Prepared for:
Choctaw Generation Limited Partnership, L.L.L.P

Modeling Report
Red Hills
Generating Facility
1-hour SO_2 NAAQS Modeling

AECOM, Inc.
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1.0 Introduction

On June 2, 2010, the EPA issued final revisions (75 FR 35520) to the primary National Ambient Air Quality Standards (NAAQS) for sulfur dioxide (SO_2). In the final rule, the EPA established a new primary 1-hour standard for SO_2 set at a level of 75 parts per billion (ppb). Also in the revision, the EPA revoked the two existing primary NAAQS (the 24-hour and annual standards) which will become effective one year after the area is designated for the new 1-hour standard

EPA is issuing area designations for the 1-hour SO_2 NAAQS in separate rounds. On August 10, 2015, as part of its implementation, the EPA issued the final Data Requirements Rule for the 2010 1-Hour Sulfur Dioxide Primary NAAQS[1] (e.g. "SO_2 Data Requirements Rule," or "DRR"). The DRR directs state and tribal air agencies to provide data to characterize air quality in the vicinity of sources of certain SO_2 emissions to identify maximum 1-hour SO_2 concentrations in ambient air. The air quality data provided pursuant to the DRR presumably will be used by the Mississippi Department of Environmental Quality (MDEQ) and EPA in future actions regarding area designations as the agencies continue implementing the SO_2 NAAQS.

In part, the DRR required air agencies to submit to EPA by January 15, 2016, a list identifying the sources in the state around which SO_2 air quality is to be characterized. This list must include sources located in areas that have not been designated nonattainment and have emissions greater than 2000 tons per year of SO_2 unless otherwise exempt (e.g. unit retirement, fuel switch, permit limits, etc.). The DRR sets forth two options air agencies may utilize to characterize air quality; by using either modeling of actual source emissions or by using ambient air quality monitors. For each source on the list, air agencies are required to identify the approach (ambient monitoring or modeling) it will use to characterize air quality in the vicinity of the source unless the source chooses to adopt emission limits.

In a letter to the EPA dated January 13, 2016, MDEQ identified the sources in Mississippi that have SO_2 emissions greater than 2000 tons per year for the most recent year for which emissions data are available (2014). MDEQ identified Choctaw Generation Limited Partnership, LLLP - Red Hills Generating Facility (RHGF) in Choctaw County as a source on this source list. MDEQ requested that air quality in the vicinity of RHGF be evaluated through modeling with respect to the 1-hour SO_2 NAAQS and the DRR. The DRR requires that for sources that choose to characterize air quality through modeling, a modeling protocol must be provided to the EPA by July 1, 2016.

EPA has issued[2] separate non-binding draft Technical Assistance Documents (TAD) for modeling and monitoring that set forth procedures for both pathways. The current version of the TADs (updated August 2016 and February 2016, respectively) reference other EPA modeling guidance documents, including the following clarification memos (1) the August 23, 2010 "*Applicability of Appendix W Modeling Guidance for the 1-hour SO_2 NAAQS*" and (2) the March 1, 2011 "*Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour NO_2 National Ambient Air Quality Standard*" (hereafter referred to as the "additional clarification memo"). In the March 1, 2011, clarification memo, EPA declares that the memo applies equally to the 1-hour SO_2 NAAQS even though it was prepared primarily for the 1-hour nitrogen dioxide (NO_2) NAAQS.

In order to comply with the requirements of the DRR, a draft dispersion modeling protocol was submitted to MDEQ in June 2016. EPA Region 4 provided comments on this draft protocol in July 2016. These comments are resolved in this final modeling report.

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[1] 80 FR 51052, August 21, 2015 Federal Register Notice. Docket ID No. EPA–HQ–OAR–2013–0711.

[2] EPA, 2014. Modeling and Monitoring Technical Assistance Documents. Available at https://www.epa.gov/sites/production/files/2016-06/documents/so2monitoringtad.pdf https://www.epa.gov/sites/production/files/2016-06/documents/so2modelingtad.pdf.

In addition, modeling procedures are consistent with applicable guidance, including the August 2016 "SO_2 NAAQS Designations Modeling Technical Assistance Document" (TAD) issued by the USEPA (EPA 2016). The modeling approach is also consistent with the final Data Requirements Rule (DDR) for the 2010 1-hour SO_2 primary NAAQS (80 FR 51052, August 21, 2015). This report presents the modeling methods and assumptions, including model selection and options, meteorological data and source used in the modeling analyses that characterize air quality in the vicinity of the Red Hills Generating Facility.

This document consists of the following three additional sections:

Section 2 - Facility Description and Emission Sources
Section 3 - Modeling Approach
Section 4 - Analysis of Modeling Results.

2.0 Facility Description and Emission Sources

Red Hills Generating Facility is an electric power generation plant that includes two lignite-fired circulating fluidized bed (CFB) boilers. The facility also includes an emergency diesel generator and an emergency diesel fire pump. However, as shown in Table 2-1, these sources operate very infrequently and have insignificant SO_2 emissions. As such, they were not included in the modeling analysis.

The RHGF is located in Choctaw County, MS near Ackerman, MS.
The location of RHGF is shown in Figures 2-1 and 2-2.

The two CFB boilers exhaust to a 350-foot shared-flue common stack.

Since the modeling was performed with actual hourly emissions from the CFB boilers, the actual stack height was used in accordance with recommendations in the DRR and TAD. Table 2-2 shows the physical stack parameters for the shared CFB boiler stack.

For the CFB boilers, the emissions for modeling consisted of actual hourly emissions, temperatures, and flow rates for the most recent three calendar years (2012-2014). Since there are no other large sources of SO_2 emissions at the RHGF, the modeling was limited to just the CFB boilers.

Table 2-1 Annual SO_2 Emission and Operating Hours for Emergency Equipment

Year	Emergency Diesel Generator	Emergency Diesel Fire Pump
	SO_2 – Tons/Year	
2012	1.19E-02	1.29E-02
2013	4.45E-03	4.44E-03
2014	2.50E-01	1.00E-02
	Operating Hours	
2012	16	29.9
2013	6	10.3
2014	337	23.3

Table 2-2 CFB Boilers Stack Physical Parameters

Unit	Description	Location (UTM Zone 16 NAD 1983)		Stack Base Elevation (feet)	Stack Height (feet)	Stack Diameter (feet)
		Easting (meters)	Northing (meters)			
Boiler 1	Coal Boiler Stack	293637.7	3695190.400	558	350	24.5
Boiler 2						

Figure 2-1 Location of Red Hills Generating Facility

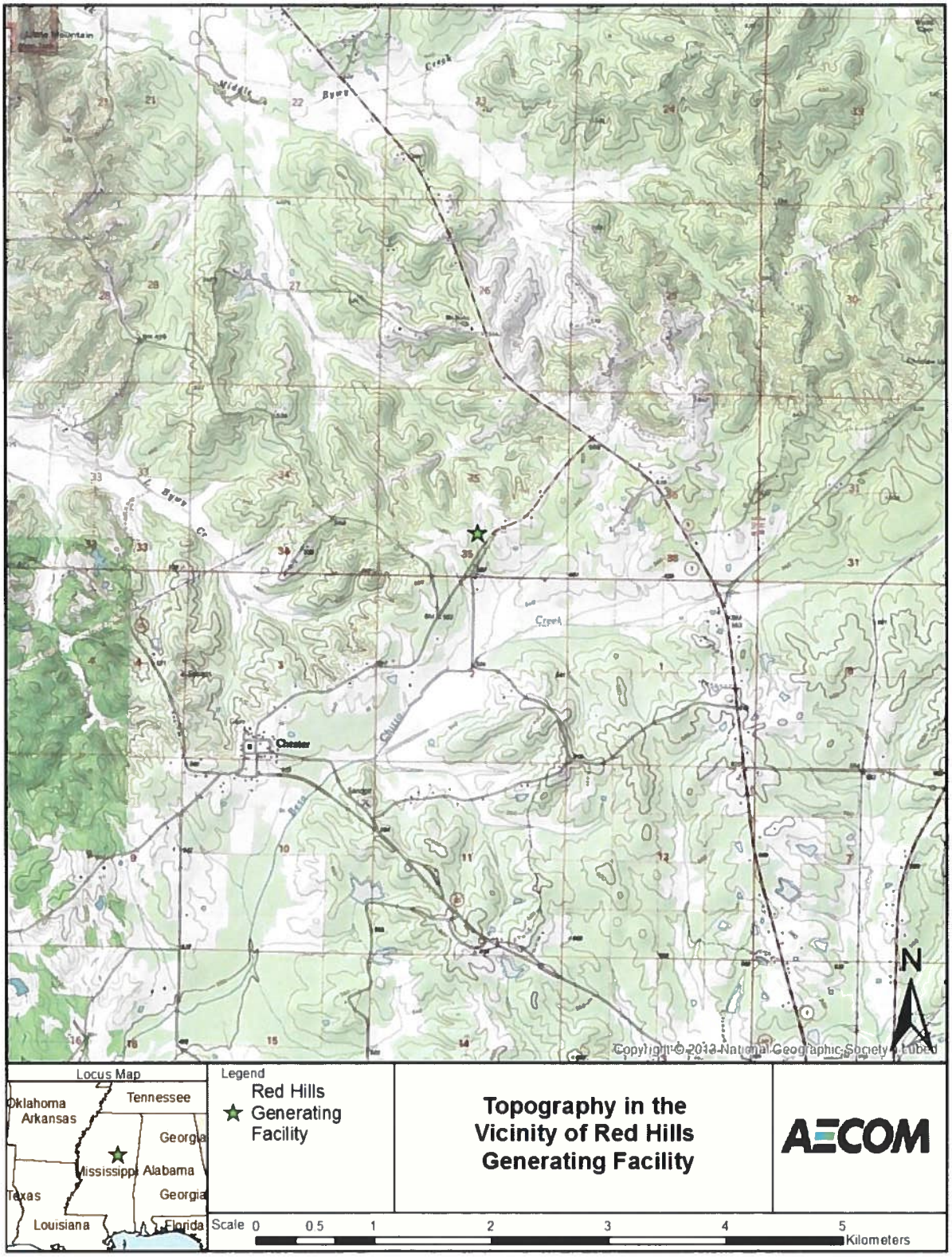
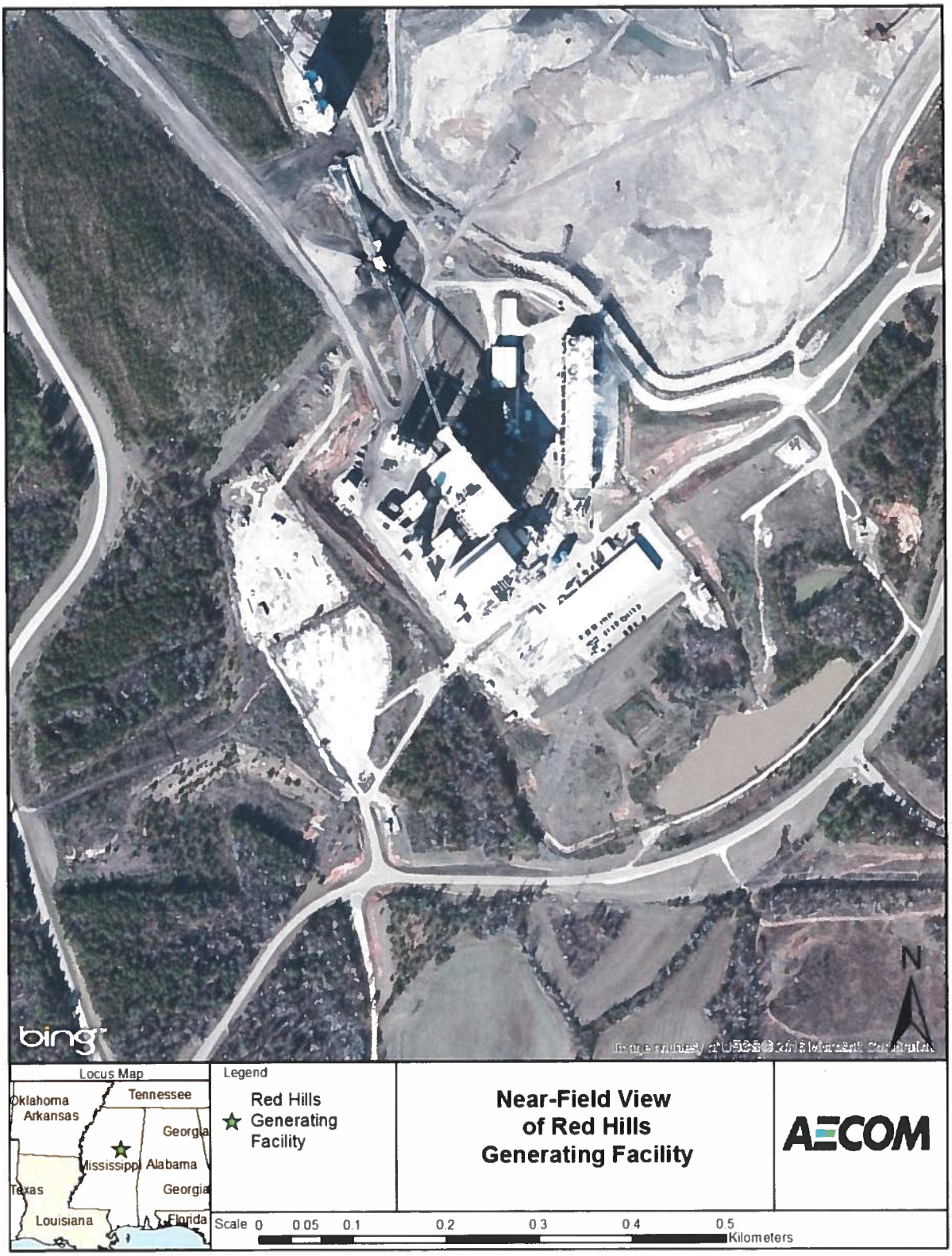


Figure 2-2 Near-Field View of Red Hills Generating Facility



3.0 Modeling Approach

3.1 Overview

This section presents the approach to the dispersion modeling analysis that was used for the 1-hour SO_2 NAAQS modeling for Red Hills Generating Facility. The modeling approach was consistent with the guidance provided in the DRR and TAD where applicable. The following sections address each relevant portion of the modeling approach, including model selection, building downwash, terrain, meteorology, and ambient air quality data.

3.2 Model Selection and Options

AERMOD is EPA's recommended refined dispersion model for simple and complex terrain for receptors within 50 kilometers (km) of a modeled source. AERMOD is also capable of producing the statistical output required for the 1-hour SO_2 NAAQS. As such, AERMOD Version 15181 (released June 30, 2015) was used for this analysis.

Figure 3-1 shows that the area surrounding the Red Hills Generating Facility is predominantly rural. Therefore, the urban source options in AERMOD were not used.

3.3 Building Downwash

In accordance with the DRR and TAD, since actual hourly emissions are being used, the modeling analysis was conducted with the actual physical stack height for all stacks. The effects of building downwash was incorporated into the modeling analysis. EPA's Building Profile Input Program software (BPIP PRIME Dated 04274) was used to calculate the direction-specific building dimensions for input to AERMOD.

Figure 3-2 shows the location of the modeled stack locations and buildings that were used as input to BPIP.

3.4 Terrain and Receptor Processing with AERMAP

EPA modeling guidelines require that the differences in terrain elevations between the stack base and model receptor locations be considered in the modeling analyses. There are three types of terrain:

- simple terrain – locations where the terrain elevation is at or below the exhaust height of the stacks to be modeled;
- intermediate terrain – locations where the terrain is between the top of the stack and the modeled exhaust "plume" centerline (this varies as a function of plume rise, which in turn, varies as a function of meteorological condition);
- complex terrain – locations where the terrain is above the plume centerline.

The area in the vicinity of the RHGF is characterized as simple terrain relative to the modeled stacks.

A comprehensive Cartesian receptor grid extending to approximately 20 km from RHGF was used in the AERMOD modeling to assess ground-level SO_2 concentrations. The 20-km receptor grid was more than sufficient to resolve the maximum impacts and any potential significant impact area(s).

The Cartesian receptors grid consisted of the following receptor spacing:

- From the center of the plant out to a distance of 3,000 meters (m) at 100-m increments
- Beyond 3,000 m to 5,000 m at 200-m increments
- Beyond 5,000 m to 10,000 m at 500-m increments
- Beyond 10,000 m to 20,000 m at 1000-m increments.
- Receptors were also placed at 25-m intervals along the ambient air boundary.

RHGF operates on a single contiguous property that contains fuel handling and storage, the boilers, and ash handling and the ash management unit. Adjacent to RHGF is the Red Hills Lignite Mine (RHLM), which provides fuel to RHGF. A fence surrounds the entire RHGF property except for a small opening at the RHLM. The gate to RHGF is kept in the closed position; to obtain access to RHGF requires calling the control room operator, who will then remotely open the gate upon confirming the requestor. The gate then closes automatically after an allowed vehicle has entered.

Fuel from the RHLM is delivered to RHGF via material handling equipment, and no gap in the fence is required for fuel delivery. Ash from RHGF may be directed to either the ash management unit (AMU) at RHGF, or alternatively may be hauled to RHLM to use as fill. Off-highway trucks are used to transport the ash. To accommodate passage of the off-highway trucks between RHGF and RHLM, there is short opening in the fence surrounding RHGF. The short gap is entirely on mine property where access is prohibited, and only off-highway trucks that are hauling ash from the RHGF ash silos cross through that opening. This opening is monitored and is not accessible to the general public.

Because access by the general public is restricted for the entire contiguous RHGF facility, the entire facility is not considered ambient air for the SO_2 modeling and receptors were not placed in area where public is excluded access, as shown in Figure 3-3.

The AERMAP domain corresponds to a 5-km buffer beyond the receptor grid and will provide sufficient resolution of the hill height scale required for each receptor. A 5-km buffer is sufficient as there are no significant terrain features just beyond this distance.

Terrain elevations from the National Elevation Dataset (NED) acquired from USGS[3] were processed with AERMAP (version 11103) to develop the receptor terrain elevations and corresponding hill height scale required by AERMOD. The NED file is referenced to Datum NAD 83 (note all receptors are referenced to NAD 83 UTM Zone 16). The NED files are included in the modeling archive CD (see Appendix A).

The extent of the receptor grid is shown in Figures 3-3 and 3-4.

3.5 Meteorological Data for Modeling

No on-site meteorological data is available, so the application of a refined dispersion model requires multiple years of hourly meteorological data that are representative of the model application site. In addition to being representative, the data must meet quality and completeness requirements per EPA guidelines.

For this application, three years (2012-2014) of model-ready meteorological data was obtained from MDEQ's website[4]. Specifically, surface data from Golden Triangle Regional Airport, MS along with upper air data from Jackson Thompson Field, MS. This data was processed by MDEQ using AERMET Version 15181 and provided in model-ready format for this application. The meteorological station information can be found in Table 3-1. The location of the meteorological station is shown in Figure 3-5.

Table 3-1 Meteorological Stations used for Modeling

Met Site	Latitude	Longitude	Base Elevation (ft)	Station Call Sign
Golden Triangle Regional Airport, MS	33.450 N	88.583 W	80.5	KGTR
Jackson Thompson Field, MS	32.321 N	90.078 W	100.9	KJAN

[3] http://viewer.nationalmap.gov/launch/

[4] http://www.deq.state.ms.us/MDEQ.nsf/page/epd_AERMET_Preprocessedmetdata?OpenDocument

3.6 Ambient Monitoring Data and Nearby Background Sources

As part of the 1-hour SO_2 NAAQS analysis, ambient background was added to the modeled concentrations.

The Jackson, MS monitor is located approximately 150 kilometers to the southwest of Red Hills Generating Facility. The next closest monitor in the State of Mississippi is more than 325 kilometers south in Pascagoula. Given this extreme distance, the Jackson, MS monitor was used for this analysis as it conservatively represent ambient background concentrations of SO_2 in the vicinity of Red Hills Generating Facility. In addition, the Pascagoula monitor is influenced by nearby sources that would largely overstate the ambient background SO_2 around the Red Hills Generating Facility.

The Jackson, MS monitor has a segmented dataset that starts in December of 2010 and is still currently operating. There is a 1-year gap in the dataset starting July 1, 2012 through June 30, 2013 when the monitor was moved above 1.5 kilometers to the west.

Based on the availability of data, a "true" design concentration in the form of the 1-hour SO2 NAAQS cannot be calculated using three consecutive calendar years of monitoring data until the end of 2016. However, there is sufficient data to establish a conservative level of ambient SO_2 background that can be added to the modeled concentration from Red Hills Generating Facility to determined compliance with the NAAQS.

There are several options in this regard. A calendar-year design concentration can be calculated for the following three years: 2011, 2014, and 2015. In addition, there is 33 consecutive months (nearly 3 years) of data available starting July 1, 2013 through March 31, 2016 that could be used to make 2 full non-calendar years along with 3 quarters for the third year. Specifically the three non-calendar years would be (1) July 1, 2013 through June 30, 2014, (2) July 1, 2014 through June 30, 2015, and (3) July 1, 2015 through March 31, 2016. Table 3-2 presents the results of the multiple design concertation calculations as noted above.

A comparison of the design concentrations presented in Table 3-2 shows very little difference in looking at the three-year averages. In addition, there is very little change in the calendar-year design concentrations calculated in 2011 vs 2014 and 2015 indicating the air shed is relatively stable with the respect to SO_2 concentration levels. Therefore, the modeling was performed using an ambient background concentration of 15 ppb (39.3 $\mu g/m^3$) which represented the 33 consecutive month design concentration shown in Table 3-2. The location of the Jackson monitor is shown in Figure 3-5.

There are no other large SO_2 background sources in the area that would need to be included when modeling the Red Hill Generating Facility. The Choctaw Gas Power Plant is located adjacent to the Red Hill Generating Facility; however, this plant burns natural gas and thus has very low SO_2 emissions. Therefore, the two CFB boilers were the only sources included in the modeling analysis.

Table 3-2 Jackson, MS Ambient Monitoring Data Summary

Year	Design Concentration (ppb)
2011	13
2014	14
2015	12
Three-Year Average (2011, 2014, 2015)	***13***
July 1, 2013 - June 30, 2014	22
July 1, 2014 - June 30, 2015	8
July 1, 2015 - March 31, 2016	15
Three-Year Average (2013/2014, 2014/2015, 2015/2016)	***15***

Figure 3-1 Land Use within 3 km of Red Hills Generating Facility – Aerial Photo

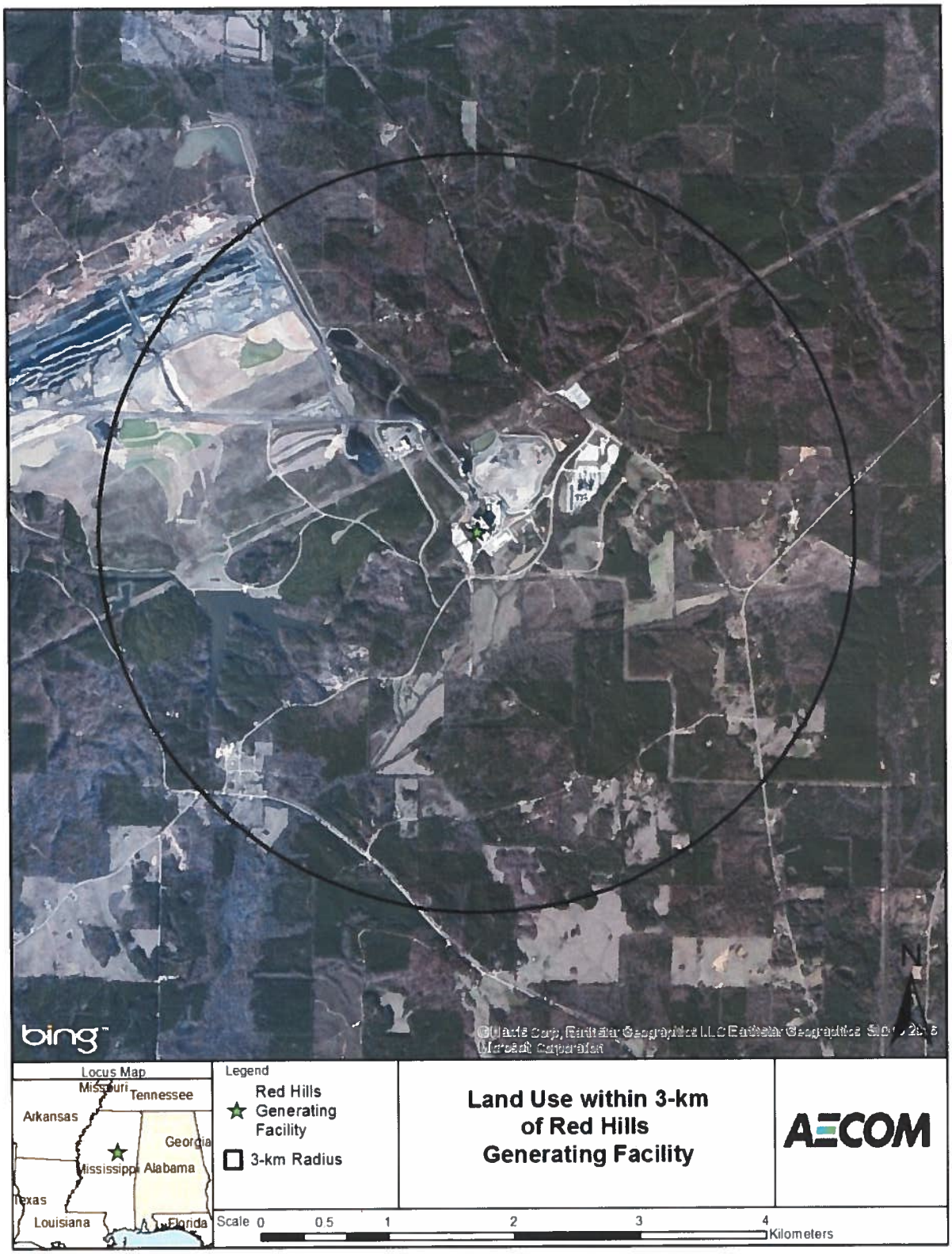


Figure 3-2 Red Hills Generating Facility Buildings and Stacks used for the BPIP Analysis

Figure 3-3 Near-field Receptor Grid for Red Hills Generating Facility

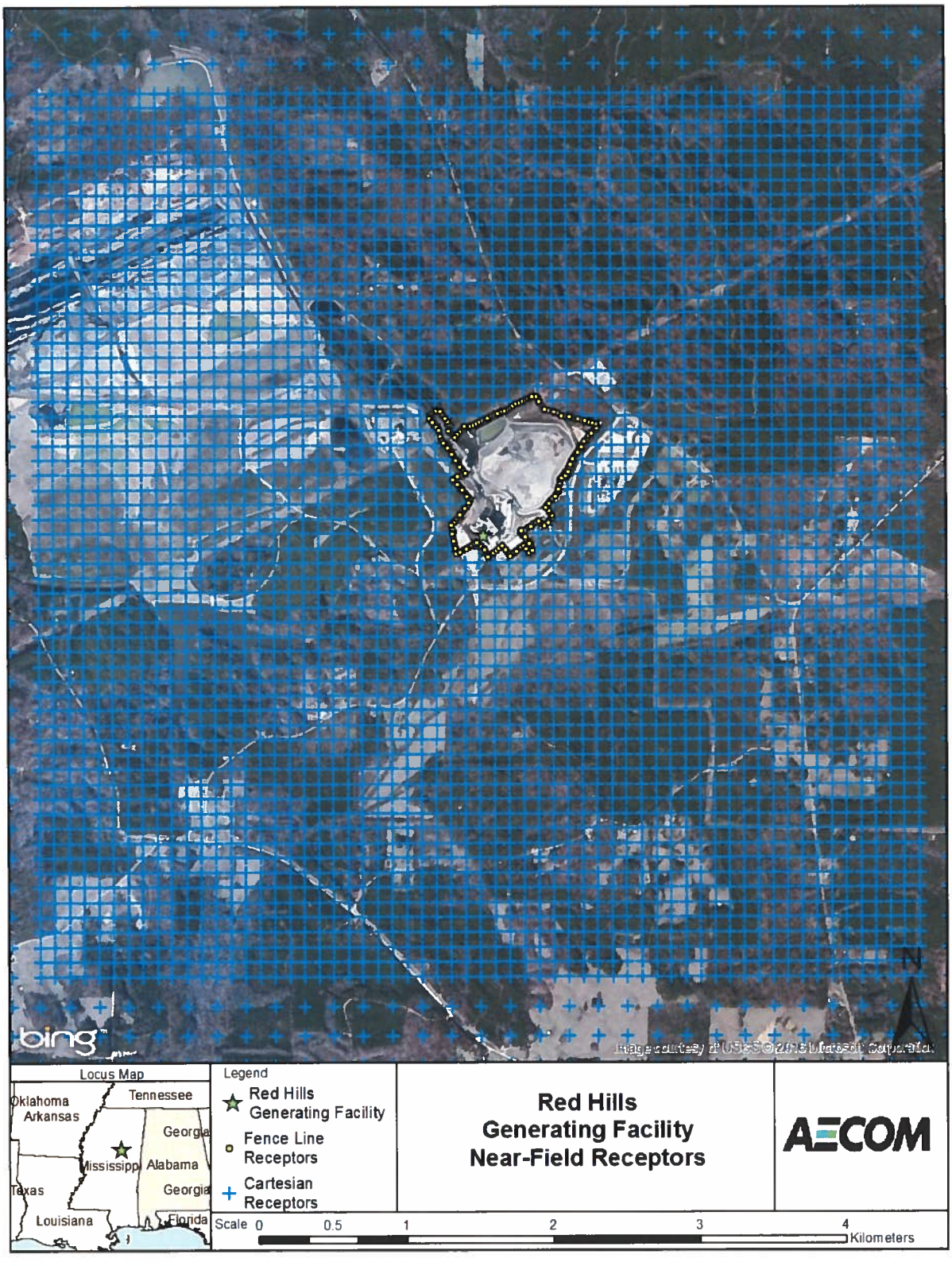


Figure 3-4 Extent of Entire Receptor Grid for Red Hills Generating Facility

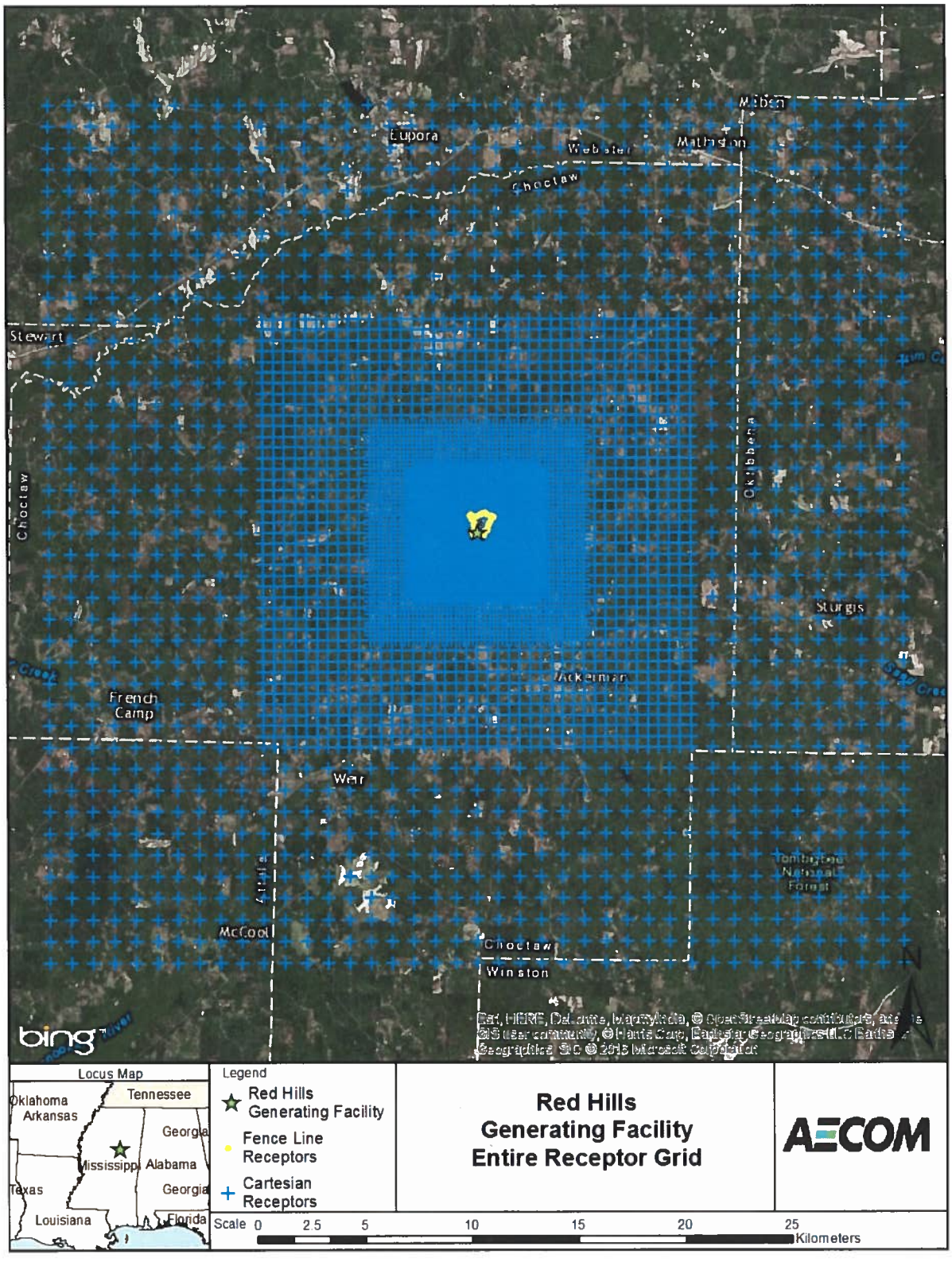
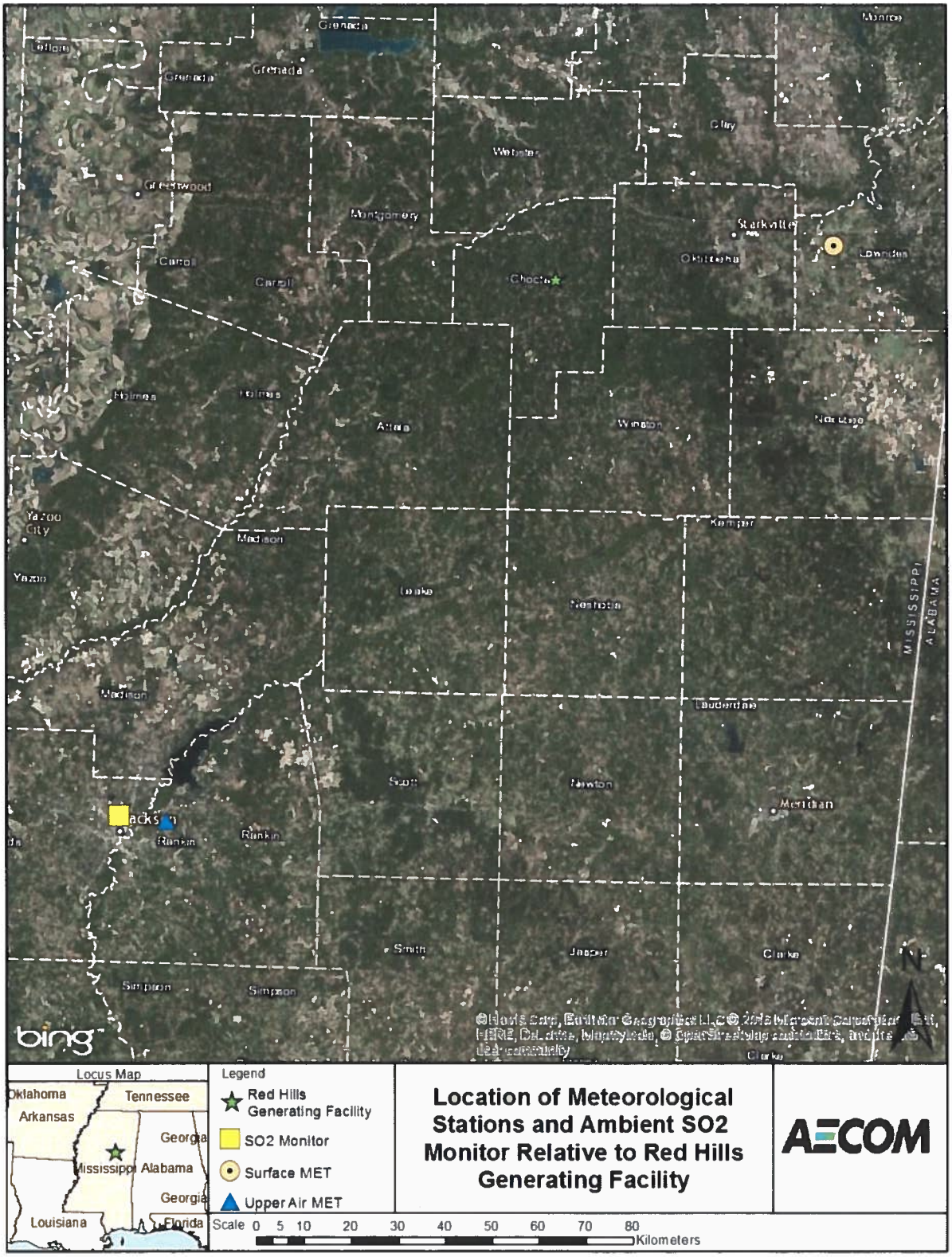


Figure 3-5 Location of Ambient SO_2 and Meteorological Sites Relative to Red Hills Generating Facility



4.0 Analysis of Modeling Results

The modeling results for the 1-hour SO_2 NAAQS are presented in Table 4-1 and are based on the sum of the modeled design concentration from the Red Hill Generating Facility using actual hourly emissions from 2012-2014 plus the ambient background concentration. The modeled design concentration was calculated by AERMOD and reflects the three-year average of the 99th percentile ranked peak daily 1-hour SO_2 concentration.

Table 4-1 compares the total concentration (modeled plus background) with the 1-hour SO_2 NAAQS of 196.5 $\mu g/m^3$. Figure 4-1 shows the location of the maximum modeled concentration which is along the northern boundary of the Red Hill Generating Facility plant boundary. At this location maximum total design concentration was located in an area with 100-meter spaced receptors

As shown in Table 4-1, the modeling results indicate that all areas surrounding the facility are in compliance with the applicable NAAQS standard and should be designated as attainment. In addition, given how low the results are relative to the NAAQS, additional future maintenance modeling should not be warranted.

The modeling archive (included with this report as Appendix A) contains all the electronic files needed to review and produce the results contained in this report.

Table 4-1 Summary of 1-hour SO_2 NAAQS Analysis

Pollutant	Averaging Period	Model Design Concentration ($\mu g/m^3$)	Monitored Background Concentration ($\mu g/m^3$)	Total Concentration ($\mu g/m^3$)	NAAQS ($\mu g/m^3$)	Below NAAQS (Y/N)?	Percent of NAAQS (%)
SO_2	1-hour	45.43	39.3	84.73	196.5	Y	43%

Figure 4-1 Isopleth Map of 1-hour SO_2 NAAQS Total Concentrations (Modeled + Background)