AIR QUALITY CHARACTERIZATION FOR SOURCE AREA: AIR DISPERSION MODELING

Charles R. Lowman Power Plant

SO_2 1-Hour NAAQS Data Requirements Rule

B&V PROJECT NO. 188991

PREPARED FOR

PowerSouth Energy Cooperative

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1.0 Introduction

On June 2, 2010, the USEPA announced new NAAQS (National Ambient Air Quality Standards) 1-hour for sulfur dioxide (SO_2) of 75 ppb (196 µg/m^3) and revoked the existing annual and 24-hour standards, which were published in the Federal Register on June 22, 2010 and became effective on August 23, 2010.

The United States Environmental Protection Agency (USEPA) established a timetable and other requirements for state air agencies to characterize current air quality in areas with large sources of SO_2 emissions through monitoring or modeling techniques. The rule outlining these requirements is referred to as the Data Requirements Rule (DRR) for the 2010 1-Hour SO_2 primary NAAQS and was published in the Federal Register on August 21, 2015. The Alabama Department of Environmental Management (ADEM) identified PowerSouth Energy Cooperative's (PowerSouth) Charles R. Lowman (Lowman) generating facility near Jackson, Alabama, as a source of SO_2 emissions and thus must characterize the air quality within its vicinity. The DRR allows for such large sources to characterize the air quality by utilizing ambient air monitors or by conducting an air dispersion modeling analysis.

ADEM chose to characterize the current air quality near the Lowman facility through an assessment of the ambient SO_2 concentration that utilized the air dispersion modeling approach. This document describes the air quality impact analysis methodology for characterizing the ambient air quality near the Lowman facility and summarizes the model results in support of the requirements of the DRR.

2.0 Ambient Air Quality Impact Analysis

The following subsections in this document provide the methodology that was utilized to characterize the ambient air quality near Lowman in conformance with a modeling protocol submitted on June 14, 2016. The EPA responded to this modeling protocol submittal with comments on August 18, 2016, which are reflected in the modeling analysis herein, and did not require a resubmittal of the modeling protocol. The methodology includes a discussion of the meteorological and geophysical databases used in the analysis and the air modeling approach characterize air quality relative to the 1-hr SO_2 NAAQS standard. In addition to the previously submitted modeling protocol, the methodology provided herein is based on the procedures recommended in USEPA's *Guideline of Air Quality Models* (GAQM) (Appendix W of 40 CFR 51), the SO_2 NAAQS Designations Modeling Technical Assistance Document (TAD)[1], as well as several guidance memorandums issued by USEPA.

2.1 CUMULATIVE SOURCE INCLUSION

In May 2016, ADEM performed an analysis to determine if any "cluster" of emission sources near the Lowman facility would be required to be included in any ambient air quality analysis. ADEM identified sources within a 20 km area surrounding Lowman and for each source calculated the 2014 actual emissions (in tpy) divided by the distance. This included small sources at very close distances. The metric ADEM used is as follows:

ADEM Metric: Q/D > 20 within 20km

- First, ALL sources within 20km of each facility were pulled,
- Next, a Q/D value was developed for each facility on the list, where Q represents the 2014 actual SO_2 tpy emissions totals, and D represents the distance between the two facilities,
- If the Q/D metric yielded a value of greater than 20, the facility was retained and additional QA/QC was performed on a unit by unit basis.

It is important to note that EPA did not prescribe criteria on selecting such nearby sources and in absence of prescribed guidance, states used their discretion in developing criteria they feel is appropriate to the form of the standard combined with acceptable and approved methods used in NAAQS evaluations in the past to develop criteria for additional source inventories.

As a result of this analysis, ADEM chose to include the emission sources located at the Boise White Paper, L.L.C. (Boise Paper Mill), a subsidiary of Packaging Corporation of America, located directly across the Tombigbee River from the Lowman facility in the characterization for the area around Lowman.

[1] "SO_2 NAAQS Designations Modeling Technical Assistance Document". USEPA, Office of Air and Radiation. December 2013. DRAFT

2.2 FACILITY CHARACTERIZATION

The following sections briefly characterize the Lowman facility including a general description of the site location as well as a discussion of the existing operation at the facility.

2.2.1 Facility Location

PowerSouth's Lowman generating facility resides in Leroy, Alabama. Lowman is on the eastern boarder of Washington County, overlooking the Tombigbee River and Clarke County. The specific location of the Lowman facility is illustrated in Figure 2-1. Boise Paper Mill is also illustrated in Figure 2-1, and is discussed in further detail in Section 2.3.1.

2.2.2 Existing Operation Description

The significant sources of air pollutants at this facility are one dry bottom wall-fired power boiler (Unit 1) that burns coal and fuel oil with a nominal input of 905 mmBtu/hr; two dry bottom opposed wall-fired power boilers (Units 2 and 3) that burn coal and fuel oil with a nominal input of 2,500 mmBtu/hr each; material handling systems; and four emergency generators. Each unit is equipped with an electrostatic precipitator (ESP) for control of particulate matter emissions. Units 1 and 2 share a flue gas desulfurization (FGD) system for the control of SO_2 which vents to the common stack (CS004). Unit 2 is also equipped with a selective catalytic reduction (SCR) system for control of nitrogen oxides (NO_X). In addition to the ESP for particulate matter emissions control, Unit 3 is equipped with a SCR system for control of NO_X and FGD system for control of SO_2. Unit 3 emissions exhaust through one chimney that houses two flues (MS03C and MS03D). Although PowerSouth has emergency generators onsite, ADEM agrees that the emergency nature of the engines deems it unnecessary to model them for this characterization analysis.

Figure 2-1 Facility Location

2.3 EMISSION SOURCE DATA

The final DRR, published in the Federal Register on August 21, 2015 states the modeling analyses shall characterize air quality based on either actual SO_2 emissions from the most recent 3 years, or on any federally enforceable allowable emission limit or limits established by the air agency or the USEPA and that are effective and require compliance by January 13, 2017. This provision reflects the view that designations are intended to address actual air quality (i.e., modeling simulates a monitor), and recognizes that permanent changes in emissions during the period of the DRR are relevant to the characterization and to designations. PowerSouth characterized the air quality based on the actual SO_2 emissions data.

For the purpose of conducting modeling to characterize air quality for use in SO_2 designations, the USEPA recommends using the most recent 3 years of actual data. Consistent with the TAD, only those emissions scenarios that are continuous enough or frequent enough to contribute significantly to the annual distribution of the maximum 1-hour concentrations need to be included in the analysis. As such, the SO_2 emissions associated with the infrequent operation of the four emergency generators were not included.

When using the actual emissions approach, it is necessary to provide an accurate representation of the variability in emissions from the source. Continuous emissions monitoring systems (CEMS) data provided acceptable hourly varying emissions data, per the TAD. PowerSouth collected the CEMS data for the three coal-fired boilers by retrieving the data from USEPA's Clean Air Market Database (CAMD) by using the ECMPS Client Tool. This data was corrected for any documented bias and utilized within the model.

In 2016, PowerSouth installed a permanent damper within the Unit 1 exhaust duct to prevent Unit 1 from exhausting to MS001 (also known as the bypass stack). As such, the exhaust gases from Unit 1 flow through the common air quality control equipment shared with Unit 2 and exhaust through stack CS004.

Because Unit 1 no longer utilizes the MS001 stack, and could not remove the permanent damper without authorization, the most accurate representation of relevant emissions from Unit 1 is exhausting through stack CS004. Accordingly, the emissions data was adjusted to reflect this scenario.

In addition to the hourly emission rate, the temperature and exhaust gas velocity for each stack was processed and an hourly emissions file was generated for input into the AERMOD model. The following static stack parameters for this analysis are presented in Table 2-1. This is a representation of the PowerSouth stack parameters, however, an electronic copy of the hourly emission files used in the model are found on the CD within Appendix A. Cluster source emission information was included in the model as well, and is discussed further in Section 2.3.1.

2.3.1 Boise Paper Mill

Boise Paper Mill is directly east of Lowman, bordering the east shore of the Tombigbee River, illustrated in Figure 2-1. Boise Paper Mill has three emission units included in the modeling, including a lime kiln, one chemical recovery furnace with two separate flues, and a combination fuel boiler. The hourly emissions data and building files for downwash were provided from and approved by ADEM on 10/26/2016, and are included in the hourly file within Appendix A. Documentation of ADEM’s approval is also included in Appendix A.

Table 2-1 Stack Parameters

STACK ID	X COORD (m) [1]	Y COOR (m) [1]	STACK ELEVATION (ft)	STACK HEIGHT (ft) [2]	STACK DIAMETER (ft)	EXHAUST TEMPERATURE (°F)	EXIT VELOCITY (ft/sec)	SO_2 EMISSION RATE (lb/hr)
MS03C	413515.9	3484128.8	41	401	16.5	See Appendix A	See Appendix A	See Appendix A
MS03D	413510.3	3484131.4	41	401	16.5	See Appendix A	See Appendix A	See Appendix A
CS004	413641.0	3484170.2	40	400	19.75	See Appendix A	See Appendix A	See Appendix A

NOTES [ ]:
1. Stack coordinates were updated from the protocol using surveyed measurements (Source: Thompson Engineering, Inc., 9/27/2016).
2. Stack heights are the actual physical stack height.
3. Hourly values obtained from the continuous monitoring system. Data is provided in electronic format in Appendix A.

2.4 MODEL SELECTION

Consistent with the previously submitted modeling protocol and the TAD, the American Meteorological Society/Environmental Protection Agency (AMS/EPA) Regulatory Model (AERMOD, Version 15181) air dispersion model was used to predict maximum ground-level concentrations associated with the facility's emissions. The AERMOD model was established as the USEPA preferred air dispersion model effective December 9, 2005, for regulatory applications[2].

2.5 MODEL DEFAULT OPTIONS

Since the AERMOD model is specifically designed to support the USEPA's regulatory modeling programs, the regulatory modeling options are considered the default mode of operation for the model. The following modeling features are referred to as the regulatory default options:

- Use of the elevated terrain algorithms;
- Use of stack-tip downwash (except for building downwash);
- Use of the calms processing routines;
- Use of the missing data processing routines;
- Use of a 4-hour half-life for exponential decay of SO_2 for urban sources.

This model did not utilize any beta low wind options as they have not yet been incorporated into Appendix W. Although the default options are used, PowerSouth reserves the right to use these low wind options should they become approved in the future.

2.6 DISPERSION COEFFICIENT

The AERMOD model has the option of assigning specific sources to have an urban effect, thus enabling AERMOD to employ enhanced turbulent dispersion associated with anthropogenic heat flux, parameterized by population size of the urban area. Section 7.2.3 of the GAQM provides the basis for determining the urban/rural status of a source. Land use was used to determine whether the urban or rural dispersion coefficient would be applied using the methodology described in Section 7.2.3(c) of the GAQM. The procedure for evaluating land use to determine the proper urban/rural classification is as follows:

- Classify the land use within the total area, Ao, circumscribed by a 3-km radius circle about the source using the meteorological land use typing scheme proposed by Auer.
- If land use types I1 (heavy industrial), I2 (light-moderate industrial), C1 (commercial), R2 (single-family compact residential), and R3 (multifamily compact residential) account for 50 percent or more of Ao, use urban dispersion coefficients; otherwise, use appropriate rural coefficients.

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[2] Federal Register, Volume 70, No. 216. November 9, 2005. EPA 40 CFR Part 51, Revision to the Guideline on Air Quality Models: Adoption of a Preferred General Purpose (Flat and Complex Terrain) Dispersion Model and Other Revisions. Final Rule.

The land use classification analysis was performed using the most recent available USGS National Land Cover Data (NLCD), which is the 2006 dataset. Data was obtained from the Multi-Resolution Land Characteristics Consortium (MRLC)[3]. GIS software was utilized to read the NLCD data files and to extract the land cover categories within the 3-km area centered on the facility. Given that urban land use accounts for well below 50 percent of the Ao, the urban dispersion coefficient option was not invoked in AERMOD and appropriate rural dispersion coefficients were applied.

2.7 BUILDING DOWNWASH

The dispersion of a plume can be affected by nearby structures when a stack is short enough to allow a plume to be significantly influenced by surrounding building turbulence. This phenomenon, known as structure induced downwash, generally results in higher model-predicted ground level concentrations in the vicinity of the influencing structure.

Sources are subject to Good Engineering Practice (GEP) stack height requirements outlined in 40 CFR Part 51, sections 51.100 and 51.118. These regulations basically state that facilities are not permitted to take credit for ground level emissions reductions resulting from building source stacks above the GEP stack height to justify a lesser degree of control than would be needed otherwise. GEP stack height is defined to be the greater of:

1. 65 meters,
2. A height established by applying the formula:

   $$H_{GEP} = H + 1.5\ L$$

   where:

   H_{GEP} = GEP stack height

   H = height of nearby structure(s)

   L = lesser dimension (height or projected width) of nearby structure(s), or
3. A height demonstrated by a fluid model or a field study which ensures that emissions from a stack do not result in excessive concentrations of any pollutant as a result of atmospheric downwash, wakes, or eddy effects created by the source itself, nearby structures, or nearby terrain features.

Since a fluid model analysis or a field study was not completed, the GEP stack height is defined by Definitions 1 or 2. As such, the term nearby is defined as a distance up to five times the lesser of the height or width dimension of a structure or terrain feature, but not greater than 800 meters.

For this analysis, the existing buildings and structures of significant height were analyzed to determine their potential to influence the plume dispersion from the Project's emissions and used the actual physical stack height for each emission source. Figure 2-2 and Figure 2-3 illustrates the

[3] USGS National Land Cover Data, 2006. http://www.mrlc.gov

layout of structures that were included in the downwash analysis for PowerSouth and Boise Paper Mill, respectively. Structure dimensions and relative locations were entered into the USEPA's Plume Rise Model Enhancement (PRIME) version of Building Profile Input Program Prime (BPIPPRM, Version 04274) to produce an AERMOD input file with direction-specific building downwash parameters for each 10 degree azimuth direction.

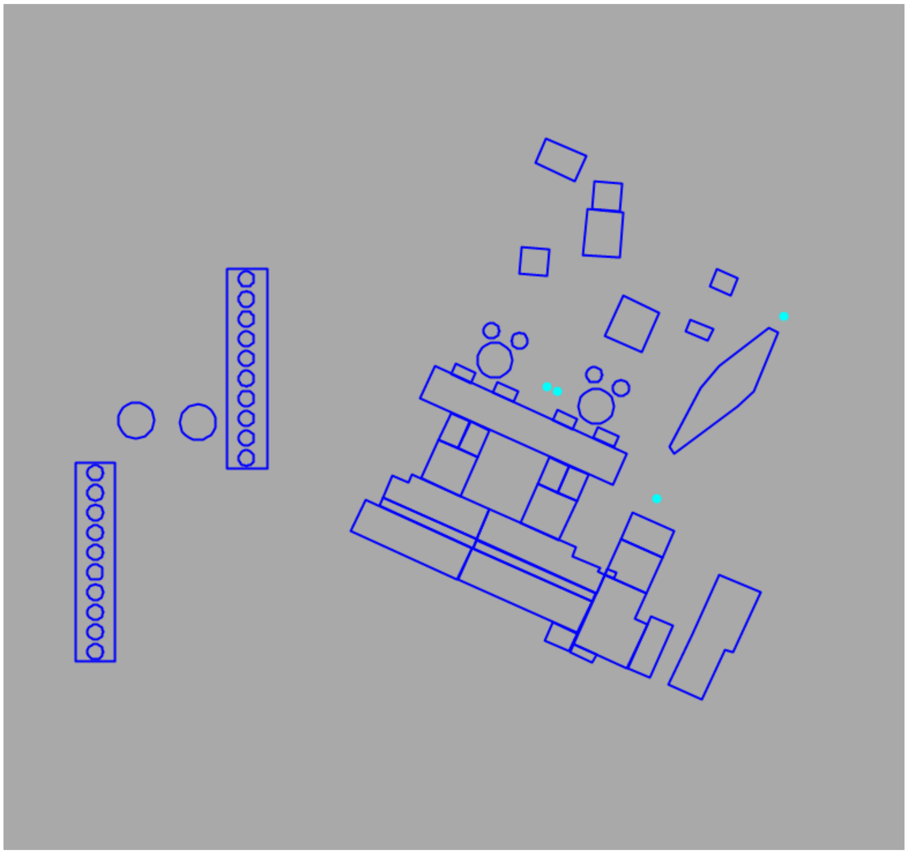

Figure 2-2 Location of Sources and Surrounding Buildings – Lowman

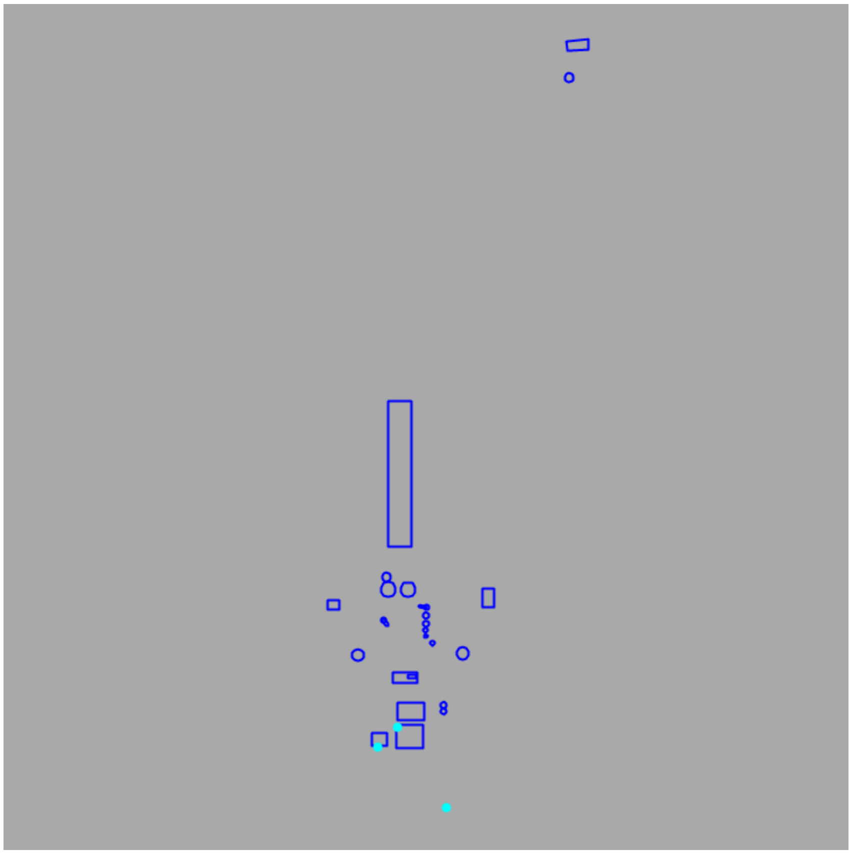

Figure 2-3 Location of Sources and Surrounding Buildings – Boise Paper Mill

2.8 RECEPTOR GRID

For the purpose of modeling for SO_2 characterizations, the receptor placement strategy differs from those applications for PSD review. The TAD allows receptors to be ignored in areas where it is not feasible to place a monitor (e.g., water bodies). However, for this analysis, it was conservatively assumed that the location of all gridded receptors were such that it was feasible to place a monitor at that location. The air dispersion modeling receptor locations were implemented using a sufficient density to properly represent the area around the site. A nested rectangular grid network extended 40 km from the center of the site in order to incorporate enough area to sufficiently represent the dispersion characteristics of the area. The course grid was extended from the modeling protocol to account for terrain to the northeast of Lowman on the extent of the original 20 km grid. The nested grid of receptors consisted of four tiers, as presented in Table 2-2. As discussed in the protocol, should the maximum impact occurred beyond 2,000 meters, a nested refined grid consisting of 100 meter spacing receptors would be centered on the maximum impact to ensure the maximum impact had been captured. However, as discussed in Section 3.0, the maximum impact occurred in the extra fine grid, as such, a refined grid was not necessary.

Table 2-2 Receptor Grid Spacing

RECEPTOR GRID TYPE	DISTANCE FROM PROJECT CENTER [m]	RECEPTOR SPACING [m]
Extra Fine	Fence line to 2,000	100
Fine	2,000+ to 5,000	250
Medium	5,000+ to 8,000	500
Course	8,000+ to 40,000	1,000

2.8.1 Facility Boundary

The analysis was performed in all locations of "ambient air", which has been defined by USEPA as "that portion of the atmosphere, external to buildings, to which the general public has access". In order to limit public access to a source's property, USEPA has generally required that a fence or some other barrier must be present to define the ambient air boundary. This "other barrier" has been established as certain geographical barriers such as a cliff or river which may preclude public access. A visual presentation of the ambient air boundary utilized for this AAQIA is presented in Figure 2-4. A description of the barriers used to demarcate the ambient air boundary is provided as follows.

The ambient air boundary follows along the facility's property line. On the north and west sides of the boundary exist heavy dense forested and swamp lands which restrict public access to the facility. The only road to the facility has a security gate to restrict access and also has a manned security checkpoint. The Tombigbee River boarders the facility on the east and southern edges. The river's bank is steep and heavily vegetated in several areas along the facility's property boundary. Additionally, PowerSouth has placed "No Trespassing" signs along the boundary bordered by the river, heavily forested areas, and the marsh/swamp areas. Notably, this assessment was conservative in that not all locations represented with modeled receptors would be appropriate locations for physical monitors due to, for example, terrain, access or infrastructure considerations. The PowerSouth facility boundary and receptors are illustrated in Figure 2-5. The Boise Paper Mill fence line from the cluster source analysis is also illustrated in this figure as well.

Figure 2-4 Lowman Facility Boundary

2.8.2 Boise Paper Mill Boundary

A fence line was incorporated for Boise Paper Mill. Although Boise Paper Mill owns a large amount of land, as estimated by the larger green outline in Figure 2-6, it was conservatively assumed that a smaller blue boundary around the facility's operation and equipment is restricted to public access.

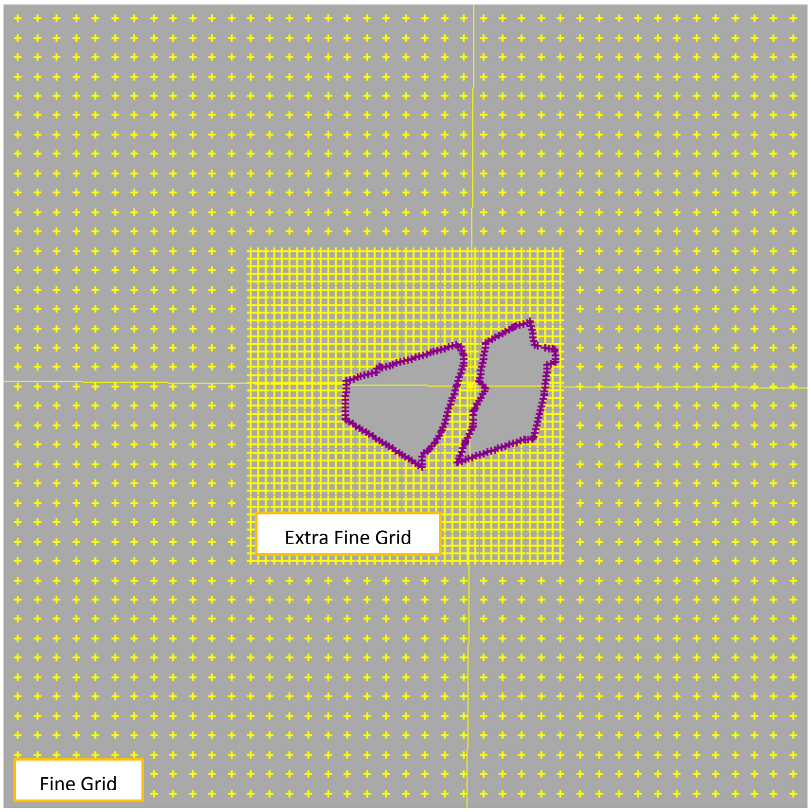

Figure 2-5 Receptor Grid

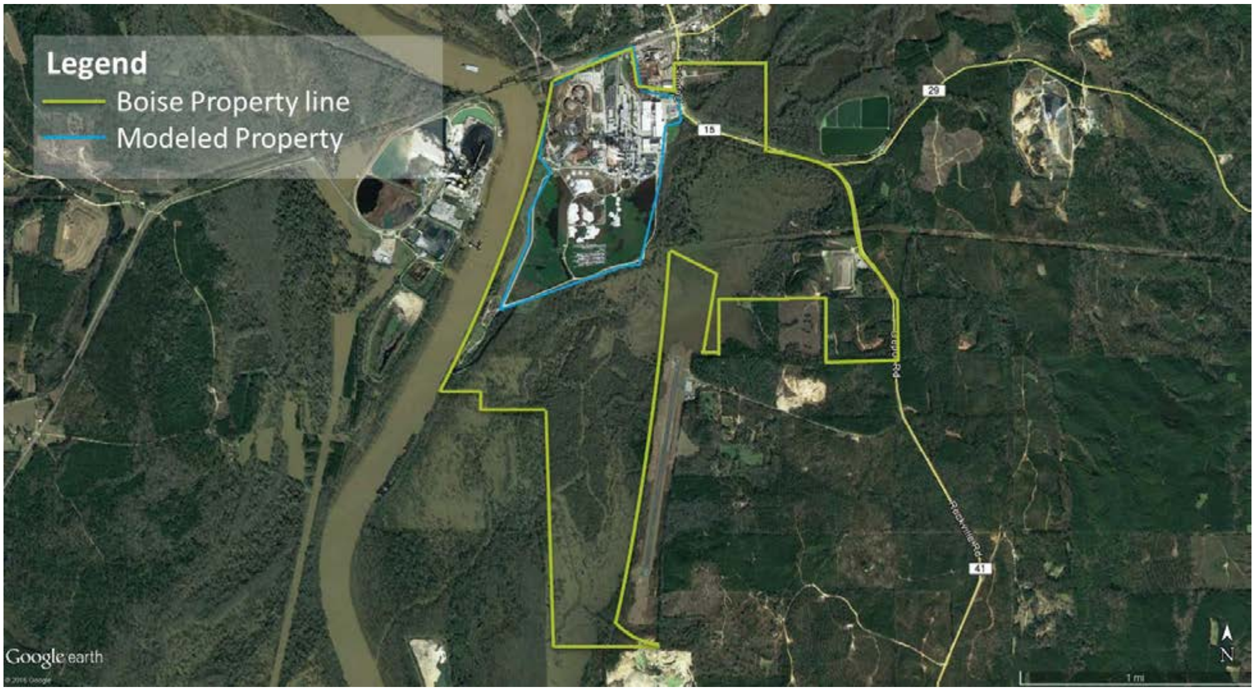

Figure 2-6 Boise Paper Mill Facility Boundary

2.9 TERRAIN CONSIDERATIONS

Terrain elevations at receptors were obtained from United States Geological Survey (USGS) National Elevation Dataset (NED) files and were incorporated into the most recent AERMOD model (version 15181). The NED files had a resolution of ⅓ arc second and used the horizontal reference datum of the North American Datum of 1983 (NAD83). Using AERMAP, terrain elevations were determined for each receptor by applying a method that locates interpolated terrain elevation near each receptor.

There is no distinction in AERMOD between elevated terrain below release height and terrain above release height, as with earlier regulatory models that distinguished between simple terrain and complex terrain. For applications involving elevated terrain, the user must input a hill height scale along with the receptor elevation. The AERMAP terrain preprocessor generated the hill height scales for AERMOD. For each receptor, AERMAP searched for the terrain height and location that has the greatest influence on dispersion. In order to calculate the hill height scale, the NED array and domain boundary must include all terrain features that exceed a 10 percent elevation slope from any given receptor.

2.10 METEOROLOGICAL DATA

The AERMOD model utilized a file of surface boundary layer parameters and a file of profile variables including wind speed, wind direction, and turbulence parameters. ADEM provided a standard regulatory meteorological data set on October 30, 2015 for Meridian, MS that ADEM processed with the most updated AERMET (version 15181) preprocessor. ADEM's justification for the development and selection of meteorological data is included in Appendix B. The upper air data was obtained from Alabaster, AL. The meteorological data was deemed to be representative of the area as this dataset was determined by ADEM to be appropriate for use in regulatory applications. The years provided were 2010 through 2014, although, only years 2012 through 2014 were utilized in this analysis. Although ADEM provided the meteorological data, for this analysis as representative of the Lowman plant location, a representativeness analysis was performed.

2.10.1 Representativeness Analysis

The GAQM indicates that when site-specific data are not available, 5 years of adequately representative data from a nearby National Weather Service station may be used. Representativeness of meteorological data is dependent on the following four factors:

- Spatial – The proximity of the meteorological monitoring site to the area under consideration.
- Temporal – The period of time during which the data is collected.
- Exposure – The siting of the meteorological instruments at the monitoring site.
- Geographic – The geographic features and land use cover in the vicinity of the monitoring site.

2.10.1.1 Spatial Considerations

The spatial representativeness of the meteorological data can be adversely affected by large distances between the source and the monitoring site. As such, spatial representativeness is best achieved using meteorological data in close proximity to the emissions source being modeled. Meridian, MS is approximately 76.2 miles from the Lowman site, which is an acceptable distance.

2.10.1.2 Temporal Considerations

Temporal representativeness of the meteorological data refers to year to year variations or climatological accuracy of the data. The period of record of meteorological data should be sufficient to ensure that the worst-case meteorological dispersion conditions are adequately captured and that a stable distribution of meteorological conditions is provided. Meteorological data that has a limited temporal span could cause undesirable variability in the model predicted concentrations.

The GAQM states that 5 years of meteorological data is sufficient to reduce the variability of model predicted concentrations. The *Draft New Source Review Workshop Manual* (October, 1990) indicates that a five year period of meteorological data is necessary to ensure that the worst-case conditions are captured by the model in terms of predicted concentrations. The meteorological data provided by ADEM meets these recommendations. Even though the GAQM states 5 years of meteorological data should be utilized, since this analysis is for designations purposes, only 3 years of meteorological data is necessary since the analysis is to simulate a monitor.

2.10.1.3 Exposure Considerations

The Iowa Department of Natural Resources document, *Meteorological Data Representivity Analysis* (http://www.iowadnr.gov/air/prof/tech/files/representivity_analysis.pdf), states that exposure refers to a meteorological instrument's ability to obtain measurements without interference from naturally occurring or man-made objects. The MEI meteorological data set was obtained by an Automated Surface Observing Station (ASOS). The *Federal Standard for Siting Meteorological Sensors at Airports* requires that sensors be installed in appropriate locations to assure that the resultant observations are representative of the ambient meteorological conditions. Assuming that the MEI ASOS is installed according to the Federal standard, instrument exposure does not affect the representativeness of the MEI meteorological data set.

2.10.1.4 Geographic Considerations

Geographic representativeness refers to the degree that surface characteristics and key parameters derived from those characteristics, which influence atmospheric mixing, differ between the site of the emissions source that is being modeled and the meteorological monitoring site.

The Lowman site is surrounded by trees, is situated on the west bank of the Tombigbee River, and is to the southwest of Jackson, AL. The MEI site is a regional airport and is mostly surrounded by trees and is located to the southwest of the town of Meridian, MS. Inspection of 2006 NLCD data indicates the MEI site is primarily based in a rural setting; therefore, urban heat island effects will not be invoked.

As previously mentioned, an evaluation of geographic representativeness also includes a comparison of key parameters derived from surface characteristics. AERMET uses three land use based parameters in its dispersion algorithms: surface roughness (zo), Bowen ratio (Bo), and albedo (r). The USEPA's *AERMOD Implementation Guide* (Revised March, 2009) specifies that when determining data representativeness, a comparison of these parameters should be made between the NWS data collection site and the location of the emission source being modeled. AERSURFACE (13016) was used to process land cover data (USGS 1992 NLCD) to determine the annually averaged surface parameters for both the PowerSouth and Meridian, MS. The results of the AERSURFACE analysis are presented in Table 2-3.

Table 2-3 AERSURFACE Results for Lowman and Meridian, MS

SURFACE CHARACTERISTIC	WET YEAR (2012 AND 2013)		AVERAGE YEAR (2014)	
	Lowman	Meridian (MEI)	Lowman	Meridian (MEI)
Albedo (r)	0.14	0.15	0.14	0.15
Bowen Ratio (B_o)	0.22	0.31	0.43	0.59
Surface Roughness (z_o)	0.10	0.15	0.10	0.15

NOTES [ ]:
Values were derived from USGS 1992 NLCD data.

Table 2-3 above shows that albedo, Bowen ratio, and surface roughness values for the areas surrounding Lowman and areas surrounding MEI are very similar. Larger differences exist between the two sites with respect to surface roughness. A study conducted by the USEPA and presented at the 8th Modeling Conference (September 2005) showed that model predicted concentrations were shown to be sensitive to varying surface roughness, but that the effects are still relatively small given stack heights similar to those at Lowman and variations in surface roughness of the same magnitude as those seen in Table 2-3.

2.10.1.5 Conclusion

The four factor test and a comparison of land use surface characteristics demonstrate that the meteorological data set obtained by the MEI ASOS is sufficiently representative and will therefore be used as input for the AERMOD model in the AAQIA.

2.11 BACKGROUND CONCENTRATION DATA

Background SO_2 data was provided by ADEM from a Centreville, Alabama monitor for 2012, 2013, and 2014. ADEM has deemed this monitor to represent the non-anthropogenic background for the entire state of Alabama. The background values provided by ADEM were collected using the following methodology:

"The 1-hour SO_2 background values used for this analysis were derived from data collected at the Centreville, Alabama, SEARCH site. The Centreville SEARCH site is considered to be representative of background SO_2 concentrations based on a number of factors. The data from this SEARCH site has very little impact from anthropogenic sources, therefore, it should be representative of background 1-hour SO_2 values for most areas of the State of Alabama. The purpose of adding the background value to the final model-predicted concentration is to account for the potential impact of sources outside the scope of the modeling analysis, such as natural and distant sources, which may minimally impact air quality in the area. Due to the fact that an inventory of sources is modeled in addition to the source under review, there is a high possibility that the air quality impacts from many sources could be double-counted when the background value is added to the final 1-hour SO_2 concentration predicted by the model.

Other monitors located outside the State were considered as possible background sites, but due to the proximity of alternative monitors to urban areas and anthropogenic sources, these monitors would not provide an appropriate background concentration. Using concentrations from urbanized/industrialized areas can unduly influence the monitors and not provide a value that is truly representative of background conditions in a rural area. These areas tend to be more populated and urbanized, which is not representative of rural areas such as the Jackson area. These monitors are likely impacted by urban influences and would not be representative of the rural background conditions in Jackson, Alabama.

Additionally, due to the Centreville site's location relative to PowerSouth, the synoptic-scale weather conditions in the Centreville area would be very similar to the Jackson area. Most major weather systems that would impact the Jackson area would, in general, impact the Centreville area as well. Due to all the factors cited above, ADEM determined that the Centreville, Alabama, site was the appropriate background monitor to use for this analysis."

Based on USEPA guidance, a "first tier" assumption for combining a cumulative modeling impact with a background concentration to demonstrate compliance with NAAQS will be to add the overall highest hourly monitored SO_2 value, i.e., the 99^{th} percentile of the annual distribution for the daily maximum 1-hr values averaged across the most recent three years of monitored data. The USEPA recognized in a memo on March 1, 2011, as well as in the TAD, that this "use of the overall highest hourly background concentration may be overly conservative in many cases". The USEPA described an appropriate alternative to this overly conservative assumption may be the use of temporally varying background concentrations, because it would be "representative of the 'meteorological conditions accompanying the concentrations of concern'"[4].

As mentioned in USEPA's March 1, 2011 memo[4], one of the important factors to consider in relation to the background concentration is that the standard is based on the annual distribution of daily maximum 1-hour values, which implies that diurnal patterns of ambient impacts could play a significant role in determining the most appropriate method for combining modeled and monitored concentrations. If the daily maximum 1-hour impacts associated with air dispersion modeling generally occur under nighttime stable conditions whereas maximum monitored concentrations occur during daytime convective conditions, pairing modeled and monitored concentrations based on hour of day should provide a more appropriate and less conservative estimate of cumulative impacts than a method that ignores this diurnal pattern. Incorporating a seasonal or monthly component to the variability of background monitored concentrations would also account for some of the variability in meteorological conditions that may contribute to high hourly impacts.

Therefore, for this analysis, a temporary-vary background concentration was employed within the AERMOD model. The following sections describe the temporary-vary methodology that was utilized for this AAQIA. Although the TAD guidance does not require (by rule) the use of seasonal calculation methodology over any other methodology nor does it specify a hierarchy of temporal varying background methodologies, PowerSouth has employed a seasonal varying background per the request of the EPA. The hour by season background concentrations used in the modeling analysis are presented in Table 2-4. An electronic spreadsheet is provided on a CD within Appendix A that computes the hour by season values. Use of hour by season background concentrations is an altered approach as outlined in the protocol. Based on initial feedback from USEPA, PowerSouth chose to not use the hour by month; however, PowerSouth reserves the right to use different time varying options for any potential future analysis.

2.11.1 Missing Data Procedures

There are several reasons why missing data may exist from a monitor's dataset. Data may be missing due to equipment malfunction, human error, maintenance of the monitoring equipment, or it can be attributed to the required QA/QC and calibration requirements. In order to ensure that underestimation of SO_2 impacts are minimized, data gaps should be filled-in. The following fill-in technique was utilized.

[4] "Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour NO2 Ambient Air Quality Standard", USEPA, March 1, 2011

For a single hour, it is widely accepted that the best method of gap filling is the use of a linear interpolation of the hour before and after the missing hour. As such, the concentrations for the hour before and after were averaged by summing the two individual values and dividing by two. The missing single hour was filled-in with this average value.

For data gaps spanning more than a single hour, no single acceptable method has been developed. As such, the following conservative approach was utilized to fill-in data for those gaps spanning multiple hours. The maximum concentration for each hour for each season was determined from the dataset. For each gap spanning multiple hours, the specific hour that is missing was filled-in with the maximum seasonal hourly value. Once all hours were filled-in, this new dataset was used to process the time varying values that were utilized in the modeling analysis.

2.11.2 Time Varying Procedures

A 99th percentile seasonal hour-of-day (2nd highest) value was used for a temporally-varying background concentration. The methodology to calculate this value followed the methodology outlined in the San Joaquin Valley APCD protocol[5]. The seasons were defined as follows: Winter consisted of December of the previous year, January and February, Spring consisted of March April and May, Summer consisted of June, July and August, and Autumn consisted of September, October, and November. The value was calculated by taking all SO_2 concentrations for each hour of the day (1AM, 2AM, 3AM, etc.) for each season in descending order. Next, the 2nd highest SO_2 concentration was selected for each hour of the day for each season, which resulted in a total of 48 values, and was repeated for each season and all three years (2012 to 2014). The average of each hour of each season across all three years was calculated, resulting in 48 values, one for each hour of each season.

The following is an example of the procedures for the 1AM value.

1. Take all the 1AM SO_2 concentrations (maximum of 90-92) for each season.
2. Organize the SO_2 concentrations in descending order (highest to lowest).
3. Take the 2nd highest SO_2 concentration.
4. This value will be used to represent the 1AM 2nd highest hour or 99th-percentile of available data.
5. The above process is repeated for each hour of the day and season.
6. Repeat steps 1 through 5 for each of the three years under review.
7. Average the three 1AM SO_2 concentrations.
8. This value was then used in AERMOD as the SO_2 background concentrations (3-year average of the 99th percentile) for the 1AM hour and season.
9. Repeat step 7 and 8 for each of the hours in the day and season.

[5] San Joaquin Valley Air Pollution Control District. "1-Hour SO_2 NAAQS Area Designation Modeling Protocol".

2.11.3 Time Reporting Methodologies

The conventions regarding reporting time differ between ambient air quality monitoring, where the observation time is based on the hour-beginning convention, and meteorological monitoring, where the observation is based on the hour-ending time. As such, ambient monitoring data reported for hour 00 should be paired with meteorological data for hour 01, etc. This was important when incorporating time-varying background concentrations in the AERMOD calculations; thus, the time reporting convention was taken into account with regards to the time-varying analysis.

Table 2-4 Background SO_2 Concentration – Hour of Day by Season

HOUR OF DAY	SO_2 CONCENTRATION (ppb) [1]			
	WINTER (DEC-FEB)	SPRING (MAR-MAY)	SUMMER (JUN-AUG)	AUTUMN (SEPT-NOV)
1	3.24	2.13	1.74	1.51
2	2.89	2.33	2.58	1.99
3	2.98	1.91	2.80	2.65
4	2.21	1.92	2.55	3.85
5	2.92	1.50	2.32	6.51
6	3.31	1.65	3.23	7.79
7	2.99	1.88	5.58	7.73
8	4.18	2.73	7.59	8.77
9	4.64	5.50	7.39	9.78
10	2.94	3.83	5.78	10.71
11	4.05	3.15	6.53	4.93
12	4.71	2.65	2.67	3.50
13	2.84	2.67	3.21	4.11
14	2.77	3.08	3.00	2.77
15	3.22	3.26	2.47	1.96
16	3.31	2.79	1.81	2.05
17	3.73	2.88	1.48	2.51
18	2.28	2.99	1.74	2.89
19	2.37	2.63	1.87	2.56
20	2.63	2.35	1.91	1.91
21	2.62	2.33	2.40	2.11
22	3.37	1.89	2.36	1.95
23	3.67	2.68	1.73	2.31
24	3.21	2.59	1.24	2.34

NOTES [ ]:
1. Background concentrations were provided by ADEM for Centreville, AL.

3.0 Model Predicted Impacts

A full impact analysis was performed to assess the ambient pollutant concentration around the Lowman facility against the 1-hr SO_2 NAAQS of 196 µg/m^3. This required a cluster source impact analysis, which incorporated Boise Paper Mill emissions along with PowerSouth emissions. An hour by season background concentration was also included to represent the non-anthropogenic background SO_2 concentration for the area. A comparison of the model results for these sources against the NAAQS standard is given in Table 3-1. As shown in the table, the maximum modeled impact is below the 1-hour SO_2 NAAQS standards. Therefore, the area surrounding the Lowman facility should be designated as attainment with respect to the 1-hour SO_2 NAAQS.

Table 3-1 Maximum Model Impacts Compared to 1-Hour SO_2 NAAQS

LOCATION OF MAXIMUM IMPACT		IMPACT CONCENTRATION (µg/m^3)	NAAQS (µg/m^3)	EXCEED NAAQS
X COORD	Y COORD			
413,606.7	3,485,033.6	179.25	196	**No**

Table 3-1 also gives the location of the receptor where the maximum impact occurred. The maximum impact occurs to the north of the Lowman facility, on the northern shore of the Tombigbee River. A contour plot of the SO_2 impacts is shown in Figure 3-1. The main locations of SO_2 impacts are located close to the Lowman facility, then decrease with increased distance from the source.

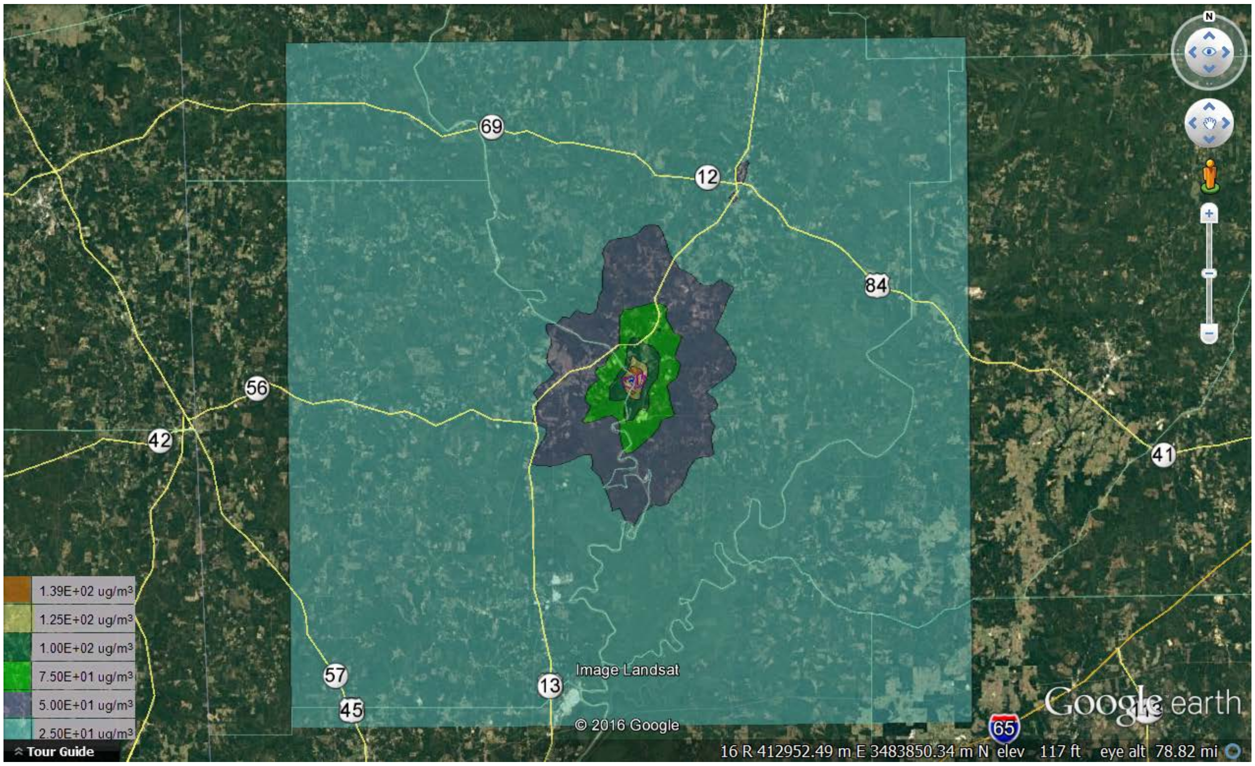

Figure 3-1 SO_2 1-Hour Maximum Impact Isopleths

Appendix A. ADEM Data Approval

From: Weant, Jeremy B <jweant@adem.alabama.gov>
Sent: Tuesday, November 29, 2016 10:43 AM
To: Horton, Brett
Subject: RE: Boise - Actual Emission Data Submittal for Use with SO2 NAAQS DRR

Brett,
On October 26, 2016, I reviewed the data presented, along with the methodology used in calculating the values, and determined that it was acceptable to be used in the SO2 NAAQS DRR. I also conveyed that acceptance to the pertinent individuals within the Department. Thank you,

Jeremy Weant, P.E.
Air Division
Industrial Chemical Section
Alabama Department of Environmental Management
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Montgomery, Alabama 36130-1463
(334) 270-5671
www.adem.alabama.gov
jweant@adem.state.al.us
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From: Horton, Brett [mailto:BrettHorton@boisepaper.com]
Sent: Monday, November 28, 2016 9:56 AM
To: Weant, Jeremy B
Subject: RE: Boise - Actual Emission Data Submittal for Use with SO2 NAAQS DRR

Jeremy,
Would it be possible to receive written verification via email or letter of ADEM's acceptance of our data to be used in the SO2 NAAQS DRR demonstration application?
Thanks,

Brett Horton
Environmental Engineer
Jackson, Alabama
Work: (251) 246 - 8242
Cell: (251) 744 - 4907
PCA
PACKAGING CORPORATION OF AMERICA

From: Weant, Jeremy B [mailto:jweant@adem.alabama.gov]
Sent: Tuesday, October 25, 2016 10:19 AM
To: Horton, Brett <BrettHorton@boisepaper.com>
Subject: RE: Boise - Actual Emission Data Submittal for Use with SO2 NAAQS DRR

Brett,
I got your voicemail concerning this email, and I just now have had the opportunity to look at this information. I will review it, and get back to you with any questions, I may have. Thank you,

Jeremy Weant, P.E.
Air Division
Industrial Chemical Section
Alabama Department of Environmental Management

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(334) 270-5671
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jweant@adem.state.al.us

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Mission: Assure for all citizens of the state a safe, healthful and productive environment

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From: Horton, Brett [mailto:BrettHorton@boisepaper.com]
Sent: Friday, October 21, 2016 2:46 PM
To: Weant, Jeremy B
Subject: Boise - Actual Emission Data Submittal for Use with SO2 NAAQS DRR

Dear Mr. Weant:

On May 23, 2016, Boise was contacted by ADEM and asked to provide the information regarding mass emission rates for the year 2014 from each source that is considered to be a contributable sulfur dioxide (SO2) emission source. Although these sources have very small annual emissions of SO2, we were made aware that this information would be considered with regard to the SO2 1-Hour National Ambient Air Quality Standards (NAAQS) Data Requirement Rule (DRR) for area designation. The sources at the Boise Jackson facility include the Lime Kiln (102-0001-Z003), No.2 Recovery Furnace north and south stack (-Z011A & -Z011B), and Combination Fuel Boiler (-Z013). Boise previously provided very conservative maximum/allowable hour rates, but we have now developed more accurate and representative data for the years 2012 to 2014. That more accurate data is enclosed and described below.
Specifically, the attached Excel file has been prepared by Boise and has each of the four (4) stack locations listed with mass emission rates (g/s), exhaust temperature (K), and exhaust velocity (m/s) that has been calculated to be as representative as possible of the actual hourly emissions. The data has been derived from hourly production rates and trade organization specific emission factors, site specific emission factors, or Continuous Emission Monitoring Systems (CEMS) data. The derivation of emissions for each source is described in greater detail below:

Lime Kiln (Z003) – CEMS data was available and used for the years 2013 and 2014. The CEMS was not installed on this unit until 2012. For 2012 emissions calculations, the pulp & paper trade organization specific emission factors from the National Council for Air and Stream Improvement (NCASI) were used. For the base emission rate from the Lime Kiln, the mean SO2 emission factor of 0.07 lb/ton CaO for lime kilns with wet scrubbers was used (NCASI Technical Bulletin No. 1020, Table 4.13). The major contribution of SO2 emissions from the Lime Kiln is due to the kiln being a control device for incineration of Non-Condensable Gases (NCG) from the pulping process. The NCASI emission factor for Total Reduced Sulfur content of uncontrolled NCGs is 0.961 lb/ADTUBP (NCASI Technical Bulletin No. 973, Table 4.15). The Total Reduced Sulfur emission factor was converted quantitatively to SO2, and a 90% removal rate for destruction in the kiln was used and applied to the hours during 2012 when the Lime Kiln was incinerating NCGs.

Exhaust temperature is measured on the Lime Kiln and is supplied as well. Stack velocity is static since it is derived from the latest particulate test flowrate and usually not changed unless the velocity is higher than the previous year which would give a conservative bias, if any.

No. 2 Recovery Furnace North & South Stack (Z011A & Z011B) – Boise has used a site specific emission factor that was produced from an actual emission test that was performed on the boiler in March 2006. The factor of 0.0686 lb/ton black liquor solids (BLS) was used and applied to each hour of BLS fired in the Recovery Furnace during the years 2012 to 2014. The No. 2 Recovery Furnace is one unit with two stacks with equal mass emission rates. The mass emission rate was divided in half to represent the emission rate for each stack.

Exhaust temperature is measured on each stack and is supplied. The stack velocity is static due to the derivation from the site specific emission factor.

Combination Fuel Boiler (Z013) – SO2 concentration CEMS data is available for the years 2012 to 2014. The hourly emission rate calculation from SO2 ppm and O2 % to lb/hr assumes a maximum boiler heat input of 429 MMBtu/hr. To better determine a more accurate heat input for the boiler, hourly steaming rates were used to calculate heat input. Using a conversion of 1203.7 btu/lb (Cameron Hydraulic Data) of steam and assuming an efficiency of 69.8% conversion of heat generated to steam produced, a more accurate heat input value was derived. The newly derived heat input was applied to the hourly emissions data to calculate the mass emission rate. This calculation method is consistent with Title V permit application emission calculations.

The stack exhaust temperature for this unit is not measured for this unit. The control device for the boiler is a venturi wet scrubber and a static exhaust temperature of 158F was assumed due to the stable nature of the saturated flue gas. Please note that in review of previous information provided by ADEM this data indicates an exhaust temperature of 378F which is not correct. Additionally, a stack velocity was also assumed to be static.

To the best of our knowledge and ability, using the available emission and production data, we have derived what we believe to be the most accurate representation of hourly emissions data for the years 2012 to 2014 for our emission sources.

Furthermore, attached please find an air dispersion modeling file containing our facility's building configuration information for use in developing downwash information for modeling and an illustration for reference.

We appreciate your timely review and request your approval of this emissions data and building information for use in the aforementioned NAAQS DRR for area designation analyses.

If you have any questions or comments concerning the data or derivation thereof, please do not hesitate to call me at 251-246-8242 or request a meeting to discuss further.

Brett Horton
Environmental Engineer
Jackson, Alabama
Work: (251) 246 - 8242
Cell: (251) 744 - 4907

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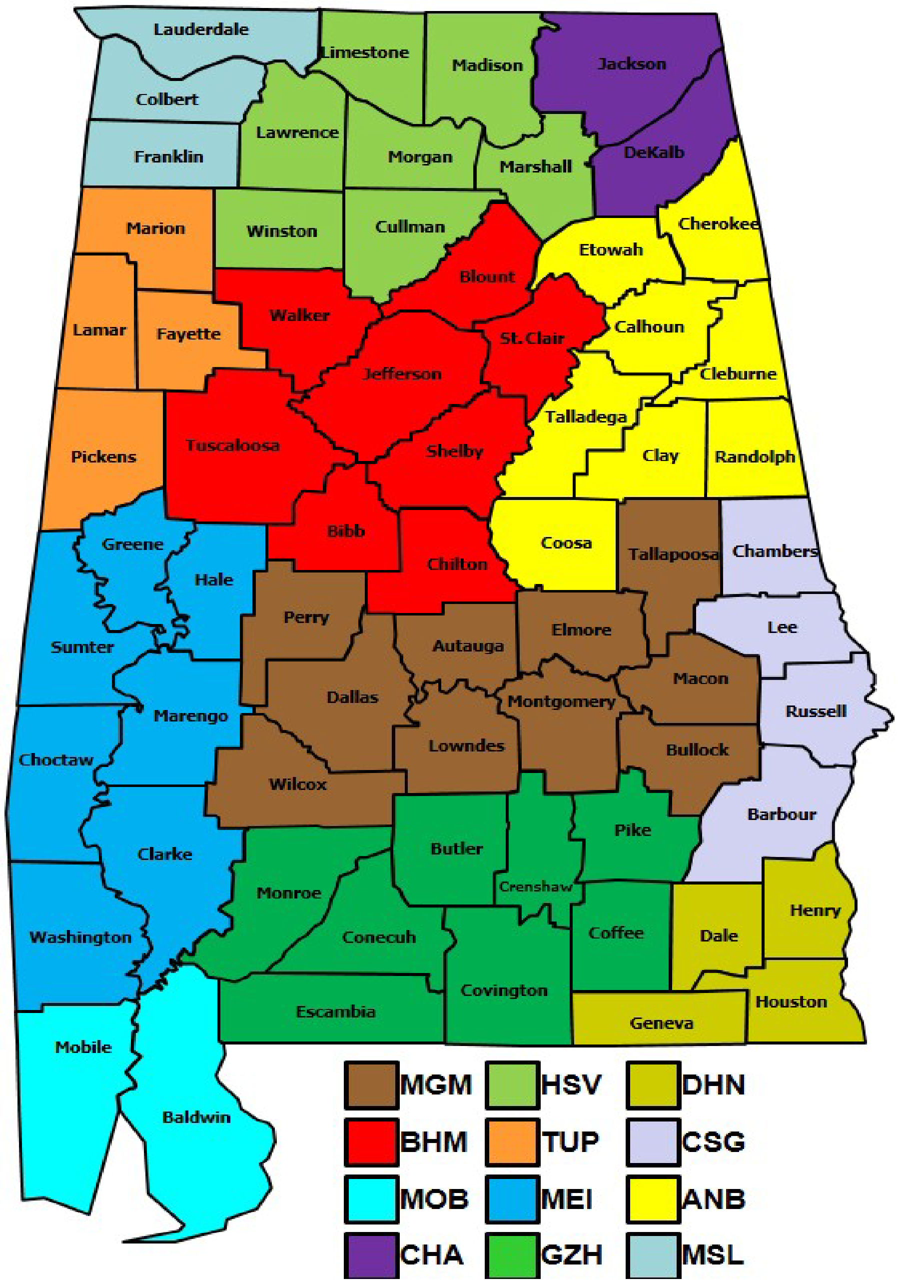
Appendix B. ADEM Meteorological Justification

ADEM has developed pre-processed meteorological data for each county for use in Prevention of Significant Deterioration (PSD) air dispersion modeling applications. ADEM developed these datasets based on both meteorology and the effect the surface characteristics have on the lower layers of the atmosphere. The dataset utilized for air dispersion modeling analyses at the Lowman facility has historically been used to characterize modeling for this facility since the 1980's. The following section of information is from ADEM's guidance document that addresses representativeness[6]:

> *There have not been any geographical changes in the area that would deem this NWS site unrepresentative. There are no other new datasets nearby that would better represent this location. NWS surface and upper air sites are limited in this area. Furthermore the data map below has been used to determine meteorological data for use in PSD analyses for decades. Use the following Meteorological PSD Data Map to identify the area of the State in which the proposed new source or modified source will be located to determine which National Weather Service (NWS) station data to use in the modeling. The station identification numbers are also indicated:*

[6] http://www.adem.state.al.us/programs/air/emissionsModeling.cnt

METEOROLOGICAL PSD DATA



The map of Alabama modeling domains was broken out into 12 sections. These sections were determined by average monthly precipitation, average monthly mean temperature and topography. In each county, a COOP weather station was chosen and a 30 year (some stations less than 30) monthly average rainfall and monthly mean temperature was compared to the 12 surrounding NWS stations monthly data. The NWS station that correlated the closest to the COOP station was linked to that county. Once all the counties were looked at, they were grouped together by NWS station. The regions were adjusted to account for the various topographical differences across the state of Alabama.

AREA	NWS SURFACE STATION	ID #	PROFILE BASE (M)	NWS UPPER AIR STATION	ID #
HSV	Huntsville, Alabama	723230	196	Nashville, Tennessee	13897
CHA	Chattanooga, Tennessee	723240	210	Nashville, Tennessee	13897
TUP	Tupelo, Mississippi	723320	110	Alabaster, Alabama	53823
BHM	Birmingham, Alabama	722280	192	Alabaster, Alabama	53823
CSG	Columbus, Georgia	722255	124	Alabaster, Alabama	53823
MEI	Meridian, Mississippi	722340	94	Alabaster, Alabama	53823
MGM	Montgomery, Alabama	722260	62	Alabaster, Alabama	53823
MOB	Mobile, Alabama	722230	67	Slidell, Louisiana	53813
ANB	Anniston, Alabama	722287	183	Alabaster, Alabama	53823
DHN	Dothan, Alabama	722268	108	Tallahassee, Florida	93805
GZH	Evergreen, Alabama	53820	79	Alabaster, Alabama	53823
MSL	Muscle Shoals, Alabama	723235	171	Nashville, Tennessee	13897

Appendix C. Electronic Files

Appendix D. Background Data