2010 1-HOUR SO_2 NAAQS Air Dispersion Modeling Report:

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APPENDICES

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1.0 INTRODUCTION & BACKGROUND

On June 3, 2010, the U.S. Environmental Protection Agency (EPA) set a 1-Hour "Primary" National Ambient Air Quality Standard (NAAQS) for Sulfur Dioxide (SO_2) at 75 parts per billion (ppb). On August 21, 2015, the EPA promulgated the *Data Requirements Rule for the 2010 1-Hour Sulfur Dioxide (SO_2) Primary National Ambient Air Quality Standard (NAAQS)*[1] (hereafter *2010 SO_2 DRR*) whereby states use predictive dispersion modeling or monitoring to evaluate specific contributors of SO_2 with annual emissions exceeding 2,000 tons per year (tpy). Because the EPA's view is that SO_2 is a "source-oriented" criteria pollutant that is relatively stable in the first few kilometers from the source, this rule directs agencies to focus on specific sources as the main contributors to SO_2 air quality impacts and to determine those potential source contributions through either dispersion modeling or source-oriented ambient air monitoring.

On January 8, 2016, the Arkansas Department of Environmental Quality (ADEQ) submitted a letter to EPA R6 identifying sources as required by the *2010 SO_2 DRR* that included Plum Point Services Company, LLC – Plum Point Energy Station (Plum Point) with actual emissions of 2,549.46 tpy (2014 reporting year). Here, the ADEQ, along with Plum Point, submits to the EPA an AERMOD-based SO_2 predictive dispersion Modeling Report that is accompanied by a complete archive of the electronic modeling files (Appendix A).

The 1-Hour SO_2 characterization modeling described in this Modeling Report adheres to the following guidance documents: the August 2016 *SO_2 NAAQS Designations Modeling Technical Assistance Document*[2] (*SO_2 Modeling TAD*) issued in draft form by the EPA, the August 2015 *2010 SO_2 DRR*, the March 2011 *Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-Hour NO_2 National Ambient Air Quality Standard*[3] (*NO_2 Memorandum*) and any direction received from the EPA.

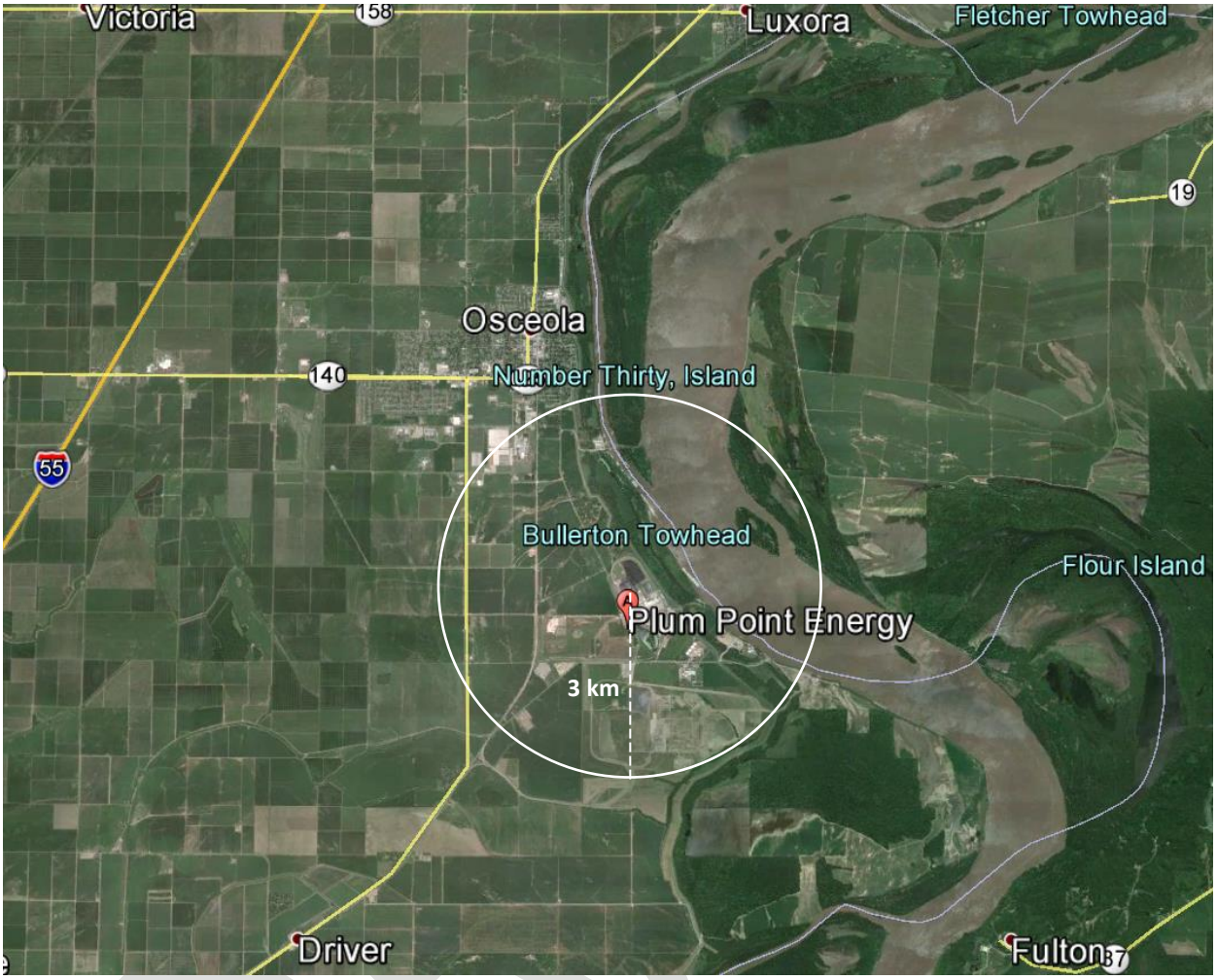
2.0 FACILITY LOCATION

As shown in Figure 2, Plum Point is located in a rural area of the Arkansas River Valley, comprised mainly of agricultural land with flat terrain. Plum Point is located approximately 4.2 kilometers (km) south of Osceola in Mississippi County, Arkansas. Figure 1 provides an overview of the Plum Point and immediate surrounding area. The approximate central Universal Transverse Mercator (UTM) coordinates of the facility are 232,855 meters (m) east and 3,950,471 m north in Zone 16 [World Geodetic System 1984 (WGS 84)].

[1] https://www.regulations.gov/#!documentDetail;D=EPA-HQ-OAR-2013-0711-0125
[2] https://www3.epa.gov/airquality/sulfurdioxide/pdfs/SO2ModelingTAD.pdf
[3] https://www.epa.gov/sites/production/files/2015-07/documents/appwno2_2.pdf

Figure 1: Plum Point and immediate surrounding area

Figure 2: Plum Point and broader surrounding area (Osceola and Plum Point are 4.2 km apart)



3.0 DISPERSION MODELING ANALYSIS

This section describes the input data and modeling methodology that was used in this SO_2 NAAQS modeling demonstration. The modeling methodology conforms to the *SO_2 Modeling TAD* and other relevant documents.

3.1 Model Selection

The latest version of USEPA's AERMOD model (v.15181) was used for predicting ambient impacts for 1-Hour SO_2 and regulatory default options were used in the analysis.

3.2 Source Description

The modeled sources (Unit #1 Boiler [SN-01] and Auxiliary Boiler [SN-05]) account for 99.9% of the permitted allowable SO_2 emissions from the facility (Table 1). It should be noted that although the Unit #1 Boiler and Auxiliary Boiler are capable of operating simultaneously, since the Auxiliary Boiler's commission the Auxiliary Boiler has only been operated for testing

purposes and the Auxiliary Boiler is limited to 500 hours of operation annually per Permit #: 1995-AOP-R8 (Issued October 31, 2016; p. 47). Therefore, simulating 1) the permitted allowable emissions, and 2) modeling both sources simultaneously and constantly throughout the 2013-2015 period (26,280 hours) made this modeling simulation an extremely conservative analysis.

Table 1: Facility SO_2-emitting sources (Permit #: 1995-AOP-R8; Issued October 31, 2016)

Source Number	Source Description	Permitted Allowable SO_2 Emission Rate lb/hr (tpy)	Included in / Excluded from Model
SN-01	Unit #1 Boiler	1069.0 (4684)	Included
SN-05	Auxiliary Boiler	0.5 (0.2)	Included
SN-06	Emergency Diesel Generator #1	0.5 (0.2)	Excluded
SN-07	Emergency Diesel Fire Pump #1	0.2 (0.1)	Excluded
SN-47	Emergency Diesel Fire Booster Pump #1	0.1 (0.1)	Excluded

Per Section 5.5 of the *SO_2 Modeling TAD* and the *NO_2 Memorandum* regarding intermittent emergency sources such as an emergency diesel-fired generator and fire water pump engines, all SO_2 emitting sources at Plum Point will be modeled except for three very small intermittent emergency SO_2 sources (Emergency Generator #1 [SN-06], Emergency Diesel Generator #1 [SN-07], and Emergency Diesel Fire Booster Pump #1 [SN-47]) with a combined allowable total SO_2 emissions of 0.8 lb/hr (0.4 tpy):

> "*Given the implications of the probabilistic form of the 1-Hour NO_2 NAAQS discussed above, we are concerned that assuming continuous operations for intermittent emissions would effectively impose an additional level of stringency beyond that intended by the level of the standard itself. As a result, we feel that it would be inappropriate to implement the 1-Hour NO_2 standard in such a manner and recommend that compliance demonstrations for the 1-Hour NO_2 NAAQS be based on emission scenarios that can logically be assumed to be relatively continuous or which occur frequently enough to contribute significantly to the annual distribution of daily maximum 1-Hour concentrations. EPA believes that existing modeling guidelines provide sufficient discretion for reviewing authorities to exclude certain types of intermittent emissions from compliance demonstrations for the 1-Hour NO_2 standard under these circumstances.*"[4]

[4] https://www3.epa.gov/ttn/scram/guidance/clarification/Additional_Clarifications_AppendixW_Hourly-NO2-NAAQS_FINAL_03-01-2011.pdf (Page 9)

In addition, these three intermittent emergency sources are limited to not exceeding 500 hours of operation each in a 12-month period by Permit: 1995-AOP-R8 (Issued October 31, 2016; p. 69).

3.3 Modeled Emission Rates

As described in Section 5.4 the *SO_2 Modeling TAD*[5], we used the worst-case more conservative measure of permitted allowable SO_2 emissions (Unit #1 Boiler [4,684 tpy; 1,069 lb/hr] and Auxiliary Boiler [0.2 tpy; 0.5 lb/hr]) per the current active permit (Permit Number: 1995-AOP-R8; Issued October 31, 2016; p. 8)[6] for the period of 2013-2015. The use of permitted allowable emissions in this modeling simulation allows Plum Point to be removed from further examination under the DRR based on the requirements in 40 CFR 51.1205(c).

> "*It also remains acceptable to use allowable emissions instead of actuals for designations purposes because allowable emissions would provide a more conservative estimate.*"[5]

3.4 Stack Parameters

Source stack parameters (Table 2) that were input into the model were obtained from the EPA's Emissions Inventory System (EIS) Gateway.

Table 2: Model-input source stack parameters

Source Number	Source Description	Stack Height (m)	Exit Temperature (K)	Exit Velocity (m/s)	Stack Diameter (m)
SN-01	Unit #1 Boiler	144.78	352.59	25.85	7.32
SN-05	Auxiliary Boiler	57.91	619.26	22.40	1.83

3.5 Good Engineering Practice & Stack Height

Per the *SO_2 Modeling TAD*, because we used allowable emissions, we also employed the Good Engineering Practice (GEP) stack height policy:

> "*If modeling with allowable emissions as discussed in Section 5.4, however, the GEP stack height policy should be used in the model. For those stacks that are above the GEP stack height, the GEP height should be used. For stacks below the GEP stack height, the actual stack height is used. The reasoning for following the GEP stack height policy when using allowable emissions is that since those emissions limits were set with GEP heights, the GEP height policy should be followed even for designations.*"[7]

[5] https://www3.epa.gov/airquality/sulfurdioxide/pdfs/SO2ModelingTAD.pdf (Section 5.4)
[6] https://www.adeq.state.ar.us/downloads/WebDatabases/PermitsOnline/Air/1995-AOP-R8.pdf
[7] https://www3.epa.gov/airquality/sulfurdioxide/pdfs/SO2ModelingTAD.pdf (Section 6.1)

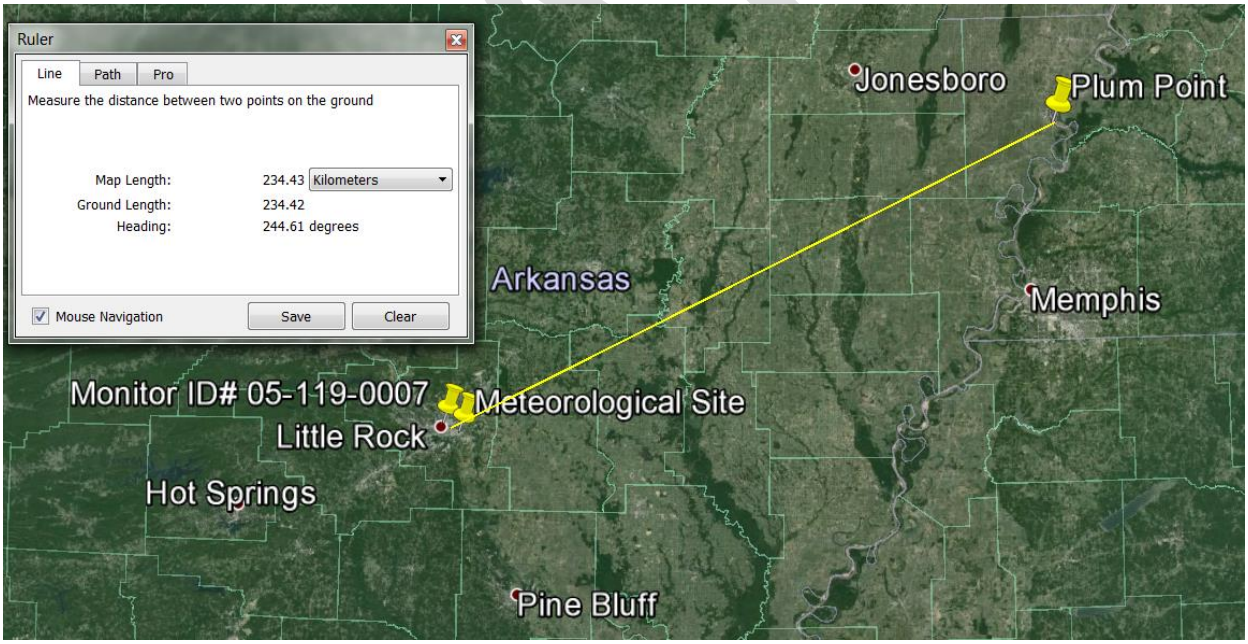
3.6 Building Downwash

This modeling exercise used allowable emissions and therefore, also followed the GEP stack height policy, using the BPIPPRIME program[8] to input building parameters for building downwash.

3.7 Ambient SO_2 Background Concentrations

Ambient background data from the closest Arkansas SO_2 monitor (Figure 3), located in North Little Rock, Arkansas (Monitor ID# 05-119-0007), was used to represent background concentrations of SO_2. EPA Guidance allows the inclusion of background values that vary by season and hour of day that could simulate a lower value than the 99th percentile design value from the monitor. The modeled concentrations will be paired with a set of 2013-2015 seasonal diurnal values that was developed using methodology described in Section 8.1 of the *SO_2 Modeling TAD* and the *NO_2 Memorandum*, which addresses NO_2 modeling and is applicable for developing seasonal diurnal background values for SO_2. Table 3 includes the seasonal diurnal values that were used in the model inputs.

Figure 3: Relative locations of Plum Point, North Little Rock SO_2 Monitor ID# 05-119-0007 and airport meteorological site



[8] U.S. EPA, 2004d: User's Guide to the Building Profile Input Program. EPA-454/R-93-038. U.S. Environmental Protection Agency, Research Triangle Park, North Carolina 27711.

Table 3: 2013-2015 Seasonal Diurnal SO_2 Concentrations ($\mu g/m^3$) at North Little Rock Monitor (Monitor ID# 05-119-0007)

Hour[1]	Winter	Spring	Summer	Fall
1	8.5	6.6	6.6	13.1
2	9.3	6.7	7.6	16.1
3	9.2	7.4	7.7	18.7
4	9.3	7.0	7.2	20.8
5	9.4	5.4	7.6	20.2
6	10.1	5.9	7.9	22.3
7	9.7	7.3	7.2	25.9
8	9.6	6.4	8.5	26.8
9	9.0	7.6	9.3	21.0
10	9.5	8.3	8.6	16.6
11	10.4	8.6	10.4	14.0
12	11.8	12.1	9.0	12.3
13	9.3	10.1	10.6	15.1
14	10.5	10.2	9.3	13.1
15	10.9	9.0	13.4	12.2
16	10.2	9.7	9.0	12.0
17	8.2	10.1	10.7	10.7
18	7.8	8.9	10.6	10.3
19	10.3	6.0	12.3	8.2
20	11.3	7.1	10.2	7.4
21	9.3	7.2	7.6	7.6
22	7.0	6.8	6.9	7.7
23	7.6	6.8	6.9	10.1
24	8.6	8.0	7.3	11.9

[1]Hours in AERMOD defined as hour-ending. (i.e., Hour 1 is midnight through 1 AM)

3.8 Meteorological Data

Since on-site data was not available for Plum Point, meteorological data available from the National Weather Service (NWS) was used in this analysis. Three years (2013-2015) of NWS data from the Adams Field Airport in Little Rock, AR (WBAN No. 13963) was prepared using the latest version of the EPA's AERMET meteorological processing utility (version 15181). In addition to surface meteorological data, concurrent upper air data from North Little Rock Municipal Airport in North Little Rock, AR (WBAN No. 03952) was also processed with the most recent version of AERMET (version 15181) along with the two pre-processors to AERMET: AERSURFACE (version 13016) and AERMINUTE (version 14337). As AERMET requires specification of site characteristics including surface roughness (z_o), albedo (r), and Bowen ratio (B_o), these parameters were developed according to the guidance provided by EPA in the AERMOD Implementation Guide (AIG)[9] using AERSURFACE. In addition, the following seasonal distribution will be used: December, January, and February were categorized as winter with no snow, March, April, and May as spring, June, July, and August as summer, and September, October, and November as fall. The precipitation was assumed to be average over the 3-year period. Data completeness for Adams Field Airport in Little Rock, AR (WBAN No. 13963) for 2013-2015 was 99.62%.

3.9 Receptor Grid

As described in Section 4.2 of the *SO_2 Modeling TAD*, this analysis used a comprehensive Cartesian receptor grid extending out 20 kilometers (km) from Plum Point to assess maximum ground level 1-Hour SO_2 concentrations. The near-field (within 5 kilometers) and far-field (out to 20 km) receptor grids are shown in Figure 4 and Figure 5, respectively. The *SO_2 Modeling TAD* states that the receptor grid must be sufficient to determine ambient air quality in the vicinity of the source being studied. The Cartesian receptor grid consisted of the following receptor spacing:

- 50 m spacing along the Plum Point fenceline;
- 100 m spacing extending from the Plum Point emission points to 5 km;
- 500 m spacing extending from 5 km to 10 km; and
- 1,000 m spacing extending from 10 km to 20 km.

Although the *SO_2 Modeling TAD* allows for excluding or ignoring receptors from over bodies of water[10] and the Mississippi River occurs immediately to the east of Plum Point (Figure 2), no receptors were excluded or ignored in this analysis. Terrain elevations from the United States Geological Survey's (USGS) National Elevation Data (*NED*) were processed using the most recent version of AERMAP (v.11103) to develop the receptor terrain elevations required by AERMOD.

[9] https://www3.epa.gov/ttn/scram/7thconf/aermod/aermod_implmtn_guide_3August2015.pdf
[10] https://www3.epa.gov/airquality/sulfurdioxide/pdfs/SO2ModelingTAD.pdf (Section 4.2)

Figure 4: Near-field (within 5 kilometers) Model Receptors

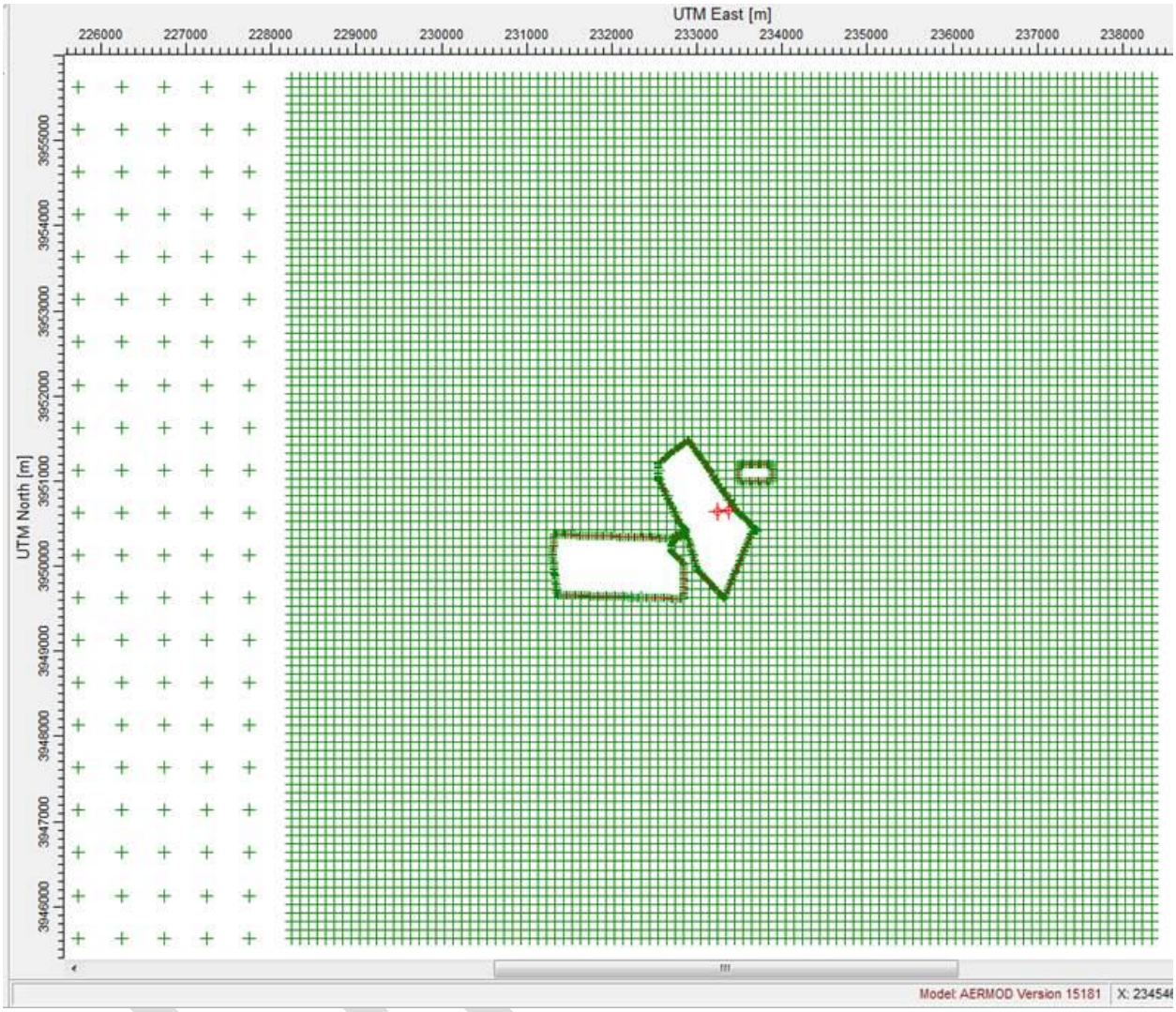


Figure 5: Far-field (out to 20 kilometers) Model Receptors

4.0 MODELING RESULTS & CONCLUSION

The modeling results are shown in Table 4 and the contours of the predicted impacts, including the location of the maximum predicted impact, are shown in Figure 6 (Near-field) and Figure 7 (Far-field). Table 4 shows that model-predicted impacts from Plum Point, when simulated using the very conservative approach of permitted allowable emissions, as well as modeling both sources simultaneously and constantly throughout the 2013-2015 period are below the 1-Hour SO_2 NAAQS.

The air dispersion modeling performed as described in this Modeling Report illustrates that the maximum predicted impact of 38.96 $\mu g/m^3$ of SO_2 from Plum Point is below the 1-Hour SO_2 National Ambient Air Quality Standard. Therefore, a SO_2 NAAQS Attainment designation for Mississippi County is warranted.

Table 4: 1-Hour SO_2 Modeling Results ($\mu g/m^3$) for Plum Point

Facility	Facility Emissions Only	Background Only	Facility and Background Combined	1-Hour NAAQS Limit	Below NAAQS Limit	Percent of NAAQS
Plum Point Energy Station	19.44	19.52	38.96	196.5	Yes	19.8

Figure 6: Plum Point 1-Hour SO_2 Impact Contours (Near-field)

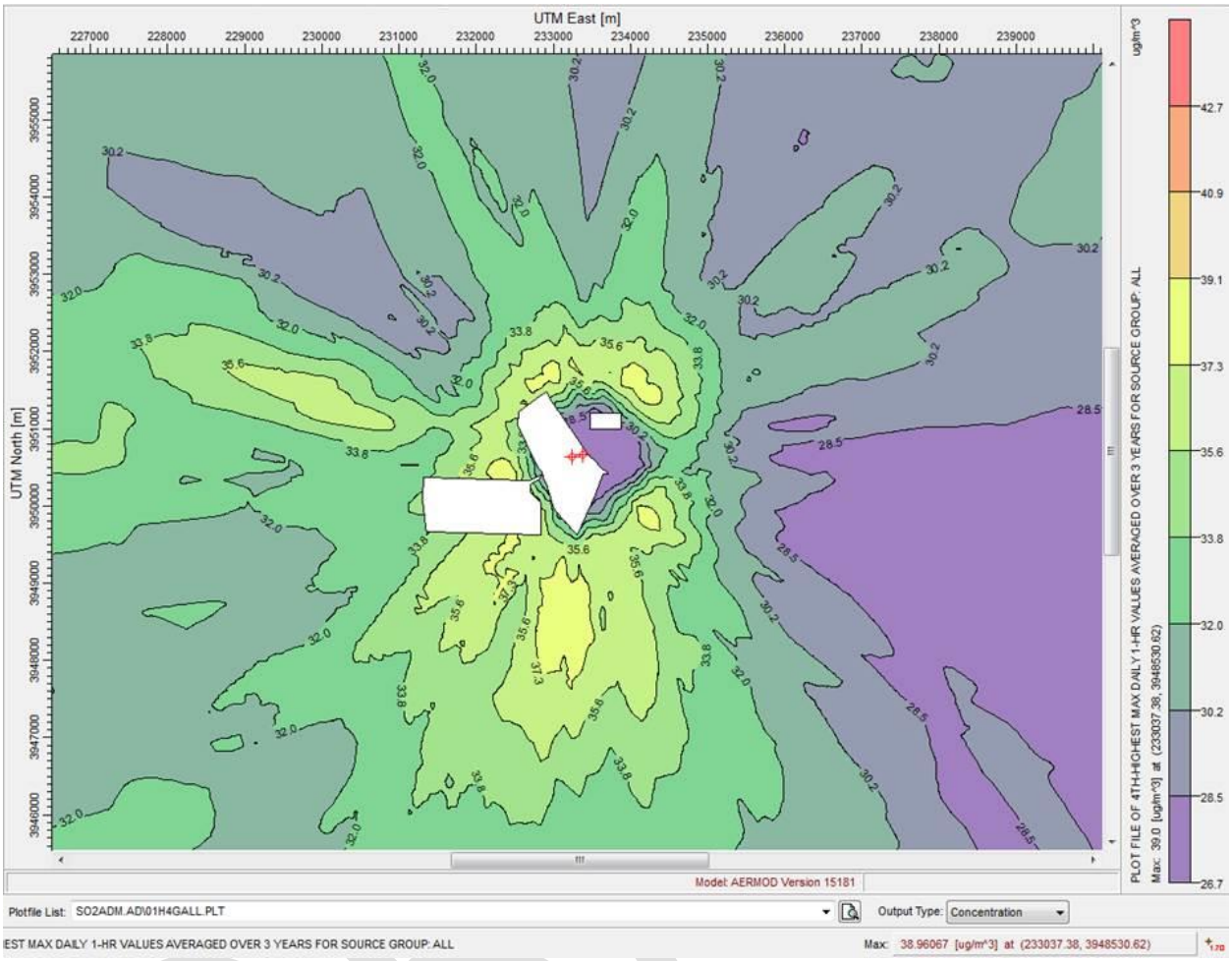


Figure 7: Plum Point 1-Hour SO_2 Impact Contours (Far-field)