is not utilized with the modeling since the ISHD surface data would be more representative.

For each affected source domain a specific meteorological data set was developed based on spatial and climatological (temporal) representativeness. The representativeness of the specific meteorological data set to the affected source domain was based mainly on proximity and terrain. Representativeness of the surface characteristics (albedo, Bowen ratio, and surface roughness) were also reviewed when assigning a specific metrological data set to an affected source domain. There are approximately 83 ISHD automated weather stations in and around Oklahoma that were evaluated for combining with Oklahoma Mesonet data to accurately represent the individual modeling domains. These stations usually take atmospheric measurements once every hour. The ISH data files were downloaded from the NCDC ISHD web site: ftp://ftp.ncdc.noaa.gov/pub/data/noaa. Some of the sites are ASOS stations with continuous sub-hourly values.

The ISH data sites were reviewed for completeness by evaluating the number of hours that were recorded at each site. If a specific site contained a significant amount of missing hours, then those specific sites were not considered when assigning ISH sites to specific Oklahoma Mesonet sites. Since data from the Oklahoma Mesonet is combined with the ISHD data, there is generally no need to replace missing values for individual variables. One of the main variables utilized from the ISH data is cloud cover (GF1). For each ISHD data file, the specific number of missing cloud cover values was also evaluated. If a specific site had a significant number of missing cloud cover values, it was also excluded.

The NCDC began archiving 1-minute ASOS wind data (TD-6405), beginning January 2000 for first-order NWS ASOS stations, and beginning March 2005 for all other ASOS stations. For those ASOS sites, AERMINUTE (version 14337) data was used to incorporate continuous sub-hourly wind data. The ASOS (6405) files were downloaded and then processed using AERMINUTE. The ASOS 1-minute files were downloaded from http://www1.ncdc.noaa.gov/pub/data/ for each year and applicable ASOS station. There was one ASOS site (KSWO) near the affected facility (Sooner station) with sub-hourly data that was used for surface data.

The Oklahoma Mesonet measures a large variety of meteorological conditions at many sites across Oklahoma. Oklahoma Mesonet is a cooperative venture between Oklahoma State University (OSU) and the University of Oklahoma (OU). At each site, the meteorological conditions are continuously measured and packaged into 5-minute observations. These 5-minute observations from the Oklahoma Mesonet were processed into an AERMET acceptable format. No missing data interpolation was performed for the 5-minute data sets.

Specific NCDC ISHD data sites and ESRL UA rawinsonde observation (RAOB) data sites were assigned to each Oklahoma Mesonet site based on distance and representativeness. Oklahoma's Appendix E lists the Oklahoma Mesonet sites used in the ambient air quality analyses and the assigned NCDC ISHD data site and ESRL UA RAOB data site for each Oklahoma Mesonet site. Wind roses for the specific domains are contained in Oklahoma's Appendix F.

The ESRL operates nine RAOB weather stations in and around Oklahoma. These stations usually take soundings twice a day. The ESRL data files were downloaded from the ESRL RAOB web site: http://esrl.noaa.gov/raobs/.

The UA data was reviewed for missing soundings. A single missing sounding will cause a whole day (24 hours) of missing meteorological data values. To reduce the number of missing meteorological data, replacement soundings were substituted for the missing soundings. The replacement soundings were selected from a site with similar thermodynamic profiles. Each UA data station was assigned a primary and a secondary replacement UA station. The primary station is basically the station that is closest to the station being reviewed. Each replacement sounding was documented.

When using AERMET (version 14134), to prepare the meteorological data for AERMOD, three surface characteristics (Albedo, Bowen Ratio, and Surface Roughness Length) must be

determined for each surface site. Albedo is the fraction of total incident solar radiation reflected by the surface back to space without absorption. Bowen ratio, an indicator of surface moisture, is the ratio of sensible heat flux to latent heat flux. Surface roughness length relates the height of obstacles to the wind flow and is an important factor in determining the magnitude of mechanical turbulence and the stability of the boundary layer. Albedo and Bowen Ratio are used for determining planetary boundary layer parameters for convective conditions driven by the surface sensible heat flux.

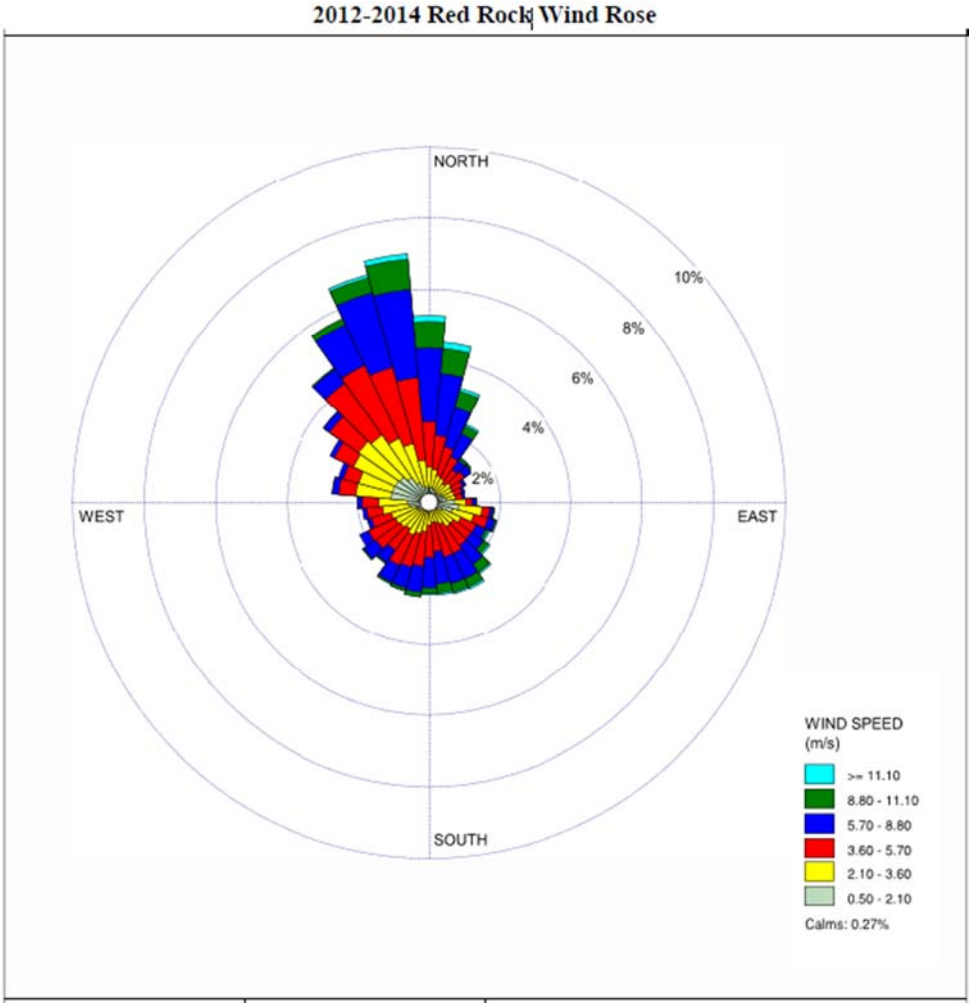
AERSURFACE (version 13016) uses land cover data from the U.S. Geological Survey (USGS) National Land Cover Data 1992 archives (NLCD92) to determine the land cover types for a specified location. AERSURFACE was run for the surface met data site.

AERSURFACE matches the NLCD92 land cover categories to seasonal values of Albedo, Bowen Ratio, and Surface Roughness and then calculates the surface characteristics for input into AERMET. NLCD92 data in GeoTIFF format was downloaded from the Multi-Resolution Land Characteristics (MRLC) Consortium at the following link: http://www.mrlc.gov/viewerjs/. The surface characteristics of the individual domains are included in Appendix G.

The monthly rainfall since establishment of the Mesonet program (approximately 20 years) has been analyzed for each Mesonet site. The surface moisture conditions (Average, Wet, Dry) for each of the Oklahoma Mesonet stations for each month were then determined using the monthly rainfall amounts compared to the average rainfall. These determinations were based on the guidance contained in the AERSURFACE Users Guide. The Bowen Ratio was then assigned based on the monthly surface moisture conditions for each Oklahoma Mesonet station.

The 3-year surface wind rose for the Sooner station is depicted in Figure 3. In this figure, the frequency and magnitude of wind speed and direction are defined in terms of where the wind is blowing from.

Figure 3: Sooner Cumulative Annual Wind Rose for Years 2012 – 2014



Modeling Parameter: Geography and Terrain

Terrain data was included in all 2010 1-hour SO_2 designations modeling analyses. Terrain data was obtained from the USGS Seamless Data Server at http://viewer.nationalmap.gov/viewer/. The 1/3 arc-second NED data was obtained in the GeoTIFF format for use in AERMAP. Interpolation of receptor and source heights from the 1/3 arc-second NED elevation data was based on the current AERMAP guidance in Section 4.4 of the *User's Guide for the AERMOD Terrain Preprocessor (AERMAP)* (EPA-454/B-03-0003, 10/2004). AERMAP uses a distance weighted bilinear interpolation method.

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 Noble County area of analysis, the state chose background concentrations based on the 2012-2014 years of available monitoring data. The background concentration for this area of analysis was determined by the state to be 9.6 micrograms per cubic meter ($\mu g/m^3$), or 3.67 ppb,[7] using the 3 year average of 99th percentile 1-hour daily maximum, and that value was incorporated into the final AERMOD results. The monitor was located in Oklahoma County, Oklahoma, and was chosen as a site located away from the areas of interest but impacted by similar natural and distant man-made sources. All other monitors in the state are impacted by other large SO_2 sources except for Oklahoma County.

Summary of Modeling Results

The AERMOD modeling parameters for the Noble County area of analysis are summarized below in Table 3:

Table 3: AERMOD Modeling Parameters for the Noble County Area of Analysis

Noble County, OK Area of Analysis	
AERMOD Version	14134
Dispersion Characteristics	Rural
Modeled Sources	3
Modeled Stacks	12
Modeled Structures	-
Modeled Fence Lines	Yes (see Figure 4)
Total receptors	-
Emissions Type	Actual
Emissions Years	2012-2014
Meteorology Years	2012-2014
Surface Meteorology Station	Integrated Surface Hourly Database (ISHD) surface data
Upper Air Meteorology Station	9 weather stations in and around OK
Methodology for Calculating Background SO_2 Concentration	1st tier monitoring data
Calculated Background SO_2 Concentration	3.67 ppb or 9.6 $\mu g/m^3$

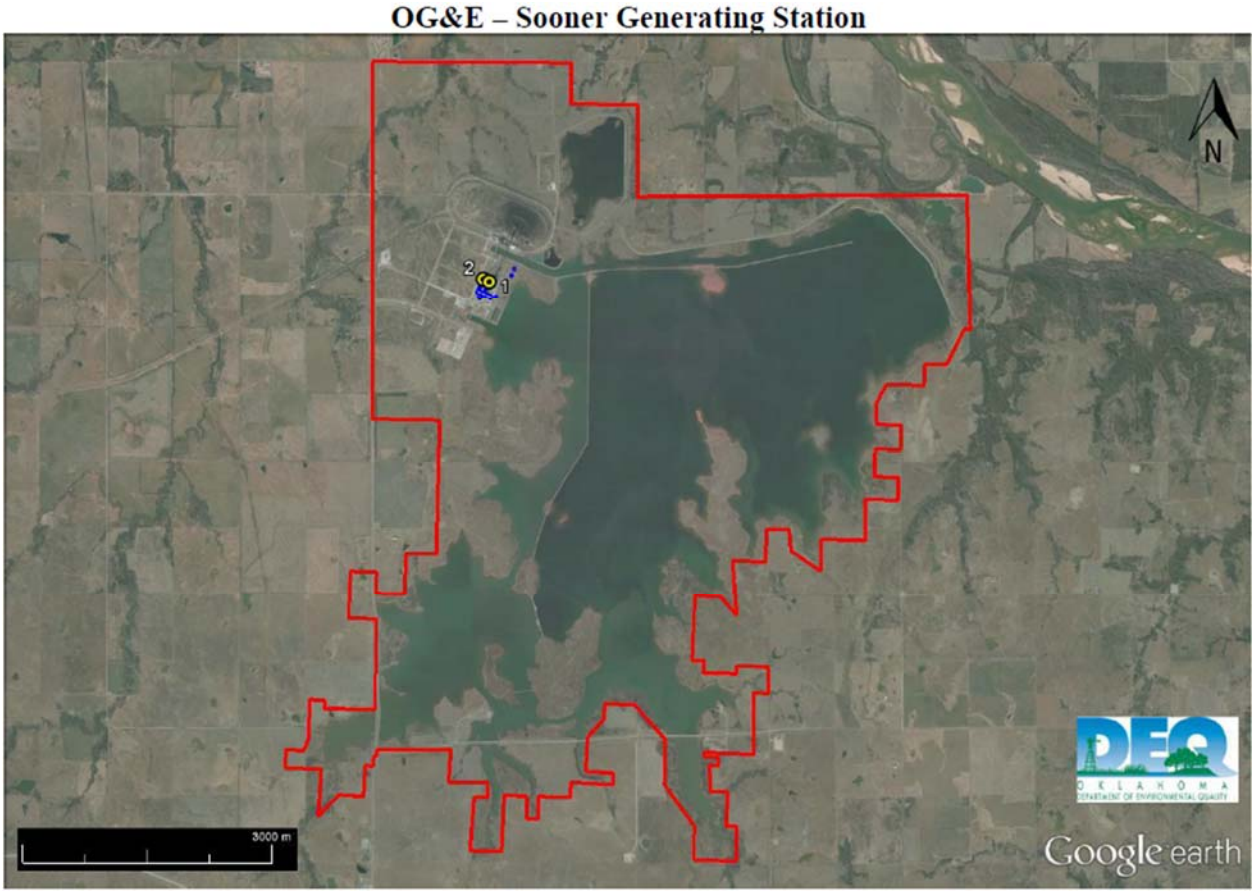
[7] The conversion factor for SO_2 (at the standard conditions applied in the ambient SO_2 reference method) is 1ppb = approximately 2.62$\mu g/m^3$.

The results presented below in Table 4 show the magnitude and geographic location of the highest predicted modeled concentration based on actual emissions.

Table 4: 2012 – 2014 Max Predicted 99th Percentile 1-Hour SO_2 Concentration in the Noble County Area of Analysis based on Actual Emissions

		Modeled Impact	Background	Total Impact
Domain	Source Group	($\mu g/m^3$)	($\mu g/m^3$)	($\mu g/m^3$)
D39	ALL	127.0	9.6	136.6
	OGE	126.8		
	CONT	33.5		
	PHILLIPS	1.8		

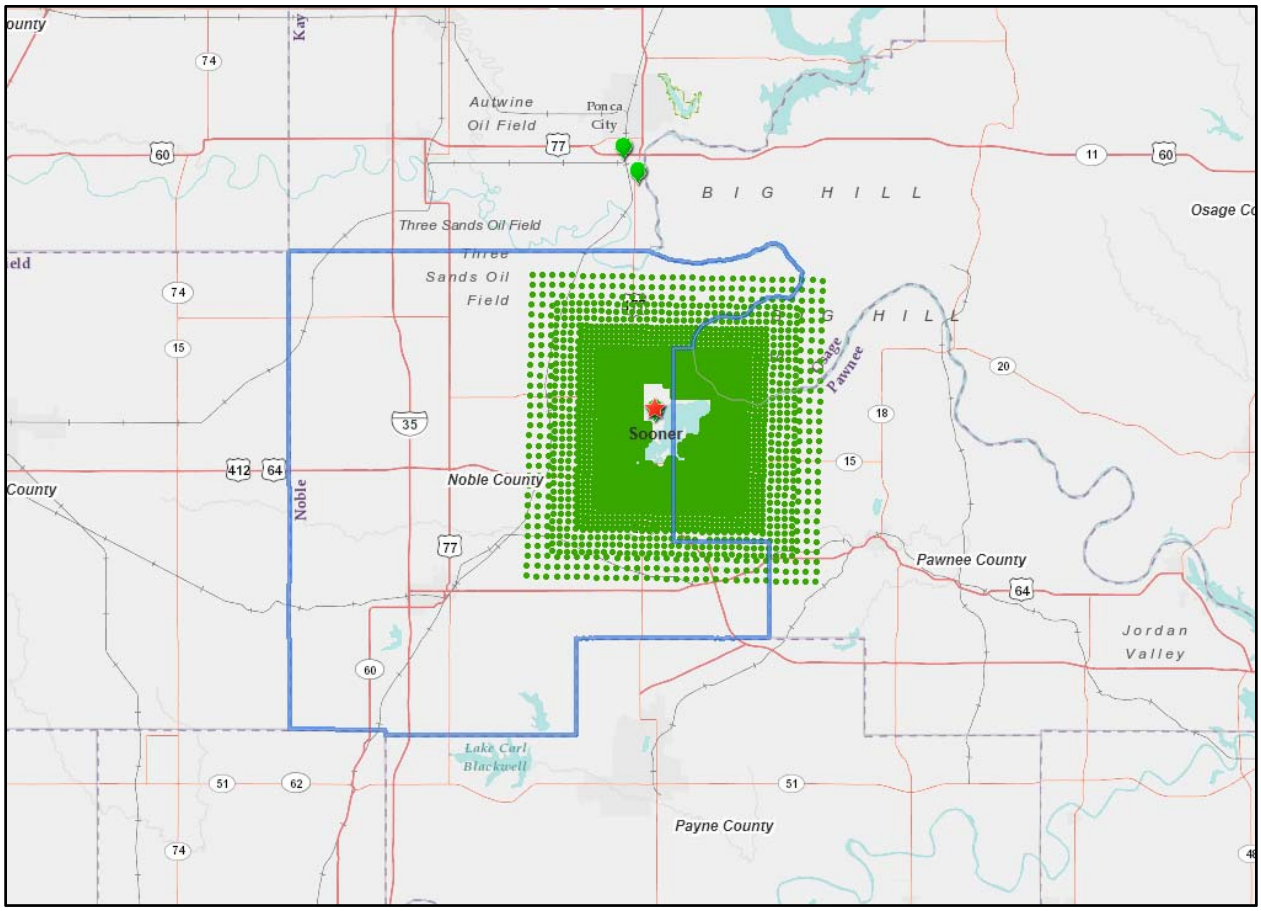
Figure 4: OG&E Sooner Generating Station Modeled Fence Lines



The state's modeling indicates that the predicted 99th percentile 1-hour average concentration within the chosen modeling domain is 136.6 $\mu g/m^3$, or 52.19 ppb. This modeled concentration included the background concentration of SO_2, and is based on actual emissions from the facilities.

Figure 5 is modeling results for Scenario 1 with all receptors below the standard (denoted with green color). The wind rose for the area indicates the maximum impacts from the Sooner station emissions is to the NW of the facility. While the modeling grid located below only extended to 10 km it does cover most of Noble County, and the facility is isolated with only two SO_2 sources near enough to potentially cause a significant concentration gradient. When the wind is out of the South or Southeast, as happens much of the time, modeled concentrations on the northern/northwestern receptors 10+ km from Sooner station are well below the standard in the 50-60s $\mu g/m^3$ and the winds are such that 2 sources in Kay County would not contribute to these values. When the winds are from the north, the southern edge of receptors 10+ km from Sooner station are also well below the standard in the 50-60s $\mu g/m^3$. Therefore, while the receptor grid is on the small side it is adequate to characterize the air quality levels in the area of concern. We also note that the larger of the two sources modeled will be installing controls and the Continental Carbon emissions will drop significantly in the near future.

Figure 5: Cumulative modeling results, Noble County boundary in blue and all receptors below the standard.



Jurisdictional Boundaries:

Once the geographic area of analysis associated with the Sooner station, other nearby sources, and background concentration is determined, existing jurisdictional boundaries are considered for the purpose of informing our intended unclassifiable/attainment area, specifically with respect to clearly defined legal boundaries.

With the exception of Sooner station, whose emissions have been modeled to show compliance with the standard, there are no other sources within Noble County that emit at or above 100 tpy, based on 2011 NEI. Two facilities located in Kay County, i.e., Ponca City Refinery and Ponca City PLT/Continental Carbon (approximately 8 – 10 km from the Noble County border) have reported emissions of 235 tpy and 1,444 tpy, respectively, based on data from the 2011 NEI. Historic and current monitored data in the general area of these facilities, i.e., within 5 km, do not indicate violations of the NAAQS. Specifically, Air Quality Systems ID 40-071-0604 and 40-071-0602 recorded design values of 37 ppb (2012 – 2014) and 33 ppb (2009 – 2011). While it is unknown whether these monitors were deployed in order to capture the points of maximum concentration from either of these facilities, the EPA does not, based on available information, have reason to believe their emissions, when considered with the distance from the Noble County border, are likely to cause or contribute to a violation of the NAAQS within Noble County.

The EPA believes that our intended unclassifiable/attainment area, consisting of Noble County, Oklahoma, 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.

Other Relevant Information

The EPA did not receive any other relevant information for the area surrounding Sooner station.

Conclusion

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

When evaluating the modeling submitted by the state, no major issues were identified. The modeling shows attainment, and the modeling follows EPA guidance, including the TAD. We came to the decision of choosing the area within Noble County as the boundary area for this designation based upon the state's recommendation. Additionally, the EPA has confirmed that there are no other sources in Noble County or near its borders that are likely to cause or contribute to a violation of the NAAQS within Noble 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 consent decree, the EPA will evaluate and designate all remaining undesignated areas in Oklahoma by either December 31, 2017, or December 31, 2020.